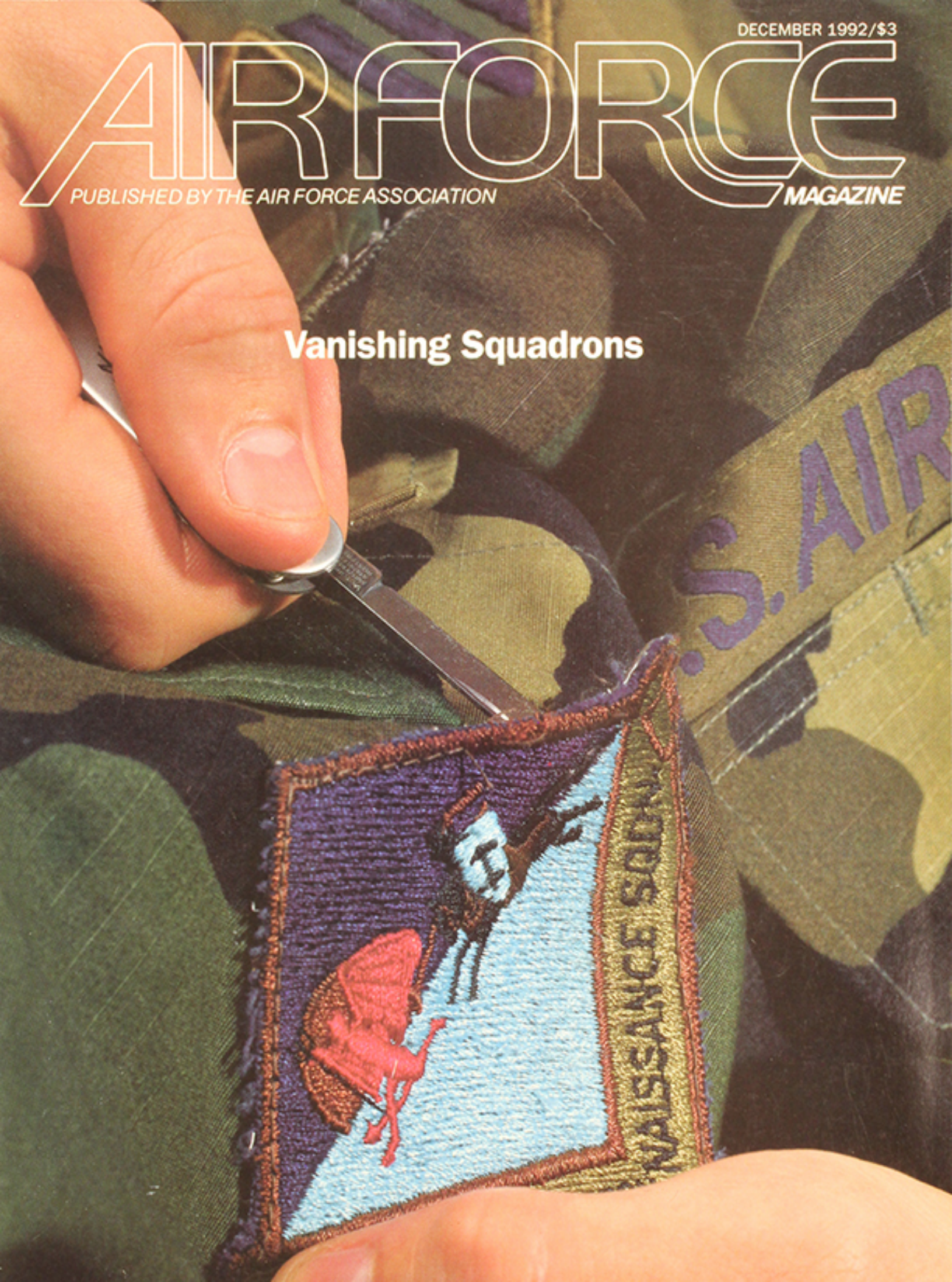
DECEMBER 1992/$3

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Vanishing Squadrons



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December 1992, Vol. 75, No. 12

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

About the cover: A crew chief removes the patch signifying his membership in the recently deactivated 91st TRS—a unit that dates to World War I. For more on squadron histories, see p. 43. Photo by Paul Kennedy.

AIR FORCE Magazine (ISSN 0730-6784) December 1992 (Vol. 75, No. 12) 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; $60 for three-year membership. **Life Membership:** $400 single payment, $420 extended payments. **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 $3 each. Special issues (USAF Almanac issue and Anniversary issue) $5 each. **Change of address** requires four weeks' notice. Please include mailing label. **POSTMASTER:** Send changes 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

On Mr. Clinton's Watch

NATIONAL defense was not an issue in the 1992 election. The voters weren't interested, or so the pollsters said, and the defense programs laid out by the candidates got no more than superficial examination.

A popular misconception, touted by the Washington *Post* and others prominent in analyzing the campaign, was that Gov. Bill Clinton and President George Bush had fundamentally the same positions on defense. That is not true.

Mr. Clinton's position was a virtual clone of "Option C," the detailed plan written by Rep. Les Aspin (D-Wis.), chairman of the House Armed Services Committee, in challenge to the Base Force plan of the Bush Administration. Mr. Clinton's campaign statements followed Option C straight down the line, not only in concept but also in specific details of cost and force structure.

This points to a defense program that would be below the Base Force projection by about 200,000 troops, eight fighter wings, three army divisions, two aircraft carriers, and $60 billion over five years. That is not a trivial difference. The armed forces would shrink toward 1.4 million active-duty troops, almost forty percent below their peak strength in the 1980s. Capabilities would be closely measured to meet threats that are immediately apparent and not much more.

Campaign programs typically undergo some modification before they are launched as policy by a new administration. Mr. Clinton should take the opportunity to do just that in this instance.

A few months ago, Mr. Clinton was chastising Mr. Bush for his reluctance to order air strikes on the Serbs. The Balkans are by no means the only potential trouble spot on Earth. It will be surprising if US armed forces do not engage in conflict somewhere during Mr. Clinton's term.

The most likely form of crisis (and, incidentally, the primary threat to which the Base Force strategy was calibrated) is a limited regional conflict, but once war begins, there is never any assurance of where it will end or what turns it will take. An unduly degraded US military posture could even be a factor in stimulating crisis.

The defense program Mr. Clinton prescribed during the campaign would divest the armed forces of substantial striking power and flexibility. The only real imperative pushing that program is the promised cost savings of $60 billion over five years.

His defense program is a clone of Mr. Aspin's "Option C." He should think again before he launches it as policy.

On an annual basis, that amounts to less than one percent of what the federal government spends in outlays. It won't make a dent in the deficit, and it wouldn't fund more than a fraction of the new domestic initiatives that some of Mr. Clinton's colleagues have in mind.

The reason that removing another five percent from the budget has such severe consequences for defense posture is that the Base Force plan already incorporated a reduction of about twenty-five percent. The peripheral expenditures were cut in the early rounds. It is very difficult to make further reductions without taking combat power off the line.

Mr. Clinton will also be getting an earful from those who think Option C doesn't cut nearly enough. Some proposals now afloat would take the force level down to 1.25 million or lower, pulling close to numerical parity with such powers as India and North Korea. As Mr. Aspin argued at length in his Option C papers, though, it isn't just numbers that count. Combat power is measured in quality and capability. So far, Mr. Clinton is holding strong on most of the big weapons modernization programs. He supports "programs that improve our technological edge, like the F-22 fighter."

Not everyone shares Mr. Clinton's declared belief in the need to stay ahead on weapon systems quality, and he will soon face heavy pressure to relax his commitment. Once the force-structure cuts are conceded, the defense cutters will concentrate their attack on the modernization programs. After all, why buy weapons for forces you no longer have?

In his role as commander in chief, Mr. Clinton will be uniquely vulnerable to criticism. Questions about his antiwar activities and avoidance of military service in the Vietnam period dogged him throughout the campaign. In the end, the voters decided it didn't matter.

The questions could come roaring back in a hurry if Option C leads to gaps and shortages in the defense posture, resurrecting the scandal of "hollow forces." If Mr. Clinton should preside over a failure of US combat arms reminiscent of Jimmy Carter's Desert One fiasco in 1980, he will be besieged by comparisons with Reagan-Bush successes in Grenada, Panama, and the Persian Gulf.

The important thing, of course, is not Mr. Clinton's personal credibility but the effect of all this on national security. Many of us thought Option C cut it too close when Mr. Aspin proposed it last February. We still think so.

During the campaign, Mr. Clinton expressed his determination to keep US armed forces the strongest in the world. "Whatever else we expect of our presidents," he said, "we still need a resolute leader who will wield America's might and marshal all our resources and the resources of our allies to defend our most fundamental interests."

That is well said, and a most suitable premise on which to base a defense program in the new administration. Now that the electioneering is over, Mr. Clinton should take a fresh look at how well a clone of Option C matches the national security objectives he has espoused. ■

People who know mission planning plan on Sanders.

Lockheed Sanders leads the industry in state-of-the-art mission planning systems for all the Armed Forces.

Backed by Lockheed mission planners, pilots flying F-117 stealth fighters in Desert Storm rewrote the book on aerial warfare. Air Force Special Ops Forces also rely on Sanders expertise, using our strategic/tactical mission planning system. And, we are currently delivering upgrade kits for mission support systems for composite wings throughout the United States Air Force.

For the future, we're building prototypes for the next generation mission support system (AFMSS), the most sophisticated, flexible and effective mission planner ever conceived. We're also an integral part of the Air Force's F-22 team, with development of that 21st century fighter's mission support element already under way.

And, Sanders' Special Operations Forces Planning and Rehearsal System will enable Navy SEALS and Army Special Forces to apply the latest automation technology to their unique and intensely demanding missions.

Strengthened by 40 years of defense electronics experience, Sanders delivers innovative, affordable mission planning systems—land, sea and air. That's how we became the industry's preferred supplier; and how we intend to stay that way.

Lockheed leads.

Lockheed Sanders

Letters

Composite Wing Harmony

Thanks for the excellent article on the new 366th Wing forming at Mountain Home AFB, Idaho *["Gunfighter Country," October 1992, p. 24].*

It was refreshing to read about some of the positive results of the intense restructuring that Air Force people are grappling with. While I am gravely concerned about the effect of these drawdowns on national security, I was pleased to see what is taking place at Mountain Home.

As a former member of Strategic Air Command, I was particularly encouraged to see the former TAC and SAC forces working together. I can recall the days at Red Flag and other exercises that generated not only the bombers and tankers but massive paperwork as well.

The 366th can go anywhere in the world—without all that documentation—while exemplifying the harmony of Air Force teamwork.

Andrew S. Biscoe
Coeur d'Alene, Idaho

Training the Warfighters

"Gunfighter Country" certainly foretells the wave of the future for force structure—combining under one commander all the air assets needed to execute a campaign. The training for these types of composite forces is unfolding at the 99th Tactics and Training Wing (TTW) at Ellsworth AFB, S. D. Operation Warfighter is being developed to provide the interactive training required to ensure that all assets work together to maximize mission effectiveness.

Red Flag and other exercises are available to practice interactive skills. Operation Warfighter is designed to expose the aircrews and staff to those skills. Each aircraft's mission capabilities are explored to ensure that each works with the other. The addition of heavy aircraft (B-52s, B-1s, KC-135s, and KC-10s) to composite operations receives particular attention because they have long been ignored as integral parts of a composite force. Operation Desert Storm brought a quick end to this thinking, as B-52s dropped a large portion of the weapons and KC-135s and KC-10s were flying in harm's way. In addition to the Air Force trend toward composite wings, the air battle of the future will include both Air Force and Navy aircraft. . . . Operation Warfighter is designed to address the training needs of this type of joint and composite operation.

Operation Warfighter involves a three-phased training program over a two-week period. Phase I, classroom training, exposes participants to the skills needed for composite operation and discusses aircraft capabilities and tactics. Phase II, a scripted flight environment, explores the topics discussed in the classroom. Phase III, a three-mission campaign, executes the tactics explored in Phases I and II. The major advantage that this program has over such exercises as Red Flag is the structure and instruction provided prior to executing a campaign. In addition, the 99th TTW has the most experienced heavy-aircraft tactics instructors to ensure that the heavy aircraft are a match for their smaller counterparts. . . .

Although there were and are problems that need attention, Operation Warfighter participants found the training opportunities here to be excellent. All participants received training at the first Operation Warfighter last July that was not available anywhere else. The bomber crews obtained the greatest benefit, but all came away with new composite skills.

Because joint and composite operations are the way to fight, joint and composite training is the way to prepare. Operation Warfighter provides the best in training by providing the environment to learn and then apply.

Maj. James D. Boorn,
USAF
Ellsworth AFB, S. D.

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

Actions Have Consequences

I read "The Coming Flap on Roles and Missions" *["Washington Watch," October 1992, p. 10]* with dismay and was reminded of the iron law, "Actions have consequences." Now that the Air Force has done away with Strategic Air Command (SAC) and banned the word "strategic" from the Air Force lexicon, we are left with a looming identity crisis, vis-à-vis the Navy, which takes us back doctrinally to where we were almost fifty years ago.

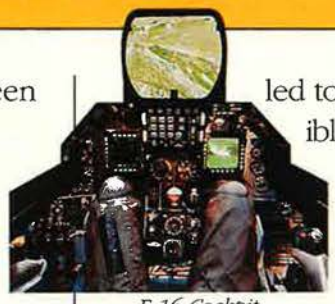
Our present dilemma stems not from unmanageable international political turmoil but rather from a cloudy kind of dogma, parroted endlessly and without challenge in the pages of AIR FORCE Magazine and in speeches and articles by Air Force leaders at all levels. This dogma, referred to yet again in your article, asserts that the distinction between "strategic" and "tactical" has become fuzzy because of modern weapons and communications technology as well as new political alignments in the world. Among the consequences of this supposedly intractable semantic fuzziness, says the dogma, is a need for the massive restructuring of the Air Force into composite aircraft wings. . . .

Since World War II, bomber crews have known—unambiguously—the difference between "tactical" and "strategic." When you are on a tactical mission, you can flick on your (hypothetical) wideband communications receiver and pick up AWACS, MiG CAP, BAR CAP, Red Crown, Blue Chip, Sandy, (insert your favorite call signs here), and "the gang's all here." When you are on a strategic mission, the only people on whom you might possibly eavesdrop are the enemy's ground-controlled intercept controllers, vectoring enemy fighters toward a lethal rendezvous. You're all alone, having flown a thousand miles or more beyond fighter escort range.

TIMES CHANGE. SO DO F-16S.

The world has seen some dramatic changes since the first F-16 was introduced. The Berlin Wall has come down. The Soviet Union and Warsaw Pact have been dissolved. And new potential trouble spots have emerged.

Dramatic changes in weapon technology have also taken place.



F-16 Cockpit (Night Attack)

Fighter aircraft have improved radar capabilities, faster computers and more advanced weapons.

Through the years the F-16 has proven it can truly stay ahead of the threat.

Its ability to continually adapt new avionics and weaponry has led to an incredible service record, including over 60 aerial dogfight victories, with no losses.

The F-16 was the workhorse of Desert Storm. It flew over 13,000 sorties and had the highest readiness rate of any fighter in theater. With LANTIRN and GPS, F-16s were the premiere scud hunters.

The F-16 we're building today incorporates literally hundreds of new state-of-the-art technologies. The entire cockpit has been modernized. Engine thrust has been increased 25%, and there is a choice of the world's two best fighter engines manufactured by Pratt & Whitney and General Electric.

We've added beyond-visual-range firepower with Sparrow and AMRAAM radar missiles; night/under-the-weather attack and autonomous precision attack with LANTIRN, IIR Mavericks, and laser guided bombs; anti-radar attack with HARM; and anti-ship with Penguin.

While the F-16's combat capability has been significantly enhanced, it was not done at the expense of operation and support costs. In terms of reliability, maintainability, readiness and lifecycle cost, the F-16 remains the best frontline fighter in the world.

And that's something we never intend to change.

Pratt & Whitney F100-PW-229

GENERAL DYNAMICS
Fort Worth Division

AIR FORCE MAGAZINE
PUBLISHED BY THE AIR FORCE ASSOCIATION

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BPA Circulation audited by Business Publication Audit

Letters

You will succeed only through good mission planning, stealth, your wits, and whatever offensive and self-defense systems you carry on board. . . .

The trajectory of the present Air Force organizational restructuring is leading to the total abdication of strategic capability in nonnuclear warfare. Bomber crews now train to fly their missions as "big fighters." The remaining B-52s will merely be "bomb trucks," flying only in benign airspace. B-1s will serve as giant F-111s with more bomb capacity. Each B-2 is justified by the Air Staff in congressional testimony as being able to do the job of a squadron of F-117s in the Persian Gulf War, and so on. Self-defense systems—the paltry few that SAC developed for long-range bombers—have been scrapped: Tailguns have been removed from the B-52s, and the AGM-136 Tacit Rainbow—the only lethal defense-suppression system ever built for jet-age strategic conventional missions—has been canceled outright in favor of Wild Weasels.

While I do not lament the passing of SAC or tailguns and see nothing inherently wrong with creating composite wings or keeping Wild Weasels, the unfocused (and unquestioned in our professional magazine) rationale used to justify these actions is disturbing. It seems to reflect a pervasive but unacknowledged and perhaps unconscious bias toward tactical thinking. Apparently, bombers will no longer fight without "the gang" around. With the notable exception of robot weapons (conventional warhead cruise missiles), inland bombardment operations will now be limited by the range of escorting fighters.

Without true strategic capability, the Air Force will have nothing to offer the national defense that the Navy does not already provide with its aircraft carriers. Maybe someone powerful in Washington, D. C., will notice. Maybe the next Key West Agreement will result in much more than the readjustment of roles and missions that Mr. Canan foretells. Maybe we'll get to eliminate the term "United States Air Force" from the DoD lexicon.

Actions surely have consequences, and sweeping actions based on fuzzy concepts promise terrible consequences.

Maj. Robert D. Klimek,
USAF (Ret.)
Renton, Wash.

Neglecting the Enlisted

I must make a comment concerning your response to Captain Noble's letter about the enlisted force *["Faces of the Drawdown," October 1992 "Letters," p. 4].* "The Enlisted Airman" *[August 1992, p. 46]* indeed shows how AFA feels about enlisted members of the Air Force.

Of the fifty-six pages devoted to articles in the entire issue, eight concerned the enlisted force. Two pages were devoted to CMSAF Gary Pfingston, and the remaining six dealt with the history of the enlisted force. The article was interesting, but it was a rehash of many that have appeared in the magazine in years past. In the one issue of the last several years that supposedly dealt with the enlisted member, this paltry coverage shows where your priorities are.

The enlisted force, according to the 1992 Air Force Almanac, makes up 80.2 percent of the Air Force. Just over five percent of the entire service are rated officers. Granted, enlisted members do not fly fighters or bombers, and they do not command squadrons. They do, however, keep the aircraft in the air through maintenance and repair, and they check the weather, staff the control tower, and make certain that everyone gets paid.

The enlisted member joins the Air Force and suffers low wages, insecurity, and constant moves. They join for love of country and a call to duty that is as real and profound as that of our fine officer corps.

Do not pretend that a few gratuitous articles give the enlisted men, women, and families their due. If the members of the Air Force Association and the editors of its magazine feel that this is proper recognition of the enlisted force, then perhaps Captain Noble was right in his idea that our association is not really for the entire Air Force but is only "an officer thing."

John P. Dillon
Sylvania, Ohio

■ *The problem with your scoring system is that it assumes that articles without a prominent "enlisted" label are not relevant or of interest to enlisted members. Thus, you find just two of our ten August articles as qualifying. You overlooked "Angst at Olympic Arena," which quoted both NCOs and officers. Only one feature article, "Demise of the Aggressors," could possibly be interpreted as an "officer" article, and even there, one of the illustrations has an enlisted tie-in. The rest of the month's lineup—coverage that ranged from USAF's new mission statement to the space program—is not grade-specific.*

Flip forward to the September issue and check out "Stripes on the Line," a

readiness story with lots of enlisted emphasis; "The Twelve," about the Outstanding Airmen of the Year; and "Their Mission Is Munitions," an enlisted article all the way.

Look at a year's worth of AIR FORCE *Magazine and you'll see a great deal of enlisted force coverage, but most of the articles won't sort neatly into either an "officer" or "enlisted" category.*—THE EDITORS

A Roaring Error

I have to comment on the caption in the October 1992 issue on p. 28. I agree that the aircraft depicted is an F-15C; however, it does not appear to be "roaring" off the runway at all. I have had some experience watching F-15s in the past and have never witnessed the fighter "roar" off the runway with his speed-brake extended! Correct me if I'm wrong, but this particular Eagle seems to be in a landing configuration.

TSgt. Todd R. Clayton
Baltimore, Md.

■ *Sergeant Clayton is one of more than a dozen readers who caught this error.*—THE EDITORS

Professional Munitions Handlers

"Their Mission Is Munitions" *[September 1992, p. 110]* was unusual in the all-too-rare recognition it gave those who perform indispensable weapon-loading tasks. The team of Marquart, Wood, Evans, Kelly, and Carrizales is living proof that a vision of the 1960s was worth all the effort.

Some thirty years ago, a few of us, products of special weapons training, were horrified to see the offhand way in which conventional weapons handling and loading were treated. "Opie" Opelenic of USAFE, "Boom-Boom" Wetzler of PACAF, and I, with the backing of such generals as TAC's Gen. Walter "Cam" Sweeney, worked long and hard to bring a high degree of professionalism to the job.

Judging from the Team of the Year, our work paid off. My thanks and congratulations to all those who kept our plans alive over the years.

Maj. J. Harvey Patrick O'Brien
USAF (Ret.)
York, Pa.

The Aggressors' Demise

Thanks for "Demise of the Aggressors" *[August 1992, p. 38].* I want to congratulate James Kitfield on a well-balanced article describing what the Aggressors were created to do and where they are today.

Many fighter pilots believe there is still a need for Adversary Tactics instructors to help keep tactical airpower proficient and informed as we meet the challenges of the coming years. Unfortunately, much of today's dissimilar air combat training involves different types of USAF fighter aircraft and pilots who modify their tactics to emulate potential adversaries, thereby reducing the time and energy focused on training the way we intend to fight in combat.

As flying hours are cut and "banked" pilots start entering the flying force, squadron weapons officers and instructors will have their work cut out for them to maintain an air combat capability equal to that enjoyed in the recent past. For these and other reasons, as Mr. Kitfield's article points out, we need Adversary Tactics instructors today just as much as we did twenty years ago.

Maj. Michael S. Roller,
USAF
Tel Aviv, Israel

Pass along my congratulations to James Kitfield on "Demise of the Aggressors." He managed to research and put together a six-page article on the Aggressors and their mission and not once mention the role of the 17XX Aggressor weapons controller. It's as if we never existed.

Capt. Tom Parson,
USAF
Langley AFB, Va.

The diminution of the Aggressor Squadrons is another extremely shortsighted move that seems to be indicative of our "new" Air Force. Have we profited nothing from lessons learned the hard way in World War II, Korea, and Vietnam?

When I was assigned to the Air Staff, Gen. John Ryan was one of the chiefs that I was privileged to serve under. He had a huge plaque [inherited from his predecessor, Gen. John P. McConnell] on the door of his office that said: "The mission of the Air Force is to fly and to fight—don't you forget it." I certainly never did.

Another of his dictums was: "If it does not help the man in the cockpit or the missile silo, it probably is not worth doing."

These are pretty good statements to live by if you aspire to be a military professional. Trying to invent new mission statements, dressing up Air Force people to look like United Air Lines crews, or attempting to remodel the force in a different image may look good inside the Beltway, but from out here it just does not cut it. I am trying to be loyal, but it is very hard.

Maj. Gen. James B. Currie,
USAF (Ret.)
San Antonio, Tex.

Capitol Hill

By Brian Green, Congressional Editor

Another Cut, Another Drop

For the eighth year in a row, the Pentagon's spending power will decline.

COMPLETING its work on the Fiscal 1993 Pentagon budget, Congress approved a spending package of $274.3 billion. The final authorization and appropriations bills thus provide $7.2 billion less than the Pentagon sought in its $281.5 billion budget request.

The new military budget comes in markedly lower than the Fiscal 1992 total of $291 billion and marks the eighth straight year in which the real value of DoD budgets has declined since arms expenditures peaked in Fiscal 1985. The Air Force received an authorization of $77 billion from Congress, which shaved nearly $7 billion from the original $83.9 billion USAF request.

Fighters Fenced, B-2 to End

The compromise authorization bill stipulates that no more than sixty-five percent of funding for "major new tactical aircraft" can be obligated "until sixty days after Congress receives the roles and missions and comprehensive affordability assessment of tactical aviation modernization." The "fencing" provision applies to the Air Force F-22, multiservice A/F-X, and Navy F/A-18E/F fighters.

Sen. Sam Nunn (D-Ga.), chairman of the Senate Armed Services Committee, argued that current US fighter plans are unaffordable and must be changed. The authorization bill requires the Joint Chiefs of Staff (JCS) to review fighter modernization and to conduct "a very comprehensive assessment of roles and missions in tactical aviation." The Department of Defense also must approve a new A/F-X acquisition plan.

In its authorization bill, Congress fully funded the F-22 at $2.2 billion. The appropriations bill—the actual money bill—reduced that to $2 billion.

Congress approved the request for twenty-four new F-16 fighters, appropriating $614 million for their purchase. The authorization bill did not, however, provide advanced procurement funding for aircraft in Fiscal 1994.

The defense bills provide $2.7 billion to acquire four B-2 Stealth bombers, bringing the total to twenty. Congress directed that the program be terminated with this purchase. The lawmakers also approved $1.3 billion for B-2 research and development work.

Numerous conditions must be met before USAF can spend the money on the bombers. The service must submit to Congress a review of reports on the B-2's stealth capabilities and survivability in the conventional role and provide the total acquisition cost of the program. Congress must vote again to release acquisition money.

The authorization bill provides $86 million for R&D on the B-1B bomber and $218 million for modifications and procurement, somewhat less than the Administration's requests for $91 million and $265 million, respectively. The money will pay for upgrades to the B-1B's electronic countermeasures and the development of an organic maintenance capability.

Roles and Missions

In its version of the authorization bill, the Senate called for tough steps to rationalize service roles and missions. The final compromise bill modifies some of the tougher provisions but still forces the services and DoD to face the issue squarely.

The bill requires the JCS Chairman to submit his internally produced roles and missions report to Congress, orders the Air Force and Navy to hold a competition between the Navy EP-3 and Air Force RC-135 tactical intelligence aircraft to determine which will be upgraded, and eases restrictions on DoD authority to let government depots and private companies compete for maintenance work.

The final budget document dropped a Senate plan to give sole possession of the standoff jamming mission to the Navy and to terminate modernization of the Air Force EF-111. It also eliminated the Senate requirement that the Air Force use the Navy F/A-18E/F as its new multirole fighter.

Other Key Programs

Though the final bills give US servicemen and -women a pay raise effective January 1 and provide for an expansion of certain benefits, Congress rejected major aspects of the Administration's force-reduction plans. Members readily agreed to trim the force during 1993 by another 100,400 active-duty troops, but they cut the Reserve components by only 39,617 of the 115,997 reduction requested by the Pentagon.

In its final budget actions, Congress rejected the Bush Administration's proposal to hold US troop strength in Europe in 1995 to 150,000. The lawmakers instead voted to cap it at 100,000 in 1996 for the four military services.

The final appropriations bill staves off the House move to make major reductions in operations and maintenance. The budget makes some cuts in Air Force O&M. Though these will be partially compensated by repayments from various funds and the sale of excess inventory, the Air Force will lose about $650 million from its original O&M request of $17.6 billion.

Though support for modernizing the airlift fleet remains strong, Congress continues to express concern about the performance of the C-17 contractor, McDonnell Douglas. The defense bills provide $1.8 billion for six airlifters in Fiscal 1993 and long-lead funding for eight more in Fiscal 1994. The Administration requested $2.5 billion for acquisition of eight aircraft in Fiscal 1993 and long-lead funding for twelve C-17s in Fiscal 1994.

After prolonged wrangling, lawmakers finally agreed to appropriate $3.8 billion for the Strategic Defense Initiative, well below the $5.3 billion requested. The authorization bill eliminated the 1996 deployment date set last year. Congress mandated development of tactical missile defenses and initial deployment of defenses against long-range ballistic missiles as early as possible in a manner "consistent with sound acquisition procedures" and with "low to moderate" risk. The bill report estimates the new deployment date to be 2002. ■

C-27A Spartan

Harsh, corrosive tropical climates... Short, undeveloped runways... for the Air Combat Command and the U.S. Southern Command, they're a way of life. But how to perform the mission when the right aircraft does not exist?

Chrysler Technologies Airborne Systems, Inc. is providing the sensible solution: Combine the proven ruggedness of Alenia's G222 STOL airlifter with state-of-the-art avionics to produce the reliable, multi-mission C-27A Spartan aircraft. When the mission calls for airland, airdrop, aeromedical, LAPES or follow on in-flight tanker refueling support capabilities, the versatile C-27A meets the challenge. Chrysler Technologies Airborne Systems then backs it with the industry's most comprehensive support package.

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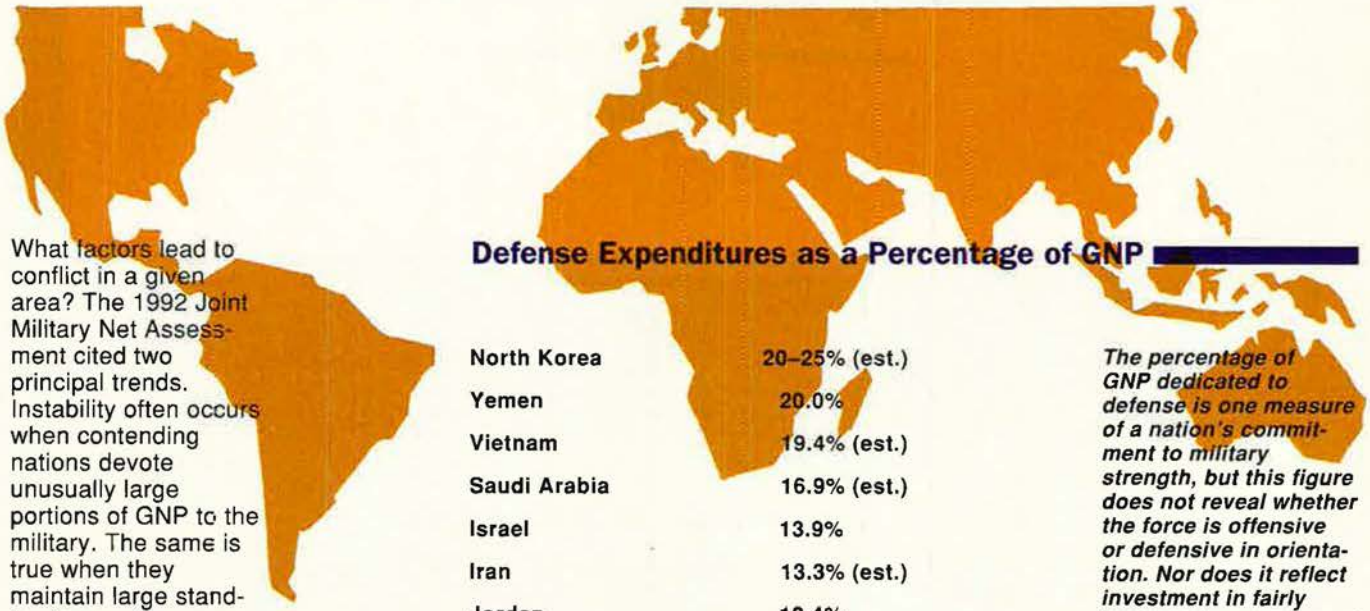
The Chart Page

By Tamar A. Mehuron, Associate Editor

Tracking Regional Instability



What factors lead to conflict in a given area? The 1992 Joint Military Net Assessment cited two principal trends. Instability often occurs when contending nations devote unusually large portions of GNP to the military. The same is true when they maintain large standing forces. These factors upset the balance of power and regional stability and delay economic growth.

Defense Expenditures as a Percentage of GNP

North Korea	20–25% (est.)
Yemen	20.0%
Vietnam	19.4% (est.)
Saudi Arabia	16.9% (est.)
Israel	13.9%
Iran	13.3% (est.)
Jordan	12.4%
Libya	11.1%
South Africa	11.0%
Syria	10.9% (est.)

The percentage of GNP dedicated to defense is one measure of a nation's commitment to military strength, but this figure does not reveal whether the force is offensive or defensive in orientation. Nor does it reflect investment in fairly inexpensive weapons of mass destruction or the amount of military assistance given by other nations.

Ten Largest Active Armed Forces

China	3,200,000
Russia	2,000,000–2,500,000[a]
United States	1,870,000
India	1,200,000
North Korea	1,200,000
Vietnam	750,000
South Korea	700,000
Pakistan	500,000
Iran	460,000
Iraq	430,000

Although none of these is currently at war, there is a risk of conflict between and among many of them.

[a] The formation of the Russian armed forces in the spring of 1992 and the chaotic state of the conscription system make it very difficult to establish the force size of individual armies with any degree of precision. However, the goal of the Russian Defense Ministry is to reduce the size of the Russian armed forces to 1.2 million–1.5 million personnel by the end of the decade.

Source: US Department of Defense, *1992 Joint Military Net Assessment.*

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AX
GRUMMAN
BOEING
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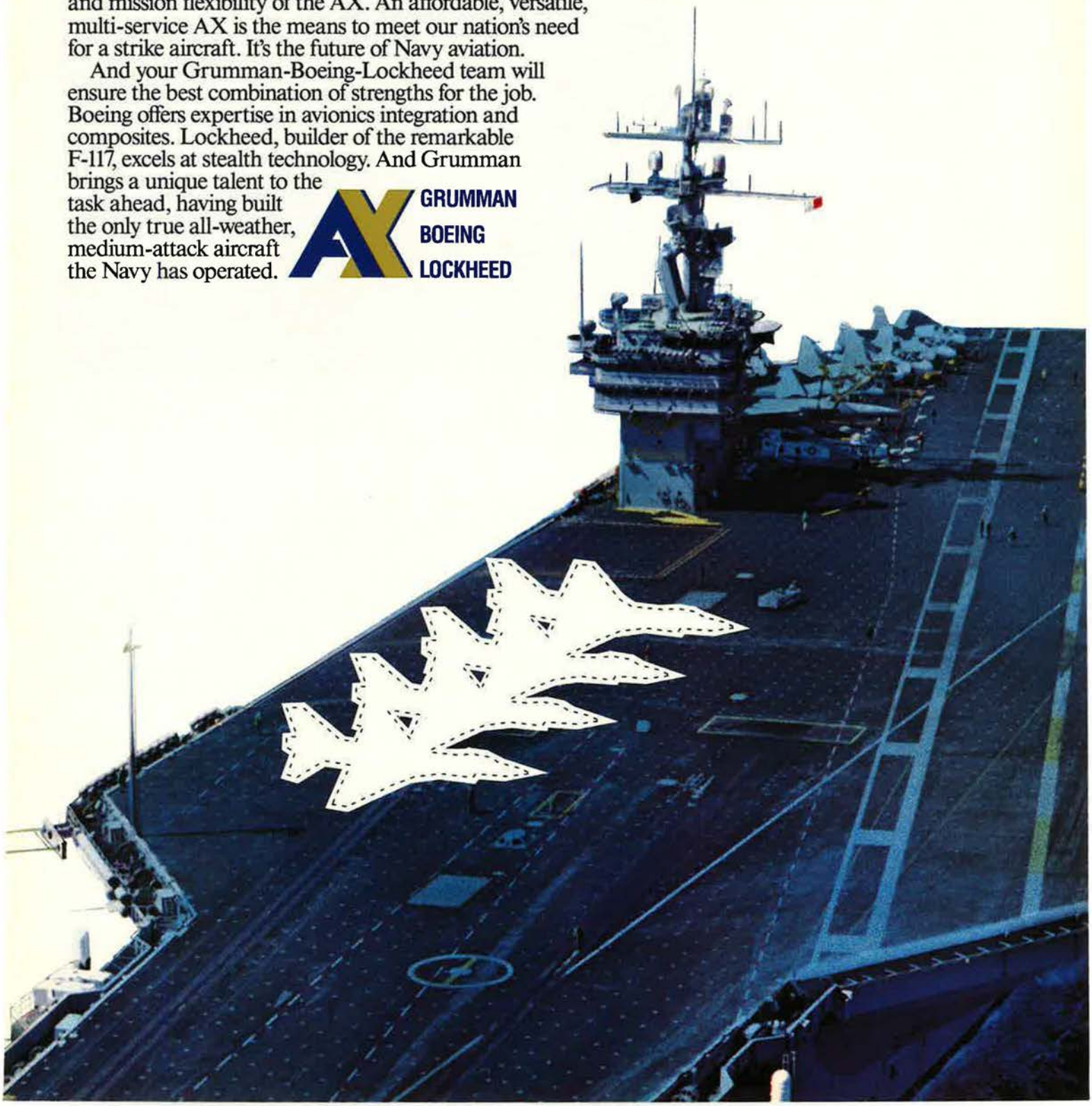


Aerospace World

By Frank Oliveri, Associate Editor

USAF Issues YF-22 Crash Report

The Air Force's investigation of the crash of the YF-22 prototype found that the flight control and thrust-vectoring systems of the production fighter will require modest adjustments, and some flight procedural changes will be required. The prototype was built by an industrial team of Lockheed, Boeing, and General Dynamics.

The accident investigation report concerning the April 25 crash at Edwards AFB, Calif., was released in October. It said that, after successfully completing a low approach to the runway, the Lockheed test pilot, Tom Morgenfeld, began a second low approach. Upon completing the second low pass, the pilot retracted the landing gear, whereupon the aircraft experienced pitch oscillations approximately forty feet above the runway. Then the aircraft hit the runway nose-up and slid about 8,000 feet.

Investigators said they had "determined that the aircraft and flight-control systems operated as designed. There was no indication of any system failure or malfunction." However, "they did find the pitch control system is prone to pilot-induced oscillation under certain conditions, specifically when the landing gear handle is raised with full forward control stick and the thrust vector switch in the 'on' position."

Immediately before the crash, the thrust-vectoring switch was in the "on" position. After certain checklist items are completed, the thrust-vectoring switch can be in any position, according to the flight manual. There had been earlier restrictions on the use of thrust vectoring, but those were based on structural and flight-control considerations and were later rescinded, the report states.

Despite the change, flight-control engineers required that the thrust-vectoring switch be in the "off" position during takeoff and landing as a precaution.

The pilot chose not to follow the instruction, for the following reasons: The thrust vectoring worked properly throughout testing, no restriction prohibited thrust vectoring, and he thought the flight test engineers had agreed that turning the thrust-vectoring switch off during landings was unnecessary.

After the accident, flight engineers acknowledged that they would have agreed the procedure was unnecessary. "However, engineers for the flight-control system stated after the mishap that the procedure was necessary and should have been followed," the report says. "They did not, however, issue any restrictions against thrust vectoring at the time of the mishap because they had no known or suspected reason to do so."

Above, the third and fourth B-2 bombers refuel. The fifth B-2 bomber completed its maiden flight, which lasted nearly four hours, in October. Its tests included flight maneuvering at altitudes up to 35,000 feet. It will be used in armament, climatic, and low-observables testing.

Fifth B-2 Starts Tests

USAF's fifth B-2 Stealth bomber entered developmental flight testing in October, with its first flight lasting nearly four hours.

The new, long-range, multirole bomber flew from Northrop's Palmdale, Calif., facility to nearby Edwards AFB after initial testing over desert ranges. The tests included taxi, takeoff, landing, and flight maneuvering at altitudes up to 35,000 feet.

The fifth B-2 will be used in armament, climatic, and low-observables phases of the flight test program. To date, the B-2s have completed 176 flights for a total of 815 flying hours.

In a separate September flight test, the fourth B-2 successfully dropped a conventional weapon, the first time a B-2 had done so. The event took place during the third in a series of separation tests intended to demonstrate safe release of the weapons that the bomber will use in operational service.

The bomb used in this test was an inert, 2,000-pound Mk. 84 conventional weapon. It left the bay at 20,000 feet. Two earlier drops used test versions of B83 and B61 gravity bombs. All three drops used the B-2's rotary launcher.

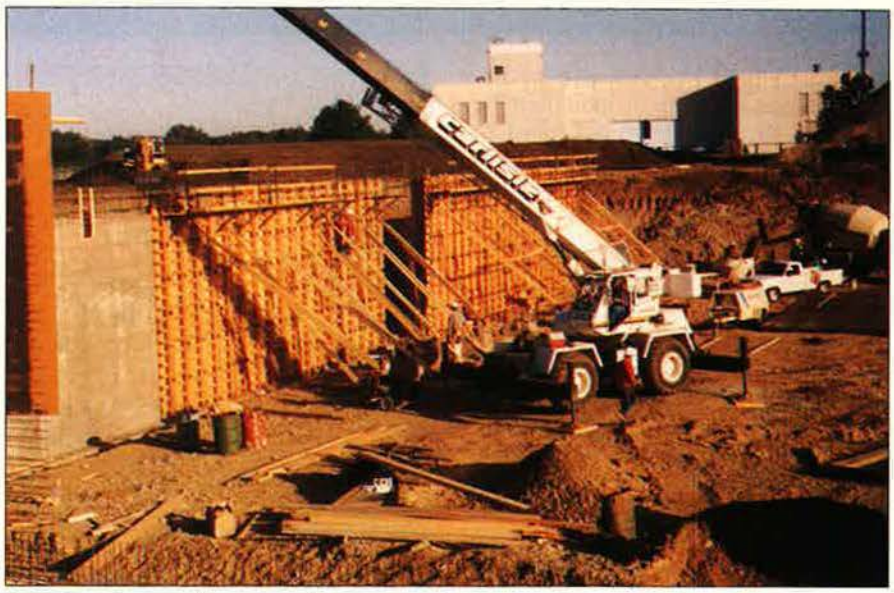
A-X, Now A/F-X, Gets New Role

The Navy gave a new generic name to its prospective next-generation attack plane. Formerly called the A-X (Attack, Experimental), the aircraft is now known as the A/F-X (Attack/Fighter, Experimental).

The Navy approved the change to better reflect the aircraft's true nature. In a significant change, the Navy

now projects the new jet to be a dual-role air-to-air and air-to-ground fighter, much like the current-generation F/A-18 carrier-based strike fighter. Previously, the Navy had viewed the A-X as a single-mission replacement for the aging A-6 Intruder attack plane.

Acting Secretary of the Navy Sean O'Keefe announced the name change in October. The A/F-X is expected to have significant air-to-air capability, according to Rear Adm. Philip S. Anselmo, the Navy's deputy director of Air Warfare. Vice Adm. Leighton Smith, Jr., the Navy's top plans and operations officer, recently told reporters that the program has the full support of the Air Force, which is looking to buy hundreds of A/F-Xs as replacements for its interdiction aircraft.



USAF photo by Bill Holder

Construction continues on the new acquisition management center for Air Force Materiel Command's Aeronautical System Center. Work is expected to be completed by late March 1994. The project, commonly known as ASC Tomorrow, will be located just east of the Air Force Museum at Wright-Patterson AFB, Ohio.

B-52 Pilot Is Eaker Winner

Capt. Robert E. Wheeler, a B-52 aircraft commander with the 644th Bomb Squadron, K. I. Sawyer AFB, Mich., is the latest winner of the Gen. Ira C. Eaker Outstanding Airmanship Award.

Captain Wheeler, who received the award in September of this year for outstanding performance in 1991, was cited for his safe landing of a crippled B-52 while administering a pilot initial qualification checkride.

Only a few hundred feet off the ground, just after gear retraction, the bomber crew received an indication that the plane was being endangered by an overheating air-conditioner. With the unit hampered by a stuck manifold valve, temperatures hit 570°—extremely dangerous since on-board fuel can explode at 475°. Captain Wheeler attempted to retard the throttles individually, but the temperature remained too high, indicating it could be uncontrollable. Then came indications that the primary and secondary rudder elevator systems had malfunctioned. As he pored over manuals that explained the rudder problem, Captain Wheeler controlled the overheating problem by retarding two engines.

Minutes later, the navigator detected an electrical fire in his equipment. With multiple emergencies, Captain Wheeler ordered the crew to prepare to bail out. Once the fire was extinguished, the crew established an orbit away from populated areas and set up communications with the wing command post and the Boeing Co. Despite the possibility that the rudder had failed totally, Captain Wheeler decided to make a heavyweight landing. He descended, touched down, and brought the aircraft to a full stop using only six of the bomber's eight engines.

Greek F-16 Buy Boosts GD

General Dynamics, manufacturer of the F-16 multirole fighter, got another economic boost in October when the

Lockheed photo by Denny Lombard

Two Lockheed fighters, an F-117 and a P-38 Lightning, came to Peterson AFB, Colo., in October for the dedication of a P-38 memorial at the USAF Academy. The first 400-mph fighter, the P-38 became the star of the Pacific theater during World War II. The F-117 became the star of Operation Desert Storm, accounting for forty percent of all strategic targets attacked.

Greek government announced its decision to purchase forty additional F-16C/D aircraft. The order is valued at $1.8 billion.

The decision in Athens came on top of the announcement last September that Taiwan would buy 160 of the front-line US fighters, which are built in GD's Fort Worth plant. Moreover, the Fiscal 1993 Air Force budget passed by Congress includes funds for thirty more F-16s.

The Greek Air Force has been flying the F-16 for years. The Greek deal also included the purchase of ten spare engines and forty sets of Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) systems, including navigation (Pathfinder) and targeting (Sharpshooter) pods.

Photo © Peter R. Foster

The Royal Air Force officially stood down its remaining F-4 Phantom II fighters in October. No. 74 Squadron of RAF Wattisham, UK, sent its F-4s to reserve units and into storage as it made the transition to the F. Mk. 3 Tornado. In 1991, No. 74 Squadron became the UK's last user of the venerable Phantom.

Congress Acts on Benefit Issues

Congress approved a revision of the Voluntary Separation Incentive (VSI) and the Special Separation Benefit (SSB), basic programs that the Pentagon uses to ease the pain of today's major force reductions.

The revision, contained in the 1993 defense authorization bill, removes inequities in the two programs, mostly by including new transition benefits in the VSI program. Congress ordered that the VSI, like the SSB, include limited medical care, commissary and exchange benefits, and employment assistance. Congress also approved a pay raise of 3.7 percent for military personnel, effective January 1, 1993.

The lawmakers granted authority to the Secretary of Defense to offer early retirement to servicemen and -women with fifteen to twenty years of service. However, Congress stated that the move is temporary and should be used to reduce the size of certain overstrength specialties and year groups. Early retirement may also be offered to service members who have already taken advantage of the SSB or VSI programs enacted last year.

AMC Finishes Angola Mission

In October, the Air Force completed Operation Provide Transition, during which three Air Mobility Command C-130 aircraft transported and separated 8,643 Angolan former combatants. The object of the mission was to relocate soldiers of the formerly hardline Marxist Angolan government in Luanda and of the UNITA guerrilla movement from nine marshaling areas to their distant home regions.

The operation, conducted in support of a major Angolan election, involved eighty airlift missions. It began in August, lasted sixty days, and required the services of eighty Air Force personnel and up to fifteen Army soldiers.

USAF photo by 1st Lt. Eric Butterbaugh

Crew chief SSgt. James Greathouse talks F-16s with RAAF Cpl. Greg Terry during Viper South '92. The two-week exercise pitted F-16s from Kunsan AB's 8th Fighter Wing against 77 Squadron F-18s from Williamtown, New South Wales, Australia.

T-1A Instructors Start Training

The Air Force has begun training the instructor pilots selected to teach flight training in the T-1A Jayhawk next September at Reese AFB, Tex.

The T-1A is the first new training aircraft to reach Air Training Command since the 1960s. It marks the first step in the restructuring of Air Force pilot training into the dual-track system known as specialized undergraduate pilot training (SUPT). The T-1A will be used in the tanker/transport track of SUPT. More than twenty instructor pilots had received training by December.

About 180 aircraft and eleven simulators will be provided by McDonnell Douglas Aircraft Co., which is teamed with Beech Aircraft Corp. and Quintron Corp. About twenty aircraft and two flight simulators have been delivered to date. The test aircraft have logged

3,000 flying hours and 6,660 landings.

USAF Probes C-17 Anomaly

The wings of a nonflying C-17 test aircraft buckled prematurely during a load-testing operation in September.

The C-17 is required to withstand 150 percent of normal maximum operating loads. In the recent test, however, the C-17's wings buckled symmetrically at the same time under loads equal to 130 percent of normal maximum operating weight, said McDonnell Douglas spokesman Larry McCracken.

The wing problem is being investigated by two teams, one made up of McDonnell Douglas engineers and the other comprising Air Force and independent experts. The teams plan to examine the test to see if there was a problem with the 200 hydraulic actuators and 2,000 strain gauges. However, McDonnell Douglas officials said that the failure of both wings at the same place suggests structural problems.

Four C-17s have together accumulated more than 600 hours of flight time. Those aircraft have been restricted to eighty percent of maximum loads, but that will not affect flight scheduling, as the C-17s were not expected to fly with wing loads greater than eighty percent until February.

Investigators will try to pinpoint the cause of the wings' buckling while identifying a number of steps that could fix the problem. First, the static aircraft must be fixed; then fixes have to be applied to existing aircraft; finally, a change must be incorporated into the assembly line for future production aircraft. No timetable has been set for completion of the investigation.

Pentagon Survey Targets Drinking

The Pentagon's 1992 Health Practices Survey reports that forty-one percent of military personnel are either moderate to heavy or heavy drinkers. The survey defined "moderate/heavy" drinking as the consumption of two to five alcoholic drinks per occasion at least once a week and "heavy" drinking as the consumption of five or more drinks per occasion at least once a week.

The forty-one percent figure is considered high. Nevertheless, it continues a modest decline in those categories since 1980, when moderate to heavy and heavy drinkers made up fifty percent of the active force. In the interim, the number of personnel who abstain from alcohol or who describe themselves as infrequent or light drinkers has increased.

The survey, the fifth since 1980, asked approximately 16,000 active-duty service members about their illegal drug use, smoking, excessive drinking, steroid use, gambling, and medically risky sexual behavior.

The survey showed an overall decline in the use of illicit drugs, a problem that encompassed 27.6 percent of the active-duty force in 1980 but only 3.4 percent in 1992. The drugs most frecuently used in the past twelve months were marijuana, LSD, and cocaine. The survey showed that service members who are younger, less educated, single, anc lower in rank are most likely to use illegal drugs.

Smoking among service members has declined from 40.9 percent in 1988 to thirty-five percent in 1992. Only eighteen percent of the force is considered to be in the "heavy smoker" category.

KC-135 Crew Chief Wins Award

SSgt. Jason R. Bell, a KC-135R crew chief assigned tc the 42d Organizational Maintenance Squadron at

General Dynamics's Fort Worth Division has applied a Japanese manufacturing technology to co-cure and assemble the first composite aircraft hardware produced in the US for Japan's FS-X fighter program. The structure accounts for about one-quarter of the wing, including spars, ribs, and lower wing skin in one unit.

Loring AFB, Me., won the latest USAF Pursuit of Excellence Award for his swift work in extinguishing a fire that had threatened to destroy an aircraft parked nearby.

On December 5, 1991, Sergeant Bell and a co-worker were running engines on a KC-135R tanker when a vehicle on the next hardstand burst into flames. Sergeant Bell instructed his co-worker to use the aircraft radio to inform the control tower of the fire and to send fire fighters. He pushed a fire extinguisher toward the vehicle and, despite the intense heat, apparently contained the fire, but it soon surged anew. The sergeant opened the door and discovered flames coming from under the dashboard. He extinguished those as well. Investigators later determined that Sergeant Bell, by containing and dousing the fire, prevented an explosion that would have damaged the aircraft, within which three USAF maintainers were working.

Rollover Plan Criticized

The practice of "rolling over" technologies into new development and technology demonstration programs will not yield the financial return needed to keep prime contractors healthy, says Thomas M. Culligan, vice president of program development and marketing for McDonnell Douglas.

He said that the government would have to change the total acquisition process to address the problems faced by prime contractors, who must operate their own facilities with substantial fixed costs and whose fee structure and financial health principally have depended on volume production.

"A succession of technology demonstrators or prototypes does not address or demonstrate the complex transition from development to production, and they are unlikely to preserve critical core competencies or capacity required to make the transition to production in the future," Mr. Culligan said.

An investment climate that supports a strong defense technology and industrial base must be created, he continued. A more cooperative relationship between the government and defense industry must be nurtured. Mr. Culligan also called for greater budget stability and more privatization of industrial functions now performed by government depots.

Lieutenant Gabel's Flying Spirit

Last July, 1st Lt. Mark Gabel, a weapon systems officer with the 196th Reconnaissance Squadron (ANG) at March AFB, Calif., climbed into the rear seat of his RF-4C, taxied, and took off. After a ninety-minute flight, his aircraft landed.

This would have been unremarkable if not for Lieutenant Gabel's medical history: Three years ago, doctors told him he would never walk again.

On July 6, 1989, Lieutenant Gabel, serving as a Runway Supervisory Officer, was standing outside his vehicle watching F-4Es launch and land. One F-4 rolled right during liftoff, touched tail and wing to the runway, and slammed onto the tarmac. Lieutenant Gabel saw the flash as the F-4 crew ejected; then the F-4 and his own vehicle crashed into him.

Lieutenant Gabel suffered multiple leg fractures, a crushed pelvis, and severe injuries to his right buttock. The early assessment of his doctors was that he was crippled for life. After one month of intensive care, he endured ten months of excruciating daily physical therapy. In May 1990, he was placed on disability retirement. He moved to San Diego and eventually began flying private aircraft. In September 1991, he returned to active duty. Earlier this year, he passed his flying physical. His return to military flying last summer drew a huge crowd of well-wishers.

GAO Looks Askance at B-2

In a new report issued in October, the General Accounting Office, an arm of Congress, leveled fresh criticism at the new B-2 bomber. GAO analysts maintained that the Air Force does not need the stealth aircraft for the strategic nuclear mission because the Soviet Union's air defenses were overrated, the Soviet Union's disintegration has weakened them further, and the cost of the B-2 program is too high.

A declassified summary stated, "Evaluation of the data showed . . . that DoD studies have . . . greatly overestimated the effectiveness of these air defense systems." It adds that, given the demise of the Soviet Union and the dire economic conditions that persist in the republics of the former superpower, current air defenses are likely to erode further.

In a broad indictment of the program, the GAO report contended that the B-2 will cost $2 billion per plane, that B-2 stealthiness is uncertain, and that B-52Gs and Hs are still viable bombers and have lengthy service lives remaining.

GAO's analysts believe that, on balance, the submarine leg of the strategic nuclear triad shapes up as the most cost-effective. The speed and reliability of day-to-day communications to submerged boomers are far better than is widely believed, said GAO, adding that the undersea deterrent force is "essentially invulnerable."

Mars Observer Begins Voyage

In late September, a Martin Marietta commercial Titan III booster propelled NASA's Mars Observer spacecraft

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from Cape Canaveral AFS, Fla., into a brief Earth orbit, where it was then fired by an Orbital Sciences Corp. Transfer Orbit Stage booster toward a Mars orbit.

The mission could be called flawless. The spacecraft is successfully pushing toward Mars. The Observer will examine Mars in much the same way that Earth-orbiting satellites now map this planet's weather and resources. The mission will provide scientists with geological and atmospheric information throughout a full Martian year, the equivalent of 687 Earth days.

The flight to Mars will take about eleven months, with the Observer deploying four of its six solar panels to draw energy. In August 1993, the Observer will arrive in the vicinity of Mars, where, as it approaches the planet, the spacecraft will fire on-board rocket engines to slow down and allow Mars's gravity to capture it in orbit around the planet.

The Observer's payload of seven instruments will examine Mars from the ionosphere, an envelope of charged particles that surrounds Mars. These instruments will also provide a daily global map of the planet. The Mars Observer's camera will resolve far smaller objects than was previously possible.

ANG "Goes to the Bank"

The 125th Fighter Group of the Florida ANG recently pioneered a personnel innovation that may well become widespread in the current force drawdown.

The ANG is taking advantage of the current surplus in banked Air Force pilots by using it to fill vacancies in its flying units. One example is ANG Lt. Tom Herring, formerly a banked Air Force pilot, who began recurrency training in T-38 trainers in October at Randolph AFB, Tex. This is the first of three flight training courses on the way to his becoming an F-16 air defense fighter pilot.

Training the banked pilot proved tough initially. The main obstacle was regaining the T-38 currency required for Basic Flight Transition at Holloman AFB, N. M. But there was high motivation. Banked pilots can expect to wait thirty-four months before getting back into active-duty cockpits. Many could be eager to seek immediate positions in ANG or Reserve units.

Eurofighter Team At Odds

In October, the German government officially notified its three national industrial partners—Great Britain, Italy, and Spain—that it intends to withdraw from the European Fighter Aircraft (EFA) program.

Termination of the four-nation memorandum of understanding places the future of the cooperative European fighter development program in limbo. Great Britain has indicated that it intends to stick with the EFA program, whatever Germany does, and that it would even go it alone if necessary.

Sources say that the German Air Staff is currently working on a new requirement for a light, less expensive, and less formidable aircraft, known as "EFA Lite." The prospective German aircraft is politically mandated to be defensive.

The German Air Staff is still committed to codeveloping a fighter with European allies. However, if Great Britain persists in pushing the high-performance EFA, Germany, Spain, and Italy would be hard pressed to find an alternative. Germany might then look favorably on a purchase of the Swedish Gripen, French Rafale, or US F-15, F-16, and F/A-18 fighters.

German officials said that the EFA would cost about $90 million per copy, far more than Germany wants to pay.

DoD Moves to Quell Sexual Harassment

The Department of Defense has established a number of programs and organizations to "advise, assist, monitor, and direct" its efforts to eradicate sexual harassment, according to Christopher Jehn, the Assistant Secretary of Defense for Force Management and Personnel.

In September testimony before the House Committee on Veterans' Affairs' Subcommittee on Oversight and Investigations, Mr. Jehn outlined those programs.

The Defense Equal Opportunity Council coordinates policy and reviews military and civilian equal-opportunity programs. "It [also] monitors progress of program elements, advises the Secretary of Defense on policies for EO [equal opportunity] matters, and assists in developing policy guidance

Senior Staff Changes

RETIREMENT: Gen. James P. **McCarthy.**

PROMOTIONS: To be **General:** Charles G. **Boyd;** Robert L. **Rutherford;** Henry **Viccellio,** Jr.

To be **Lieutenant General:** Jay W. **Kelley.**

To be **ANG Major General:** Tandy K. **Bozeman;** Stephen P. **Cortright;** Dennis B. **Hague;** E. Gordon **Stump.**

To be **ANG Brigadier General:** Charles L. **Blount;** Stewart R. **Byrne;** Harris R. **Henderson;** John S. **Hoffman;** Donald E. **Joy,** Jr.; Ronald H. **Morgan;** Harry E. **Owen,** Jr.; Daniel H. **Pemberton;** Kenneth M. **Taylor,** Jr.

CHANGES: L/G Joseph W. Ashy, from Cmdr., Hq. ATC, Randolph AFB, Tex., to Cmdr., Allied Air Forces Southern Europe, and Dep. CINC for the Southern Area, USAFE, Naples, Italy, replacing retiring L/G James T. Callaghan . . . **B/G Bruce J. Bohn,** from Dir., Plans & Policy, DCS/C⁴, Hq. USAF, Washington, D. C., to Dir., Defense Network Systems Org., Defense Information Systems Agency, Arlington, Va., replacing retired B/G Dennis C. Beasley . . . **L/G (Gen. selectee) Charles G. Boyd,** from Cmdr., Hq. AU, Maxwell AFB, Ala., to Dep. CINC, Hq. USEUCOM, Stuttgart-Vaihingen, Germany, replacing retired Gen. James P. McCarthy . . . **B/G Lee A. Downer,** from DCS/Ops., 2d ATAF, NATO, Rheindahlen, Germany, to DCS/Ops., and Dep. Dir , Ops., EACOS, Hq. USAFE, Ramstein AB, Germany, replacing M/G George B. Harrison . . . **M/G (L/G selectee) Jay W. Kelley,** from Dir., Public Affairs, Hq. USAF, Washington, D. C., to Cmdr., Hq. AU, Maxwell AFB, Ala., replacing L/G (Gen. selectee) Charles G. Boyd . . . **L/G (Gen. selectee) Robert L. Rutherford,** from Vice CINC, Hq. PACAF, Hickam AFB, Hawaii, to CINC, Hq. PACAF; Air Comp. Cmdr., USCINCPAC; anc Exec. Dir., PACOS, Hickam AFB, Hawaii, replacing retiring Gen. Jimmie V. Adams . . . **L/G (Gen. selectee) Henry Viccellio, Jr.,** from Dir., Joint Staff, Washington, D. C., to Cmdr., Hq. ATC, Randolph AFB, Tex., replacing L/G Joseph W. Ashy.

SENIOR EXECUTIVE SERVICE (SES) RETIREMENT: John A. **Zoellner.**

SES CHANGES: John M. Gilligan, from Dir., C⁴ Resources, Hq. USAF, to PEO for Automated Information Systems, Hq. USAF, Washington, D. C., replacing Robert C. Majors . . . **Steve N. Smith,** from Asst. DCS/Personnel, Hq. AFLC, Wright-Patterson AFB, Ohio, to Dep. Dir., Work Force Effectiveness, Hq. USAF, Washington, D. C. ■

for education and training in EO and human relations for DoD personnel," Mr. Jehn said.

The Defense Advisory Committee on Women in the Services assists and advises the Secretary on policies and matters relating to women in the military services.

The Defense Equal Opportunity Management Institute provides primary training for all DoD military and civilian personnel assigned to military EO billets. It also develops curricula and training for EO and human relations education.

The Military Equal Opportunity Climate Survey helps military commanders assess the EO climate at their organizations. "Among other things, it addresses sexual harassment and discrimination, differential command behavior toward women, and sexist behaviors," Mr. Jehn said. As of September, 315 surveys had been conducted and returned to requesting units, and another 297 were in different stages of processing.

The process by which harassment complaints are handled is the same as that used for complaints about discrimination based on race, ethnic background, religion, national origin, or age. Sexual assault and rape are handled under the Uniform Code of Military Justice and differ from complaints of harassment.

NASA Scientist Wins Medal

Dr. Wesley T. Huntress, Jr., a NASA scientist, received the Korolev Medal, awarded by the Russian Federation of Astronautics and Cosmonautics, for his achievement in space research.

The director of NASA's Solar System Exploration Division received the award in September at the sixth annual meeting of the US-Russia Joint Working Group on Solar System Exploration, held in San Francisco. The award citation recognized Dr. Huntress's "great contribution to the development of Russian-American cooperation in solar system exploration."

Dr. Huntress currently leads the nation's planetary science and exploration program, including the ongoing missions of Ulysses, Magellan, and Galileo, and the Mars Observer mission.

SDIO Results Challenged

In four of seven separate flight tests, the Strategic Defense Initiative Organization inaccurately described some results, said a September General Accounting Office report. SDIO claimed that five of the seven tests were successes and the other two failures, but GAO differed with those results.

In one Kinetic Kill Vehicle Integrated Technology Experiment (KITE), SDIO said that the shroud design used by KITE 1 was validated. GAO found this to be untrue. KITE 1 was planned to demonstrate key technologies for a ground interceptor that could destroy enemy nuclear warheads as they reenter Earth's outer atmosphere. The system's optical sensor has a window that requires cooling and a shroud during the first five to ten seconds for protection. During the test, the shroud broke into pieces and struck the KITE 1 vehicle. SDIO was forced to redesign the shroud, said GAO.

The Exoatmospheric Reentry Vehicle Interceptor Subsystem (ERIS) allegedly successfully achieved target discrimination. ERIS is designed to pick out and destroy warheads among various decoys. During the second test of ERIS, the systems failed to intercept the target, said GAO.

In the case of the Lightweight Exoatmospheric Projectile (LEAP), a technology program to develop the smallest, lightest, kinetic kill vehicle possible, SDIO claimed that accuracy and altitude goals were met. However, GAO said that test information avail-

able at the time of the press release showed that the experiment had not reached the altitude claimed. In fact, "information available at that time on the relative positions of the target and projectile did not provide the accuracy to positively conclude that they were positioned correctly," the GAO report said.

Brilliant Pebbles testing was also inaccurately reported, said GAO. Brilliant Pebbles, a space-based system, is expected to destroy ballistic missiles early in flight. In some cases SDIO claimed the system was ninety percent successful in the test. However, SDIO failed to make clear that some test goals had been redefined or significantly reduced. Furthermore, SDIO claimed that Phase 1 of the test program was complete because the system had successfully completed more difficult tests each time. GAO found that "the actual test results accomplished much less than planned." In fact, the second test, supposed to be more difficult than the first, was actually a repeat of the first.

News Notes

■ The Army's Space and Strategic Defense Command awarded a $491 million contract to Raytheon in September for the Ground-Based Radar family of radars, which is being developed for use both in theaters for regional conflicts and for the US National Missile Defense against strategic attack.

■ Air Mobility Command (AMC) handed over control of Hurlburt Field, Fla., to Air Force Special Operations Command in October. The most extensive change required by the move will be the changing of shoulder patches.

■ In October at Altus AFB, Okla., the 97th Air Mobility Wing became the first AMC wing to combine airlift and refueling assets under the Air Force's restructuring program. The move required inactivation of the 443d Airlift Wing and the 340th Air Refueling Wing. The installation includes four squadrons of KC-135Rs, C-5Bs, and C-141Bs.

■ Congress authorized $14.892 billion in October for NASA in Fiscal 1993, with $2.1 billion approved for the Space Station Freedom program.

■ The first radar-equipped AV-8B Harrier II Plus made its first flight in September. The McDonnell Douglas aircraft uses the APG-65 radar built by Hughes. The Marine Corps plans to buy twenty-seven radar-equipped Harriers. Italy has committed to buy thirteen.

■ The Israeli Arrow antitactical ballistic missile completed a successful flight test in September at a test range in Israel. This last of four planned flights accomplished "verification of airframe response and integrity, performance of the solid fuel rocket motor, control system response, and operation of the sensing device carried on the Arrow to guide to its target," said Israel Aircraft Industries.

■ In September, GAO rejected five protests made by Enhanced Flight Screener program competitors faulting the way the Air Force awarded the contract to Slingsby Aviation Ltd. of Great Britain in April. GAO found that the Air Force evaluators were reasonable and consistent with Air Force regulations, that USAF met standards for conducting meaningful discussions, and that the award was reasonable and consistent with stated evaluation criteria.

■ The Carlyle Group announced in October that it had purchased the San Diego–based Electronics Division of General Dynamics for under $100 million. The 2,300-employee division expects to take in revenues of $300 million in 1992.

■ Cosmonauts Sergei K. Krikalev and Col. Vladimir G. Titov will train to fly on a space shuttle mission scheduled for launch in November 1993, NASA announced in October. The two cosmonauts will receive mission specialist training on shuttle systems, flight operations, and manifest payload procedures. One will be a primary crew member; the other will be a backup.

Purchases

The Air Force awarded GEC-Marconi Electronics Systems Corp. a $16 million firm fixed-price contract for the Joint Tactical Information Distribution System low-rate initial production Lot 3 buy consisting of ten F-14D terminals. Expected completion: September 1995.

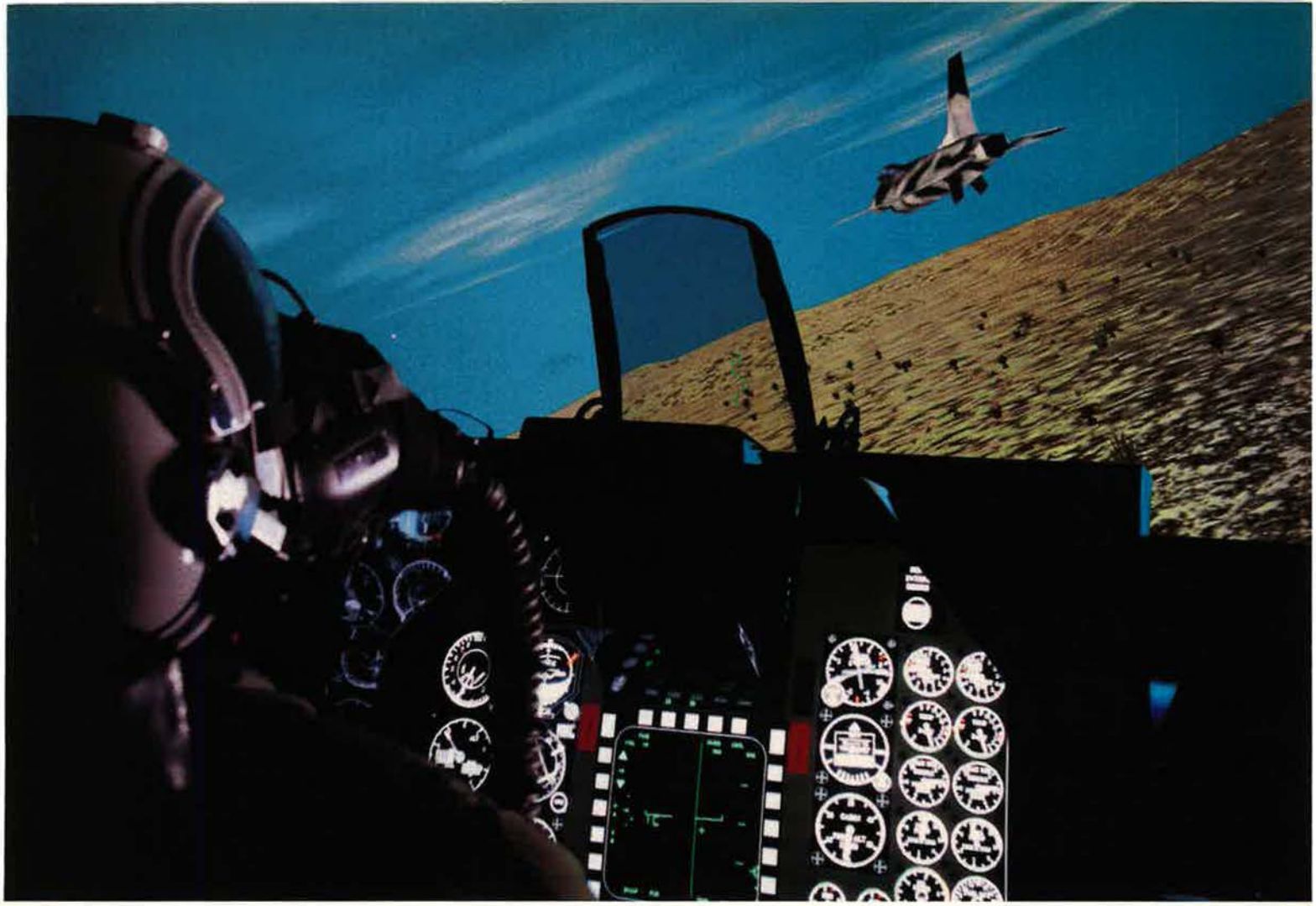
The Air Force awarded Martin Marietta Electronic Systems a $51 million cost plus fixed-fee contract for development and demonstration of the Advanced Infrared Search and Track sensor, a long-range sensor employing a wide-angle scan to detect, track, and declare unresolved targets in the presence of clutter. Expected completion: September 1997.

Loral Vought Systems was awarded a $202 million contract from Army Missile Command to develop and demonstrate new technology for the Line-of-Sight Antitank weapon system. Expected completion is in 1996.

Deaths

Army Gen. James A. Van Fleet, who fought in two world wars, battled Communist forces in Greece and Korea, and was one of the most respected United States military leaders, died in his sleep in September at his home in Polk City, Fla. He was 100. General Van Fleet retired from the Army in 1953. He is survived by two daughters, eight grandchildren, and twelve great-grandchildren. ■

Index to Advertisers



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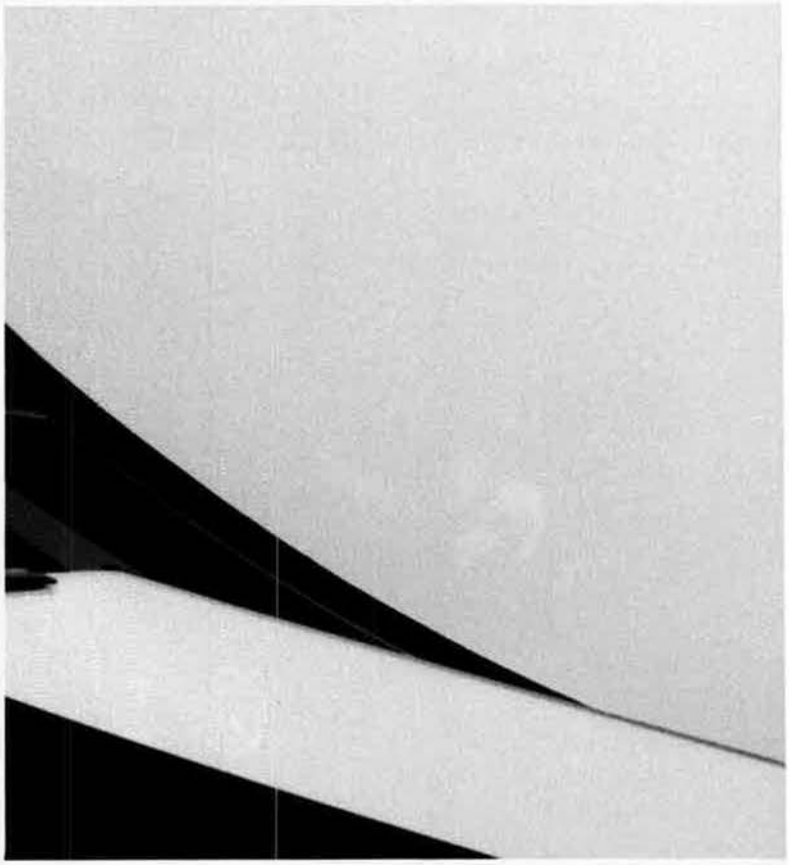


What aircrews learn at Cope Thunder might make the difference between life and death in combat.

Training at the Top of the World

By Frank Oliveri, Associate Editor

Staff photos by Guy Aceto

THE self-proclaimed "ghost" stood before his colleagues to explain just what went wrong. You should not use strike aircraft as "detonators" or "missile-draggers" to disrupt air defenses, he growled. The plan of attack had been "good, but complex," and it fell apart when the Alaskan weather turned foul.

The next to stand up was another "ghost," who delivered a sharp lecture to an intelligence officer. In a sarcastic aside, he told mission planners that the Navy's EA-6 Prowler is supposed to jam ground targets, not air targets.

The speakers—first an Air Force pilot, then a Marine aviator—had been "shot down" in mock air combat, but they learned valuable lessons. It is humiliating to stand before fellow pilots to admit screwing up, and it does not feel good to know you were "killed." But it is all part of the drill at Cope Thunder, the huge Air Force exercise in which large composite groups go after each other in simulated combat across the vast Alaskan airspace.

The logic behind Cope Thunder is simple. Most pilots who get shot down in real war do so before completing ten combat missions; in this break-in period, inexperience is a killer. For pilots

Considered a high-value asset, tankers tactically play along with fighters and attack aircraft in Cope Thunder. Here, MSgt. Donna Horne, a boom operator with the 168th Air Refueling Group of the Alaska ANG, refuels an F-16 from the 51st Wing at Osan AB, Korea, which is about to join the mock battle.

Staff photos by Guy Aceto

Jointness is the key to Cope Thunder. Above, a Marine Corps EA-6B Prowler awaits its next mission, during which it will support USMC F/A-18s and USAF F-15s and F-16s, like these (below) from the 343d Wing.

who survive ten missions, however, the shoot-down rate declines dramatically. Cope Thunder lets the new pilot come as close as possible to experiencing the first ten missions without the risk. He returns after each sortie—ego bruised, pride wounded, but alive—to correct errors, refine tactics, and become a deadlier adversary.

Cope Thunder provides this kind of top-flight training to Air Force, Navy, Marine, and allied pilots. Each exercise unfolds over two weeks. Crews fly a total of some 1,200 sorties. The flights go on twice a day, every day, and grow more intense as attackers and defenders become cagier and more skilled at the combat art. Like heavyweight boxers, the opposing teams trade blows; return to their corners after each round to rest, think about what they have just been through, and find the weaknesses of the opponent; and, at the bell, come out swinging.

Sand in Their Eyes

One recent exercise was outlined by Maj. Richard Barnett, the Air Force's assistant director of Cope Thunder operations. During a session in August, he explained, the Red (air defense) team was played by sixteen Marine Corps F/A-18 strike fighters. It confronted a tough challenge from the Blue (attacking) force, a strike package containing twenty F-15C air-superiority fighters, eight F-15E strike fighters, and many F-16 multirole fighters.

Of the Red team, Major Barnett said, "Their plan was the best I've seen to date. It was to go out at high altitude, right before what they thought would be push time, and seed the sky with chaff to completely blind all the [F-15C] Eagles so nobody could see. Now, this chaff falls slowly; it's like throwing sand in their eyes. Then they [Red F/A-18s] were going to drop down low and, while the Eagles are up here with their white canes trying to find these guys up in the stratosphere, they [Red F/A-18s] would be down there [attacking] the F-16s at low altitude."

Before the mission could even get under way, however, disaster struck the Red team. "Weather took out their tanker," recalled Major Barnett. "They couldn't refuel." Most of the sixteen F/A-18s had to go home, and only three remained to face the attackers. "Now, they did a good job," said the Major, "but it wasn't what they had planned. The best laid plans occasionally go astray."

Afterward come the questions. "What would be a better idea?" Major Barnett asked rhetorically. "What worked against these guys? The majority of learning that occurs at Cope Thunder takes place in the debrief. You might think the culmination of Cope Thunder is the mission. Well, it's the debrief."

At Cope Thunder, aerial tankers also "play" in the air combat scenario, said Major Barnett. "In a lot of exercises, tankers are used as gas stations. These guys are playing. They are considered 'HVAA'—high-value airborne assets—so they and AWACS [E-3 Airborne Warning and Control System aircraft] will be attacked during a mission if they don't have adequate protection. They have to have a plan to know where they can run to escape. . . . To 'retrograde' is a term they like to use."

It is not uncommon for one or two aircraft to attempt to break away toward AWACS aircraft or tankers for an attack. Loss of either of these assets could change the complexion of a battle. The E-3s can see an attacker at great distance and turn away in time, but fighters on combat air patrol act as bodyguards for "their" tankers. Tank-

ers are also used as decoys. "They're using tankers to put a blip to confuse the enemy radar," Major Barnett said. "They are looking out and seeing four packages when in truth one of these packages was nothing more than the tanker giving a blip. When the war starts, they bug out."

Training the Whole Machine

Cope Thunder, owned and operated by Pacific Air Forces, was set in the Philippines until recently. PACAF moved the whole operation to Alaska in mid-1991, shortly before USAF withdrew from Clark AB and lost access to the Crow Valley Range. Alaska's uncluttered airspace and the proximity of Eielson and Elmendorf AFBs make the area ideal for air combat training.

Maj. Ray Dissinger of the 3d Fighter Training Squadron, USAF's director of Cope Thunder operations, said the big exercise has changed in other ways. Once, Cope Thunder focused mainly on training aircrews. Now, "the purpose of Cope Thunder is to train the whole warfighting machine. We run an objectives program for things that we want the aircrews to get out of it, but, over on the maintenance side, we have a maintenance staff with training objectives. We do the same thing for our intelligence people."

Every session at Cope Thunder becomes a kind of laboratory, "a chance to try different things and integrate different units," said one USAF officer. Each mission is planned carefully by Blue and Red forces, usually the day before the exercise takes place. In the morning, the key players are briefed again. Then the pilots hit the ramp.

Photo by James Benson

The 3d Wing at Elmendorf AFB, Alaska, was on the front lines in the confrontation with the USSR, and the performance of its F-15Cs in Cope Thunder confirmed the Eagle's status as the world's premier air-superiority fighter.

Long before that, however, planners draw up their schedules and set priorities. "We have a planning conference two months before everyone comes in," explained Major Barnett. "They . . . say, 'This is what we want to do.' Generally those things [are approved], but they may not mesh perfectly with what another wing wants done. We get them together, and we make them blend until we . . . figure out what this composite wing wants to do."

In addition to having Red and Blue teams, each Cope Thunder session has an intelligence section designated "White," which plays a neutral role. White takes the input of each unit and lays out a generic war scenario. "We don't do anything specific," Major Dissinger said. "It can be tailored. It may favor Korea or Europe, but it is not designed [to be] specific. One of the reasons we do that is that we have people from all over the world who have different taskings."

Meanwhile, logisticians are bedding down aircraft, finding accommodations for personnel, providing fuel, and performing the usual multitude of tasks required to move in fighter units. When the units arrive, they form up in composite units containing two or more different types of aircraft. Taking charge of the force, and designated as the wing commander, is a full colonel. The fighter units operate out of Eielson and Elmendorf and communicate with each other over Air Force satellite links. All told, about 1,000 Air Force personnel participate. About 100 aircraft are on hand, and as many as eighty will be airborne at any given time.

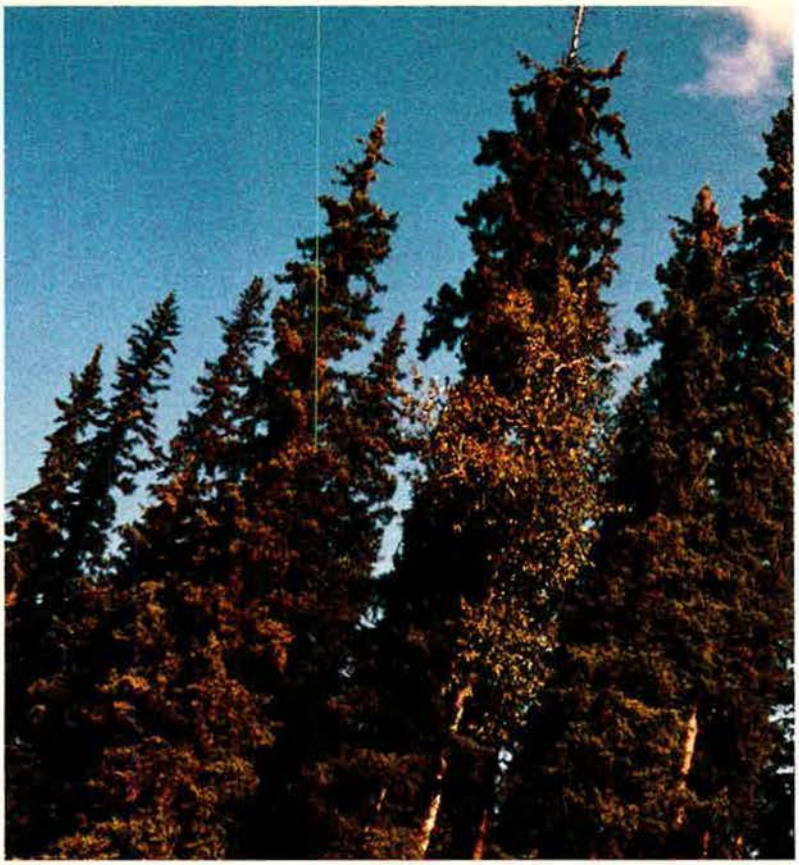
The key to Cope Thunder is jointness. Air Force, Navy, Marine, and allied personnel learn about each others' aircraft, tactics, tricks, and capabilities, but the most important goal is to learn how to communicate with

Photo by James Benson

Cope Thunder provides the pilot with experience that comes as close as possible to those first ten combat missions. Much of the real work, however, takes place on the ground at planning sessions and debriefings.

each other, which is not always as straightforward as it might seem. For example, Air Force pilots talk about "two-ship" or "four-ship" formations. The Marines talk about divisions and sections. "Divisions? Damn, isn't that about 5,000 men?" asked one USAF officer. "No, that's just four airplanes."

Maj. John Ostrom, an operations officer for the Marine Corps's VMFA-232 F/A-18 fighter unit, based in Japan, said, "It's abnormal for us to have more than eight or twelve airplanes out there, where they [the Air Force] have forty or fifty. The other thing we notice is that every airplane has its own capabilities and limitations, and they have different ones that we have to become familiar with. You always want to optimize your aircraft's abilities and minimize your limitations."



Red vs. Blue

Typically, the Blue, or offensive, mission will be handled primarily by air-to-ground aircraft—F-16s, F-15Es, and the like. The Red forces typically are air-to-air aircraft such as F-15Cs. During a certain week, air-to-air fighters will escort strike aircraft to their targets. The next week, they switch and become Red interceptors.

The Blue team must deal with opposing air threats and assorted simulated surface-to-air threats. Red and Blue are forced to contend with communications and radar jamming.

To control the engagement area and provide a big picture of the unfolding exercise, White will use AWACS aircraft and the Alaskan Regional Operational Control Center, also known as "TOPROCC."

Much of Cope Thunder's learning comes through trial and error. It gives a pilot the opportunity to try new things and validate other plans. Simulated combat forces pilots to deal with numerous stimuli. Flying becomes instinctive. "If you spend time thinking about flying the airplane, then you're not going to be able to use it," Major Barnett said. "Your hands fly the plane. Your brain is trying to figure out what the adversary is doing, or where the target is, or what the SAMs are trying to do to you."

Cope Thunder places the pilot in an extremely work-intensive environment. Sorties last up to one and a half hours each, but the difficult part is the two minutes or so that the pilot spends directly in the target area, where he is up against surface-to-air missiles, antiaircraft artillery, jamming, enemy fighters, and the threat of colliding with one's own jets. "You don't spend a lot of time in the threat," one pilot said.

Many commanders who come to Cope Thunder have already been through a weapon systems course, so they come to sharpen skills and teach younger pilots. Air officers with the neutral White team mostly take a back seat in planning operations, which can be difficult. Major Barnett said that there is an urge to say, "Somebody thought of that last time, and it didn't work for them." However, he added, "it's tough to tell a guy, 'Hey, you've got an ugly baby.' "

The White team's job is to make sure plans are safe. Some call for bringing thirty aircraft into a small area within ten minutes, and the team's officers must make sure the sides don't inadvertently "plan" a midair collision. In addition, the rules bar air-to-air forces from attacking attackers when they pop up in front of the target. This is realistic, because that is usually the time when integrated air defense systems take over from air defense fighters.

Jammers and Spoofers

In debriefing sessions, Blue and Red team members get together to sort out their respective missions. They talk about what was planned and what actually happened. Communication jammers say which frequencies they jammed. "Spoofers," personnel who speak to the pilots in attempts to mislead them, explain what they did and why.

"You've got all the parties in there in a nonadversarial role—in theory," Major Barnett said, though he acknowledged that making it through one of the sessions often "takes thick skins. Nobody likes to hear they screwed up. Nobody likes to stand up in front of a bunch of other fighter pilots and say, 'Boy, I farmered that,' but that's the point of the debrief."

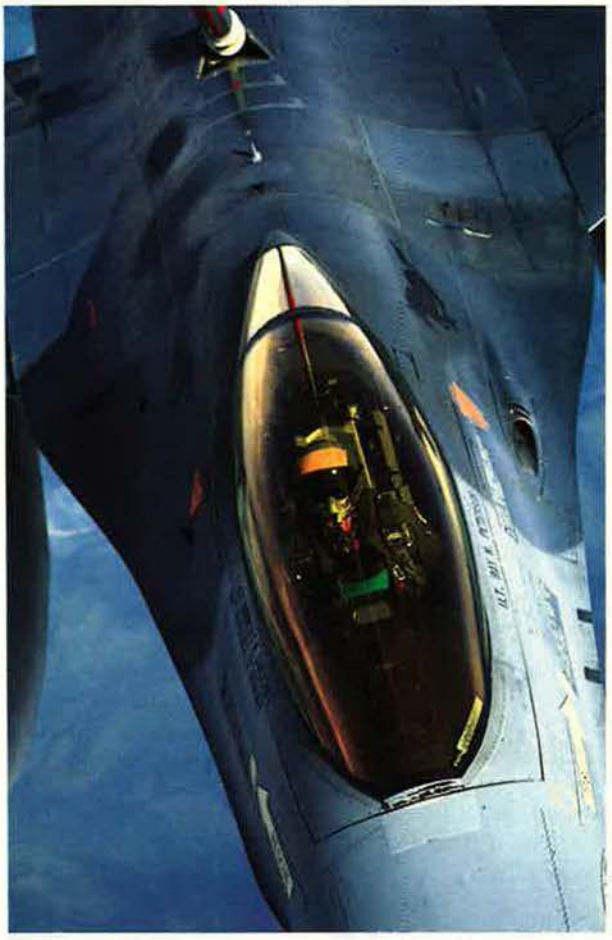
For example, in one mission, F/A-18s "were hammering the F-16s. They were getting in on them unobserved at six o'clock," one pilot said. "After a couple of debriefs where the guys were seeing themselves getting whacked, all of a sudden the Marines aren't getting in on anybody at six o'clock."

Work also goes on alone for pilots in darkened rooms in front of videocassette players and television screens,

where they watch gun camera footage. This time is especially useful for newer pilots. Veterans believe that it is very important to handle these pilots properly in the aftermath of a poor mission performance.

"You have to set aside the emotions," said Marine Lt. Col. Jim Cartwright, commander of VMFA-232. "There has got to be a learning objective in there, and you've got to make him understand what he did wrong. If he did something wrong, you've got to show him where he could do something right. We've got several tools for that—the HUD [head-up display] tapes . . . plus the AWACS plots. Rarely is it an 'I'm a failure' approach. It's, 'Okay, I got shot.' You can always find four or five good points, four or five bad points. You try to get as much learning as appropriate for that particular session. You have to meter out how much a person can stand in one session."

At times, frustration erupts during a debriefing session, but Colonel Cartwright attributes that to the physical exhaustion and mental fatigue that come from flying two missions per day. Surrounding those taxing missions are numerous planning sessions,



Staff photos by Guy Aceto

"In the lower forty-eight, your survival kit consists of a dime for a pay phone," said one Cope Thunder official, pointing out the starkly different circumstances that prevail in the unforgiving Alaskan wilderness, where the extreme cold is a major concern.

When USAF traded Crow Valley for Alaska, it also left behind its ACMR/I scoring system. A planned improvement will free scorers from relying on the Television Ordnance Scoring System, used here by A1C Timothy Smith.

briefings and debriefings, and solitary performance analysis.

Trouble Keeping Score

At present, Air Force officers at Cope Thunder have difficulty assessing air-to-air engagements. Alaskan Cope Thunder lacks an Air Combat Maneuvering Range/Instrumentation (ACMR/I) system like the one at Crow Valley used to track and score air-to-air engagements. Major Dissinger said money has been set aside to deploy a new-generation ACMR/I system called the Measurement Debriefing System (MDS), which is likely to be fully operational in mid-1995.

The old ACMR/I tracked thirty-six aircraft. The MDS will track up to 100, with greater ability and the possibility for so-called "no-bomb-drop" scoring. "That is where the guy hits the button and they can figure out when and where it hit the ground, which allows you to pick targets that aren't actually on the ground, or [that] . . . you're not allowed to drop on," Major Dissinger said.

Today USAF uses old-fashioned scoring techniques, based on AWACS tracks, radar records, and videotapes. After the conclusion of a mission, Blue pilots get together to determine what they think happened, Red pilots do the same, and they meet in a debriefing session to argue and resolve differences.

In the SAM field, Air Force personnel work closely with personnel from Loral Corp., which provides most of the simulated ground threat environment. System operators watch a mission through the ground videocameras as some aircraft are "locked" and others evade ground threats through effective terrain masking, tactics, or use of weather conditions.

In one recent engagement, a Blue aircraft flew into the target area straight and level for a few seconds. "He's dead," said an operator tracking it on his equipment. Another aircraft dipped between hills and employed aggressive maneuvering to evade radar lock. The missile was launched, but it lost the aircraft. "It's strange," said one SAM operator. "We feel good if we get one, but we also feel good if they get away."

Bombing missions are scored by the Television Ordnance Scoring System, which allows an airman to plot the location of a bomb hit on his screen and record the data. As commanders gain experience through the week, ground threats are handled with greater and greater effectiveness.

Alaskan weather makes for interesting operations. In summer, the sun seems to shine around-the-clock. In winter, darkness lasts most of the day. Extreme cold—down to –40° Fahrenheit—prevails seven months of the year. Ground crews must be cautious because even the simple act of picking up a metal wrench in subzero temperatures can be hazardous. Though the airman may be wearing gloves, they may not be the right type, and the tool can freeze to the hand so thoroughly that it takes a surgeon to remove it.

Staff photos by Guy Aceto

In extreme cold, pilots take to their planes wearing bulky outfits and boots and carrying survival kits. "In the lower forty-eight, your survival kit consists of a dime for a pay phone if your plane goes down," Major Barnett said. "Out here, you have to have the equipment to survive. You've got all this stuff on your body . . . and you can't get your feet down the holes to get to your rudder pedals." In the wilderness, moreover, "there are a couple of things that might eat you and a couple of things that *will* eat you. There are no pay phones in the bush." ■

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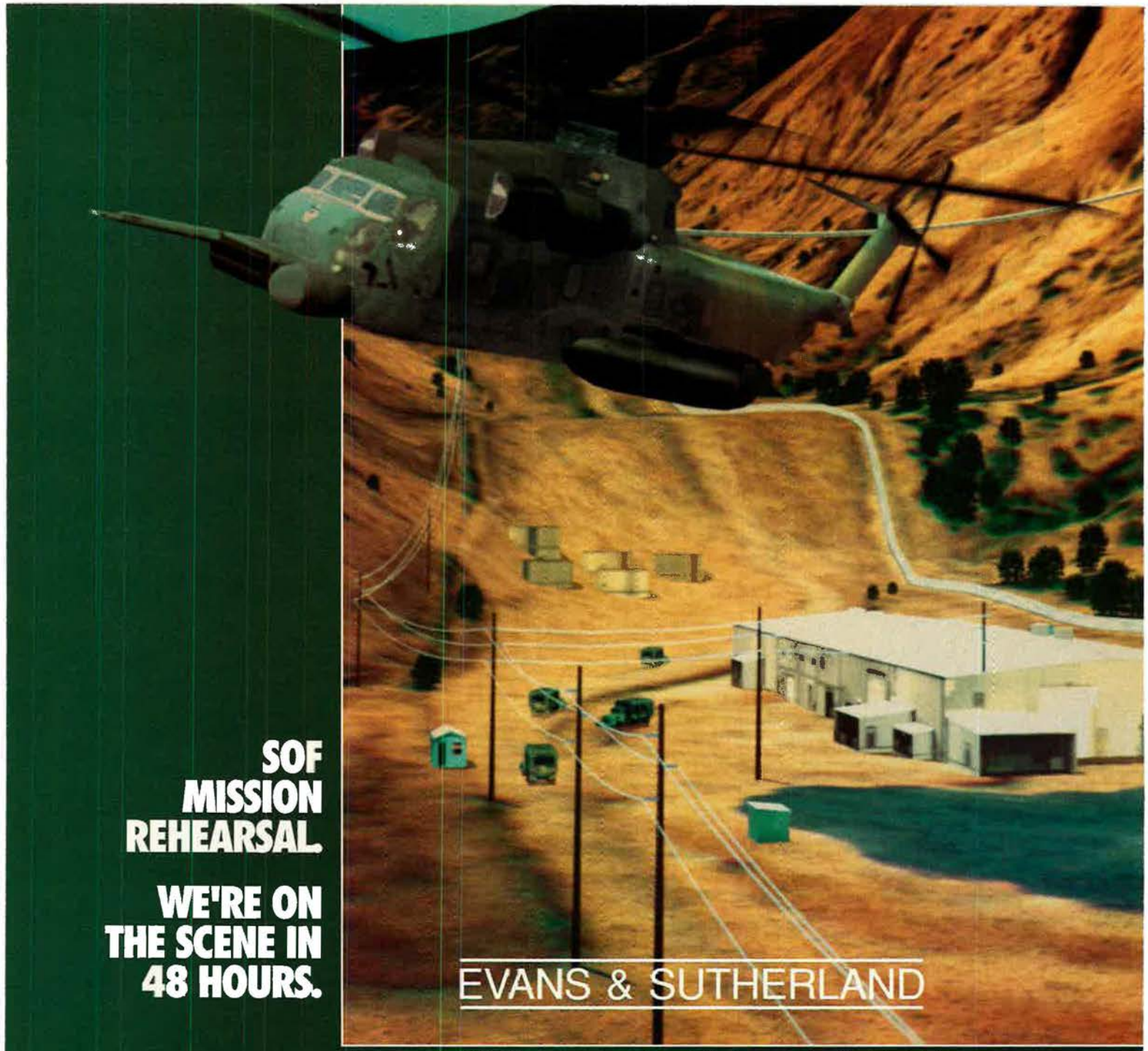

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For a complete picture of the new ESIG-4000, contact: Evans & Sutherland, Simulation Division, 600 Komas Drive, Salt Lake City, Utah 84108. Tel: 801-582-5847, Ext. 6521, Fax: 801-582-5848

World Gallery of Trainers

By John W. R. Taylor and Kenneth Munson

Jet Trainers

Alpha Jet, Egyptian Air Force (Denis Hughes)

C-101 Aviojet, Spanish Air Force

Tzukit (CM 170 Magister), Israeli Defense Force/Air Force

Alpha Jet

The original variants of the Alpha Jet were conceived, developed, and manufactured as a Franco-German collaborative program, with parallel assembly lines at Dassault and Dornier. The prototype flew on October 26, 1973, and was followed initially by 176 trainers for the French Air Force and 175 close-support Alpha Jets for the German Air Force, in 1978–85. These 351 aircraft were completed with essentially identical structure, landing gear, Larzac 04-C6 engines, and equipment. Subsequently, the German aircraft were retrofitted with uprated Larzacs, improved instruments, provision for carrying two Sidewinder self-defense missiles, a podded 27-mm Mauser gun, and other refinements. Most of the 166 surviving aircraft are being sold, 30 of them to the French Air Force to replace 40 aging Alpha Jets serving at Cazaux AB in the weapons and tactics training role. Only 45 will be retained by the German Air Force, for acclimating pilots to the European environment after training in the US, before they convert on to the Tornado. Direct export orders for the basic versions were received from Belgium (33), Egypt (30, designated MS1), Ivory Coast (seven), Morocco (24), Nigeria (24), Qatar (six), and Togo (six). Most aircraft for the Egyptian Air Force were assembled by the Arab Organization for Industrialization at Helwan. Dassault offered an alternative close-support Alpha Jet, with inertial platform, head-up display (HUD), laser rangefinder, and radar altimeter, to Egypt, which ordered 15 as MS 2s. Seven were acquired by Cameroon.

Contractors: Dassault Aviation, France, and Dornier Luftfahrt GmbH, Germany.

Power Plant: two SNECMA/Turbomeca Larzac 04-C6 turbofans standard; each 2,976 lb thrust. Two 3,175 lb thrust Larzac 04-C20s now standard for German close support aircraft, optional for other variants.

Dimensions (trainer): span 29 ft 10¾ in, length 38 ft 6½ in, height 13 ft 9 in.

Weights (trainer): empty 7,374 lb, gross 11,023 lb (clean), 17,637 lb (max with external stores).

Performance (at 11,023 lb weight, 04-C6 engines): max speed at 32,800 ft Mach 0.85, max speed at S/L 621 mph, stalling speed (gear and flaps down) 104 mph, service ceiling 48,000 ft, T-O run 1,215 ft, landing run 1,640 ft, radius of action (with reserves) at high altitude 764 miles on internal fuel, 901 miles with external tanks, *g* limits (ultimate) +12/–6.4.

Accommodation: crew of two, in tandem, on Martin-Baker AJRM4 zero height/104 mph, or B10N series zero/zero, ejection seats.

Armament: centerline stores pylon, or pod for 30-mm DEFA or 27-mm Mauser gun. Provision for two hardpoints under each wing for 18-tube rocket packs, bombs of up to 882 lb, cluster bombs, 30-mm gun pods, Sidewinder or Magic air-to-air missiles (AAMs), Maverick air-to-surface missiles (ASMs), a reconnaissance pod, drop tanks, and other stores. Max load on five pylons 5,510 lb.

AT-3

This tandem-seat, twin-turbofan trainer first flew on September 16, 1980, and entered production in March 1982. Sixty were built and have served since 1984 as the standard basic and advanced trainers of the Republic of China Air Force. With a 6,000 lb external stores capacity, the AT-3 offered potential for secondary ground or maritime attack missions, and in 1989 work was begun by Smiths Industries to upgrade two aircraft for evaluation in a close-support role, with added Westinghouse APG-66 radar and fire-control system. Twenty of the original 60 AT-3s have been modified to this standard to equip one RoCAF night attack squadron. They are designated **AT-3B**, the trainer models being retrospectively redesignated **AT-3A**.

Contractor: Aero Industry Development Center, Taiwan.

Power Plant: two Garrett TFE731-2-2L turbofans, each 3,500 lb thrust.

Dimensions: span 34 ft 3¾ in, length 42 ft 4 in, height 14 ft 3¾ in.

Weights: empty 8,500 lb, gross 11,500–17,500 lb.

Performance (at max gross weight): max speed at S/L 558 mph, max cruising speed at 36,000 ft 548 mph, stalling speed (gear and flaps down) 104 mph, service ceiling 48,000 ft, T-O run 1,500 ft, landing run 2,200 ft, max range on internal fuel 1,416 miles.

Accommodation: crew of two, in tandem; zero/zero ejection seats. Rear seat raised.

Armament: two hardpoints under each wing and one under fuselage for up to 6,000 lb of single, cluster, or fire bombs, flare dispensers, or rocket launchers. Centerline hardpoint can be occupied instead by a semirecessed machine-gun pack or (in conjunction with outboard underwing pylons) an aerial target system. Provision for infrared AAM at each wingtip.

C-101 Aviojet

The Aviojet was designed with assistance from MBB of Germany and Northrop of the US. The first of four prototypes flew on June 27, 1977. Ninety-two **C-101EB** fully aerobatic basic and advanced trainers for the Spanish Air Force followed, under the designation **E.25 Mirlo**. These aircraft have 3,500 lb thrust Garrett TFE731-2-2J engines. An armed export version, with a 3,700 lb thrust TFE731-3-1J turbofan, was ordered by Chile (14 **C-101BB-02**) and Honduras (four **C-101BB-03**). All but the first four of the BB-02s were assembled under license by ENAER in Chile, with partial local manufacture, and have the official Chilean Air Force designation **T-36 Halcón**. During 1982, ENAER and CASA initiated development of a dedicated light attack version of the Aviojet, designated **C-101CC-02** in Spain and **A-36 Halcón** by the Chilean Air Force. The first of two prototypes flew on November 16, 1983, and 23 similar production A-36s, with more powerful TFE731-5-1J engines, are being manufactured for the Chilean Air Force. All Halcóns now have a nose-mounted ranging radar, ventral gun pod, and six underwing weapon pylons. Sixteen basically similar **C-101CC-04s** serve with the Royal Jordanian Air Force. An enhanced training version, with the TFE731-5-1J engine and additional avionics, including a GEC Ferranti HUD, Alenia mission computer, Litton inertial platform, and Doppler velocity sensor, flew for the first time on May 20, 1985, as the **C-101DD**. It is being developed jointly with Alenia of Italy. *(Data for C-101CC.)*

Contractor: Construcciones Aeronauticas SA, Spain.

Power Plant: one Garrett TFE731-5-1J turbofan; 4,300 lb thrust, with military power reserve (MPR) rating of 4,700 lb thrust.

Dimensions: span 34 ft 9½ in, length 41 ft 0 in, height 13 ft 11¼ in.

Weights: empty 7,716 lb, gross 11,023 lb (trainer, clean), 13,890 lb (max).

Performance (at 9,590 lb weight, except where indicated): max speed at 15,000 ft with MPR 518 mph, stalling speed (gear and flaps down) 102 mph IAS, service ceiling 44,000 ft, T-O run 1,835 ft, landing run 1,575 ft, ferry range (with reserves) 2,303 miles, *g* limits at 10,802 lb weight +7.5/–3.9.

Accommodation: crew of two, in tandem on Martin-Baker Mk 10L zero/zero ejection seats. Rear seat raised.

Armament: bay beneath rear cockpit for quick-change packages, including a 30-mm DEFA gun with 130 rounds, twin 12.7-mm Browning machine guns, reconnaissance camera, ECM package, or laser designator. Six underwing hardpoints for up to 4,960 lb of stores, including four LAU-10 rocket packs, six 550-lb bombs, two Maverick ASMs, or Sidewinder or Magic AAMs.

CM 170 Magister

More than 900 of these French jet trainers were built between 1953 and 1969, and more than one-third are still in service, including about 300 with original customers France (more than 160, including 16 navalized **CM 175 Zéphyrs**), Israel (45+), Belgium (18), Lebanon (five), and Morocco (22). Other operators include the air forces of Algeria, Bangladesh, Cameroon, El Salvador, Gabon, Ireland, Libya, and Senegambia, with some of which they perform alternative weapons training/counterinsurgency duties.

The basic Magister version has 880 lb thrust Marboré IIA turbojets, but the final 137 aircraft were **Super**

Magisters (also designated CM 170) with the uprated Marboré VI power plant. Between 1981 and 1986 Israel's Magisters, which have the local name **Tzukit**, were rebuilt and upgraded by IAI's Bedek Aviation Division under a program known as AMIT (Advanced Multimission Improved Trainer). *(Data for Super Magister.)*

Contractor: Aerospatiale (originally Fouga), France.

Power Plant: two Turbomeca Marboré VI turbojets; each 1,058 lb thrust.

Dimensions: span over tiptanks 39 ft 10 in, length 33 ft 0 in, height 9 ft 2 in.

Weights: empty 5,093 lb, gross 6,280–7,187 lb.

Performance: max speed at S/L 435 mph, max speed at 30,000 ft 451 mph, service ceiling 13,125 ft, T-O run 1,970 ft, range with reserves 870 miles.

Accommodation: crew of two, in tandem; ejection seats.

Armament: two 7.62-mm machine guns, with 200 rds/gun, in nose; hardpoint under each wing for rocket launcher, wire-guided missile, or bomb.

Fan Ranger

Rockwell International and MBB announced the Fan Ranger in late 1990. It is a modified version of the turboshaft-powered, tandem-seat Fantrainer produced by RFB (a former MBB subsidiary), adapted to accept a turbofan power plant, and is intended as a candidate for the USAF/USN JPATS requirement. Rockwell Collins will furnish updated avionics and instrumentation. Two prototype/demonstrators are being built. First flight is due in early 1993.

Contractors: Rockwell International Corporation, US, and Deutsche Aerospace–MBB, Germany.

Power Plant: one Pratt & Whitney JT15D-4 turbofan; 2,500 lb thrust.

Dimensions: span 34 ft 4 in, length 33 ft 1 in, height 11 ft 3 in.

Weights: design gross 5,300 lb.

Performance (estimated): max speed 345 mph.

Accommodation: crew of two, in tandem; zero/zero ejection seat. Rear seat raised.

Armament: none.

G-2A Galeb

The straight-winged Galeb was in production from 1963 to 1983. A few of the 200 built for the Yugoslav Air Force remain in service, but most have been replaced by sweptwing Super Galebs (described separately). Two of the six exported to Zambia in 1971 are believed to continue in service. About 90 of the 120 G-2A-Es supplied to Libya in 1975 and 1983–84 are thought to survive, with both training and light attack roles.

Contractor: Vazduhoplovna Industrija SOKO, Yugoslavia.

Power Plant: one Rolls-Royce Viper 11 Mk 22-6 turbojet; 2,500 lb thrust.

Dimensions: span 34 ft 4½ in, length 33 ft 11 in, height 10 ft 9 in.

Weights: empty 5,775 lb, gross 7,438 lb (trainer), 9,480 lb (max).

Performance: max speed at 20,350 ft 505 mph, stalling speed (flaps down) 98 mph, service ceiling 39,375 ft, T-O run (grass) 1,610 ft, landing run (grass) 1,310 ft, range 770 miles, *g* limits +8/–4.

Accommodation: crew of two, on tandem ejection seats.

Armament: two 12.7-mm machine guns in nose, with 80 rds/gun; four underwing hardpoints for bombs or rocket pods.

G-4 Super Galeb

Like the BAe Hawk, to which it bears a close resemblance, the Super Galeb has formidable light attack capability. The first of two prototypes flew in July 1978, and six preseries aircraft (with no tailplane anhedral, and inset elevators) followed. The Yugoslav Air Force ordered about 150 production G-4s, to replace T-33s and to reequip G-2A Galeb units on a one-to-one basis. G-4s were also flown by the Air Force's Letece Zvezde aerobatic display team. The Air Force of Myanmar has 12, with an option on more.

The Super Galeb has been used in combat during the civil war in the former Yugoslavia, together with J-1 Jastreb single-seat light attack counterparts of the earlier G-2A Galeb.

Contractor: Vazduhoplovna Industrija SOKO, Yugoslavia.

Power Plant: one Rolls-Royce Viper Mk 632-46 turbojet; 4,000 lb thrust.

Dimensions: span 32 ft 5 in, length 40 ft 2¼ in, height 14 ft 1¼ in.

Weights: empty 6,993 lb, gross 10,379 lb (training), 13,889 lb (max).

Performance (at 10,379 lb gross weight): max speed at 13,120 ft 565 mph, max cruising speed at 19,700 ft 525 mph, stalling speed (gear and flaps down) 112 mph, service ceiling 42,160 ft, T-O run 1,877 ft, landing run 2,674 ft, range with two drop tanks (with reserves) 1,553 miles.

Accommodation: crew of two, in tandem on Martin-Baker Mk 10Y zero/zero ejection seats. Rear seat elevated.

Armament: removable centerline gun pod containing 23-mm GSh-23L twin-barrel gun with 200 rds. Two pylons under each wing for such weapons as napalm tanks, cluster bombs containing eight 35-lb fragmentation munitions, containers for 40 antipersonnel or 54 antitank bomblets, 16-tube rocket packs, triple carriers for 220-lb bombs, 12.7-mm gun pods, or drop fuel tanks. Max weapon load 2,822 lb.

Hawk

Since 1976, this tandem two-seat jet has been the Royal Air Force's standard basic/advanced flying and weapons trainer. Hawks have also been chosen by 14 other air forces in forms that include a radar-equipped single-seat multirole combat aircraft. The initial RAF order was for 176 **Hawk T. Mk 1s**, each with a 5,200 lb thrust Adour 151 turbofan. Eighty-nine of these were upgraded to **T. Mk 1A** standard, with a Sidewinder missile under each wing, in addition to the standard underbelly 30-mm gun pack, to accompany radar-equipped Tornados on air defense sorties. Since September 1991, six T. Mk 1s and six T. Mk 1As have replaced Canberras of No. 100 Squadron for target-towing and as "silent targets" for electronic warfare training.

The basic **Hawk 50** export series, with 5,200 lb thrust Adour 851 turbofan, 70 percent greater disposable load, and 30 percent longer range, has been sold to Finland (57 Mk 51/51A, with a 12.7-mm centerline gun), Kenya (12 Mk 52), and Indonesia (20 Mk 53). The further improved **Hawk 60** series, with four-position flaps, modified wing leading-edge devices, and other refinements, has been bought by Zimbabwe (13 Mk 60/60A), Dubai (nine Mk 61), Abu Dhabi (16 Mk 63), Kuwait (12 Mk 64), Saudi Arabia (30 Mk 65), Switzerland (20 Mk 66), and South Korea (20 Mk 67). Fifteen of the Abu Dhabi aircraft are being upgraded to Mk 63A, with Adour 871 and new wings with wingtip Sidewinders.

More specialized, high-performance two-seat and single-seat strike versions are designated, respectively, **Hawk 100** and **200** series. These have been ordered or selected by Abu Dhabi (18 Mk 102), Malaysia (10 Mk 108, 18 Mk 208), Oman (four Mk 103, 12 Mk 203), and Saudi Arabia (60, mostly Mk 205); most will have wingtip rails for Sidewinders. Indonesia is expected to buy 69 series 100/200 Hawks. *(Data for Hawk 60 series.)*

Contractor: British Aerospace plc, UK.

Power Plant: one Rolls-Royce Turbomeca Adour 861 turbofan; 5,700 lb thrust.

Dimensions: span 30 ft 9¾ in, length (incl probe) 38 ft 11 in, height 13 ft 1¼ in.

Weights: empty 8,845 lb, gross 20,061 lb.

Performance: max Mach number in dive 1.2, max speed at S/L 632 mph, stalling speed (gear and flaps down) 110 mph, service ceiling 46,500 ft, T-O run 2,330 ft, landing run 1,800 ft, ferry range with two drop tanks 1,842 miles, *g* limits +8/–4.

Accommodation: crew of two, in tandem on Martin-Baker Mk 10LH zero/zero ejection seats. Rear seat elevated.

Armament: centerline pack for 30-mm Aden gun with 120 rds, or pylon, plus two pylons under each wing. Within overall max of 6,614 lb, typical loads can include centerline gun pack or reconnaissance pod and four underwing rocket packs; 1,000-lb bombs; 36 x 80-lb runway denial bombs; five 600-lb cluster bombs; four Sidewinder/Magic AAMs; two Maverick ASMs and two drop tanks.

Fan Ranger prototype

G-4 Super Galeb

Hawk Mk 66, Swiss Air Force (Ivo Sturzenegger)

I-22 Iryda, Polish Air Force (Richard Malachowski)

HJT-16 Kiran

The prototype of the Kiran side-by-side jet trainer flew for the first time in September 1964. Delivery of 118 Viper-engined **Mk Is** for basic flying training with the Indian Air Force began in the spring of 1968. They were followed by 72 **Mk IAs**, for the IAF and Indian Navy, with a hardpoint under each wing to carry armament for weapons training. On July 30, 1976, Hindustan Aeronautics Ltd flew the first of the more powerful **Kiran Mk IIs**, with an Orpheus turbojet, updated instruments and avionics, an improved hydraulic system, and an additional pair of underwing weapon stations for either training or counterinsurgency roles. Sixty-one Mk IIs were built for the Indian Air Force and Navy between 1982 and 1989. *(Data for Mk II.)*

Contractor: Hindustan Aeronautics Ltd (Bangalore Complex), India.

Power Plant: one Rolls-Royce Orpheus 701-05 turbojet; 4,200 lb thrust.

Dimensions: span 35 ft 1¼ in, length 34 ft 9½ in, height 11 ft 11 in.

Weights: empty 6,603 lb, gross 9,369 lb (clean), 11,023 lb (max).

Performance (at max gross weight): max speed at S/L 418 mph, max cruising speed at 15,000 ft 386 mph IAS, stalling speed (gear and flaps down) 98 mph IAS, service ceiling 39,375 ft, T-O run 1,772 ft, landing from 50 ft 4,725 ft, max range (internal fuel) 457 miles.

Accommodation: side-by-side Martin-Baker H4HA zero-height ejection seats for crew of two.

Armament: two 7.62-mm machine guns in nose; two hardpoints under each wing for 551-lb bombs, 18-tube rocket pods, or drop tanks.

I-22 Iryda

Designed to replace the TS-11 Iskra and LiM-6 (MiG-17) basic and advanced trainers of the Polish Air Force, the **I-22 Iryda** also offers considerable potential for reconnaissance and close support missions. The first of five prototypes flew on March 5, 1985, and is being followed by a preseries of 12 similar aircraft. In service, the Iryda will cover the entire spectrum of pilot, navigation, air combat, reconnaissance, and ground attack training, with day/night and adverse weather capability. It is able to operate from unprepared airfields and has been designed to tolerate a degree of battle damage, together with subsequent ease of repair. The airframe has been stressed to a standard that will permit the installation of more powerful engines, such as the new 3,968 lb thrust Polish D-18A turbofan, or Western equivalents, as well as improved avionics from Bendix/King and other suppliers. An **I-22MS** single-seat combat version is under development. *(Data for initial version.)*

Contractor: Instytut Lotnictwa (Aviation Institute), Poland.

Power Plant: two PZL-5 SO-3W22 turbojets; each 2,425 lb thrust.
Dimensions: span 31 ft 6 in, length 43 ft 4½ in, height 14 ft 1¼ in.
Weights: empty 10,361 lb, gross 15,211 lb.
Performance: max speed (clean) at 16,400 ft 522 mph, max cruising speed 447 mph, stalling speed (gear and flaps down) 127 mph, service ceiling 36,100 ft, T-O run (12,350 lb weight) 2,575 ft, landing run (11,025 lb weight) 2,461 ft, max range 559 miles, *g* limits (12,930 lb weight) +8/–4.
Accommodation: crew of two, on tandem zero-height/94 mph ejection seats. Rear seat elevated.
Armament: one 23-mm twin-barrel GSh-23 gun in underfuselage pack; two hardpoints under each wing for up to 2,645 lb of bombs, guided or unguided rockets, or (inboard stations only) drop tanks.

IA 63 Pampa

Design of the Pampa started in 1979, to develop a replacement for the Argentine Air Force's elderly Morane-Saulnier Paris IIIs in the basic, advanced, and weapons training roles. FMA, the national military aircraft factory, enlisted the technical assistance of Dornier of Germany, which built the wings and tailplanes of the prototypes. The first of these made its initial flight October 6, 1984. Delivery of the 18 production Pampas so far ordered by the Air Force began in April 1988. All are due to be retrofitted with a podded 30-mm gun and underwing weapon pylons. Subsequent aircraft will have these features as standard and will be fitted with a more powerful Garrett TFE731-3G engine. They will also have an Air Force–developed HUD (already fitted in the first six aircraft) and a new weapon delivery and navigation system.

FMA has teamed with Vought Aircraft Co (formerly LTV Aerospace and Defense) to enter a **Pampa 2000** variant, with Bendix/King digital avionics and a modified fuel management system, in the JPATS competition. A version for the Argentine Navy is also under development.

Contractor: Fábrica Militar de Aviones, Argentina.
Power Plant: one Garrett TFE731-2-2N turbofan (3,500 lb thrust) in first 18 aircraft; TFE731-3G of 4,500 lb thrust thereafter.
Dimensions: span 31 ft 9¼ in, length 35 ft 10¼ in, height 14 ft 1 in.
Weights: empty 6,219 lb, gross 8,157–11,023 lb.
Performance (at 8,377 lb gross weight except where indicated): max speed at S/L 466 mph, stalling speed 106 mph, service ceiling 42,325 ft, T-O run (at 8,157 lb weight) 1,390 ft, landing run (at 7,716 lb weight) 1,512 ft, range 932 miles (1,151 miles with external tanks), *g* limits +6/–3.
Accommodation: crew of two, in tandem; zero/zero ejection seats. Rear seat raised.
Armament: hardpoint under fuselage and two under each wing for up to 2,557 lb (with standard fuel) of gun pods, bombs, and rockets. With uprated engine, external load can be increased to 3,748 lb.

IAR-99 Şoim and IAR-109 Swift

Design of this indigenous Romanian jet trainer began in the early 1980s, the aircraft's existence being revealed publicly at the 1983 Paris Air Show. The initial flight, by the first of two **Şoim** prototypes, was made on December 21, 1985. The Romanian Air Force has ordered 50 and has options for up to 100 more; roles include intermediate and advanced training.

Efforts to promote the IAR-99 for export, and to fulfill a domestic need for a secondary ground attack capability, first emerged in 1991 as a proposal supported by Jaffe Aircraft Corp for an enhanced version with a HUD, modern gunsight, and Western avionics. Early this year, however, Avioane revealed that it was discussing a similar upgrade package with Israel Aircraft Industries, under the designation **IAR-109**. Details of this version, now named **Swift**, became available at this September's Farnborough International Air Show. Two versions are available: the **IAR-109T** "all-through" jet trainer and the **IAR-109TF** light attack version. Avionics, compatible with a MIL-STD-1553B multiplex data bus, include HUD, a ring-laser gyro INS, radar altimeter, and laser rangefinder. The attack version has a semiconformal underfuselage pod housing a twin-barrel 23-mm gun, while the four underwing pylons are adapted for up to 2,205 lb of ordnance. *(Data for IAR-99 trainer.)*
Contractor: Avioane SA, Romania.
Power Plant: one Rolls-Royce Viper Mk 632-41M turbojet; 4,000 lb thrust.
Dimensions: span 32 ft 3¾ in, length 36 ft 1½ in, height 12 ft 9½ in.
Weights: empty 7,055 lb, gross 9,700 lb.
Performance: max speed at S/L 537 mph, service ceiling 42,325 ft, T-O run 1,477 ft, landing run 1,805 ft, max range 683 miles, *g* limits +7/–3.
Accommodation: crew of two, in tandem; zero/zero ejection seats. Rear seat raised.
Armament: underfuselage attachment for 23-mm gun pack with 200 rds; two hardpoints under each wing for up to 2,756 lb of bombs, gun or rocket pods, drop tanks, or other stores.

IA 63 Pampa, Argentine Air Force

Jet Squalus F1300 NGT

L-29 Delfin, Czech and Slovak Air Force (P. R. Foster)

Jet Squalus F1300 NGT

It is now five and a half years since the first Jet Squalus prototype flew (April 30, 1987), and 1991 plans for the aircraft to be license-built in Portugal appear to have fallen through. Its side-by-side seating has now ruled it out as a JPATS contender, and plans now center on possible production in Canada.

Conceived as an "all-through" jet trainer to meet a specification similar to that for USAF's Next-Generation Trainer (the Fairchild T-46A), the Italian-designed Jet Squalus is intended to cover all stages of flying training from initial pilot screening, primary, and basic to part of the advanced syllabus, including weapons training. Promavia announced a proposed twin-engine tandem-seat **ATTA 3000** version in 1989 that may be developed in partnership with Mikoyan of Russia. *(Data for first prototype.)*
Contractor: Promavia SA, Belgium.
Power Plant: one Garrett TFE109-1 turbofan; 1,330 lb thrust.
Dimensions: span 29 ft 8 in, length 30 ft 8½ in, height 11 ft 9¾ in.
Weights: empty 2,866 lb, gross 5,291 lb.
Performance: max speed at 14,000 ft 322 mph, stalling speed (gear and flaps down) 77 mph, service ceiling 37,000 ft, T-O run 1,100 ft, landing run 1,200 ft, max range 1,150 miles, *g* limits +7/–3.5.
Accommodation: crew of two, side by side; lightweight ejection seats.
Armament: two hardpoints under each wing for a total of up to 1,323 lb of gun pods, rocket launchers, practice bombs, or fuel tanks.

K-8 Karakorum 8

The K-8 (originally L-8) program started in China but quickly became international when Pakistan agreed to take a 25 percent share in mid-1987. The K-8 is now being developed as a jet trainer and light ground attack aircraft for both countries' air forces. The first of three flying prototypes made its initial flight November 21, 1990. The second followed on October 18, 1991, and by the end of that year these two aircraft had completed some 50 hours of test flying. According to Chinese sources in September of this year, "limited production" (probably a small preproduction batch of perhaps 15 aircraft) has already started, and much foreign interest was shown during the K-8's public debut at last February's Asian Aerospace show in Singapore. Initial production will be for the air forces of Pakistan and China.
Contractors: Nanchang Aircraft Manufacturing Company, People's Republic of China, and Pakistan Aeronautical Complex, Pakistan.
Power Plant: one Garrett TFE731-2A-2A turbofan; 3,600 lb thrust.
Dimensions: span 31 ft 7¼ in, length 38 ft 0¾ in, height 13 ft 9¾ in.
Weights: empty 5,924 lb, gross 8,003–9,546 lb.
Performance (at 8,003 lb gross weight): max speed at S/L 497 mph, landing speed (gear and flaps down) 103 mph, service ceiling 42,650 ft, T-O run 1,345 ft, landing run 1,680 ft, max range on internal fuel 870 miles, *g* limits +7.33/–3.
Accommodation: crew of two, in tandem; zero/zero ejection seats. Rear seat raised.
Armament (optional): one 23-mm gun pod under centerfuselage; two hardpoints under each wing for gun or rocket pods, bombs, missiles, drop tanks (inboard pylons only), or a single reconnaissance pod.

L-29 Delfin

The **L-29 Delfin** first flew on April 5, 1959, powered by a Viper turbojet. The Czech M 701 engine was fitted in the second prototype and became standard in the 3,600 or so Delfins built between 1961 and 1974. Two-thirds of the production aircraft were delivered to the USSR, the bulk of the remainder being supplied as the standard jet basic trainer of all other members of the Warsaw Pact except Poland. At least nine other nations received L-29s, of which Afghanistan (20+), Ghana (eight), Mali (six), and Syria (60) still have the Delfin in their active inventories. An **L-29R** version was produced for light attack duties, with underwing stores pylons and nose-mounted cameras. *(Data for standard L-29.)*
Contractor: Aero Vodochody National Corporation, Czechoslovakia.
Power Plant: one Motorlet Walter M 701c 500 turbojet; 1,960 lb thrust.
Dimensions: span 33 ft 9 in, length 35 ft 5½ in, height 10 ft 3 in.
Weights: empty 5,027 lb, gross 7,231 lb (clean), 7,804 lb (max, with external stores).
Performance (at 7,165 lb gross weight): max speed at S/L 382 mph, stalling speed (flaps down) 81 mph, service ceiling 36,100 ft, T-O run 1,805 ft, landing run 1,444 ft, max range with underwing tanks 555 miles.
Accommodation: crew of two, on tandem ejection seats. Rear seat elevated.
Armament: single attachment point under each wing for rocket pod, 7.62-mm machine-gun pod, 220-lb bomb, or drop fuel tank.

L-39/59/139 Albatros

Standard basic jet trainer of the former Warsaw Pact nations, except Poland, since entering service in 1974, the L-39 production run has exceeded 2,800 (including 2,094 of the **L-39C** basic and advanced flying trainer for the former USSR). Apart from the Czech and Slovak Air Force (36), other customers for the L-39C have included the air forces of Afghanistan (12), Cuba (30), Ethiopia (20), and Vietnam (24). The **L-39ZO**, with strengthened wings for additional stores carriage, has been exported in large numbers to the former German Democratic Republic (52), Iraq (81), Libya (181, of which 10 later transferred to Egypt), and Syria (55). The ground attack/reconnaissance **L-39ZA**, which adds a centerline 23-mm gun pod to the capability of the ZO, has been produced for six customers: Algeria (32), Bulgaria (55), Czechoslovakia (31), Nigeria (51), Romania (32), and Syria (44). Eight examples were also built (Czechoslovakia six, East Germany two) of the **L-39V**, a specialized target-towing version. All of these models have a 3,792 lb thrust Ivchenko AI-25TL turbofan.

The principal change in the **L-59** (formerly L-39MS) is the use of a new and more powerful DV-2 turbofan. The airframe and avionics have also been upgraded. The first of three prototypes flew on September 30, 1986, and the first production L-59 on October 1, 1989. Initial customer for the L-59 is Egypt, which ordered 48.

Like a number of other former Soviet and East European aircraft, the Albatros is now being offered in Westernized form for world markets, this version being known as the **L-139**. Principal differences are a 4,000 lb thrust Garrett TFE731-4 turbofan engine and a Bendix/King avionics suite. The first L-139 is expected to fly early next year and enter production in 1994. *(Data for L-59.)*

Contractor: Aero Vodochody Akciová Společnost, Czechoslovakia.
Power Plant: one ZMDB Progress DV-2 turbofan; 4,850 lb thrust.
Dimensions: span incl tiptanks 31 ft 3½ in, length 40 ft 0¼ in, height 15 ft 7¾ in.
Weights: empty 9,149 lb, gross 12,147–12,566 lb.
Performance (at max gross weight): max speed at 16,400 ft 544 mph, stalling speed (gear and flaps down) 106 mph, service ceiling 38,500 ft, T-O run 2,035 ft, landing run 2,135 ft, range with external fuel 932 miles.
Accommodation: crew of two, in tandem; zero/zero ejection seats. Rear seat raised.
Armament: one 23-mm GSh-23 twin-barrel gun in centerline pod; four underwing pylons for a total of 2,425 lb of stores, including bombs of up to 1,102 lb, rocket pods, infrared AAMs (outer pylons only), drop tanks, or (port inner pylon only) a daylight camera pod.

MB-326 and Impala

The Aermacchi MB-326 prototype first flew on December 10, 1957, with a Viper 8 turbojet. This was changed to a higher-powered Viper 11 (2,500 lb thrust) in the initial production **MB-326** for the Italian Air Force and in the **326B** (for Tunisia), **E** (Italy), **F** (Ghana), **H** (Australia), and **M** (South Africa). The strengthened wings of the E (each with three pylons) were combined with the more powerful Viper 540 to produce the trainer/light attack **MB-326GB** built by Aermacchi for Argentina, Zaïre, and Zambia, and by Embraer for the air forces of Brazil, Paraguay, and Togo. The Brazilian version is known as the **AT-26 Xavante**. Final Italian-built variants, both with a 4,000 lb thrust Viper 632, were the single-seat **MB-326K** and two-seat **MB-326L**, the former for operational training/ground attack and the latter for advanced training. Atlas Aircraft Corp in South Africa built 151 examples of the MB-326M under license as **Impala Mk 1** trainers and a further quantity of MB-326Ks as the **Impala Mk 2**. All 11 of the countries mentioned, plus Dubai, still operate various models of the MB-326. *(Data for MB-326GB.)*
Contractor: Aermacchi SpA, Italy.
Power Plant: one Rolls-Royce Viper 20 Mk 540 turbojet; 3,410 lb thrust.
Dimensions: span 35 ft 7¼ in, length 35 ft 0¼ in, height 12 ft 2 in.
Weights: empty 5,920 lb, gross 10,090 lb (training), 11,500 lb (max, with external stores).
Performance (trainer at 8,680 lb gross weight, internal fuel only): max speed 539 mph, max cruising speed 495 mph, service ceiling 47,000 ft, T-O run 1,350 ft, landing from 50 ft 2,070 ft, range (with reserves) 1,150 miles.
Accommodation: crew of two, on tandem ejection seats.
Armament: three attachment points under each wing for up to 4,000 lb of gun or rocket pods, bombs, wire-guided missiles, camera pack, or drop fuel tanks.

MB-339 and T-Bird II

The **T-Bird II** is the team entry by Lockheed, Aermacchi, Rolls-Royce, and AAI Corp for the JPATS competition. The T-Bird II is a "missionized" version of the MB-339, flown already by the air forces of Italy (101 delivered), Argentina (Navy, 10), Dubai (seven), Ghana (two), Malaysia (13), New Zealand (18), Nigeria (12), and Peru (16). Its name recalls Lockheed's T-33, known as the "T-Bird" to pilots trained on it over the past 42 years. The first MB-339 prototype flew on August 12, 1976, followed by the first production **MB-339A** on July 20, 1978. The 101 built for the Italian Air Force included four **MB-339RM** (radiomisure) calibration aircraft and 20 **MB-339PANs** for the Frecce Tricolori aerobatic display team, the latter having the normally standard wingtip tanks deleted to aid formation keeping. Primary role of the basic MB-339A is for all phases of advanced training, but the Italian aircraft are camouflaged for use as an emergency close-support force. Production of the "A" ended in 1987, by which time Aermacchi had flown the prototype of the improved **MB-339C**, with advanced avionics, including a digital nav/attack system, and with new vertical tail surfaces. Only customer to date for this version is New Zealand. These aircraft have HOTAS controls, GEC Avionics radar and nav/attack computer, a Kaiser HUDWAC, Litton INS, Honeywell radar altimeter, FIAR laser rangefinder, Tracor chaff/flare dispenser, and Elettronica active ECM pod. *(Data for MB-339C.)*
Contractor: Aermacchi SpA, Italy.
Power Plant: one Rolls-Royce Viper Mk 680-43 turbojet; 4,400 lb thrust.
Dimensions: span over integral tiptanks 36 ft 9¾ in, length 36 ft 10½ in, height 13 ft 1¼ in.
Weights: empty 7,297 lb, gross 10,767 lb (training), 14,300 lb (max).
Performance (at training gross weight): max speed at S/L 558 mph, max speed at 30,000 ft 508 mph, stalling speed 93 mph, service ceiling 46,700 ft, T-O run 1,608 ft, landing run 1,493 ft, ferry range with two drop tanks (with reserves) 1,266 miles, *g* limit +7.33.
Accommodation: crew of two, in tandem on Martin-Baker IT10LK zero/zero ejection seats. Rear seat elevated.

MB-326LT, Republic of Tunisia Air Force (Ivo Sturzenegger)

MB-339As, Italian Air Force

Su-25UBK, Czech and Slovak Air Force (Letectvi + Kosmonautika/Václav Jukl)

Armament: six underwing hardpoints for up to 4,000 lb of stores including 12.7-mm or 30-mm gun pods, rockets of 50-mm to 5-in caliber, 500-lb bombs, 100-mm runway demolition bombs, AIM-9L Sidewinder and Magic AAMs, AGM-65 Maverick ASMs, Marte Mk II sea-skimming antiship missiles, and other weapons.

S.211

Fifty-two firm sales of the S.211 have been made since the prototype made its first flight on April 10, 1981. First and major operator is the Republic of Singapore Air Force, which received six from Italy in November 1984, plus 24 assembled locally by Singapore Aerospace. The Philippine Air Force received four Italian-built S.211s in September 1989 and a further 14 assembled by Philippine Aerospace Development Corp. Four early S.211s sold to the Air Force of Haiti were later resold in the US.

Agusta is developing an improved **S.211A** model with a more powerful (3,190 lb thrust) JT15D-5C engine and a new wing aerofoil section. This has higher gross weights (6,393–7,716 lb) and a max speed at 25,000 ft of 472 mph. Two are flying: one in Italy and one in the US. Teamed with Grumman Aircraft Systems Group as its US partner, Agusta has also entered an improved S.211 for the JPATS competition. *(Data for standard S.211.)*
Contractor: Agusta SpA (Sesto Calende Works) (formerly SIAI-Marchetti), Italy.
Power Plant: one Pratt & Whitney Canada JT15D-4C turbofan; 2,500 lb thrust.
Dimensions: span 27 ft 8 in, length 30 ft 6½ in, height 12 ft 5½ in.
Weights: empty 4,078 lb, gross 6,063–6,944 lb.
Performance (at 5,511 lb gross weight): max cruising speed at 25,000 ft 414 mph, stalling speed (gear and flaps down) 86 mph, service ceiling 40,000 ft, T-O run 1,280 ft, landing run 1,185 ft, max range on internal fuel 1,036 miles, *g* limits +6/–3.
Accommodation: crew of two, in tandem; zero/zero ejection seats. Rear seat raised.
Armament: two hardpoints under each wing for up to 1,455 lb of gun pods (single or twin guns), rocket launchers, bombs, napalm tanks, cartridge throwers, two camera/IR reconnaissance pods, or two drop tanks.

Su-25/28

Production of the Su-25 single-seat close-support aircraft has been completed, but the Su-25T specialized antitank derivative is under development, and two-seat operational conversion and weapons training versions of the type remain available. In the basic **Su-25UB** (NATO "Frogfoot-B"), the rear seat is raised considerably, under a continuous framed canopy, giving a humpbacked appearance. A taller tailfin is fitted, and the gun and weapon pylons of the combat single-seater are retained. The **Su-25UT** is generally similar, but without weapons. It flew for the first time August 6, 1935, and has been demonstrated at Western air shows under its export designation **Su-28**. Another version is the Su-25UTG. With a tail hook for deck landing training, the "UTG" was used initially in conjunction with a dummy flight deck marked on the runway at Saki Naval Air Station before becoming, on November 1, 1989, the third aircraft to land for trials on the 65,000-ton carrier *Admiral Kuznetsov* (then named *Tbilisi*). All versions can carry four underwing auxiliary fuel tanks for ferrying. *(Data for Su-25UT and Su-28.)*
Contractor: P. Sukhoi OKB, Russia.
Power Plant: two Soyuz/Tumansky R-195 turbojets; each 9,921 lb thrust.
Dimensions: span 47 ft 1½ in, length 50 ft 4¾ in, height 17 ft 0¾ in.
Weights: normal T-O 29,100 lb, max gross 37,965 lb.
Performance: max speed at S/L 621 mph, min speed (clean) 146 mph, T-O run (clean) 1,640 ft, landing run 1,640 ft, range (clean) 348 miles at low altitude, 652 miles at 23,000 ft, ferry range 1,335 miles, *g* limits (ultimate) +8/–2.
Accommodation: crew of two, in tandem on K-36D zero/zero ejection seats.
Armament: normally none, although provision retained.

T-2 and T-2A

First flown on July 20, 1971, the XT-2 prototype was the first supersonic aircraft designed and built by the Japanese aerospace industry. Ninety production aircraft were built for the Japan Air Self-Defense Force, of which 28 were configured as **T-2** advanced trainers and the remaining 62 as **T-2A** combat proficiency trainers. The T-2 also formed the basis for the Mitsubishi F-1 single-seat close air support fighter, which was put into series production for the JASDF. Production of the T-2 and T-2A ended in 1988.
Contractor: Mitsubishi Heavy Industries Ltd, Japan.
Power Plant: two Ishikawajima-Harima TF40-IHI-801A (license Rolls-Royce Turbomeca Adour Mk 801A) turbofans; each 7,305 lb thrust with afterburning.

Dimensions: span 25 ft 10¼ in, length 58 ft 7 in, height 14 ft 5 in.
Weights: empty 13,905 lb, gross 28,219 lb.
Performance (clean): max speed Mach 1.6, service ceiling 50,000 ft, T-O run 2,000 ft.
Accommodation: crew of two, on tandem Daiseru/Weber zero/zero ejection seats. Rear seat elevated.
Armament: one Vulcan JM61 multibarrel 20-mm gun in lower fuselage, aft of cockpit on port side. Hardpoints on centerline and two under each wing for drop tanks or weapons. Wingtip attachments for AAMs.

T-4

Under Kawasaki's leadership, Fuji and Mitsubishi each have a 30 percent share in manufacture of this intermediate trainer, which has been in production since FY 1986 to replace Lockheed T-33As and Fuji T-1A/Bs of the Japan Air Self-Defense Force. The specification to which it was developed called for high subsonic maneuverability and an ability to carry external stores under the fuselage and wings. The first of four prototypes flew on July 29, 1985; the first 12 of an expected 200 T-4s entered service with the 31st Flying Training Squadron of the 1st Air Wing at Hamamatsu, near Tokyo, in September 1988. Eventually, nine wings will fly T-4s. Some will be used for liaison and other support duties. An enhanced-capability version has been proposed as a replacement for the Mitsubishi T-2.
Contractor: Kawasaki Heavy Industries Ltd, Japan.
Power Plant: two Ishikawajima-Harima F3-IHI-30 turbofans; each 3,680 lb thrust.
Dimensions: span 32 ft 7½ in, length 42 ft 8 in, height 15 ft 1¼ in.
Weights: empty 8,157 lb, gross 12,125 lb (clean), 16,535 lb (max).
Performance (at clean gross weight): cruising speed Mach 0.75, service ceiling 50,000 ft, T-O run 1,800 ft, landing run 2,200 ft, max range (with two drop tanks) 1,036 miles, *g* limits +7.33/–3.
Accommodation: crew of two, on tandem UPC (Stencel) SHIS-3J ejection seats. Rear seat elevated.
Armament: two hardpoints under each wing for drop tanks or other stores; underfuselage pylon for target towing equipment, an ECM/chaff dispenser, or an air sampling pod.

T-33A Shooting Star

Longest-serving jet trainer in the world, the Lockheed T-33, in various forms, continues to give useful service to more than a dozen of the world's air forces, with between 500 and 600 thought to be still playing an active training **(T-33A)**, counterinsurgency **(AT-33A)**, or tactical reconnaissance **(RT-33A)** role. Largest fleets are those of Canada, whose more than 50 **CT-133A Silver Stars** have 5,100 lb thrust Rolls-Royce Nene engines; Greece (nearly 50); Japan (100+); Thailand (75+); and Turkey (75+). Japan's T-33As are no longer used for training, but are being retained for liaison and other duties pending replacement by the Kawasaki T-4. Other operators using the aircraft for training include Bolivia, Ecuador, Guatemala, Iran, South Korea, Mexico, Pakistan, the Philippines, and Taiwan. *(Data for T-33A.)*
Contractor: Lockheed Aircraft Corporation, US.
Power Plant: one Allison J33-A-35 turbojet; 4,600 lb thrust.
Dimensions: span 38 ft 10½ in, length 37 ft 9 in, height 11 ft 4 in.
Weights: empty 8,084 lb, gross 11,965 lb.
Performance: max speed at S/L 600 mph, max speed at 25,000 ft 543 mph, service ceiling 47,500 ft, range 1,345 miles.
Accommodation: crew of two, in tandem.
Armament: none in T-33A.

T-37 Tweet

The familiar Tweet, one of the two main types that JPATS is destined to replace later in the 1990s, began life as the Cessna Model 318, which flew for the first time on October 12, 1954. It entered US service as a primary and intermediate trainer in 1957. More than 400 original **T-37As**, with 920 lb thrust J69-T-9 engines, were reengined to **T-37B** standard. Combined production of the two models reached almost 1,000. About 550 are still in USAF service, being upgraded by SLEP kits produced by Sabreliner Corp *(see May 1992 USAF Gallery)*.

The **T-37C**, produced to fill MAP orders only, was generally similar to the B but had provision for underwing armament and tiptanks. T-37Bs and/or Cs are operated today by the air forces of Chile (20+), Colombia (eight), Germany (34), Greece (31), South Korea (40+), Pakistan (50+), Thailand (15+), and Turkey (65+). Also in service with several air forces is the **A-37B Dragonfly** attack version, with more powerful J85 engines and heavier armament. *(Data for T-37B.)*
Contractor: Cessna Aircraft Company, US.
Power Plant: two Continental J69-T-25 (license Turbomeca Marboré) turbojets; each 1,025 lb thrust.

T-33A Shooting Star, Pakistan Air Force (Denis Hughes)

T-45A Goshawk, US Navy

TS-11R Iskra, Polish Air Force

Dimensions: span 33 ft 9¼ in, length 29 ft 3 in, height 9 ft 2¼ in.
Weights: empty 3,870 lb, gross 6,575 lb.
Performance: max speed at 25,000 ft 426 mph, cruising speed at 35,000 ft 360 mph, service ceiling 35,100 ft, T-O to 50 ft 2,000 ft, landing from 50 ft 2,545 ft, range at 360 mph with standard fuel 870 miles.
Accommodation: crew of two, side by side; ejection seats.
Armament (T-37C): provision for two 250-lb bombs under wings, or four Sidewinder AAMs, and for fuselage-mounted camera.

T-38 Talon

As USAF's first supersonic trainer, the YT-38 first flew in April 1959. Nearly 1,200 production **T-38As** were delivered over the next decade, the final contract being placed in 1970. More than 1,100 of these were for USAF, which still has over 700 in service. Forty-six, of which 41 survive, were allocated for US-based training of West German pilots; NASA received 24 on which its astronauts carried out spaceflight readiness training; and 18 others went to the US Navy, which still employs about 10 in the "aggressor" role. More than 130 of the USAF aircraft were modified to **AT-38Bs** for specialized weapons training, with an underfuselage gun pod and practice bomb dispensers. A SLEP named Pacer Classic, to enable USAF's T-38As to extend their service life until at least 2010, is currently under way. Portugal (12), Taiwan (21), and Turkey (20) also operate T-38As. *(Data for T-38A.)*
Contractor: Northrop Corporation, US.
Power Plant: two General Electric J85-GE-5A turbojets; each 3,850 lb thrust with afterburning.
Dimensions: span 25 ft 3 in, length 46 ft 4½ in, height 12 ft 10½ in.
Weights: empty 7,164 lb, gross 12,093 lb.
Performance: max speed at 36,000 ft more than 812 mph, typical cruising speed at 43,400 ft 578 mph, stalling speed (gear and flaps down) 156 mph IAS, service ceiling above 55,000 ft, T-O run 2,500 ft, landing run 3,000 ft, range with reserves 1,093 miles.
Accommodation: crew of two, in tandem; ejection seats. Rear seat raised.
Armament: none in T-38A.

T-45A Goshawk

As a new undergraduate jet pilot-trainer, the T-45A development of the BAe Hawk has to replace the T-2C Buckeye as well as the TA-4J. Initial changes introduced by the US prime contractor, McDonnell Douglas, included a new main and nose landing gear, an arrester hook, and airframe strengthening to make the aircraft carrier-compatible. In addition, the basic Hawk airbrake and ventral strakes were replaced, avionics and cockpit displays changed for compatibility with USN front-line fighters, and a derated version of the Adour installed to prolong engine life. The handling characteristics suffered from these modifications, leading to aerodynamic changes to the wing leading edges (including the addition of full-span slats) and airbrakes and use of a more powerful model of the engine. The first flight was made on April 16, 1988. Production was initiated by an FY 1988 Lot 1 contract for 12 production T-45As on January 26, 1988. A total of 300 T-45As are planned to enter USN service by 1999, to train up to 600 pilots each year at three Naval air stations. A prototype with a digital/"glass" cockpit will fly in 1995, and this upgrade is intended to be standard from the 97th production aircraft, in 1996. Engine manufacturers will also be entitled to enter into competition with Rolls-Royce to provide power plants for the later aircraft.
Contractors: McDonnell Douglas Corporation, US, and British Aerospace, UK.
Power Plant: one Rolls-Royce Turbomeca F405-RR-401 (Adour Mk 871) turbofan; 5,900 lb thrust.
Dimensions: span 30 ft 9¾ in, length (incl probe) 39 ft 3 in, height 14 ft 0 in.
Weights: empty 9,399 lb, gross 12,758 lb.
Performance: max speed at 8,000 ft 620 mph, max Mach number in dive 1.1, service ceiling 42,250 ft, T-O to 50 ft 3,744 ft, landing from 50 ft 3,900 ft, ferry range (internal fuel) 1,150 miles, *g* limits +7.33/–3.
Accommodation: crew of two, in tandem on Martin-Baker Mk 14 NACES zero/zero ejection seats. Rear seat raised.
Armament: one pylon under each wing for practice multiple bomb rack, rocket pod, or drop fuel tank. Provision for centerline stores pylon.

TS-11 Iskra-Bis

Poland's first indigenous jet trainer, the **Iskra** was developed for use by the Polish Air Force in preference to the Czechoslovak L-29 Delfin used by other member nations of the Warsaw Pact. First flight was made in February 1960, production began in 1963, and the first Iskras entered service in 1964. Initial production aircraft had a 1,720 lb thrust HO-10 turbojet, which was replaced from 1967 by the 2,205 lb thrust SO-1, from 1969 by the identically rated SO-3, and finally by the SO-3W. In addition to these engine variations, the Iskra was built in five models. The **Iskra-Bis A** and **B** were two-seat primary trainers, with two and four underwing hardpoints, respectively; the single-seat **C** (first flight June 1972) was a reconnaissance version; the **D** was similar to the B, but with a wider range of weapons; and final production model was the **DF** combat and reconnaissance trainer, with three Soviet AFA-39 cameras in the nose plus the weapons of the D.

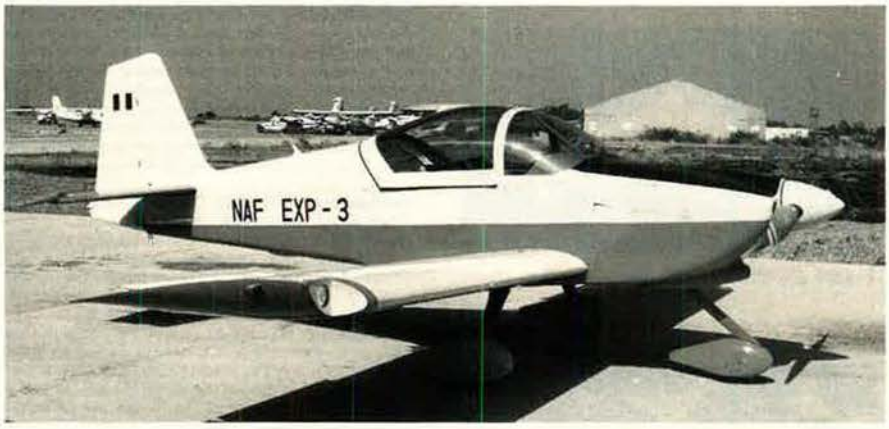
Production of 500 Iskras ended in 1979, but the line was reopened in 1982–87 to build 50 more, to offset an order for this number placed by the Indian Air Force. A new version, the **TS-11R**, has emerged to meet a Polish Naval Air Force requirement. Converted from an Iskra-Bis DF, a prototype was delivered in late 1991 to the PNAF's 7th Regiment for evaluation as a replacement for a small number of coastal reconnaissance MiG-15UTIs. The modification consists of installing a Bendix/King RDS-81 weather radar in the nose and replacing the dual controls in the rear cockpit with a radar display screen and artificial horizon. *(Data for Iskra-Bis DF.)*
Contractor: PZL Mielec, Poland.
Power Plant: one Instytut Lotnictwa SO-3W turbojet; 2,425 lb thrust.
Dimensions: span 33 ft 0 in, length 36 ft 7 in, height 11 ft 5½ in.
Weights: empty 5,655 lb, gross 8,232–8,465 lb.
Performance (at 8,232 lb gross weight): max speed at 16,400 ft 478 mph, normal cruising speed 373 mph, stalling speed (gear and flaps down) 114 mph, service ceiling 37,725 ft, T-O run 2,150 ft, landing run 2,330 ft, range 783 miles, *g* limits (ultimate) +8/–4.
Accommodation: crew of two, in tandem; lightweight ejection seats.
Armament: 23-mm gun in starboard side of nose; two hardpoints under each wing for gun or rocket pods, or small bombs of up to 220 lb.

Yak-UTS

The Yak-UTS is said to be the favorite among five advanced jet trainers designed to replace the L-29 and L-39 Albatros in service with CIS air forces. Some Western experts regard it as the best attempt yet to combine the dual-role capabilities of the Hawk with the

attack potential of such light combat aircraft as the Italian/Brazilian AMX. Its SR-71-like front fuselage, and all-swept surfaces (except for the wing trailing-edge), absence of wing dihedral or anhedral, and winglets represent an up-to-the-minute configuration that will permit flight at angles of attack up to 32°. Instead of the ZMDB Zaporozhye AI-25TLM turbofans specified for the prototypes, production Yak-UTSs would have new Klimov/SNECMA engines, rated at 4,300 lb thrust, with Rafale-like kidney-shaped underfuselage air intakes. The tandem cockpits will be equipped from the start with CRT displays. Roles will include everything from advanced pilot training to weapons training and aircraft carrier deck training. First flight is scheduled for late 1994 or early 1995.

Model of Yak-UTS



Air Beetle, Nigerian Air Force

Contractor: Yak Aircraft Corporation, Russia.
Power Plant: two ZMDB Zaporozhye AI-25TLM turbofans; each 3,729 lb thrust.
Dimensions: span 36 ft 11 in, length 40 ft 8¼ in, height 15 ft 1 in.
Weight: gross 12,125 lb.
Performance (estimated): max speed at height 560–620 mph, landing speed 106 mph, T-O run 820–1,085 ft, landing run 1,400–1,705 ft, max ferry range with conformal tank 1,550 miles, *g* limits +8/–3.
Accommodation: crew of two, in tandem. Rear seat raised.
Armament: not yet specified.

Airtrainer CT4

AS 202/18A4 Bravo

Piston-Engine Trainers

Air Beetle

When AIEP sought an easy-to-build type with which to inaugurate an aircraft manufacturing capability in Nigeria, it chose a specially modified version of US Van's RV-6A homebuilt lightplane for its requirement. Named Air Beetle, the AIEP version was developed as a fully aerobatic military and civil primary trainer having a flat-four engine that could run on either avgas or mogas. It is of all-metal construction, with conventional three-axis flying controls all equipped with electric trim, and is IFR-equipped. First flight was made in 1989, and by the beginning of this year the three prototypes had between them accumulated more than 1,000 hours of flying. Series production for the Nigerian Air Force was expected to begin shortly afterward.
Contractor: Aeronautical Industrial Engineering and Project Management Co Ltd, Nigeria.
Power Plant: one Textron Lycoming O-360-A1A piston engine; 180 hp.
Dimensions: span 23 ft 0 in, length 20 ft 2¼ in, height 7 ft 6½ in.
Weights: empty 1,050 lb, gross 1,800 lb.
Performance: max speed at S/L 173 mph, max cruising speed at 10,000 ft 178 mph, stalling speed (flaps down) 58 mph, service ceiling 20,000 ft, T-O run 656 ft, landing run 673 ft, range 679 miles.
Accommodation: crew of two, side by side; baggage space aft of seats.
Armament: none.

Airtrainer CT4B

Following the completion of six CT4Bs for the Royal Thai Air Force, manufacture of the Airtrainer has again been terminated. The six aircraft will supplement the remaining 18 of 24 delivered in the 1970s, and which are being modified by RTAF personnel to extend their wing fatigue life. Australia retired its CT4s during the past year, leaving the Royal New Zealand Air Force, which purchased 15 CT4Bs, as the only other military operator of this small primary trainer.
Contractor: Facific Aerospace Corporation Ltd, New Zealand.
Power Plant: one Teledyne Continental IO-360-HB9 piston engine; 210 hp.
Dimensions: span 26 ft 0 in, length 23 ft 2 in, height 8 ft 6 in.
Weight: gross 2,650 lb.
Performance max speed at S/L 166 mph, max cruising speed at S/L 161 mph, stalling speed (flaps down) 51 mph, service ceiling 14,500 ft, T-O run 733 ft, landing run 510 ft, max range (no reserves) 691 miles.
Accommodation: two seats, side by side. Space to rear for third seat or 115 lb of baggage.
Armament: none.

AS 202 Bravo

Deliveries of a total of 180 AS 202/18A primary trainers were completed in 1989, but the Bravo remains available. Subtypes are the **AS 202/18A2**, with higher max T-O and landing weights than the basic 18A, an extended canopy, and electrical instead of mechanical trim; the **A3**, which differs from the A2 in having mechanical trim, and 24V instead of 12V electrics; and the **A4,** with British CAA approved special instrumentation. All versions are fully aerobatic. Customers include the air forces of Indonesia (40), Iraq (48, of which some were transferred to Jordan), and Morocco (10), plus four for the Royal Flight of Oman and eight for the Uganda Central Flying School. *(Data for AS 202/18A4.)*
Contractor: FFA Flugzeugwerke Altenrhein, Switzerland.
Power Plant: one Textron Lycoming AEIO-360-B1F piston engine; 180 hp.
Dimensions: span 31 ft 11¾ in, length 24 ft 7¼ in, height 9 ft 2¾ in.
Weights: empty 1,565 lb, gross 2,226 lb (aerobatic), 2,380 lb (max).
Performance (at max gross weight): max speed at S/L 150 mph, max cruising speed at 8,000 ft 141 mph, stalling speed (flaps down) 56 mph, service ceiling 17,000 ft, T-O run 705 ft, landing run 690 ft, max range (no reserves) 707 miles, *g* limits +6/–3.
Accommodation: crew of two side by side in aerobatic version; space behind these in utility version for third seat or 220 lb of baggage.
Armament: none.

Bulldog

The Bulldog began life as the Beagle B.125, a military primary trainer version of that company's civil Pup design. It was acquired by Scottish Aviation following Beagle's collapse. SA eventually becoming part of British Aerospace. The Beagle prototype first flew in May 1969, and the first 98 production Bulldogs were **Series 100s** for Sweden (Model 101, known as **Sk61s** in Swedish Air Force service), Malaysia (Model 102), and Kenya (Model 103). Model 121 for Britain's Royal Air Force marked the introduction of the **Series 120**, with a strengthened wing center-section and higher aerobatic takeoff weight. The RAF ordered 130 as the Bulldog **T. Mk 1**. Other Series 120 customers included Ghana (Model 122), Nigeria (Model 123), Jordan (Model 125), Lebanon (Model 126), Kenya (Model 127), and Botswana (Model 130). Current Bulldog operators are the RAF (100+), Sweden (60+), Nigeria (25+), Jordan (20), Kenya (12), Malaysia (11), Ghana (10), and Lebanon (five). *(Data for Series 120.)*
Contractor: British Aerospace plc, UK.
Power Plant: one Textron Lycoming IO-360-A1B6 piston engine; 200 hp.
Dimensions: span 33 ft 0 in, length 23 ft 3 in, height 7 ft 5¾ in.
Weights: empty 1,430 lb, gross 2,238–2,350 lb.
Performance: max speed at S/L 150 mph, max cruising speed at 4,000 ft 138 mph, stalling speed (flaps down) 61 mph EAS, service ceiling 16,000 ft, T-O run 900 ft, landing run 500 ft, max range 621 miles, *g* limits +6/–3.
Accommodation: crew of two, side by side; optional third seat or 220 lb of baggage at rear.
Armament: normally none, but provision for four underwing points for up to 640 lb of air-to-surface weapons, machine-gun pods, bombs, grenade launchers, or other stores.

CAP 10

The uncommon wooden airframe and fabric-covered rear fuselage of the **CAP 10** reflect its development from the popular Piel Emeraude sport aircraft. It first flew in prototype form in August 1968, and it received French certification in September 1970. The current prooduction **CAP 10 B**, with an enlarged rudder, and ventral fin, was FAA certificated for day and night VFR operation in 1974. Both models are fully aerobatic; a combined total of 260 had been delivered by early 1992. Major military operator is the French Air Force, which received 30 CAP 10s and 26 CAP 10 Bs. Eight CAP 10 Bs were supplied to the French Navy. The CAP 10s are used to pregrade French cadet pilots before proceeding to full flying training on the Epsilon or Zéphyr. Twenty CAP 10 Bs were delivered in the early 1980s to the Mexican Air Force's flying school; these aircraft are equipped almost to IFR standard. *(Data for CAP 10 B.)*
Contractor: Avions Mudry et Cie, France.
Power Plant: one Textron Lycoming AEIO-360-B2F piston engine; 180 hp.
Dimensions: span 26 ft 5¼ in, length 23 ft 6 in, height 8 ft 4½ in.
Weights: empty 1,213 lb, gross 1,675 lb (aerobatic), 1,829 lb (max).

Performance: max speed at S/L 168 mph, max cruising speed 155 mph, stalling speed (flaps down) 50 mph IAS, service ceiling 16,400 ft, T-O run 1,149 ft, landing run 1,182 ft, max range 621 miles, *g* limits +6/–4.5.
Accommodation: crew of two, side by side; space behind seats for 44 lb of baggage.
Armament: none.

Cessna 150/152/172 and T-41 Mescalero

The Model 150 two-seat lightplane first flew in 1957, early models up to the 150E having an unswept fin and rudder and 100 hp Continental O-200-A engine; a swept fin was introduced in 1966, with the Model 150F. From 1977, the 150s were replaced by the **Model 152** range with uprated 110 hp Textron Lycoming O-235 engine. The four-seat **Model 172** preceded them both, having flown for the first time in 1955 and being a trigear derivative of the earlier Model 170. Power plant was a 145 hp Continental O-300-A. Major introductions in 1960 were a sweptback fin and a new standard deluxe model named Skyhawk. A more powerful **R172E** (210 hp Continental IO-360) appeared in 1964, and uprated engines for the basic Model 172 and Skyhawk were introduced in 1968 (150 hp Lycoming O-320) and 1977 (160 hp O-320), respectively.

The **T-41A Mescalero** represented an off-the-shelf procurement of 204 Cessna 172s for USAF, followed by production of three further models, all based on the civil R172E. The latter comprised 255 **T-41Bs** for the US Army, 52 **T-41Cs** for USAF, and 238 **T-41Ds** for MAP exports to friendly nations. More than 250 T-41A/B/Cs continue to serve as trainers with the US Air Force and Army.

Other operators using for training about 170 T-41s (mostly Ds), some 70 Cessna 150/152s, and 50 or so Model 172s include Angola, Argentina, Bangladesh, Bolivia, Botswana, Burundi, Chile, Ciskei, Colombia, Dominica, Ecuador, El Salvador, Greece, Haiti, Honduras, Ivory Coast, South Korea, Madagascar, Mexico, Mozambique, Paraguay, Peru, the Philippines, Saudi Arabia, the Seychelles, Somalia, Sri Lanka, Turkey, Uruguay, and Zaïre. *(Data for R172E/T-41D.)*
Contractor: Cessna Aircraft Company, US.
Power Plant: one Teledyne Continental IO-360-D piston engine; 210 hp.
Dimensions: span 35 ft 10 in, length 26 ft 11 in, height 8 ft 9½ in.
Weights: empty 1,405 lb, gross 2,550 lb.
Performance: max speed at S/L 153 mph, max cruising speed at 5,500 ft 145 mph, service ceiling 17,000 ft, T-O run 740 ft, landing run 620 ft, max range 1,010 miles.
Accommodation: four seats, in two pairs; up to 200 lb of baggage aft of rear seats.
Armament: none.

CJ-6A

The Soviet Yak-18 primary trainer was one of the first aircraft mass-produced in post-1949 China, 379 being license-built at Nanchang between 1954 and 1958. Two years before this run ended, work on the CJ-6 derivative started at Shenyang, a prototype with a 145 hp Mikulin M-11ER engine flying on August 27, 1958. Disappointing performance led to replacement of this engine by a 260 hp Ivchenko AI-14R, with which a new prototype made its first flight on July 18, 1960. The project was then transferred to Nanchang, where further redesign was followed by flight of the first production-standard aircraft on October 15, 1961. More than 2,000 CJ-6s had been built by 1992, of which probably at least 1,500 are still in Chinese service. Standard version since December 1965 has been the **CJ-6A**, although ten armed **CJ-6Bs** were built in 1964–66. The CJ-6A retains the general configuration of the Yak-18A/CJ-5 but has an all-metal airframe with fully retractable landing gear, fitted with low-pressure tires for operation from grass strips. Export examples, which have the Westernized designation **PT-6A**, totaled about 200; these are currently operated by Bangladesh (35), North Korea (100 or more, including some CJ/PT-5s), and Zambia (12). *(Data for PT-6A.)*
Contractor: Nanchang Aircraft Manufacturing Company, People's Republic of China.
Power Plant: one SMPMC (Zhuzhou) HS6A radial piston engine; 285 hp.
Dimensions: span 33 ft 6½ in, length 27 ft 9 in, height 10 ft 8 in.
Weights: empty 2,414 lb, gross 3,086 lb.
Performance: max speed 185 mph, service ceiling 20,500 ft, T-O run 920 ft, landing run 1,150 ft, max range 429 miles.
Accommodation: crew of two, in tandem.
Armament: none.

Eurotrainer 2000A

Design of the high-performance Eurotrainer was initiated by FFA of Switzerland in 1985. Development and manufacture of wings for the carbonfiber-reinforced glassfiber airframe were entrusted to FFT GmbH of Germany, and this company took over responsibility for the entire Eurotrainer program in 1989–90. The prototype flew for the first time on April 29, 1991. Suitable for IFR training and limited aerobatics, the Eurotrainer is able to meet military pilot selection and *ab initio* training requirements, up to the stage of transition to a tandem-seat turboprop or jet advanced trainer. Features include side-by-side seating in a high-visibility, ergonomically designed cockpit, advanced laminar flow wings, and retractable landing gear. Four persons can be carried, in pairs, in military liaison or civil sporting use.
Contractor: FFT (Gesellschaft für Flugzeug- und Faserverbund-Technologie mbH), Germany.
Power Plant: one Textron Lycoming AEIO-540-L1B5 piston engine, flat rated at 270 hp.
Dimensions: span 34 ft 0¾ in, length 26 ft 8½ in, height 10 ft 6 in.
Weights: empty 2,028 lb, gross 2,865 lb (aerobatic), 3,263 lb (max).
Performance: max speed at S/L 212 mph, econ cruising speed at 12,000 ft 198 mph, stalling speed (flaps down) 64 mph, service ceiling 20,000 ft, T-O run 1,000 ft, landing run 820 ft, range 1,120 miles, *g* limits +6/–3.5 (aerobatic), +5/–3 (utility).
Accommodation: two to four persons, side by side in pairs.
Armament: none.

CJ-6A, Chinese Air Force (Kenneth Munson)

Eurotrainer 2000A

Yak-52, Russian Air Force (Piotr Butowski)

LT-1 Swati

HPT-32 Deepak

The prototype of this fully aerobatic side-by-side two-seat basic trainer flew for the first time on January 6, 1977. Production was delayed, and the first 22-week student grading course on HPT-32s did not begin at the Indian Air Force Academy until eleven years later. The key design requirement was to perform two consecutive training missions 50 km (31 miles) from base before needing to refuel. As well as fulfilling the roles of *ab initio*, aerobatic, night flying, instrument flying, and navigation training, the aircraft had to be suitable for such secondary duties as liaison, observation, glider and target towing, and search and rescue. Initial orders were placed for 80 HPT-32s for the Indian Air Force and eight for the Indian Navy. Delivery of a further 32 will begin next year.
Contractor: Hindustan Aeronautics Ltd (Kanpur Division), India.
Power Plant: one Textron Lycoming AEIO-540-D4B5 piston engine; 260 hp.
Dimensions: span 31 ft 2 in, length 25 ft 4 in, height 9 ft 5½ in.
Weights: empty 1,962 lb, gross 2,756 lb.
Performance: max speed at S/L 164 mph IAS, max cruising speed at 10,000 ft 132 mph, stalling speed (flaps down) 69 mph, service ceiling 18,045 ft, T-O run 1,132 ft, landing run 720 ft, max range 462 miles, *g* limits +6/–3.
Accommodation: two seats, side by side.
Armament: none.

Iak-52 (Yak-52) and Condor

Now known by the Romanian designation **Iak-52**, Yakovlev's Yak-52 tandem two-seat primary trainer has been manufactured under license at Bacau for 13 years. The Romanian prototype had flown for the first time in May 1978. Deliveries peaked at 150 a year but have been reduced recently to an annual rate of fewer than 100. The majority of more than 1,600 built were for the air forces of Romania and the former Soviet Union.

The basic configuration and structure of the Iak-52 differ little from those of the Yak-18, which entered production immediately after World War II. A metal semimonocoque rear fuselage replaces the original fabric-covered structure, and a smooth cowling encloses the more powerful engine. In addition, the Iak-52 has a unique tricycle landing gear, in which all three wheels remain totally exposed under the wings and fuselage when retracted, to offer greater safety in a wheels-up emergency landing.

A Westernized version of the Iak-52 known as the **Condor**, with a 300 hp Textron Lycoming AEIO-540-L1B5D engine, wingspan of 31 ft 2 in, and square-tip rudder, was rolled out at Bacau on October 5, 1991. *(Data for Iak-52.)*
Contractor: Aerostar SA (formerly IAv Bacau), Romania.
Power Plant: one VMKB (Vedeneyev) M-14P radial piston engine; 360 hp.
Dimensions: span 30 ft 6¼ in, length 25 ft 5 in, height 8 ft 10¼ in.
Weights: empty 2,238 lb, gross 2,877 lb.
Performance: max speed at S/L 177 mph, at 3,280 ft 167 mph, service ceiling 13,125 ft, T-O run 591–657 ft, landing run 853 ft, max range (with reserves) 310 miles, *g* limits +7/–5.
Accommodation: two seats, in tandem.
Armament: none.

L-70 Vinka

The Vinka has been operational at the Finnish Air Force's Air Academy, Kauhava, since October 1981. It first flew in prototype form, as the Leko-70, on March 23, 1973. Only 30 production aircraft were built, all for the Air Force. Their major roles are primary, aerobatic, night, instrument, and tactical training, but they can be used also for casevac, search and rescue, supply dropping, weapons training, target towing, and reconnaissance. Fatigue life is better than 8,000 hours, and they are easily adaptable for ski takeoffs and landings.
Contractor: Valmet Aviation Industries, Finland.
Power Plant: one Textron Lycoming AEIO-360-A1B6 piston engine; 200 hp.
Dimensions: span 31 ft 7¼ in, length 24 ft 7¼ in, height 10 ft 10¼ in.
Weights: empty 1,691 lb, gross 2,293 lb (aerobatic), 2,756 lb (max).
Performance (at 2,205 lb gross weight): max speed at S/L 146 mph, max cruising speed at 5,000 ft 138 mph, stalling speed (flaps down) 53 mph, service ceiling 16,400 ft, T-O run 755 ft, landing run 575 ft, max range (no reserves) 590 miles, *g* limits +6/–3.
Accommodation: crew of two, side by side; space behind these for two more seats or up to 617 lb of baggage.
Armament: two hardpoints under each wing for (as two-seater) total of up to 661 lb of bombs, flare pods, rocket pods, machine-gun pods, antitank missiles, TV or still camera pods, or life raft/rescue packs and a searchlight.

LT-1 Swati

The Technical Center of India's Civil Aviation Department has designed a number of gliders and light aircraft. It began design of the LT-1 in the late 1980s, and the prototype flew for the first time on November 17, 1990. Certification flight testing was nearing completion at the beginning of this year. Initially, the prototype had a 130 hp engine (see data), but BHEL, chosen to manufacture the production version, was modifying it in early 1992 to have a 116 hp Textron Lycoming O-235-N2C engine and tricycle instead of "taildragger" landing gear. Production aircraft, destined primarily for Indian civilian flying clubs, will at first have wooden wings, like the prototype, but later examples are intended to have all-metal wings. Approval has been given for BHEL to build 15 Swatis a year. *(Data for prototype with original engine.)*

Contractor: Bharat Heavy Electricals Ltd, India, for production aircraft.
Power Plant: one Rolls-Royce Continental O-240-A piston engine; 130 hp.
Dimensions: span 30 ft 2¼ in, length 23 ft 3½ in, height 9 ft 2 in.
Weights: empty 1,120 lb, gross 1,543–1,653 lb.
Performance: max speed 130 mph, cruising speed 115 mph, stalling speed (flaps down) 45–47 mph, service ceiling 15,000 ft, T-O run 626 ft, landing run 752 ft, range 342 miles, *g* limits +4.4/–1.76.
Accommodation: crew of two, side by side.
Armament: none.

Mushshak

Following Pakistan's import of 15 Saab Safari/Supporter two/three-seat light aircraft from Sweden, 92 more were assembled from kits at Risalpur for the Pakistan Army and Air Force between 1975 and 1982. Meanwhile, in 1981 the Aircraft Manufacturing Factory (AMF) of the Pakistan Aeronautical Complex had been set up as a license production center for the aircraft, which is known locally by the Urdu name **Mushshak**. Subsequent manufacture has been from raw materials, and by January this year a further 120 had been delivered to the Pakistan services, with production continuing at the rate of 24 a year. Twenty-five were ordered by the Iranian Pasdaran Revolutionary Guard; the remainder serve with the Pakistan Army (130+) and Air Force (50). A feature of the design is the 5° of wing sweep-forward that enhances the view from the cockpit. Provision is made for full IFR instrumentation, radio, and armament.

In 1987 the AMF test-flew the first of four Mushshaks (renamed **Shahbaz**) in which the standard engine was replaced by a 210 hp Teledyne Continental TIO-360-MB; this version received FAR Pt 23 certification in 1989 but has not replaced the earlier model in production. Swedish-built Safari/Supporters are used for training by the air forces of Norway (17) and Zambia (20).

Contractor: Pakistan Aeronautical Complex.
Power Plant: one Textron Lycoming IO-360-A1B6 piston engine; 200 hp.
Dimensions: span 29 ft 0½ in, length 22 ft 11½ in, height 8 ft 6½ in.
Weights: empty 1,424 lb, gross 1,984–2,645 lb.
Performance: max speed at S/L 148 mph, cruising speed 130 mph, stalling speed (flaps down) 63 mph, service ceiling 15,750 ft, T-O run 493 ft, landing run 460 ft, endurance (with reserves) 5 h 10 min, *g* limits (aerobatic) +6/–3.
Accommodation: two seats, side by side; provision for rearward-facing seat or 220 lb of baggage to rear.
Armament: six underwing hardpoints (two carrying 330 lb each, four 220 lb each) for two 7.62-mm or 5.56-mm machine-gun pods, two pods of 7 x 75-mm or 2.75-in rockets, four pods of 7 x 68-mm rockets, 18 x 75-mm rockets, or six wire-guided antitank missiles.

SF.260

More than 860 piston-engined SF.260s, in various forms, have been delivered to civil customers and to 24 air forces worldwide. The basic military **SF.260M** is an improved and strengthened version of the civil SF.260A, designed by Dott Ing Stelio Frati (the SF in its designation). It flew for the first time on October 10, 1970, and subsequently became the Italian Air Force's standard primary trainer, capable of basic flying training, instrument flying, aerobatics including deliberate spinning, night flying, navigation instruction, and formation flying. From the SF.260M was developed the **SF.260W Warrior** dual-role trainer/tactical support version, with underwing pylons for up to 661 lb of weapons or other stores. Countries now operating the M, the W, or a mix of both include Belgium, Brunei, Burkina Faso, Burundi, Chad, Dubai, Ireland, Italy, Libya, Nicaragua, the Philippines, Singapore, Somalia, Thailand, Tunisia, Uganda, Zaïre, Zambia, and Zimbabwe. Forty of the current improved and updated civil **SF.260Ds** are being supplied to the Turkish Air Force. *(Data for SF.260M.)*

Contractor: Agusta SpA (Sesto Calende Works) (formerly SIAI-Marchetti SpA), Italy.

SF.260W, Republic of Tunisia Air Force (Ivo Sturzenegger)

T67M EFS Firefly (Kenneth Munson)

TB 30 Epsilons, air forces of Togo, France, and Portugal

Power Plant: one Textron Lycoming O-540-E4A5 piston engine; 260 hp.
Dimensions: span over tiptanks 27 ft 4¾ in, length 23 ft 3½ in, height 7 ft 11 in.
Weights: empty 1,797 lb, gross 2,425 lb (aerobatic), 2,645 lb (max). (SF.260W, max gross 2,866 lb.)
Performance: max speed at S/L 207 mph, max cruising speed at 4,925 ft 186 mph, stalling speed (gear and flaps down) 79 mph, service ceiling 15,300 ft, T-O run 1,260 ft, landing run 1,132 ft, max range 1,025 miles, *g* limits (aerobatic) +6/–3.
Accommodation: two seats, side by side, with third seat to rear.
Armament: none on SF.260M.

T-25 Universal

First flown on April 29, 1966, the Universal had been designed, as the Neiva N 621, to meet a Brazilian Air Force requirement for a basic trainer. Of all-metal construction, it has side-by-side seating under a rearward-sliding canopy. A total of 140 were built for the Brazilian Air Force, of which about 100–120 are still in service in two versions. The **T-25** basic and advanced trainer serves with the 2° Esquadrão de Instrução Aérea and the Academia da Força Aérea, plus some utility units, while the **T-25A** is used in a light attack and reconnaissance role. Neiva also built ten Universals for Chile; when these were later replaced by the ENAER Pillán, they were passed on to the Paraguayan Air Force.

Contractor: Sociedade Construtora Aeronáutica Neiva Ltda, Brazil.
Power Plant: one Textron Lycoming IO-540-K1D5 piston engine; 300 hp.
Dimensions: span 36 ft 1 in, length 28 ft 2½ in, height 9 ft 9¾ in.
Weights: empty 2,535 lb, gross 3,306–3,747 lb.
Performance (at 3,306 lb aerobatic gross weight): max speed at S/L 186 mph, max cruising speed at S/L 177 mph, stalling speed (flaps down) 65 mph, service ceiling 20,000 ft, T-O run 1,148 ft, landing from 50 ft 1,970 ft, range with reserves 621 miles.
Accommodation: crew of two, side by side; space for baggage or optional third seat at rear.
Armament: two underwing hardpoints for 7.62-mm machine-gun pods.

T-35 Pillán

This fully aerobatic and instrument flying trainer was designed by Piper as a spinoff from its Cherokee family, embodying many components of the PA-28 Dakota and PA-32 Saratoga. The first of two Piper-built prototypes made its initial flight on March 6, 1981. Production was then started in Chile by ENAER, a state-owned company established by the Chilean Air Force. Three aircraft were assembled from kits delivered from the US, and, after changes to the design of the tail unit and deepening of the canopy, series manufacture began in September 1984. Sixty **T-35A** primary trainers and 20 **T-35B** instrument trainers for the Chilean Air Force had been delivered by the spring of 1990. ENAER also supplied kits for 40 **T-35Cs** (plus one attrition replacement) to Spain, where they were assembled by CASA for the Spanish Air Force; equipped as primary trainers, they have the Spanish designation and name **E.26 Tamiz**. Ten **T-35D** instrument trainers were delivered to the Panamanian Air Force in 1988–89, and deliveries have been under way this year of 12 T-35Ds ordered by the Paraguayan Air Force in 1991.

Flight testing of a single-seat **T-35S** began on March 5, 1988. A turboprop two-seat version, the **T-35DT**, is described separately. *(Data for T-35A.)*

Contractor: Empresa Nacional de Aeronáutica de Chile (ENAER), Chile.
Power Plant: one Textron Lycoming IO-540-K1K5 piston engine; 300 hp.
Dimensions: span 29 ft 0 in, length 26 ft 3 in, height 8 ft 8 in.
Weights: empty 2,050 lb, gross 2,900–2,950 lb.
Performance: max speed at S/L 193 mph, max cruising speed at 8,800 ft 166 mph IAS, stalling speed (gear and flaps down) 72 mph, service ceiling 19,160 ft, T-O run 940 ft, landing run 780 ft, max range with reserves 748 miles, *g* limits +6/–3.
Accommodation: two seats, in tandem. Rear seat raised.
Armament: none.

T67M Firefly

USAF's selection of the Firefly as its new Enhanced Flight Screener (EFS) aircraft, in April 1992, is expected to result in British manufacture of kits by which Northrop will assemble 113 of the glassfiber-reinforced plastics airframes. There are four models in the Firefly range. The basic **T67C**, supplied for primary training of Canadian military and Dutch naval pilots, has a carburetor version of Textron Lycoming's 160 hp engine and fixed-pitch propeller. The lowest-powered model of the military M version is the **T67M Mk 2**, with 160 hp fuel-injected Textron Lycoming AEIO-320-D1B, constant-speed propeller, 42-gallon increased fuel capacity, and fuel and oil systems suitable for inverted flight. The intermediate **T67M200**, serving the Royal Netherlands Air Force and Royal Hong Kong Auxiliary Air Force, has a 200 hp AEIO-360-A1E. The top-of-the-range **T67M260**, designed specifically to meet the EFS requirement, has a 260 hp AEIO-540-D4A5, enabling it to cruise at 178 mph at 8,000 ft, climb to 10,000 ft in under eight minutes, and carry a 500 lb load of two pilots plus full fuel on training flights of more than three hours. It is air-conditioned for worldwide operation. A representative airframe has completed dynamic fatigue tests simulating 90,000 flight hours, based on the RAF spectrum of loading cycles for basic training aircraft. *(Data for T67M260.)*

Contractor: Slingsby Aviation Ltd, UK.
Power Plant: one Textron Lycoming AEIO-540-D4A5 piston engine; 260 hp.
Dimensions: span 34 ft 9 in, length 24 ft 10 in, height 7 ft 9 in.
Weights: empty 1,714 lb, gross 2,500 lb (aerobatic and max).
Performance: max speed at S/L 175 mph, stalling speed (flaps down) 68 mph, T-O run 450 ft, landing run 970 ft, max range (with reserves) 405 miles, *g* limits +6/–3.
Accommodation: two seats, side by side.
Armament: none.

TB 30 Epsilon

The Epsilon was developed by Aerospatiale subsidiary Socata to meet a French Air Force requirement for a propeller-driven aircraft to improve the cost-effectiveness of its basic pilot training. First flight took place on December 22, 1979, and an initial contract for 30 was placed in March 1982. The first production aircraft flew in June 1983, and deliveries began a year later, eventually totaling 150. Serving with Groupement Ecole 315 at Cognac/Chateaubernard, they amassed more than 100,000 flying training hours within their first five years. Pupils can complete full *ab initio* and basic training on the Epsilon, then progress directly to an operational type without needing intermediate transition training.

Esquadra 104 of the Portuguese Air Force received 18 Epsilons from early 1989, of which 17 were assembled locally by OGMA, and four armed examples have been supplied to the Togolese Air Force. Performance of the latter version includes the ability to loiter

for 30 min at low altitude over a combat area 195 miles from its base.

Contractor: Socata (subsidiary of Aerospatiale), France.

Power Plant: one Textron Lycoming AEIO-540-L1B5D piston engine; 300 hp.

Dimensions: span 25 ft 11¾ in, length 24 ft 10¾ in, height 8 ft 8¾ in.

Weights: empty 2,055 lb, gross 2,789 lb.

Performance: max speed at S/L 236 mph, max cruising speed at 6,000 ft 222 mph, stalling speed (gear and flaps down) 73 mph, service ceiling 23,000 ft, T-O run 1,345 ft, landing run 820 ft, range with reserves at 184 mph at 12,000 ft 783 miles, *g* limits +6.7/–3.35.

Accommodation: crew of two, in tandem. Rear seat raised.

Armament (optional: not on French or Portuguese Air Force aircraft): four underwing hardpoints for up to 661 lb of stores when flown as a single-seater. Typical loads can include two gun pods (each with two 7.62-mm machine guns), two 275-lb bombs or grenade launchers, four packs of 6 x 68-mm rockets, or four survival kit pods.

UTVA-75

This adaptable light aircraft made its first flight on May 19, 1976, and more than 150 production examples were manufactured at Pančevo, near Belgrade, from about 1978 until 1990. At the beginning of this year, before the disintegration of Yugoslavia, some 70+ were in service with the Yugoslav Air Force and about half that number with civilian flying clubs. Sturdily built and able to operate from grass or unprepared strips of 500 ft or less, they were originally used for basic training, glider towing, and a range of utility duties. However, they also have the ability to carry light weapon loads and may have been employed in such a capacity during the present internal conflicts. Prototypes were flown in 1986 of a four-seat **UTVA-75A**, and in March 1989 of an **UTVA-75AG11** agricultural version.

Contractor: UTVA–Sour Metalne Industrije, Ro Fabrika Aviona, Yugoslavia.

Power Plant: one Textron Lycoming IO-360-B1F piston engine; 180 hp.

Dimensions: span 31 ft 11 in, length 23 ft 4 in, height 10 ft 4 in.

Weights: empty 1,510 lb, gross 2,116 lb.

Performance: max speed 133 mph, max cruising speed 115 mph, stalling speed (flaps down) 51 mph, service ceiling 13,125 ft, T-O run 410 ft, landing run 328 ft, max range on internal fuel 497 miles, *g* limits +6/–3.

Accommodation: two seats, side by side.

Armament: pylon under each wing for a bomb, 220-lb cargo container, two-round rocket launcher, machine-gun pod, or drop fuel tank.

Turboprop Trainers

EMB-312 Tucano

Including British-built S312s (described separately), 635 Tucanos had been ordered by the beginning of this year, with options for a further 101; deliveries then totaled 494. Customers for the Brazilian-built EMB-312 included the air forces of Argentina (30), Brazil (128), Egypt (54), France (80), Honduras (12), Iran (25), Iraq (80), Paraguay (six), Peru (30), and Venezuela (32).

The first prototype **Tucano** flew on August 16, 1980, and deliveries to the Brazilian Air Force began in September 1983. In the same month, Egypt placed an initial order for 120 for its own Air Force and that of Iraq. The French version has strengthened wings like those of the S312, improved deicing and demisting systems, and French avionics and instruments.

On September 9, 1991, Embraer flew a proof-of-concept prototype of the new EMB-312H **Tucano H**. Compared with the standard Brazilian trainer, this has a more powerful (1,600 shp instead of 750 shp) PT6A turboprop, lengthened fuselage, zero/zero ejection seats, pressure refueling, and OBOGS (On-Board Oxygen Generating System). Able to cover the whole primary and half of the advanced training syllabus of a jet trainer, it represents the Embraer/Northrop entry for the USAF/USN JPATS competition. A production-standard JPATS **Super Tucano** was expected to fly late this year, with a "glass" cockpit and FADEC (full authority digital engine control). *(Data for Tucano H.)*

Contractor: Empresa Brasileira de Aeronáutica SA, Brazil.

Power Plant: one Pratt & Whitney Canada PT6A-68/1 turboprop; 1,600 shp.

Dimensions: span 36 ft 6½ in, length 37 ft 5¾ in, height 12 ft 1 in.

Weights: empty 5,269 lb, gross 6,967 lb (clean), 8,356 lb (max).

Performance (clean): max speed at 20,000 ft 350 mph, econ cruising speed at 20,000 ft 269 mph, stalling speed (gear and flaps down) 87 mph, service ceiling 38,000 ft, T-O run 890 ft, landing run 1,414 ft, max range on internal fuel (with reserves) 944 miles, *g* limits +7/–3 (aerobatic).

Accommodation: crew of two, in tandem on ejection seats. Rear seat raised.

Armament: four underwing hardpoints for up to 2,205 lb of stores, including (typically) two 0.30-in machine-gun pods, four 250-lb bombs, or four 7-tube rocket launchers.

L-90 TP Redigo

Two prototypes of the Redigo were flown, one with an Allison 250 engine (on July 1, 1986) and the other with a similarly rated Turbomeca TP 319 turboprop (in December 1987). The Allison was selected for production aircraft, which also have new vertical tail surfaces with an unswept fin, revised dorsal fin, and enlarged rudder. Valmet optimized the design to cover primary and basic, aerobatic, night, instrument, navigation, formation, and tactical flying training, drawing on experience gained with the earlier, piston-engine L-70 Vinka. The Finnish Air Force has 10 Redigos. Deliveries are now in progress of a further 18 Redigos to three so-far-unnamed customers. Dassault of France is assisting Valmet in marketing the aircraft.

Contractor: Valmet Aviation Industries, Finland.

Power Plant: one Allison 250-B17F turboprop; 420 shp (flat rated).

Dimensions: span 34 ft 9¼ in, length 27 ft 11¾ in, height 10 ft 6 in.

Weights: empty 2,094 lb, gross 2,976–4,189 lb.

Performance (at max gross weight): max speed 258 mph CAS, max cruising speed at 7,875 ft 219 mph, stalling speed (flaps down) 63 mph, service ceiling 25,000 ft, T-O run 788 ft, landing run 788 ft, max range with reserves 870 miles, *g* limits (aerobatic) +7/–3.5.

Accommodation: crew of two, side by side; space behind these for two more seats or 440 lb of baggage. Zero/zero rocket escape system optional.

Armament: none specified, but three hardpoints under each wing can (when aircraft is flown solo) carry up to 1,764 lb of photographic, TV, radar, or reconnaissance pods and two flares, or other stores appropriate to role.

EMB-312H Super Tucano

PC-7 Turbo-Trainer

More than 400 PC-7s have been sold, and most of them delivered, with the first flight of a production aircraft on August 18, 1978. Customers have included the air forces of Abu Dhabi (24), Angola (18), Austria (16), Bolivia (36), Bophuthatswana (three), Botswana (seven), Chad (two), Chile (Navy, 10), France (five), Guatemala (12), Iran (35), Iraq (52), Malaysia (44), Mexico (75), Myanmar (17), Netherlands (10), Switzerland (40), Uruguay (six), and one undisclosed country. Swiss law does not permit the export of aircraft equipped for combat duties, so the PC-7 is marketed as a fully aerobatic trainer suitable for basic, transition, and aerobatic training and, with added equipment, for IFR and tactical training. Aircraft operational with some air forces can be seen carrying a wide variety of stores on underwing weapon pylons that have been installed under separate contract by armament manufacturers.

Contractor: Pilatus Flugzeugwerke AG, Switzerland.

Power Plant: one Pratt & Whitney Canada PT6A-25A turboprop; 550 shp (flat rated).

Dimensions: span 34 ft 1 in, length 32 ft 1 in, height 10 ft 6 in.

Weights: empty 2,932 lb, gross 4,188 lb (aerobatic), 5,952 lb (max).

Performance (at 4,188 lb weight): max cruising speed at 20,000 ft 256 mph, stalling speed (gear and flaps down) 74 mph, service ceiling 33,000 ft, T-O run 787 ft, landing run 968 ft, max range (with reserves) 745 miles, *g* limits +6/–3.

Accommodation: two seats, in tandem; Martin-Baker Mk CH 15A lightweight ejection seats optional. Space for 55 lb of baggage aft of seats.

Armament: see above.

PC-9

The similar configurations of the PC-7 and PC-9 are misleading, as structural commonality is only 10 percent. The **PC-9** has a more powerful engine, raised rear cockpit, ejection seats as standard, a ventral airbrake, modified wing sections and tips, new ailerons, a longer dorsal fin, larger wheels with high-pressure tires, and mainwheel doors. The first of two preseries aircraft flew on May 7, 1984. Customers have included the air forces of Angola (four), Australia (67 PC-9/As), Iraq (20), Myanmar (six), Saudi Arabia (30), and Switzerland (eight); the US Army has three and the Cyprus National Guard two.

The RAAF **PC-9/As** have Bendix EFIS instrumentation, PC-7 low-pressure tires, and bulged mainwheel doors. The first two were supplied in flyaway form, the next 17 as kits and components. The remaining 48 are being built in Australia by Hawker de Havilland and AeroSpace Technologies of Australia. The German Air Force leases 10 **PC-9Bs** from a private company to provide target-towing services. For the USAF/USN JPATS competition, Pilatus is teamed with Beech in offering the **PC-9 Mk II**, with a 1,708 shp PT6A-68

L-90 TP Redigo

PC-9, Royal Saudi Air Force

turboprop, flat rated at 1,250 shp, single-point fueling, a pressurized cockpit, birdstrike-proof canopy, and zero/zero ejection seats. The first of two PC-9 Mk II test-beds, modified by Beech, flew in summer 1992. *(Data for basic PC-9.)*

Contractor: Pilatus Flugzeugwerke AG, Switzerland.
Power Plant: one Pratt & Whitney Canada PT6A-62 turboprop; 950 shp (flat rated).
Dimensions: span 33 ft 2½ in, length 33 ft 4¾ in, height 10 ft 8¼ in.
Weights: empty 3,715 lb, gross 4,960 lb (aerobatic), 7,055 lb (max).
Performance (at 4,960 lb weight): max speed at S/L 311 mph, max speed at 20,000 ft 345 mph, stalling speed (gear and flaps down) 81 mph, service ceiling 38,000 ft, T-O run 745 ft, landing run 1,368 ft, max range (with reserves) 1,020 miles, *g* limits +7/–3.5.
Accommodation: crew of two, in tandem, on Martin-Baker Mk CH 11A ejection seats. Rear seat raised. Space for 55 lb of baggage aft of seats.
Armament: see remarks under PC-7 entry.

PZL-130 Turbo Orlik

Adaptation of the piston-engine Orlik to turboprop power was initiated in 1985. The third Orlik, fitted with a Pratt & Whitney Canada PT6A-25A turboprop, made its first flight as the Turbo Orlik prototype July 13, 1986, but was lost in an accident early the following year. Development has continued since then with the completion of several further prototypes: a replacement **PZL-130T** with the original Canadian engine; a **PZL-130TM** (first flight January 12, 1989) and a **PZL-130TB** (first flight September 18, 1991), each powered by a 750 shp Czechoslovak Walter (Motorlet) M 601 E. The TB has increased wingspan and incidence, double-slotted flaps, six underwing hardpoints instead of four, a modified ventral fin, ejection seats under a modified canopy, more powerful brakes, nosewheel steering, and a higher gross weight.

The Polish Air Force placed an order in 1991 for up to 48 Turbo Orliks, to be delivered by the end of 1994, but it is not certain whether all have yet been funded. *(Data for PZL-130TB.)*

Contractor: PZL Warszawa-Okecie, Poland.
Power Plant: one Motorlet M 601 E turboprop; 750 shp.
Dimensions: span 29 ft 6¼ in, length 29 ft 6¼ in, height 11 ft 7 in.
Weights: empty 3,527 lb, gross 4,409–5,952 lb.
Performance (at 4,409 lb aerobatic gross weight): max speed at 19,685 ft 311 mph, max speed at S/L 282 mph, service ceiling 33,000 ft, T-O run 729 ft, landing run 604 ft, range on internal fuel (no reserves) 602 miles, *g* limits +6/–3.
Accommodation: crew of two, in tandem. Rear seat raised.
Armament: six underwing hardpoints for up to 1,764 lb of practice bombs, gun and rocket pods, or other weapons training stores.

S312 Tucano

Chosen in 1985 to replace the Royal Air Force's Jet Provost basic trainers, the S312 is a much-modified version of the original Embraer-designed Tucano, having only some 25 percent commonality with its progenitor. It has a different engine, ventral airbrake, strengthened structure, new cockpit layout, and extensive British internal equipment. The first of 130 production **T. Mk 1s** for the RAF flew for the first time on December 30, 1986. Deliveries began in June 1988, and fewer than 20 of the original order now remain to be delivered, although the RAF has options on a further 15. Strengthened flying controls, modified com/nav equipment, and structural improvements to extend fatigue life to 12,000 hours were introduced during the production run, and the first 50 aircraft are being upgraded to the current standard.

The export variant of the S312 can be equipped with an optional stores management system, giving the capability for both weapons training and counter-insurgency missions. Twelve **T. Mk 51s** (first flight October 11, 1989) have been delivered to the Kenyan Air Force, and 16 **T. Mk 52s** (first flight September 21, 1990) to the Kuwait Air Force. *(Data for T. Mk 1.)*

Contractor: Short Brothers plc, UK.
Power Plant: one Garrett TPE331-12B turboprop; 1,100 shp.
Dimensions: span 37 ft 0 in, length 32 ft 4¼ in, height 11 ft 1¾ in.
Weights: empty 4,872 lb, gross 6,470 lb.
Performance: max speed at 10,000 ft 319 mph, max speed at S/L 310 mph, stalling speed (flaps and gear down) 81 mph EAS, service ceiling 34,000 ft, T-O run 1,190 ft, landing run 1,180 ft, range on max internal fuel 1,099 miles, *g* limits +6.5/–3.3.
Accommodation: crew of two, in tandem. Rear seat raised.
Armament (export versions, optional): up to 2,205 lb of stores on four underwing hardpoints: typically two 550-lb or four 290-lb bombs, four 7 x 70-mm rocket launchers, four practice bombs, two 0.50-in or two twin 0.30-in machine-gun pods. Aircraft for Kenya equipped with FN Herstal rocket pods and Forges de Zeebrugge 12.7-mm gun pods.

SF.260TP

More than 60 SF.260TP two/three-seat turboprop trainers have been sold to military operators, most of them with a secondary light attack role. Details have not been provided, but customers are reported to include the air forces of Burundi (four), Brunei (four), Dubai (five), Ethiopia (19), Haiti (six), and Sri Lanka (nine). Twelve SF.260s are believed to have been converted to SF.260TP standard in Zimbabwe.

First flown in July 1980, the SF.260TP is identical to its piston-engine counterpart except for the engine, automatic fuel feed system, and an inset rudder tab. *(Data as for SF.260, except as follows.)*

Power Plant: one Allison 250-B17D turboprop; 350 shp.
Dimensions: length 24 ft 3¼ in.
Weights: empty 1,654 lb, max gross 2,866 lb.
Performance: max speed at 10,000 ft 262 mph, max cruising speed at 8,000 ft 248 mph, stalling speed (gear and flaps down) 79 mph, service ceiling 24,600 ft, T-O run 978 ft, landing run 1,007 ft, max range (with reserves) 589 miles.

T-5

This two/four-seat turboprop primary trainer is the latest of a series of training and utility aircraft developed by Fuji from the Beech T-34 Mentor. The prototype was produced by replacing the standard piston engine of a company-owned KM-2 primary trainer version with an Allison 250 turboprop. First flown on June 28, 1984, as the KM-2D, this aircraft persuaded the Japan Maritime Self-Defense Force to replace its existing fleet of 31 KM-2s with a KM-2Kai version of the KM-2D embodying additional changes to the cabin structure and equipment. Deliveries to the JMSDF, under the designation T-5, began in August 1988. Twenty-four T-5s had been funded by March of this year, of which 15 had been delivered: five more were approved in the FY 1992 budget.

Contractor: Fuji Heavy Industries Ltd, Japan.
Power Plant: one Allison 250-B17D turboprop; 350 shp (flat rated).
Dimensions: span 32 ft 11¼ in, length 27 ft 8¼ in, height 9 ft 8½ in.

S312 Tucano T. Mk 52, Kuwait Air Force

T-34C, Royal Air Force of Morocco (Ivo Sturzenegger)

TB 31 Oméga (Air Portraits)

Weights: empty 2,385 lb, gross 3,494 lb (aerobatic), 3,979 lb (max).
Performance (at aerobatic gross weight except where indicated): max speed at 8,000 ft 222 mph, econ cruising speed at 8,000 ft 178 mph, stalling speed (gear and flaps down) 65 mph, service ceiling 25,000 ft, T-O run 990 ft, landing run 570 ft, range (at max gross weight, with reserves) 587 miles.
Accommodation: crew of two side by side in aerobatic configuration. Second pair of seats behind these in utility version.
Armament: none.

T-34C

The first turboprop-powered YT-34C prototype was flown for the first time in September 1973. About a hundred earlier piston-engine T-34A/Bs are still in service with Argentina (20), Colombia (21), Dominica (10), El Salvador (three), the Philippines (12), Turkey (12), Uruguay (Navy, two), and Venezuela (12 or more).

The Navy received 353 **T-34Cs;** around FY 2000 they will begin to be replaced by the eventual winner of the upcoming JPATS competition which will also replace USAF's veteran Cessna T-37 Tweets. Six T-34Cs went to the US Army, to serve as chase and photographic aircraft for the Airborne Special Operations Test Board at Fort Bragg, N. C.

Beech also built 139 **T-34C-1** armament systems trainers, with FAC and light attack capability, for Argentina, Ecuador, Gabon, Indonesia, Morocco, Peru, Taiwan, and Uruguay. *(Data for T-34C, except where indicated.)*

Contractor: Beech Aircraft Corporation, US.
Power Plant: one Pratt & Whitney Canada PT6A-25 turboprop; 400 shp (550 shp version optional).
Dimensions: span 33 ft 4 in, length 28 ft 8½ in, height 9 ft 7 in.
Weights: empty 2,960 lb, gross 4,300 lb.
Performance: max cruising speed at 17,000 ft 246 mph, stalling speed (gear and flaps down) 61 mph, service ceiling 30,000 ft, T-O run 1,155 ft, landing run 740 ft, max range 814 miles, *g* limits +6/–3.
Accommodation: crew of two, in tandem.
Armament (T-34C-1): four underwing hardpoints for total of 1,200 lb of stores, including practice bomb/flare containers, LAU-32 or LAU-59 rocket launchers, Mk 81 bombs, SUU-11 Minigun pods, BLU-10/B incendiary bombs, AGM-22A wire-guided antitank missiles, and target-towing equipment.

T-35DT Turbo Pillán

The **T-35DT** follows an earlier program in which Soloy Corporation of Olympia, Wash., converted a **T-35TX** prototype of the piston-engine Pillán known as **Aucán** by installing a 420 shp Allison 250-B17D turboprop. This flew for the first time in February 1986, but trials were suspended in 1987 after about 500 flight hours. The T-35DT, which has the same engine, was converted, also by Soloy, under a 1990 contract to develop a production-ready conversion kit to be offered to existing Pillán operators, including the Chilean Air Force. *(Data as for T-35A except as follows.)*

Power Plant: one Allison 250-B17D turboprop; 420 shp.
Dimensions: length 27 ft 7 in.
Weights: empty 2,080 lb, gross 2,900–2,950 lb.
Performance: max speed at S/L 265 mph, max cruising speed at 7,600 ft 209 mph, stalling speed (gear and flaps down) 72 mph, service ceiling 25,000 ft, T-O run 640 ft, landing run 420 ft, max range (with reserves) 472 miles.

TB 31 Oméga

After using the first prototype Epsilon as a test-bed for the Turbomeca TP 319 turboprop engine, Socata introduced additional changes to produce the Oméga. Under the new designation TB 31, it first flew on April 30, 1989. The Oméga retains some 60 percent commonality with the Epsilon but has a more fatigue-tolerant airframe, full IFR instrumentation, a wider maneuvering envelope, optional ejection seats, and a single sideways-opening bubble canopy instead of the Epsilon's separate rearward-sliding hoods. The derated engine offers a substantial power reserve throughout the flight envelope and is equipped with FADEC (full authority digital engine control).

Contractor: Socata, France.
Power Plant: one Turbomeca TP 319-1A2 turboprop; 488 shp (derated to 360 shp).
Dimensions: span 25 ft 11¾ in, length 25 ft 7½ in, height 8 ft 9½ in.
Weights: empty 1,896 lb, gross 3,197 lb.
Performance: max speed at 16,000 ft 322 mph, max cruising speed at 10,000 ft 269 mph, stalling speed (flaps down) 79 mph, service ceiling 30,000 ft, T-O to 50 ft 1,870 ft, range at 20,000 ft (with reserves) 813 miles, *g* limits +7/–3.5.
Accommodation: crew of two, in tandem. Rear seat raised. Martin-Baker Mk 15FC ejection seats optional.
Armament: optional (as for Epsilon). ■

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AIR NATIONAL GUARD

A2A10F**122P0

The British GR. Mk. 1s swept in low, scattering strings of 490 bomblets along the Iraqi runways.

Tornado in the Desert

By Alfred Price

Photo by Paul Jackson

An RAF GR. Mk. 1 named* MiG Eater *sports mission markings from the Persian Gulf War, including three for JP233 raids. Its MiG "kill" came when it sprayed bombs on an Iraqi fighter taxiing for takeoff. Opposite, four RAF Tornados, laden with JP233 containers, refuel from a Victor tanker of No. 57 Squadron.

It was pitch dark at 3:59 a.m. on January 17, 1991, as Wing Cmdr. Ian Travers Smith eased the nose of his Tornado around to align it for the bomb run on Al Asad Airfield. Thundering toward the target at 580 knots, he held the GR. Mk. 1 at 200 feet above the Iraqi desert, using terrain-following radar. Out of sight of the leader, using advanced navigation systems to hold precisely to briefed route and timing points, three other Royal Air Force crews in the formation mimicked his move.

"I had a few problems with my autopilot, so I had to fly the aircraft manually," Wing Commander Travers Smith recalled. "I was head-down in the cockpit as we turned on the IP [initial point] for the target run, which was almost along the line of the valley. Then I looked up, and I couldn't believe my eyes: All of the runway and taxiway lights were on. The entire airfield was lit up. We really had caught them by surprise. I could see my aiming point, no problem at all. We were absolutely spot on; all the symbology was in the right place."

For a Tornado crew to see the target during a low-altitude night attack was an unexpected bonus.

It was also an unnecessary one, for the plane's attack computer had matters well in hand. Wing Commander Travers Smith followed the steering demands. As the aircraft reached the designated weapon release point, just short of the web of taxiways feeding the eastern end of one of the runways, the attack computer transmitted a firing signal to the two JP233 canisters under the fuselage.

As a succession of detonating charges punched the 490 small bombs out of their containers, the overflying Tor-

nado shuddered "like a car driven at sixty miles per hour over a long cattle grid," as the pilot described the experience. Had anyone been in position to see and brave enough to watch, the aircraft would have looked like a spawning salmon releasing her eggs.

As each bomblet left the aircraft, a small parachute opened behind it, killing its forward speed so that it fell vertically to the ground. The munitions were of two basic types. The larger—the SG357 runway-cratering bomb—was the size and shape of a jackhammer without the handles or bit. It weighed fifty-seven pounds. Each time one struck a runway or taxiway, a shaped charge punched a small circular hole in the concrete surface. A fraction of a second later, a secondary warhead was blown through the hole and into the foundation, where it detonated. The force of the secondary explosion, confined between the foundation and the concrete surface, blasted a cavity topped with a circular area of "heave"—cracked and broken concrete pushed up from below. If an aircraft ran over the undermined area, the surface would collapse and the plane would suffer major damage. The Tornado released sixty of these SG357 bomblets in a long line.

Interesting Times

If that were all there was to the JP233 system, Iraqi engineers would have faced a difficult repair problem but would surely have gotten the runways back in operation eventually. However, the role of this weapon is "airfield denial," to render the area unusable for as long as possible. To make repairs difficult and hazardous, the dispenser also released 430 HB876 area-denial mines, each weighing 5.5 pounds, with the cratering bomblets. They ended up scattered across the area and among the rubble. Powerful enough to disable a bulldozer if one tried to push it out of the way or inflict casualties over large distances, these munitions also would become live at random intervals during the days to follow. They would also detonate at random intervals to provide interesting times for anyone trying to clear the area and effect repairs.

Moments after the first bombs detonated, the lights at Al Asad were extinguished and the local Iraqi air defense burst into action. "Until we started to drop the bombs, I don't remember being shot at," Wing Commander Travers Smith continued. "Then, when we were halfway across the airfield, I looked around and saw all these flashing white lights. Not until we were about twenty miles away from the target and on the way out did it dawn on me that the 'flashing lights' had been the muzzle flashes from guns firing at us."

Operation Desert Storm had begun. At Mudaysis Airfield, too, the RAF's Tornado attack force enjoyed the element of surprise right up to the moment of bomb release.

At Tallil, some 200 miles to the east, it was a different story. US Navy A-6 Intruders opened the attack on the airfield, and RAF Tornados arrived eight minutes later. The JP233-equipped aircraft had to attack last, or else the bombs from following aircraft might have detonated the HB876 mines laid across the operating surfaces. The disadvantage of this order of attack, as Tornado crews learned to their discomfort, was that the defenses were thoroughly alerted by the time they ran in to bomb.

Flt. Lt. Rupert Clark described the approach to Tallil. "In the distance, a huge fireworks display lit up the sky to my left, and I saw a couple of missiles going up. I thought, 'Bloody Hell, I'm glad we're not going there!' Then we entered our final turn before the target,

the computer flew the aircraft round the corner, and, when we leveled out, we were pointing straight into the flak—exactly where I didn't want to go. . . . The fireworks display was right over our target, Tallil!"

Filling the Sky With Gunfire

Wing Cmdr. John Broadbent, the navigator in the lead aircraft, had a similar reaction when he saw, straight ahead, what seemed to be a solid curtain of tracers rising to an altitude of about 15,000 feet, plus an enormous amount of what he took to be small-arms fire directed skyward.

Wing Commander Broadbent had a simple answer to this intimidation. He lowered his seat as far as it would go so that the cockpit sides shielded him from the sight. That did not make the tracer go away, but it caused less distraction as he attended to the all-important business of picking out his radar offset points on the screen.

Photo by Paul Jackson

Ending a mission, a GR. Mk. 1 returns to base at Muharraq, Bahrain. Note the ECM pods on outboard pylons, fuel tanks, and Sidewinder near intake. The RAF's Muharraq detachment drew its crews from Nos. 9, 17, 27, 31, and 617 Squadrons.

Photo by Paul Jackson

The Tornado crews' sense of duty and loyalty to their comrades, combined with the instincts imbued during innumerable training attacks, overcame the gut-wrenching fear of having to fly into the blizzard of fire ahead. Mechanical inertia also helped: Unless its pilot took conscious action to turn away, each Tornado would continue its headlong charge over the airfield and release its munitions automatically. Wing Commander Broadbent's force delivered its attack and, as it sped clear of Tallil, a second four-ship formation ran in to attack other parts of the airfield. At Al Taqaddum, within thirty miles of Baghdad, Tornado crews had similar problems attacking a fully alerted target.

After his first experience of combat, Winston Churchill wrote, "Nothing in life is so exhilarating as to be shot at without result." Many a coalition attack crewman learned the truth of that sentiment on the first night. Flying through barrages of unaimed tracer above the Iraqi airfields was an alarming experience, but far less perilous than it appeared at the time. No aircraft was lost in the initial wave of attacks.

Later, satellite photographs revealed that the Tornado crews had laid their JP233 munitions accurately across the airfields at the required points.

GR. Mk. 1 crews in the Persian Gulf area flew as constituted fours as part of composite squadrons based at Dhahran and Tabuk in Saudi Arabia and Muharraq in Bahrain. At Dhahran, the senior flying commander was Wing Cmdr. Jerry Witts, with crews drawn from squadrons 9, 14, 17, and 31. At Muharraq, the senior flying commander was Wing Commander Broadbent, with crews from squadrons 9, 17, 27, 31, and 617. At Tabuk, the senior flying commander was Wing Commander Travers Smith, with crews drawn from squadrons 2, 9, 13, 14, 16, 20, and 617.

Simple, but Hard

The three squadron-sized detachments operated a total of forty Tornado GR. Mk. 1 attack planes. The tactics for attacking airfields with JP233s were simple enough: Crews made a high-speed dash straight across the airfield at night at 200 feet, carrying out a precision weapons drop on the way. It required complex electronic systems and a high degree of training for crews to fulfill that apparently simple task. The Tornado's primary navigation and attack system is the European-built Texas Instruments terrain-following and ground-mapping radar, linked to a three-axis digital inertial navigation system and Doppler radar.

In the course of the war, the GR. Mk. 1 force flew over 1,600 operational sorties and lost six aircraft in

Weapon technicians install the JP233 system on a Tornado. When loaded with a full complement of munitions, each container weighs 5,000 pounds; together the two pack 490 SG357 runway-cratering bomblets and HB876 area-denial mines.

combat, resulting in an overall loss rate of about 0.4 percent. Five crewmen were killed, and seven were taken prisoner.

Some commentators have linked the comparatively high losses suffered by these aircraft to the ultralow-altitude tactics employed when striking at airfields with the JP233 system and implied that this type of attack had inherent weaknesses. The British Ministry of Defence was understandably keen to refute this. It ascribed the series of losses to a "run of bad luck."

The GR. Mk. 1 force flew only about fifty JP233 sorties—fewer than one in every thirty combat sorties. All took place during the first four nights of the conflict.

The first Tornado loss occurred shortly after dawn on January 17. The aircraft was not on a JP233 sortie. Three aircraft, each carrying eight 1,000-pound bombs, ran in to deliver a low-altitude daylight loft attack on hardened aircraft shelters at Ar Rumaylah Southwest Airfield. The standard procedure during this type of attack was to run in at altitudes of 200 feet or below and accelerate to 600 knots. About four miles from the target, the aircraft commenced a four-G pull-up. Bomb release began soon after the aircraft passed through 1,500 feet. When the last bomb had gone, the aircraft was rolled rapidly through 135° and pulled into a tight descending turn. The aim was to present the most difficult target possible to the enemy ground defenses with continual changes in range, azimuth, and elevation.

As the Tornados neared the ground, their bank was progressively reduced until they were heading away from the target in a shallow dive with wings level. As one Tornado was returning to low altitude, it was hit in the rear by a shoulder-launched surface-to-air missile (SAM) and caught fire. Flt. Lts. John Peters and John Nicholl were forced to eject and were taken prisoner.

Never again would Tornados attack a target at low altitude by day.

"Aircraft Down"

On the evening of January 17, after dark, Tornados carrying JP233 systems struck airfields at Tallil (for the second time), Shaibah, Ubaydah Bin Al Jarrah, Wadi Al Khirr, and Al Asad (a second attack, this time with two four-ship formations). At Shaibah, the Tornados already had completed their attack and were forty to fifty seconds into their dash for home when a fireball erupted on the ground and a Tornado crew member called out, "Aircraft down."

The fireball marked the crash site of the No. 3 aircraft, flown by Wing Cmdr. Nigel Elsdon. Both he and his navigator were killed. None of the other crews taking part in the attack saw any indication that No. 3 was being engaged by the enemy immediately before it crashed. There was no radio call, and the reason for the loss is unclear. On the meager evidence available, it appears that the aircraft might have flown into the ground, an ever-present danger during ultralow-altitude operations of this type. In fact, this was the only Tornado lost in action during a JP233 sortie, and the aircraft was several miles from the target area when it crashed.

On the next night, January 18, and into the early morning of January 19, the Tornados used revised tactics during attacks on H-2 and Jallibah Airfields. Four aircraft, each carrying eight VT (radar airburst–fuzed) 1,000-pounders, delivered low-altitude loft attacks on the antiaircraft artillery (AAA) and

RAF Tornados in desert camouflage carry JP233 systems for low-level runway attacks. In their 1,650 Gulf War combat sorties, GR. Mk. 1s attacked with laser-guided Paveway II weapons, ALARM antiradar missiles, and 1,000-pound bombs.

Photo by Paul Jackson

Mission completed, Tornado aircrew members cool off and talk it over with the crew chief. GR. Mk. 1 crews charged into some of the deadliest flak ever seen in war, attacking unsubdued defenses without suffering excessive losses.

SAM positions. Then four aircraft armed with JP233 systems ran in to attack the runways. These tactics would be used during all later JP233 attacks.

On the night of January 19 and early morning of January 20, the RAF again attacked Tallil. Flight Lieutenant Waddington, who flew in the loft bombing force, began his pull-up about three and a half miles from the target. Almost immediately, he noticed that a missile was coming in from directly ahead. Breaking left, he shouted to his navigator, Flt. Lt. Robert Stuart, to drop chaff. Then came a white flash and "the sound of rushing wind," after which Flight Lieutenant Waddington lost consciousness.

Later, in captivity, Flight Lieutenant Waddington learned that his navigator had ejected the pair of them after the aircraft was hit. It is believed that the missile was a Roland.

By the time this attack occurred, the Iraqi Air Force was collapsing under the sustained attack on its airfields and infrastructure and the relentless pursuit and destruction of its aircraft whenever they got airborne. There was little point in continuing to attack runways that the Iraqis were not using, and the final JP233 attack took place on the night of January 20 and early morning of January 21 against Ubaydah Bin Al Jarrah Airfield.

No Explanation

The Tornado GR. Mk. 1s shifted their attack to other targets, but still the force took losses. On the night of January 21–22, another Tornado was lost during an eight-aircraft, low-altitude loft bombing attack with 1,000-pounders on a radar site at Ar Rutbah. No other crew saw the aircraft being engaged before it crashed, there was no radio call, and once again there is no clear explanation for the loss. Low-altitude loft attacks flown on instruments are regularly practiced by Tornado crews, but even in peacetime things sometimes go wrong. Both crewmen, Squadron Leaders Garry Lennox and Kev Weeks, were killed.

Coalition defense-suppression units had neutralized much of the Iraqi long-range SAM threat. To exploit this opening, US Air Force and Navy planes abandoned low-level attacks in favor of attacks from medium altitude, where the aircraft were above the reach of most enemy AAA. Air Vice Marshal Bill Wratten, the British air commander, ordered the Tornado GR. Mk. 1 force to follow the move.

On the night of January 23–24, a Tornado was lost during a medium-altitude attack on Ar Rumaylah Airfield, though the Iraqi defenses played no part in it. Shortly after Flying Officer Simon Burgess and Squadron Leader Bob Ankerson released their eight VT-fuzed 1,000-pounders, one detonated prematurely, seriously damaging the aircraft. Both crewmen ejected and were taken prisoner.

For three weeks the GR. Mk. 1 force suffered no further losses. At the beginning of February, the Tornado force moved to medium-altitude attacks with laser-guided bombs (LGBs) with Buccaneers and Tornados providing laser designation. On February 14, during a daylight medium-altitude LGB attack on Al Taqaddum Airfield by a mixed team of Buccaneers and Tornados, one of the latter was brought down by SAM-3 missiles. Flight Lieutenant Clark, the pilot, ejected and was taken prisoner. His navigator was killed. It was the final GR. Mk. 1 loss of the conflict.

Detailed interviews with many Tornado crew members, including survivors from aircraft that were shot down, show that each aircraft loss had unique features and there was no common factor to link the tactics or weaponry with the known or apparent cause of loss. The "run of bad luck" diagnosis, implausible though it might seem at first, appears to be the most likely explanation.

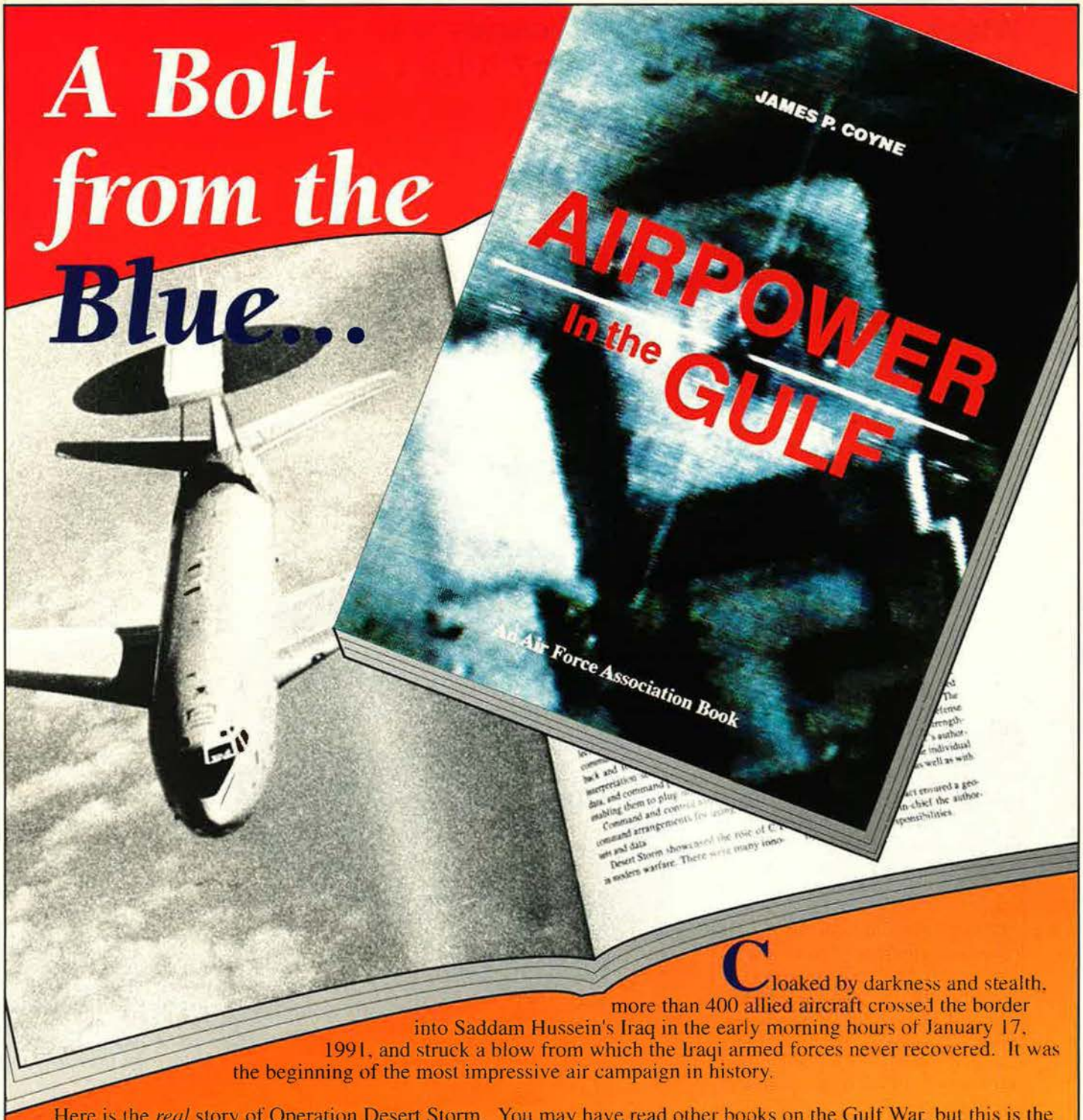
There is no easy way to disable runways at an airfield with strong AAA, SAM, and fighter defenses. Like clearing a minefield under fire, it is one of those military operations in which losses might have to be accepted in order to save more lives later in the engagement. During the Persian Gulf War, the RAF Tornado GR. Mk. 1 force demonstrated that it had the level of training and the determination necessary to perform this task. It conducted missions in the face of unsubdued defenses without excessive losses.

The JP233 system is still a practical weapon, though it was designed in the 1970s and modern technology offers systems that do not require aircraft to overfly the target. As one Tornado pilot commented, "The only thing wrong with JP233 is that it doesn't have a wing on top and a rocket in the back."

When the RAF Tornados returned to the skies over southern Iraq this summer, flying reconnaissance missions, they found that in many cases the damage to runways and taxiways had still not been repaired. ■

Alfred Price flew with the RAF for sixteen years. He has published some three dozen books, including The Spitfire Story, The Last Year of the Luftwaffe, *and* Battle of Britain: The Hardest Day. *His last article for* Air Force *Magazine, which appeared in January 1980, was "Raid 250: Target Berlin," written with Jeffrey Ethell.*

A Bolt from the Blue...



Cloaked by darkness and stealth, more than 400 allied aircraft crossed the border into Saddam Hussein's Iraq in the early morning hours of January 17, 1991, and struck a blow from which the Iraqi armed forces never recovered. It was the beginning of the most impressive air campaign in history.

Here is the *real* story of Operation Desert Storm. You may have read other books on the Gulf War, but this is the one you'll turn to again and again over the years. Veteran fighter pilot Jim Coyne draws on a year's research and almost 200 interviews with participants—the sergeants and the airmen as well as the generals and the captains—to explain how the air campaign was planned, fought, and won. It's loaded with eyewitness reports and first-person accounts.

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by James P. Coyne
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Which unit designations and names will survive the defense drawdown? It isn't an easy decision.

Photos by Paul Kennedy

Squadrons

By George W. Cully

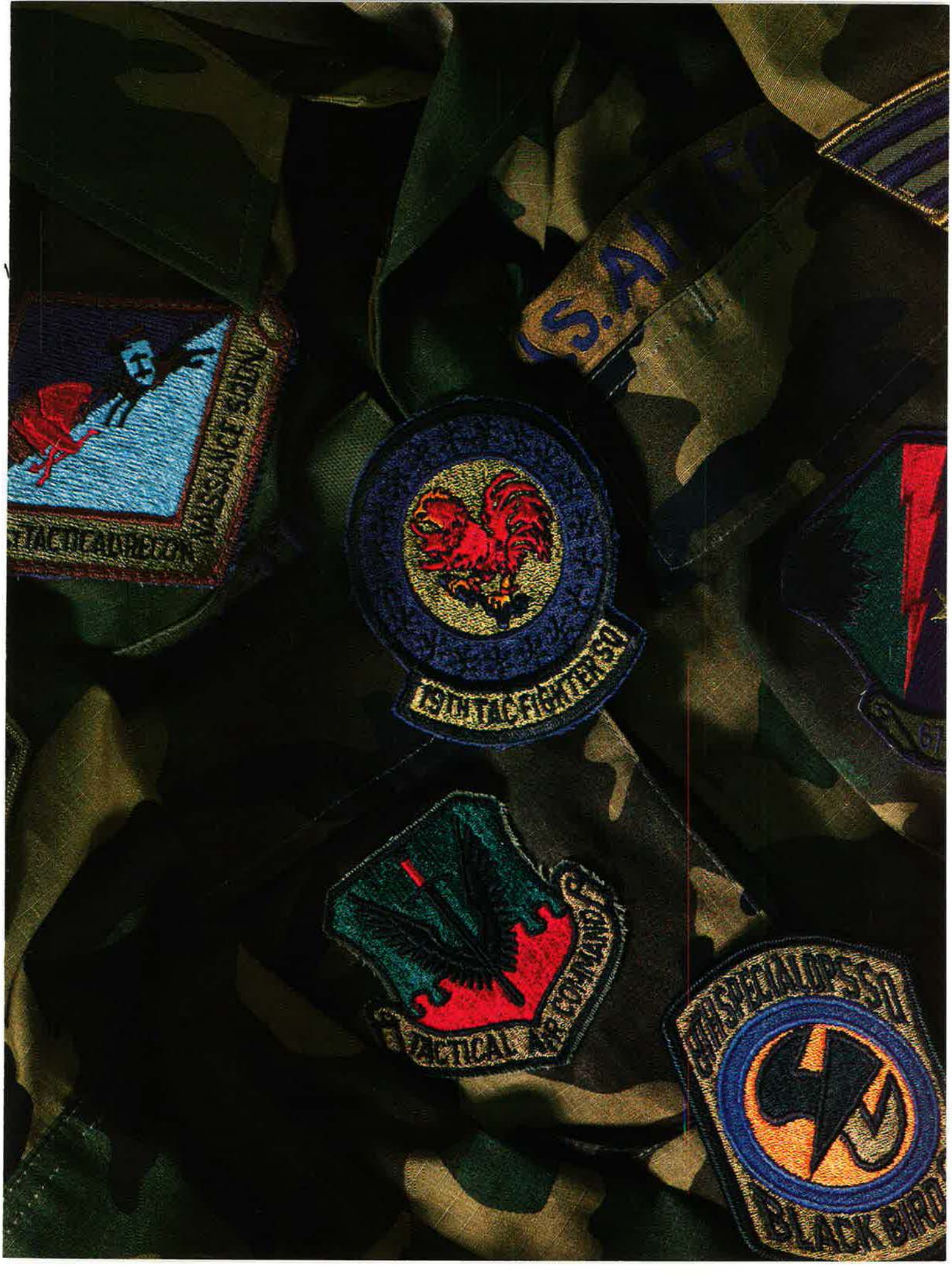
The oldest continuously active flying squadron in the Air Force is the 1st Strategic Reconnaissance Squadron. Currently flying the Lockheed U-2R, it began as the 1st Provisional Aero Squadron in March 1913, flying Curtiss JN-3 Jennies on the US-Mexican border.

Like much of the Air Force, uniform patches are changing. Opposite, clockwise from top left: The 91st Tactical Reconnaissance Squadron's insignia dates to World War I. The 91st last flew RF-4Cs at Bergstrom AFB, Tex., and was inactivated in August 1991. The 19th Fighter Squadron is still part of the 363d Fighter Wing at Shaw AFB, S. C. The 8th Special Operations Squadron has seen its eagle become stylized since it began as the 8th Aero Squadron in 1917. Tactical Air Command's patch has changed also as wings and squadrons changed.

ON THE day it is created, every unit in the Air Force begins to accumulate a lineage—a kind of military pedigree based on the unit's historical origins, length of service, places of assignment, campaigns in which it has served, and honors it has received for valor in battle and achievement in peace.

Lineage rules turn on strict, near-legalistic definitions. A unit's lineage, once established, cannot be awarded to a different unit. As a result, each approved lineage becomes a unique expression of collective bravery, service, and sacrifice. Put another way, unit lineages are the stuff of authenticated legend.

Not surprisingly, long-established Air Force units have a strong interest in their heritage, and they zealously guard the prestige that accompanies a famous ancestry. At present, there are in service fifty-one Air Force and Air National Guard flying squadrons that can trace their lineages to World War I or earlier *[see p. 54]*. Boasts of pioneering exploits can be made by each, beginning with the 1st Reconnaissance Squadron, the oldest, which saw service on the US-Mexican border during 1913–14. At the time, it


TACTICAL AIR CONTROL SQ
BLACK BIRD

was called the 1st Provisional Aero Squadron, one of the first of its kind in the world.

Some of these units continue to carry emblems originally devised in World War I. Two well-known examples are the 94th Fighter Squadron's "Hat in the Ring" and the 95th Reconnaissance Squadron's "Kicking Mules." Units claim famous "Great War" crewmen, like the 94th's Capt. Eddie Rickenbacker, America's leading World War I ace, or 2d Lt. Frank Luke, who scored more than fifteen victories in seventeen days while serving on the Western Front with the 27th Fighter Squadron's original ancestor, the 27th Aero Squadron. Some of these senior units had relatively inauspicious beginnings but went on to greater things. The 30th Aero Squadron, for example, spent World War I in France repairing and overhauling aircraft engines. Most readers will more readily recognize the 30th in its present form as the world-famous USAF Air Demonstration Squadron—the Thunderbirds.

Whatever designations they now carry—fighter squadrons, bombardment squadrons, missile squadrons, and so on—these fifty-one units are direct heirs to some of the longest unbroken histories of group achievement in flight.

Vanishing Organizations

With the Air Force expected to shrink from 200 to 150 active-duty, Reserve, and Air National Guard flying and nonflying wings, many organizations will be redesignated, consolidated, or reassigned. Others will simply disappear. The big drawdown has already brought about inactivation of some long-serving units. One is the 48th Fighter-Interceptor Squadron at Langley AFB, Va., organized as the 48th Aero Squadron on August 4, 1917, at Kelly Field, Tex. Others are the 12th and 91st Reconnaissance Squadrons, Bergstrom AFB, Tex. They were organized, respectively, as the 12th Aero Squadron on June 2, 1917, at San Antonio, Tex., and the 91st Aero Squadron on August 21, 1917, at Kelly Field. These units may someday be reactivated, but for now they exist only as entries on the inactive list.

Every organization in the Air Force fits into one of two categories: unit or establishment. Units are the junior of the two, since they are generally assigned to establishments. Units come in three types: headquarters, squadrons, and miscellaneous. Headquarters units contain the command staff personnel of an establishment; squadrons are the basic working components of all establishments; and miscellaneous units include such organi-

The 27th Fighter Squadron still has the same insignia that adorned this World War I Nieuport 28, photographed somewhere in France. The 27th's sister squadron is the famous 94th "Hat in the Ring" Fighter Squadron, best known as the squadron of Capt. Eddie Rickenbacker. Both belong to the 1st Fighter Wing at Langley AFB, Va.

The insignia of the 37th Bomb Squadron (28th Wing, Ellsworth AFB, S. D.) depicts a growling Bengal tiger. It too has changed little since the squadron began as the 37th Aero Squadron in June 1917.

Patch photos by Paul Kennedy

What's in a Name?

Activate. To bring into physical existence by assigning personnel (from 1922 to 1959, and again after 1968). During 1959–68, "activate" meant to place on the active list, thereby making the unit or establishment available to be organized.

Active list. USAF-controlled and Major Command–controlled units currently in active status, along with all Majcom-controlled units awaiting activation.

Assign. To place a unit in a military organization as a permanent subordinate element or component of that organization. A unit is customarily assigned to an establishment, never to another unit.

Attach. To place one military organization with another temporarily for operational control or other purposes, such as administrative or logistical support.

Consolidate. To combine two units, merging their lineage and histories into those of a single unit.

Constitute. To create a unit and place it on the inactive list, thus making it available for activation.

Designate. To give an official name, or name and number, to an organization. Differently named organizations on the active list may bear the same designation number, *e.g.*, 1st ACCS and 1st RS.

Disband. To remove an inactive USAF-controlled unit from the inactive list, thereby ending its existence.

Disestablish. To terminate an establishment concurrent with disbandment of its headquarters unit, whereupon the establishment returns to the inactive list until such time as it may be reconstituted (see "constitute").

Establish. To assign a designation to an establishment concurrent with the designation (1947–48) or the constitution (1922–47 and 1948–present) of the headquarters unit.

Establishment. A military organization at group or higher echelon, composed of a headquarters unit and any other elements that might be assigned. Personnel are assigned to an establishment's elements, rather than directly to the establishment itself.

Inactivate. To withdraw all personnel from the headquarters unit and place the establishment and its headquarters unit on the inactive list. From 1959 to 1968, however, to be inactivated meant to be transferred from the active list to the inactive list.

Inactive list. Those organizations that have been constituted but are not in active status.

Organize. In the early Air Force, to designate and activate a unit; later, to bring a previously designated, nonconstituted unit into physical existence by assigning personnel.

Provisional organizations. Units or establishments to which subordinate organizations may be attached but not assigned. Provisional organizations are intended to be temporary and thus are not ordinarily entitled to a lineage of their own.

Redesignate. To change the designation (number or number and name) of both the establishment and its headquarters unit, or of a unit.

Reestablish. To return a previously existing establishment from disestablished status to the active list so it can be activated.

Relieve from active duty. To return a Reserve unit to its original status on completion of an extended active-duty period with the Air Force.

Unit. An Air Force numbered flight, squadron, miscellaneous unit (such as a hospital, band, etc.), or the headquarters of a group or higher organization. Detachments and provisional units are not ordinarily entitled to a separate lineage or battle honors.

zations as hospitals, bands, and so on.

Establishments differ from units in that no personnel are directly assigned to them. Instead, the staff personnel of, say, Air Combat Command (an establishment) are assigned to Headquarters, ACC (a unit). A group is generally the lowest-level establishment. Lower-level establishments are assigned to higher-level ones—for example, groups to wings, wings to numbered air forces, numbered air forces to commands, commands to Headquarters, USAF. This arrangement—units reporting to establishments, subordinate establishments to superior ones—constitutes the chain of command, through which all control and accountability flow.

At any given time, hundreds of organizations are in active service, while many more paper organizations exist only in inactive status. Each unit must be identified in a unique fashion to avoid confusion and preserve historical continuity. This is done through a system of rules and definitions called lineage.

A Complicated Task

Determining a given organization's lineage requires systematic tracing of all actions that have affected the organization's status through its entire service, including those times it has been inactive, disbanded, or disestablished. These actions are defined in ways that may seem arcane to the nonspecialist, but each term has a specific meaning *[see box at left]*.

This task can be complicated because definitions have changed over time and because units and establishments have different lineage terminologies. Units are created, or "constituted," by Headquarters, USAF, and assigned to commands or operating agency establishments for activation. Thereafter, a unit's existence continues until it is disbanded, even if it is redesignated (given a new number or functional name) or inactivated in the meantime. A disbanded unit may be reconstituted, meaning that it resumes existence with its previous lineage restored intact, or it may be consolidated with another unit, in which case its lineage merges with the receiving unit's lineage to combine the accomplishments of both.

Establishments, on the other hand, are established by Headquarters, USAF, and they continue to exist until they are disestablished. They may also be redesignated or inactivated; once disestablished, they may be reestablished with a restored lineage. Establishments may be consolidated with other establishments. In such cases, the new organization inherits the combined lineages of the respective headquarters units.

Finally, there is the matter of provisional organizations. These are temporary units or establishments. Though they have many administrative characteristics of permanent organizations, they are intended to exist only so long as a given operation requires. Unit detachments or rotating temporary duty personnel normally are attached, rather than assigned, to provisional establishments, and there is no lineal relationship between a provisional orga-

nization and its regular replacement, even if no actual change of personnel or location takes place during the turnover.

When he became Air Force Chief of Staff in October 1990, Gen. Merrill A. McPeak applied his long-standing personal interest in unit history and heraldry to the task of maintaining *esprit de corps* in the face of major organizational change. General McPeak initiated a revitalization of the unit heraldry program. He renewed the emphasis on unit lineage to underscore his desire that Air Force members see themselves as warriors rather than as technical specialists. By regulation, responsibility for both unit history and heraldry falls to the Air Force Historical Research Agency (AFHRA) at Air University, Maxwell AFB, Ala.

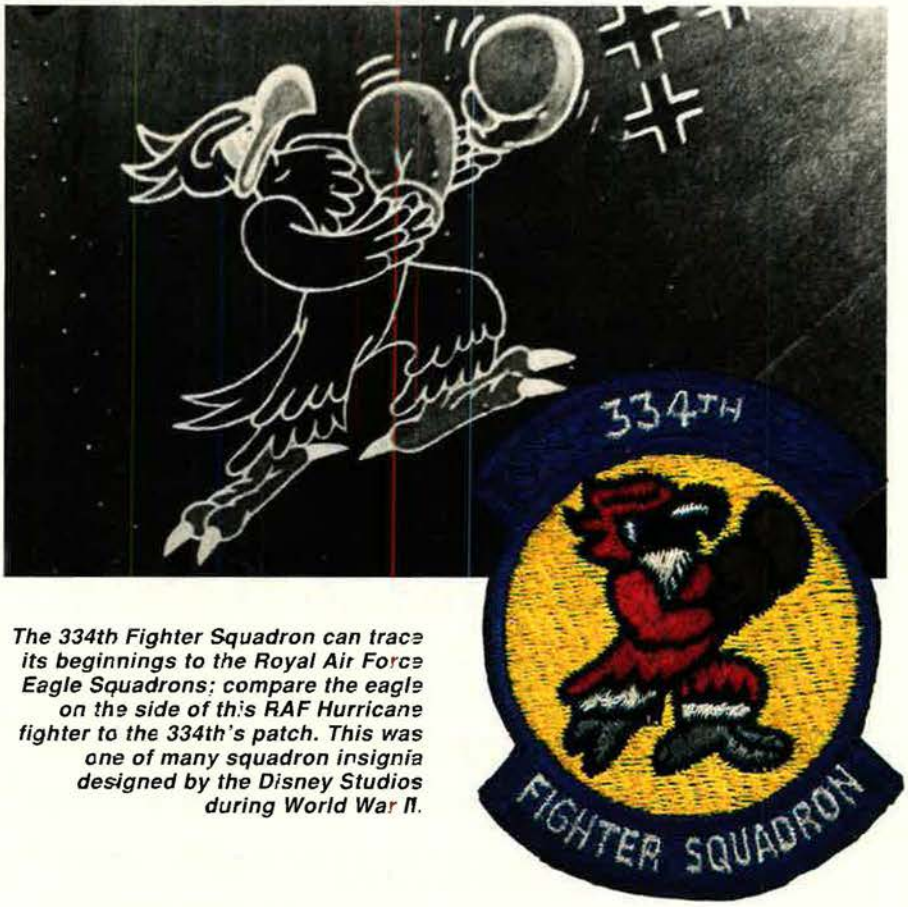
Experts at AFHRA deal with a wide variety of lineage issues. They use a sixty million–page collection of unit histories and other source documents to generate and maintain unit lineage and honors statements—official determinations of the lineage and awards to which each USAF unit is entitled. (ANG lineage issues are resolved by the Air National Guard Bureau.) When a new unit is constituted, or when an inactive unit is reactivated, AFHRA advises the unit of its entitlements. AFHRA also coordinates its lineage determinations with the Air Force Military Personnel Center at Randolph AFB, Tex. AFMPC ensures that units receive formal authorization to display the battle honors and campaign awards they have earned.

The Rules Bend—Sometimes

As the arbiters of USAF lineage matters, AFHRA experts occasionally find themselves at odds with commanders seeking to improve the standing of their organizations by misapplying lineage definitions or by seeking exemptions from certain rules. However, the definitions have become well settled, and most commanders eventually agree that consistent application is vital.

Even so, Air Force officials on occasion have set aside the rules because of policy. In the late 1940s, for example, the Air Force examined various arrangements for restructuring its operations. That reorganization was subject to a mix of politics and economics that, in some ways, resembles today's circumstances.

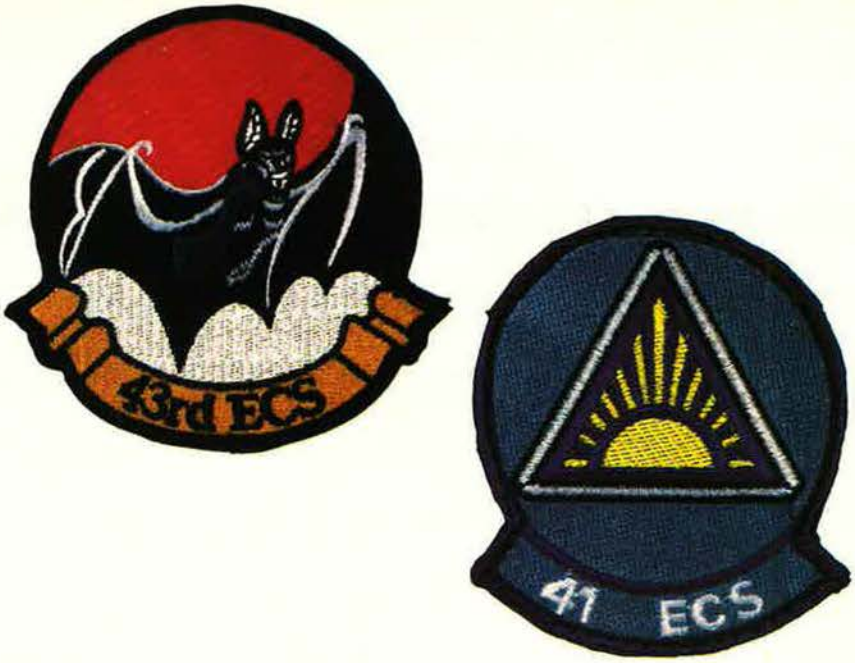
The key question was whether the wing or the combat group would be the primary building block of the postwar Air Force. After considerable experimentation (and a few false starts), the existing wings were restructured and redesignated as divisions. These



The 334th Fighter Squadron can trace its beginnings to the Royal Air Force Eagle Squadrons; compare the eagle on the side of this RAF Hurricane fighter to the 334th's patch. This was one of many squadron insignia designed by the Disney Studios during World War II.

The 25th Flying Tactics Training Squadron's executioner (far left, in his Strategic Training Squadron guise) is the same pleasant fellow who was painted on the unit's SE-5 biplanes in 1917 when it was the 20th Aero Squadron. Along with the searchlights that spell out the Roman numeral IX, the 9th Bomb Squadron's patch originally showed a small town's skyline and the biplane the lights were looking for.

Patch photos by Paul Kennedy



The missions of some squadrons have changed greatly over the years. The Compass Call EC-130H aircraft flown by the 41st Electronic Combat Squadron (355th Fighter Wing, Davis-Monthan AFB, Ariz.) are a far cry from the observation balloons it flew as the 4th Balloon Squadron in 1917, though its insignia has changed very little. The 43d ECS, another 355th FW squadron, also dates from 1917, when it was the 86th Aero Squadron.

divisions were assigned to the active numbered air forces, and new wings were established and activated to replace them. Gradually, combat squadrons were assigned directly to the new wings. This arrangement was viewed as an efficiency measure. It made combat groups redundant, and USAF began to inactivate them in 1952.

It soon dawned on many, however, that this process had inadvertently created a lineage problem: Strictly speaking, the new wings were not entitled to claim the lineages (and, more important, the accompanying battle honors and campaign streamers) of the famous World War II combat groups they had previously owned. This was unacceptable, and USAF's leadership resolved the matter by decreeing that the honors of combat groups would be assigned to like-numbered wings, regardless of customary practice.

By contrast, the Air Force has often rigorously enforced the rules despite the existence of a good argument that they should be bent. During the Vietnam War, for example, Strategic Air Command's bomb and refueling wings were required to send large contingents and numerous aircraft overseas to provisional wings controlled by Pacific Air Forces. These contingents conducted Arc Light air strikes over South Vietnam and, later, Operation Linebacker II raids over North Vietnam. It has been said that the numbers involved were such that, in an earlier time, they would have been considered unit deployments. Only a handful of officers and enlisted troops stayed behind to maintain the fiction that the units were still in the United States.

Unfortunately, battle honors that might accrue to a provisional wing cannot be transferred to the permanent units that support it. As a result, SAC's "heavies" received no battle honors for their participation in the Vietnam War. Given the losses and the scale of effort involved, many believed that an exception to the rules was in order.

Operation Desert Storm also saw some use of in-theater provisional wings. AFMPC has not announced what battle honors will be awarded or how they might be apportioned among the organizations that participated. It remains to be seen whether there will be a repeat of the Vietnam War battle honor experience.

Given the likelihood that long-standing units will be caught in the force drawdown, discussions of lineage seniority and ownership have intensified, especially within the fighter community, and various officers have studied ways to quantify a unit's standing. One concept envisions a seniority value based on factors of varying weight. Included in the calculation would be length of service, battle honors and campaign awards, aerial victory credits, and the like. The idea is, unless overriding factors intervene, to inactivate those wings with the least illustrious histories first, thereby preserving the fame and prestige of the longer-serving outfits. Officers of Tactical Air Command (before it was merged into Air Combat Command on June 1) and US Air Forces in Europe drew up their own seniority lists, but no consensus has emerged on how points or credits should be assigned, especially with regard to comparisons between units with very different backgrounds.

Many Air Force organizations—more than 300 tactical units alone, by a recent count—have already been redesignated or reassigned, and this process will continue as more bases close and US forces are brought home from overseas. The composite wing concept is also affecting the kinds of designations being given to units. The bottom line is that virtually every organization in the Air Force is going to change the way it operates, and most will change their names to reflect that process. ■

George W. Cully is a recently retired Air Force captain. He is now Senior Research Associate of Aerohistory Associates, based in Montgomery, Ala. This is his first article for AIR FORCE *Magazine.*

The Oldest Squadrons

Active-Duty, Air Force Reserve

Squadron	Establishment	Origin	Organized
1st Reconnaissance Squadron	9th Wing, Beale AFB, Calif.	1st Provisional Aero Squadron, Texas City, Tex.	March 5, 1913
2d Air Refueling Squadron	480th Air Refueling Group, Barksdale AFB, La.	1st Company, 2d Aero Squadron, Rockwell Field, San Diego, Calif.	December 1, 1915
3d Fighter Training Squadron	343d Wing, Eielson AFB, Alaska	3d Aero Squadron, Fort Sam Houston, Tex.	November 1, 1916
911th Air Refueling Squadron	4th Wing, Seymour Johnson AFB, N. C.	16th Aero Squadron, Camp Kelly, Tex.	May 15, 1917
33d Fighter Squadron	363d Fighter Wing, Shaw AFB, S. C.	33d Aero Squadron, Camp Kelly, Tex.	June 12, 1917
35th Fighter Squadron	8th Fighter Wing, Kunsan AB, South Korea	35th Aero Squadron, Camp Kelly, Tex.	June 12, 1917
36th Fighter Squadron	51st Wing, Osan AB, South Korea	36th Aero Squadron, Camp Kelly, Tex.	June 12, 1917
25th Flying Tactics Training Squadron	99th Tactics & Training Wing, Ellsworth AFB, S. D.	20th Aero Squadron, Camp Kelly, Tex.	June 13, 1917
USAF Air Demonstration Squadron	57th Fighter Wing, Nellis AFB, Nev.	30th Aero Squadron, Camp Kelly, Tex.	June 13, 1917
31st Test and Evaluation Squadron	USAF Air Warfare Center, assigned to Edwards AFB, Calif.	31st Aero Squadron, Camp Kelly, Tex.	June 13, 1917
32d Air Refueling Squadron	22d Air Refueling Wing, Barksdale AFB, La.	32d Aero Squadron, Camp Kelly, Tex.	June 13, 1917
37th Bomb Squadron	28th Wing, Ellsworth AFB, S. D.	37th Aero Squadron, Camp Kelly, Tex.	June 13, 1917
43d Fighter Squadron	3d Wing, Elmendorf AFB, Alaska	43d Aero Squadron, Camp Kelly, Tex.	June 13, 1917
9th Bomb Squadron	7th Wing, Carswell AFB, Tex.	9th Aero Squadron, Camp Kelly, Tex.	June 14, 1917
19th Fighter Squadron	363d Fighter Wing, Shaw AFB, S. C.	14th Aero Squadron, Camp Kelly, Tex.	June 14, 1917
27th Fighter Squadron	1st Fighter Wing, Langley AFB, Va.	21st Aero Squadron, Camp Kelly, Tex.[1]	June 15, 1917
17th Fighter Squadron	363d Fighter Wing, Shaw AFB, S. C.	29th Aero Squadron, Camp Kelly, Tex.	June 16, 1917
23d Bomb Squadron	5th Wing, Minot AFB, N. D.	18th Aero Squadron, Camp Kelly, Tex.	June 16, 1917
8th Special Operations Squadron	1st Special Operations Wing, Hurlburt Field, Fla.	8th Aero Squadron, Camp Kelly, Tex.	June 21, 1917
28th Bomb Squadron	384th Wing, McConnell AFB, Kan.	28th Aero Squadron, Camp Kelly, Tex.	June 22, 1917
11th Missile Squadron	341st Missile Wing, Malmstrom AFB, Mont.	11th Aero Squadron, Camp Kelly, Tex.	June 26, 1917
20th Bomb Squadron	7th Wing, Carswell AFB, Tex.	20th Aero Squadron, Camp Kelly, Tex.	June 26, 1917
49th Test and Evaluation Squadron	USAF Air Warfare Center, assigned to Barksdale AFB, La.	49th Aero Squadron, Kelly Field, Tex.	August 6, 1917
55th Fighter Squadron	20th Fighter Wing, RAF Upper Heyford, UK	55th Aero Squadron, Kelly Field, Tex.	August 9, 1917
43d Electronic Combat Squadron	355th Fighter Wing, Davis-Monthan AFB, Ariz.	86th Aero Squadron, Kelly Field, Tex.	August 17, 1917

87th Flying Training Squadron	47th Flying Training Wing, Laughlin AFB, Tex.	87th Aero Squadron, Kelly Field, Tex.	August 18, 1917
436th Training Squadron	Hq. Air Combat Command, stationed at Carswell AFB, Tex.	88th Aero Squadron, Kelly Field, Tex.	August 18, 1917
90th Fighter Squadron	3d Wing, Elmendorf AFB, Alaska	90th Aero Squadron, Kelly Field, Tex.	August 20, 1917
94th Fighter Squadron	1st Fighter Wing, Langley AFB, Va.	94th Aero Squadron, Kelly Field, Tex.	August 20, 1917
95th Reconnaissance Squadron	9th Wing, stationed at RAF Alconbury, UK	95th Aero Squadron, Kelly Field, Tex.	August 20, 1917
99th Reconnaissance Squadron	9th Wing, Beale AFB, Calif.	99th Aero Squadron, Kelly Field, Tex.	August 21, 1917
1st Airborne Command and Control Squadron	55th Wing, Offutt AFB, Neb.	Company A, 2d Balloon Squadron, Fort Omaha, Neb.	September 25, 1917
41st Electronic Combat Squadron	355th Fighter Wing, Davis-Monthan AFB, Ariz.	Company A, 4th Balloon Squadron, Fort Omaha, Neb.	November 13, 1917
77th Fighter Squadron	20th Fighter Wing, RAF Upper Heyford, UK	77th Aero Squadron, Waco, Tex.	February 20, 1918
79th Fighter Squadron	20th Fighter Wing, RAF Upper Heyford, UK	79th Aero Squadron, Waco, Tex.	February 22, 1918

Air National Guard

Squadron	Assigned to	Origin	Organized
119th Fighter Squadron	177th Fighter Group, Atlantic City, N. J.	5th Aviation School Squadron, Langley Field, Hampton, Va.	June 5, 1917
110th Fighter Squadron	131st Fighter Wing, St. Louis, Mo.	110th Aero Squadron, Kelly Field, Tex.	August 14, 1917
111th Fighter Squadron	147th Fighter Group, Ellington ANGB, Tex.	11th Aero Squadron, Kelly Field, Tex.	August 14, 1917
112th Fighter Squadron	180th Fighter Group, Swanton, Ohio	112th Aero Squadron, Kelly Field, Tex.	August 18, 1917
101st Fighter Squadron	102d Fighter Wing, Otis ANGB, Mass.	101st Aero Squadron, Kelly Field, Tex.	August 22, 1917
102d Rescue Squadron	106th Rescue Group, Suffolk, N. Y.	102d Aero Squadron, Kelly Field, Tex.	August 23, 1917
113th Fighter Squadron	181st Fighter Group, Terre Haute, Ind.	113th Aero Squadron, Kelly Field, Tex.	August 26, 1917
105th Airlift Squadron	118th Airlift Wing, Nashville, Tenn.	105th Aero Squadron, Kelly Field, Tex.	August 27, 1917
106th Reconnaissance Squadron	117th Reconnaissance Wing, Birmingham, Ala.	106th Aero Squadron, Kelly Field, Tex.	August 27, 1917
107th Fighter Squadron	127th Fighter Wing, Selfridge ANGB, Mich.	107th Aero Squadron, Kelly Field, Tex.	August 27, 1917
108th Air Refueling Squadron	126th Air Refueling Wing, Chicago, Ill.	108th Aero Squadron, Kelly Field, Tex.	August 27, 1917
109th Airlift Squadron	133d Airlift Wing, Minneapolis–St. Paul, Minn.	109th Aero Squadron, Kelly Field, Tex.	August 27, 1917
115th Airlift Squadron	146th Airlift Wing, Channel Island ANGB, Calif.	115th Aero Squadron, Kelly Field, Tex.	August 28, 1917
120th Fighter Squadron	140th Fighter Wing, Buckley ANGB, Colo.	120th Aero Squadron, Kelly Field, Tex.	August 28, 1917
116th Air Refueling Squadron	141st Air Refueling Wing, Fairchild AFB, Wash.	116th Aero Squadron, Kelly Field, Tex.	August 29, 1917
118th Fighter Squadron	103d Fighter Group, Windsor Locks, Conn.	118th Aero Squadron, Kelly Field, Tex.	August 31, 1917

This list is limited to continuously active flying units, each of which can trace its lineage to a forerunner unit organized before or during World War I. Information is current as of July 31, 1992.

[1]Redesignated 27th Aero Squadron June 23, 1917.

USAF Human Systems Checklist

Work in progress at Air Force Materiel Command's Human Systems Center, Brooks AFB, Tex., and at Armstrong Laboratory, Brooks AFB and Wright-Patterson AFB, Ohio

Edited by Tamar A. Mehuron, Associate Editor

Human Systems Program Office

ACES II Advanced Recovery Sequencer
Program to develop improved sequencing/sensing system for the Advanced Concept Ejection Seat II. The system will expand the performance envelope of the seat, will be reliable and maintainable, and will reduce life-cycle cost. **Contractor:** McDonnell Douglas (MD). **Status:** Engineering development.

Active Noise Reduction
Investigation of a new electronic approach to noise attenuation in aircrew helmets to reduce hearing loss and improve communications capability. **Contractors:** Bose, Ketron. **Status:** Engineering development.

Advanced Technology Anti-G Suit
Program to develop an extended-coverage anti-G suit to replace the CSU-13 series anti-G suits. This new anti-G suit will reduce fatigue induced by sustained high accelerations and allow the aircrew member to extend the time spent in a high-G environment during flight. **Contractor:** To be determined (TBD). **Status:** Pre-Engineering and manufacturing development.

Advanced Training System
Program to develop for Air Training Command's Training Centers an interactive computer support system capable of performing and unifying training, development, delivery, testing, and evaluation. With special emphasis on improving training for wartime and sortie generation, ATS will have an impact on the electronic and mechanical specialties, which have expanding training requirements. **Contractors:** IBM, SAIC. **Status:** Engineering and manufacturing development (EMD).

Aircraft Mishap Prevention
Program to develop a centralized human factors database. AMP will operate jointly with other human factors–related databases, as well as research, literature, and abstract services. The program provides for analysis, identification, and dissemination of human factors–related trends for reducing aircraft mishaps. **Contractor:** ETA. **Status:** EMD.

Aircrew Chemical/Biological Ensemble
Initiative to develop a new aircrew chemical defense ensemble with improved chemical protection and reduced thermal load. **Contractor:** TBD. **Status:** Follow-on production.

Aircrew Eye-Respiratory Protection
Program to replace the MBU-13/P chemical/biological oxygen mask with an improved system. Final objective is to equip all crew members in all aircraft with a chemical defense capability. **Contractor:** TBD. **Status:** Follow-on production.

Automatic Life Preserver
Development, design, and qualification of an automatic water-actuated inflator for existing LPU-G/P life preservers. Procurement of 4,195 life preservers. **Contractor:** S-Tron. **Status:** Production.

Automatic Liquid Agent Detector
Program to provide a small, lightweight, rugged unit to detect falling liquid chemical agents and activate audible and visible alarms. **Contractor:** Arvin Calspan Corp. **Status:** Production.

Automatic Mustard Agent Detector
Program to provide an off-the-shelf detector that will automatically activate alarms in the presence of mustard agents. System may add on to the currently fielded M8A1 or stand alone. **Contractor:** TBD. **Status:** Preproduction planning.

Base Training System
Initiative to develop computerized training management and to optimize methods for on-the-job training for both military and civilian members of the Department of Defense. **Contractor:** MD. **Status:** EMD.

Chemical Defense Ground Crew Ensemble
Program to design and develop a one- or two-piece clothing configuration with hood to provide liquid, vapor, and aerosol protection. It also would reduce thermal stress, provide limited flame protection, and be washable and decontaminable. **Contractor:** TBD. **Status:** EMD in Fiscal 1993.

Chemically Hardened Air Transportable Hospital
Program to provide capability for front-line medical personnel to deploy, set up, and operate in high-threat chemical environments. Aim is to provide immediate and improved treatment of troops to increase personnel return to combat units and unit combat effectiveness and to reduce permanent injuries. **Contractors:** Many. **Status:** Prototype and initial production.

Civil Reserve Air Fleet Aeromedical Evacuation Shipsets
Program to convert commercial Boeing 767 aircraft to aeromedical evacuation platforms by removing airline interiors and installing litter stanchions, liquid oxygen converters, and electrical power converters. **Contractor:** E-Systems. **Status:** Production.

Clothing Branch
Program executes all aspects of research and development on uniform items from concept to phaseout, including test and evaluation, development of specifications, value engineering, and quality assurance. **Contractor:** Red the Uniform Tailor. **Status:** EMD.

Combat Edge
Investigation of methods to provide fighter pilots with enhanced protection against the effects of Gs and to improve pilot endurance using a Pressure Breathing for G System that reduces dependence on the anti-G straining maneuver. **Contractors:** Boeing, General Dynamics (GD). **Status:** Production.

Combat Survivor/Evader Locator
Program to develop an extended-range survival radio with geolocation capability and low probability of intercept and detection. The system may include airborne and/or space-based relay platforms as well as ground stations. **Contractor:** TBD. **Status:** Cost and operational effectiveness analysis.

Crew Casualty Assessment Process
Development of a system to determine the type, severity, and probability of physical injury that humans will sustain when exposed to the mechanical forces of weapons. This system will be one element of a DoD-accredited vulnerability assessment process chartered under a joint JTCG/AS/ME working group. **Contractor:** BDM International. **Status:** System requirements analysis.

Disposable Eye-Respiratory Protection
Program to develop an inexpensive, compact, disposable mask to be used for short-term chemical/biological protection. **Contractors:** Mine Safety Appliance, ILC Dover, National Draeger. **Status:** EMD.

Lightweight Helmet Development
Development and procurement of a lightweight helmet designed for improved stability in the high-acceleration environment. **Contractor:** Gentei Corp. **Status:** Production.

Maintenance Skills Tutors
Program to develop computer-based training systems that use artificial intelligence to teach advanced troubleshooting skills to improve tactical air forces maintenance. **Contractor:** TBD. **Status:** Pre-EMD.

Multifunction RADIAC Equipment
Production program to provide an off-the-shelf radiological detector for replacement of the currently fielded suite of nonsupportable RADIAC instruments. Detector will activate alarms in the presence of alpha, beta, gamma, and X radiation. **Contractor:** TBD. **Status:** Preproduction planning.

Night Vision System
Development of a low-profile night vision system to enable aircrews to see outside the aircraft despite limited illumination while retaining the capability to monitor cockpit displays. System will be ejection-safe. **Contractor:** TBD. **Status:** Source selection.

Operational Support System
Program to support Threat-Related Attrition System application validation efforts and to conduct concept exploration activities associated with employment of the THREAT System to support Air Force contingency and wartime operation planning requirements. **Contractor:** BDM International. **Status:** Ongoing.

Passenger Smoke and Fume Protection
Development of a device that provides supplemental oxygen for rapid-decompression/oxygen-deficient situations and eye and respiratory protection for passengers aboard AMC aircraft. **Contractor:** TBD. **Status:** Conceptual study.

Pilot Candidate Selection Method
Program to develop hardware and software evaluation capability to select the most capable flight-training candidates. Payoffs include selection of highest-quality pilots, reduced attrition, optimal assignment, and decreased training costs. **Contractor:** CTA. **Status:** Production.

Spinal Cord Injury Transport System
Program to develop and procure standard-of-care transport system for aeromedical evacuation of spinal cord injury patients. **Contractor:** TBD. **Status:** Pre-EMD.

Thermal Flash Blindness Protection
Development of systems to protect aircrews from permanent and temporary flash blindness effects associated with nuclear detonations. **Contractor:** TBD. **Status:** Ongoing.

Threat-Related Attrition (THREAT) System
Development of a system for Air Force planners and programmers to estimate personnel attrition due to conventional and nonconventional attacks on air bases, diseases, and accidents. **Contractor:** BDM International. **Status:** Concept exploration and demonstration/validation.

Transportable Blood Transshipment Center
Program to develop a transportable modular facility for in-theater rechilling or refreezing of human blood and blood products en route to worldwide theaters of military operations or disaster areas. **Contractor:** Arthur D. Little, Inc. **Status:** Full-scale engineering development.

Transportable Collective Protection System
Program will provide mobile system to personnel that offers a toxic-free work, rest, and relief environment. May provide chemical protection to bare bases and deployed and detached units. **Contractor:** ILC Dover. **Status:** Production.

Universal Water-Activated Release System
Program to provide the crew member an automatic backup parachute release capability that will release the parachute canopy upon entry into saltwater. **Contractor:** Conax Florida Corp. **Status:** Ongoing development.

Vacuum-Packed One-Man Life Raft
Development of a zero-leak life raft inflation system to be used on current life rafts. Procurement of 1,450 vacuum-packed systems for use by ACC, AFRES, and ANG. **Contractor:** Conax Florida Corp. **Status:** Production.

Wartime Medical Planning System
Development of automated system analysis tools for the Air Force Surgeon General to allow planners to evaluate selected medical system options against threats to US air bases and to validate wartime medical force structure and assemblages. **Contractor:** BDM International. **Status:** Advanced development.

Water-Activated Mask Release System
Program to develop and field a water-activated oxygen mask release system. This system will complete the antidrown triad and enable the unconscious or incapacitated aircrew member to breathe. **Contractor:** H. Koch & Sons. **Status:** Engineering development.

Armstrong Laboratory

Advanced Aircrew Vision Protection
Advanced Technology Transition Development (ATTD) program to reduce risk of eye damage and visual performance loss due to exposure to adverse environmental conditions (lasers, dust, etc.). **Contractor:** Krug International. **Status:** Ongoing.

Advanced Technology Anti-G Suit
ATTD program to demonstrate technology employed in a full-coverage anti-G suit directed toward decreasing fatigue, increasing endurance, and ultimately decreasing the probability of G-induced loss of consciousness. **Contractor:** Krug International. **Status:** Ongoing.

Aeromedical Neuropsychiatric Standards
Evaluation and application of research techniques in neuro-behavioral science applied to the flying population. Active studies on aviator suicide, ten-year psychiatric outcomes, seizure risk after head injury, and new cognitive assessment tests. **Contractor:** TBD. **Status:** Ongoing.

Aeromedical Visual Standards
Development of new techniques for visual-disease detection, epidemiological studies of visual disorders, and development and evaluation of optical devices that may enhance or protect visual performance in the flying population. **Contractor:** TBD. **Status:** Ongoing.

Assessment System for Aircraft Noise
ATTD program to provide Air Force environmental and airspace planners the technology to develop technically sound and legally defensible noise elements in environmental documents prepared to assess military flight activities. **Contractor:** BBN System Technologies. **Status:** Ongoing.

Basic Job Skills
ATTD program to develop computer-based trainers to accelerate learning of troubleshooting skills by aircraft maintenance technicians. **Contractor:** University of Pittsburgh. **Status:** Ongoing.

Clinical Consult Service
The Consult Service evaluates more than 700 grounded aircrew members each year, returning, on average, 72 percent to flying duties. Research is conducted on aviator selection and retention standards, using data from the world's largest aviator database. Consultation requests are received from all elements of the Air Force Medical Service. **Contractor:** In-house. **Status:** Ongoing.

Crew Protection and Life Support
Basic, applied, and advanced research to ensure effectiveness and safety of aircrew personnel exposed to mechanical stresses, including acceleration, aerodynamic forces, impact, transient thermal energy, and vibration. **Contractors:** Many. **Status:** Ongoing.

Crew Systems Design Techniques
Program to develop design and evaluation criteria for display and control technologies to improve crew member/avionic system interface. Intermediate products include helmet-mounted display (HMD), quick disconnect system, and specifications for testing HMD and miniature cathode-ray tubes. **Contractors:** Many. **Status:** Ongoing.

Drug Testing
Supports the DoD objective of maintaining a drug-free, mission ready force. Advanced laboratory technology is used for more than 800,000 tests annually on 250,000 specimens. **Contractor:** In-house. **Status:** Ongoing.

Early Disease Detection
Research to detect significant asymptomatic illness in otherwise healthy flying population. Aerospace Medicine Directorate operates 23 study groups to follow disease conditions over time to learn their operational significance. **Contractor:** TBD. **Status:** Ongoing.

Epidemiological Research
Provides worldwide reference laboratory service; provides support to DoD and the Air Force Surgeon General for epidemiological and preventive medicine/disease surveillance; and collects, analyzes, and interprets health data on Air Force populations. More than 2.5 million procedures were performed in FY 1991, expanding services to 85 medical treatment facilities. **Contractor:** In-house. **Status:** Ongoing.

Hyperbaric Medicine
Develops and provides hyperbaric medicine advanced training, education, and application. **Contractor:** In-house. **Status:** Ongoing.

Information Integration Technology
ATTD program to develop and demonstrate a prototype integration information system to store design, manufacturing, and logistics data and make it easily available on-line to Systems Program Offices and Air Logistics Centers. **Contractor:** Knowledge Based Systems, Inc. **Status:** Ongoing.

Integrated Maintenance Information System
ATTD program that uses computer technology to provide rapid access to all information needed for a particular maintenance job. **Contractor:** GD. **Status:** Ongoing.

Intelligent Computer–Assisted Training Test-Beds
ATTD project to create, evaluate, and demonstrate a capability to rapidly develop and deliver effective simulation-based intelligent tutoring systems for equipment-related tasks. **Contractors:** University of Southern California, GSA. **Status:** Ongoing.

Interim Night Integrated Goggle and Helmet Tracker Systems
ATTD program to demonstrate ejection-compatible night vision and integrated helmet-mounted display system. **Contractor:** MD. **Status:** Ongoing.

Logistics Systems Technology
Development of models to aid logistics personnel and designers with computer-aided design and computer-aided modeling. Aim is to produce an integrated maintenance information system that interacts with the aircraft and the maintenance technician to permit faster repair of the aircraft and higher sortie-generation rates. **Contractors:** GDE, Logicon. **Status:** Advanced development.

Manpower Personnel Training Decision Support System
ATTD program to develop a family of analysis tools for weapon system planners and designers, Systems Program Offices, and Majcoms to ensure mission capable systems at the lowest life-cycle costs. **Contractor:** Dynamics Research. **Status:** Ongoing.

Multiship Training Research and Development
ATTD project to develop, demonstrate, and document training value and performance requirements for microprocessor-based, selective fidelity aircrew training devices and distributed simulation networks. **Contractors:** General Electric, University of Dayton Research Institute. **Status:** Ongoing.

Night Vision Goggle/Head-Up Display
ATTD program to demonstrate technology leading to the replacement of current unsafe/non-ejection-compatible NVG systems. Goal is to increase safety and situational awareness in night flight. **Contractor:** In-house. **Status:** Ongoing.

Noise
Development of models on the effects of noise and sonic boom on humans, animals, and structures. Supports development of Environmental Impact Assessments. **Contractors:** Many. **Status:** Ongoing.

Occupational and Environmental Health
Program to provide consultative support to Air Force bases through telephone consultations and on-site visits. Consultation is provided in occupational medicine, ergonomics, hearing conservation, radiation monitoring, safe drinking-water standards, environmental compliance, and hazardous-waste disposal and minimization. **Contractors:** Many. **Status:** Ongoing.

Operator/System Interfaces
Exploration of ways to improve aircrews' ability to perform under challenging operational conditions. Technologies include active noise reduction, voice communication countermeasures, helmet-mounted system technology, night vision goggles, and display systems. **Contractors:** Many. **Status:** Ongoing.

Radiation
Program of studies on the biological effects of electromagnetic and ionizing radiation. Supports program offices in ensuring appropriate safety measures in design of systems producing radiation. **Contractors:** Many. **Status:** Ongoing.

Selection and Classification Technology
Development of the Air Force Officer Qualifying Test, used with other criteria for selection of officers for the Air Force, and development of the Basic Attributes Test, a battery of psychomotor, cognition, and effectiveness tests, for selection and classification of pilot candidates. **Contractors:** Metric, CTA. **Status:** EMD, advanced development.

Simultaneous Engineering Technology
ATTD program to develop and demonstrate computer tools to integrate logistics support, training needs, and costs seamlessly into the design process. **Contractors:** GD, Rockwell International. **Status:** Ongoing.

Technical and Aircrew Training Technologies
Program to develop intelligent computer–assisted training devices for basic skills enhancement, single-job tutors for flight-line maintenance personnel, intelligent instructional software for technical training instructors, multiship training devices and HMDs for various aircrew members. **Contractors:** Lehigh University, University of Texas at San Antonio, GD, Boeing, General Electric, Rockwell. **Status:** EMD, advanced development.

Toxicology
Program to provide toxicological evaluations of Air Force chemicals and materials, studies to support program offices in evaluating the risk to human health of new materials under development, and development of a pharmacokinetics model to allow assessment of a chemical based on its structure and activity. **Contractors:** Many. **Status:** Ongoing. ■

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■ Golf Tournament

AFA's Central Florida Chapter will sponsor a golf tournament on Walt Disney World's Magnolia and Palm Courses on Wednesday, February 3. **Contact** Robert E. Ceruti **407/365-1519.**

■ Gala

The Chapter will sponsor its ninth annual black-tie Gala on Friday, February 5. Proceeds will benefit AFA's Aerospace Education Foundation as well as AFROTC scholarships and other aerospace education activities. **Contact** Thomas M. Churan **407/365-8330.**

■ Exhibits and Displays

For each Gala table purchased, companies will be allowed 100 square feet of exhibit space. Exhibits will be on display during the two-day Symposium and Gala. **Contact** Pat Teevan **703/247-5836.**

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Moscow is aggressively marketing air-to-ground weapons, including such Western look-alikes as "Harpoonski," "HARMski," and "Maverickski."

The Fire Sale on Russian Missiles

By David R. Markov

RUSSIA has produced a wide range of fighters armed with sophisticated air-to-air and air-to-surface weapons and is making these integrated systems available on the open market at fire-sale prices. Much is known about the air-to-air missiles. Until recently, however, the West was largely ignorant about Russia's air-to-surface weapons.

That's all changed. At the Dubai Air Show, held last December, Russia publicly exhibited, for the first time, late-model precision guided munitions (PGMs). Western analysts gathered valuable data. The latest Moscow Air Show, held in mid-August at the Gromov Flight Research Institute, revealed still more.

What emerges from a lengthy review of these two events is a portrait of advanced systems that should give the West pause. The precision arms on display duplicate Western capabilities. Most startling are the huge size, heavy warheads, and astonishing speed of the missiles. Also of note is the ability of a single Russian weapon to perform missions across a range of targets. This flexibility—provided by the diverse guidance-seeker packages—is attractive for cash-poor countries looking to get the biggest bang for the buck.

The upshot, in the view of many analysts, is the near-certain proliferation of these weapons. This should greatly concern the United States, whose forces will face hostile nations possessing increasingly potent attack capabilities.

The biggest exhibitor of air-to-ground weaponry was the recently formed missile production consortium Spetztekhnika. This organization was brought into being by a major reshuffling of the Russian aerospace industry, intended to make it more export- and market-oriented. It is a composite firm comprising a number of former missile design bureaus and producers.

One of the more innovative members is Zvezda, a design bureau responsible for the development of tactical air-to-surface missile weaponry. Among the more important weapons developed by Zvezda and displayed at the Moscow Air Show were derivatives of the Kh-35 antiship tactical missile, the Kh-31 air-to-surface missile, and the Kh-29/25 air-to-surface missile.

The Kh-35 multipurpose antiship tactical missile was publicly displayed

The Kh-31 (opposite), on display in the West for the first time at the Farnborough Air Show, virtually matches the capabilities of the AGM-88 High-Speed Antiradiation Missile. It is also available in an antiship variant.

Staff photo by Guy Aceto

for the first time in Moscow. This missile is produced in three variants—an antiship missile for use in an environment of heavy electronic countermeasures (ECM); an around-the-clock, standoff, surface-attack missile for destruction of surface and above-water targets; and a simulator of Western antiship missiles for training and air defense system testing.

The "Harpoonski"

Westerners gave the Kh-35 the nickname "Harpoonski" in recognition of its similarity to the US Navy's 150-mile-range AGM-84D Harpoon antiship missile and AGM-84E Harpoon air-to-surface weapon, also known as the Standoff Land-Attack Missile. The Russians, like their US counterparts, found that an inexpensive, high-precision, remotely guided, air-launched weapon with a long range and conventional warhead was required to engage fixed targets outside the lethal range of air defense systems. Such a missile would be intended to destroy such fixed targets as weapon storage facilities, power stations, and bridges.

The Kh-35 in its many variants is twelve feet long, compared to the seventeen-foot Harpoon, and 1.4 feet in diameter, compared to the one-foot-wide Harpoon. The maximum speed of the missile exceeds 671 miles per hour, compared to the Harpoon's 647 mph. The Kh-35 variants have a total missile weight of 1,058 pounds, compared to 1,730 for the Harpoon. The warhead size is the same for all three Kh-35 variants, 320 pounds, in contrast to the 500-pound Harpoon warhead. The Kh-35 has a range of from 3.1 miles to eighty-one miles, depending upon the variant. The Harpoon's range is sixty to 150 miles.

The guidance unit for the antiship Kh-35 uses an inertial navigation system coupled with an active radar seeker to find the target in the terminal engagement phase. The air-to-surface Kh-35 variant uses an inertial thermal imaging system to engage fixed-site surface targets. At the Moscow Air Show, the Kh-35 was carried on dedicated naval tactical aircraft and displayed in front of the MiG-27K, the navalized version of the "Fulcrum." It can also be carried on the navalized Su-27K "Flanker."

"HARMski" is the name attached to another Russian weapon, the Kh-31, which was displayed in Dubai in an antiradiation role only. This system is similar in capability to the US Standard or AGM-88 HARM antiradiation missiles. Exhibitors' brochures state that there are four variants of the missile:

- A precision weapon for destruction of active radars of all types of medium- to long-range air defense systems, including US Patriot control and warning radars.
- An air-to-air, passive/active, radar-guided missile to attack early warning AWACS-type aircraft and low maneuvering long-range aircraft.
- A standoff antiship missile to strike maritime targets in heavy ECM environments.
- An antiradiation missile simulator for training and air defense system testing.

The HARMski in its many variants is seventeen feet long and 2.5 feet in diameter. The maximum speed of the missile is 2,237 mph. The Kh-31 weighs 1,323 pounds, except for the antiship variant, which weighs 1,443 pounds. The warhead size is the same for all variants—198 pounds.

A Weapon for Many Aircraft

The Kh-31 has a range from 3.1 to 43.4 miles, depending on the variant.

Photos by David R. Markov

Zvezda, an innovative designer for the market-oriented military consortium Spetztekhnika, has produced both the Kh-35 (above), which resembles the US Harpoon, and the Kh-25MP (below), with capabilities similar to the Maverick.

The US HARM AGM-88 weighs about 800 pounds with a 146-pound warhead, is fourteen feet long, and has a range of more than ten miles. The Kh-31 can be carried on the MiG-21 "Fishbed," MiG-23/27 "Flogger," Su-24M "Fencer," MiG-29M/K Fulcrum, Su-27M/K/KU/UB Flanker, and Yak-141M "Freestyle."

The antiship variant, the Kh-31A supersonic all-weather antiship missile, was displayed for the first time in Moscow. The basic Kh-31 was modified to conduct antiship missions, making it the world's first supersonic antiship missile designed specifically for use on tactical aircraft. The Kh-31A can be carried on the Su-24M, MiG-29M/K, Su-27M/K/KU/UB, and Yak-141M.

Variants of the Kh-29 missile, known widely in the West as the AS-14 "Kedge," were not displayed, but brochures provided more specific operational data on technical characteristics. This system is similar to the US Maverick (thus the name "Maverickski") in that it has two different guidance seekers for the missile. One, a passive fire-and-forget television guidance, is found on the Kh-29T. The other, a semiactive laser seeker, can be found on the Kh-29L.

The Kh-29T is tied to an aircraft cockpit display and can either be fired and forgotten or directed to a target through the pilot's TV display. The Kh-29L semiactive laser homing missile can be carried on the Su-24M, MiG-29M/K, Su-27M/K/KU/UB, and Yak-141M, as can the T variant.

The Kh-29T weighs 1,543 pounds, and the Kh-29L weighs 1,455 pounds. Both have a 705-pound penetrating warhead designed to attack missile-hardened shelters, runways, large bridges, and industrial facilities. Both are thirteen feet long and 1.3 feet in diameter and have a minimum/maximum range of 1.2 to nineteen miles. In contrast, the Maverick has a launch weight of 662 pounds, a much smaller 298-pound blast fragmentation warhead, and a range of only 0.6 to fourteen miles.

Another Like Maverick

The Kh-25 is an example of first-generation Russian precision guided munitions and was designed by the Zvezda Design Bureau. This family of missiles currently equips many Russian attack aircraft and was on display. Like the Kh-29, the Kh-25 resembles the US Maverick with its multiple guidance seekers to perform different missions. The Kh-25 family comprises the laser-guided Kh-25ML (six to twelve mile range), the anti-radiation Kh-25MP (twenty-five miles), and the radio command–guided Kh-25MR (six miles).

The Kh-25MR, at 705 pounds, differs in launch weight from the other two versions, which weigh 661 pounds each. However, all three missiles have a 200-pound warhead. The maximum speed varies, from the Kh-25MR's 2,013 mph to 1,900 mph for the Kh-25ML and Kh-25MR.

The Kh-25MP is the longest member of the family at fourteen feet, while the Kh-25ML and the Kh-25MR are thirteen feet long. All three missiles are eleven inches in diameter. The US Maverick is closer in capabilities to this missile family than to the Kh-29.

Brochures handed out by Zvezda also indicated several modifications under developmental consideration for the Kh-25 missile family. These would include the addition of a television-guided seeker and an imaging infrared guidance seeker. The Kh-25 family is carried on many older aircraft platforms, such as the MiG-21, MiG-23/27, Su-17M, and Yak-38. The Kh-25 was also observed on newer planes such as the Su-24, Su-25, MiG-29, and Yak-141M.

Another unit of the consortium Spetztekhnika, the Raduga Design Bureau, develops antiship and fixed-target missiles. In Moscow, Raduga displayed its Airborne Supersonic Missile (ASM-MSS) and a new-generation air-launched cruise missile. These

Photo by David R. Markov

The 1,235-pound KAB-500Kr is a television-guided aerial bomb designed to destroy stationary targets with its 837-pound warhead. Its cousin, the KAB-1500L-Pr, can pierce targets encased in up to seven feet of concrete.

arms represent new and unique capabilities for tactical Russian carrier aircraft, such as the MiG-29K and Su-27M/K/KU/UB, and for landbased bombers, such as the Su-24M and Tu-22M "Backfire."

The ASM-MSS was displayed under the two centerline pylons on the Su-27K Naval Flanker, wedged between the engine inlets. The missile uses a rocket/ramjet propulsion system to reach Mach 3 at high altitude. This is by far the largest antiship missile currently deployed on any tactical naval aircraft in the world. The brochures touted the ASM-MSS's ability to attack carrier battle groups, amphibious groupings, convoys, or single ships in a heavy ECM environment. Currently it can be carried only on the Su-27K and Tu-22M aircraft. It could be modified to attack fixed-site surface targets.

The ASM-MSS is thirty-two feet long, and its body diameter is 2.5 feet. The missile weighs a whopping 9,921 pounds and contains a 705-pound penetrating warhead. Its range, ninety-three miles, can be increased to 155 miles when flown on high-altitude cruise with a thirty-mile low-altitude terminal phase. It travels at Mach 3 at high altitude and Mach 2.1 at sea level. The ASM-MSS relies on a navigation and internal control system to guide it to the target and uses an active/passive radar seeker in the midcourse and terminal phases to acquire the target.

Russia's Conventional ALCM

A line drawing of an air-launched cruise missile also appeared in the literature handed out by Spetztekhnika. This missile would be launched from an aircraft against a stationary ground target with known coordinates, such as a powerplant. This system is similar to the US conventionally armed AGM-86C air-launched cruise missile (ALCM), which was first used operationally in Operation Desert Storm.

Both the US and Russian missiles are twenty feet long and two feet in diameter. The Russian missile weighs 2,756 pounds, while its US counterpart weighs 3,200 pounds. The Russian missile can carry cluster munitions or a 904-pound penetrating warhead, similar to the 1,000-pound high-explosive blast fragmentation warhead of the AGM-86C. Launch range qualities are similar, 311 to 500 miles, as are the missiles' cruising speeds, which are 365 and 568 mph.

The missile would be guided to its target by an inertial, Doppler-based, terrain-following, and space navigation system and would have a circular error probable of nine feet. The AGM-86C uses both a terrain-following map system and the Global Positioning System for guidance updates, which is similar to the Russian system. No aircraft platforms for this missile were designated, but the Tu-160 "Blackjack," Tu-142M "Bear," Tu-22M3 Backfire, Su-24M Fencer, and possibly Su-27M/K/KU/UB Flanker could carry this missile.

In addition to air-to-surface missiles, the Russians displayed and discussed a family of heavy guided bombs, several examples of which were loaded on, and displayed in front of, the Su-25 and MiG-27 attack aircraft.

One of these, the KAB-500Kr, is a television-guided, aerial bomb designed to destroy stationary targets that require the bomb to penetrate concrete. These include bridges, fortifications, and runways. The bomb is ten feet long and one foot in diameter. The KAB-500Kr weighs 1,235 pounds and has a concrete-piercing warhead weighing 837 pounds. The bomb can be launched from altitudes of 0.3 to 3.1 miles and is able to fly at speeds ranging from 341 to 682 mph.

Another GBU-type weapon, the KAB-1500, has two models that use a semiactive laser vane-type seeker and have the same launch altitude and speed as the KAB-500Kr. The KAB-1500L-Pr is designed to destroy small, deep, extremely hard targets, such as reinforced concrete fortifications, nuclear weapon storage facilities, and command posts. The warhead can penetrate soil to a depth of sixty-six feet and pierce reinforced concrete to a depth of seven feet.

The KAB-1500L-F is designed to destroy ground targets like military-industrial facilities, concrete fortifications, and other hardened targets. Both models of this bomb are fifteen feet long and two feet in diameter. This bomb weighs 3,439 pounds and has a blast warhead weighing 2,601 pounds. Both models of the KAB-1500 are unlike any Western GBU. Their closest counterpart is the GBU-28/B, which weighs 4,700 pounds and was used for the first time in the Persian Gulf War.

Like the United States, Russia has begun developing, producing, and selling precision weapons to the world at large. With trade in such weapons likely to expand, a continued understanding of these weapons and their capabilities is vital to the planning, preparations, and conduct of any future conflicts with nations that have these devastating weapons. ■

David R. Markov is on the staff of the Institute for Defense Analyses in Alexandria, Va.

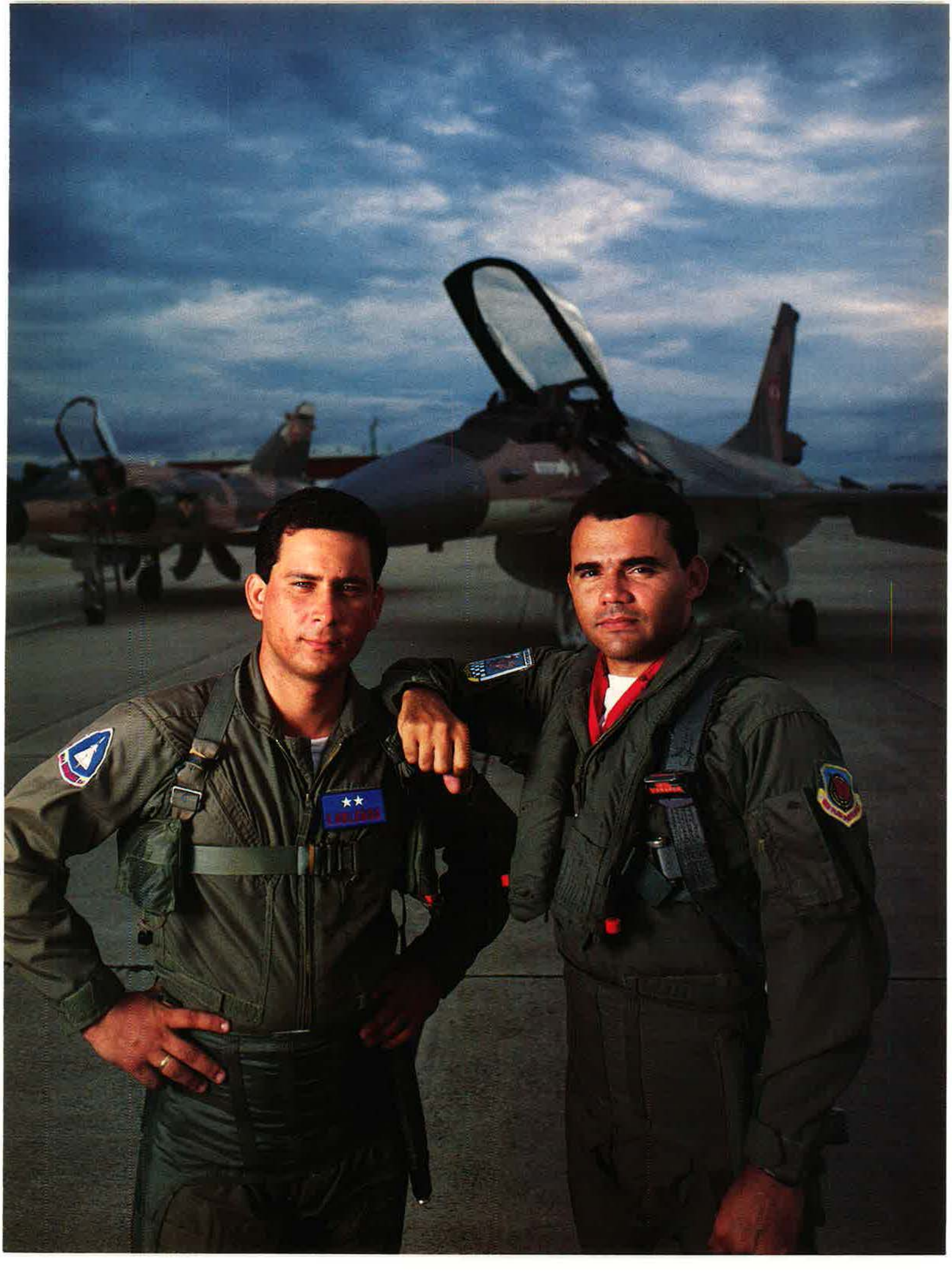
This South American nation has flown F-16s for almost a decade without a major mishap.

Venezuelan Falcons

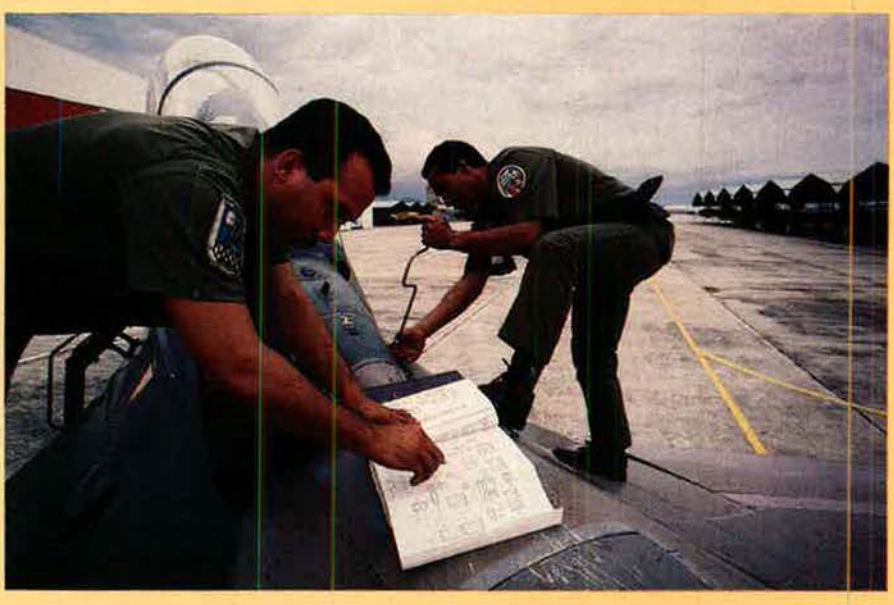
Photographs by Lans Stout

Though it rarely finds its way into US headlines, oil-rich Venezuela (a founding member of OPEC) wields significant power in an important region. Group 11 Mirage pilot Lt. Francesco Orlando (opposite, left) and Group 16 F-16 pilot Capt. Eli LaBarca helped build ties between this South American nation and the US by taking part in a Red Flag exercise at Nellis AFB, Nev., where they quickly established a reputation for aggressive tactics.

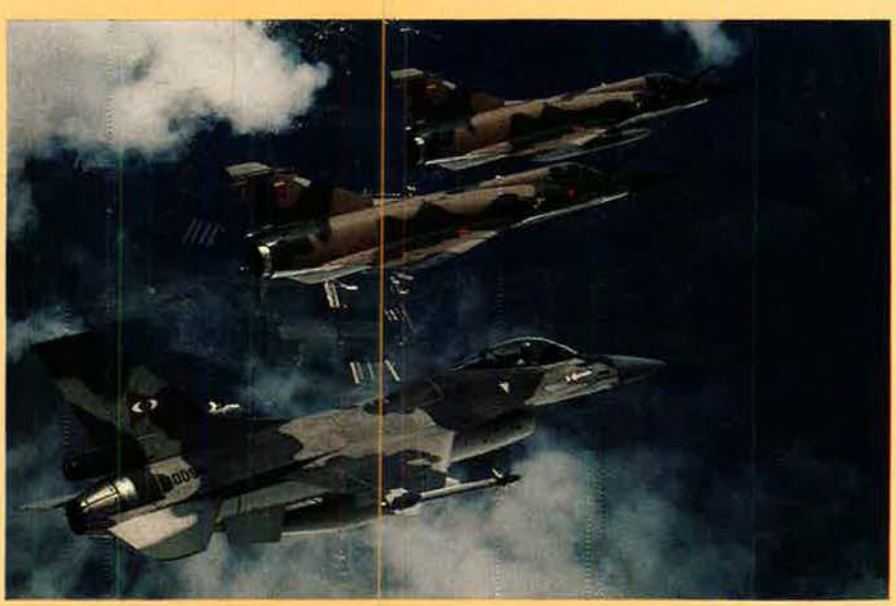
Dense forests, Andean highlands, and wide plains are all part of the varied geography in a nation about twice the size of California. Above, a Venezuelan Air Force F-16 and Mirage zip through a mountain pass. The F-16, a little slower but much more agile, is used mostly as a multirole fighter and for ground support, while the Mirage shoulders much of the burden for intercept and bombing missions. Right, an F-16 banks out of Base Liberator near Maracay City (about fifty miles west of Caracas).



Maj. Hector Diaz (right) uses the international language of hand flying during a postflight debrief with Lt. Manuel Ramirez under a flight-line shade that protects them from the equatorial sun. Below, maintainers labor to keep an F-16 in top shape. The VAF has racked up ten years of mishap-free flying in the F-16—a tribute to the skills of Venezuelan maintainers in a challenging environment.



Squadrons of F-16s and Mirages flying out of the same base at Maracay make for some healthy intraservice rivalry. Venezuela's twenty-two Mirages were recently upgraded to the 50EV standard, which boasts improved avionics and powerplants and added canards. Its twenty-four F-16s will soon receive an Operational Capabilities Upgrade.



Above, Air Force Reserve A-10s from the 930th Fighter Group at Grissom AFB, Ind., flew nonstop to Maracay to train with the Venezuelan F-16s. The nation's sparsely populated interior permits lots of low flying over long distances. The A-10 pilots were impressed by the VAF's aggressiveness, and the Venezuelans admired the A-10's close air support capabilities.

Photos © Lans Stout

Col. Arturo Garcia is the commander of Group 16. In 1983, he was part of the first group of six Venezuelans to visit Luke AFB, Ariz., for flight training in the F-16. He led his squadron back to the US this year for participation in Red Flag at Nellis AFB. The Venezuelans flew nonstop with the aid of a VAF-modified Boeing 707 tanker, which made a good impression on their hosts at Nellis. Colonel Garcia views international cooperation as the linchpin of security. "South America, North America, it is all America," he says. "Democracy is what we all have in common."

The Air Force needs these technologies for its own use, but many of them will also have commercial spinoffs.

Look What the Labs Are Cooking Up

By James Kitfield

WHEN your sunglasses automatically turn a shade darker to adjust to the glare of bright sunlight, think of the Air Force.

The folks at Air Force Materiel Command would say the same to the sports fan flicking through scores of TV channels courtesy of direct satellite links, the airline passenger enjoying the comfort of travel on a jumbo jet, and the transatlantic telephone caller whose connection is crystal clear thanks to fiber-optic lines.

Just think of the Air Force, because one of its laboratories produced the enabling technology behind each advancement.

It's a story that often goes untold. Officials at AFMC are intent on correcting this oversight. "We haven't done a good job in the past of publicizing the advances in technology that have come as a result of Air Force research," says Gen. Ronald Yates, AFMC's commander. The General, whose headquarters is at Wright-Patterson AFB, Ohio, says that the service is emphasizing the potential commercial applications of basic research.

"Dual use of Air Force research by both the military and commercial sectors of the nation is more important than ever," says General Yates. "National strength involves not only military strength but also economic strength, and the importance of maintaining our position as a world economic leader has come into sharp focus for the Air Force."

That theme was recently highlighted when officials of AFMC previewed some of their most promising research at the Air Force Association's National Convention last September in Washington, D. C. The underlying technology promises to lead not only to a far more capable Air Force but also to commercial spinoffs that could boost US companies.

Advances in optical signal process-

ing, for instance, could vastly improve both military target identification and tracking and industrial parts inspection by US industry. Laser-aided telescopes that can accurately measure atmospheric distortion and improve communications with Air Force satellites are already helping astronomers explore uncharted expanses of the universe. Portable laser medical packs promise to aid medics in cauterizing wounds and stabilizing patients on battlefields and at civilian accident sites of the future. New computer-based aircraft maintenance systems will become common on military and commercial flight lines around the world, as well as in auto repair shops. Processes to encourage the appetite of pollution-eating bacteria may become standard at environmental cleanup sites of the future.

The Premier Technology

The twentieth century has been dominated by electronics. Given recent advances, however, some scientists believe that the premier technology of the next century will be optics. One of the believers is Dr. Joseph Horner of the Air Force's Rome Laboratory, Griffiss AFB, N. Y. Dr. Horner, who works at a Rome branch at Hanscom AFB, Mass., is an expert on optical signal processing.

The military need that is driving optical signal processing is automatic target recognition and tracking, whether it involves a pilot searching for a Scud missile launcher or a cruise missile homing on a target. Present systems use electronics and microprocessing, breaking down data gathered by sensors into digital code processed by a computer. However, today's systems are overmatched by the extremely high closing speeds of modern aircraft and missiles and by the huge amount of information that must be processed quickly. The effectiveness of these systems is limited by the relatively slow computing speed and processing capability of on-board computers.

By contrast, optical processing systems more closely resemble the interface between the eye and the brain. The eye takes in an entire, three-dimensional scene at once and transmits that image to the brain. If the brain recognizes a general pattern stored under the heading of "tree," or "automobile," or "Scud," then it automatically identifies it as a match.

"Though the technology is in its infancy, optics have the advantage of inherently operating in three dimensions, which more accurately reflects our world," says Dr. Horner. With optics, he says, there's no need to break down each object in the field of view into zeroes and dots that must be reassembled by a computer. "Once you can see the target, and you have the right filter, this system literally works at the speed of light."

Though it may sound simple in theory, this ability to "see" the target in a meaningful way and match it against stored memory for possible "recognition" hinges on the confluence of some very sophisticated technologies. To solve the "vision thing," Dr. Horner says, he and other scientists are conducting optical signal processing experiments using holographic devices, photorefractive optics, and phase-only filter correlators. They are further along, he says, in developing filters for stored pattern recognition.

Also highly promising is the industrial potential of such optical signal processing. That probably explains, says Dr. Horner, why Japanese scientists have taken an especially keen interest in this technology, as have US firms. "When you take applications such as industrial inspection, you often find that digital equipment is just not fast enough," says Dr. Horner. "With an optical system, once you have the right filter, you can instantly identify a defective part coming off an assembly line."

Solving a Centuries-Old Problem

The Air Force has long needed to image, track, communicate with, and collect data from its extensive network of satellites. AFMC officials at the AFA Convention disclosed that much of this work is conducted at the Starfire Optical Range in the southeast corner of Kirtland AFB, N. M.

The central problem facing Air Force personnel at Starfire was one that has confounded astronomers for centuries: atmospheric turbulence. Light from astronomical objects can travel millions of miles without distortion in the vastness of space, only to be skewed in the fraction of a second it takes to travel the last few miles through Earth's relatively dense atmosphere.

Enter laser guidestar adaptive optics, developed at the Air Force's Phillips Laboratory. By using light from a bright star, or "guidestar," scientists can measure with a wavefront sensor the distortions caused by the atmosphere. If no bright star exists in the section of sky they want to explore, researchers can generate an artificial guidestar by focusing a powerful laser beam in the atmosphere. Feedback on atmospheric distortions then goes into a high-speed computer, which corrects the distortions by adjusting a deformable mirror inside the telescope. The result is a telescope operating near its theoretical resolution limit—a revolutionary development.

"Every time we point our telescope to a new area of the sky, we discover something that has never before been seen by any ground-based astronomer," says Capt. Mark Jelonek, an experiment leader in laser guidestar optics at Phillips. He says that the technology will allow astronomers to increase the resolution of their giant telescopes by a factor of fifty, perhaps more.

Observers at Starfire, for instance, have identified never-before-seen stars in the trapezium of the constellation Orion, which astronomers have been studying for centuries.

It is one more way, says Captain Jelonek, that the Air Force is sharing and transferring its research to the outside world—in this case, academia. "Astronomers from around the world are now submitting proposals to use our adaptive optics system to support their research projects, and in the future they'll come to the Starfire Optical Range to conduct that research."

Lasers Get Small

If researchers with the Phased Integrated Laser Optics Technology (PILOT) program at Phillips have their way, the days of the hastily applied compress to stop bleeding on the battlefield may be numbered. Since it was established in 1985, the PILOT pro-

gram has focused on developing small but ever-more-powerful lasers for a variety of uses. During that time, they have become twenty times more powerful than individual semiconductor lasers.

That kind of increase in power without sacrificing portability has led to the development of the Laser Medical Pack, a completely self-contained laser package that fits inside a beltpack and runs on batteries. Researchers at Phillips say that it will soon be fitted with common VCR camcorder batteries for even easier operation. The prototype system weighs only six pounds but boasts output power intense enough to allow medics or rescue personnel to cauterize bleeding wounds. To do the same job today, technicians must have a standard Argon laser half the size of an office desk, plus an electrical outlet.

"The Laser Medical Pack is also relatively inexpensive compared to laser systems being used for medical applications today," says Capt. Mike Prairie of Phillips Laboratory. "By changing fiber tips, it can function either as a cauterizer or a laser scalpel."

Captain Prairie says that lasers being developed under the PILOT program have a variety of civilian uses as well. "One application with civilian utility is chemical sensing for pollution monitoring, where a laser of the right color is used to probe the emissions of a smokestack or automobile exhaust pipe to determine pollution levels," he says. "Another potential use is eye-safe laser radar to detect wind shear from an aircraft or to detect speeding motorists. Those are only a few of the applications."

Information on the Flight Line

Armstrong Laboratory's work on the Integrated Maintenance Information System (IMIS) is perhaps more evolutionary than revolutionary, but it is poised to take a giant step forward with the appearance of portable integrated information systems on the flight line. Gone are the days, say researchers, of stacks of grease-smudged technical manuals at workstations, parts-ordering snafus, and flight line technicians scratching their heads in confusion.

IMIS is the last of three phases of a project that began in 1982 with the introduction of electronic manuals on the flight line. Using the large storage capacity and search capability of what is essentially a small, microprocessor-driven computer, "electronic manuals" helped eliminate the need for voluminous technical manuals on the flight line.

Phase II began with the addition of

an interactive diagnostics capability to these computers, allowing maintenance technicians to hook portable systems directly to the aircraft for fault detection.

The Phase III prototype demonstration now under way has seen these portable computers further upgraded to completely integrated information systems linked to maintenance computer systems with mainframe power. That has placed an unprecedented amount of information at the fingertips of the flight line technician. He or she now has electronic technical manuals, diagnostics instructions, work orders, direct parts orders, historical data, and step-by-step maintenance instructions.

"The key advantage of these integrated information systems is that they are so portable, which means they don't require nearly as much deployable airlift space as earlier systems," says Robert Johnson, chief of operational logistics at Armstrong Laboratory. "We've redesigned the technical database itself, so that less experienced personnel can do a far wider array of maintenance tasks."

IMIS has reduced the number of components falsely identified as defective, cut demand on parts supply through direct and accurate parts ordering, and lowered the requirements for shop-level support and test-equipment backup. Programs already signed up for IMIS include the B-2 bomber, E-8 Joint Surveillance and Target Attack Radar System aircraft, and F-22 fighter.

Commercial aircraft-makers and automobile companies have closely followed the project. "We've talked to all the major airframe manufacturers, as well as to General Motors," says Mr. Johnson. "I also brief the Federal Aviation Administration on the project each year. I think you'll see commercial applications for IMIS in the airline and automobile industries fairly soon."

Harnessing Hungry Bacteria

Air Force scientists are looking to a very old source for help in combating fuel spills. "Fuel has been in our subsurface practically since time began, so it's not surprising that Mother Nature provides bacteria that over the centuries have developed the ability to feed on fuel hydrocarbons," says Capt. Catherine Vogel, an expert in bioremediation at Air Force Civil Engineering Support Agency (AFCESA) at Tyndall AFB, Fla. "The problem is that these microorganisms use up all their oxygen in the process, and new oxygen can't infiltrate the soil fast enough to keep the biodegradation process going."

The solution developed by researchers at AFCESA is a process dubbed "bioventing." Technicians inject air into a contaminated area through shafts, greatly increasing the amount of pollutants removed through biodegradation. Other experiments have succeeded in optimizing the appetites of nature's own pollution-eaters. At fuel spills in arid climates, for instance, researchers developed a sprinkler system that added moisture to the soil, enhancing biodegradation. In Alaska, they experimented with ways to alter the soil to keep biodegradation going longer, first by placing insulation over the contamination site, then by passing warm water through the soil.

AFCESA has expanded its bioventing experiments to eighty sites across the US, and the technology appears to have a promising commercial future. "The Environmental Protection Agency is keeping close tabs on this process, because they fully recognize the possibilities," says Captain Vogel. ■

James Kitfield is a defense correspondent in Washington, D. C., and winner of the 1991 Gerald Ford Prize for Defense Journalism. His most recent article for Air Force *Magazine was "Demise of the Aggressors" in the August 1992 issue.*

Valor

By John L. Frisbee, Contributing Editor

"Here Am I. Send Me."

Karl Richter's heroism and commitment are as much an inspiration to his successors as they were a quarter-century ago to his comrades who flew Downtown.

A NATION that does not honor its heroes, it has been said, loses its soul. The soul of a military organization is its *esprit de corps*, arising from the memory of heroic deeds in the past. When Montgomery, Ala., offered to donate a static display aircraft to Air University as a memorial, AU Commander Lt. Gen. Charles G. Boyd had a better idea. A statue of a distinctive hero would have greater inspirational impact on rising generations of blue-suiters. Montgomery city officials joined enthusiastically in raising funds for the statue.

General Boyd, a former F-105 pilot, recipient of the Air Force Cross, and for nearly seven years a POW in North Vietnam, could have elected to memorialize one of the many distinguished generals whose careers are associated with Maxwell AFB. Instead he chose twenty-four-year old 1st Lt. Karl W. Richter, whose extraordinary courage, commitment, and determination to excel would be an inspiration to the thousands of young Air Force people who pass through the Air University each year.

Why Lieutenant Richter?

During his years at the Air Force Academy, Karl Richter's overarching goal was to become a fighter pilot in southeast Asia. After graduating in 1964, he completed pilot school and operational training in the F-105 "Thud." Declining leave, he flew his fighter-bomber directly to Thailand to join the 388th Tactical Fighter Wing and then-Captain Boyd at Korat RTAFB in April 1966.

F-105 pilots who flew "Downtown" into North Vietnam's Route Package One to attack the most heavily defended targets in the history of air warfare were judged by their contemporaries against four standards: courage, skill, aggressiveness, and eagerness for combat. Lieutenant Richter entered this deadly game with enthusiasm and disregard for his own safety. He soon became a flight leader, volunteering for the most hazardous missions. He believed his most important contribution, next to destroying enemy targets, was to pass along his growing knowledge of tactics to newly assigned pilots.

The F-105 was designed in the 1950s for low-level delivery of nuclear weapons, not for air-to-air combat with the enemy's maneuverable MiGs. Nevertheless, Thud pilots often had to defend themselves against attacking fighters. On September 21, 1966, Lieutenant Richter used the tremendous firepower and speed of his F-105 to become one of the first Thud pilots—and the youngest—to shoot down a MiG-17.

At the time of his tour with the 388th, forty-three percent of F-105 pilots were either killed or declared missing in action before completing 100 missions in the North. As he approached the 100-mission mark, Lieutenant Richter asked permission to fly a second 100 missions. He believed his combat experience should be used to advance the war effort.

That experience paid off handsomely on April 20, 1967. Richter led a defense-suppression flight of F-105s through weather that obscured navigation references and into intense enemy fire. His flight destroyed or pinned down enemy AAA and SAM crews, enabling the strike force to eliminate an important railroad target. Lieutenant Richter, who had already won the Silver Star, was awarded the Air Force Cross for his skill and heroism that day.

Karl Richter's total commitment was reflected in the goals he set. After completing his second F-105 tour in the North, he hoped to fly F-100s on in-country missions, then serve as a forward air controller, covering the spectrum of tactical air combat. He doubtless would have fulfilled his plan if fate had not intervened.

On July 28, 1967, after completing his second 100 missions, Lieutenant Richter was checking out a newly assigned pilot. He took his aircraft down on a bridge, instructing the new wingman to stay aloft and observe. His aircraft disabled by flak, he had to punch out over very rough country studded with sharp pinnacles of karst (uneven limestone). The wingman saw a good chute, and an Air Rescue Service force heard Richter's beeper, but when they located him, he was near death from multiple injuries probably caused by striking a karst formation. He died aboard the rescue helicopter.

A history of the 388th Tactical Fighter Wing notes that among those who did not come back from the North were the wing's vice commander, Col. John P. Flynn, and commander, Col. Edward Burdett. Significantly, their names are followed by that of 1st Lt. Karl W. Richter, "a name that has become an inspiration to those who fly 'Downtown.' "

The statue of Karl Richter was unveiled at Maxwell AFB on June 13, 1992. An inscription from the prophet Isaiah at its base reads: "Whom shall I send, and who will go for us? Here am I. Send me." These words epitomize Karl Richter's spirit of commitment—a spirit that underlies the Air Force tradition of valor in the service of this nation. It will inspire those who follow him, as it did his comrades who flew Downtown. ■

1st Lt. Karl W. Richter after becoming the Air Force's youngest MiG-killer.

AFA's Gerrity Award goes to the 9th Air Force loggies for achievements in the Persian Gulf War.

Logistics Heroes

By Amy D. Marchand

When the Air Force launched the Persian Gulf War buildup, it had access to a few local sites with prepositioned equipment and no actual base infrastructure. In short order, however, 9th Air Force logisticians changed all that.

Within a few weeks, USAF was able to deploy and bed down 1,229 aircraft. On the Arabian Peninsula and the island of Diego Garcia and in Egypt, the Air Force was operating from twenty-five bases, built up with $1.3 billion in equipment. The service could provide housing for 55,000 uniformed men and women.

When combat began on January 17, 1991, 9th Air Force logisticians really picked up the pace. They helped USAF fighter units redeploy and reconstitute. They supplied 138.6 million pounds of ordnance, 824 million gallons of fuel, tons of other consumables, and a steady flow of repaired engines and other subsystems, even as the combat aircraft were cranking out an unprecedented 66,128 combat sorties in forty-two days.

Throughout the war, the overall mission capable rate of Air Force aircraft never fell below ninety-three percent.

The contributions of logisticians to the coalition's stunning victory in the Gulf War were recognized at AFA's National Convention last September in Washington, D. C. For leading the units through this turbulent and demanding period, Col. William M. Rider received the 1992 Thomas P. Gerrity Memorial Award, the highest honor AFA bestows in logistics. AFA honored his "timely, effective, and efficient action to assure combat readiness and air victory."

Colonel Rider, the deputy chief of staff, Logistics, for 9th Air Force, Shaw AFB, S. C., advises the commander on aircraft and munitions maintenance, transportation, supply,

logistics plans, and contracting. During the Gulf War, that commander was Lt. Gen. Charles A. Horner, the air boss of Operation Desert Storm.

The "Logistics Hero"

In recommending Colonel Rider for the AFA award, the leaders of 9th Air Force pointed out that he and his team of logisticians had "orchestrated the largest logistics buildup over the greatest distance since World War II." General Horner had high praise for the Gulf War logistics team, hailing Colonel Rider as the "logistics hero of Desert Storm."

Shortly after the war ended, General Horner observed, "Every time we'd give the logistics people a hard task, they'd succeed." Later, the air boss related a story that illustrates the efficiency of the logistics operation:

"One afternoon, I turned to my logistics chief, Col. Bill Rider, and told him I wanted to move the F-16s [from southern and central Saudi air bases] up where the A-10s were, near Dhahran, so we could get more sorties and more time over the battlefield out of them. 'Would you please look into it,' I said, 'and see if there are any showstoppers?'

"The next day at a staff meeting, I said, 'How's the move coming?' I thought they would say they were working the problem. They responded, 'The F-16s are there now.' That's what these young logistics people brought to this war—tremendous enthusiasm and tremendous confidence."

That enthusiasm and confidence translated into flexibility and a bent for coming up with innovative ideas and solutions.

Frequently, the advance plans of Operation Desert Storm had to be changed quickly to accommodate the demands of war. For example, the prewar aircraft maintenance plans called for deployment to each air base of an Intermediate Level Maintenance package. However, Colonel Rider's team coordinated its maintenance efforts with the logisticians of US Air Forces in Europe. Then, at existing USAFE facilities, they established "Queen Bee" centers to repair spare aircraft engines, augmenting the centers with personnel and equipment sent from the US.

Concentrating the work at these sites reduced the number of personnel required in the Persian Gulf theater, and the Queen Bee shops proved more efficient and capable than the proposed bare-base facilities in the war theater.

The 9th Air Force logistics team established three aircraft forward operating locations—at Al Jouf, King Khalid Military City near Hafar al Batin on the northern Saudi border, and King Fahd International Airport. These bases proved invaluable in the drive to "turn" combat aircraft rapidly, generate sorties, and maintain overwhelming pressure on Iraqi Air Force units.

The average duration of an actual wartime sortie was much longer than specified in prewar planning, as were the actual number of sorties per airplane. The 9th Air Force logisticians recognized this early in the game, making it possible for USAF to speed necessary parts to the area to sustain the pace of air operations. Central Air Forces, the air component of US Central Command (provided mainly by 9th Air Force), was the only coalition air organization to exceed preplanned sortie rates.

When insufficient munitions storage at austere bases posed a problem, Colonel Rider and his logistics team established a depot in central Saudi Arabia to provide sufficient storage capacity for fourteen million pounds of high-explosive weapons. With this depot, the Air Force could count on having a thirty-four-day supply of munitions on the ground when Operation Desert Storm began. Three replenishment ships riding at anchor in nearby seas carried another ten days' worth of ammunition.

The munitions from these stockpiles were redistributed daily. Proof of the plan's success, according to Colonel Rider's nomination, was that "no missions were canceled for [lack of] munitions and all aircraft were flown with full munitions loads."

Saving the Computer

The flexibility of the logistics operation was further reflected in the Air Force's determination that it did not need to import into the theater a special supply computer to keep track of materiel requisitioned and delivered to fighting units.

Originally, plans called for the deployment of a large computer, to be housed in Tactical Shelter Systems. Rather than risk damaging delicate computer equipment, however, Colonel Rider opted to use centralized computer support provided by the system at Langley AFB, Va. Field units received data-processing terminals; a dedicated channel on a military satellite provided instantaneous access to the US-based computer.

This step not only protected the fragile equipment from possible damage but also reduced the number of computer operations personnel, stock-control technicians, and materiel-accounting personnel from 400 to 300.

Prepositioned assets were crucial to the success of Operation Desert Storm. In Oman, the United States over the years had delivered and stockpiled military equipment and consumables estimated to be sufficient to support 30,000 personnel and 750 aircraft at fourteen beddown locations. The Oman stockpiles actually supported 55,000 personnel and 1,229 combat aircraft at twenty-five beddown locations.

The stockpiles were only part of the story. Getting such items to the points of greatest need amounted to one of the greatest logistics challenges of Desert Storm. Prepositioned assets in Oman had to be hauled to distant destinations. International border clearance processes and customs inspections sometimes held up high-priority cargo for as much as a week.

The scope of the problem was described by Colonel Rider in a postwar interview. "Our trucks would drive from Oman into the United Arab Emirates and then into Saudi Arabia," he explained. "At the border, there might be a customs agent who was not entirely clear about what the cargo was for, and he would refuse permission to enter Saudi Arabia.

"Sometimes we'd have twenty-five to thirty trucks loaded with munitions or some other important cargo held up by the customs people. They might stay there for a week or so until we could get the proper authority to release it."

The Colonel noted a bright spot, however. "We didn't have that problem when we flew the equipment or supplies in by C-130. They landed at military fields well inside Saudi Arabia. Much simpler." ■

Amy D. Marchand is a former Editorial Associate of Air Force *Magazine.*

In this recent issue paper, AFA denounces the opportunists who undercut the nation's plans for orderly military reductions.

Keeping Faith With the Force

Staff photo by Guy Aceto

THE DEFENSE drawdown has had a devastating impact on the men and women of the armed forces. At least one million of them—active-duty service members, Guardsmen, Reservists, and civilian employees—will be displaced, along with their families, before these reductions have run their course.

The pain is not limited to those who have been released or otherwise affected directly. Keenly aware that additional force reductions are coming, millions of other military members and defense workers look to the future with apprehension and uncertainty. Earlier this year, the Air Force Deputy Chief of Staff for Personnel told the Senate that "the anxiety factor for our people is almost off the chart."

Their anxiety is compounded, unfortunately, by political opportunists who dismiss plans for orderly force reductions and clamor incessantly for deeper and faster reductions. We deplore such irresponsible behavior and declare our support for the phased drawdown proposed by the Department of Defense in its Base Force concept. We have seen no better or more equitable solution to implement the sweeping reductions that have been mandated.

We also pledge the full strength and commitment of the Air Force Association to the men and women of the armed forces, those who will be released as well as those who will remain. Others may forget their contributions to the nation or overlock the difficulty they now confront. This Association will not forget them, and we will do our utmost on their behalf.

We further declare our commitment to veterans, retired military members, and their families, who are feeling the repercussions of a rampant demand to cut military-related programs so that funding can be reallocated for different purposes. The service of these veterans, often arduous and frequently dangerous, did much to secure the

hope for peace the world now enjoys. They deserve our fullest measure of respect and consideration.

The end of the cold war—along with promises held out by some individuals and groups who had reason to know better—created an unrealistic public expectation of a massive "peace dividend." When it became manifest that defense reductions could not possibly resolve the federal deficit and underwrite all of the new spending ventures envisioned, activists in Congress and elsewhere accelerated their campaign for deeper force cuts and reductions in programs for military people, who are not perceived as a potent force in the electoral process.

USAF photo by MSgt. Tyra Ohlenkamp

A Compact With the Nation

Military personnel and defense employees are not motivated primarily by financial compensation. If they were, they would likely have selected different careers. Military families do not expect to live lavishly. They do expect, however, reasonable compensation, adequate medical care, and decent housing.

In their view, they have a compact with the nation they defend. It includes, on their part, the readiness to put their lives at risk in armed combat. In return, they believe the nation has agreed to keep the faith with them, treat them fairly, and make reasonable provisions for them and their families. If military members should conclude that the nation has broken faith with them, we will have lost something vitally important.

Today, military pay trails that in the private sector by 11.7 percent. Housing allowances fall some twenty percent short of covering actual expenses. The lines at military hospitals and clinics are getting longer. Many pharmaceuticals have been eliminated, and in some cases, specialty care is not readily available. Programs to benefit special interests and others who have not served the nation often seem to have a priority higher than that accorded to programs that benefit military members or defense employees.

When military people look ahead to retirement, a benefit they regard as pivotally important, they see proposals for cost-cutting maneuvers that would treat military annuities as different from other pension programs, the decreasing availability of medical care that was supposedly guaranteed, and a general erosion of benefits for veterans.

Ironically, some partisans who call for a more radical defense drawdown, without regard to the difficulties and instability it would bring, seem inclined to a more tolerant standard for our former adversaries in what once was the Soviet Union. The slow Russian withdrawal from eastern Europe and the persistence of Russian military forces at a level of 2.1 million through 1995 are said to be justified by a shortage of jobs and housing and by the instability a faster drawdown would cause to the Russian economy. We urge that those expressing compassion and understanding for the forces of the Russian Federation demonstrate at least equal concern and regard for the troops in our own ranks.

Right, Honorable—and Smart

Despite the tales told by those working toward a different set of purposes, the resources of the United States are sufficient to provide adequately for its military members—the Guard, Reserve, and active-duty components—as well as Department of Defense civilian employees, veterans, retirees, and their families. The nation should do this because it is right and honorable. If that motivation is not compelling enough, we should act in enlightened self-interest.

The United States does not support the armed forces as a matter of charity to those in uniform but because it needs them for the defense of its interests and freedom. In June 1990, the Administration and Congress reached a consensus to cut force strength by twenty-five percent. Two months later, those forces were preparing to fight an unexpected war in the Persian Gulf. In the summer of 1992, concurrent with the calls to disband more US forces and units, the prospect of committing US troops to action in the Balkans or the Middle East was daily fare in the news media and on the political stump.

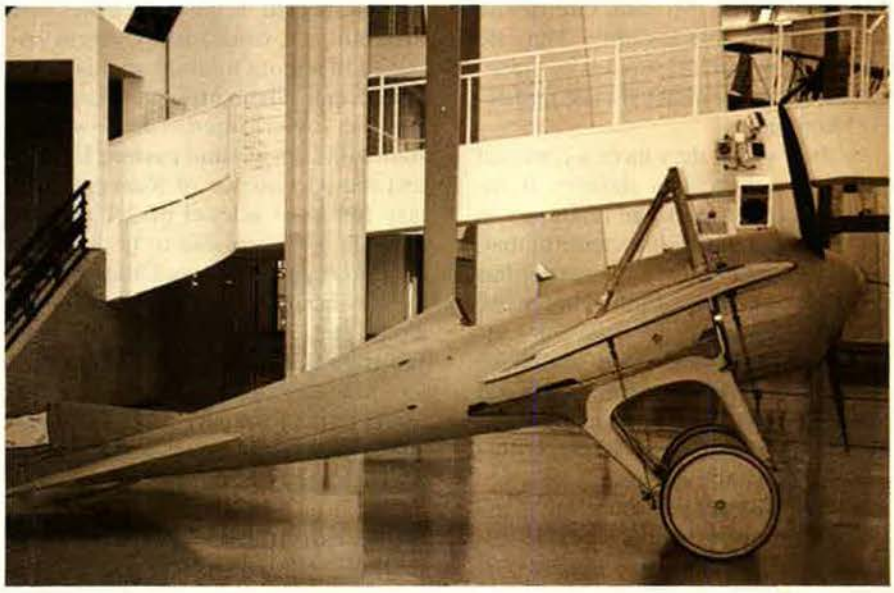
Wholesale slashing of a military force has ramifications that those who take a simplistic approach do not understand. Even with careful restructuring, it will be difficult for the military departments to manage this drawdown without damage to the force structure. There is also a risk of losing too many well-trained and highly skilled personnel. The simplistic approach sees, for example, only that the Air Force currently has an excess of new pilots for whom it has no flying assignments. It does not see that a pilot retention rate of sixty percent—some twenty percent higher than the present rate—in sequential year groups is required to sustain the force and that the Air Force may have a shortfall of 3,000 pilots by 1997. Many on Capitol Hill have also failed to take into account the requirements of the Air Force at the entry level. Adequate numbers of high-quality recruits are needed today in order to produce the well-trained NCOs of tomorrow.

Americans who demand a financial peace dividend from the drawdown should accept as a tremendous bargain the substantial savings that will accrue from a force reduction of one million people. The nation should recognize that keeping faith with the force that remains is well within its means and certainly in its best interests. ■

The big trophy races of the 1920s and 1930s explored new limits of what air machines could do.

Legacy of the Air Racers

By Robert E. van Patten



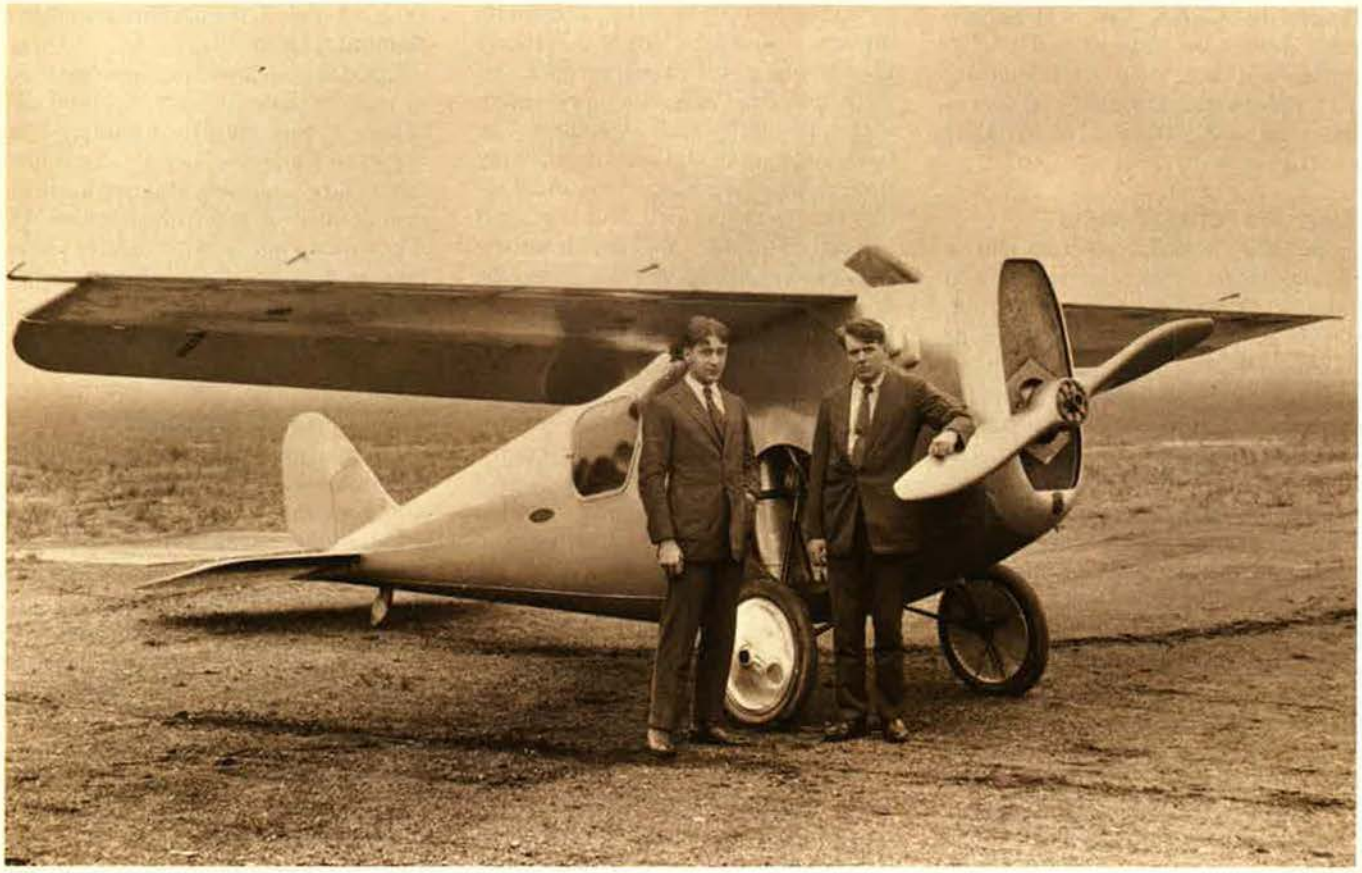
The record-setting 1913 Deperdussin monoplane (above) was the first aircraft built specifically for racing. The Dayton-Wright RB-1 (opposite), with its fully retractable landing gear, astounded onlookers at the 1920 Gordon Bennett race.

THE EARLIEST of the great classic airplane speed races was the Gordon Bennett Aviation Cup, first run in 1909 and won by Glenn Curtiss at a brisk forty-eight miles per hour. Scientific opinion of that day confidently predicted that speeds of 100 mph would one day be attained.

In 1913 at Reims, France, under the auspices of the International Aeronautical Federation, Maurice Prevost flew a Deperdussin midwing monoplane at a record 126 mph. This trim little crate, powered by a 160-horsepower LeRhone rotary engine, was the first aircraft built specifically for racing. It was also the first to evolve into a military aircraft, being one of several French monoplane designs of World War I.

The war sparked great technical innovation. The speed of military airplanes greatly increased; by war's end, fighter design had advanced four generations. In the 1920 Gordon Bennett race, Sadi Lecointe won for France by flying a modified Nieuport fighter at 170 mph—only slightly faster than the best wartime planes.

The military and racing communities soon reverted to their original, prewar roles. Brig. Gen. Billy Mitchell,



Assistant Chief of the US Air Service after the war, became convinced that air racing was the way to excite public support for aircraft advances. He secured financial backing for such ventures, which contributed to the development of fighter designs.

Radical advances in technology had always been viewed with some trepidation, which was why monoplane fighters did not figure prominently in the Great War. Nobody trusted the wings to stay on. However, the monoplane spirit was stirred anew at the 1920 Gordon Bennett race in the form of the Dayton-Wright RB-1 racer.

The First Composite

The RB-1 was an astounding piece of work, the first racing plane with fully retractable landing gear. It had both leading wing slats and trailing edge flaps. The same crank lowered the wheels for landing and deployed the flaps and slats to reconfigure the wing for low speeds. These features appeared decades later in the F-104.

On the RB-1, the wing was a true cantilever, tapered both in plan and thickness, and used blocks of balsa wood covered with a plywood veneer. Considered an exotic design at that time, it is one of the earliest examples of what is known today as a "composite" structure. The deep, slab-sided fuselage enclosed the pilot and was formed by laying thin strips of veneer in a fabric-and-glue matrix and criss-crossing each layer. It was painted silver and polished to a smooth, glassy finish. Had it not been for the failure of a leading edge slat control cable, the plane might have won, but it retired twenty minutes into the race.

The 1920 competition was the last Gordon Bennett race, after which the most important contests were the 1920–25 Pulitzer Trophy races. For the first time, organizers specified aspects of aircraft design. For the 1920 race, biplanes had to be designed to withstand four Gs, monoplanes six Gs. Planes had to exceed 100 mph.

The US military turned out in force, accounting for all but three of the forty-seven entries. The field was dominated by the Air Service, though the Navy and Marine Corps were well represented. The winner, Air Service 1st Lt. Corliss Champion Moseley, flew 156.5 mph in a Verville VCP-R, the first in a series of innovative fighter designs produced by Alfred Verville. General Mitchell had secured financial backing for the VCP-R effort. The result was a biplane fighter prototype for the Air Service, incorporating a plywood monocoque fuselage, a tapered and continuous upper wing, and a lower wing smoothly faired into the fuselage to reduce drag.

Postwar austerity hit the armed services so hard in 1921 that they could not participate in that year's Pulitzer. Only six planes started. The manufacturers, primarily Wright and Curtiss, were forced to borrow military airplanes in order to participate. The speed ante was upped; every plane had to be able to exceed 140 mph. That requirement eliminated all but special-purpose racing planes or military "pursuit" planes.

In 1921, Bert Acosta, a Curtiss test pilot flying the Curtiss CR-1, set a new American speed record exceeding 176 mph. Second place went to a little triplane, Curtiss's *Cactus Kitten*, privately sponsored by Texas wildcatter S. E. J. Cox and piloted by C. B. Coombs at slightly more than 170 mph. Third place went to the man who had set a world altitude record, USAS Capt. John A. Macready. He clocked a bit more than 160 mph in a Thomas Morse MB-6 (R-2). The R-2,

funded by USAS, had a "phenomenal" power-off sink rate. This airplane must have been a real handful: The understated Macready, a pilot of immense skill, described its handling as "tricky."

Enter the "Sesqui-plane"

In 1922, the military returned to racing in force, with Secretary of War John W. Weeks encouraging participation. General Mitchell continued to exploit racing as a means of developing high-speed fighters. The Navy funded developments under the aegis of Cmdr. Jerome C. Hunsaker. The year 1922 was one of blossoming innovation, especially among Navy entries. The Navy-Wright NW-1 was a big, beautiful sesqui-plane, an aircraft with one main wing and one "half wing." The NW-1, with its half wing located at the level of the fixed gear, looked as if it belonged in a science fiction film. The gear-and-wing assembly was externally braced to the main midwing by a big, streamlined, W-shaped truss running spanwise. With the wheels shrouded in "spats," the NW-1 was a magnificent sight, but it was unlucky. Its engine lost oil pressure and seized, but pilot Lt. L. H. N. Sanderson survived.

Another innovative Navy design was the Aerial Engineering Corp. BR-1 (Booth Racer), the creation of former Curtiss designer H. T. Booth. The BR-1 was the first Pulitzer racer with retractable landing gear and was similar to the Verville design. The single midwing, designed for a 6.3G load factor, was a full cantilever and carried conformal wing-mounted radiators patented by A. L. Thurston. The wing attachment was a stub beam wing design, which both Northrop and Boeing later incorporated into transport aircraft. Thurston and Booth understood aeroelasticity problems, and the BR-1's wing could deflect seventeen inches under static load without deformation when the load was removed. The curse of lost oil pressure prevented the BR-1 from demonstrating its design top speed of 216 mph.

The 1922 Pulitzer winner, USAS 1st Lt. Russell L. Maughan, flew the Curtiss R-6, a basically conventional but souped up biplane fighter derivative. Lieutenant Maughan set a new record with a race average of nearly 206 mph. Flying this identical aircraft on October 18, 1922, General Mitchell set a new absolute world airspeed record of 222.98 mph.

The 1922 Pulitzer race introduced more than technical innovations. It was here that the attention of specialists and the public was first directed to a lethal aerial threat: G-induced loss of consciousness, which seventy years later is still killing pilots. *[See "G-Lock and the Fighter Jock," October 1991, p. 50.]*

Badly shaken by his experience with G-LOC, Lieutenant Maughan described the problem in an article. "On one of the laps," he wrote, "I'm certain I made 220 mph. On the Gaukler Point turn on the fourth lap, . . . I was whirled into unconsciousness for three or four seconds. When I regained my senses I was almost skimming the waves of Lake St. Clair. . . . I got lost in the haze [and] was stunned more or less at each of the fifteen turns. My worst moments, however, were at the turn at Gaukler Point. I lost confidence, which a good aviator ought not to do, and then became unconscious. On the straightaway, I came to."

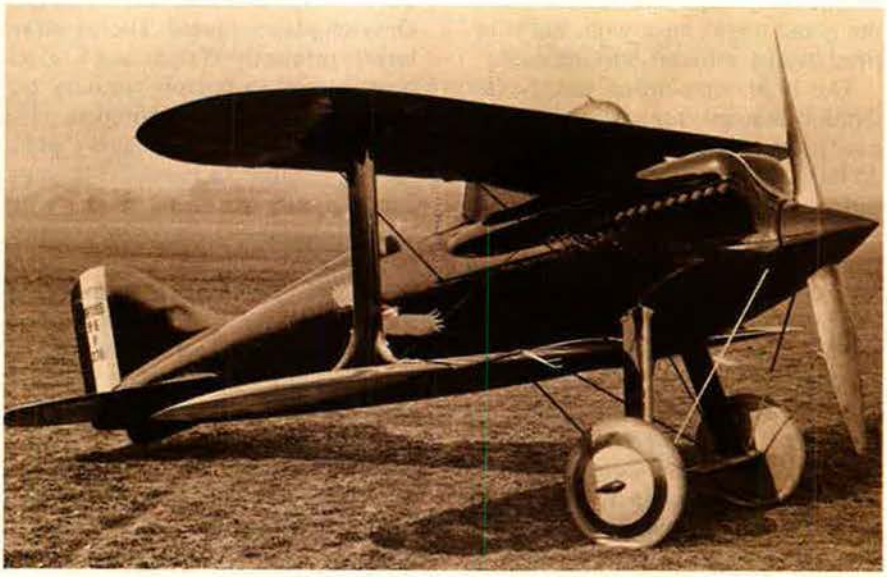
The Limit of Endurance

Lieutenant Maughan's ordeal, estimated to have taken place at over +7Gz (headward acceleration), caused widespread concern among the pilots. Prior to the next Pulitzer in 1923, Commander Hunsaker told the organizers that experimenters in England had concluded that "humans cannot withstand more than four Gs." This figure agrees closely with the observed tolerances for relaxed, unprotected individuals during a high onset rate exposure to +Gz. As a result of Hunsaker's warning, pylon turns in the 1923 race were widened to reduce the G forces on the turns to a safe level.

The 1923 Pulitzer, caught up in a dispute that led to the withdrawal of all foreign entries, saw only six starters and was the usual USAS vs. Navy-USMC and Curtiss vs. Wright brawl, with a lone Verville-Sperry R-3 thrown in. The winning plane was the usual Curtiss biplane fighter derivative, an R2C-1 flown by Lt. j.g. Alford J. Williams, who became a famous racer and exhibition pilot in all-civilian races of the 1930s. Williams astonished the aviation world, setting a speed record of almost 244 mph.

The Pulitzer series, sliding further downhill, had only four entries in 1924, plus one fatality. USAS Capt. Bert E. Skeel was killed on the diving start while flying an experimental Curtiss R-6. An innovation in this event was a new category for "low power" civilian aircraft, and the field was fleshed out with entries from Beech, Cessna, Stinson, Stearman, and Laird. This new category was a signpost to the future as military planes became more costly and dominant. The race was won by the new Verville-Sperry R-3, flown by USAS 1st Lt. Harry H. Mills. Had the R-3 been equipped with the more powerful engine planned for it, the winning speed would have been even higher.

The R-3 was a landmark design. A



1st Lt. Russell L. Maughan, the 1922 Pulitzer winner, flew this Curtiss R-6. His brush with G-induced loss of consciousness during the race caused widespread alarm among pilots and led to the adoption of safer conditions for later races.

low-wing monoplane with a full cantilever composite plywood wing, it was equipped with conformal wing-mounted radiators. The landing gear was fully retractable and sealed up with flush covers. This plane was a trendsetter. Looking at a drawing of it and imagining a closed cockpit and a squared-off vertical fin, one can almost see a Messerschmitt Bf-109. The R-3 inspired Sydney Camm's design of the Hawker Hurricane ten years later. The irony is that this aircraft, the father of the type that helped save Britain, was deemed unworthy of further development by USAS.

Stuck in the Curtiss biplane rut, the USAS flew biplanes until the Boeing P-26 went operational with the Army Air Corps in 1934. Even then, the P-26 was not a cantilever monoplane; it still sported external bracing and had shapely but fixed streamlined landing gear. It was barely 15 mph faster than the R-3 and had only its all-metal construction to recommend it. Even Boeing knew better than to build its commercial planes along the lines of the P-26A, as was demonstrated by the Boeing "Monomail" transport, an all-metal, low-wing monoplane with retractable gear, which hit the market three years before the "Peashooter."

The Verville-Sperry R-3 low-wing monoplane, winner of the 1924 Pulitzer race, inspired Sydney Camm's design for the Hawker Hurricane, but was not developed further by the US Air Service, which continued to fly biplanes until 1934.

Fading Enthusiasm

The 1925 Pulitzer race was the last. The military services, stating that air racing was no longer relevant to the development of fighters, made it plain that they would abandon participation after that year. The USAS and Navy sent only one plane each to the 1925 race. However, these Curtiss R3C-1 aircraft, powered by the new Curtiss V-1400 V-12 665-horsepower water-cooled engine, achieved near-record speeds.

From 1926 on, few American military pilots participated in air races, except as retirees. Jimmy Doolittle flew in the 1931 Thompson Trophy race, piloting the Laird Super Solution, and won the 1932 Thompson in the treacherous Gee Bee. John Macready, also retired, participated in the 1930 Thompson, flying a Rider R-1. Structurally unsound, the aircraft shed an aileron, and Macready narrowly escaped death.

The 1930 Thompson race was the last closed-course race in which a serving US officer flew a military aircraft. The plane was a highly modified Curtiss P-1 fighter. The pilot, Capt. Arthur H. Page, USMC, and a group of military technicians altered it and installed a more powerful engine. Prior to the race, this aircraft was thought to be the certain winner, but Captain Page was overcome by carbon monoxide fumes in the cramped cockpit, lost consciousness, and crashed fatally.

By the late 1930s, Air Corps fighter designs based on the Seversky P-35 (forerunner of the Republic P-47 Thunderbolt) were winning cross-country races, such as the Bendix, with civilian pilots. Absolute speed records, however, were passing to foreign pilots. In 1934, the Macchi-Castoldi MC-72, flown by Francesco Agello, set a still-unbroken Schneider Cup floatplane record of more than 440 mph. Howard Hughes briefly held the landplane record at 352 mph in 1935.

By the spring of 1939, however, the Germans were supreme. First came Hans Dieterle's record 464 mph, set in a Heinkel 100/V-8 (probably a variant of the Heinkel 112 B-O fighter). Barely a month later, Flugkapitän Fritz Wendel, a Luftwaffe pilot, clocked nearly 470 mph in a Messerschmitt Me-209 V-1, a record that stood for nearly thirty years. It was finally broken when Darryl Greenmayer, a civilian US pilot, flew his modified Grumman F8F-2 at 483 mph.

The record makes clear that the Pulitzer, Gordon Bennett, and other races brought major benefits to military aviation. The water-cooled Curtiss D-12 engine introduced monobloc construction and set the standard for a durable and reliable military engine. Technology and experience necessary for the development of flaps and leading edge slats were established. Introduction of the Curtiss-Reed all-metal propeller increased speeds by up to 20 mph above those achieved with a wooden prop. Fairings and fillets for drag reduction were pioneered, as were flush, covered, retractable landing gear and construction techniques leading the way to all-metal aircraft with monocoque structures. Composite construction began with wooden structures and evolved to modern fiberglass and advanced composites. Military pilots gained firsthand knowledge and experience that they took back to their jobs, laying the foundation for future aeronautical engineering advances. ■

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Books

By Frank Oliveri, Associate Editor

Band of Brothers: E Company, 506th Regiment, 101st Airborne From Normandy to Hitler's Eagle's Nest, by Stephen E. Ambrose. The narrative follows this crack unit from basic training through the liberation of the concentration camp at Dachau and the capture of Berchtesgaden, conveying the regiment's strong unit pride and the unique rapport among its members. Simon & Schuster, 1230 Avenue of the Americas, New York, NY 10020. 1992. Including photos and index, 335 pages. $25.00.

Bloody Shambles: The First Comprehensive Account of Air Operations Over South East Asia, December 1941–April 1942, by Christopher Shores and Brian Cull, with Yasuho Izawa. This first volume of a projected two-volume work covers the story of the early days of air operations in the Pacific War in intimate detail, from both Allied and Japanese points of view. It is a tale of unpreparedness, panic, poor leadership, and wishful thinking. Grub Street Press, Distributors, 49 Central Ave., Cincinnati, OH 45202. 1992. Including photos and index, 392 pages. $49.95.

Foreign Military Intervention: The Dynamics of Protracted Conflict, by Ariel E. Levite. The author's major thesis is that the intervention of foreign military powers in regional conflicts leads to protracted wars. He presents six case studies, citing the similarities and differences among them. Each case is structured according to three analytical stages of intervention: getting in, staying in, and getting out. Columbia University Press, 562 West 113th St., New York, NY 10025. 1992. Including index, 334 pages. $32.50.

Hitler's Panzers East: World War II Reinterpreted, by R. H. S. Stolfi. This new picture of Hitler's conduct in World War II challenges the view that large-scale historical factors determined the outcome of the conflict. The author finds that Hitler's siege mentality undermined his generals' blitzkrieg mentality, causing Germany to miss opportunities to crush the Red Army. Its defeat would have virtually assured German victory in World War II. University of Oklahoma Press, 1005 Asp Ave., Norman, OK 73019. 1992. Including photos, notes, bibliography, and index, 272 pages. $24.95.

The Imperial Temptation: The New World Order and America's Purpose, by Robert W. Tucker and David C. Hendrickson. With the collapse of communism, the American brand of democracy seemed everywhere triumphant. Paradoxically, say the authors, the US soon floundered, looking for a new agenda. Tucker and Hendrickson argue that the Bush Administration, in its attempts to address the challenges posed by new global realities, has betrayed the fundamental ideals on which this country was founded. Council on Foreign Relations Press, 58 East 68th St., New York, NY 10021. 1992. Including notes and index, 240 pages. $22.50.

The Last Option After Nasser, Arafat, and Saddam Hussein: The Quest for Peace in the Middle East, by David Kimche. The author, a former director general of Israel's Foreign Ministry, gives a firsthand and controversial appraisal of events in which he played a central role. He discusses Israel's relations with Egypt and the US, its actions in the Iran-Iraq war and the Persian Gulf War, and the way it has handled the Palestinian intifada. Charles Scribner's Sons, Macmillan Publishing Co., 866 Third Ave., New York, NY 10022. 1992. Including index, 328 pages. $25.00.

Making War: The 200-Year-Old Battle Between the President and Congress Over How America Goes to War, by John F. Lehman, Jr. A former Secretary of the Navy, Deputy Director of the Arms Control and Disarmament Agency, and National Security Council staff member examines the history of American military decision-making from the Revolution to the Persian Gulf War. He argues vehemently for the primacy of presidential power over congressional power and provides new insights into defense politics of the post-Vietnam era. Charles Scribner's Sons. 1992. Including notes and index, 297 pages. $24.00.

Ranger at War: Combat Recon in Vietnam, by Shelby L. Stanton. This action-packed account of Army Rangers and Long-Range Reconnaissance Patrols ("Lerps") documents and describes the operations of these units in Vietnam. Crown Publishing Group, 201 East 50th St., New York, NY 10022. 1992. Including photos, notes, appendix, and index, 382 pages. $25.00.

Segregated Skies: All-Black Combat Squadrons of World War II, by Stanley Sandler. This is the story of four World War II fighter squadrons, composed exclusively of African-American aviators. The fighter pilots of those squadrons, though inexperienced and under close scrutiny, managed to compile impressive combat records. Smithsonian Institution Press, 470 L'Enfant Plaza, Suite 7100, Washington, DC 20560. 1992. Including photos, notes, bibliography, and index, 217 pages. $24.95.

Tennozan: The Battle of Okinawa and the Atomic Bomb, by George Feifer. Here is a context for understanding the collision of three cultures—American, Japanese, and Okinawan—and one of the most ominous events in history: the atomic bombing of Hiroshima and Nagasaki. The author draws on more than ten years of research and interviews to recreate the horrific drama of the engagement that was seen as the prelude to invasion of the home islands. Ticknor & Fields, 215 Park Ave. South, New York, NY 10003. 1992. Including photos, bibliography, and index, 622 pages. $29.95.

They Also Flew: The Enlisted Pilot Legacy, 1912–1942, by Lee Arbon. Between 1912 and 1942, the United States trained more than 3,000 enlisted personnel for military aviation. This book traces the history and achievements of these pilots, recognizing the seventeen aces, 155 men killed in action, and eleven promoted to the rank of general. Smithsonian Institution Press. 1992. Including photos, appendix, notes, and index, 264 pages. $29.95.

Other Titles of Note

Army Dictionary and Desk Reference, Capt. Tim Zurick, USAR. Terms and acronyms for just about anything you want to know about the Army. Stackpole Books, Cameron and Kelker Sts., P. O. Box 1831, Harrisburg, PA 17105. 1992. 263 pages. $12.95.

The Green Berets in Vietnam, 1961–71, by Francis J. Kelly. The successes and failures of Green Beret efforts in Vietnam over a ten-year period. Brassey's (US) Inc., 8000 Westpark Dr., McLean, VA 22102. 1992. Including appendix, index, photos, and diagrams, 227 pages. $12.95.

Night Letters: Inside Wartime Afghanistan, by Rob Schultheis. A sometimes harrowing account of a reporter on the front lines of the Afghan civil war. Orion Books, 201 East 50th St., New York, NY 10022. 1992. 155 pages. $18.00.

Soldat: Reflections of a German Soldier, 1936–1949, by Siegfried Knappe and Ted Brusaw. A German view of World War II from a German officer who served on many wartime fronts. Crown Publishing Group. 1992. Including photos and index, 384 pages. $23.00.

The United States and World War II, by Robert James Maddox. A concise, one-volume overview of the war's causes, conduct, and consequences. Westview Press, 5500 Central Ave., Boulder, CO 80301-2847. 1992. Including photos and index, 358 pages. $55.00. ■

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NORTH DAKOTA (Fargo, Grand Forks, Minot): **Ruby G. Crites,** 110 SW 18th, Minot, ND 58701 (phone 701-839-2700).

OHIO (Akron, Cleveland, Columbus, Dayton, Mansfield, Newark, Youngstown): **Jerry D. Schmidt,** 4140 Chico Ct., Springfield, OH 45502 (phone 513-255-5054).

OKLAHOMA (Altus, Enid, Oklahoma City, Tulsa): **Bennie G. Drake,** P. O. Box 757, Altus, OK 73522-0757 (phone 405-477-1113).

OREGON (Eugene, Klamath Falls, Portland): **Edward D. White,** P. O. Box 1805, Klamath Falls, OR 97601-0103 (phone 503-883-1770).

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): **Robert C. Rutledge,** 129 Arlington St., Johnstown, PA 15905 (phone 412-235-2711).

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): **David V. Massey,** 101 Kerryton Rd., Columbia, SC 29223 (phone 803-695-6202).

SOUTH DAKOTA (Rapid City, Sioux Falls): **Robert Jamison,** 5104 Swift Park Dr., Sioux Falls, SD 57106 (phone 605-339-7100).

TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tullahoma): **Everett E. Stevenson,** 4792 Cole Rd., Memphis, TN 38117 (phone 901-767-1315).

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): **L. E. "Buck" Webber,** P. O. Box 619119, D/FW Airport, TX 75267 (phone 214-456-8231).

UTAH (Bountiful, Clearfield, Ogden, Salt Lake City): **Dan Hendrickson,** 1930 North 2600 East, Layton, UT 84040 (phone 801-776-2101).

VERMONT (Burlington): **Eugene A. Meiler,** 35 Pine Haven Shore, Shelburne, VT 05482 (phone 802-864-8000).

VIRGINIA (Alexandria, Charlottesville, Danville, Harrisonburg, Langley AFB, Lynchburg, McLean, Norfolk, Petersburg, Richmond, Roanoke): **James E. Cvik,** 1919 Commerce Dr., Suite 445, Hampton, VA 23666-4269 (phone 804-838-2424).

WASHINGTON (Seattle, Spokane, Tacoma): **William Moore,** SO 1720 Buttercup, Spokane, WA 99212-3215 (phone 509-534-0631).

WISCONSIN (Madison, Milwaukee, Mitchell Field): **Gilbert M. Kwiatkowski,** 8260 W. Sheridan Ave., Milwaukee, WI 53218-3548 (phone 414-463-1849).

WYOMING (Cheyenne): **Robert S. Rowland,** 9001 Red Fox Rd., Cheyenne, WY 82009 (phone 307-632-8746).

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

State Conventions

Delegates from every corner of the Lone Star State gathered in San Angelo, Tex., for the state's annual convention. Recently elected National Vice President (Southwest Region) Robert J. Cantu was selected Man of the Year for his work as president of the **Alamo Chapter.** Host Chapter President John M. Haga (**Concho Chapter**) put together a good program, including remarks by Lt. Gen. Charles R. Hamm, USAF (Ret.), former superintendent of the Air Force Academy. Six military organizations from Texas were honored for their participation in Operation Desert Storm: the 136th Airlift Wing (ANG), Hensley Field; 3790th Medical Service Training Group, Sheppard AFB; 7th Air Refueling Squadron, Carswell AFB; 433d Airlift Wing (AFRES), Kelly AFB; Wilford Hall Medical Center, Lackland AFB; and 67th Reconnaissance Wing, Bergstrom AFB.

State President L. B. "Buck" Webber presented individual awards to SSgt. John P. Mook, Airman of the Year; Capt. Gregory S. Smith, Officer of the Year; Lt. Col. Gary R. Walston, Guardsman of the Year; and Lt. Col. Marie A. Moyer, Nurse of the Year. Daniel W. Bus, president of the **Del Rio Chapter,** accepted the award for Chapter of the Year. Two special presentations were made. Outgoing National President O. R. Crawford received the Gen. Claire Chennault Patriotism Award, and Mr. Webber received the Texas AFA Benjamin Foulois First Flight Award for his successful tenure as state president.

Scott Memorial Chapter President Jean Schobert is always at the center of things concerning the Mid-America Ball. Here she is flanked by (from left) Eaker Fellows Don Schaak and Chet Curnane, Spirit of St. Louis Chapter Vice President Jack Weatherford, then National Board Chairman Jack C. Price, and Doolittle Fellows Capt. William J. Cleckner and Col. Phillip Corbett.

Kansas Treasurer Cletus Pottebaum (left) honored the 384th BW's "knuckle-busters," winners of the B-1B weapon-loading competition at Lancer Joust '92, at a Lt. Erwin R. Beckley Chapter meeting. Also pictured: Col. Edgar Ott, wing commander (center), and Maj. Gregg Moser, chapter president (fourth from right).

The state organization did not neglect its educational mission. It paid tribute to the achievements of Cadet Tobey Spears, AFJRCTC Award winner, and Monika J. Kretschmer, Angel Flight Member of the Year.

New Jersey State AFA made history at its convention this year by naming its first Woman of the Year. Gerry Jones, vice president (at large), was honored with the annual award for outstanding individual achievement. Newly elected State President Bill Ramsay praised Ms. Jones for her strong interpersonal skills, demonstrated while she was vice president for Government Relations of the **Thomas B. McGuire, Jr., Chapter.** A past recipient of AFA's Medal of Merit and Exceptional Service Award, Ms. Jones has coordinated the state's Fall Ball since 1990 and has hosted the state picnic since 1989. Mr. Ramsay had special praise for her tact in dealing with thorny protocol problems and said she added "a touch of class" to the entire state organization.

State Chairman of the Board Dolores Vallone, recipient of the 1992 Dis-

At AEF's fall Board of Trustees meeting, Secretary CMSgt. Walter Scott (center) presented a $74,000 check to AEF President Gerry Hasler (left) and Chairman Jim Keck. The check represents the proceeds of an appeal for funds for the Eagle Grant scholarship program, to which 12,330 members responded.

tinguished Service Award, announced the presentation of the other awards for 1992: Esther Gregory, Thomas B. McGuire Memorial Award; Robert Boyle, Humanitarian Award; Amos Chalif, Emeritus Award; Charlotte Huff, Aerospace Education Award; and Janice Tolley, Young Astronaut Instructor Excellence Award.

Jim Young, president of New Jersey AEF, noted that the foundation had distributed sixteen awards, grants, and fellowships in 1992, worth in excess of $8,000.

In addition to Mr. Ramsay and Mrs. Vallone, newly elected state officers included Bill Mann, treasurer; Esther Gregory, secretary; Clyde Jackson, vice president (south); and Tony Vallone, vice president (north).

Help for Andrew's Victims

At the National Convention last September, delegates passed a unanimous resolution to support Air Force families displaced by Hurricane Andrew when it struck Florida last August. The Central East Region pledged $15,000 to help the families and led the effort to encourage all AFA members and organizations to provide similar support. Distribution of the funds will be coordinated by Air Force agencies to ensure efficiency, and the money will be used mainly to help relocate displaced families and assist them in reestablishing their households.

Chapter News

The **Lufbery-Campbell (Germany) Chapter** celebrated the fiftieth anniversary of US Air Forces in Europe (USAFE) in style. Chapter President and 1992 Storz Award Winner Lt. Col. James G. "Snake" Clark coordinated a fine evening of dining, dancing, speeches, and awards ceremonies to mark the event. National President O. R. Crawford (who has since been elected Chairman of the Board) presented a Presidential Award to USAFE Commander in Chief Gen. Robert C. Oaks in recognition of the command's accomplishments over the past five decades. General Oaks, Mr. Crawford, and Colonel Clark delivered remarks to the appreciative crowd.

Capt. Patricia Reese-Cloud of the ACM System Program Office accepts the Abrahamson Award from Maj. Gen. Stephen McElroy, PEO for Tactical Strike Systems, as Wright Memorial Chapter President Frank Zachary looks on. The award was one of seven handed out for excellence in ASD (now ASC) programs.

As they entered the Ramstein AB Officers Club, guests were treated to a display of historical uniforms and other memorabilia assembled by USAFE's Kisling NCO Academy. CMSgt. Spencer Baker served as master of ceremonies. Dignitaries at the event included Lt. Gen. James L. Jamerson, USAFE vice commander in chief; Brig. Gen. George T. Babbitt, USAFE inspector general; Col. Gary Bendlin, 86th Fighter Wing commander; and Nita Wilkinson, former chapter president.

The **Gus Grissom (Ind.) Chapter** was instrumental in bringing two pieces of history to the Purdue University Airport. The Collings Foundation flew a fully restored B-17 Flying Fortress and B-24 Liberator to the Lafayette, Ind., area for the first time in nearly fifty years. A crowd of almost 5,000—from preschoolers to World War II veterans—turned out for the historic occasion. Chapter President Ed Frickey stationed himself by the B-24 and recalled his days flying Liberator missions over Germany, telling reporters, "We were a bunch of kids, but we were fighting for our country." Dr. Ted Williams, a Purdue University professor and Grissom Chapter member, was the primary contact with the Collings Foundation, which restored the rare warplanes at great expense (the B-24 alone cost $1.3 million). The foundation supplies background information on the planes and conducts tours of the combat-configured aircraft for a small fee.

Inciana was also the site of a highly successful annual awards banquet held

by the **Fort Wayne Chapter**. Chapter President Allen P. Feeback presented certificates of appreciation to Donald E. Dennis, a dedicated employee of the Fort Wayne VA Medical Center; Dr. Charles C. Culp, who initiated an aerospace education program at a local elementary school when he was principal; and CAP Lt. Col. Sam Conte, for his distinguished work with the Civil Air Patrol.

The **Tulsa (Okla.) Chapter** did its part to help celebrate the fiftieth anniversary of the beginning of operations at McDonnell Douglas's aircraft plant at Tulsa. Chapter member John Loerch met with Nikki Hearne, cochairman of the fiftieth-year celebration, and Dennis Metcalf, general manager of the plant, and presented them with a commemorative plaque to mark the occasion.

The **Wright Memorial (Ohio) Chapter** has had a busy autumn. In addition to presenting awards for achievement in Aeronautical Systems Center programs *[see photo, previous page]*, the chapter staged a successful Air Force Anniversary Ball, at which awards for significant contributions to the Air Force and the Dayton, Ohio, community were distributed. Air Force Materiel Command Commander Gen. Ronald W. Yates and Chapter President Frank Zachary shared the duty of presenting the awards. Lt. Col. Travis E. Elmore was named Outstanding Senior Officer, and Daniel L. Kugel got the award as Outstanding Civilian Executive. Other award recipients were Capt. John Jordan, Outstanding Company Grade Officer; SMSgt. Sharon J. Lauritsen, Outstanding NCO; SSgt. Kathleen T. DePugh, Outstanding Junior Enlisted Member; Capt. Gary H. Boggan, Outstanding Guard and Reserve Officer; SMSgt. Max C. Holly, Outstanding Guard and Reserve Enlisted Member; Marvin Dale, Outstanding Civilian Manager; and Michael A. Schumacher, Outstanding Civilian Technician.

The **Panhandle (Tex.) Chapter** has been so pleased with the performance of Chapter President Bob Balliett that its members recently reelected him to another term. At a quarterly meeting in September, Col. Larry Driskill, commander of the 64th Operations Group at nearby Reese AFB, told chapter members of his experiences with the U-2 spy plane. Mr. Balliett, Chapter Vice President Joe Rinella, and former President Guy Leach led the applause for Colonel Driskill's speech. In another innovative initiative, the chapter sought recruits and gained exposure by entering a vehicle in the Tri-State Fair Parade.

Have AFA/AEF News?

Contributions to "AFA/AEF Report" should be sent to Dave Noerr, AFA National Headquarters, 1501 Lee Highway, Arlington, VA 22209-1198. ■

Bulletin Board

Collector and historian seeks **AAF memorabilia** from World War I through World War II: leather flight jackets, uniforms, flight equipment, and photo albums. **Contact:** Jon Cerar, 425 John St., Carlinville, IL 62626.

Seeking contact with veterans who served with the **845th Squadron,** 489th Bomb Group, during World War II. **Contact:** Russell Davis, 1921 William Way, Concord, CA 94520.

Seeking **photos, booklets, and US ration books** from the 1940s and 1950s. **Contact:** Robert Bonsall, 16 Condon Rd., Flat 2, Buxton, Derbyshire SK17 9NX, England.

Seeking information about the survivors of **Anthony Diaz** of Virginia, who was a pilot in the 47th Squadron based at Mildenhall, Norfolk, England. He was killed in 1953 when his plane crashed near Norwich. He might be buried in Cambridge, England. **Contact:** J. A. Utting, "Adela", Butt Ln., Burgh Castle, Great Yarmouth, Norfolk NR31 9PU, England.

Seeking information on **1st Lt. Kenneth W. Seeley,** who was stationed at 1532d AAFB, APO 240, in 1944. **Contact:** Roger L. Grandstaff, 2 Snow Trail, Fairfield, PA 17320.

For a history of the unit, the **44th Missile Wing** Commemorative Committee is seeking names, addresses, historical photos, and anecdotes from former personnel. **Contact:** 44th Missile Wing Historian, 1750 LeMay Blvd., Suite 1, Ellsworth AFB, SD 57706-4866.

Seeking information on the whereabouts of **George K. McMillan,** navigator with the 778th Bomb Squadron, 464th Bomb Group, 15th Air Force, stationed at Pantanella AB, Italy, in 1944–45. His home at that time was Linden, N. J. His last known address was in Union City, N. J., in the 1970s. **Contact:** Robert N. Hoskinson, 6910 Norlynn Dr., Louisville, KY 40228-1471.

For an illustrated history on the **B-25 Mitchell,** seeking contact with B-25 organizations and World War II crewmen from 1942 to 1945. **Contact:** Steve Pace, 6501 E. I St., Tacoma, WA 98404.

Collector has patches, insignia, and 35-mm slides of **current aircraft** to trade. **Contact:** Jon W. Letzkus, P. O. Box 247, Bridgeport, OH 43912.

Seeking **patches and flight scarves** from former or present AC-130, HC-130, or MC-130 units. **Contact:** Chris Harwood, PSC Box 4003, Vance AFB, OK 73705-4003.

Seeking contact with aircrew members of a B-17 named ***Trade Winds Jr.*** of the 487th Bomb Group, Lavenham, England, which was shot down over Berlin August 6, 1944. The nose gunner was SSgt. John D. Taber, who was a POW at Stalag Luft 9C and was repatriated on the Swedish ship *Gripsholm* in 1945. The pilot was 1st Lt. (or Capt.) J. J. Hatfield; the tailgunner was Henry Ong; and the bombardier was named Eddy. **Contact:** Maj. Robert M. Taber, USAF (Ret.), 3101 Mimosa Dr., Sherman, TX 75090.

Seeking information on the whereabouts of Air Force officers who were with the Defense Communication Agency in Europe in the 1960s, including officers **Glenn W. Askew, Walter F. Brothers, Thomas R. Coleman, Larry Downs,** and **James Kahl,** and enlisted men **Tim Helixon, Phil Melancon,** and **Billy Nunn. Contact:** C. R. Timms, P. O. Box 6892, Marietta, GA 30065.

Seeking information on **Eugene Humphry** and **Glenn A. Wallace** of Pilot Training Class 51-G at James Connally and Reese AFBs, Tex. Humphry was last known to be flying B-57s at Hill AFB, Utah, in the 1960s. **Contact:** Maj. Gary Sparks, USAF (Ret.), 1332 S. Camino Seco, Tucson, AZ 85710.

Seeking pilots from the **522d Strategic Fighter Squadron** ("Fire Balls"), 27th Strategic Fighter Wing, Bergstrom AFB, Tex., 1953–56, for possible

Unit Reunions

Aircraft and Missile Test Vets
Veterans of the Aircraft and Missile Test Directorate, Holloman AFB, N. M., will hold a reunion May 28–31, 1993, in Albuquerque, N. M. **Contacts:** Col. John G. Ballard, Jr., USAF (Ret.), 3301 La Sala Del Este, N. E., Albuquerque, NM 87111. Phone: (505) 299-3486. Col. George F. Myers, USAF (Ret.), 8747 W. Villa Hermosa Dr., Peoria, AZ 85382. Phone: (602) 566-1202.

Altus AAF
Personnel who served at Altus AAF, Okla., will hold a fiftieth-anniversary reunion May 20–22, 1993. **Contacts:** Joe Gilhooley, 22924 Ironwedge Dr., Boca Raton, FL 33433. Phone: (407) 368-2181. S. O'Brien, 3011 Peacock Ln., Tampa, FL 33618. Phone: (813) 933-2047.

Tonopah AAF
Personnel who served between 1941 and 1945 at Tonopah AAF, Nev., will hold a fiftieth-anniversary reunion May 28–30, 1993, in Tonopah, Nev. **Contact:** Lt. Col. Melvin S. Halpern, USAF (Ret.), 6120 Ranger Way, Carmichael, CA 95608. Phone: (916) 967-4268.

11th Bomb Group
Veterans of the 11th Bomb Group will hold a reunion June 16–20, 1993, in Omaha, Neb. **Contact:** Robert E. May, P. O. Box 637, Seffner, FL 33584. Phone: (813) 681-3544.

Class 43-D
Members of Pilot Class 43-D will hold a reunion May 5–8, 1993, at the Hyatt Regency in Kansas City, Mo. **Contact:** Jack Carlson, 3045 Silverview Dr., Cuyahoga Falls, OH 44224. Phone: (216) 688-4848.

47th Bomb Group
The 47th Bomb Group will hold a reunion April 1–4, 1993, at the Marriott Pavilion Hotel in St. Louis, Mo. **Contact:** Costa Chalas, 64 Trapelo Rd., Belmont, MA 02178. Phone: (617) 484-5620.

Class 49-B
Members of Pilot Training Class 49-B will hold a reunion July 7–11, 1993, in Dayton, Ohio. **Contacts:** Lt. Col. John Stolly, AFRES (Ret.), 11323 Cotillion Dr., Dallas, TX 75228. Phone: (214) 681-8290. Lt. Col. Roy Wampler, AFRES (Ret.),

reunion. **Contact:** Mrs. Wayne Wilson, c/o D. F. Williams, 1985 Fairlee Dr., Encinitas, CA 92024.

Seeking information on **Charles F. Ashton, Lt. S. S. Hand, Lt. J. L. Mauroner,** and **Melvin Waite. Contact:** Loizy Laurent, 157 Rue des Écoles Préaux, 76160 Darnetal, France.

For a history of Air Force Explosive Ordnance Disposal, author seeks photos, stories, unit histories, logbooks, etc., from Army Air Corps Bomb Disposal and **Air Force EOD** personnel. **Contact:** CMSgt. Marshall "Doc" Dutton, USAF (Ret.), 150 Grand View Ave., Valparaiso, FL 32580-1602.

Seeking contact with anyone who knew **2d Lt. William A. Moore,** a copilot on 1st Lt. Morton Wieand's B-17, of the 94th Bomb Group, 4th Bomb Wing, 8th Air Force, which was lost on a raid on Emden, Germany, May 21, 1943. The mission was apparently flown from RAF Bassingbourn, and this aircraft was one of five lost from the 4th Bomb Wing on that mission. **Contact:** Paul Files, 9200 Baring Way, Everett, WA 98208.

Seeking information on the service career of **L. E. "Randy" Tolbirt, Jr.** He was with the 87th Troop Carrier Squadron, 438th Troop Carrier Group, 9th Air Force, in April 1945. **Contact:** Billie Tolbirt Rankin, 500 Wichita #12, McAllen, TX 78503.

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 reserve the right to condense them as necessary. We cannot acknowledge receipt of letters. Unsigned letters, items or services for sale or otherwise intended to bring in money, and photographs will not be used or returned.—THE EDITORS

Seeking contact with veterans of 12th Bomb Group, 12th Air Force, who were **B-3 sight project participants** in July–August 1943, especially Lt. W. W. Harkness. **Contact:** J. W. Swancara, 1002 E. Mariposa Ave., El Segundo, CA 90245-3114.

Researcher/historian studying **P-51 Mustang** aircraft seeks contact with anyone who flew, maintained, or has information regarding Mustangs. **Contact:** William R. Brafford, Jr., 28450 Tonner Dr., East Highland, CA 92346. ■

2634 Oro Blanco Dr., Colorado Springs, CO 80917. Phone: (719) 597-1848.

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.

474th Fighter Group
Veterans of the 474th Fighter Group (World War II) will hold a fiftieth-anniversary reunion April 29–May 2, 1993, at the Holiday Inn in Fort Walton Beach, Fla. **Contact:** Col. Lloyd Wenzel, USAF (Ret.), 204 Turtle Creek Dr., Tequesta, FL 33469. Phone: (407) 747-2380.

622d Air Refueling Squadron
Veterans of the 622d Air Refueling Squadron will hold a reunion April 28–May 1, 1993, in Alexandria, La. **Contact:** Daniel Sloan, 1507 Hwy. 1204, Pineville, LA 71360. Phone: (318) 640-4208.

820th Bomb Squadron
Veterans of the 820th Bomb Squadron, 7th Air Force (World War II), will hold a reunion May 6–9, 1993, at the Holiday Inn Surfside in Clearwater, Fla. **Contact:** Willliam W. Childs, 3637 Patsy Ann Dr., Richmond, VA 23234. Phone: (804) 275-6012.

B-24 Personnel
For the purpose of planning a reunion in 1993, I am seeking contact with pilots, crew members, or production personnel associated with the B-24 Liberator at Willow Run Bomber Plant in Ypsilanti, Mich. and Romulus Airfield during World War II. **Contact:** R. J. Blodgett, P. O. Box 802, Riverdale, GA 30274.

9th/513th Bomb Squadrons
I am trying to locate members of the 9th and 513th Bomb Squadrons for a fiftieth-anniversary reunion in 1993. **Contact:** Harold Raiklen, 4300 Cerritos Ave., Long Beach, CA 90807. Phone: (310) 426-7581.

Class 54-G
Seeking contact with members of Class 54-G (Lackland, Goodfellow, and Foster AFBs, Tex.) for the purpose of organizing a fortieth-anniversary reunion in 1994. **Contact:** John P. Noonan, RR 1, Box 192B, Linden, TX 75563. Phone: (903) 835-1014.

Class 56-10
Seeking contact with navigators of Class 56-10, Harlingen AFB, Tex., for a reunion. **Contact:** Col. Richard W. Schoonmaker, USAF (Ret.), 6694 E. Easter Pl., Englewood, CO 80112. ■

Bob Stevens'

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THIS MAGAZINE ONCE RAN A STORY WHICH FEATURED A COLUMN CALLED, "YOU KNOW YOU'RE OVERSEAS WHEN..." THIS PROMPTED THE FOLLOWING FROM THE *EX-CBI (CHINA BURMA INDIA) ROUNDUP* FROM WW II –

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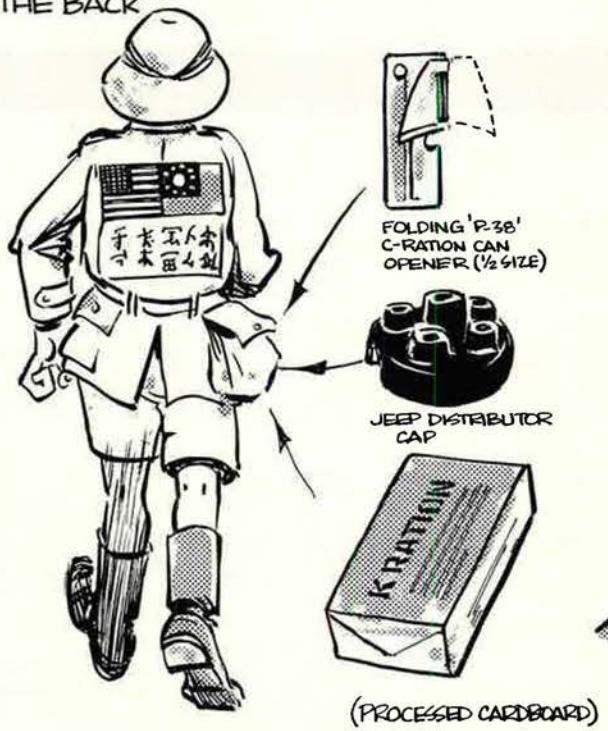

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