DECEMBER 1988/$2

AIR FORCE MAGAZINE

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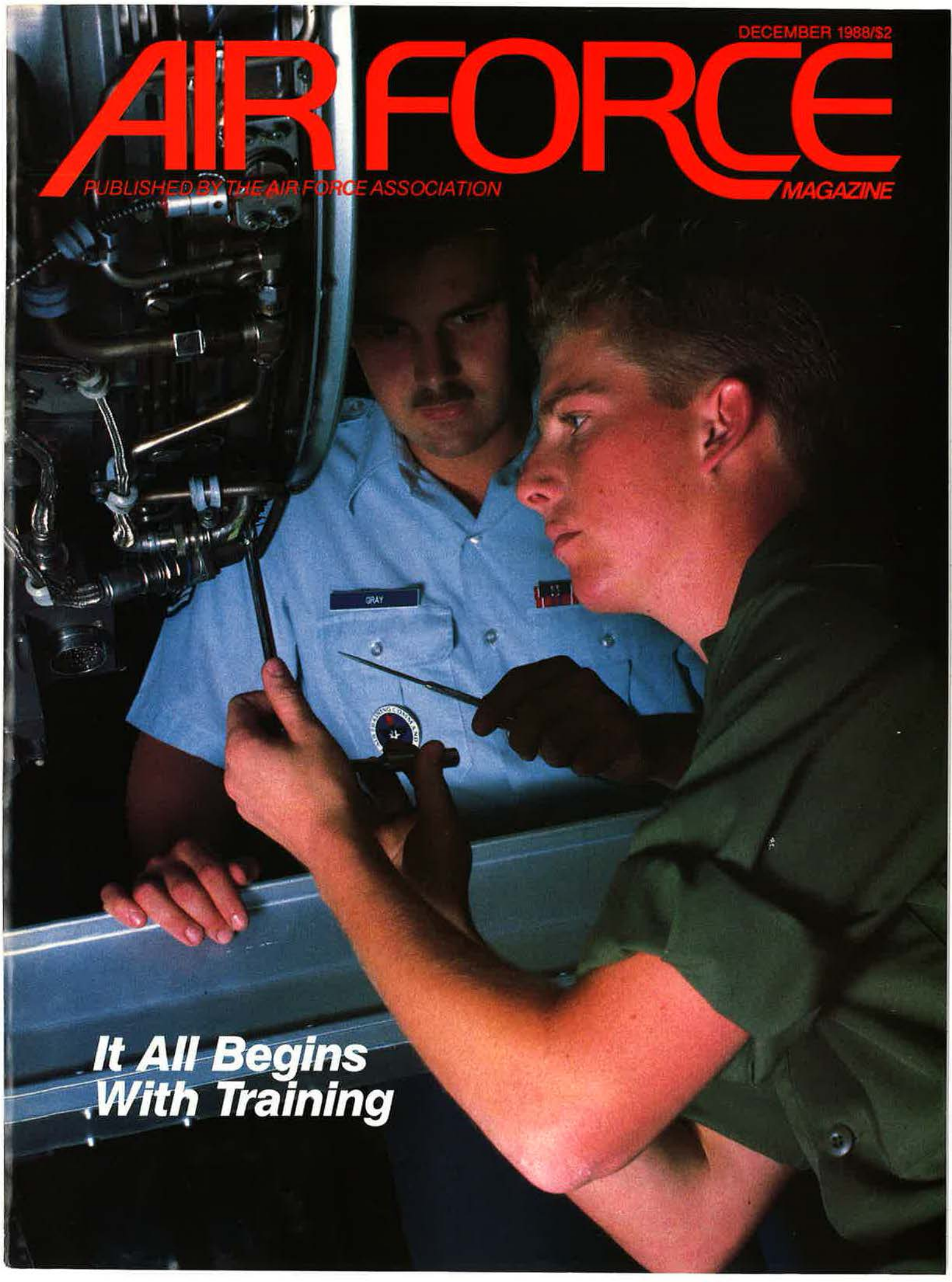
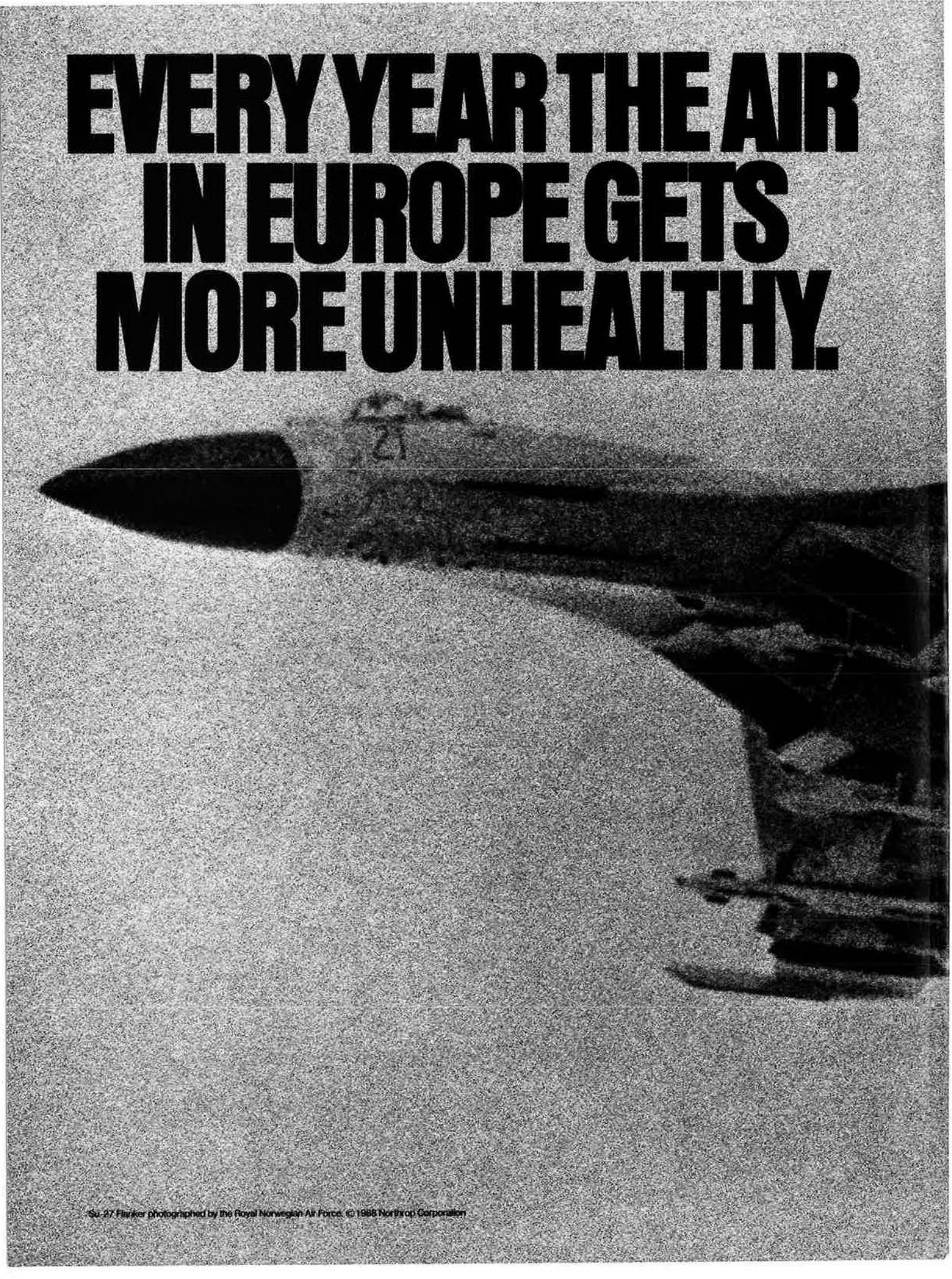


It All Begins With Training

EVERY YEAR THE AIR IN EUROPE GETS MORE UNHEALTHY.



Su-27 Flanker photographed by the Royal Norwegian Air Force. © 1988 Northrop Corporation

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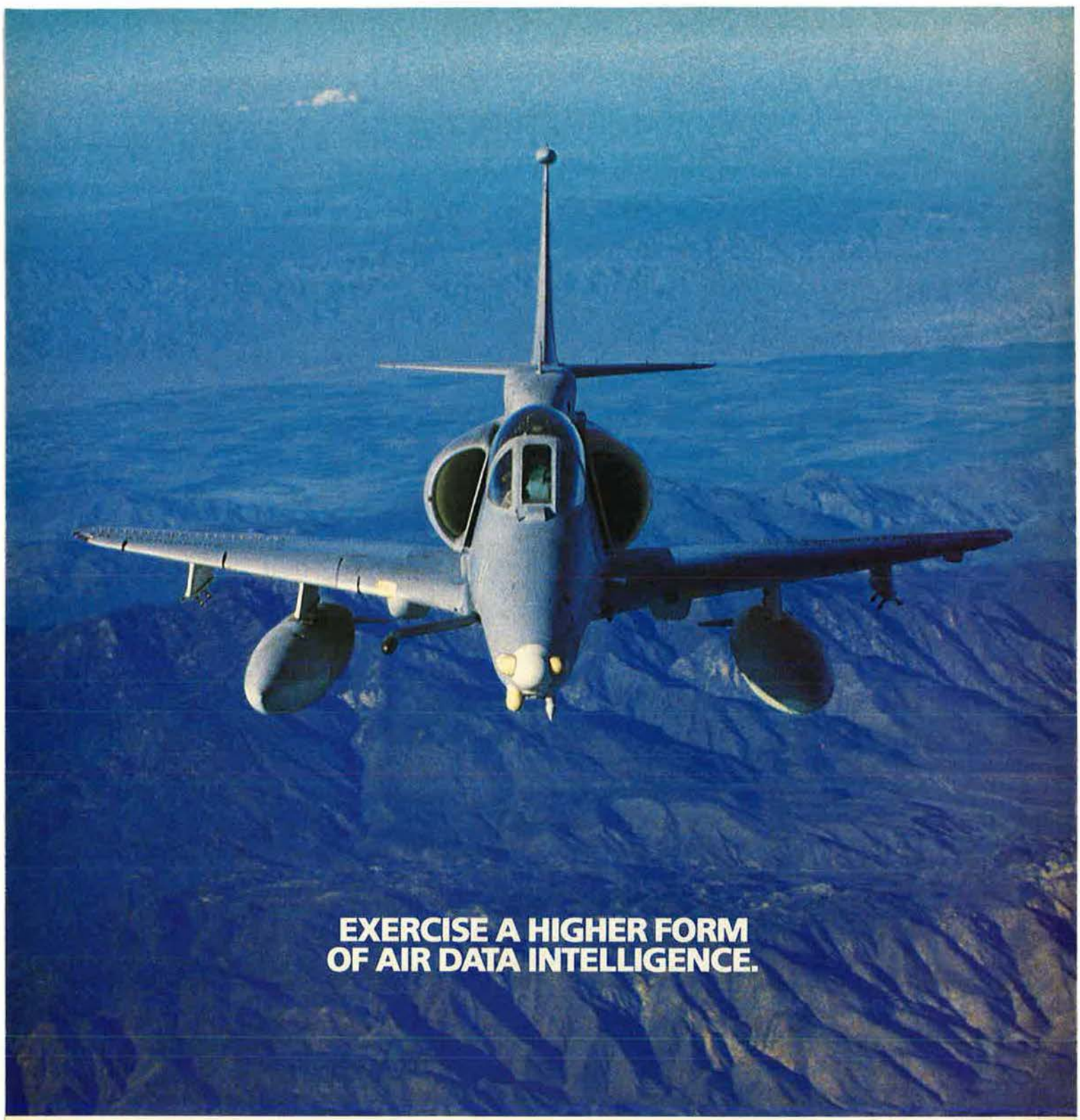

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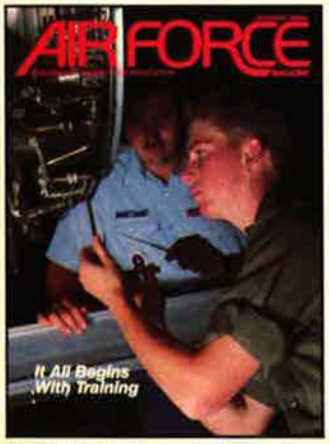

About the cover: In this Don Smith photo, SSgt. Matthew Gray instructs AB Alan Greg Salter in the finer points of jet-engine maintenance at Chanute AFB, Ill. A special section on Training begins on p. 40.

Special Section: Training

Features

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An Editorial

Of MiGs and Plowshares

By John T. Correll, EDITOR IN CHIEF

KREMLIN-watchers have had plenty to watch since General Secretary Mikhail Gorbachev came to power in March 1985. He moves with great sweeps and flourishes in the foreign-policy arena, often catching the West insufficiently prepared to respond. In the eyes of the world, he has taken the initiative in East-West relations away from the United States. NATO leaders are wary of Mr. Gorbachev's aggressive courtship of Europe, but public-opinion polls find his popularity booming.

At home, Mr. Gorbachev continues to send shock waves through Soviet industry with his relentless program of reform. He is lowering the priority on military production in favor of domestic output—or so he says. To the Soviet member republics and East European client states, he holds out the promise of increased freedom on selected matters. Mr. Gorbachev seems to know what he wants, and he does not hesitate to sack those, from ministerial rank on down, who stand in his way.

In the course of a spectacular hour on September 30, Mr. Gorbachev replaced twenty-two departments of the Communist Party Central Committee with six sleek commissions, added the Soviet presidency to his own portfolio, and threw a clutch of foot-draggers off the Politburo.

To give Mr. Gorbachev his due, he is the most innovative Soviet leader since Lenin. But how should a prudent world interpret his exertions? We can probably take his industrial reforms at near face value. Whatever his agenda is, the inefficiency of Soviet industry is a barrier to achieving it. The outlook is more ambiguous on other internal reforms. Mr. Gorbachev is not going to abolish single-party rule or weaken Moscow's control of Soviet affairs. His regime of the future may be slightly less oppressive, but the essential trappings of a police state are likely to remain.

For the West, however, the big questions are about Mr. Gorbachev's military intentions and his foreign policy. Speechmaking aside, there is no sign that he is on the verge of beating his MiGs into plowshares.

The Defense Policy Panel of the House Armed Services Committee recently took a fresh look at Soviet military posture. Its conclusion was that Mr. Gorbachev "does not appear to have caused any concrete, operational changes in Soviet military behavior. Military procurement policies have not been affected, and while there have been some changes in deployment and training practices, they have not been significantly different from what would be expected from evolving military-technical doctrine." The panel found that:

- Soviet military spending grew by about three percent in both 1986 and 1987, almost double the rate of growth in the previous five years.
- Military *perestroika* appears to be mostly a matter of modernizing and streamlining. The Soviets are moving toward a unified corps-brigade organization, which, along with other improvements, might allow them to maintain their force capability with three to five percent less manpower.
- Overall, Soviet forces are manned at eighty percent of wartime strength, somewhat lower than in the 1970s. The number of Soviet troops deployed in Europe, however, has not declined. In fact, the USSR has added more equipment and logistics support, thereby creating a larger wartime force.

The House panel was in accord about the tangible evidence, but split in its speculation on Soviet doctrine. The majority view was that the Soviets may be telling the truth when they say they have shifted to a defensive doctrine and now seek nuclear parity rather than superiority. Ten members of the panel dissented. They said that if the Soviets no longer emphasize nuclear supremacy and offensive operations, they have done precious little to demonstrate it.

Additional perspectives on Soviet military posture come from US Secretary of Defense Frank C. Carlucci and David Mellor, a British minister of state.

"The Red Army has more divisions in Czechoslovakia than the US has in all of Europe, and more divisions in East Germany than the US has in its entire active Army," Mr. Carlucci said in an August 30 *Wall Street Journal* column. He added that the emphasis on tanks, motorized artillery, forward-based bridging equipment, and operational maneuver groups is inconsistent with a defensive doctrine.

Mr. Mellor, at a meeting of the Western European Union, observed that the Soviet Union produces two new aircraft, six artillery pieces, and eight tanks each day. The Soviet Navy acquires a new nuclear submarine every thirty-seven days.

Columnist Charles Krauthammer contends that "in foreign policy, the Gorbachev Doctrine is imperial triage. Discard the losers. Deal away the marginals. Keep the jewels." Afghanistan was a loser, so the Soviets are pulling out. They are ready to deal on Cambodia and Angola. The three great jewels, Mr. Krauthammer says, are Central America, China, and above all, Europe. Mr. Gorbachev's methods are more genteel than those of his predecessors, but the goal is the same: Drive a wedge between the United States and Western Europe and, if possible, neutralize that part of the continent.

At present, the probability of direct Soviet military aggression against the major Western powers is very low. The Soviet Union must still be regarded as an adversary, though, and it is increasingly a better armed adversary, potentially more dangerous than ever. The confrontation of the great powers goes on, and the underlying nature of it is about the same as it was before. ■

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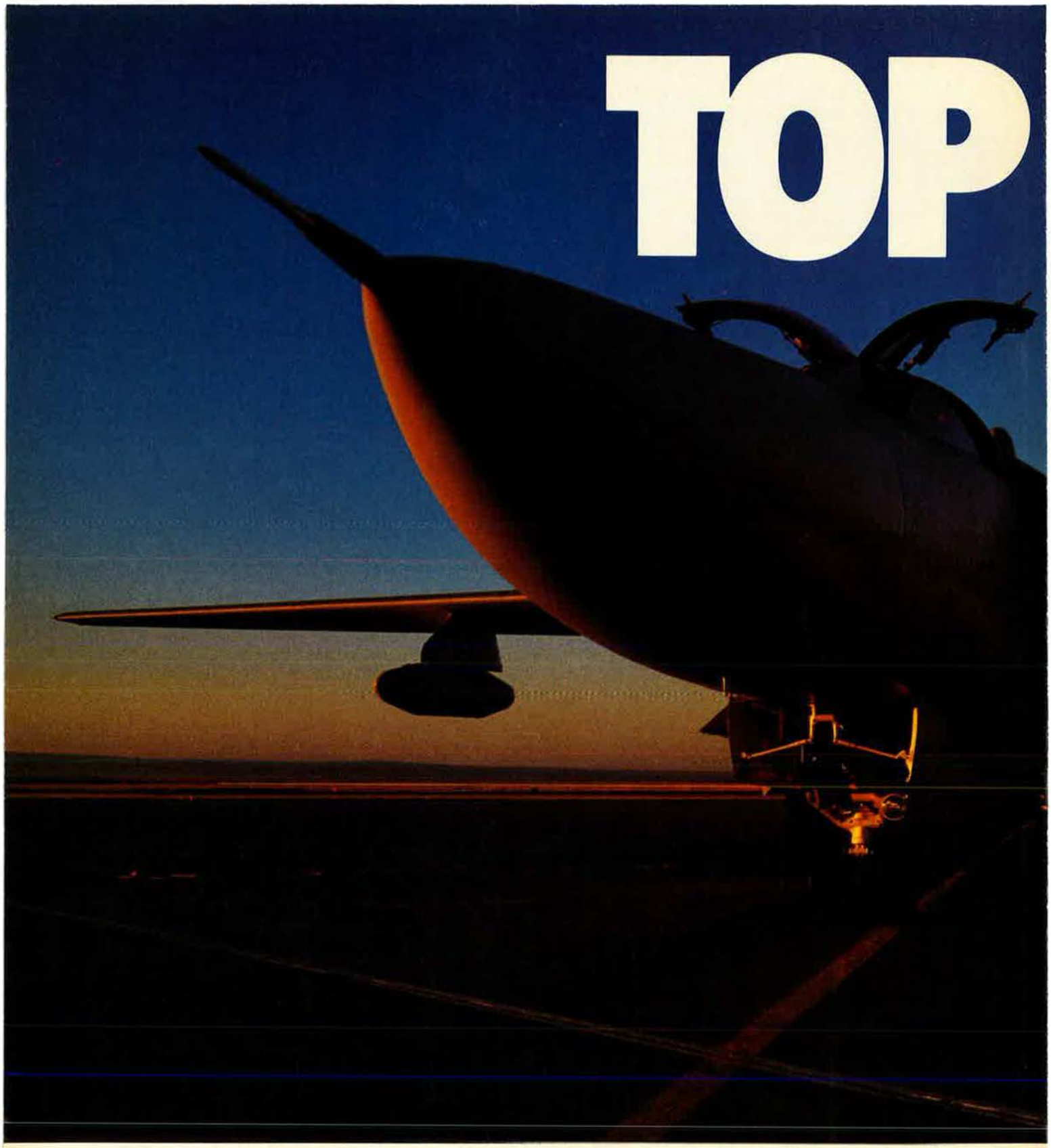

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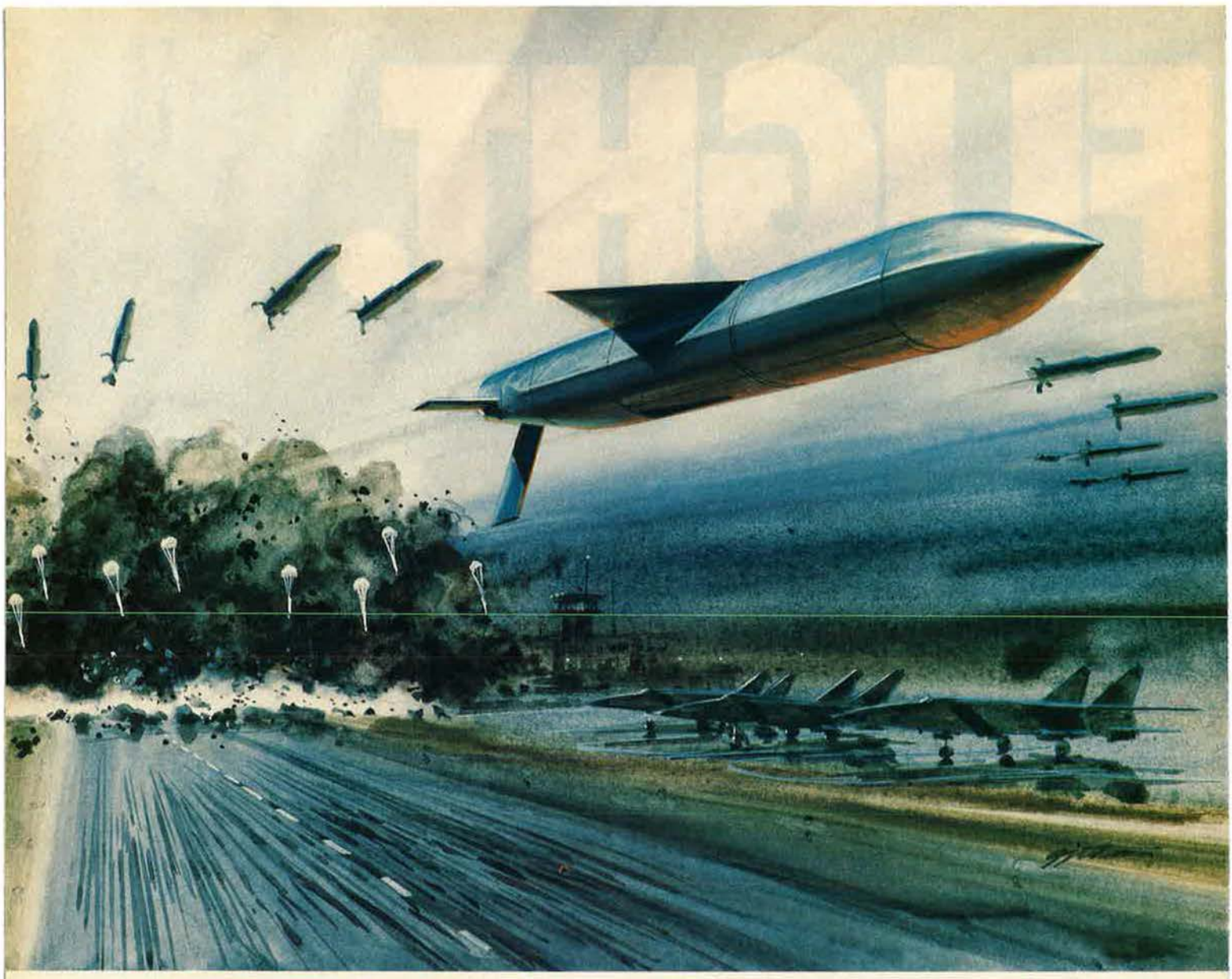

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Airmail

CAS/BAI Debate

Your October 1988 article entitled "Of Mudfighters and Elephants" is typical of Air Force thinking (and force structure planning) since the end of World War II. Unfortunately, the rationale underlying Maj. Gen. William A. Gorton's article is inconsistent with the realities of Close Air Support (CAS) and Battlefield Air Interdiction (BAI) environments. To recognize this inconsistency, one need merely reflect on the CAS and BAI situations that the Air Force faced in Korea and in Southeast Asia (SEA).

There is little reason to expect that future combat environments will differ markedly from what we experienced in Korea and SEA. In short, the CAS and BAI scenes that were most prevalent in those major conflicts were characterized by:

- Fluid, ill-defined battle lines wherein the enemy capitalized on the inability of our CAS resources to see and attack his forces effectively when they were in "close contact" with friendly forces.
- Marginal weather conditions during much of the combat periods, dictating the use of aircraft that could operate and survive beneath low cloud ceilings and in poor visibility.
- Periodic breakdowns in the channels of communication between ground units and USAF CAS resources, necessitating the use of airborne weapons platforms that could respond to the changing needs of the ground commander by selectively applying a wide variety of ordnance and remaining in the immediate battle area for relatively long periods of time.
- The unsuccessful attempt by USAF to apply "high-performance" aircraft to the CAS role. In Korea, the F-84 and the F-86 were singularly unsuccessful in attacking CAS targets. They were most effective when assigned to counterair and deep interdiction. In SEA, helicopter gunships and A-1 aircraft were the consistent preference of ground units in close contact with the enemy. Again, the high-performance aircraft (F-100, F-105, F-4, and F-5) were judged less effective for CAS and BAI.
- The continuing need for USAF units to train newly arrived pilots in CAS and BAI [techniques for] that particular combat arena. The effectiveness of pilots is directly and significantly [related to] the prior training that they have received in CAS and BAI tactics; the ease with which they can adjust those tactics to the combat zone, given a certain weapon system; and their perception of the importance of the CAS and BAI missions, relative to the counterair and interdiction tasks.

I find it difficult to accept the fact that the Air Force is still pushing the mistaken idea that aircraft zooming in and out of the CAS and BAI environments at 550 knots provide a useful platform for pilots to see and hit targets in close proximity to friendly forces.

I have flown high-performance jet fighter aircraft, and I know that target acquisition in the CAS and BAI environments is dependent on identification and marking of targets by either ground-based or airborne Forward Air Controllers. To imply otherwise is to distort the lessons learned in Korea and SEA.

Col. Richard L. (Larry) Mehr, USAF (Ret.)
Oregon, Ill.

I am writing in response to Major General Gorton's article, "Of Mudfighters and Elephants." In many respects, I found the article informative and eye-opening; however, I am compelled to add to the General's discussion of aircraft survivability in the CAS/BAI role.

True, knowing precisely where the target is, prior to aircraft exposure, would significantly reduce exposure to hostile fire and hence the chance of a shoot-down, but let's keep in mind that in the friction of battle, over a "fluid" battlefield, often under adverse weather and at night, precise target location will often be more a matter of luck than a matter of technology.

In addition, the General played down the ability to absorb hits as an important consideration in the aircraft selected to perform the CAS/BAI role. Sortie generation will be a key factor in the attainment of air superiority in a future war. Aircraft that can absorb hits and make it back to base so that they can be repaired and flown again with minimal logistic support could prove more valuable than a "high-speed, flexible-mission" platform. A flight line of badly damaged, unrepairable "multirole" aircraft will be of little use to the Army.

Ground crews, suffering from exhaustion, working in a chemical warfare environment, and falling victim to attrition and parts shortages, will likely perform the same type of "make it fit, tape and glue" repairs that have been characteristic of ground crews throughout the history of aerial warfare. *[See "Improvise. Adapt. Overcome." on p. 72 of this issue.]* An airframe of rugged, simple design may prove the best platform in this environment.

Basing our future CAS/BAI planning on the hope that we will be able to avoid being hit by hostile fire seems a risky, if not downright dangerous, proposition. The F-16 could probably better employ its talents in the deep interdiction role against stationary, large, high-value targets. It is in this environment that its precision tactical bombing capability and high speed could prove most valuable.

A flight line of potential "hangarqueens" serves little value as a deterrent and will be of little use in a future war. Perhaps, if push comes to shove, we could roll them out of the hangars and use them as decoy aircraft as we await the arrival of a squadron of fresh A-10s from the United States.

Arthur P. Katz
Victorville, Calif.

Do you have a comment about a current issue? Write to "Airmail," AIR FORCE Magazine, 1501 Lee Highway, Arlington, Va. 22209-1198. Letters should be concise, timely, and legible (preferably typed). We reserve the right to condense letters as necessary. Unsigned letters are not acceptable, and photographs cannot be used or returned.

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Airmail

Maj. Gen. William A. Gorton writes of the AV-8B, "The penalty paid to 'operate off the beach, right with the troops' is that you trade range and payload to achieve a vertical takeoff and landing (VTOL) capability. This does not mean that the AV-8B cannot and does not do BAI. It simply means that its BAI capability is less than that of a conventional aircraft."

I would like to point out respectfully that we at British Aerospace and our partners at McDonnell Douglas do not use the acronym VTOL, which is most accurately applied to rotary-wing aircraft. We prefer V/STOL, for "Vertical/Short Takeoff and Landing," or, better still, STOVL for "Short Takeoff and Vertical Landing." Using its Short Takeoff (STO) capability, the Harrier II AV-8B can lift nine tons of fuel and ordnance into the air from about a 300-meter takeoff roll on rough ground. Once fuel and ordnance are expended, the aircraft will land vertically. Or, if the conditions allow it, the aircraft will take off vertically with a reduced payload—fuel and ordnance in any combination the circumstances dictate. For the life of me, I can't think of any other aircraft that will take off with fifty percent of its maximum disposable load in its minimum takeoff distance (zero meters in the Harrier's case), or with 100 percent of its payload from 1,000 feet of rough ground.

In the context of another article that was published in the same issue ("Fighting Under Attack," by John T. Correll, p. 50), I believe that the flexibility of the Harrier, and especially its ability to operate off-base or from a damaged airfield, offers at the very least a partial solution to the problem of sustaining an effective air effort in the face of determined enemy counterair interdiction. A force structure that embraces a significant V/STOL element offers the defending (and, hopefully, counterattacking) force enormous flexibility and presents the enemy with a great many tactical uncertainties; the confusion of our enemies can only be of benefit to ourselves.

Gregor M. Ferguson
British Aerospace
Kingston upon Thames
England

Beneficial Veto

Your October "Capitol Hill" column pointed out some Pentagon concerns that the President's veto of the 1989 defense authorization bill would end up hurting the military. [Those concerned will] be pleased to hear that we finally passed a bill that included all the authorizing and appropriating language we agreed on in the original bill—but also strengthened SDI and improved our arms-control negotiating position. In short, our defense bill turned out a lot better, thanks to the President's courageous veto.

Sen. Robert W. Kasten, Jr.
(R-Wis.)
Committee on Appropriations
Washington, D. C.

Chairman's Valediction

Recently, I concluded four years in the top two elected leadership positions of the Air Force Association—National President and Chairman of the Board. It was an honor to be able to serve this Association, but I think it necessary to reflect on what we do and what we can do in performing our mission.

AFA is officially a veterans' organization, comprising members from the retired military, active-duty military, reserve forces, aerospace and other industry, business people, and concerned citizens representing most communities throughout our nation. Our primary concern is assuring adequate military preparedness of the United States and its allies to maintain security and thus peace. We do this through education of our members and the general public—education in publications, such as AIR FORCE Magazine; education through symposia, such as those in Los Angeles and Orlando; education in the community through the meetings of our chapters; and education of the public through the Roundtables and other functions of our Aerospace Education Foundation.

Many of our members have become activists in getting the word to the public via talks to service organizations, or ensuring that white papers and other timely publications have been distributed within their areas, or obtaining media coverage. However, the number of activists has been far too few and the coverage inadequate. We must all, if we are going to succeed in our mission, do more in getting the facts concerning military needs and the defense budget to the American people. This, in turn, will provide an educated public with the ammunition to demand that their representatives in Congress make the proper decisions regarding the security of our nation.

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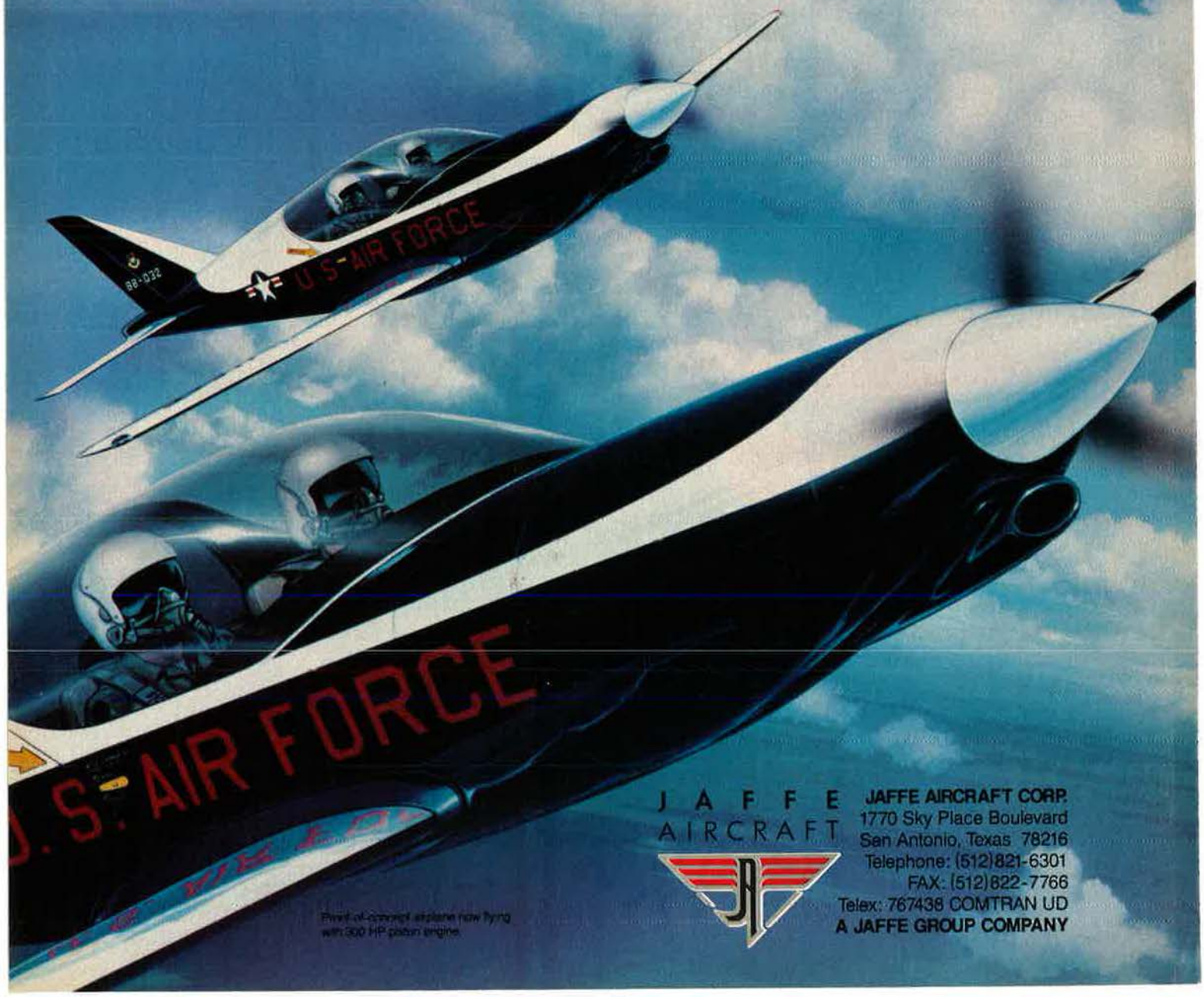

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I wish to thank the many members of this fine organization for the support they have provided me, and for the many hours spent as volunteers in carrying forth the messages of AFA. For those who have not actively joined in the pursuit of our mission, I encourage you to get involved—you'll like the results.

Martin H. Harris
Past AFA National President
and Chairman of the Board
Winter Park, Fla.

The First Cadet

I write to correct Dr. William Teague's October review of George Fagan's book on the Air Force Academy.

The *first* cadet, Valmore P. Borque, a fine young man, arrived at Lowry at 0400 hours July 11, 1955. He showed up early because he wanted to be the first cadet to be sworn into the Air Force Cadet Wing.

It is the prince of ironies to have to add that Val Borque was the first Academy graduate killed in action and the first man buried in the Academy's cemetery.

Col. James B. Townsend,
USAF (Ret.)
Manhattan, Kan.

• *Colonel Townsend was the Academy's first Air Officer Commanding (AOC).*—THE EDITORS

Going Downtown

Regarding the review *[see "Airman's Bookshelf, October '88 issue, p. 110]* of the Jack Broughton book *Going Downtown* and the disparaging remarks therein concerning the top brass of the 388th TFW, it seems only proper that you check the facts.

I was a Squadron Ops Officer at Korat RTAFB from November 1966 to June 1967, and I don't know of a single "jock" who would have traded his Korat assignment for one at Takhli. In fact, the outstanding reputation of the 388th TFW was well known in the States and elsewhere. It was common [practice], if you were headed for SEA in 105s, to do all you could to get assigned to the 388th.

The credit for this reputation was no secret, it was the caliber of its Wing Personnel—all top-notch professionals: a Wing Commander who commanded a 105 wing at Spangdahlem AB, Germany, and a D. O. and Assistant D. O. with careers of "fighter" experience dating back to P-40s and P-51s, respectively. These are facts that can be easily checked, and should have been, prior to publishing a favorable review of this book.

Can you possibly imagine the grief and devastation that has been thrust on these individuals as a result of the irresponsible and false accusations concerning their performance made in this book by the author?

What has happened here is an injustice of the greatest magnitude. Every effort must be made to rectify the situation. [The Editors should not only] make amends to the gentlemen concerned, but should set the record straight in print. A retraction of your favorable review of this book is likewise in order.

Alfred J. Lagrou, Jr.
San Marcos, Calif.

Price's Crewmates

Regarding your August '88 "Valor" article on Capt. Donald Price, what were the fates of Capt. Lynwood Bryant, the F-4 backseater, and SSgt. Clyde Jackson, the HU-16 crewman who was so badly injured when the artillery shell hit his plane? Your article didn't explicitly state what happened to them.

Capt. Michael Devine,
USAF
Kirtland AFB, N. M.

• *Capt. Donald Price's reply appears below:*—THE EDITORS

Captain Bryant was the first one picked up by the Navy helicopters because he was the closest to shore. The same chopper also picked up Westenbarger, Jackson, and Hall. It was then too heavy to pick up any more survivors and returned to the USS *Enterprise.*

The second chopper came to me and Peerson, and while I was trying to help Peerson into the "horsecollar," the craft took several hits from the sampans and began leaking fuel very heavily. The helicopter vacated the area, and I never saw it again. This is when I was left alone and swam to get the liferaft that Peerson had left.

Jackson was evacuated to the States for surgery on his left wrist and left knee, which took some heavy shrapnel hits. He never returned to the 33d ARRS.

As for Captain Bryant, I have no knowledge as to whether he flew again up north or if he went Stateside. The policy at that time was that if you got shot down, you had a ticket home.

I can certainly verify that both Jackson and Bryant were saved.

Offsets Blackmail

In his article titled "You Scratch My Export and I'll Scratch Yours," *[see September '88 issue, p. 128]* F. Clifton Berry, Jr., points out one of the most serious problems facing the US aerospace industry: offsets agreements. Unfortunately, these problems do not seem to have worried either of the two Presidential candidates.

The author explained very well all of the aspects and consequences of this odious blackmail.

Even if America designs and makes the best aerospace, military, and high-technology equipments in the world, the country as a whole does not benefit very much from these advantages. In order to sell these products to countries that have an absolute need to procure them anyway, the US must import products that have domestic counterparts, thus hurting other American industries. Moreover, the US gives away hard-earned and costly technologies and, consequently, fosters future competitors around the world. All this does not help the trade balance and the employment rate in the States.

Ironically, the most voracious countries in terms of offsets agreements are the ones running very healthy trade surpluses with the US (Japan, Canada, the UK, and France). The Administration and US manufacturers should not give up. They should insist on getting offsets each time America imports Japanese VCRs and cars, Canadian fish and lumber, British whiskey and sweaters, and French wines and ocean liners.

Philippe Cauchi
Montreal, Quebec
Canada

The Last Shooting Star

The October '88 issue of AIR FORCE Magazine reported in "Aerospace World" the retirement of the last T-33 aircraft, except for the possible existence of an NT-33 remaining for test purposes. I wish to bring to your attention the one remaining USAF T-33A, #51-4120, which is indeed an NT-33A. Not only is it the sole remaining T-33 in USAF, but it is the oldest flying tail number in the Air Force.

This NT-33A is assigned to the Flight Dynamics Laboratory at Wright-Patterson AFB, Ohio, where it has a unique R&D mission. It has been used for more than thirty years as an "in-flight simulator."

Modifications include a "fly-by-wire" front cockpit with electrohydraulic center and side sticks, digital and analog computer systems, a pro-

grammable head-up display, an inertial navigation system, and an extensive data-recording capability. To house all of this equipment, the original nose was replaced with one from an F-94A.

As an in-flight simulator, the NT-33A can be programmed to duplicate the flight and handling qualities of other aircraft (within the performance limits of the T-33 airframe, of course). Over the years, it has contributed to the design of such aircraft as the X-15, X-24, F-15, F-16, F/A-18, and the Space Shuttle; performed research in display requirements and generic flying qualities; and helped train hundreds of Air Force, Navy, Marine, and Army test pilots.

The NT-33A will remain active for several more years. Efforts planned include continued test pilot training, research in HUD requirements, and support for the next generation of new fighters. Current plans are for the NT-33A to remain in service until 1992.

At that time it will be replaced by the NF-16D in-flight simulator, currently being developed by General Dynamics and Calspan. The NT-33A then will be retired to the Air Force Museum, Wright-Patterson AFB, Ohio, where it will join other historic research aircraft on display.

Steven R. Markman
Wright-Patterson AFB, Ohio

Security Police History

I am compiling a history of the 475th Security Police Squadron and would like to hear from former squadron members. I'd also like to obtain photographs or other memorabilia that could be displayed by the squadron.

The 475th SPS was first activated as the 475th Air Police Squadron in August 1948 at Itazuke AFB, Japan. The squadron was activated again at Misawa AB, Japan, in December 1967; the squadron's final activation was in November 1971 at Yokota AB, Japan.

Please write to the address below.

Capt. Douglas Matthews
475 ABW/SPO
APO San Francisco 96328-5000

The Eternal City

Re: Colonel Atherton's report [*"Airmail," September and October '88*] of the first raid on Rome.

Four groups of B-17s—the 301st, 99th, 97th, and 2d—were from Algeria, not Tunis, and were the first groups to bomb Rome on July 19, 1943.

The lead bombardier of the mission was Capt. Fred Wheeler of Redwood City, Calif., of the 353d Squadron, 301st Group. The target for the 301st was the marshaling yards in Rome, and Wheeler's aiming point was the roundhouse. Starting at six o'clock, he walked his train of bombs right through the roundhouse.

I witnessed this precision bombing because I was the bombardier in the lead plane of the second flight of the 353d Squadron.

Colonel Atherton could not have bombed Rome on July 18, 1943. He may have been the lead bombardier of his squadron on July 19, 1943, but he was not the lead bombardier for the 301st Group.

I am enclosing a copy of my official record of my fifty missions; you will note that the Rome raid was on July 19, 1943.

Lt. Col. William H. Oldenburg, USAFR (Ret.)
Boise, Idaho

I was interested to read Lt. Col. Roy Atherton's comments in the "Airmail" column of your September '88 issue concerning the date of the first bombing of Rome during World War II.

I, too, was on that first mission. I was lead navigator of the 96th Squadron, 2d Bomb Group. The pilot was Capt. Doug Metcalf. We were briefed very thoroughly that this was the first mission and that we *were not* to overfly or go near the Vatican. (Previous to this date, it was the policy not to bomb Rome because of the danger of hitting the Vatican.) The target of the raid was the railroad marshaling yards in the northeast section of the city proper.

I must disagree with Lieutenant Colonel Atherton on the date of the mission. It was July 19, 1943. I have a copy of the 5th Wing operations order #31 to prove it. It includes target and orders for the 301st Group. My files show that we bombed Naples on July 17, Rome on July 19, and Rome again on August 13.

Lt. Col. Paul Rix, USAF (Ret.)
Cottonwood, Ariz.

FTD 903

I am seeking information on and pictures of commanders, superintendents, and instructors who conducted training at Clark AB, the Philippines, Field Training Detachment (FTD) 903, or, as it was previously known, the Mobile Training Detachment. Photographs of the facilities are also sought.

Please include names, years, and other pertinent data. Any type of information would be appreciated. Send to the address below.

TSgt. Paul M. Foster, Jr., USAF
Unit Historian
3752 FLDTS/FTD 903
APO San Francisco 96274-5000

Baldwin Bio

For a biography of Hanson W. Baldwin, the former military editor and analyst for the New York *Times*, I would appreciate hearing from his acquaintances who would be willing to share with me their reminiscences and letters.

Robert B. Davies
1001 10th St. South
Moorhead, Minn. 56560

Scorpions and Black Widows

I am researching photos and information for two books on Northrop aircraft—the P-61 Black Widow (includes the F-15 Reporter) and the F-89 Scorpion series.

Anyone who has photos and/or color slides, or information and/or stories about Widow or Scorpion operations is asked to contact the address below.

Larry Davis
Squadron/Signal Publications
4713 Cleveland Ave., N. W.
Canton, Ohio 44709

Army Air Corps Cadets

I would like to hear from former Army Air Corps cadets and pilots about their experiences during training, including routines, instruction, curricula, etc., and about their lives on air bases in England during World War II.

Please contact the address below.

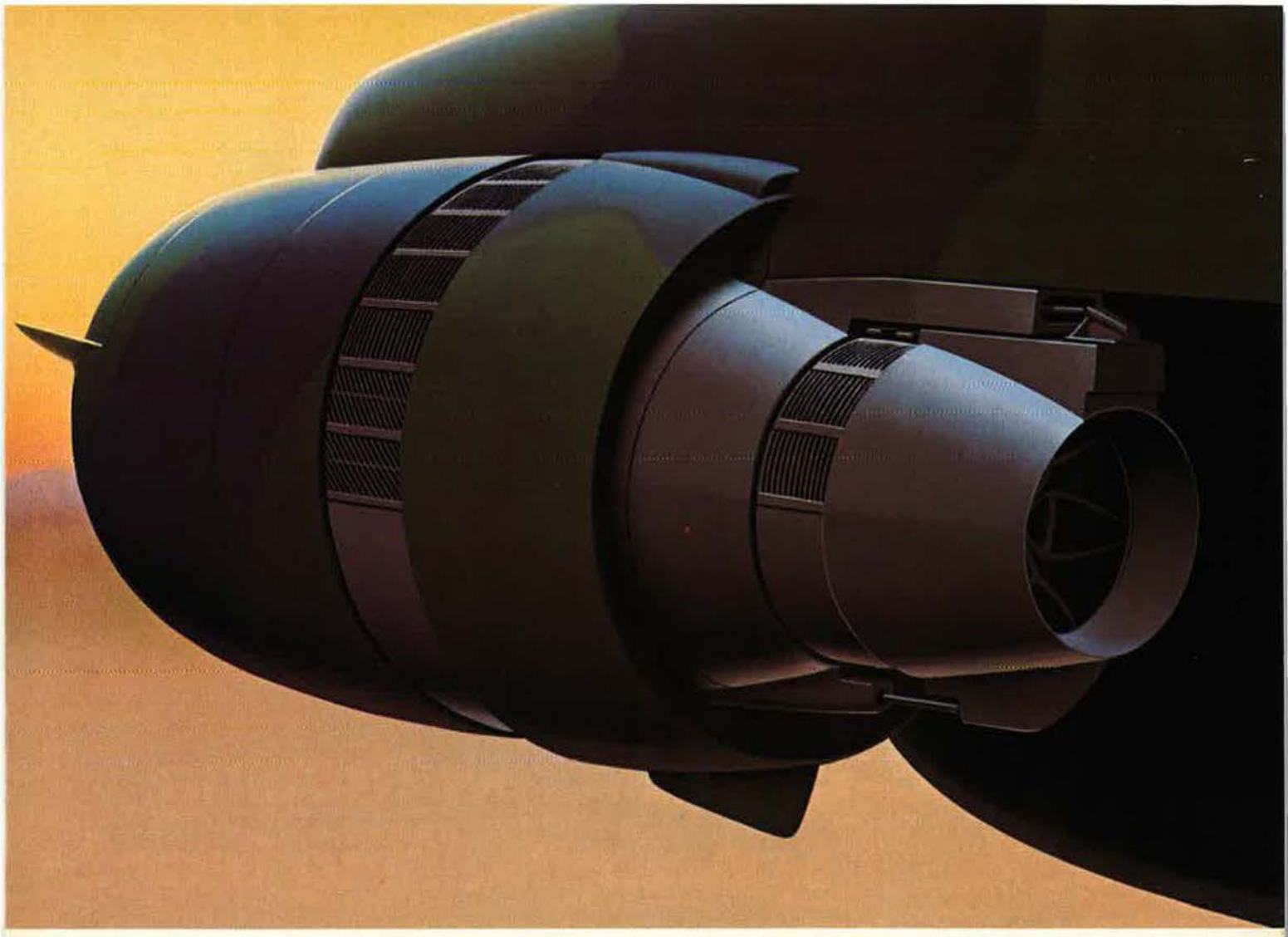
John Woods
3519 Clarington Ave. #7
Los Angeles, Calif. 90034

Roll Call

I am trying to locate an old World War II buddy from 15th Bomb Squadron and Hq. 12 AFSC, Andy Scarla, who was last seen in the Washington, D. C., area in 1947. Anyone with information can call me collect at (405) 732-4744 or write to the address below.

Norwood B. McGlamery
3704 Bella Vista
Midwest City, Okla. 73110

I am trying to locate a World War II AACS buddy, Lt. William Jakeway, who was with me on the troopship en route to the CBI (he was formerly MSgt. Jakeway). Also, my roommates at premeteorology at the University of Iowa, Dick Davis and Ed Eich. And the



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captain from Georgia, the last AACS C. O. at Kunming, China.

John W. Hardebeck, M. D.
7430 Jackson Dr.
San Diego, Calif. 92119
Phone: (619) 460-3311

Our crew is trying to locate two missing individuals, Sgt. Leonard Goldberg (radio operator) and Sgt. James F. Rafferty (right scanner), from B-29 Crew #60. We were assigned to 17th Bomb Squadron, 16th Bomb Group, 315th Bomb Wing, on Northwest Field, Guam. Any information regarding their whereabouts would be greatly appreciated.

Clifford A. Wiggers
126 Deleon Rd.
Cocoa Beach, Fla. 32931
Phone: (407) 783-3167

I am trying to establish contact with a William Curtis, ASN 36453108, who was assigned to 44th Depot Supply in Merville, France, in 1945. His last known address was in Detroit, Mich.

John C. Cheban
204 Curtis Ave.
Wilmington, Del. 19804

I would like to contact an old school/Air Force friend, Capt. Richard M. Crockwell. He was last known to be at Langley AFB, Va., in 1971 or 1972. Prior to that he was at SAC Headquarters. If you know of his whereabouts, please call or write me.

SMSgt. Ed Keeney, USAF (Ret.)
Rte. 2, Box 2545
Benton City, Wash. 99320
Phone: (509) 967-5575

Collectors' Corner

I am a collector/historian whose main interest is World War II US Army Air Forces items. One area of special interest to me is the very popular A-2 leather flight jacket worn throughout World War II. The great majority of these jackets have been worn out or in other ways destroyed or discarded. I and others like me are interested in preserving these pieces of aviation history.

Anyone who would be willing to part with one of these jackets is asked to contact me at the address below. I am willing to purchase jackets regardless of their present condition. I will accept collect phone calls from persons responding to this letter.

Maj. C. C. Blanchard III, USAF (Ret.)
906 Hyzer Ct. NE
Palm Bay, Fla. 32907
Phone: (407) 951-1845

The Chart Page

Defense and Fiscal "Reality"

Edited by Colleen A. Nash, STAFF EDITOR

At the "budget summit" a year ago, the Administration and Congress cut the FY '88 defense budget by $20.6 billion in recognition of fiscal "reality." Shortly thereafter, the Defense Department told the services to reduce their spending plans by ten to twelve percent a year for the next five years. The Air Force submitted a revised budget request for $97.5 billion for FY '89. The Appropriations bill, passed this fall, gave USAF $94.9 billion, distributed as shown here. Chronic complaints that defense was consuming too much of the federal dollar subsided a bit after the budget summit, but now are rising again. Even in the "good" budget years of the 1980s, defense took a smaller percentage of GNP than it had in the 1960s. As the chart below demonstrates, the real growth has been in entitlements and other mandatory federal spending.

The Air Force Budget

(Total Obligational Authority in FY '89 $ billions)

	FY '89 Request	FY '89 Appropriations
Aircraft Procurement	16.6	15.9
Missile Procurement	8.2	7.2
Other Procurement	8.4	8.2
RDT&E	14.9	14.5
Military Construction		
USAF	1.3	1.2
Air Force Reserve	0.1	0.1
Air National Guard	0.1	0.2
Operation and Maintenance		
USAF	22.0	21.7
Air Force Reserve	1.0	1.0
Air National Guard	2.0	2.0
Military Personnel		
USAF	20.1	20.1
Air Force Reserve	0.7	0.7
Air National Guard	1.0	1.0
Stock Fund	0.2	0.2
Family Housing	0.9	0.9
Totals	**97.5**	**94.9**

Source: DoD.

Where the Dollars Went

(As percentage of GNP)

Fiscal Year	National Defense	Entitlements and Other Mandatory Spending	Nondefense Discretionary Spending	Net Interest
1962	9.4	5.5	4.3	1.2
1963	9.1	5.6	4.3	1.3
1964	8.7	5.4	4.6	1.3
1965	7.5	5.1	4.8	1.3
1966	7.9	5.0	5.2	1.3
1967	9.0	5.7	5.2	1.3
1968	9.6	6.1	5.2	1.3
1969	8.9	6.3	4.4	1.4
1970	8.2	6.7	4.6	1.5
1971	7.5	7.6	4.7	1.4
1972	6.9	8.2	4.9	1.3
1973	6.0	8.6	4.6	1.3
1974	5.6	8.8	4.7	1.5
1975	5.7	10.2	5.6	1.5
1976	5.3	10.7	5.5	1.6
1977	5.0	10.2	5.5	1.5
1978	4.8	10.0	5.7	1.6
1979	4.8	9.6	5.5	1.7
1980	5.0	10.4	5.9	2.0
1981	5.3	10.7	5.7	2.3
1982	5.9	11.4	4.9	2.7
1983	6.3	12.0	4.7	2.7
1984	6.2	10.7	4.5	3.0
1985	6.4	11.1	4.5	3.3
1986	6.5	10.9	4.2	3.2
1987	6.4	10.8	3.7	3.1

Source: Congressional Budget Office.

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2272 **45 Min.** **$39.95**

●THE RED BARON

This is the story of Manfred Von Richthofen, WWI's premier ace who shot down 80 allied planes! This Ace of Aces was the greatest aerial tactician of World War I. Included are interviews with the last surviving pilots who flew with and against him. Excellent WWI dogfight footage, crashes, and The Red Baron's last flights are highlighted in this compelling story of the most legendary personality in the annals of aviation.

2569 **60 Min.** **$29.95**

●MODERN COMBAT AIRCRAFT: FIGHTERS AND BOMBERS

Leading aviation authority enthusiast Christopher Chant scripted this all-action film of the West's most modern and powerful land-based fighters and bombers. Included are the Dassault Mirage 2000, Boeing B-52 Stratofortress, Northrop's F-5 Tiger II and F-20 Tigershark, and more.

2623 **60 Min.** **$59.95**

●EAGLE COUNTRY

Have you ever dreamed of flying in the world's hottest fighter aircraft? The F-15 Eagle's superior dogfight capabilities will keep you at the edge of your seat as the F-15s go head-to-head against F-14s, F-16s, and F/A-18s. This one is for anyone interested in aviation.

2150 **85 Min.** **$59.95**

●Naval Combat Aircraft

All action footage puts you on board the top types which are Western naval air power today. You'll ride in the cockpit of the most advanced aircraft in the world including: F-8 Crusader, F/A-18A Hornet, F-14A Tomcat, F-4 Phantom II, E-2C Hawkeye, and many more. Also included is a detailed look at the instruments and weaponry as we witness anti-submarine, ground attack, and interceptor runs.

2340 **60 Min.** **$59.95**

●THUNDERBIRDS

The magnificent Air Force Thunderbirds put on a spectacular aerial show in this specially produced thirty-minute highlight film. You'll be strapped into the cockpit and get a look at the hottest pilots and planes in the business. WOW!

2691 **30 Min.** **$24.95**

●TOP GUN AIR SHOW

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2701 **120 Min.** **$49.95**

●HISTORY OF NAVAL AVIATION

From the first aircraft carriers, the job of naval aviation has been filled with danger and excitement. This historical look back at the proud tradition of naval aviation is brilliantly chronicled. If you want to know where naval aviation is heading, one must appreciate where it has been. GREAT FOOTAGE!

2642 **60 Min.** **$29.95**

●COMBAT TEAMS: SUPERSONIC THUNDERBIRDS

Three films highlight this collection. F-100 Sabrejets, Loops, Vertical 360 turns, and the T-38 Talons provide all the excitement you can take.

2689 **60 Min.** **$39.95**

●AIRSHOW 1987: The Return of The Blue Angels

The fabulous Blue Angels made their triumphant return flying the hot F/A-18 Hornet in this film. Get a pilot's eye view from the Hornet, NASA QSRA, and the redesigned Israeli "Super Phantom." If you like action and excitement, experience the thrill of *Airshow 1987!*

2015 **90 Min.** **$39.95**

●HISTORY OF THE BLUE ANGELS: SKYHAWK TO HORNET

Exclusive, behind-the-scenes footage of the Blue Angels highlights this exciting program that features spectacular air-to-air footage. Precision flying and aerial artistry combined with a superb musical score in HI-FI, this program is a must for all Blue Angels fans.

2690 **40 Min.** **$39.95**

●FALCON DOMAIN

The F-16 Fighting Falcon was designed to out-fight any enemy aircraft in the sky and is armed to dominate. In this full-color panorama, you get a detailed look at the systems, weapons, and "magic" which make the F-16 a 21st century fighter plane. You'll be strapped in the cockpit during gut-wrenching dogfights as the pilots take the F-16 to the edge. From the LANTIRN infrared night attack system to the high-powered ride with the "Thunderbirds," Falcon Domain is a stunning film to add to your collection.

2178 **90 Min.** **$59.95**

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The most awesome display of aerial fire-power ever was unleashed in Vietnam. *Air War in Vietnam* uses the pick of air combat footage to tell the story from the first U.S. advisor to the massive U.S. bombings. Also included is captured North Vietnamese footage of their anti-aircraft defenses.

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Austerity Is Relative

By Robert S. Dudney, SENIOR EDITOR

Defense consumes less of the GNP than it once did, while entitlement programs consume more. Even so, the impending cuts should still fund defense at a relatively high level. This is a legacy of the Reagan-era rearmament.

Washington, D. C. When the new President takes office next month, he will inherit an important military advantage from the Reagan years. He is certain to have to hold down defense spending. But because of precedents set in Ronald Reagan's tenure, future Pentagon austerity may well prove to be different from earlier periods of retrenchment.

Few doubt that a budget crunch lies ahead. But President Reagan has rewritten the rules of the game in military spending. One result is that forthcoming defense budgets, though cut far below original goals, could still reach relatively high levels, by postwar standards.

The reason is clear. The President's support for a steady expansion of spending, pursued over several years, has pushed military budgets near peacetime highs—some forty percent higher in Fiscal Year '89 than they were at the start of the decade, discounting inflation. Once set, this higher base has become the opening bid in new budget calculations.

The impact of this sustained upward shift will be seen in the Fiscal 1990–91 funding blueprint that the next President inherits. The two-year plan now being completed by Defense Secretary Frank Carlucci has taken savage cuts from planned levels. Even so, if Carlucci holds to stated guidelines, Defense Department spending will be set at about $297 billion in 1990 and $302 billion for the next year, measured in today's dollars. These would represent, respectively, the seventh and fifth largest Pentagon budgets, in real terms, since World War II.

The question, as always, is whether Congress will enact the Carlucci budgets as presented or take them as starting points for yet another round of cuts. Congressional leaders suggest that Pentagon authorizations probably will remain flat at the 1989 level of $291 billion. The 1989 budget comes in as number seven on the postwar list.

For all its undisputed cost, the Reagan defense era falls short of earlier periods in at least one important respect—in the relative burden that it has imposed on Americans. As our Staff Editor Colleen Nash points out on p. 18 of this issue, national defense spending in the Reagan years never consumed more than 6.5 percent of US Gross National Product, slightly more than in most of the 1970s but considerably less than at any time in the 1960s and 1950s. "The real growth" in US outlays, she notes, "has been in entitlements and other mandatory federal spending." Defense also consumes a significantly smaller fraction of the federal budget than has been the historic norm.

Whether the future level of funding will prove sufficient to maintain adequate defenses is another matter. Service leaders are unanimous in claiming that it will not, given the scale of Soviet military power. It will now be up to the new President and Congress to grapple once again with this fundamental policy issue.

Budget figures tell only part of the story. Equally important are the underlying reasons that caused defense spending in the 1980s to reach levels that are high by historical standards.

Sources of the Reagan Program

Some expenses were unique to the Reagan years. Example: high payments in military retirement benefits, a result of obligations made to service members by previous Presidents. Until recently, such payments remained small. Over the 1980s, however, as the retiree population grew, the Pentagon has shelled out the equivalent of $187.2 billion in 1989 dollars—reducing its actual purchasing power by nearly $19 billion each year.

Of far greater significance, however, was the pressure brought about by the perceived military need. The rationale provided by former Defense Secretary Caspar Weinberger in February 1982, at the threshold of the Reagan buildup, still stands as the most succinct justification offered by the Administration for its spending program. Three principal factors were advanced by Weinberger:

- *The Decade of Neglect.* While the Soviet Union engaged in a far-reaching military buildup in the 1970s, Washington's investment in its own forces stagnated, meaning that the US had to "pay the bill for our collective failure to preserve an adequate balance."
- *Strategic Parity.* With the Kremlin having matched the US in nuclear arms, deterrence required a compensatory buildup of expensive conventional forces. Pentagon leaders could not "in good conscience increase our reliance on the threat of nuclear weapons."
- *The Need for Readiness.* With the nation having endured years of "hollow" military forces, the Reagan Administration would never again put up "a mere facade of security by deploying forces that lack the necessary materiel and training."

To address these problems, President Reagan, continuing the trend set by President Carter in his final two years, put Defense Department spending on an even steeper upward trajectory. The result has been major increases in defense budgets in the 1980s. Compared to what would have been spent had budgets stayed at the 1979 level, allocations to the Pentagon have been $741.4 billion higher, in 1989 dollars, over this decade.

Where did this increment go? The greatest expenditure, according to an

analysis of Pentagon documents, came in the weapons and other hardware accounts. The equivalent of more than $339 billion—45.7 percent of the additional funds—was used to procure new warships, fighters, tanks, artillery, rifles, and other items. Another $116.7 billion, or 15.8 percent of the increment, went to fund research and development programs. Taken together, these accounts consumed three-fifths of the total amount.

President Reagan's determination to keep his existing forces supplied, trained, and ready to fight accounted for another huge portion of the extra expenditures—$193.8 billion, or 26.1 percent. The remaining 12.4 percent of the new money was allocated to better pay for active-duty and reserve personnel, additional military construction, provision of additional housing for military families, and military pensions.

Did any service forge ahead in the battle of the defense budget? All evidence suggests that the answer is no. Of that portion of the new funding actually allocated to the services in the 1980s, 36.3 percent went to the Navy/Marine Corps, 35.5 percent to the Air Force, and 28.2 percent to the Army. This is about the same as historical service shares.

Making the Defense Program Fit

Whatever the pros and cons in the debate over the Reagan era, there can be no denying that the new national leadership faces a budget crunch. The ambitious funding profile set forth in the Five-Year Defense Program unveiled in early 1987 has collapsed. Pentagon leaders warn that there will not now be enough money to fund their program, as originally conceived, in its entirety. Something has to give.

What, and how much, is not clear. But Sen. Sam Nunn, the Georgia Democrat who heads the Armed Services Committee, predicted at a hearing last October 4 that the original 1987 program must be trimmed by some $200 to $250 billion to fit under new, scaled-down 1989–93 Pentagon budget ceilings. In Senator Nunn's view, the challenge for the next administration will be to take on "the tough job of putting 100 pounds of fertilizer into a fifty-pound sack." Today, the question being asked is how the new President and Secretary of Defense will do it.

The statements of the two presidential candidates and their advisors in the national campaign just concluded provided a basic range of options for tackling the problem. One specific type of solution was proposed by Democrat Michael Dukakis. Noting that he was unimpressed with the Peacekeeper and Midgetman strategic nuclear missiles and the Strategic Defense Initiative program, he made a case for canceling major programs to keep budgets within bounds.

Republican George Bush took a radically different position on how to keep arms spending in tune with the new "fiscal reality" of the 1990s. Rather than scrapping weapons programs on a wholesale basis to reduce funding needs, Bush would attempt to achieve the same goal more safely by continuing the programs but stretching them out over a longer time. Even before the November 8 election, this approach was viewed by many as the likelier step.

William Schneider, a defense policy advisor to the Republican campaign, provided fuller details of the Vice President's concepts at a meeting with defense writers in October. Schneider, a former associate director for defense programs in the Office of Management and Budget and former Under Secretary of State for Security Assistance, Science, and Technology, also had headed the President's General Advisory Committee on Arms Control and Disarmament.

Schneider expressed optimism that the US will not necessarily be forced to sustain ever-higher defense budgets "as a way of life for the rest of history." Flat or slower growth budgets can be sufficient, he maintained, if the US builds on the "relatively good condition" of today's armed forces in smart ways. The overall cost of the defense program can be lowered in the short term, he maintained, by slowing the pace of modernization. "I agree," he explained, "that we will have to cut back on some major programs. What I am saying is that the technique [shouldn't be] to zero the programs."

This kind of action would mark a reversal of President Reagan's Pentagon position. It opposes "stretchouts" on the grounds that they provide the illusion of savings but cause inefficiencies that drive up the actual unit cost of weapons in the long run. The Bush advisor, however, maintained that the Pentagon can compensate for the negative effects of stretchouts with liberal use of multiyear procurement practices.

"You may buy [fewer] widgets," Schneider argued, "but if you buy them in a multiyear program, you can still retain economy of scale. . . . The problem that's killed the [defense] industry has been the annual appropriations cycle and the unpredictability. . . . What I'm suggesting is you can get to economic acquisition practices, even at lower levels of acquisition, if you procure in an efficient way."

Congress would have to approve. And Schneider acknowledged that such a process would not be without pain. Big tactical arms programs just coming to maturity "are going to face some hard times." What's more, he said, "not every system in R&D is going to be procured" because stopping a program before it gets started "is where the [new] administration will have the most leverage."

This budget-cutting approach would be controversial. William J. Perry, director of Pentagon research and engineering during the Carter Administration, recently told an electronics industry conference that arms stretchouts and research cutbacks would be "bad news"—particularly for the long-term health of the defense industry.

The Pentagon evidently will not be permitted to attempt another possible solution—pushing Congress to approve larger budgets. Even the more hawkish Republican candidate, said Schneider, already had conceded the need for "a higher order of consensus" between Congress and the White House. "We are not going to have a situation where [the Pentagon] sends up a budget that's dead on arrival because it's $40 billion higher than the Congress will appropriate."

The Widening Impact

Shock waves from the Pentagon budget bust are reverberating far beyond the confines of Washington. Tremors clearly have been picked up at USAF's Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio, proving ground for new fighters, bombers, and other aeronautic weapon systems. There, the need to control the costs of weapon systems has contributed to what might prove to be fundamental change in the way the $10 billion-a-year organization plans and produces weapons.

The new ASD Commander, Lt. Gen. J. M. Loh, is pressing for a streamlined, no-frills "total quality management" structure far more in tune with the demands of the 1990s. The General's aim, outlined in a recent talk at his headquarters, boils down to this: Cut

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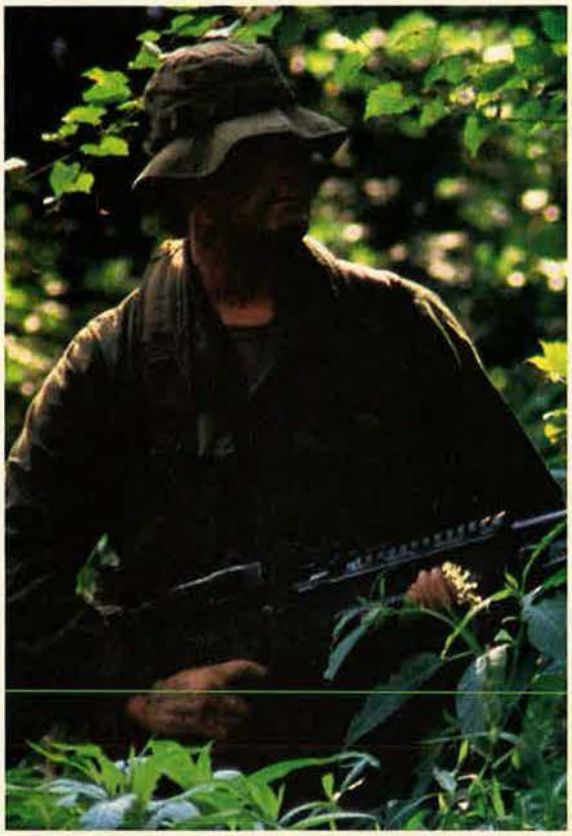

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The tough CV-22 approaches its destination quickly, quietly. It hovers there if necessary, then returns without refueling. It can fly faster and farther on one load of fuel than any helicopter.

Carrying a Special Forces A-Team, the CV-22 flies through the worst weather in the dead of night. And it's self-deployable worldwide.

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The Tiltrotor Team

A JOINT SERVICE PROGRAM

out all of the wasted motion in weapons development and, in the process, realize huge savings on new systems. "Believe me," he says, "I'm not being critical of ASD. ASD is a fine organization. But any organization can improve and can improve significantly —and must."

One goal that the General seeks is to put weapons programs on a "could-cost" basis. By that, he means abandoning unnecessary activity that leads to the high prices that weapons "do cost" and therefore buying them for what they "could cost." Robert Costello, Under Secretary of Defense for Acquisition and godfather of the "could-cost" philosophy, estimates that expenditures could be pared ten to fifteen percent by eliminating such factors as bureaucracy and outdated manufacturing procedures.

"I'm a firm believer in doing that," reports General Loh. "We're going to be doing that on the B-2 bomber, on the C-17 transport. I've just begun an exercise to do that on the F-16. We can still save millions of dollars on the F-16 program."

He may be right. Rear Adm. Kenneth C. Mally recently disclosed that the Navy has been able to trim $500 million from the cost of the Trident II SLBM by applying "could-cost" measures to the program.

Attaining the "could-cost" level is but one of the objectives of General Loh's broader push for "total quality management," which he says will encompass two major elements, equal in weight. The first entails shaping up the efficiency level of ASD itself. The second calls for achieving the same goal within industry.

For ASD's part, General Loh has set in motion a far-reaching decentralization of authority and responsibility that he says amounts to nothing less than a "cultural change" in pursuit of productivity.

"It's the kind of thing that delegates authority and responsibility down to the lowest level," he says. "It's more a bottom-up management than a top-down, autocratic management style. It forces project teams to be accountable for what they're doing, by setting goals, measuring progress, establishing rewards based on team effort rather than individual effort."

Lengthy and confusing contracts, requests for proposals, and statements of work used by ASD are being trimmed. The source-selection process for weapons has been shortened. The requirement for detailed, certified cost and price data, in many cases, has been abandoned. The ASD structure has been changed to remove extra layers of management and to provide the system program officer with sweeping authority.

Within industry, a few contractors are picking up on the "total quality" theme. The General notes that Pratt & Whitney engine-makers "are getting into it in a big way." The contractor recently eliminated 2,650 of its 18,000 positions after determining that they added little or no value to the product but did add cost.

The General says that the Pentagon will have to do more to get contractors to invest in equipment that enhances productivity. "Part of what we're talking about here is a real, stable, multiyear procurement," says the General. "Otherwise, the contractor is not going to take any risk."

Convincing Congress to expand this type of contracting won't be easy. Nor is everyone at ASD convinced of the need for change. General Loh concedes as much, pointing out that various ASD communities have built up safeguards for their "turf" for many years. "Some supervisors may have less authority," he says. "That's going to be difficult. That's going to be painful."

How can we best stop the flow of high-tech wares to the Soviets?

Holes in the Technology-Trade Net?

While the Pentagon's budgetary problems continue to hold center stage in Washington, fresh concerns also are emerging over its power to protect militarily sensitive US technology.

Current evidence is that the Soviet Union, thwarted in recent years by stiffer trade controls, has redoubled its effort to lay hands on prohibited high-tech wares. This time, the thaw in Soviet-American relations and other changes in the international landscape may lead to a different outcome. Stopping the flow in the 1990s might not be possible in the absence of new, restrictive legislation.

That, in a nutshell, is the view of Stephen D. Bryen, until recently the Deputy Under Secretary of Defense for trade security policy and the Pentagon's point man, since 1981, for technology security efforts. Bryen, hardest of hard-liners on trade, outlined his concerns about the dangers of "Détente II" in a recent meeting with defense writers.

The essence of those concerns is that, as superpower relations improve, US-Soviet trade contacts will expand and Washington will come under enormous pressure to relax current restrictions. Bryen's words: "As we open up relations with the Eastern bloc—and we are—there'll be lots of folks seeing national and even private opportunities. For one reason or another, there is going to be pressure to let 'em go. In that circumstance, I see it as quite difficult to maintain export controls that are vital to security."

The problem of shaping effective technology export-controls, reports Bryen, was difficult enough in the 1980s, at a time of intense superpower hostility and virtually nonexistent trade. The problem is being made more vexatious by new factors:

- *Joint Ventures.* Soviet-American business combines, now few in number, are certain to become more common. They fall into a kind of legal limbo, where current US law may not apply. Unlike direct US exports to Soviet destinations, purchases by the joint venture do not require a license and thus are not subject to Pentagon review. But joint-venture offices in the US might well be staffed by Soviet workers, who would try to learn whatever they could about available technologies.

"The joint venture is a new field in many ways," says Bryen, "one that is very difficult. What is a joint venture? Is it an American company? Is it a Soviet company? What is its legal place? How do you deal with that in terms of the existing export control laws? The export control laws we have honestly don't address that issue."

The best solution, says Bryen, would be to enact new laws that would compel those who sell restricted technology to a joint venture to get a license first.

- *Scientific Exchanges.* These exchange programs—official and private—are on the rise. "During the 1980s, there weren't very many exchanges with the Soviets," Bryen notes. "That's changing, and changing rapidly." Current exchange activities range up to cooperative efforts in space research. "When you get many of these programs, and the thing starts to proliferate, it becomes difficult to be as careful." ■

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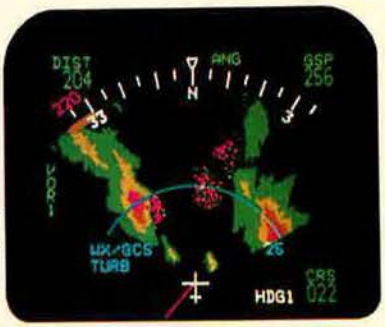

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Currently in production for use on transoceanic airliners, Collins Satellite Communications (SATCOM) will provide reliable data link and, later, voice communications that won't be lost in the "black hole"—where conventional radio links drop out. Compatible with today's ACARS and AIRCOM data communications networks, the versatile SATCOM system can help expand ATC flight-following, improve aircraft maintenance and enable air-to-ground telephone communications and other in-flight passenger services.

ATC Enters a New Mode

The new Collins TPR-720 provides reliable Air Traffic Control (ATC) transponder reporting, plus selective address (Mode S), which lets ATC interrogate individual aircraft. A new, efficient design reduces input power by 30% for cooler, more reliable operation than conventional systems. Now in production, the TPR-720 has been customer-selected for such airplanes as the A320, 737-300, 747-400 and MD-11. Mode S provides a data link for automatic ground communications and for the Traffic-Alert Collision Avoidance System (TCAS) now being developed by our Air Transport Division.

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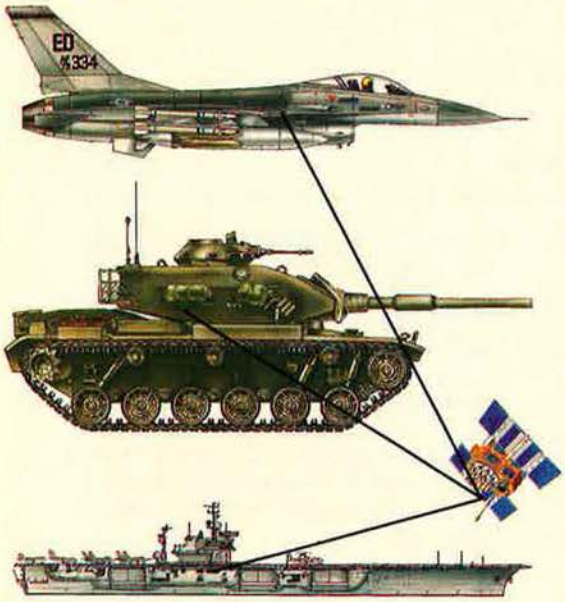

Tri-Service Data: Nobody's in the Dark

The U.S. military's first interoperable tactical data reporting system for combined operations is now available. The Joint Tactical Information Distribution System (JTIDS) will provide real-time situational awareness of hostile and friendly forces, including position, speed, strength and target assignments. JTIDS information will be distributed to whatever platforms need it, and displayed on suitable situation display CRTs, radar scopes or HUDs. Rockwell and Singer will provide JTIDS terminals to U.S. and NATO military forces.

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Capitol Hill

By Brian Green, CONGRESSIONAL EDITOR

Washington, D. C.

Funding Approved

In an uncharacteristic display of self-discipline, Congress approved the Defense Appropriations Bill prior to the October 1 start of the new fiscal year. The timeliness of the action eliminated the need for a continuing resolution, a measure to keep the government funded in the absence of an appropriations bill. The bill provides funding consistent with $299.5 billion in budget authority and $294 billion in outlays. The Air Force share is $94.9 billion in the appropriations bill, compared to $95.7 billion in the authorization bill.

By and large, the appropriators provided the same funding levels as the authorization bill. ICBM modernization R&D and SDI funding were identical *(see "Capitol Hill," November '88 issue),* but the funding levels in the appropriations bill were lower than those in the authorization bill for tactical aircraft procurement, aircraft spares, and some R&D programs.

The appropriations report expressed concern over the apparent increase in unit costs of the advanced medium-range air-to-air missile (AMRAAM) from the $500,000 estimated in the FY '88 budget to almost $900,000 in 1989. The Air Force notes that this unit cost calculation is inaccurate because the AMRAAM budget contains funding for producibility enhancements and other nonrecurring costs in addition to production funding for the missile itself. AMRAAM unit cost was pegged at $413,000 in the most recent (December 31, 1987) selected acquisition report. The Air Force also maintains that it continues to make progress in cost control as the program matures.

Base-Closure Bill Passed

The base-closure bill *(see "Capitol Hill," September '88 issue)* to provide expedited procedures to close unneeded military facilities was passed in the end-of-session rush. The procedures include:

- Creation of a one-time base-closure commission. The commission has, in fact, been meeting for some time now.
- Preparation of a list of proposed closures and/or consolidations, drawn up by DoD and submitted to the commission and Congress.
- Submission, by December 31, 1988, of the commission's list of bases to be closed, for consideration by the Secretary of Defense.
- A decision by January 16, 1989, by the Secretary to accept or reject the entire list.
- A congressional vote on whether to accept or reject the entire list, during a period of forty-five session days starting March 1, 1989. If Congress opts not to act (and if approved by the Secretary), the bases on the list would be closed.
- DoD development during 1989 of a detailed plan for closures and base closures starting in 1990. Closures are to be completed by 1995.

CAS Fly-off

An amendment attached to the base-closure bill requires an independent assessment by the Secretary of Defense of the Army and Air Force studies and analysis of close air support (CAS) aircraft alternatives, a competitive fly-off of CAS alternatives, and another study of whether the CAS mission should be transferred to the Army. This measure had been deleted earlier from the defense appropriations bill. The Air Force opposed the measure, citing previous agreements between the Army and Air Force on roles and missions and the inevitably ambiguous results of fly-offs.

The Army and Air Force have closely coordinated their efforts on upgrading CAS aircraft with regard to new Army requirements to fight on a fluid battlefield not marked by static battle lines and to fight deep in the enemy rear. The Army leadership is in full accord with the Air Force approach, according to top Air Force sources.

ICBMs or SDI?

Rep. John Kasich (R-Ohio) raised the possibility of funding SDI through cuts in the ICBM modernization program at a hearing before the Senate and House Armed Services Committee. He argued that enhanced deterrence and survivability—both goals of strategic offensive systems—could be provided by strategic defenses as well, while defenses would also provide protection against accidental and "Third World" ballistic missile launches.

He contended that the money saved by canceling the Peacekeeper and Small ICBM could pay for an early version of Strategic Defense System (SDS) deployment. Representative Kasich's suggestion was made in the context of a Defense Acquisition Board (DAB) review of SDI that found that the program "is proceeding in the right direction."

Gen. Robert Herres, USAF, Vice Chairman of the Joint Chiefs of Staff and Vice Chairman of the DAB, responded to Representative Kasich's proposals by arguing that ICBM modernization is still critical to deterrence. While stating that the Small ICBM could be a very capable system, he suggested that funding constraints made it difficult to afford and that a combination of "Phase I" SDS and Peacekeeper deployments would provide a high-quality deterrent. He said that the SDS Phase I deployment was "the minimum capability to begin making a contribution" to deterrence.

Phase I SDS deployment would consist of a space-based interceptor (SBI) system (the interceptors would destroy missiles and warheads by colliding with them), a ground-based interceptor system, three sensor systems, and battle management and command control and communications systems. The DAB review noted substantial cost reductions projected for Phase I, from $115 billion estimated earlier this year to $69 billion. The cost reductions result principally from technical gains in sensors, computers, and rocket motors that permit deployment of a smaller SBI constellation. ■

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The roll call includes such diverse programs as:

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- complete EFIS, digital avionics and flight controls for the recently-announced Air National Guard Operational Support Turboprop Aircraft (ANGOSTA) C-26A;
- EFIS and weather radar for the Air Force/Army/Navy C-20 fleets;
- the HF communications system for the F-16 Air Defense Fighter;
- and EFIS and communications/navigation/identification (CNI) for the 8G, fully-aerobatic PC-9 international military trainer.

But despite their differences, these programs all have one thing in common: The requirement for low-risk, high-reliability avionics systems that offer the maximum in operating performance, flexibility and growth—the same goals outlined for TTTS, the USAF Tanker-Transport Training System.

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Aerospace World

By Jeffrey P. Rhodes, AERONAUTICS EDITOR

America's manned spaceflight drought ended with the spectacular launch of the Space Shuttle Discovery on September 29. In space, its crew performed experiments, launched the TDRSS-3 satellite, and proved the spaceworthiness of the improved Shuttle orbiter and boosters.

Washington, D. C.

★ Exactly 974 days, twenty-three hours, fifty-eight minutes, and 0.313 seconds after the Space Shuttle *Challenger* exploded, America made its triumphant return to manned spaceflight. It had been a long road, but the space program was finally heading "back to the future" (to quote a popular slogan around the Kennedy Space Center) when the Shuttle *Discovery* lifted off Pad 39B at 11:37:00.687 a.m. on September 29.

The objectives of the STS-26 mission were actually fairly modest. The crew of five successfully deployed the third Tracking and Data Relay Satellite System satellite (TDRSS-C) and conducted several in-space experiments, but the major push was for the National Aeronautics and Space Administration (NASA) to prove that the Space Transportation System (STS) worked once again. Except for a few minor glitches, *Discovery* worked as advertised.

The launch was delayed ninety-eight minutes because the winds were too light and from the wrong direction. A complex equation for figuring winds aloft for late September and structural loads on the orbiter during liftoff had been programmed into the launch computers, but the uncharacteristically light winds would have put undue stress on *Discovery.* The winds picked up and shifted two hours before launch and the launch minimums were met.

Mission Commander Rick Hauck had a problem with fuses for the cooling fan in his pressure suit (a change from the coveralls and helmets that crews wore during the Shuttle missions immediately before the *Challenger* accident), but technicians were able to fix it during an extended hold in the countdown.

At T minus thirty-one seconds, an oxygen-flow warning light came on in the launch blockhouse. It was overridden when it was determined that oxygen flow was too high only because of the difficulty the astronauts had in closing their visors. The countdown proceeded, and the liftoff was spectacular as *Discovery* began its seventh mission.

The redesigned solid-rocket boosters (one of the changes mandated by the Rogers Commission after its investigation of the *Challenger* accident) produced a brilliant orange flame on liftoff and worked perfectly. After separation, the solids landed about eight miles from the recovery ships. The Shuttle's external tank separated nine minutes after launch and impacted in the Pacific Ocean.

The orbiter developed a problem with a flash evaporator during the mission, and the cabin temperature stayed in the low eighties. The astronauts—Hauck, a Navy captain; Air Force Col. Richard Covey (pilot); and the three mission specialists, George "Pinky" Nelson, Marine Lt. Col. David Hilmers, and Mike Lounge—did not seem to mind the heat.

The crew deployed the TDRSS satellite six hours and thirteen minutes into the mission. The satellite, built by TRW and operated by Contel for NASA, was boosted into geosynchronous orbit by the Air Force-developed Inertial Upper Stage, which fired one hour after being ejected from the Shuttle payload bay. The satellite's designation changed to TDRSS-3 after launch, and it was boosted into position at a point over the Pacific south of Hawaii. It is a replacement for TDRSS-B, which was lost on the *Challenger* mission.

The TDRSS-1 satellite is in orbit over the Atlantic, and the two satellites provide two basic types of services—a multiple-access service, which can simultaneously relay data from as many as nineteen low-data-rate user spacecraft, and a single-access service, which will provide two high-data-rate communications re-

lays from each satellite. TDRSS-D will be launched on STS-29 to replace TDRSS-1, which will then become an on-orbit spare.

The experiments the crew conducted included two student experiments that were to have been conducted by the *Challenger* crew. Other experiments included ones for physical vapor transport of organic solids, which is a method of producing organic crystals; voice communications via infrared rather than radio frequency waves; and an automated directional solidification furnace experiment, developed to produce better-performing magnetic composite materials in a microgravity environment.

At one point during the mission, the crew had a little fun as they "surfed" through the orbiter's middeck in the zero-G environment while wearing Hawaiian shirts and shorts. The last day in orbit, the crew held a press conference and paid tribute to the *Challenger* crew.

After sixty-four orbits, *Discovery* and crew came back to earth on October 3. The orbiter made the trademark double sonic boom after reentry and glided to a landing on Runway 17 at Edwards AFB, Calif., at 8:37:08 a.m. PDT.

Damage to the orbiter during the mission was minimal (mainly a gash in six of the heat-shield tiles), and *Discovery,* flown back to the Kennedy Space Center (KSC) on the back of NASA's 747, arrived at the KSC Shuttle runway on October 8. On October 11, Captain Hauck retired from the space program, saying he wanted to go out on a high note.

The orbiter *Atlantis* is next up and was scheduled for a late November or early December launch. It will carry a classified DoD payload.

On November 15, the Soviets successfully launched their first reusable shuttle. The unmanned craft, which closely resembles the American orbiters, made two orbits of the earth and landed automatically. Launched by the Energia booster, the Soviet shuttle is named Buran, or "Snowstorm."

In other space news, the *Magellan* spacecraft, which will be used to map seventy to ninety percent of the planet Venus, was rolled out at the Martin Marietta Space Systems plant in Denver, Colo., on September 27. *Magellan* arrived at KSC on October 7. It will be carried aboard *Atlantis* on STS-30, scheduled for next April.

The same day that *Discovery* launched, Secretary of State George P. Shultz and representatives of the eleven participating governments signed a multilateral agreement concerning the space station *Freedom.* The agreement, signed in Washington, concerns development, use, and operation of the permanently manned space station.

★ A number of varied activities have been going on in the missile world lately. Here's a rundown.

Hughes symbolically delivered the first production AIM-120A advanced medium-range air-to-air missile **(AMRAAM)** to the Air Force in ceremonies at its Tucson, Ariz., plant on October 26. The actual delivery of the first production missile took place on schedule in September. Contracts for low-rate AMRAAM production through Lots 1 and 2 have already been awarded to Hughes and Raytheon, the second-source manufacturer.

Hughes also recently delivered to the Navy the 1,000th AIM-54C **Phoenix** long-range missile. Deliveries of the C-model began in 1981.

The first of six launches of a Texas Instruments AGM-88A high-speed antiradiation missile **(HARM) from an F-16** was carried out on September 23 at Edwards AFB, Calif. The launch marked the start of Phase II of a three-step process toward fully integrated antiradar capability for the General Dynamics F-16.

Phase I was the integration of older AGM-45 Shrike antiradar missiles on F-16Cs at Spangdahlem AB, Germany, in order to make the F-16s the "killer" element in the Wild Weasel (F-4G) hunter/killer teams. Phase II is the integration of HARMs to F-16s by means of a new aircraft launch interface computer (ALIC) on the LAU-118 launcher. This fix does put some limitation on tactics, though. Phase III, now in development, will be the fully integrated antiradar capability. The Phase III mods will be included in the F-16 Block 50 upgrades starting in 1991.

Another F-16 milestone was the successful firing of an AIM-7 **Sparrow from the F-16A** Air Defense Fighter test aircraft at the Navy's Pacific Missile Test Center at Point Mugu, Calif., on October 18. This was the first of thirteen planned separation firings. Four guided launches will be made against target drones starting in 1989. Test firings with the AIM-7 from an F-16C/D aircraft will begin in late 1989.

The integration of the AIM-7 gives the F-16 an operational beyond-visual-range (BVR) missile capability. Under the Air Defense Fighter program, 270 F-16A/B aircraft will be retrofitted to accept the Sparrows. The first Air Defense F-16 with AIM-7 capability and other modifications is scheduled for delivery in February.

Naval Air Systems Command (NAVAIR) awarded $6 million cost-plus-incentive-fee contracts to the teams of General Dynamics/Westinghouse and Hughes/Raytheon in early October for the demonstration/validation phase of the Navy's advanced air-to-air missile **(AAAM).** The AAAM is designed to replace the AIM-54 Phoenix, and it has future applications for a number of Navy and Air Force aircraft. Completion of both contracts is scheduled for the fall of 1992.

LTV's hypervelocity missile **(HVM)** hasn't hit the target in five tries at the White Sands Missile Range in New Mexico, but it's getting closer. More important, control of the small missile is improving, say both the Army and Air Force. The HVM is a relatively simple missile that relies on kinetic energy to defeat armor. The missile travels at about 5,000 feet per second and has a range in excess of 10,000 feet.

The first launch of an AIM-7 Sparrow radar-guided missile from an F-16 took place in October. This launch was the first in a series of thirteen unguided and guided Sparrow shots from an F-16. The addition of AIM-7s will give the F-16 a beyond-visual-range (BVR) capability. The first AIM-7-capable F-16 is scheduled for February delivery.

The carrier aircraft communicates with the missile via a laser link. Seven more tests are planned. HVM is a joint Air Force/Army/Marine Corps program.

The Rockwell **AGM-130A** scored its second consecutive direct hit on a target at Eglin AFB, Fla., on October 7. The missile covered its entire glide-boost-glide flight profile after being released from an F-4E. The rocket motor, which had caused problems in earlier tests, performed flawlessly and allowed the F-4 to remain more than seventeen nautical miles from the target. This was the fourth of eight planned launches in the missile's development, test, and evaluation (DT&E) program. Testing is to be completed by the end of FY '89.

In Intermediate-range Nuclear Forces (INF) Treaty news, the first nine Army **Pershing II** missiles were withdrawn from a base near Stuttgart, West Germany, on September 1. The launchers were cut up on October 19. A total of forty-one BGM-109 **Gryphon** ground-launched cruise missiles (GLCMs) and seven launchers was destroyed at Davis-Monthan AFB, Ariz., on October 18 and 19.

The Soviets conducted their first short-notice inspection at the Pershing II base at Waldheide-Neckarsulm on September 27. It was the first of twenty such inspections allowed each side for the first three years of the INF Treaty. The US has not conducted any short-notice inspections yet.

Finally, the **Chinese** launched their first **sea-launched ballistic missile** (SLBM) from a submerged nuclear submarine in mid-September. The target area was described as a thirty-five-mile-diameter circle in the high seas, but there was no mention of the missile's range.

Workers at the LTV Aircraft Products Group Aircraft Modernization and Support Division in Dallas, Tex., swing the nose section of the YA-7F prototype into position on its assembly jig. The first YA-7F, which will have an F100-PW-220 engine, new avionics, and structural modifications, is scheduled for reassembly by late fall. First flight is expected in April 1989, and testing will continue at Edwards AFB, Calif., until 1990.

★ **APPOINTED—Dr. John H. Morrow, Jr.,** has been named the ninth occupant of the **Charles A. Lindbergh Chair of Aerospace History** at the Smithsonian's National Air and Space Museum in Washington. Dr. Morrow will complete a book on World War I aviation during his one-year tenure, and he will advise the Museum's Aeronautics Department staff as they conduct a major redesign of the World War I Aviation gallery.

★ **HONORS**—The **Secretary of Defense Environmental Quality Award** for installations was presented in late September to officials from **Vandenberg AFB, Calif.** The annual award recognizes outstanding leadership and progress in programs to clean up and safeguard the environment at military installations. Vandenberg was the first base to set up a separate environmental management directorate under the base's senior command, and it was cited for "consistent application of sound planning to meet the objectives of environmental protection laws." The award was presented for actions in 1987.

The **top (and only) award** in the 1988 **Air National Guard A-10 weapons loading competition** went to the team from the **104th Tactical Fighter Group** at Barnes MAP in Westfield, Mass. The two-day competition matched load crews made up of drilling Guardsmen (not full-time Guardsmen) from the five Guard units flying A-10s. Load crews are graded on actual weapons loading, tool and equipment safety, and a written exam. Other units participating included the 128th Tactical Fighter Wing (Truax Field, Madison, Wis.), the 174th TFW (Hancock Field, Syracuse, N. Y.), the 103d TFG (Bradley ANGB, Hartford, Conn.), and the 175th TFG (Glenn L. Martin State Airport, Baltimore, Md.).

★ **PURCHASES—Switzerland** decided on October 3 **to buy the McDonnell Douglas F/A-18 Hornet** as its next interceptor. Switzerland has set aside SFr 3 billion ($1.8 billion) for thirty-four F/A-18C/D aircraft, spares, and support. The final appropriations bill will not be presented to Swiss legislators until 1990, but approval is expected. The final agreement is expected to include offsets equal to 100 percent of the purchase price. The first Swiss F/A-18 squadron is expected to be operational in 1994. In a related note, the Swiss also recently picked the FIM-92 **Stinger** to be its new man-held portable missile. The Swiss will build the Stingers under license.

Lockheed Aeronautical Systems Co.-Georgia topped the 1,900 mark in sales for the C-130 Hercules on October 3, when Venezuela bought its sixth C-130H. It will be based at FAV El Libertador at Palo Negro. The first flight of the C-130 took place on August 23, 1954, and 1,868 of the aircraft have been built. Thirty-two C-130s are on back order. Continued production of the C-130 is expected until the turn of the century.

Air Force Systems Command's Electronic Systems Division **(ESD)** at Hanscom AFB, Mass., recently **awarded contracts** to Eaton's Management Systems Division ($6.6 million), the Communication Systems Division of Unisys ($9.8 million), and Federal Electric ($5.1 million) for each company **to develop two Automated Weather Distribution Systems** (AWDS). After a sixteen-month test and evaluation period, one contractor and a second-source manufacturer will be selected to complete the remainder of the contract. AWDS

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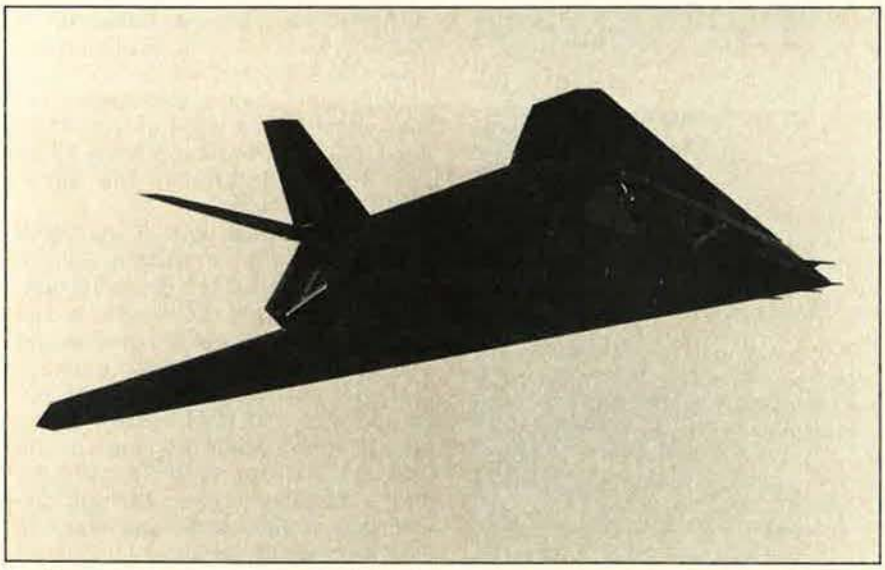
AFSC's Aeronautical Systems Division **(ASD)** at Wright-Patterson AFB, Ohio, **awarded a $48 million contract to Teledyne Continental Motors, Aircraft Products Division,** in late September for production of 104 A/M32A-85 **ground power generation systems** (GPGS). The new generators will be used during maintenance to provide electrical power, compressed air, and air-conditioning to aircraft. The GPGS can be used to support all Air Force tactical aircraft and the FB-111.

ASD awarded **McDonnell Douglas Training Systems, Inc.** (MDTSI) a $421 million contract on October 27 for the **C-17 Aircrew Training System** (ATS). MDTSI will give Military Airlift Command a guaranteed training program for all aircrew members and engine-runup maintenance personnel. The contractor will provide all the training, software, hardware, and coursework necessary to train and upgrade the C-17 crews and technicians. Altus AFB, Okla., will serve as the central training base.

Rockwell International was awarded a $48 million Navy contract to **upgrade** fifteen Marine **OV-10A Bronco counterinsurgency aircraft** to the OV-10D configuration. The aircraft will get new turboprop engines, new avionics, a reconfigured cockpit, and a strengthened airframe. Also included in the contract are seven service life extension program (SLEP) kits that will allow the Navy to do depot upgrades. Contract options worth $25 million allow for twenty-seven additional aircraft to be modified by Rockwell and for seven more SLEP kits. On the subject of Broncos, **the 23d Tactical Air Support Squadron** at Davis-Monthan AFB, Ariz., **will become the "schoolhouse" for both Air Force and Marine OV-10 crew training.** The 23d TASS will train thirty to forty-five students a year.

The first flight of the Teledyne Ryan Aeronautical Model 350 Joint Service Common Airframe Multiple Purpose System (JSCAMPS) unmanned aerial vehicle was completed on October 22. The UAV was recovered after a thirty-minute flight. The vehicle was launched from an F-4C operated by Flight Systems, Inc., at Mojave, Calif. The Model 350, a company-funded effort, was designed for both air and ground launching and is made of composite materials.



On November 10, the Air Force officially announced the existence of the Lockheed F-117A Stealth fighter. Fifty-nine of the single-seat, twin-engine aircraft are being procured, and fifty-two have been delivered. The aircraft are based at Tonopah, Nev., and are flown by the 4450th Tactical Group at Nellis AFB, Nev. The aircraft first flew in 1981 and became operational in 1983.

Electrospace Systems, Inc., recently received a $42.6 million ASD contract to modify two Boeing 707s for use as dedicated **Cruise Missile Mission Control Aircraft** (CMMCA). A single CMMCA (designated EC-18D) will be capable of monitoring, tracking, and controlling cruise missiles during tests—a job that currently requires as many as six aircraft. Following completion of flight tests in early 1991, the EC-18Ds will be flown by the 4750th Test Wing at Wright-Patterson AFB, Ohio, in support of Navy and Strategic Air Command missile tests. The aircraft can also be used to monitor and control unmanned aerial vehicles.

★ **DELIVERIES**—Capts. B. D. Dickerson and Larry Jones took a shortcut when they ferried their **F-15Cs to Elmendorf AFB, Alaska,** on September 10. Instead of flying **from Bitburg AB, Germany,** through the lower forty-eight states and then to Alaska, which is the normal route, the duo flew the fighters **over the North Pole.** This marked the first time Alaskan Air Command fighters had taken that path. The F-15Cs from the 21st Tactical Fighter Wing are on a record pace for intercepts and escorts of Soviet aircraft. As of late September, forty-one Soviet aircraft had been turned back, compared with fifty-seven in all of 1987.

The **Texas Army National Guard received the first** of fifteen Sikorsky **UH-60A** Black Hawk helicopters in late September. The 149th Aviation Battalion, 49th Armored Division, in

Austin will receive the remainder of its aircraft in the next three years. Texas is the eighth state to fly UH-60s. In a milestone delivery, **Sikorsky delivered the 1,000th UH-60** to the Army on October 11. The aircraft will be delivered to the Army Reserve's 7th Battalion, 158th Aviation Regiment, at Scott AFB, Ill.

★ **MILESTONES**—The **first three** of sixteen **KC-135R tankers arrived at Malmstrom AFB, Mont.,** on October 3, giving that base its first fixed-wing flying mission in almost twenty-five years. The 301st Air Refueling Wing, which joins the 341st Strategic Missile Wing at Malmstrom, has one flying squadron and two maintenance squadrons. The remainder of the wing's KC-135Rs will have arrived by next summer. The 301st AREFW, which had been deactivated for ten years prior to January 1988, was Strategic Air Command's first all-jet refueling wing in 1964.

The **44th Strategic Missile Wing** at Ellsworth AFB, S. D., **celebrated its twenty-fifth anniversary** in October. The wing's 150th and final LGM-30B Minuteman I missile was placed on strategic alert on October 23, 1963.

The **25th Air Division celebrated its fortieth anniversary** on October 27. The 25th AD, headquartered at McChord AFB, Wash., was the first unit organized specifically for the air defense of the continental US.

The **Atlantic Fleet's last diesel submarine,** the USS *Bonefish* (SS-582) **was decommissioned** on September 28 in Charleston, S. C. The *Bonefish* was extensively damaged by a fire that broke out on April 24 during a training exercise, and instead of spending an estimated $110 million on repairs, the Navy decided to decommission the boat. At the decommissioning ceremony, seven crewmen were decorated for acts of heroism in evacuating eighty-nine shipmates and saving the sub during the fire. The three sailors who died in the blaze received posthumous decorations.

★ **NEWS NOTES**—One year after its formal activation, the **US Transportation Command assumed operational control of all Department of Defense common-user lift forces** on October 1. Common-user lift forces are the long-range land, air, and sea transportation systems that all military services use in common for deployment. Military Airlift Command, Military Sealift Command, and Military Traffic Management Command commanders retain responsibility for their service-unique missions, peacetime DoD charters, industrial funds, contracting, rate negotiations, procurement, and maintenance. USTRANSCOM is headquartered at Scott AFB, Ill.

In what had to be one of the strangest missions ever performed by a helicopter, **an Alaska Army National Guard CH-54 Skycrane was used** to drop a 10,000-pound, steel-reinforced concrete block on the ice near Barrow, Alaska, **in an effort to free** "Bone," "Crossbeak," and "Bonnet," the **three California gray whales** trapped in an ice-blocked bay during October. The Air Force also got involved in the whale rescue as a C-5 was dispatched, at White House direction, to carry more equipment from Prudhoe Bay to Barrow. A massive effort to get the whales to the open sea finally paid off on October 28, after a Soviet icebreaker cut through the final few miles of ice. "Bone" died during the twenty-three-day ordeal.

Secretary of the Interior Donald Hodel announced on September 16 that **the Korean War Memorial will be built** in Ash Woods, a grove of trees on the south side of the Reflecting Pool in front of the Lincoln Memorial and **opposite the Vietnam Memorial** in Washington, D. C. The $6 million Korean War Memorial will be built with private funds, and a nationwide design competition will be held. More than 54,000 Americans were killed and 103,000 injured in the thirty-seven-month war.

One of the last acts of the **100th Congress** was to **award Calvin Graham back pay and disability benefits** for his World War II service. The Navy had argued that Mr. Graham did not deserve compensation because he lied about his age when he enlisted at age twelve in 1942. He suffered a mouth injury while serving on the USS *South Dakota* (BB-57) during the battle of Guadalcanal. He was discharged in 1943 when his true age was discovered. Mr. Graham will get his 1943 mustering-out benefits of $337 in 1988 dollars ($4,917) plus $18,000 for the mouth injury. He had been granted an honorable discharge in 1978.

December Anniversaries

- *December 22, 1898:* The Secretary of War approves a site at Fort Myer, Va., for a barracks, officer quarters, administrative building, and a balloon house to consolidate the Signal Corps schools in one place.
- *December 17, 1903:* With the toss of a coin, Orville Wright wins the right to enter the history books. At 10:35 a.m., at Kill Devil Hill, Kitty Hawk, N. C., the Wright *Flyer* starts down the launching track. Twelve seconds and 120 feet later, Orville had achieved the world's first manned, powered, sustained, and controlled flight by a heavier-than-air aircraft.
- *December 4–22, 1918:* Under the command of Maj. Albert D. Smith, four JN-4s fly from San Diego, Calif., to Jacksonville, Fla., to complete the Army's first transcontinental flight. Only Major Smith's plane manages the entire trip.
- *December 31, 1933:* The prototype Soviet Polikarpov I-16 *Mosca* (Fly) is flown for the first time. When the type enters service in 1934, it is the first monoplane fighter in the world to have an enclosed cockpit and fully retractable landing gear.
- *December 31, 1938:* First flight of the Boeing Model 307 Stratoliner, the world's first passenger plane to have a pressurized cabin.
- *December 5, 1943:* Ninth Air Force begins Operation Crossbow raids against German bases where secret weapons are being developed.
- *December 17, 1948:* The forty-fifth anniversary of the first powered flight is celebrated by the donation of the original Wright *Flyer* to the Smithsonian Institution. The *Flyer* had been displayed in Britain for many years because of a dispute between the Wrights and the Smithsonian.
- *December 31, 1948:* The 100,000th flight of the Berlin Airlift is made.
- *December 12, 1953:* Maj. Chuck Yeager pilots the rocket-powered Bell X-1A to a speed of Mach 2.435 (approximately 1,650 mph) over Edwards AFB, Calif.
- *December 18, 1953:* Project Score, an Atlas booster with a communications repeater satellite, is launched into earth orbit. The satellite carries a Christmas message from President Dwight Eisenhower that is broadcast to earth, marking the first time a human voice has been heard from space.
- *December 17, 1963:* The Lockheed C-141A StarLifter transport makes its first flight at Marietta, Ga.
- *December 21–27, 1968:* The *Apollo-8* mission racks up several important milestones, as it is the first manned mission to use the Saturn V booster, and astronauts Frank Borman, Jim Lovell, and William Anders become the first humans to orbit the moon.

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The **US Navy began to downgrade operations in the Persian Gulf** in late September, as reflagged Kuwaiti tankers were only escorted in the most dangerous parts of the Gulf and the Strait of Hormuz. Tensions in the area have decreased dramatically since the cease-fire between Iran and Iraq took effect. The Navy also started reducing the number of ships in the area by not replacing ships that had finished their rotation in the Gulf area. The USS *Vincennes* (CG-49), the *Ticonderoga*-class Aegis cruiser that mistakenly shot down an Iranian airliner last summer, returned to its home port of San Diego, Calif., in late October.

The **Royal Air Force completed *Exercise Golden Eagle*** on October 25, having flown around the world in ten weeks. Four Panavia F.3 interceptors, two TriStar K.1 tankers, and several Hercules C.1 airlifters left RAF Coningsby on August 21, and after a stop in Oman, flew to RMAF Butterworth, Malaysia. There the No. 29 Squadron Tornado crews exercised with crews and aircraft from Malaysia, Singapore, Australia, and New Zealand. The entourage then flew to Korat RTAFB, where the crews participated in dissimilar air combat training with Royal Thai Air Force crews. The RAF flyers then went on to RAAF Richmond, near Sydney, where the group took part in the Australian Bicentennial airshow. Stops in Pago Pago; Hickam AFB, Hawaii; Travis AFB, Calif.; and Harrisburg IAP, Pa., rounded out the tour before the crews returned home to England.

Apaches are now helping build Apaches. **Native Americans** from the White Mountain Apache Nation have started **crafting thermal insulation blankets for** McDonnell Douglas **AH-64 Apache attack helicopters.** The thermal blankets are used to line the cockpit walls of the AH-64s and are made in several sizes and shapes. The work the Apaches will do is valued at approximately $250,000 annually. Plans are in the works for the Apache Manufacturing Co. (the company formed to do the insulation work) to produce $200,000 per year worth of wooden crates for AH-64 and MD500 helicopters, as well as for ordnance.

Senior Staff Changes

PROMOTION: To be **Lieutenant General:** Thomas A. **Baker.**

RETIREMENTS: M/G Stuart E. **Barstad;** B/G Samuel J. **Greene.**

CHANGES: M/G (L/G selectee) Thomas A. Baker, from Vice Cmdr., Hq. ATC, Randolph AFB, Tex., to Cmdr., 7th AF, PACAF, and Dep. CINC, UN Cmd. Korea, and Dep. Cmdr., US Forces Korea, and Cmdr., ROK/US Air Component Cmd., Combined Forces Cmd., Osan AB, Korea, replacing L/G Craven C. Rogers, Jr. . . . **M/G Robert S. Delligatti,** from DCS/P&R, Hq. ATC, Randolph AFB, Tex., to Vice Cmdr., Hq. ATC, Randolph AFB, Tex., replacing M/G (L/G selectee) Thomas A. Baker.

B/G Ronald W. Iverson, from Dep. Ass't DCS/Pers. for Eval. Prgms., Hq. AFMPC, Randolph AFB, Tex., to Vice Cmdr., Hq. AFMPC, and Dep. Ass't DCS/Pers. for Mil. Pers., Randolph AFB, Tex., replacing B/G Walter Kross . . . **B/G Walter Kross,** from Vice Cmdr., Hq. AFMPC, and Dep. Ass't DCS/Pers. for Mil. Pers., Randolph AFB, Tex., to DCS/P&R, Hq. ATC, Randolph AFB, Tex., replacing M/G Robert S. Delligatti . . . **L/G George L. Monahan, Jr.,** from Principal Dep. Ass't Sec'y of the Air Force for Acq., OSAF, Washington, D. C., to Dir., SDIO, OSD, Washington, D. C., replacing retiring L/G James A. Abrahamson.

L/G Craven C. Rogers, Jr., from Cmdr., 7th AF, PACAF, and Dep. CINC, UN Cmd. Korea, and Dep. Cmdr., US Forces Korea, and Cmdr., ROK/US Air Component Cmd., Combined Forces Cmd., Osan AB, Korea, to Dep. CINC, Hq. USCENTCOM, MacDill AFB, Fla., replacing L/G Hansford T. Johnson. ■

Index to Advertisers

Air Training Command has begun the most sweeping round of changes in thirty years.

Tradition and Change in ATC

BY JOHN T. CORRELL
EDITOR IN CHIEF

Air Training Command has always been the domain of the prompt salute and poster-perfect military bearing. Each year, ATC must drill the customs, discipline, and heritage of the force into some 60,000 new airmen and officers. This command is justifiably known for dishing up tradition in generous portions.

At the same time, change is pervasive. ATC constantly adjusts its training program to fit new weapon systems and evolving circumstances in the operational commands. These days, however, ATC has more than adjustment on its mind. The most sweeping round of changes in thirty years is under way.

Next spring, the Air Force will choose a modified business jet as a trainer for transport and tanker pilots. In doing so, it will take a big step toward specialized undergraduate pilot training, which is scheduled to begin in 1991. *(See "Always Good—and Often Superb," p. 46.)* That will also be the first stage in a modernization plan under which ATC will eventually replace all of its major training aircraft.

Other changes are gathering momentum, too. In a program called "Rivet Workforce," ATC is revising more than 700 of its resident and field training courses to prepare maintenance people to work on specific systems. In the past, it has largely been up to the gaining unit to tailor a newcomer's general training to the equipment in use locally.

Another initiative, "four-level" training, promises to take more of the work load off operational commands by sending them specialists who arrive with several weeks of additional training behind them. *(See "Apprentices With a Difference," p. 56.)*

In a long list of career fields, computer-based instruction is catching on fast. ATC is optimistic about its applications for classroom use and says that it will also make upgrade training easier and more effective.

Even the support operation is in motion. ATC is about halfway through a transition to civilian and contract maintenance for the trainer fleet at its flying training wings. Eventually, maintenance will be done by military people only at Randolph AFB, Tex., where the command headquarters is located.

At the Technical Training Center at Lowry AFB, Colo., students TSgt. Raymond Berry and A1C Michael Schmidt learn how to install a fixture on the forward shroud of an LGM-118A Peacekeeper missile with the help of instructors SSgt. Russell L. Carter and T. W. Randall and instructor supervisor James Tollerud.


HOLDING FITTING
ET 108 LBS.

ATC's new Commander, Lt. Gen. Robert C. Oaks, surveys the task ahead with conspicuous enthusiasm. He pronounces the trainees eager and the instructors impressive. The new assignment, he says, "makes me feel ten years younger."

The Dual Track

Of all the changes pending, none generates more interest—mixed with some apprehension—than the prospect of Specialized Undergraduate Pilot Training (SUPT). Since 1959, the Air Force has put all of its student pilots through the same course of instruction and sorted them out later. SUPT sends them on separate training tracks, one for those who will later fly tankers and transports, the other for those going to fighters and bombers.

Given a choice, most young pilots would prefer to fly fighters. The reality, General Oaks says, is that more than half of them will fly heavy aircraft throughout their careers. Under the new system, officers will be selected for specific categories of flying before they begin undergraduate pilot training.

SUPT, General Oaks says, "will give us better, more appropriately trained pilots—and, I think, more highly motivated pilots. From day one, they know what they're going to be. If they don't want to be that, they don't have to sign up for it.

"Right now, a significant number of people are disappointed with what they get coming out of pilot training. The needs of the Air Force never match the desires of the pilot training class."

General Oaks believes that there will be plenty of takers for the opportunity to fly tankers and transports and that pilots will be better satisfied with their subsequent assignments if they know what to expect from the beginning.

ATC forecasts that the distribution of first assignments for new SUPT graduates will be as follows: bombers, eleven percent; fighters, 33.6 percent; tankers, twenty-three percent; transports, 32.4 percent.

The original plan was to train bomber pilots on the same track as tanker and transport pilots. About a year ago, however, the Air Force decided to restructure the tracks. The reason, General Oaks says, is that "the B-1B and bombers of the future will have flight envelopes and flight characteristics closer to those of a T-38 or its replacement than to those of the business jet tanker-transport aircraft."

The command is still working on details of the process by which it will designate student pilots for the different training tacks, but says that it will use a combination of mental, psychological, and psychomotor tests and candidate interviews.

Replacing the Trainers

Since more than half of the student pilots in the 1990s will train in the new tanker-transport airplane, an additional advantage of SUPT is that it takes much of the load off the overworked T-38 Talon fleet. Both of ATC's main aircraft—the subsonic T-37 primary trainer and the supersonic T-38 now flown by all student pilots in the last phase of undergraduate training—date from the late 1950s and are approaching midlife crises.

The T-37 was to have been replaced by the ill-fated T-46. After its rollout, though, the T-46 ran into development and budgetary problems and the program was canceled. That left the Air Force with an equipment problem.

The T-37s, General Oaks says, "take a beating every day. It's not just casual flying. They get multiple landings, multiple G applications, and multiple throttle applications." The Tweet is wearing out.

Without a new primary trainer in reach, the Air Force must make the T-37 fleet last another ten years anyway and will do that with a structural life-extension program. It expects to award a contract in February. The modifications will be extensive and should give each T-37 at least 8,000 additional hours of service life.

Until recently, the Air Force seemed determined that the eventual replacement for the T-37 would be a jet. Now, according to General Oaks, the objective is "to acquire an off-the-shelf trainer with the most current technology possible—but we have not designated a preference with respect to turboprop or jet."

The primary trainer of the future will also eliminate such problems as lack of pressurization and inadequate cooling, currently experienced with the T-37. "A fellow out at Williams [AFB, Ariz.,] the other day measured the temperature in the cockpit at 135 degrees as he sat there waiting to take off," General Oaks says.

The T-38, which continued in production until 1972, is not quite so old as the T-37, but it has also seen hard use. The average T-38 in the fleet today has 15,500 hours of fly-

—USAF photo by CMSgt. Don Sutherland

Pilot 1st Lt. Timothy Shields (left) and student navigator 2d Lt. Jack Swonson check their gear before a T-37 training mission out of Mather AFB, Calif.

—USAF photo by A1C Greg Spraggins

A1C James Rohlik (foreground) and SSgt. Mark Starsick do a flap-and-stab operation check before a T-38 launch. Both are assigned to the 64th OMS Eagle Flight at Reese AFB, Tex.

ing behind it. This exceeds the originally programmed life expectancy of the T-38.

"We're going to run out of T-38s if we don't get some relief," General Oaks says. Part of the relief will come from SUPT when tanker and transport pilots begin training in the business jet. The plan is to buy 217 of these aircraft.

A more immediate source of relief is the "Pacer Classic" modernization program. It includes structural, engine, and avionics renovation. ATC says that this will keep the T-38s flying until 2010. By that time, the Air Force expects to have a T-38 replacement in hand.

Tech Training Initiatives

In this year's authorization bill, Congress suggested that the Air Force consider switching its trainer-modernization plan around and buying the T-38 replacement first. Specifically, Congress said, the Air Force might tag onto the end of the production line for the British Aerospace-McDonnell Douglas T-45 Goshawk, which the Navy is buying as its intermediate and advanced trainer. After replacing the T-38 with this T-45 variant in the 1990s, the Air Force could then join the Navy in codevelopment of a primary trainer to replace the T-37 and the Navy's T-34C. The Air Force does not think much of the idea. The Secretary of Defense is to report to the Senate and House Armed Services Committees by February 15 on trainer acquisition plans for both services.

ATC is supporting an Air Force Logistics Command initiative, "Rivet Workforce," to "reorganize maintenance skills into more general categories and improve the versatility of flight-line folks," General Oaks says. "We're reworking 700 courses, changing them to match the new mix of skills needed by using commands."

This program complements another initiative, "four-level" training, which sends tech school graduates to the field with an additional month of training. The idea is to enable them to be more useful to their units right away and to position them somewhere between apprentices—skill level three, which had been standard for tech school graduates—and five-level journeymen.

ATC is still gathering and evaluating data on how "four-level" graduates perform on the job. General Oaks says that the final verdict isn't in yet, "but it looks to me, from everything I can see, that we will go with 'four-level' training."

The most widespread change in technical training is the increasing use of computer-based instruction (CBI). Last summer, the ATC news service proclaimed it "the wave of the future." Earlier this year, an interactive video program developed to train radar specialists at Keesler AFB, Miss., won an award for excellence from the University of Nebraska. ATC is examining both its courses and various technical applications to see where it might benefit by adapting them for use in classrooms. It has also begun training instructors and other people in CBI design and use.

One benefit of such technology is illustrated by a computerized program that Chanute AFB, Ill., hopes to employ in training weather specialists. Students in this course have only seven days of weather operation. What they have been able to observe in the past has been limited to whatever kind of weather nature provided during that period. The computerized system, able to simulate a wider range of weather conditions, seems ideal in this instance.

ATC also points out that, once developed, computer-based instruction is "exportable" to airmen who cannot come to the tech schools for training. Proficiency and upgrade training also becomes easier. Those who used CBI for the basic course will be familiar with the approach and format, so they can easily absorb follow-up training in building-block packages.

General Oaks says that computer-based instruction can reduce training time by "letting the fast ones go faster," but realizes that "we need to be careful that we don't just train everybody to the minimum standards."

There is no intention to automate

—USAF photo by Carlos Baker

AFROTC cadets at the University of Texas at San Antonio socialize following a leadership lab.

There are a few ways to enter the Air Force without coming through ATC—but not many.

Front Door to the Force

With a handful of exceptions, most of the people serving in the Air Force today came in through the gates of Air Training Command. ATC operates not only the Air Force Recruiting Service but also AFROTC and the sprawling complex at Lackland AFB, Tex., where the Basic Military Training Center and Officer Training School are located. There are a few other ways to enter the Air Force, but not many.

The average Air Force recruiter signs up forty new people a year. (Average for the other services is twenty per recruiter.) Only thirty-two of every 100 serious applicants can meet the Air Force's physical and mental standards. Those who make the grade are good. Last year, ninety-nine percent of the recruits were high school graduates.

Air Force Recruiting Service began this fiscal year with a goal of 55,000 recruits and was well along toward having that many lined up when radical reductions to the defense budget suddenly cut the number of new airmen USAF could afford to 40,000. The goal next year is expected to be 50,000. Recruiting Service reported in August that it already had 2,400 applicants booked and waiting.

The old days, when military presence was unwelcome on many college campuses, appear to be over. When the Air Force proposed closing some ROTC units as the requirements for new officers declined, a wave of public and congressional protest ensued. As a result, the closures have been postponed, and the Air Force has been told to reexamine the situation in 1990.

The current structure consists of 154 AFROTC units, capable of producing 3,500 line officers a year. The most effective goal, the Air Force believes, would be to stabilize AFROTC production at about 2,500 a year. That could be achieved by 115 or so units.

If, for any reason, the Air Force needs more officers to meet end-strength requirements than it will get from AFROTC in a particular year, it can turn to Officer Training School, which is a more flexible, faster-reacting source. OTS output, which was up to 4,550 in FY '80, graduated only 912 officers last year. It is projected to turn out 1,200 this year.

The most difficult recruiting problems are in the health professions. The shortage of nurses is national. Enrollment at nursing schools declined by twenty-one percent between 1983 and 1986 while job opportunities for nurses proliferated. Recruiting physicians is even tougher, in large part because doctors earn $40,000 to $60,000 more in civilian practice than they can in the military.

every course. "It wouldn't make sense to use computers or an interactive videodisc if a chalkboard will do," says Maj. Tim Whitacre of ATC Plans and Requirements.

. . . And Still More Changes

Military maintenance people will soon be a rare sight on ATC flight lines. Only the flagship base, Randolph, has been excluded from the change. For the others, the only question is whether the function will be done by contractors or by civil servants.

Two years ago, the Air Staff directed ATC to examine the relative cost of various maintenance options. As the studies progressed, the prospect of turning ATC aircraft maintenance over to contractors ran into some congressional opposition, but an amendment that would have blocked such a change was dropped from this year's Defense Authorization bill.

Three bases—Columbus AFB., Miss., Vance AFB, Okla., and Sheppard AFB, Tex.—have already gone contract. Comparison of costs at Laughlin AFB., Tex., Reese AFB, Tex., Williams AFB, Ariz., and Mather AFB, Calif., will be finished by FY '91.

To ensure that the changes it makes are the right ones, ATC is staying closer than ever to the operating commands and talking with them regularly about their problems and needs. For an extra edge, it also participates with those commands in exercises.

Although ATC is not a combat command, it does have a role in wartime preparedness. In the event of conflict, ATC could quickly deploy about 9,000 people—medical, civil engineering, and security police personnel—to combat theaters.

Command planners are also building a capability to expand training if that became necessary for a mobilization. ATC forecasts that it could increase the output of its basic military training operation from 4,896 a month to more than 25,000 and the number of people coming out of its technical training centers from 10,675 a month to about 25,000. Simultaneously, it would be able to accept as many as 91,000 pretrained Reservists for "reblueing," or if need be, retraining. ■

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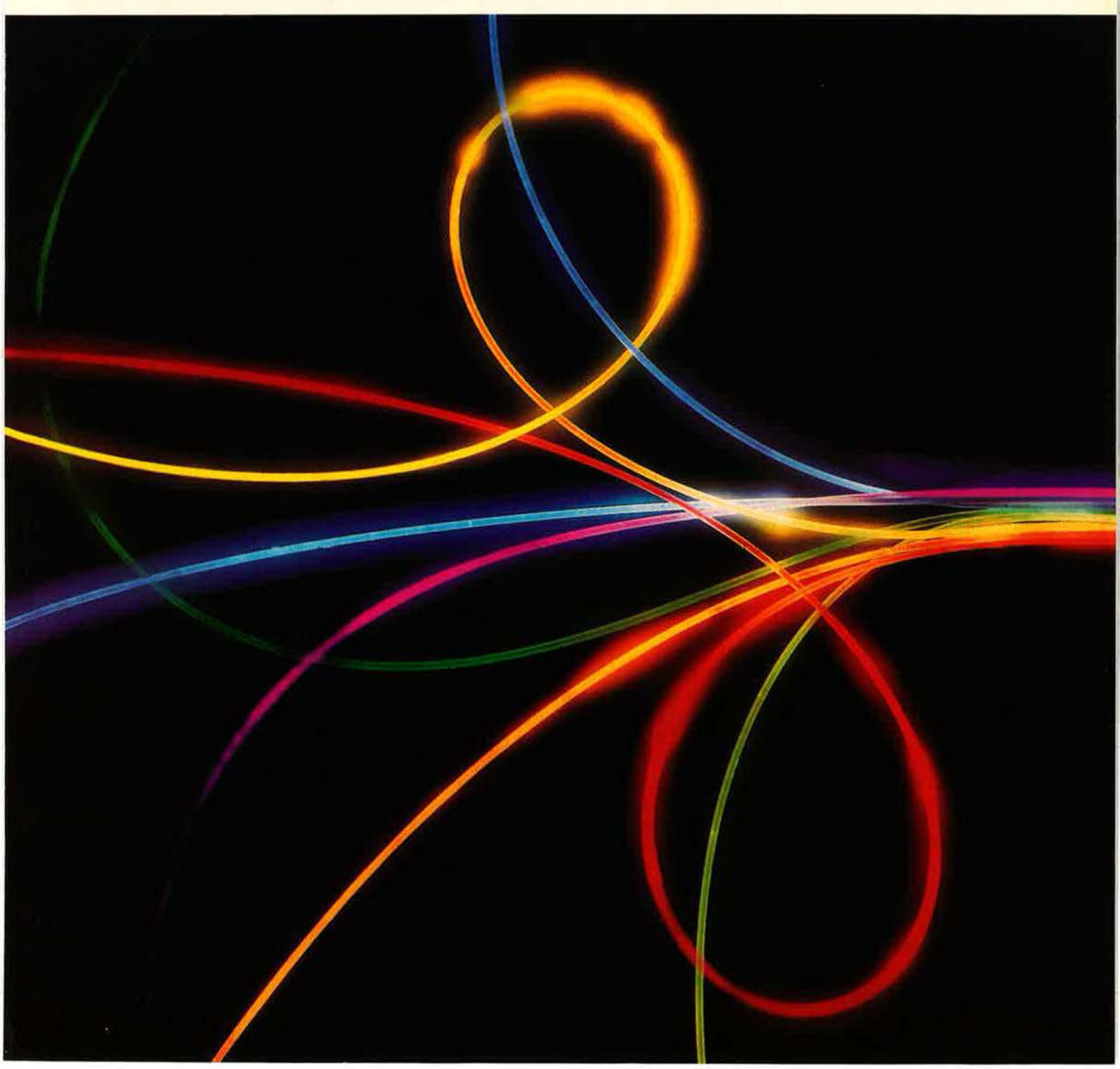

ATC hopes to put an extra edge on new pilots as it moves to a dual-track specialized training program.

Always Good—And Often Superb

BY JAMES W. CANAN, SENIOR EDITOR

Lt. Col. John Block told a story not long ago that illustrates what the Air Force's undergraduate pilot training (UPT) is all about. He was reminded of it as he watched student pilots at Reese AFB, Tex., take off and land over and over in their T-37 Tweets and T-38 Talons, "smoothing out the runways" to the tune of 300 sorties a day.

It was a story about something that happened years ago, back when Colonel Block, now the Assistant Deputy Commander for Operations at Reese, was a young instructor pilot there.

He was airborne in a Tweet alongside a student pilot who was on his first flight. The beginner had the stick when bad weather came up suddenly and caught them well short of the airfield. The instructor had to take over and bring them home on instruments amid turbulence and almost no visibility.

The experience left the trainee limp. "After we landed," Colonel Block recalls, "he put his head in his hands and said he'd never be able to do that. He said it would be too much for him. He was ready to quit. I suggested that he give the course a chance one step at a time."

The student did so. On his last flight in a T-37 during primary training, he and his instructor pilot Block were caught in the same situation, blanketed by bad weather. This time, though, the student kept the controls. Applying his lessons, he calmly brought them home to a perfect recovery and landing, eventually graduating into fighters and becoming a first-rate driver of an RF-4C reconnaissance aircraft.

The moral of this story is the same one that comes through whenever the men and women of Air Force Air Training Command draw on ATC's rich folklore for anecdotes about airmanship: UPT does a solid job of developing flying skills that become second nature to students by the time they pin on their wings and report to the so-called gaining commands.

Besides Reese, ATC bases devoted to undergraduate pilot training are Columbus AFB, Miss.; Laughlin AFB, Tex.; Vance AFB, Okla.; and Williams AFB, Ariz. Some undergraduate pilots are taught at Sheppard AFB, Tex., as part of the highly successful Euro-NATO Joint Jet Pilot Training (ENJJPT) program there.

An instructor pilot and his student head for their T-37 Tweet during a typically busy day of undergraduate pilot training at Vance AFB, Okla. Air Training Command also conducts UPT at Reese, Laughlin, and Sheppard AFBs, Tex.; Columbus AFB, Miss.; and Williams AFB, Ariz.

—USAF photo by Candy Tate


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U.S.AIR FORCE
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ATC trains instructor pilots at Randolph AFB, Tex., where the command is headquartered. Some of the best of each UPT graduating class are selected to go straight into the instructor-pilot course and are called FAIPs (first-assignment instructor pilots) on emerging from it. Most FAIPs eventually become fighter pilots.

There has never been any question that ATC produces pilots who are competent at worst and superb at best. They can fly. They have had a minimum of eighty-one hours of primary training in the T-37 and 109 hours in the supersonic T-38, a fairly hot and unforgiving airplane.

"If you can fly the T-38 you can fly anything in the Air Force," goes the saying in ATC.

But the UPT graduates are not as prepared as they could be to mesh with the flying machines and methods of the major commands that they join. Each of those commands would like its new pilots from UPT to become a bit more adept at its particular brand of flying more quickly than they are now.

Switching to Dual-Track

Military Airlift Command is a case in point. According to ATC officials, MAC would much prefer newly graduated pilots to have learned transport-type flying and multicrew management to a greater extent than is possible in T-38s.

MAC is not alone. As the Air Force "Trainer Master Plan" published earlier this year puts it, "ATC has been unable to find a training formula that fully satisfies all its customers. Significant trade-offs and compromises have been necessary."

This is why ATC is preparing to switch from generalized, single-track UPT to the dual-track, specialized variety called SUPT (specialized undergraduate pilot training), in which students will be trained to fly either tankers and transports or fighters and bombers. ATC officials believe that SUPT will cost less in the long run.

The first order of business will be to buy an off-the-shelf, twin-engine business jet for the projected Tanker/Transport Training System (TTTS). ATC plans to acquire 211 such aircraft and associated training systems for about $1.5 billion.

But the TTTS aircraft is only the beginning. Looking ahead to the three new types of aircraft and associated training methods that it will eventually need for SUPT, ATC is also pondering big changes in the ways it trains would-be pilots of high-performance aircraft. Changes being contemplated come under the heading of keeping man in the cockpit—making sure that fighter and bomber pilots are here to stay and that unmanned aircraft do not come to dominate by default the combat squadrons of tomorrow.

In recent years, a great deal of the work in USAF's research and development community has been pegged to two main purposes: (1) making combat aircraft more maneuverable and all-around capable while (2) giving their crews the automated tools needed to fly them, use them well as weapon systems, and survive.

The need to help pilots handle the flying and fighting work loads imposed on them by today's and tomorrow's hot fighters—even bombers—prompted such innovations as head-up displays (HUDs) and TV-type displays instead of dials in cockpits, computers that steer planes in response to voice commands, helmet-mounted sights, computerized voice warnings to crews in case of dangerously low altitudes, and the "pilot's associate" subsystem, in which computers programmed for artificial intelligence will serve in effect as co-pilots.

The Air Force has also been working on what it calls "new ways to fly." In this, fast-acting fly-by-wire digital flight controls are teamed with advanced aerodynamic control surfaces and electronically controlled propulsion systems to enable fighters to slip and slide around the sky in unconventional attitudes that do not crush aircrews under unbearable G-loadings.

The Advanced Tactical Fighter that USAF is developing toward deployment in the mid-1990s is expected to exemplify such supreme—but relatively unstressful—maneuverability.

All well and good. Much is being done to make high-powered aircraft less forbidding to their human flyers. But what about the flyers themselves? Can the Air Force do a better job of acclimating its pilots to such aircraft?

—USAF photo by Bennie Sanders

A US Air Force pilot and a West German Air Force pilot (kneeling) check out a T-38 at Sheppard AFB, Tex., home of ATC's highly successful Euro-NATO Joint Jet Pilot Training program. ATC has a reputation for producing pilots with superb stick-and-rudder skills. Today's UPT students are said to be the best ever.

Replacing the T-38

The answer is probably yes, and the place to begin is Air Training Command's undergraduate pilot training. Lt. Col. T. Patrick Flanagan, ATC's Deputy Director of Requirements, addressed the question in the context of ATC's plan to acquire a new aircraft for the future Reconnaissance / Attack / Fighter Training System (RAFTS) in SUPT. This aircraft would replace the T-38 around the year 2005.

"One thing we could do better is to train students to operate under fighter-sustained G-loads," Colonel Flanagan says. "So one of our goals is to have the RAFTS airplane provide us with that capability. It's a capability that doesn't exist in our trainers today."

New aircraft would make a big difference. But so would new training techniques on the horizon.

Student pilots now pull fairly heavy G-loads while doing their mandatory aerobatic maneuvers. But those loads are fleeting. The reason is that the maneuvers are flown vertically as a matter of course, and the Gs come and go in accordance with aircraft ups and downs.

"Our pilots learn to fly under rather benign G conditions," Colonel Flanagan says. "We're thinking of flying some maneuvers, like the Cuban eight for example, horizontally instead of vertically in order to sustain the G-loads for fairly long periods."

This, he says, would accustom student pilots to "thinking under the stress of their [added] weight, their helmets pushing down on them, and their vision coming in on them."

The way the training is now carried out, student pilots must put off learning to fly in the grip of unrelenting G-loadings until they proceed into fighter lead-in training at Holloman AFB, N. M., and from there into operational fighter and attack squadrons in Tactical Air Command and the tactical air forces.

By then, it could be too late. Blackouts have become bad news in the operational fighter community. All too many pilots and planes have been lost in recent years to crashes resulting from loss of consciousness under G-loadings at unrecoverable altitudes. Loss of consciousness or of situational awareness due to a dimming of the senses is often lethal at the low altitudes at which attack aircraft routinely are flown so pilots can practice evading enemy radars and missiles.

"We can teach our students to operate under G-loadings, without interfering with what the gaining commands will teach them to do," Colonel Flanagan asserts. "They'll be better able to learn how to drop bombs and defend against attackers—how to apply their aircraft as weapon systems—if they don't have to unlearn the benign G environment in which they were trained as pilots."

Extra shots of physical conditioning may also be in store for undergraduate pilots, who do a lot of it already. TAC is said to be putting more emphasis on such training, too, and is considering subjecting its fighter crews to sessions in centrifuges—a la the space program—to let them feel what it's like to verge on blacking out in order to help them resist the phenomenon in flight.

The Straight-Arrow Airman

The physical and mental rigors of becoming and remaining a pilot of today's high-tech, high-performance aircraft have brought about what might be called the straight-arrow airman.

In ATC circles and in the air-combat fraternity at large, there is widespread agreement that today's fighter jocks are a self-disciplined and sobersided lot compared to the free spirits in yesteryear's fighter cockpits. Contemporary combat pilots are said to take far better care of themselves in off-duty pursuits—including much less drinking and late-night carrying on—as a matter of sheer survival.

Today's gut-wrenching, mind-bending airplanes do not mix with, and are unforgiving of, hangovers and lack of sleep.

Colonel Flanagan, who flew F-4s at a time when flamboyance was more fashionable in fighter pilot circles, believes that the trend has been and will continue to be "toward persons who don't wear big watches and stay out having a good time at the bar on weeknights, who can do well with mental arithmetic and with managing the flows of information" on which their flying and fighting have come to depend so heavily.

Maj. Denny Grady, operations officer of the 64th Student Squadron at Reese and a fairly recent returnee to USAF after ten years in civilian life, has seen many a pilot come and go. He believes "the students of today are more serious and more dedicated than I've ever seen them. They're here because they really want it. They're the best ever."

Talks with a score of student pilots and instructor pilots at Reese tended to confirm the thesis that self-discipline is now the off-duty order of the day. Even so, said one instructor pilot: "I think pilots today are just as crazy underneath as they ever were. We just show it in ways that don't affect our everyday operations. We can do that because we're a very controlled group of people. We know that if we make a big mistake, we won't walk away from it."

Undergraduate pilot training takes fifty-two weeks. That's three weeks longer than the course covered as recently as Fiscal Year 1987, when high attrition rates convinced the Air Force that the undergraduates needed more time to work out their problems in the course.

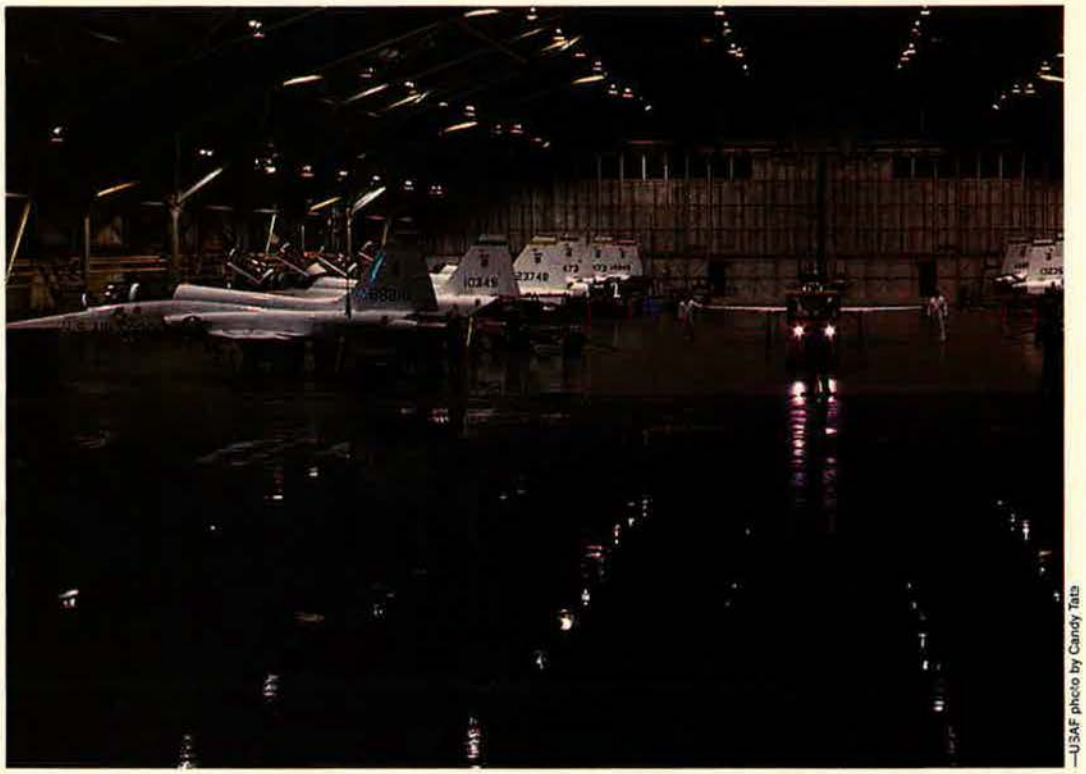
ATC expects that about twenty-two percent of students will wash out each year. In Fiscal Year 1987, the rate was an alarming 36.9 percent, which reduced the number of pilots produced that year to 1,447—422 fewer than should have been the case.

ATC officials say the attrition has been turned around and will be back down to about twenty percent in this fiscal year.

The lengthening of the course receives major credit for the turnaround. The additional time—fifteen training days—is just enough to enable borderline students to hang in there, surmount difficulties, and become good students.

Specialized undergraduate pilot training will first take effect at Reese. The first ATC dual-track freshman class will report there in June 1991. Fittingly, Reese is where SUPT once ended, in effect.

SUPT was the accepted way of doing things until the late 1950s, when the Air Force had no choice but to abandon it. In 1957, a severe hailstorm struck Reese AFB and all



—USAF photo by Candy Tate

Maintenance personnel at Vance AFB prepare T-37s and T-38s for the next day's steady flying. ATC will buy business jets to take some of the load off its T-38s in advanced UPT. The command plans to replace the Tweets and Talons in the mid-1990s and after the turn of the century, respectively.

but wiped out the whole ATC fleet of TB-25s parked there, a fleet that USAF had been using for specialized training of student pilots slated for tankers, transports, and bombers. There were no multiengine jet trainers available to replace the TB-25s and no funds to develop any.

So USAF settled for a single-track program of general UPT in which Cessna T-37s and Northrop T-38s would soon be used, as they are to this day, to train all undergraduates, no matter their individual airborne destinies. Those trainers replaced the T-28 and the T-33, respectively.

In the second coming of SUPT, all students will still go through primary training in the T-37 or the new subsonic trainer that USAF expects will replace the Tweet in the mid- to late 1990s. Undergraduate pilots headed for tankers and transports will take advanced training in the business-jet TTTS aircraft that USAF is in the process of selecting.

Students tapped for fighters and bombers will progress from primary training to the T-38 or the RAFTS aircraft that the Air Force foresees supplanting the T-38 around the year 2005.

New Lease on Life

The new TTTS aircraft will take a big load off the T-38 fleet, which has amassed about nine million hours in flight since the first Talon trainer went operational in 1961. The business-jets-turned-trainers will relieve the T-38s of their tanker-transport training, which amounts to about half their present training load, and give them a new lease on life to last beyond the turn of the century.

"SUPT is going to change the way we think about pilot training in many ways," asserts Lt. Col. Dan Fucci, chief of ATC's Pilot Training Division at Randolph AFB.

To make ready for the TTTS aircraft and training, ATC is working up new ways of screening and selecting students and is originating a TTTS syllabus. Also involved will be changes to both the T-37 primary syllabus and the T-38 advanced syllabus to be used by fighter/bomber students only.

The basic categories of primary training will remain the same in SUPT. Instrument flying, formation flying, and navigation will still be emphasized. There will be but slight variations in numbers of T-37 sorties and flying hours.

But some training will be quite different. For example, TTTS primary students will spend more time in formation flying, because they will have little time for such flying in the TTTS aircraft later on. They will concentrate instead on such things as getting into position to rendezvous and refuel, handling the airplane under asymmetric thrust, taking off in low visibility, managing information from sensors and computers, mastering cockpit resources, and coordinating crew assignments and work loads.

All this should make MAC happy. As the Air Force trainer master plan notes, today's advanced UPT centered on the T-38 is "essentially a fighter lead-in program" pegged to only about twenty-five percent of the trainees, the ones headed for fighter-type aircraft.

In consequence, says the master plan, "UPT does not address many of the specific needs of the approximately sixty percent majority [of students] bound for multicrew, multiengine aircraft."

When SUPT is in full swing, tanker/transport trainees will go through the mill at Reese AFB, Columbus AFB, and Vance AFB. Williams AFB and Laughlin AFB will be devoted to students on the fighter/bomber track.

According to the Air Force, fighter/bomber trainees will concentrate on "advanced aircraft handling; mission information management; three-dimensional situational awareness; advanced formation, element,

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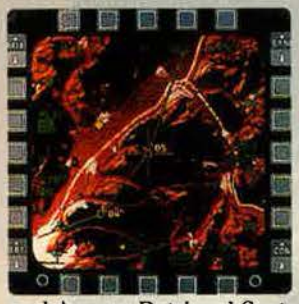

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and flight management; and mission-oriented low-level skills."

ATC officials claim that the T-38 will suffice for all that, but they leave no doubt that they itch for its successor all the same. In the opinion of many, UPT is being updated and streamlined not a moment too soon—and the new, modern trainer aircraft to keep all flight-instruction phases abreast of the times are needed more urgently than the corporate Air Force will acknowledge.

One reason for USAF's reticence may be its experience with the next generation trainer program, which resulted in the development and subsequent abandonment of the Fairchild T-46 trainer a couple of years ago.

On the bright side, that experience led to the TTTS program and to carefully laid plans to procure off-the-shelf primary aircraft training system aircraft and reconnaissance, attack, fighter training system aircraft to begin replacing the T-37 and the T-38 in 1999 and 2005, respectively, or thereabouts.

The RAFTS airplane could turn out to be the F-16, the F-15, or even the ATF, which will have been an operational air-superiority fighter—if all goes as planned—for ten years by the time of the RAFTS trainer's planned introduction. It is far too early to tell about this, however.

Meanwhile, as expressed in the trainer master plan, "The challenge is to remold a [training] system from one that was adequate in the age of the B-52 and 'Century Series' fighter to one that will be equal to . . . teaching the piloting skills required in the age of the Advanced Tactical Fighter, the [B-2] Advanced Tactical Bomber, and the Advanced Technology Transport (ATT)—and several generations beyond.

"The technology and training capability that was adequate in the 1950s is proving inadequate to the challenges facing ATC in the twenty-first century."

ATC officials point out that contemporary UPT graduates are the pilots who will fly the ATF, the B-2, the C-17, and the ATT if all those planes do indeed pan out.

How Much High Tech?

A big question before ATC is how much high technology to put into its new trainer aircraft of the future. Its goal is to keep such technology in "the heart of the envelope" rather than at the leading edge. The command is putting a much higher premium on the reliability and maintainability of its new trainers than it is on their technological sophistication. This is especially true of the TTTS business-jet trainer, which will take quite a pounding.

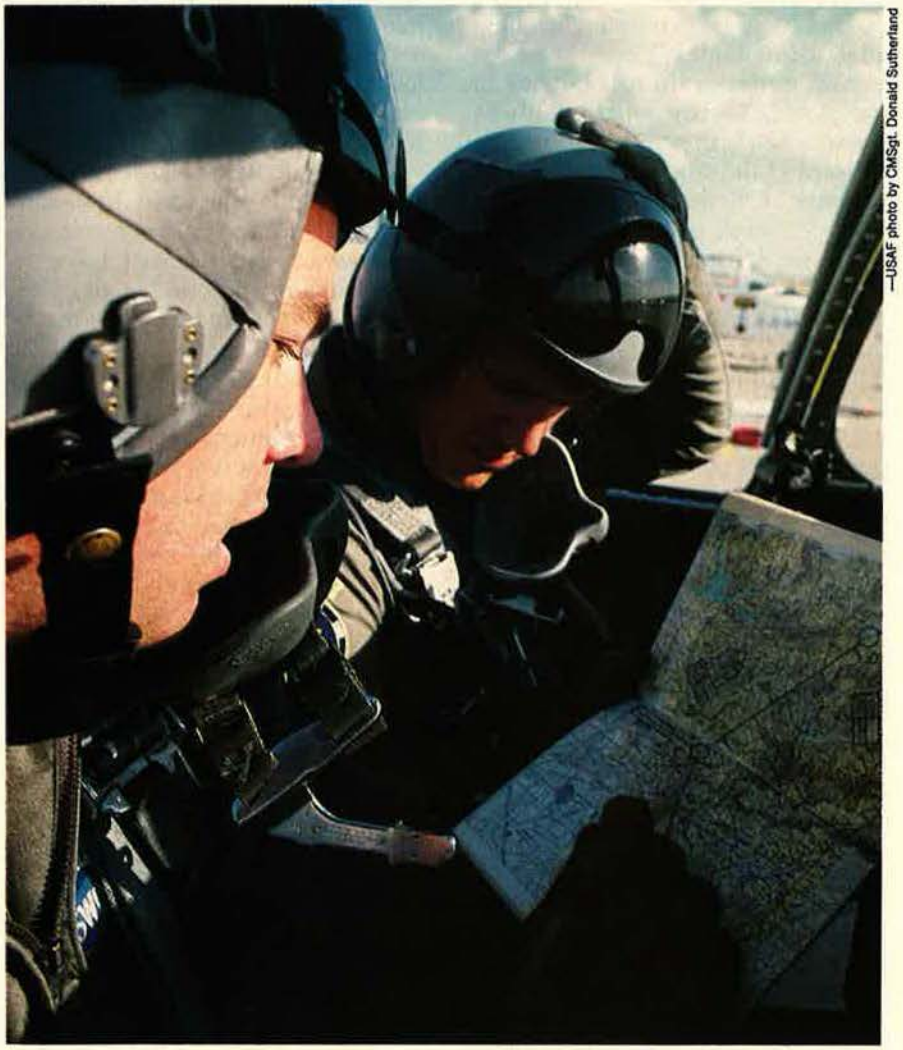
Maj. Michael Thomas, chief of curriculum in ATC's Pilot Training Division, declares: "The guy flying the F-16 may have fantastic technology to deal with, but if it breaks, he'll have to revert to basics, and that's our job—to teach him those basics, teach him how to fly."

Adds Colonel Fucci: "Our hard part is drawing the line, deciding how far we can let new technology come into UPT. For example, what should we do about HUDs, if anything?"

Head-up displays are now commonplace in modern fighters. UPT graduates encounter them only after they enter fighter lead-in training and begin learning how to use their aircraft as weapon systems. One school of thought maintains that trainees should become familiar with HUDs a lot sooner than that and that SUPT should see to it.

"Maybe we will put the HUD in toward the end of the fighter training track," Colonel Fucci says. "We're examining the need for it. But there are different kinds of HUDs in [operational] aircraft, and if we teach our students to use a generic HUD, they'll have to unlearn it anyway. Also, HUD technology is going to take leaps and bounds over the next ten years.

"It may be that, until the Air Force gets standardized on HUD technology, we won't be able to



—USAF photo by CMSgt. Donald Sutherland

An instructor pilot and a student pilot go over their route plan prior to taking off in a T-37. ATC is preparing to switch from generalized UPT to specialized UPT, beginning in 1991 at Reese AFB, Tex., in order to meet the demands of the major commands for pilots who are better trained for their particular machines and methods of flying.

teach the HUD. This is part of the larger question of how much technology we let come into UPT. We're here to teach the students how to walk before they run, and if we try to teach running, we could make a big mistake."

Another way of saying this is that the teaching of nighttime navigation of a fighter at low altitude is best left to TAC.

The HUD issue is being addressed in ATC's appraisal of what its RAFTS aircraft will embody when it enters the inventory around 2005. ATC has contracted with General Dynamics, Lockheed, and McDonnell Douglas to analyze RAFTS.

That system, says the Air Force trainer master plan, "may entail a limited amount of developmental work—more to assemble the available technologies into a single, integrated system than to explore the possibility of incorporating leading-edge technologies."

ATC expects aircraft entries in the RAFTS program to include trainers newly in production around the turn of the century and updated variants of modern trainers now in service, such as the McDonnell Douglas/British Aerospace T-45 Goshawk to be used by the US Navy. USAF intends to explore the possibility of jointly procuring RAFTS with the Navy, in fact.

How best to use—and not overuse—simulators is another major question that always confronts ATC and that will continue to loom in the streamlining of undergraduate pilot training.

The Air Force began going in big for simulators in the late 1970s in the aftershock of the oil crisis. They were expected to enable USAF to cut back drastically on flying time on all fronts—not just in ATC—and thus conserve fuel, cut the need for aircraft spare parts then in short supply, and save wear and tear on airplanes in general.

UPT flight time took a terrific beating. Each student lost forty hours in the air, or one-fifth of the previous total, over forty-nine weeks. All instrument training was done on simulators save for the final instrument checkrides. Those had to be done in the air.

The results were horrendous. The student pilots did so poorly on the checkrides that ATC was aghast. It moved swiftly to recapture flying time, which has been on the upswing throughout this decade. But only about half of the lost hours have been restored, fourteen of them in just the past two years.

Limits on Simulators

ATC may not be able to convince the political powers-that-be to give it any more flying hours. But it is determined not to relinquish any that it has. The command believes it has taken simulators as far as they can go.

Using them to teach instrument flying "proved rather less than successful," says Major Thomas, because "the real world is so different from the simulator."

ATC has found out that simulators are more valuable by and large for experienced pilots than they are for students. In fact, they can be a handicap for students in some ways.

"An experienced pilot can get a lot out of a simulator mission because he's seen the real world," says Major Thomas. "It's difficult for a student to do that because he's never flown in the real world. In a simulator, he's in a very controlled environment. He doesn't have to worry about traffic in his airspace. He doesn't have to talk to the rest of the world."

Colonel Fucci sums it up thus: "If a student in a simulator in an instrument environment gets a call that there's traffic at two o'clock at two miles, he doesn't have to really worry about it because the traffic isn't really there. But if I were flying an airplane, I'd be concerned. And because I have flown an airplane, when I'm in a simulator, I *am* concerned.

"The simulator will always land you where you took off from, and you know you're going to get home safely."

At the same time, Colonel Fucci and Major Thomas at Randolph AFB and instructor pilots and student pilots at Reese AFB were quick to give simulators their due as valuable tools for teaching basic aircraft control procedures and techniques, cockpit familiarization, and even, in some instances, situational awareness.

ATC's Singer-Link simulation systems, each featuring four T-37 cockpits or four T-38 cockpits, are credited with a great job of schooling pilot trainees in such intricacies as making the transition from instrument approaches to visual landings. ATC officials praise a new day-night computer imaging system recently acquired from Rediffusion.

Withal, stick-and-rudder skills will always be the *sine qua non* of ATC—skills that must be taught and tried out in the air and that will now be sharpened more keenly in the contexts of the particular airplanes in each SUPT student's future.

Specialized pilot training seems to make better sense than the generalized variety in view of the way USAF assigns and uses its operational pilots. There was a time when they were switched from fighters to transports to bombers or whatever. But such switching began going out of style about the time that the Vietnam War wound down.

At that point, says Colonel Fucci, "The need for universally assignable pilots began to diminish, and there was less money for UPT and follow-on training. The Air Force decided that it would be cheaper in the long run to train a pilot for exactly what he's going to fly and keep him doing it for a long time. If we're not going to reassign rated personnel from weapon system to weapon system, we might as well give them more specialized training from the very beginning.

"You may see a pilot go from one fighter to another or—now—to a high-performance bomber. But you won't see him go from a fighter to a C-141 or a C-5."

At Reese AFB, Col. Jerry Deakin, Deputy Commander for Operations, touched on something subjective about UPT that cannot be quantified, analyzed, or programmed, but that is clearly important nonetheless.

Said he: "When I went through pilot training in 1966, all the instructors and everybody in charge had been through Vietnam. Now, on this base at least, there are only a handful. Pretty soon, no one.

"So we'll just have to see to it that these young people continue to understand what made their predecessors successful—and *why* they're doing and learning these things here—*before* they go on to the weapon system commands." ■

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Where should tech school end and on-the-job training take over? For jet-engine mechanics, it appears that an extra month of formal schooling is a smart investment.

Apprentices With a Difference

BY BRUCE D. CALLANDER

SMALL groups of airmen have been leaving Chanute AFB, Ill., as "four-level" jet-engine mechanics and moving into units of Tactical Air Command. Actually, there is no such thing as a four-level specialist. In the hierarchy of Air Force Specialty Codes (AFSCs), enlisted members leave technical training as three-level apprentices and train on the job until they qualify as five-level journeymen.

Chanute has been holding a handful of its jet-engine students at the training center for an additional month of hands-on training on the F100 engine. The idea is to give them an added advantage in later on-the-job training (OJT). In early 1989, TAC and Air Training Command will decide if the approach is working and if it is worth using in other specialties. ATC officials say that early feedback from the experiment is encouraging.

To understand why this fairly modest departure from traditional training patterns has the experts excited, consider the process by which the Air Force traditionally transforms raw recruits into skilled specialists.

For most of this century, enlisted members have spent their first several weeks at basic military training (BMT) learning how to march, make beds, and distinguish a master sergeant from a major general. Before weapons and equipment became so complicated, most airmen then went directly to using commands, where they learned their skills by understudying more experienced specialists.

As technology invaded more and more specialties, however, growing numbers of BMT graduates were sent on to technical training centers such as Chanute. Today, more than ninety percent receive at least some formal specialty schooling.

How Much Is Enough?

With this growth of tech training came the question: How much is enough? Theoretically, airmen could be kept in school until they were fully qualified mechanics. During that time, however, they would be costing the government money and contributing nothing to the Air Force mission. And suppose they didn't reenlist?

The alternative was to teach air-

—Photo by Don Smith

At Chanute AFB, Ill., SSgt. Matthew G. Gray instructs AB Greg Alan Salter in the fine points of jet engine maintenance. By keeping some three-level apprentices in training for an additional month, ATC hopes to give them a running start, boosting their productivity and readiness.


GRAY

men only the barest essentials before turning them over to the using commands. That way, they could begin to earn their keep in a matter of weeks. That posed another problem. After only a fast few weeks of formal training, the novices couldn't just be turned loose on multimillion-dollar aircraft.

The solution that has evolved is a compromise between the quick-and-dirty approach and full vocational education. Today's tech school graduates are three-level apprentices who know the fundamentals of their skills and enough to do at least simple tasks under close supervision. They receive continuing OJT from their supervisors, and Air Training Command continues to provide follow-on training with some ninety field training activities.

Still, there are problems. One is that the demand for ATC field training is so heavy that airmen may have to wait up to six months for it. In the meantime, the bulk of the training burden falls on the airmen's immediate supervisors. Today's OJT programs require them to be teachers as well as bosses. En route to the five level, airmen must complete detailed blocks of training, all under close scrutiny. The recordkeeping of OJT alone is staggering. Moreover, such training ties up aircraft, engines, and other resources that the units can ill afford to spare.

In the past, the services had little to do in peacetime except to train for the next shooting war, so the Air Force was able to accept such conditions. But today's "peace" is not the conventional lull between storms. A command such as TAC rarely has the luxury of taking time out to teach new recruits at a leisurely pace. Increasingly, it needs new arrivals who can hit the ground running.

Clearly, some new approach was needed. The simplest answer would seem to be just to keep students in the classrooms longer. Just teaching more of the fundamentals, however, would not necessarily make airmen more productive when they hit the field.

ATC's Experiment

Two years ago, ATC began to look for another solution. What if it kept a small number of students in tech school just a little longer and gave them not more training in fundamentals but more of the practical, hands-on experience they would get in an operational unit? Would they be able to earn their keep any faster in the using commands and thus offset the time lost in delaying their graduation?

In October 1987, ATC decided to give the idea a try. A small cadre of students in the jet engine maintenance course (426x2) at Chanute was chosen to stay an additional four weeks at the center. They would receive a little more classroom training, but most of their time would be spent working on F100 engines under conditions as close as Chanute could come to those they would meet in TAC units.

To measure the results, ATC would track the graduates of the longer course and a similar number from the shorter, traditional three-level course and compare their progress.

The experiment became known as the "four-level program," but officials are careful always to use the term in quotes. The graduates still earn only three-level specialty codes. As the term implies, the added training is designed to give them a leg up in their progress toward the five-level AFSC.

The fact that ATC has added a few weeks of training is no big news. Training courses are frequently lengthened and shortened. What is different in this case is that the "four-level" training will be considered a success even if the graduates are no further along some months from now than the airmen who completed the shorter three-level course.

So why all the fuss?

Value to the Unit

Brig. Gen. Joel McKean, Commander of Chanute Technical Training Center when the new program was launched, explains. At some point during their first enlistments, General McKean says, the three-level and "four-level" graduates are expected to be neck-and-neck in their race for five-level AFSCs. The graduates of the longer course will not necessarily get there faster.

However, they should be more valuable to their TAC units in two ways. First, the "four-level" graduates should become productive faster. If the added hands-on training works, they will arrive already familiar with the work environment of real-world engine shops. They will be accustomed to following technical orders and will know the F100 engine like an old friend.

Second—and more important in terms of readiness, says General McKean—TAC should not have to tie up as many of its own resources breaking in the new graduates. In a command where readiness is an obsession, having weapons and troops ready to move on a moment's notice is a major virtue.

So far, feedback from the field suggests that ATC's version of the Head Start program is working. Graduates of the "four-level" program have gone to nine TAC bases, where they will be compared with the control group of three-level graduates until the Air Force Human Resources Laboratory makes its final report on the success of the experiment. Meanwhile, Chanute continues to move small numbers of students through the longer course in order to keep its training resources in place.

Most Chanute officials seem convinced that the "four-level" program will become a permanent fixture. In fact, ATC is already considering command suggestions for applying the approach to other AFSCs. Bringing more training "back into the schoolhouse," as ATC puts it, would relieve commands of the growing burden of OJT and allow some reduction in field training activities.

Drawbacks and Limitations

Even champions of the approach concede that it has some drawbacks and would not work for all specialties. Jet engine maintenance training was considered a natural for the program. TAC units can't spare many of the expensive powerplants for training purposes, but neither can they turn unseasoned mechanics loose on their operational equipment. The more hands-on experience Chanute can give them in its make-believe engine shops, the better. The problem is not as critical in other specialties, and added training for its own sake may not be justified.

Then, too, even the hands-on experience at Chanute is not a perfect

substitute for experience in an operational unit. Chanute's sprawling hangars have the look and feel of the real thing, but the base's runways haven't borne operational traffic in years. The only bombers and fighters that dot the landscape these days are static displays, some of them twice as old as the students who train here.

Short of bringing back live aircraft, there is no way to create the atmosphere of a functioning flight line. SSgt. John Davis, an instructor in the basic jet-engine maintenance course, agrees that the "four-level" training should help airmen destined to work in engine shops, but he suggests that those who go to the flight line will still need heavy doses of OJT.

TSgt. Donald Bishop, a master instructor in jet engines, concedes that "four-level" training is designed primarily to prepare students for shop work. He argues that hands-on experience should help them on the flight line as well. A 1973 graduate from Chanute now on his second tour as an instructor, Sergeant Bishop had his first exposure to the "four-level" program as an end-of-course evaluator. In day-long sessions with each student, he ran them through a series of tasks and rated their performance.

Sergeant Bishop now instructs in the new program itself and tries as far as is possible to duplicate the conditions he remembers from his own days in the engine shop at Cannon AFB, N. M. Playing the role of supervisor as much as instructor, he encourages students to work on their own more than they have done under the more formal conditions of the classroom.

—Photo by Don Smith

Sergeant Gray and Airman Salter examine an F100 engine. By the time "four-level" graduates arrive at using commands, they know the F100 engine like an old friend.

Graduates More Confident

Lani Krumwiede shares instructor duties with Sergeant Bishop and echoes his enthusiasm for the training. A GS-9 civilian, she also is a master instructor. She says she found an "amazing" difference between the confidence levels of three-level graduates and those of students who have been through the added month. Part of the confidence-building, she says, comes from the practice of having students not only work independently but also take turns acting as crew chief to gain an added sense of responsibility.

In this respect, Ms. Krumwiede says, the "four-level" course uses the approach she has favored in her fourteen years as an instructor. "If you are going to train jet-engine mechanics, you should do it by letting them be jet-engine mechanics. If they need guidance, you give it, but most of the time, you let them follow the tech orders and do the job in the same way they would in the field."

The learning-by-doing approach was built into the "four-level" program from the beginning. Bill Richardson, training manager, was in on the birth of the course. In the early stages, he said, planners met with TAC officials and asked what they would like to see in the training. They also asked shop chiefs at Langley AFB, Va. The consensus from these chiefs was that the added four weeks should be packed with as much hands-on training as possible.

How well it all works should be apparent soon. If the "four-level" graduates do as well as expected, students in some other skills may find themselves ankle-deep in OJT even before leaving Chanute or other tech training centers. ■

After active-duty service during both World War II and Korea, Bruce D. Callander (who earned a degree in journalism between the wars) joined the staff of Air Force Times *in 1952, becoming editor in 1972. Mr. Callander is now a free-lance writer whose by-line appeared most recently in* Air Force *Magazine with "When You Call It an Airline, Smile" in the August '88 issue.*


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Ending basic training too abruptly caused problems. But Lackland-like discipline all through tech school didn't work either. These days, student airmen decompress by phases.

It Isn't Over 'Til It's Over

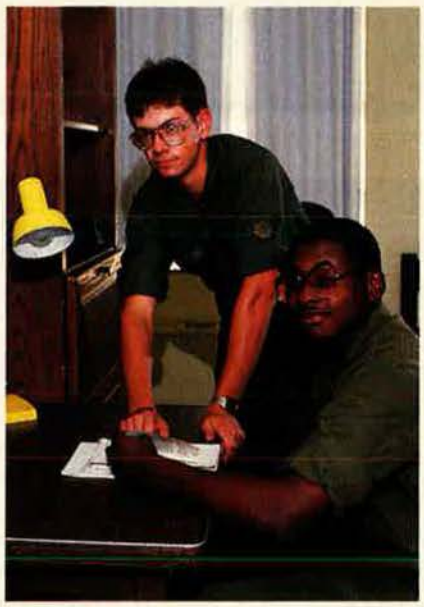
BY BRUCE D. CALLANDER

AS RECENTLY as seven years ago, an airman's basic military training (BMT) ended with graduation from Lackland AFB, Tex. When airmen reached technical training, there were no more military training instructors (MTIs) breathing down their necks, no more morning formations, no more marching to and from class, and no more soldiering.

In the early 1980s, the Air Force realized that too many airmen were taking the end of BMT as the signal to cut loose. The culture shock of moving from the supercharged discipline at Lackland to the campus-like atmosphere of tech school found many students unable to cope. Disciplinary problems mounted, and classroom work suffered.

In 1981, the joyride ended abruptly. The Air Force launched Project Right Start, which made tech training a continuation of BMT. The same strict rules that had applied at Lackland were enforced throughout the students' stay at tech school.

That didn't work either. "It was overkill," says MSgt. Gary Seep, NCOIC of the Military Training



After basic training, school is still not out. At tech school, there is still academic work and practical application. Above, A1C Damon Wheeler (standing) and AB Daniel Thomas study; at right, students and instructors of the 3755th Student Squadron, Sheppard AFB, Tex., work on an antenna.

—Photos by Paul Kennedy

Branch at Chanute AFB, Ill. "It put all students in the same category throughout their whole time here."

The short dose of additional BMT was fine for students in courses lasting only a few weeks. But most tech school courses last at least two months, and some cover the better part of a year. Keeping students under rigid discipline that long proved counterproductive.

Adjusting by Phases

In 1982, Right Start was replaced with the phased program in use today. Under the new approach, students are kept on a tight rein for their first two weeks. As the airmen progress, the rules are gradually eased so that by the time students of the longer courses are near graduation, they have most of the privileges of permanent party airmen.

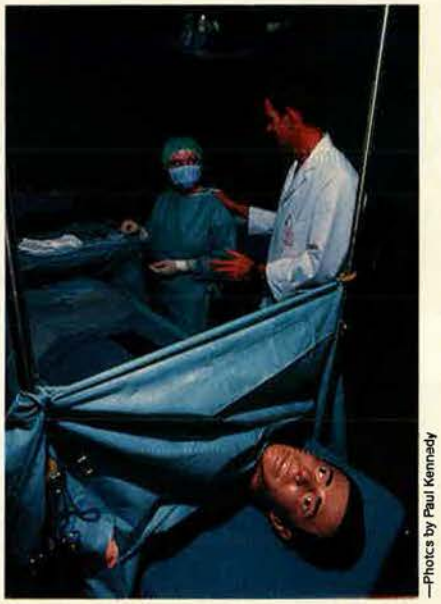
In effect, the program at Chanute and other tech training centers amounts to a decompression chamber in which airmen can make a gradual transition from the closely supervised environment of Lackland to an Air Force that expects them to behave largely under self-discipline.

SSgt. Greg Holl is one of Chanute's more than fifty student training advisors (STAs), the tech school's approximate equivalents of Lackland's MTIs. Sergeant Holl outlined the phases of the current military training program.

The primary reason for technical training is to give students the particular skills they will need in their career field. Here Amn. Amy Blasingame (right) learns the procedure for counting white blood cells from her instructor, Sgt. Fred Matos, in the laboratory technician's course at Sheppard.

For their first fifteen days of tech training (Phase I), airmen are confined to the base. They must wear their uniforms whenever they are outside their dormitories and observe curfews and quiet hours. They must march to and from class and cannot drive or ride in private cars, drink alcoholic beverages, or use the open mess.

From the sixteenth day through the thirtieth (Phase II), students are still held to many of the Phase I rules, but are allowed more leeway



—Photos by Paul Kennedy

The ratio of students to technical training staff at tech school has fallen dramatically. This allows for individual training such as TSgt. Richard Clark (right) gives here to Amn. Cressa Doshorn (in surgical garb) in the surgical technician's course at Sheppard.

The four-phase approach to tech school training has been in place since 1982, and it has proved effective. Rules are gradually eased until the students have nearly the same privileges as permanent party airmen. These troops are marching back to the dorms, a routine that must be followed until they reach Phase IV.

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SHORTS

—Photo by Paul Kennedy

If the program works as it should, tech school graduates reach the field with both the ability to take orders and the maturity and self-discipline to work responsibly when no one is around to give them orders. Here AB Dennis Fournier works on a tail rotor at the helicopter maintenance course at Sheppard.

on weekends. Then, they may go off base, drive cars, use the airmen's open mess, and drink alcohol, although not in the dormitory. They must still wear their uniforms whenever they are outside their dorms.

From the thirty-first day at Chanute until students have a total of six months' active service (Phase III), the more relaxed rules apply, not just on weekends but also during any off-duty hours. Students may wear civilian clothes when off duty, and married airmen may live off base with their spouses.

After six months of active service (Phase IV), students approach the degree of freedom they will enjoy at most bases. They still must stand roll calls and periodic inspections and remain in uniform during duty hours. They no longer have to march to and from classes, though, and they may use their private cars during duty hours. They are excused from all physical conditioning except for a monthly run of a mile and a half.

For Wayward Students

While the stepped-down rules give students progressively more freedom the longer they stay in school, there is a catch for those whose behavior or performance slips. The student squadron commander can set a wayward student back one or more phases—or all the way back to Phase I.

Students who have not reached Phase IV take three physical-conditioning sessions per week, each including a twenty-minute run and five other exercises. The average airman also participates in at least one parade and two retreat ceremonies during the stay at Chanute.

Still, the students' primary reason for being at the base is to learn technical skills, and the bulk of their time is spent in classes. "Keep in mind," says Sergeant Seep, "that the student is outside our control for six to eight hours a day. We have to pack in supervisory management of that troop after that training time."

Sergeant Seep is pleased that the ratio of students to STAs has fallen to about fifty to one. In past years, it was as high as eighty or 100 to one. Even with the luxury of a smaller ratio, the sergeant says, the kind of close personal supervision a Lackland MTI can exert is impossible at Chanute. "An STA spends about ten percent of his time with ninety percent of the troops, the ones who never do anything wrong," says Sergeant Seep. "We spend ninety percent of our time with ten percent of the troops, the ones who have problems."

The gap is filled, at least partially, by the technical training staff. About eighty percent of Chanute's technical instructors are NCOs. Most civilian instructors are former Air Force members. While their primary mission is to teach in the classroom, instructors also play the role of military supervisors. The STAs provide more formal military training, and the instructors stress the need for on-the-job discipline.

If it all comes together as intended, Sergeant Seep says, tech school graduates should reach the field not just with the ability to take orders, but with the maturity and self-discipline to work responsibly when there is nobody around to give orders. ■

—Photo by Don Smith

Many tech school instructors are ex-Air Force civilians who bring a wealth of experience and know-how to the courses they teach. The instructors stress the need for on-the-job discipline. These students are working on an F100 engine at the "four-level" jet engine repair course at Chanute AFB, Ill.

If a forward base is attacked, everyone assigned must help with defense and recovery. For starters, how about training all USAF people in firefighting, medical "buddy care," and basic infantry tactics?

More Hands for Base Defense

BY MAJ. GEN. GEORGE E. ELLIS, USAF

An important principle of war is to maintain the offensive. In any future conflict, the Army, Air Force, and Navy will work together to keep the initiative. During battle, we must force the enemy to react to our initiatives rather than allow him to exercise his alternatives. Airpower is a key ingredient in maintaining the offensive. But to do that, we must be able to launch and recover our aircraft on our time schedule and at our discretion.

As Gen. H. H. "Hap" Arnold said, "Air bases are a determining factor in the success of air operations." The Air Force flies and fights from the air base. Ten years ago, our air bases were virtual sanctuaries. That's no longer the case. Soviet weapon systems have improved in range, accuracy, and lethality to the point where they can strike and seriously damage our theater air bases. These bases must be able to survive these enemy attacks *and* generate sorties.

The Air Base Operability (ABO) program is one way we are improving the readiness and sustainability of our air bases. ABO efforts contribute to the four pillars of combat

Maintenance crews perform rapid runway repair using a front-end loader to place concrete slabs. An essential offensive tool in "fighting the air base," runways are, naturally, a prime target. The more air base personnel are cross-trained to operate such equipment in an emergency, the faster an air base can recover from an attack.

—USAF photo by TSgt. Kit Thompson

Full air base readiness calls for a well-trained multidisciplined force, "fighting air-groundsmen" such as Winston Churchill called for in 1941. Combat support forces should be trained in defense infantry tactics and should be familiar with combat weapons such as the M60 being used in this training exercise.

capability—readiness, sustainability, modernization, and force structure.

The key ABO initiative tying these elements together is training—integrated combat support training. If our bases are to launch and recover aircraft, everyone must be trained to contribute to the air base's capability to fight. Aircraft armed to the teeth but sitting on the ramp or in shelters are only high-value enemy targets. We must get them off the ground. Combat support is a critical element of our aircraft launch process. If we are to be successful, we will need the requisite combat support skills. Training is the *sine qua non* to developing those skills.

We need to focus on the integrated training of everyone assigned to the air base. We'll need people who can do more than just the specific job they were trained for at tech school. Our folks will have to assist with base-damage recovery operations, help the security police, or tend to the wounded. Everyone will need multiple skills. The performance of the air base under fire will be measured by how well the multiple skills have been learned.

At a minimum, all uniformed Air Force personnel should be trained in three ancillary areas.

• **Firefighting.** We need volunteer firefighters who know how to deal with the numerous fires that will result from an air base attack. Professional Air Force firefighters are trained to respond to wartime crash-rescue priorities. They are going to be busy.

Not too long ago, a fuel truck crashed into a restaurant in Germany and exploded. The newspapers likened it to a bomb blast. Thirteen fire departments from surrounding areas responded to extinguish the fire. That was one bomb. If more than 100 real bombs are dropped on our air bases, everyone is going to need some firefighter training. Trained firefighters extinguish fires faster than untrained firefighters do. In addition, an untrained firefighter is a hazard to himself and to his firefighting associates.

• **Medical training.** There aren't enough medics. Medics on the battlefield are a thing of the past. We now receive battlefield medical care under a program called "buddy care." If you're wounded and need help to make it back to the aid station, one of your buddies is going to have to take you. I'd like my buddy to know something about first aid. If I'm bleeding, I want him to help me stop the bleeding. If I have a broken neck, I don't want him moving me. If I've stopped breathing, I sure hope he knows CPR. Short of this training, it might be better to call the chaplain—he'll know what to do.

• **Defense infantry tactics.** Air base defense is everyone's job. We do not have enough security policemen to defend the base perimeter. Our security police are now learning basic defensive infantry tactics and air base ground defense concepts from the Army. They currently undergo a four-week training course at Fort Dix, N. J., designed to give them a working knowledge of what it takes to defend an air base. But they can't defend it alone. We need to train all airmen to defend the air base.

The need for a well-trained, multidisciplined force was highlighted at the Battle of Maleme, Crete, in 1941. The British airmen who occupied the airfield were not trained and were unprepared for the German attack. As a result, the battle

lasted only about two hours. The British airmen offered little opposition to the advancing Germans. The Germans were able to profit by the confusion and disorganization, both products of an untrained force, causing unnecessary British casualties.

The seizure of Maleme led Prime Minister Churchill to state in a 1941 letter to British Air Minister Sir Archibald Sinclair: "Every airfield should be a stronghold of fighting air-groundsmen, and not the abode of uniformed civilians in the prime of life protected by detachments of soldiers."

Churchill's words are as true now as they were in 1941. We must train our combat support forces for their wartime missions. The flying side of our business has Red Flag, the SAC Bombing Competition, and Airlift Rodeo. These exercises train aircrews and maintenance people in a realistic wartime environment. The Air Force needs similar exercises—such as Tactical Air Command's Silver Flag—for its combat support forces. Red Flag training saves aircrew lives early in the conflict (we learned that lesson the hard way in Vietnam). Combat support training would do the same.

More exercises like TAC's Silver Flag are needed to train combat support forces for their wartime mission: defending the air base and keeping it running.

USAF firefighters, trained to respond to wartime crash-rescue priorities, will have their hands full if an air base is attacked. Air base personnel should know how to deal with fires and explosions; properly trained firefighters are more effective and less dangerous than untrained volunteers. Here, firefighters sharpen their skills at a base fire training site.

We are creating integrated training opportunities. Engineering and Services folks have been training for their base recovery mission at Eglin AFB, Fla. Recently, we've expanded the training to include explosive-ordnance disposal, disaster preparedness, firefighters, and communications personnel. We train more than 8,000 people per year, but that still isn't enough. We need cooks who can drive dump trucks. We need engineers who can help defend the air base. We need "702s" who can make unexploded ordnance safe. The installation commander will have to use all his resources to "fight the air base." He must be able to draw from a trained pool of resources, a pool that is multiskilled.

We are also training our officers at the Officer Field Education course for civil engineering and services officers at Eglin AFB. This course gives our young officers experience in base recovery operations. It allows them to get their hands dirty and make mistakes. They learn from these experiences. War is neither the time nor the place to make mistakes.

Our challenge is clear. We must train the way we expect to fight. We must use the quiet and luxury of peace to train for the noise and turmoil of war. As a Chinese proverb stated, in effect, "The more you sweat in peace, the less you bleed in war." In real estate, the key elements are location, location, location! The key elements for success in combat support are training, training, training!

The time to get serious and get started is now. History will be unkind to us if we sustain wartime casualties because we were too myopic to see the necessity for realistic training. ■

Maj. Gen. George E. Ellis, USAF, is currently the Director of Engineering and Services, DCS/Logistics and Engineering. He received his USAF commission in 1958 and, after serving in Alaska, spent more than a year in Vietnam. Among his many other honors, General Ellis holds the Bronze Star with V device and the Legion of Merit with oak leaf cluster.

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Battle damage repair in wartime can't stop just because regular parts and supplies aren't available.

Improvise. Adapt. Overcome.

BY JEFFREY P. RHODES
AERONAUTICS EDITOR

PHOTOS BY GUY ACETO
ART DIRECTOR

FEW people think of Coke cans and broomsticks as having much military value. But the graduates of the Air Force's Aircraft Battle Damage Repair (ABDR) schools would beg to differ. These technicians see a cut and flattened Coke can as an emergency patch for a 7.62-mm-shell hole and a broomstick as an improvised actuator arm for a nosewheel door.

Nobody would ever use such parts by choice—but in wartime, choices may be limited. The ABDR schools prepare their graduates to keep the sorties going even if regular parts and supplies aren't available.

"The repairs don't have to look pretty," said MSgt. Raymond Smith, an ABDR instructor with the 512th Field Training Detachment at Davis-Monthan AFB, Ariz. "Our goal is to get that aircraft back into the air for another mission in a minimum amount of time."

The Air Force recognized the need for a viable aircraft battle damage repair program in 1978, and the concept was instituted in 1980. Three major commands—Air Force Logistics Command, Air Force Systems Command, and Air Training Command—are responsible for the implementation.

AFLC manages the overall program from the ABDR Program Management Office at the Sacramento Air Logistics Center at McClellan AFB, Calif. It also helps obtain salvage aircraft. The operating commands see to the tools and materials that go into the ABDR kits.

Systems Command is charged with developing improved repair and assessment techniques and developing ABDR technical orders for F-15s, F-16s, and any future aircraft. ATC developed the plans for teaching the technicians at thirty-four field training detachments located around the world. The ABDR schools, which are used by six major commands, the Air National Guard, and Air Force Reserve, turned out 1,633 graduates in FY '87 alone.

A Hands-on Course

The opportunity to practice battle damage repairs in the field does not often present itself. With more than 2,600 aircraft potentially available

Although a Coke can is not the recommended material for repairing a shell hole, this ingenious fix shows how adept Aircraft Battle Damage Repair technicians are at using almost anything to get an airplane back into the fight.

The last three days of the five-day technician's course are spent making actual repairs on the school's full-scale learning aids. Here, TSgt. Johnny Hines patches the tail of an F-105 while Sgt. Terry Hubbard observes. Eventually, the school's instructors run out of places to create new damage.

to practice on at the Aerospace Maintenance and Regeneration Center (AMARC), Davis-Monthan AFB is the ideal location for the main ABDR school.

"We teach the students to use whatever is handy—wood, metal, whatever," noted Sergeant Smith, "anything they can use to make a legal [within ABDR and safety-of-flight regulations] repair." In fact, the ABDR tech order may be the only one in the Air Force that plainly states, "Techniques are limited only to the experience and ingenuity of the technician doing the repair."

Since the ABDR school opened at Davis-Monthan in April 1987, 500 students have graduated. The six instructors teach six classes of six persons each per day, and there are two courses of study. The three-day damage-assessor course teaches students how to look at the damage and to plan the quickest and safest way to make the repair.

The first two days of the technician course are spent in the classroom of the 512th FTD's schoolhouse (built by an Air National Guard civil engineering squadron). The students are first taught basic ABDR procedures and the theories behind them.

The next three days are spent making patches and repairing structures on the school's full-scale training aids—an F-105, an early model B-52, a Boeing 707, and an F-101.

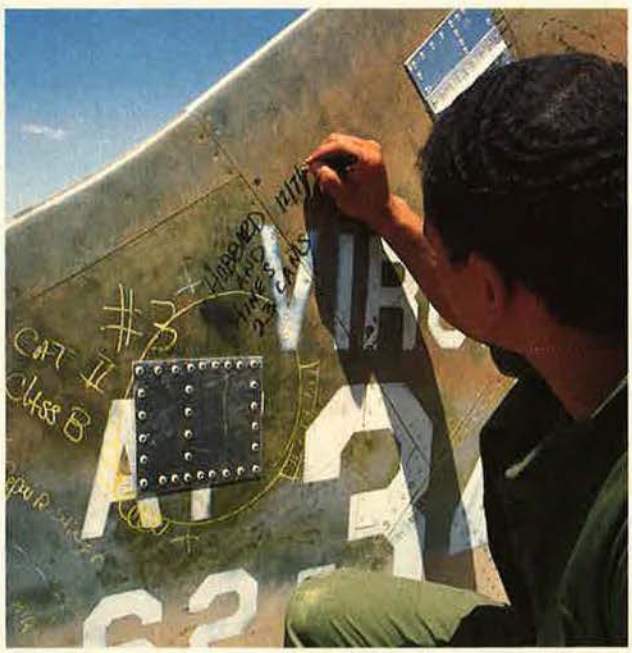
"Battle damage" is created with crash axes. Whatever damage the instructors do then has to be fixed by the students. "We have to change out the aircraft periodically," said Sergeant Smith. "After a while, we run out of places to patch them."

After learning structural fixes, the classes then go on to repair of hydraulic, electrical, and fuel systems.

The types of repairs the students make range from a simple skinhole patch with no internal fixes (usually using sheet metal, but in a pinch, the Coke can), to an external repair of a stringer (the repair can go outside because the sheet metal doesn't impede the airflow, and it makes for a quicker fix), to making pushrods and pulleys from scratch. The students also learn to splice wires and even make complex canopy and radome repairs (the canopy repair is made inside and the internal pressurization pushes it against the "glass" to seal it).

For the final exam, the instructors, as Sergeant Smith says, "go out and create problems with the ax." The student technicians and assessors have to plan and carry out all the necessary repairs. There is a time limit on each repair. Once finished, the students get to sign their work.

The motto of the 512th FTD—"Improvise, Adapt, Overcome"—is a very good description of what the ABDR schools teach and what the technicians will have to do if their skills are ever needed for real. ■



Upon completing their "final exam," ABDR students sign their names on the finished repair, as Sergeant Hubbard is doing here. The school's technical order may be the only one in the Air Force that encourages ingenuity to get the job done.

The training simulators used by today's aircrews are amazing devices. They can do just about anything except fly.

The Fast-Moving W

BY JEFFREY P. RHODES, AERONAUTICS EDITOR

orld of Simulation

—Photo courtesy of Loral Corp.

Simulators have certainly changed over the last forty years. State of the art during World War II was the Link trainer (above). The photo at the left shows the F-15E Weapon System Trainer Instructor Operator Station of today, which enables one instructor to oversee the training of both crew members.

THE World War II Link trainer was the granddaddy of all flight simulators, and as with much else, things were simpler in granddaddy's day.

The old Link was a comparatively simple device. Aviators climbed into the stubby-winged simulator—which looked something like a carnival kiddie ride—for general orientation and some practice on the instruments. The Air Force had airplanes by the thousands then, so simulation was seldom something that new or seasoned pilots had to resort to because actual flying time was at a premium.

Forty-five years later, the world of simulation is altogether different. The Air Force owns far fewer airplanes. Flying hours are limited. Almost anything that can be simulated is simulated. The simulation itself encompasses training on tasks that were undreamed-of in the era of the venerable Link.

Today's airmen try to get the easier stuff done in the simulator so they can use their cockpit time for the higher levels of training. "Simulators allow the pilots to practice things like formation work and tactics in the air, rather than routine tasks or strictly checklist procedures," said Larry Ames, the Director of Marketing for Educational Computer Corp. (ECC), a simulator manufacturer.

It's no longer accurate to think of "a simulator" for a particular aircraft. Instead, there is a whole family of training devices, ranging from individual interactive videodisc terminals for academic work to elaborate weapon system trainers (WSTs). Computer-generated gra-

phic displays can summon up a wide variety of conditions and locales. There are also part-task trainers (PTTs), which recreate only selected aspects of an aircraft's capabilities or systems.

A growing trend in the Air Force (and now the Navy, too) is the aircrew training system (ATS) approach. The services are getting out of the ground training business and are relinquishing academic and simulator training to civilian contractors.

Simulators are great ways to practice such actions as emergency procedures and firing missiles. But even advanced simulators still have some deficiencies.

"There are still no gravity cues in a simulator, short of a very expensive centrifuge arm," said Dennis Shockley, the director of Orlando, Fla., operations for Evans & Sutherland, a company that designs and builds computer-generated image systems. "There is still a problem with motion cuing, too. A pilot makes an input and expects a response. Sometimes there is a gap of perhaps 120–200 milliseconds between the movement and reaction. That is enough of a variance to produce simulator sickness."

Force packages can't be simulated, either. "You can't get the feel of working with an EF-111 without actually doing it," said Col. Wayne Lobbestael, Director of the Training Systems System Program Office (SPO) at Air Force Systems Command's Aeronautical Systems Division at Wright-Patterson AFB, Ohio.

Experts agree that simulators will never take the place of actual flying. "Some day the technology may be there to do all training, including full mission rehearsal, in simulators," said Colonel Lobbestael. "But there is something about actually being in an aircraft. You know the risks, and you know the limitations of the aircraft from working in the simulator. To apply the knowledge properly, though, you have to be in an airplane."

Parts of the Whole

Part-task trainers break out a portion of the overall mission, such as aerial refueling or cockpit procedures, and teach the basic skills. Once those are mastered, the crew member combines the accumulated skills to run a full mission profile in the WST. This, in turn, becomes preparation for actual flight.

The degree of complexity of the PTTs ranges from the relatively simple, such as a crashed C-130 fuselage being used for loadmaster training at Pope AFB, N. C., to the highly complex, such as the LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) PTT, which was recently installed at Luke AFB, Ariz.

The LANTIRN part-task trainer, built by ECC, provides initial training for crewmen on the two-pod system that will be fitted to F-15Es and selected F-16s. It has static visual imagery, a spatially correct cockpit, and the switches necessary to train in symbology, switchology, and modes of operation.

By learning in the PTT first, an F-15E crew can take off, fly low-level at night, release ordnance, and return to base without a hitch after the first couple of runs in the WST. After a few trials there, the crew can try it in the airplane with a good chance for success on the first sortie.

Since PTTs are less elaborate and less expensive than WSTs, the Air Force can afford more training equipment with available monies, which allows more crews to train at one time.

"If you relied on flight trainers or WSTs to do all of your training, including things like procedures, there would be a huge bottleneck," said Wayne Calhoun, government marketing manager for McDonnell Douglas Training Systems, Inc. (MDTSI). "There aren't all that many WSTs."

The weapon system trainers are the Cadillacs of the simulator world. They can do just about everything the aircraft can do except fly. The instruments in the WST "cockpits" all work, and with the aid of realistic computer-generated images and motion capability, the full mission profile can be "flown" from engine start, through the release of ordnance, to shutdown.

In the case of bombers, both the B-1B and B-52 WSTs include stations for the full crew. The entire crew can train together, or individuals can train separately.

The computers needed to run the simulations are very software-intensive, but the realism they generate is amazing. A crew at K. I. Sawyer AFB, Mich., for instance, can "call up" Carswell AFB, Tex., and "fly" a mission out of there. The simulation is so realistic that the General Dynamics plant in Fort Worth is visible at the edge of the runway. Light conditions can be varied, too, to simulate dusk or nighttime.

The WSTs are also valuable for specialized missions. For a variety of reasons, EW practice on training sorties is limited to places like the

—Photo courtesy of Evans & Sutherland

This picture of Marine AH-1Ws flying off the California coastline near Big Sur shows the level of realism computer-generated graphics have attained. High detail was required in this database to provide speed, altitude, and closure rate cues for the pilots in training while practicing low-level maneuvers near the cliffs.

Green Flag range at Nellis AFB, Nev. In the WST, crews go against simulated radar emitters and jam them, all through the simulator's computer.

By the time this appears in print, Luke AFB, Ariz., should have received the first F-15E WST, the first time a simulator with safety-of-flight capability has become operational at the same time the crews have begun flying a new tactical aircraft.

Loral Defense Systems/Akron started developing the F-15E WST in 1985, but research and development on how to simulate some of the sensor technology began in 1981. The computer system for the finished product required more than 600,000 lines of real-time and off-line code.

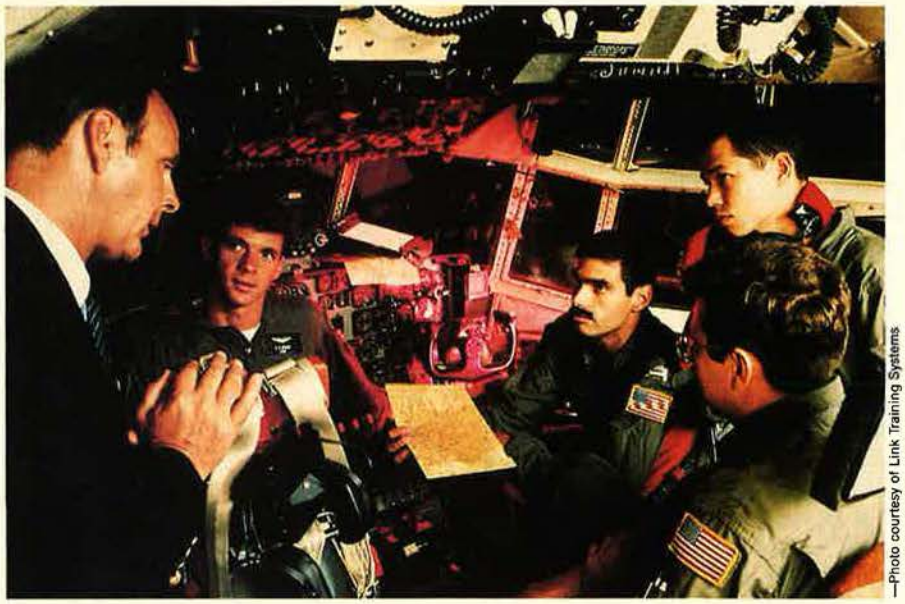
The WST includes realistic simulations of real-time synthetic aperture radar and electro-optical and infrared sensors to support the LANTIRN system. The data augmentation system improves the resolution of route information provided by the Defense Mapping Agency. Unlike earlier WSTs that used hydraulic jacks to provide motion, the F-15E WST uses a G-seat/G-cuing system.

There is also a new generation of simulators that might be described in baseball parlance as "tweeners." These new simulators are more than PTTs, but they are not so elaborate as the full-up WSTs.

British Aerospace has developed a two-dome simulator for air-to-air combat training. In each dome is a generic cockpit that can be "reconfigured" with modular avionics and computer software. The "aircraft" replicates the performance of almost any fighter aircraft, including Soviet MiGs.

The simulation can be set up so that the pilot in one dome "flies" against the other pilot. Moves by the hunter are projected on the dome of the hunted, and vice versa.

Less complex is Loral's F-15 Hotshot tactics simulator, designed for squadron-level training with no human instructor. Its only working features are the stick and throttle, radar, and tactical electronic warfare system (TEWS) indicator. The "head-up display" shows on the video screen. All manner of air-to-air situations can be programmed and run very easily. The Hotshot also includes a weighted scoring system so aviators can check their progress.



—Photo courtesy of Link Training Systems

The services are increasingly getting out of the ground training business and are turning academic and simulator training over to contractors. This Link Training Services Corp. instructor is conducting a "post-flight" briefing with a C-130 crew in the six-axis cockpit simulator at Little Rock AFB, Ark.

Contract-Run Schools

Increasingly, academic work and teaching with PTTs and WSTs are handled by contractors. Simulator training programs run entirely by the military are becoming rare. For such aircraft as the C-17 airlifter and the Navy's T-45A Goshawk, contractor-run aircrew training is part of the procurement package.

"We gain both manpower and proficiency under the contract concept," said Lt. Col. Tom Kahley, chief of the tactical aircrew training division at Military Airlift Command headquarters at Scott AFB, Ill. "The student gets state-of-the-art computer-based training, it's more efficient, and it's less costly to us."

With contract training, pilots who had been serving as simulator instructors can return to flight status. "The ATS approach frees up rated resources to be in the cockpit," said Lt. Col. Jim Stevenson, chief of MAC's training systems integration branch.

One of the contract stipulations when the ATS programs are put out for bid is that contractors make a "best effort" to hire ex-instructors for that aircraft. "We have done that 100 percent," said Don Aspenson, the C-141 ATS bid program manager for FlightSafety Services Corp., the company that runs the C-5 ATS. "Of our 100 instructors, only one is not retired Air Force. The experience base is tremendous."

The C-130 ATS has been in operation for less than a year, but the instructors are already receiving rave reviews. "People keep telling me how great the course is and how good the instructors are," said Lt. Col. Dave Rivard, MAC's chief of C-130 continuation training. "It's exactly the same course, but the crews think we have already changed to a new one."

ATS also guarantees that crews will be fully trained at a fixed cost. "Most of the budget people are happy to know exactly what each candidate will cost," said MDTSI's Wayne Calhoun.

The Air Force, however, does not just walk away and wait for the trained crew members to come out of the pipeline.

"We still have a blue-suit evaluator to check and see if the students are getting trained," said Maj. Terry Mast, the C-5 ATS program manager at MAC headquarters. "If we have a grievance, we send the student back to the contractor at no additional cost to the Air Force. They are retrained until our standards are met."

"The only disadvantage I can see with contract training is that the blue-

suit community loses its resident capability to do the training on its own," noted ASD's Colonel Lobbestael. "But all the trade-offs have to be looked at in terms of the situation. In my opinion, the ATS approach seems to be doing what the using commands want it to."

Real Success Stories

Link's Training Services Corp. or other Link divisions now handle F-16, RF-4, C-21, and A-7 Low-Altitude Night Attack training, as well as the C-130 ATS for the Air Force. It also does SH-60F Seahawk helicopter training for the Navy. FlightSafety International, in addition to the C-5 ATS, runs training programs for the Air Force's C-9, C-12F, and C-140B aircraft.

The big winner so far, though, in the move to contract training has been MDTSI. The company, headquartered in Bedford, Tex., runs the KC-10, A-10, F-4E/G, F-15/F-15E, and F-111/EF-111 programs and teaches academic coursework for the OV-10. Douglas Aircraft Co. also runs the Navy's T-45 simulators.

The first ATS program was for the KC-10 tanker/cargo aircraft. In 1980, the Air Force wanted a total training system, including all ground simulation, development of the training program, and a determination of training devices needed.

By allowing bidders to use the "best commercial products available" (the KC-10 was essentially a DC-10 Series 30CF freighter), rather than insisting on military specifications, the Air Force saved considerable money and time. American Airlines Training Corp. (which was acquired by McDonnell Douglas Corp.) won the contract in July 1980. Training started in June 1981.

The KC-10 program uses computer-based instruction terminals, a cockpit-procedures trainer, a cargo-load trainer, a boom-operator trainer (all PTTs), and a flight simulator (the WST). The boom operator trainer is unique in that the trainee actually has to stick the refueling boom into the receptacle of a scale model of the receiver. The proficiency of the receiver can be dialed in. Yes, several trainees have skewered the model with the boom.

The results, however, speak for themselves. At Barksdale AFB, La., 6,123 students have been trained, and 99.6 percent passed their Air Force evaluation on the first try. The numbers are similar at the other KC-10 bases. The school at March AFB, Calif., has seen 98.9 percent of its 3,001 students pass on the first attempt, and 99.4 percent of the 1,402 students at Seymour Johnson AFB, N. C., have passed on the first evaluation.

The C-17 ATS contract was recently awarded to MDTSI. The C-141 ATS will be awarded in 1989, and the Special Operations Forces ATS (SOFATS), which will include simulators and instruction for the AC-130U Spectre and MC-130H Combat Talon II aircraft, will be under contract in the near future.

Strategic Air Command will retain overall responsibility for the B-52/KC-135 program, but coursework, computer-based instruction, automated management and scheduling, and logistics support will be done by a contractor. The winning company will also have some platform instruction duties.

Coming Attractions

The next generation of simulators will come with the Air Force's Advanced Tactical Fighter (ATF). "We are working with the ATF SPO and the airframe contractor teams to define what the training systems will look like," said Colonel Lobbestael. "It's hard to say right now. The ATF will be more advanced, so the ATF simulator will have to reflect those advances.

"In today's state-of-the-art simulator, such as the F-15E's, we are using more actual aircraft avionics components. This approach allows us to update the simulator with changing aircraft capability in a very timely and cost-effective manner. Our biggest task is making concurrency between the simulator and the aircraft happen."

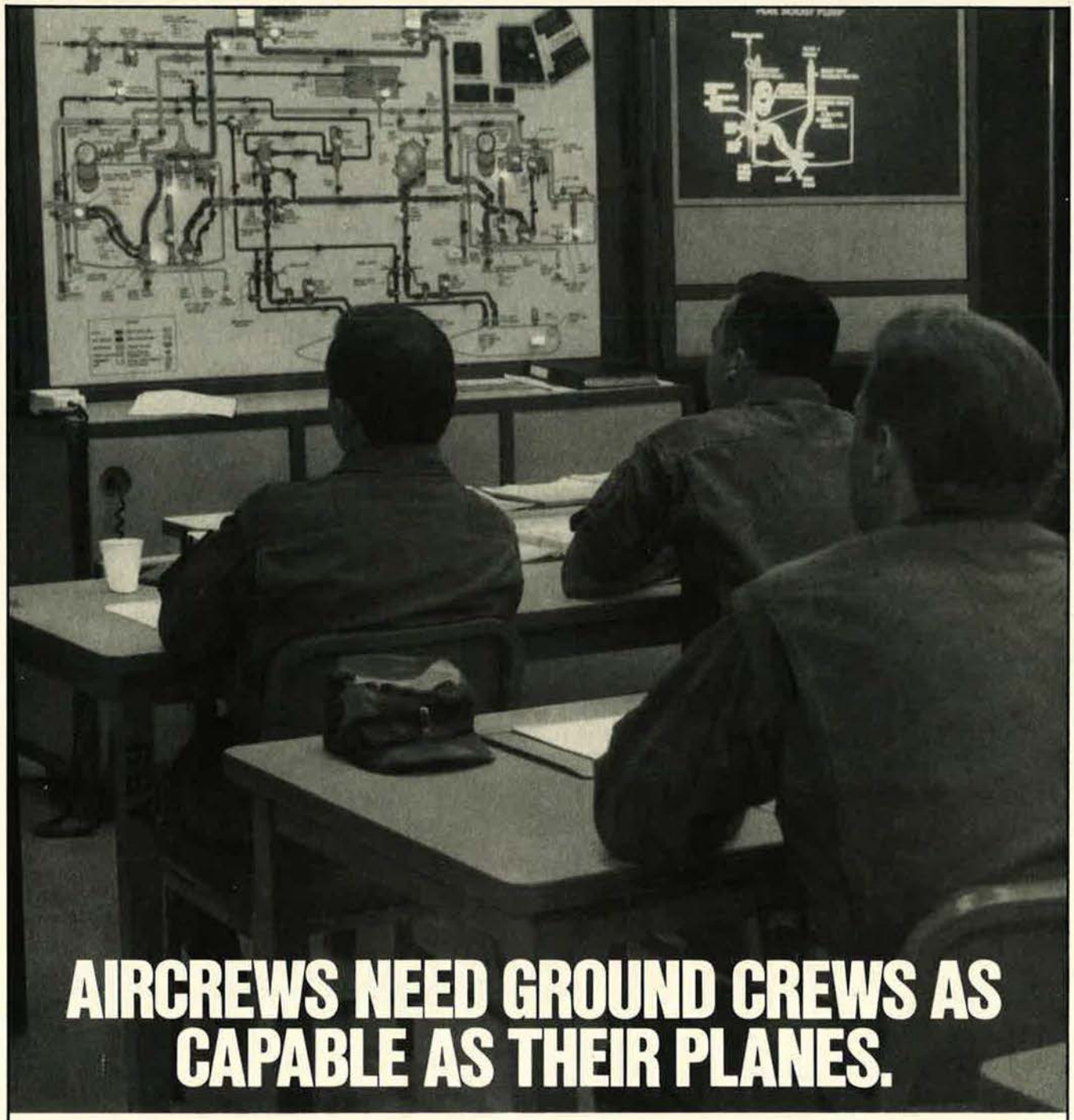
The future of simulators in general looks exciting. One expert foresees simulators linked by satellite for air-to-air combat training. Also possible is near-real-time mission rehearsal. Using satellite photo imagery, a database could be built up and plugged into the WST. Crews could then practice against the actual defensive nets they would face on the very route they would take into the target.

Closer to the Buck Rogers realm, but still possible, is a pod that will be hung under an aircraft to create an airborne simulator. The pod will create the image of a bandit for the pilot and will activate the head-up display and the electronic warfare sensors to create realistic air-to-air combat.

Stay tuned. The world of simulation is moving fast. The impressive devices of today, like their granddaddy the Link, will no doubt look like antiques when compared to the amazing simulators of the future. ■

—Photo courtesy of MDTSI

The first Aircrew Training System was for the KC-10 cargo/tanker aircraft. This ATS uses several types of part-task trainers, including this boom operator trainer. The trainee actually has to stick the refueling boom into the receptacle of the F-4 model. The proficiency level of the "receiver" can be adjusted to the skill level of the trainee.



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World Gallery of Trainers

BY JOHN W. R. TAYLOR and KENNETH MUNSON

AIRTRAINER CT4

The original CT4 Airtrainer was a New Zealand redesign of the Australian Victa Airtourer lightplane, for military primary training. The prototype first flew on 23 February 1972. When production ended in 1977, PAC had delivered a total of 94 CT4As and CT4Bs to the air forces of Australia (51), New Zealand (19), and Thailand (24). PAC is now offering three new variants, of which the CT4D is a more powerful development of the CT4A/B with a 282 hp Textron Lycoming TIO-360-X66 turbocharged piston engine and non-retractable landing gear. The CT4C is similar, but with a 420 shp Allison 250-B17 turboprop and length of 23 ft 5½ in. The CT4CR differs from the CT4C in having retractable landing gear.

Contractor: Pacific Aerospace Corporation Ltd, New Zealand.

Power Plant (CT4D): one Textron Lycoming TIO-360-X66 piston engine; 282 hp.

Dimensions (CT4D): span 26 ft 0 in, length 23 ft 2 in, height 8 ft 6 in.

Weight (CT4C/CR/D): gross 2,650 lb.

Performance (CT4D): max speed 179 mph at S/L, 216 mph at 20,000 ft; stalling speed (flaps down) 51 mph, T-O run 647 ft, max range 728 miles.

Performance (CT4CR): max speed 269 mph at S/L, 276 mph at 10,000 ft; stalling speed (gear and flaps down) 51 mph, service ceiling 17,900 ft, T-O run 384 ft, landing run 510 ft, max range 834 miles.

Accommodation: two seats side by side. Space to rear for optional third seat or baggage.

Armament: none.

ALPHA JET

Production of the initial subsonic advanced trainer/light attack and close support versions of the Alpha Jet was authorised by the French and Federal German Governments in March 1975. Production lines were established by Dassault-Breguet in France and Dornier in Germany, from which 176 of the trainers were delivered to the French Air Force and 175 close support Alpha Jets to the German Air Force between 1978 and 1985. Export orders for the trainer/light attack model were received from Belgium (33), Egypt (30), Ivory Coast (7), Morocco (24), Nigeria (24), Qatar (6), and Togo (6). The Arab Organisation for Industrialisation (AOI) assembled most of the aircraft for the Egyptian Air Force at Helwan, south of Cairo. When Dassault-Breguet developed an alternative close support version, with added inertial platform, head-up display, and laser rangefinder, seven were ordered by Cameroon and 15 by Egypt, of which 11 were co-produced by AOI. The further developed Alpha Jet 2 and Lancier are dedicated combat versions, offering day/night attack, antishipping strike, and antihelicopter capabilities. Also available but not yet ordered is the Alpha Jet 3 trainer, with a CRT raster HUD combined with collimated head-level display, rear cockpit CRT monitor, and lateral multifunction displays and keyboards in each cockpit.

Contractors: Avions Marcel Dassault-Breguet Aviation, France, and Dornier GmbH, Federal Republic of Germany.

Power Plant: two SNECMA/Turbomeca Larzac 04-C6 turbofans standard; each 2,976 lb st. Two 3,175 lb st Larzac 04-C20s optional.

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, max gross with external stores 17,637 lb.

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, *g* limits (ultimate) +12/−6.4.

PAC CT4B Airtrainer, Royal New Zealand Air Force

Alpha Jets, Air Force of the Ivory Coast

FFA AS 202/18A Bravo, Indonesian Air Force

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

Armament: centreline 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, Maverick air-to-surface missiles, a reconnaissance pod, drop tanks and other stores. Max load on five pylons 5,510 lb.

AS 202 BRAVO

This popular little trainer originated with SIAI-Marchetti in Italy, but was taken over at an early stage by the Swiss FFA company. Initial production (of 34 aircraft) centred on the AS 202/15 version, with a 150 hp O-320 engine, but the principal version since the early 1980s has been the still-current AS 202/18A, with a more powerful engine. Customers for the latter have included the British Aerospace Flying College (11), Royal Air Maroc (5), the Royal Flight of Oman (2), the Uganda Central Flying School (8), and the air forces of Indonesia (40), Iraq (48, some of which were transferred to Jordan), and Morocco (10). Sub-variants differ in having electrical instead of mechanical trim, a 24V instead of 12V electrical system, special instrumentation, or an extended canopy. Fully aerobatic, the Bravo is used for the screening and training of both commercial and military pilots, can operate from grass strips, and has a large 'teardrop' canopy offering an excellent all-round view for both occupants. The following data apply to the AS 202/18A:

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 (aerobatic) 2,160 lb, max gross 2,380 lb.

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 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.

Armanent: none.

AT-3

The AT-3, reportedly given the name Tsu-Chiang by the Chinese Nationalist Air Force, is the latest trainer to be produced by the AIDC, following earlier manufacture of the Pazmany PL-1B and its own turboprop T-CH-1. The twin-turbofan AT-3 resulted from a 1975 design contract, and fulfils the roles of both basic and advanced military jet trainer for the CNAF, which is its only customer. Deliveries of these, beginning in the Spring of 1984, have now reached about 50 of the 60 that are on order. The AT-3's primary control surfaces are actuated hydraulically, with electrical actuation for the single-slotted flaps, and the tandem cockpits are fully pressurised and air-conditioned. With a 6,000 lb external stores capacity, the AT-3 has useful potential for ground attack and/or maritime strike missions, and can carry a pair of air-to-air missiles for self-defence; a single-seat A-3 attack version is reported to have entered production. The following data apply to the standard two-seat AT-3:

Contractor: Aero Industry Development Center, Taiwan.
Power Plant: two Garrett TFE731-2-2L turbofans; each 3,500 lb st.
Dimensions: span 34 ft 3¾ in, length 42 ft 4 in, height 14 ft 3¾ in.
Weights: empty 8,500 lb, gross ('clean') 11,500 lb, max gross 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 (internal fuel) 1,416 miles.
Accommodation: crew of two on tandem zero/zero ejection seats; rear seat elevated.
Armament: two hardpoints under each wing and one under fuselage for up to 6,000 lb of bombs, flare dispensers, or rocket launchers. Centreline hardpoint can be occupied instead by a semi-recessed machine-gun pack or (in conjunction with outboard underwing pylons) an aerial target system. Provision for air-to-air missiles on wingtip launch rails.

AT-9

One of the most interesting developments of the past year has been the emergence of a series of military training, utility, and light combat aircraft based on civilian homebuilt, kitbuilt, and even ultralight designs. Among them is the Arocet AT-9 tactical trainer, based on the Stoddard-Hamilton Glasair all-composites homebuilt. The AT-9 prototype was exhibited at the EAA's 1988 Oshkosh Fly-in. Subject to successful flight testing, it will be offered in ready to fly and possibly kit form as a low-cost, high-performance, fully aerobatic military trainer adaptable to such combat roles as close support, patrol, air defence, and search and rescue.

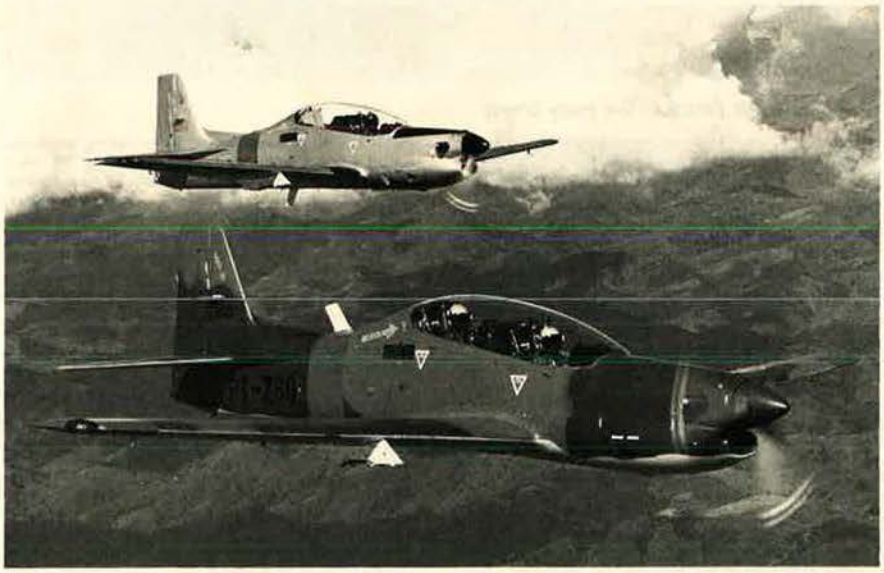
Contractor: Arocet Inc, USA.
Power Plant: one Allison 250-B17D turboprop; 420 shp.
Dimensions: span 23 ft 3½ in, length 21 ft 9½ in, height 7 ft 3 in.
Weights: empty 1,500 lb, gross 2,700 lb.
Performance: max speed 381 mph at 10,000 ft, cruising speed 366 mph at 25,000 ft, service ceiling 37,000 ft, T-O run 525 ft, landing run 360 ft, max range (with reserves) 1,587 miles, *g* limits +6.9/−4.
Accommodation: two seats side by side, and zero/zero pilot extraction system. Full IFR avionics, with gunsight and armament management system.

AIDC AT-3, Chinese Nationalist Air Force

Arocet AT-9 prototype (J.M.G. Gradidge)

CASA C-101CC-04, Royal Jordanian Air Force

NAMC Haiyan, civil version of the CJ-6



EMB-312 Tucanos, Venezuelan Air Force

Armament: two underwing hardpoints each with max capacity of 275 lb, for 7- or 19-tube rocket launchers, practice bomb racks, machine-gun pods, cartridge launchers, or rescue packs.

C-101 AVIOJET

The Aviojet is a fully aerobatic basic/advanced trainer that can also perform ground attack, reconnaissance, escort, weapons training, electronic warfare, and photographic missions. The first of four prototypes flew on 27 June 1977, after which the Spanish Air Force ordered 88 C-101EB trainers, with 3,500 lb st Garrett TFE731-2-2J engines, under the military designation E.25 Mirlo (Blackbird). An armed export version, with a 3,700 lb st TFE731-3-1J engine, was ordered by Chile (14 C-101BB-02) and Honduras (4 C-101BB-03). All but the first four of the BB-02s were assembled by ENAER in Chile, with partial local manufacture, and have the official Chilean Air Force designation T-36 Halcón (Hawk). During 1982, ENAER and CASA initiated development of a dedicated attack version of the Aviojet, designated C-101CC-02 in Spain and A-36 Halcón by the Chilean Air Force. The prototype flew in November 1983, and 23 similar production A-36s, with more powerful TFE731-5-1J engines, are currently ordered. The first four are Spanish-built, the remainder by ENAER. The Royal Jordanian Air Force is taking delivery of 16 C-101CC-04s. An enhanced training version, with the same power plant and additional avionics, including a Ferranti HUD, flew for the first time on 20 May 1985 as the C-101DD, and is now available. (Data for C-101DD.)

Contractor: Construcciones Aeronauticas SA, Spain.
Power Plant: one Garrett TFE731-5-1J turbofan; 4,300 lb st, with military power reserve (MPR) rating of 4,700 lb st.
Dimensions: span 34 ft 9½ in, length 41 ft 0 in, height 13 ft 11¼ in.
Weights: empty 7,716 lb, gross (trainer, 'clean') 10,075 lb, max gross 13,890 lb.
Performance (at 9,921 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 42,000 ft, T-O run 1,835 ft, landing run 1,575 ft, ferry range (with reserves) 2,303 miles, *g* limits at 10,582 lb weight +7.5/−3.9.
Accommodation: two crew 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 250 kg bombs, two Maverick air-to-surface missiles, or four BIN200 napalm bombs.

CJ-6 (PT-6)

This basic training aircraft was developed in China to replace the Yak-18A, and the uprated Chinese CJ-5 version, in service with the PLA Air Forces. The configuration remains generally unchanged, but construction is all-metal with a fully retractable tricycle landing gear, fitted with low-pressure tyres for operation from grass strips. More than 2,000 CJ-6s (Westernised designation PT-6) have been delivered, including exports to Albania, Bangladesh, Cambodia, North Korea, Tanzania, and Zambia. Civil variants, adapted for a wide variety of duties such as cropspraying, seed-sowing, forest firefighting and patrol, fisheries surveillance, photogrammetry, aerial photography, geological survey, coastal and border patrol, are also available, under the name Haiyan (Petrel). (Data for CJ-6.)

Contractor: Nanchang Aircraft Manufacturing Company, People's Republic of China.
Power Plant: one Zhuzhou Huosai-6A nine-cylinder radial engine; 285 hp.
Dimensions: span 33 ft 4¾ in, length 27 ft 9 in, height 10 ft 8 in.
Weights: empty 2,584 lb, gross 3,128 lb.
Performance: max speed 178 mph, service ceiling 16,665 ft, T-O run 920 ft, landing run 1,150 ft, endurance 3 h 36 min.
Accommodation: two seats in tandem.
Armament: none.

EMB-312 TUCANO

Having established its reputation with the EMB-110 Bandeirante commuter transport, EMBRAER of Brazil directed its design and engineering talent to developing a turboprop basic trainer for its national Air Force. The result was the Tucano, of which the first prototype flew on 16 August 1980. It soon proved its ability to meet the design objectives of high manoeuvrability, short take-off and landing, suitability for operation from unprepared runways, and a high degree of stability. The Brazilian Air Force ordered 118, as replacements for its Cessna T-37Cs. Designated T-27, the first six were delivered to the Esquadrilha da Fumaça (Smoke Squadron), its premier aerobatic team, and others to the Air Force Acade-

my. The Egyptian Government ordered 120 Tucanos, 40 for its own Air Force and 80 for Iraq, of which all but the first ten were delivered by EMBRAER in kit form for assembly by the Arab Organisation for Industrialisation (AOI) at Helwan, south of Cairo. Other customers include the air forces of Argentina (30), Honduras (12), Paraguay (6), Peru (20), and Venezuela (30). The re-engined S312 version (which see) is being built by Shorts in the UK for the Royal Air Force.

Contractor: Empresa Brasileira de Aeronáutica SA, Brazil.

Power Plant: one Pratt & Whitney Canada PT6A-25C turboprop; 750 shp.

Dimensions: span 36 ft 6½ in, length 32 ft 4¼ in, height 11 ft 1¾ in.

Weights: empty 3,991 lb, gross (aerobatic) 5,622 lb, max gross 7,000 lb.

Performance (at 5,622 lb weight): max speed 278 mph at 10,000 ft, max cruising speed 255 mph at 10,000 ft, stalling speed (gear and flaps down) 77 mph, service ceiling 30,000 ft, T-O run 1,250 ft, landing run 1,214 ft, max range (with reserves) 1,145 miles, *g* limits +6/−3.

Accommodation: two crew in tandem, on Martin-Baker BR8LC ejection seats. Rear seat raised.

Armament: four underwing hardpoints for up to 2,205 lb of stores, including machine-gun pods, bombs, and rockets.

EPSILON

The Epsilon was developed to meet a French Air Force requirement for a propeller-driven aircraft that would improve the cost-effectiveness of its initial pilot training. The prototype flew for the first time on 22 December 1979. The 150 production Epsilons ordered subsequently for the French Air Force were delivered at the rate of 30 a year. They equip Groupement Ecole 315 at Cognac/Chateaubernard. Eighteen ordered for the Portuguese Air Force will start to enter service next year, after assembly by OGMA in Portugal. An armed version is available for export, with four underwing hardpoints for a total of 661 lb of stores with pilot only. Armed with two twin 7.62 mm machine-gun pods, it can loiter for 30 min at low altitude over a combat area 195 miles from its base. First customer for this version was the Togolese Air Force, which has three. Also flying, in prototype form, is an Epsilon re-engined with a 350 shp Turbomeca TP 319 turboprop. (Data for standard unarmed Epsilon.)

Contractor: Aérospatiale SNI, 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 2,755 lb.

Performance: max speed at S/L 236 mph, max cruising speed at 6,000 ft 222 mph, stalling speed (gear and flaps down) 72 mph, service ceiling 23,000 ft, T-O run 1,345 ft, landing run 820 ft, endurance 3 h 45 min, *g* limits +6.7/−3.35.

Accommodation: two seats in tandem. Rear seat raised.

Armament (optional): two Matra CM pods each containing two 7.62 mm machine-guns, or four Matra F2D packs each containing six 68 mm rockets, or two 275 lb bombs, or two grenade launchers, or four survival kits.

FANTRAINER 400 and 600

The Fantrainer is unique among current military trainers in having a ducted fan propulsion system, a concept studied and developed by RFB for many years. Early prototypes, built to a 1975 German Defence Ministry contract, included one utilising a pair of Wankel rotating-piston engines to drive the fan; but production aircraft, like the second prototype, have a single Allison turboprop, mounted aft of the cockpits with shaft drive to the five-blade ducted fan. Designed for primary and basic flying training, to IFR standard, the Fantrainer is available in two versions: the 400, with a 420 shp Allison 250-C20B engine, and the more powerful but otherwise similar Fantrainer 600. Sixteen of the latter version entered service with the Royal Thai Air Force from January 1987, of which 14 were assembled in Thailand, and the RTAF is now assembling 31 Fantrainer 400s. The first two 600s, built in Germany, have glassfibre reinforced plastics wings, the rest of the airframe being all-metal; German built kits for the other 45 aircraft exclude the wings, which are also of all-metal construction and are manufactured in Thailand. The following data apply to the Fantrainer 600:

Contractor: Rhein-Flugzeugbau GmbH, Federal Republic of Germany.

Power Plant: one Allison 250-C30 turboshaft; 650 shp.

Dimensions: span 31 ft 11½ in, length 31 ft 1¼ in, height 10 ft 4½ in.

Weights: empty 2,557 lb, gross (aerobatic) 3,527 lb, max gross 5,070 lb.

Performance (at aerobatic gross weight): max speed at 18,000 ft 259 mph, cruising speed at 10,000 ft 230 mph, stalling speed 71 mph, service ceiling 25,000 ft, T-O and landing run 820 ft, range (internal fuel, 45 min reserves) 645 miles, *g* limits +6/−3.

Aérospatiale Epsilon demonstrator, with underwing pylons (Paul Jackson)

RFB Fantrainer 600, Royal Thai Air Force (Chris Pocock)

Model of FFA-2000 in wind tunnel at Swiss Federal Aircraft Factory

SOKO G-4 Super Galeb, Yugoslav Air Force

Accommodation: crew of two in tandem; rear seat elevated. Stencel Ranger zero/zero rocket assisted escape system standard, ejection seats optional.

Armament: none, but has provision for carrying two fuel drop tanks externally.

FFA 2000

Under development for Swissair, the Swiss national flag carrier, the FFA 2000 is due to make its first flight in the Autumn of 1989 and to enter service in 1991, replacing the piston engined Piaggio P.149s that have served with the airline's flying training school for the past 25 years. Its design has been configured also to meet military pilot selection and *ab initio* training requirements, up to the point of transition to a tandem-seat turboprop or jet advanced trainer. It will be suitable for IFR training and limited aerobatics, and will be built of proven composite materials, with wings designed and built by Gyroflug in West Germany; adoption of a Porsche engine will permit the use of automotive fuel, and this combination of smooth finish and fuel economy is expected to result in high performance, low operating costs, and a 2,000-hour time between overhauls. Although wind tunnel testing has been successfully completed, and two prototypes are under construction, FFA has said it will not release further specific data until early 1989.

Contractor: FFA Flugzeugwerke Altenrhein, Switzerland.

Power Plant: one Porsche PFM 3200 piston engine; 200–250 hp class.

Dimensions: not yet released.

Weights: not yet released.

Performance (estimated): cruising speed 186 mph, T-O to and landing from 50 ft 1,200 ft, service ceiling 20,000 ft, endurance (with 45 min reserves) 4 hours.

Accommodation: four seats in side by side pairs.

Armament: none.

G-4 SUPER GALEB

First flown on 17 July 1978, the Super Galeb has replaced the earlier G2-A Galeb and Lockheed T-33 in basic and advanced training units of the Yugoslav Air Force and has replaced single-seat Jastrebs in the light strike elements. Its configuration is very like that of the BAe Hawk, but it has a lower-powered engine and is lighter in weight, with correspondingly lower performance. Nonetheless, its impressive weapon-carrying ability suits it well for the tactical missions that are of primary importance to the Yugoslav Air Force, and its indigenous design contributes to Yugoslavia's aim of increasing self-sufficiency in its military procurement.

Contractor: Sour Vazduhoplovna Industrija SOKO, Yugoslavia.

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

Dimensions: span 32 ft 5 in, length 38 ft 11 in, height 14 ft 0½ in.

Weights: empty 7,165 lb, gross (training) 10,495 lb, max gross 13,955 lb.

Performance (10,495 lb weight): max speed 565 mph at 19,680 ft, landing speed 103 mph, absolute ceiling 49,200 ft, T-O run 1,745 ft, landing run 1,805 ft, range with two drop tanks (with reserves) 1,635 miles, *g* limits +8/−4.2.

Accommodation: two crew in tandem on Martin-Baker Mk J10 zero/zero ejection seats. Rear seat raised.

Armament: removable centreline gun pod containing 23 mm GSh-23L twin-barrel cannon with 200 rounds. 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.

HAWK

Recognised worldwide as the aircraft flown by the Royal Air Force's Red Arrows aerobatic display team, the BAe Hawk T. Mk 1 has been that service's standard basic/advanced flying and weapons trainer since the Autumn of 1976. Eighty-eight of the 175 production Hawks delivered to the RAF have since been wired to carry a Sidewinder missile under each wing, in addition to the standard underbelly 30 mm gun pack to accompany radar-equipped Phantoms and Tornados on medium-range air defence sorties as components of the UK Mixed Fighter Force. The initial export Hawk 50 series, with more powerful (5,340 lb st) Adour 851 turbofan, 70 percent greater disposable load, and 30 percent longer range, was sold to Finland (50 Mk 51), Kenya (12 Mk 52), and Indonesia (20 Mk 53). The further improved Hawk 60 series, described below, has been bought by Zimbabwe (8 Mk 60), Dubai (8 Mk 61), Abu Dhabi (16 Mk 63), Kuwait (12 Mk 64), Saudi Arabia (30 Mk 65), and Switzerland (20 Mk 66). More specialised and higher-perfor-

British Aerospace Hawk Mk 65s, Royal Saudi Air Force

mance two-seat and single-seat combat versions are available as the Hawk 100 and 200 series respectively. First customer for the 200 series is Saudi Arabia, whose huge defence orders under the *Al Yamamah* project include 60 Hawks. The US Navy's T-45A Goshawk version is described separately. (Data for Hawk 60 series.)

Contractor: British Aerospace plc, UK.

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

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

Weights: empty 8,015 lb, gross ('clean') 11,350 lb, max gross 18,890 lb.

Performance: max speed 644 mph, max Mach number in dive 1.2, service ceiling 50,000 ft, T-O run 1,800 ft, landing run 1,600 ft, ferry range 2,530 miles, *g* limits +8/−4.

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

Armament: centreline pack for 30 mm Aden gun with 120 rounds, or pylon, plus two pylons under each wing. Typical loads include gun and four 18-tube rocket packs; seven 1,000 lb bombs; thirty-six 80 lb runway denial bombs; five 600 lb cluster bombs; four Sidewinder/Magic air-to-air missiles; two Maverick air-to-surface missiles and two drop tanks; or a Sea Eagle antiship missile, two Sidewinders, and two drop tanks.

HJT-16 KIRAN

Now a rather elderly design, the Kiran flew for the first time in September 1964, deliveries of 118 Viper engined Mk Is to the Indian Air Force beginning in the Spring of 1968. This version, for basic flying training only, was followed by a Mk IA with a hardpoint under each wing to permit the carriage of practice armament for weapons training; Mk IA production, for both the IAF and Indian Navy, amounted to about 80 examples before being supplanted in 1982 by the more powerful Kiran Mk II, which utilises the same Orpheus turbojet as HAL's Ajeet version of the Folland/Hawker Siddeley Gnat light fighter, combined with updated instruments and avionics, an improved hydraulic system, and an extra pair of underwing stations for enhanced weapon-carrying capability in either training or counter-insurgency roles. The Kiran Mk II flew for the first time on 30 July 1976, and deliveries of 57 to the Indian Air Force began in April 1984. The following data apply to the Mk II:

HAL HJT-16 Kiran IA, Indian Air Force

HAL HPT-32, Indian Navy

PZL I-22 Iryd, second prototype

FAMA IA 63 Pampa prototype

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

Power Plant: one Rolls-Royce Orpheus 701-01 turbojet; 4,200 lb st.

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

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

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 bombs, rocket pods, or drop tanks.

HPT-32

The Indian Air Force (40) and Navy (8) are the only known customers for this Bangalore designed two-seater, deliveries to the former having started in about 1982–83. Manufacture of a further 40, against anticipated follow-on orders, is in progress. Development of the HPT-32 was somewhat protracted, four and a half years elapsing between the initial flights of the first prototype (6 January 1977) and the third (production standard) prototype on 31 July 1981. The all-metal HPT-32 was designed to FAR Pt 23 standards, to fulfil the roles of *ab initio*, aerobatic, night flying, instrument flying, and navigation training. Secondary roles can include liaison, observation, glider or target towing, and search and rescue. In June 1984, HAL began test flying a private-venture turboprop version known as the HTT-34—actually the third prototype HPT-32 refitted with a 420 shp Allison 250-B17D engine—but this programme appears to have been abandoned.

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: no details known.

I-22 IRYD

Still under flight test following its first flight in March 1985, this new Polish jet trainer is clearly intended as a successor to the long-serving TS-11 Iskra, production of which at PZL Mielec came to an end in 1987 after 550 (including 50 for India) had been manufactured during the previous 24 years. The I-22 is a larger and potentially more capable design than the Iskra, intended to perform as a reconnaissance and close support aircraft in addition to its principal function as an advanced jet trainer. It was designed to cover the full spectrum of pilot, navigation, air combat, reconnaissance, and ground attack training, day or night and in bad weather, and will be able to operate from unprepared airstrips. Service life has been calculated on the basis of 2,500 flying hours or 10,000 take-offs and landings, and the airframe is stressed for later introduction, if required, of more powerful engines and an increased ordnance load.

Contractor: Instytut Lotnictwa (Aviation Institute), Poland.

Power Plant: two PZL Rzeszów SO-3W22 turbojets; each 2,425 lb st.

Dimensions: span 31 ft 6 in, length 43 ft 4½ in, height 14 ft 1¼ in.

Weights: empty 8,735 lb, gross 16,519 lb.

Performance: max speed at S/L 568 mph, max cruising speed at altitude 574 mph, service ceiling 41,340 ft, T-O run 2,525 ft, landing run 1,085 ft, max range (internal fuel) 1,037 miles, *g* limits +8/−4.

Accommodation: crew of two on tandem zero-height/94 mph ejection seats; rear seat elevated.

Armament: one 20 mm GSh-23L cannon in underfuselage pack, plus 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

Recognising the need to replace its fleet of about three dozen ageing Morane-Saulnier Paris IIIs in the military jet training role, the Fuerza Aérea Argentina initiated the Pampa programme in 1979. In doing so, it enlisted the technical and design assistance of Dornier of Germany, which led to the eventual selection of an airframe configuration closely resembling that of the Dassault/Dornier Alpha Jet. Flight testing began in October 1984, and the first three production Pampas were delivered to the FAA earlier this year. Initial requirement is for 64, to serve in

both the basic and advanced training roles and for weapons training. In addition to underwing weapons, the Pampa can be equipped with a 145-round 30 mm underbelly gun pod, and has a weapons management system described as adequate for several different tactical configurations, indicating the likelihood of orders for a combat proficiency trainer/light close support version once the original requirement has been satisfied.

Contractor: Fábrica Argentina de Materiales Aerospaciales, Argentina.

Power Plant: one Garrett TFE731-2-2N turbofan; 3,500 lb st.

Dimensions: span 31 ft 9¼ in, length 35 ft 9¼ in, height 14 ft 1 in.

Weights: empty 6,219 lb, gross 11,023 lb.

Performance: max speed at S/L Mach 0.62 (469 mph), max cruising speed at 13,125 ft 464 mph, service ceiling 42,325 ft, T-O run 1,477 ft, landing run 1,411 ft, range (standard fuel) 621 miles, max range (auxiliary fuel) 932 miles, *g* limit +4.5.

Accommodation: crew of two on tandem Stencel ejection seats; rear seat elevated.

Armament: hardpoint under fuselage and two under each wing for up to 2,557 lb (with standard fuel) of gun pods, bombs, and rockets.

JET SQUALUS F1300 NGT

The initials NGT in the Jet Squalus designation indicate that it was conceived as an 'all-through' jet trainer to a specification similar to that which produced the Fairchild T-46A for the now-cancelled USAF Next Generation Trainer programme. The Promavia company was formed in Belgium to initiate the Jet Squalus project, to market and support the production aircraft (to be built by Sonaca), and to provide training programmes where necessary. Design and prototype construction were entrusted to the well known Italian designer Dott Ing Stelio Frati, and two aircraft have now flown. Test flying is expected to include evaluation of higher powered engines of 1,500 lb and 1,800 lb st. The Jet Squalus is intended to cover all stages of flying training, from initial pilot screening, primary, and basic through to part of the advanced syllabus, including weapons training. Since the first flight in April 1987, it has been evaluated by pilots from many countries, including representatives of the Belgian Air Force. Promavia has also proposed versions for photographic reconnaissance, maritime surveillance/SAR, police and border patrol, and target towing.

Contractor: Promavia SA, Belgium.

Power Plant: one Garrett TFE76 turbofan; 1,330 lb st.

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 363 mph, normal operating speed 345 mph, stalling speed (gear and flaps down) 77 mph, service ceiling 37,000 ft, T-O run 1,200 ft, landing run 1,100 ft, ferry range (max internal fuel at 20,000 ft) 1,150 miles, *g* limits (aerobatic) +7/−3.5.

Accommodation: crew of two side by side on Martin-Baker Mk 11 ejection seats.

Armament: two hardpoints under each wing for up to 1,323 lb of gun pods, rocket launchers, practice bombs, or fuel tanks.

KARAKORUM 8

Since it began exhibiting at foreign defence and aerospace trade shows in 1985, the People's Republic of China has managed to spring at least one major surprise per show. In Paris in June 1987 it was the model of a new jet trainer, then designated L-8 and envisaged as a project to be undertaken with an international partner. Pakistan has since emerged as that partner, and the aircraft has been named after the mountain range that the two countries share. The PLA Air Force and Pakistan Air Force both have need of a new tandem-seat jet trainer, with a combined requirement reported to be in the region of 200 aircraft, and the L-8/Karakorum 8 is now in the design development stage to provide not only all needs of basic flying training but also parts of the primary and advanced syllabi. Inevitably, it will also have a capability for weapons training and/or light air-to-ground close support. First flight is expected to take place in early 1990, with initial production deliveries following about a year later.

Contractors: Nanchang Aircraft Manufacturing Company, People's Republic of China, and Pakistan Aeronautical Complex.

Power Plant: one Garrett TFE731-2A turbofan; 3,500 lb st.

Dimensions: span 31 ft 7¼ in, length 34 ft 1½ in, height 13 ft 9¾ in.

Weights (estimated): gross ('clean') 7,716 lb, max gross 9,259 lb.

Performance (estimated at 'clean' gross weight): max speed at 25,000 ft 497 mph, landing speed 102 mph, service ceiling 42,650 ft, T-O and landing run 1,640 ft, max range (with drop tank) 1,429 miles.

Promavia Jet Squalus prototype

Model of NAMC/PAC L-8/Karakorum 8 (Brian M. Service)

now exceeds 2,000, with Algeria (16), Bulgaria, Ethiopia (12), Nigeria (10), and Vietnam (25) among the other operators worldwide, and production is scheduled to continue into the early 1990s. In 1986 Aero made the first flight of a new L-39 MS advanced training version with an uprated (4,850 lb st) engine and improved avionics, but is withholding further details until its flight test programme is completed. The following data apply to the L-39 C except where indicated:

Contractor: Aero Vodochody Národní Podnik, Czechoslovakia.

Power Plant: one Ivchenko AI-25TL turbofan; 3,792 lb st.

Dimensions: span 31 ft 0½ in, length 39 ft 9½ in, height 15 ft 7¾ in.

Weights: empty 7,617 lb, gross 10,362 lb.

Performance ('clean'): max speed at S/L 435 mph, max speed at 16,400 ft 466 mph, stalling speed 103 mph, service ceiling 36,100 ft, T-O run 1,740 ft, landing run 2,135 ft, range (internal fuel) 683 miles, max range (internal/external fuel) 1,087 miles, *g* limits +8/−4.

Accommodation: crew of two on tandem zero height/94 mph ejection seats; rear seat elevated.

Armament: one hardpoint under each wing of L-39 C, for up to 626 lb of practice weapons or drop tanks. L-39 Z0 has two underwing hardpoints each side for up to 2,425 lb of stores including bombs, rocket pods, IR air-to-air missiles (outer pylons only), or (port inner pylon only) a daylight camera pod.

L-70 VINKA

The Vinka (named after a cold Arctic wind) is a versatile, fully aerobatic two/four-seater with a general configuration reminiscent of that of the Socata/Morane-Saulnier Rallye. It was developed under a 1973 contract from the Finnish Air Force, flying for the first time two years later and entering service in 1980. As a two-seater, it meets the requirements of FAR Pt 23 in the aerobatic and utility categories; as a four-seater for liaison, air ambulance, and other duties, it conforms to normal category FAR Pt 23 standards. Fatigue life in military service is more than 8,000 hours, and it can be adapted for ski take-offs and landings. Standard roles are those of primary, aerobatic, night, instrument, and tactical training, but the Vinka can be used also for casevac, search and rescue, supply dropping, weapon training, target towing, and reconnaissance. The Finnish Air Force, which received 30 Vinkas, remains the L-70's only military operator, but the aircraft is available for export, under the name Miltrainer.

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 (aerobatic) 2,293 lb, max gross 2,756 lb.

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 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 rescue/liferaft packs and a searchlight.

Aero L-39 ZA Albatros (Letectvi + Kosmonautika, Václav Jukl)

Valmet L-70 Vinkas, Finnish Air Force

Accommodation: crew of two on tandem ejection seats; rear seat elevated.

Armament: no details yet released, but expected to have underfuselage 'wet' point for drop tank and one or two hardpoints under each wing for practice or light air-to-ground close support weapons.

L-39 ALBATROS

Successor to the still widely used L-29 Delfin, the Albatros has been the standard basic and advanced jet trainer of the Czechoslovak Air Force since 1974, being used for all pilot training including that of helicopter pilots. In its basic L-39 C version, it is also the principal jet trainer used by the Soviet air forces, and has been supplied to Afghanistan (18), Cuba (30), and the German Democratic Republic. The L-39 Z0, with strengthened wings for additional stores-carrying, has been exported to Iraq (80), Libya (170), and Syria (100); Romania received 35 of the ground attack/reconnaissance version designated L-39 ZA. The overall number of L-39s built

L-90 TP REDIGO

The Redigo was designed to fit into a training system that will enable student pilots to graduate directly on to an advanced jet trainer such as the British Aerospace Hawk. It has therefore been optimised to cover primary and basic, aerobatic, night, instrument, navigation, formation, and tactical flying training, drawing upon experience gained by Valmet with its piston engined predecessor, the L-70 Vinka. Two prototypes have been flown, one with an Allison 250 turboprop and the other with a similarly rated Turbomeca TP 319, and in August of this year the Finnish Air Force placed an initial order for ten of the Allison engined version. Like the Vinka, the Redigo has an optional second pair of seats, enabling it to be configured for liaison or observation missions; other roles can include search and rescue, photographic reconnaissance, and target towing.

Contractor: Valmet Aviation Industries, Finland.

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

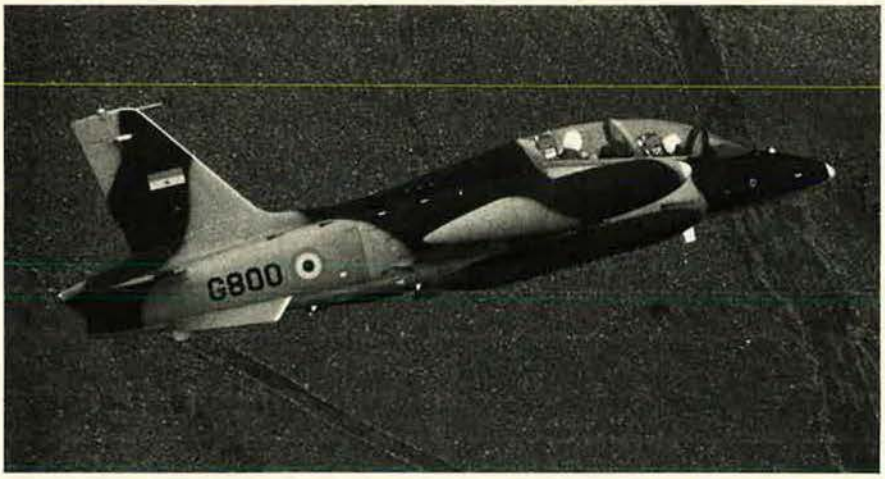
Dimensions: span 33 ft 11 in, length 25 ft 11 in, height 9 ft 4¼ in.

Weights: empty 1,962 lb, gross (aerobatic) 2,976 lb, max gross 4,189 lb.

Performance (at aerobatic gross weight): max speed at 5,000 ft 208 mph, max cruising speed at 9,850 ft 189 mph, stalling speed (flaps down) 58 mph, service ceiling 25,000 ft, T-O run 640 ft, landing run 689 ft, max range 932 miles, *g* limits +7/−3.5.

Valmet L-90 TP Redigo, first prototype (J.M.G. Gradidge)

PZL Mielec M-26 01, second prototype of the Iskierka (Andrzej Glass)



Aermacchi MB-339A, Ghana Air Force

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

Armament: three hardpoints under each wing for (as two-seater) total of up to 1,764 lb of gun or rocket pods, antitank missiles, bombs, flares, or other stores.

M-26 ISKIERKA

One of two new piston engined trainers at present being developed by the Polish aerospace industry, the Iskierka is designed to FAR Pt 23 and is intended to meet the requirements for both civilian pilot training and pilot selection for military training. Still undergoing flight test in 1988, it flew for the first time in July 1986 with a PZL-F (Polish Franklin) engine, but is being developed also, with a view to possible export, in more powerful form with a Textron Lycoming flat-six fuel injection engine, as fitted in 1987 to the M-26 01 second prototype. Both versions have a three-blade variable-pitch propeller and hydraulic actuation for the flaps and landing gear. The Iskierka (little spark) has clearly been designed for low-cost production and operation, utilising 'selected' (but unspecified) parts and assemblies of Poland's licence built version of the Piper Seneca III, the PZL Mielec M-20 Mewa.

Contractor: WSK-PZL Mielec, Poland.

Power Plant: one PZL-F 6A-350CA piston engine; 205 hp (M-26 00), or one Textron Lycoming AEIO-540-L1B5D engine; 300 hp (M-26 01).

Dimensions: span 28 ft 2½ in, length 27 ft 2¾ in, height 9 ft 8½ in.

Weights (M-26 00): empty 1,874 lb, gross 2,645 lb.

Performance: max speed at S/L 165 mph, stalling speed (flaps down) 61 mph, T-O to 50 ft 1,476 ft, landing from 50 ft 1,411 ft, max range (30 min reserves) 584 miles, *g* limits +6/−3.

Accommodation: crew of two in tandem; rear seat elevated.

Armament: none.

Prototype (foreground) and pre-production Microjet 200s

MB-339

Manufacture of 101 MB-339As for the Italian Air Force was completed in 1987, this total including four MB-339RM calibration aircraft and the MB-339PANs of the Italian Air Force's Frecce Tricolori aerobatic display team, which have the normally standard wingtip tanks deleted to aid formation keeping. In addition, ten standard MB-339A trainer/ground attack aircraft were delivered to the Argentine Navy and others to the air forces of Peru (16), Malaysia (12), Dubai (5), Nigeria (12), and Ghana. The uprated MB-339B, and the MB-339C with advanced avionics, including a digital nav/attack system, were introduced in 1985, each with a 4,400 lb st Viper Mk 680-43 turbojet. Also available with this engine is the single-seat MB-339K, which is optimised for light close air support and operational training, with equipment such as a head-up display, cockpit CRTs, and ECM optional. The twin-engined MB-339D, with overwing P&WC JT15D turbofans, is being studied by Aermacchi as a possible candidate to meet USAF's primary trainer requirement. (Data for MB-339A.)

Contractor: Aermacchi SpA, Italy.

Power Plant: one Rolls-Royce Viper Mk 632-43 turbojet; 4,000 lb st.

Dimensions: span over tiptanks 35 ft 7½ in, length 36 ft 0 in, height 13 ft 1¼ in.

Weights: empty 6,889 lb, gross (aerobatic) 9,700 lb, max gross 13,000 lb.

Performance (at 9,700 lb weight): max speed at S/L 558 mph IAS, max speed at 30,000 ft 508 mph, stalling speed (gear and flaps down) 93 mph, service ceiling 48,000 ft, T-O run 1,525 ft, landing run 1,362 ft, max range (internal fuel) 1,094 miles, *g* limits +8/−4.

Accommodation: two crew in tandem on Martin-Baker IT10F zero/zero ejection seats. Rear seat raised.

Armament: six underwing hardpoints for up to 4,000 lb of stores, including Magic or Sidewinder air-to-air missiles, 30 mm or 12.7 mm gun pods, 750 lb or 1,000 lb bombs, 7.62 mm Minigun pods, rocket launchers, antirunway weapons, drop tanks, reconnaissance pods, and ECM pods.

MICROJET 200 B

The first prototype of this diminutive twin-jet trainer began flight trials on 24 June 1980. By utilising small turbojets manufactured by Microturbo, it proved possible to offer high performance in an aircraft with low initial and operating costs. The potential of the Microjet was further demonstrated by the second pre-production example, which introduced underwing hardpoints. The specification data apply to the planned initial production version. Take-off rating of each engine will be increased progressively to 405 lb st, to improve performance and payload, with particular emphasis on the Microjet's suitability for an antihelicopter combat role.

Contractor: Marmande Aéronautique SA, France.

Power Plant: two Microturbo TRS 18-1 turbojets; each 326 lb st.

Dimensions: span 24 ft 9¾ in, length 21 ft 10½ in, height 7 ft 11¼ in.

Weights: empty 1,719 lb, gross (aerobatic) 2,513 lb, max gross 2,866 lb.

Performance: max cruising speed 287 mph at 18,045 ft, stalling speed (gear and flaps down) 83 mph, service ceiling 30,000 ft, T-O run 2,800 ft, landing run 1,280 ft, max range (with reserves) 541 miles, *g* limits (aerobatic) +7/−3.5.

Accommodation: two seats side by side. Starboard seat staggered aft of port seat for added comfort.

Armament: no details available.

PC-7 TURBO-TRAINER

More than 390 of these fully aerobatic turboprop basic trainers have been sold, and most of them delivered, since the prototype flew for the first time in 1975. The PC-7 can be used for basic, transition, and aerobatic training, and, with suitable equipment installed, for IFR and tactical training. Swiss law does not permit Pilatus to export aircraft equipped for combat use. However, some customers have installed weapon pylons, and the illustration on the next page shows a fully armed PC-7 of the Mexican Air Force. PC-7s have been sold to the air forces of Abu Dhabi (24), Angola (18), Austria (16), Bolivia (36), Burma (17), Chile (Navy, 10), Guatemala (12), Iran (35), Iraq (52), Malaysia (44), Mexico (75), Switzerland (40), and some undisclosed countries.

Contractor: Pilatus Flugzeugwerke AG, Switzerland.

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

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

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

Performance (at 4,188 lb weight): max cruising speed 256 mph at 20,000 ft, stalling speed (gear and flaps down) 74 mph, service celling 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 15 ejection seats optional.

Armament: see above.

PC-9

Despite its family resemblance to the PC-7, the PC-9 shares only a 10 percent structural commonality with that aircraft. It has a more powerful engine, a raised rear cockpit, ejection seats as standard, a ventral airbrake, modified wing profiles and wingtips, new ailerons, a longer dorsal fin, mainwheel doors, and larger wheels with high-pressure tyres. The first of two pre-series aircraft flew on 7 May 1984. First customer was the Union of Burma Air Force, which ordered four, followed by the Royal Saudi Air Force, which ordered 30. About 25 more have been ordered by two undisclosed customers, believed to be Angola (4) and Iraq. Sixty-seven are being produced for the Royal Australian Air Force, as PC-9/As. The first two were supplied ready to fly by Pilatus, followed by kits for the next six, and major components for 11 more. The remaining 48 are being built jointly by Hawker de Havilland and Aerospace Technologies of

Australia (ASTA). Deliveries to the RAAF began on 14 December 1987.
Contractor: Pilatus Flugzeugwerke AG, Switzerland.
Power Plant: one Pratt & Whitney Canada PT6A-62 turboprop; 950 shp.
Dimensions: span 33 ft 2½ in, length 33 ft 4¾ in, height 10 ft 8¼ in.
Weights: empty 3,715 lb, gross (aerobatic) 4,960 lb, max gross 7,055 lb.
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 40,000 ft, T-O run 745 ft, landing run 1,368 ft, max range (with reserves) 1,020 miles, *g* limits +7/−3.5.
Accommodation: two crew in tandem, on Martin-Baker Mk CH-11A ejection seats. Rear seat raised.
Armament: see remarks under PC-7 entry.

PILLÁN

Design of this fully aerobatic basic and instrument flying trainer was based on the Piper Cherokee series, using in particular many components of the PA-28 Dakota and PA-32 Saratoga. The first of two prototypes built by Piper was flown on 6 March 1981. Three further aircraft were delivered from the US as kits for assembly in Chile by ENAER, a state-owned company established by the Chilean Air Force. By early 1989, this Air Force will have received all 60 of the T-35A Pillán (Devil) primary trainers, and 20 T-35B instrument trainers, covered by initial contracts. Forty T-35Cs, supplied in kit form by ENAER for assembly in Spain by CASA, serve with the Spanish Air Force as E.26 Tamiz primary trainers. Four similar T-35Ds were delivered to the Panamanian Air Force at the beginning of this year. A single-seat T-35S is under development. (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 (aerobatic) 2,900 lb, max gross 2,950 lb.
Performance: max speed at S/L 193 mph, max cruising speed at 8,800 ft 166 mph, 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.

PZL-130 ORLIK and TURBO-ORLIK

The Orlik received domestic certification in the aerobatic and utility categories at the beginning of this year, following a two-prototype flight test programme that started in October 1984. Like the smaller M-26 Iskierka from Mielec, the Orlik was designed to train both civilian and military pilots, though over a wider spectrum ranging from pre-selection through basic, aerobatic, instrument, navigation, formation, weapons, and aerial combat training, as well as for such roles as reconnaissance, target acquisition, and target towing. Cockpit instruments and displays are installed in modular units similar to those of modern combat aircraft, to permit quick changes of avionics and equipment and enable the Orlik to act as a 'flying operational simulator' for jet-powered military aircraft. In collaboration with the Canadian company Airtech, Poland is also developing a Turbo-Orlik version, powered by a 550 shp Pratt & Whitney Canada PT6A-25A turboprop in a more slimline cowling. The following data apply to the piston engined PZL-130:
Contractor: WSK-PZL Warszawa-Okecie, Poland.
Power Plant: one Vedeneyev M-14Pm nine-cylinder radial engine; 330 hp.
Dimensions: span 26 ft 3 in, length 27 ft 8¾ in, height 11 ft 7 in.
Weights: empty 2,529 lb, gross (aerobatic) 3,196 lb, max gross 3,527 lb.
Performance (aerobatic): max speed 211 mph, max cruising speed 180 mph, stalling speed (gear and flaps down) 74 mph, service ceiling 14,000 ft, T-O run 1,115 ft, landing run 821 ft, max range (no reserves) 880 miles, *g* limits +6/−3.
Accommodation: crew of two in tandem; rear seat elevated.
Armament: two hardpoints under each wing for practice bombs, gun and rocket pods, or other weapons training stores.

S.211

A compact airframe, with some 60 per cent of its surface area manufactured in GRP composites, characterises this small, lightweight basic jet trainer/light attack aircraft, the prototype of which was flown for the first time in April 1981. It has a minimum air turning radius at sea level of less than 1,000 ft, a hydraulically actuated airbrake, and is claimed to have particularly safe stalling and spinning qualities. The S.211's first customer, for 30, was the Republic of Singapore Air Force, which received the first six as Italian built complete aircraft and the remaining 24 in CKD (component knocked down) form for assembly by Singapore Aircraft Industries (SAI). Four other S.211s were delivered to the air force of Haiti, and a few months ago the Philippine Air Force ordered 18, with a second 18 on option, to be assembled locally by Philippine Aerospace Development Corporation. SIAI-Marchetti is developing an improved attack version with a lightweight HUD and Omega navigation computer, and with SAI has made a joint study for a possible 'stretched' version of the aircraft.
Contractor: SIAI-Marchetti SpA (subsidiary of Agusta SpA), Italy.
Power Plant: one Pratt & Whitney Canada JT15D-4D turbofan; 2,500 lb st.
Dimensions: span 27 ft 8 in, length 30 ft 6½ in, height 12 ft 5½ in.
Weights: empty 4,078 lb, gross ('clean') 6,063 lb, max gross 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 (internal fuel, 30 min reserves) 1,036 miles, *g* limits +6/−3 'clean', +5/−2.5 with external stores.
Accommodation: crew of two on tandem Martin-Baker Mk 10 zero/zero ejection seats; rear seat raised.
Armament: two hardpoints under each wing for up to 1,455 lb of single- or twin-gun machine-gun pods, cannon pods, rocket launchers, bombs, napalm tanks, cartridge throwers, two camera/IR reconnaissance pods, or two drop tanks.

S312 TUCANO

On 21 March 1985, the UK Government announced that, after a hotly contested two-year competition, this developed version of the Brazilian EMB-312 Tucano (which see) had been chosen as a replacement for the Royal Air Force's Jet Provost basic trainers. In order to exceed the requirements of MoD Air Staff Target 412, the S312 Tucano embodies a changed power plant to improve speed, particularly at low altitude, and to provide an increased rate of climb; a ventral airbrake to control speed during descent; structural strengthening for increased manoeuvre loads and fatigue life; a new cockpit layout; and extensive British equipment. For export sales, four underwing hardpoints provide armament training and light attack capability. The first of 130 production Tucano T. Mk 1s ordered to date for the RAF flew on 30 December 1986. Deliveries began on 16 June 1988, initially to the Central Flying School at RAF Scampton. Other operators will be No. 7 Flying Training School, Church Fenton; No. 1 FTS, Linton-on-Ouse; and the RAF College, Cranwell. First export customer is expected to be the Kenyan Air Force.
Contractor: Short Brothers plc, Northern Ireland.
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 (aerobatic) 4,447 lb, gross (aerobatic) 5,952 lb, max gross 7,716 lb.
Performance (aerobatic gross weight): max cruising speed 315 mph at 10,000–15,000 ft, econ cruising speed 253 mph at 20,000 ft, stalling speed (gear and flaps down) 80 mph, service ceiling 34,000 ft, T-O run 1,010 ft, landing run 1,030 ft, max range (with reserves) 1,140 miles, *g* limits +7/−3.6.
Accommodation: two crew in tandem, on Martin-Baker Mk 8LCP ejection seats. Rear seat raised.
Armament: export version will carry up to 1,000 lb of stores on four underwing hardpoints, typically two 500 lb or four 250 lb bombs, four rocket packs or practice bombs, two 0.50 in or two twin 0.30 in machine-gun pods.

Pilatus PC-7, Mexican Air Force

Pilatus PC-9, Royal Saudi Air Force

ENAER T-35A Pillán, Chilean Air Force

PZL Warszawa-Okecie PZL-130 Orlik, Polish Air Force (Andrzej Glass)

SIAI-Marchetti S.211, Republic of Singapore Air Force

Shorts S312 Tucano T. Mk 1, Royal Air Force

SAH-1

Rated by many who have flown it as the best small primary trainer of the 1980s, the SAH-1 was the first product of a company in Cornwall named Trago Mills. The prototype flew for the first time on 23 August 1983, and had obtained a full Public Transport Category Certificate of Airworthiness by the end of 1985. Production began in the Summer of 1988 when additional capital was injected by a group of businessmen headed by Norman Whale, and the company was renamed Orca Aircraft Ltd ('orca' being Latin for 'whale'). Substantial grant assistance has been received from the UK Department of Trade and Industry to get the programme moving, and Orca is already planning an uprated version of the SAH-1 with a 160 hp AEIO-320-DB engine and constant-speed propeller.

Contractor: Orca Aircraft Ltd, England.
Power Plant: one Textron Lycoming O-235-L2A piston engine; 118 hp.
Dimensions: span 30 ft 8½ in, length 21 ft 10¼ in, height 7 ft 7½ in.
Weights: empty 1,100 lb, gross 1,750 lb.
Performance: max speed at S/L 140 mph, max cruising speed at S/L 127 mph, stalling speed (flaps down) 55 mph, service ceiling 16,400 ft, T-O to 50 ft 1,285 ft, max range (with reserves) 714 miles, *g* limit +6.
Accommodation: two seats side by side.
Armament: none.

Orca SAH-1 prototype (J.M.G. Gradidge)

SIAI Marchetti SF.260M, Belgian Air Force

Kawasaki XT-4, first and third prototypes

SF.260 and SF.260TP

More than 20 armed forces worldwide operate versions of this fully aerobatic military aircraft. The initial two/three-seat SF.260M trainer was flown for the first time on 10 October 1970 and was sold to Belgium, Bolivia, Burma, Ecuador, Libya, Morocco, the Philippines, Singapore, Thailand, Tunisia, Zaïre, and Zambia, as well as becoming the standard primary trainer of the Italian Air Force. It can be used for basic flying training, instrument flying, aerobatics including spinning, night flying, navigation, and formation training. From it was developed the SF.260W Warrior dual-role trainer/tactical support version, with underwing pylons for up to 661 lb of stores, which was bought by the air forces of the Comores Islands, Dubai, Ireland, the Philippines, Rhodesia (now Zimbabwe), Singapore, and Tunisia. The later SF.260TP has a 350 shp Allison 250-B17D turboprop instead of the piston engine of the SF.260M/W, but is virtually unchanged aft of the firewall. More than 60 SF.260TPs have been ordered by Dubai, Ethiopia, Sri Lanka, Zimbabwe, and other military customers. (Data for SF.260M, except where indicated.)

Contractor: SIAI-Marchetti SpA, Italy.
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 (aerobatic) 2,425 lb, max gross 2,645 lb. (SF.260W and SF.260TP have gross weight of 2,866 lb.)
Performance (SF.260M): max speed at S/L 207 mph, max cruising speed 186 mph at 4,925 ft, stalling speed (gear and flaps down) 79 mph, T-O run 1,260 ft, landing run 1,132 ft, max range 1,025 miles, *g* limits (aerobatic) +6/−3.
Performance (SF.260TP): max speed 262 mph at 10,000 ft, max cruising speed 248 mph at 8,000 ft, stalling speed (gear and flaps down) 79 mph, T-O run 978 ft, landing run 1,007 ft, max range (with reserves) 589 miles.
Accommodation: two seats side by side, with third seat to rear.
Armament: none on SF.260M.

T-2 and T-2A

This highly capable advanced jet trainer was the first supersonic aircraft to be designed and developed by the Japanese aerospace industry, and in addition to its training objectives formed the basis of the Mitsubishi F-1 single-seat close air support fighter. Ninety examples of the two-seat model were delivered to the Japan Air Self-Defence Force's 4th Air Wing at Matsushima, of which 28 were configured as T-2 advanced trainers and the other 62 as T-2A combat proficiency trainers. Since 1982, six of the latter version have been flown by the JASDF's official display team, the 'Blue Impulse,' and the tractability of this aircraft was further demonstrated when one was successfully test flown after conversion by Mitsubishi for use in a control configured vehicle (CCV) research programme. Production of the T-2 and T-2A ended in early 1988.

Contractor: Mitsubishi Heavy Industries Ltd, Japan.
Power Plant: two Ishikawajima-Harima TF40-IHI-801A (licence Rolls-Royce Turbomeca Adour Mk 801A) afterburning turbofans; each 7,305 lb st.
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 multi-barrel 20 mm cannon in lower fuselage, aft of cockpit on port side. Hardpoints on underfuselage centreline and two under each wing for drop tanks or weapons. Wingtip attachments for air-to-air missiles.

T-4

The first dozen T-4s, of an eventual total expected to reach about 200, began to be delivered to the Japan Air Self-Defence Force in the Autumn of this year. Classified as intermediate jet trainers, they will replace the JASDF's existing fleet of ageing Lockheed T-33As and Fuji T-1A/Bs serving with the air training wing at Hamamatsu, near Tokyo. The T-4 was required to demonstrate high subsonic manoeuvrability, and is fully aerobatic with pressurised and air-conditioned accommodation for instructor and pupil. It is an all-Japanese programme, with Mitsubishi contributing the central portion of the fuselage, Fuji building the rear fuselage, wings, and tail assembly, Sumitomo the landing gear, and IHI the engines. The T-4 is expected to be used by the JASDF for liaison and other duties, in addition to its primary role as a training aircraft.

Contractor: Kawasaki Heavy Industries Ltd, Japan.
Power Plant: two Ishikawajima-Harima F3-IHI-30 turbofans; each 3,670 lb st.
Dimensions: span 32 ft 7½ in, length 42 ft 8 in, height 15 ft 1¼ in.
Weights: empty 8,157 lb, gross ('clean') 12,125 lb, max gross 16,535 lb.
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 Stencel SIIIS-3ER ejection seats; rear seat elevated.
Armament: two hardpoints under each wing for practice bombs or other training weapons; underfuselage pylon for target towing equipment, an ECM/chaff dispenser, or an air sampling pod. Structural provision for air-to-air missiles under outer wings.

T-34C

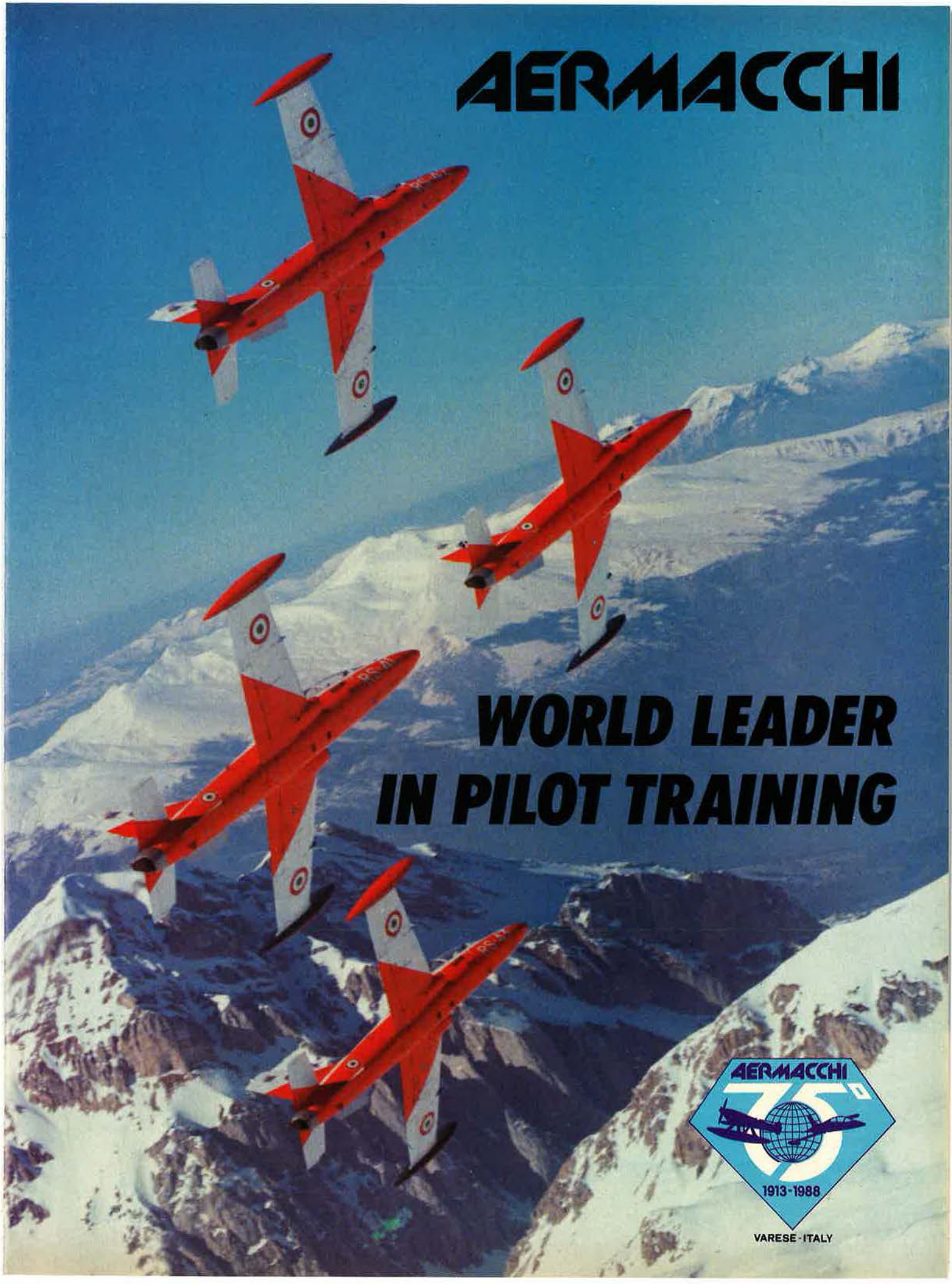
The T-34C is best known as the US Navy's standard primary trainer. Developed as a turboprop version of the piston-engined T-34A and T-34B Mentor, built for USAF and the US Navy respectively, the first of two YT-34C prototypes was flown on 21 September 1973. Beech delivered 334 new-production T-34Cs to the Navy between November 1977 and April 1984, and is currently building 19 more. These aircraft have logged around one million flight hours, with the lowest accident rate for aircraft in the Navy's current inventory. Six were transferred to the Army, to serve as chase and photographic aircraft for the Airborne Special Operations Test Board at Fort Bragg, N. C. A T-34C-1 armament systems trainer version, with FAC and tactical attack training capability, has been exported to Argentina (Navy, 15), Ecuador (Air Force, 20; Navy, 3), Gabon (Presidential Guard, 4), Indonesia (Air Force, 25), Morocco (Air Force, 12), Peru (Navy, 7), Taiwan (40), and Uruguay (Navy, 3). (Data for T-34C, except where indicated.)

Contractor: Beech Aircraft Corporation, USA.
Power Plant: one Pratt & Whitney Canada PT6A-25 turboprop; 400 shp (550 shp version available optionally).
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 246 mph at 17,000 ft, 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: two seats in tandem.
Armament (T-34C-1): four underwing hardpoints for total 1,200 lb of stores, including practice bomb/flare containers, LAU-32 or LAU-59 rocket packs, Mk 81 bombs, SUU-11 Minigun pods, BLU-10/B incendiary bombs, AGM-22A wire-guided antitank missiles, and target towing equipment.

Beech T-34C-1s of (front to rear) Moroccan Air Force, Ecuadoran Air Force, and Peruvian Navy

T-45A GOSHAWK

In competition with five other types, the British Aerospace Hawk (which see) was selected by the US Navy in November 1981 to replace the T-2C Buckeye and TA-4J Skyhawk as its undergraduate jet pilot trainer. To meet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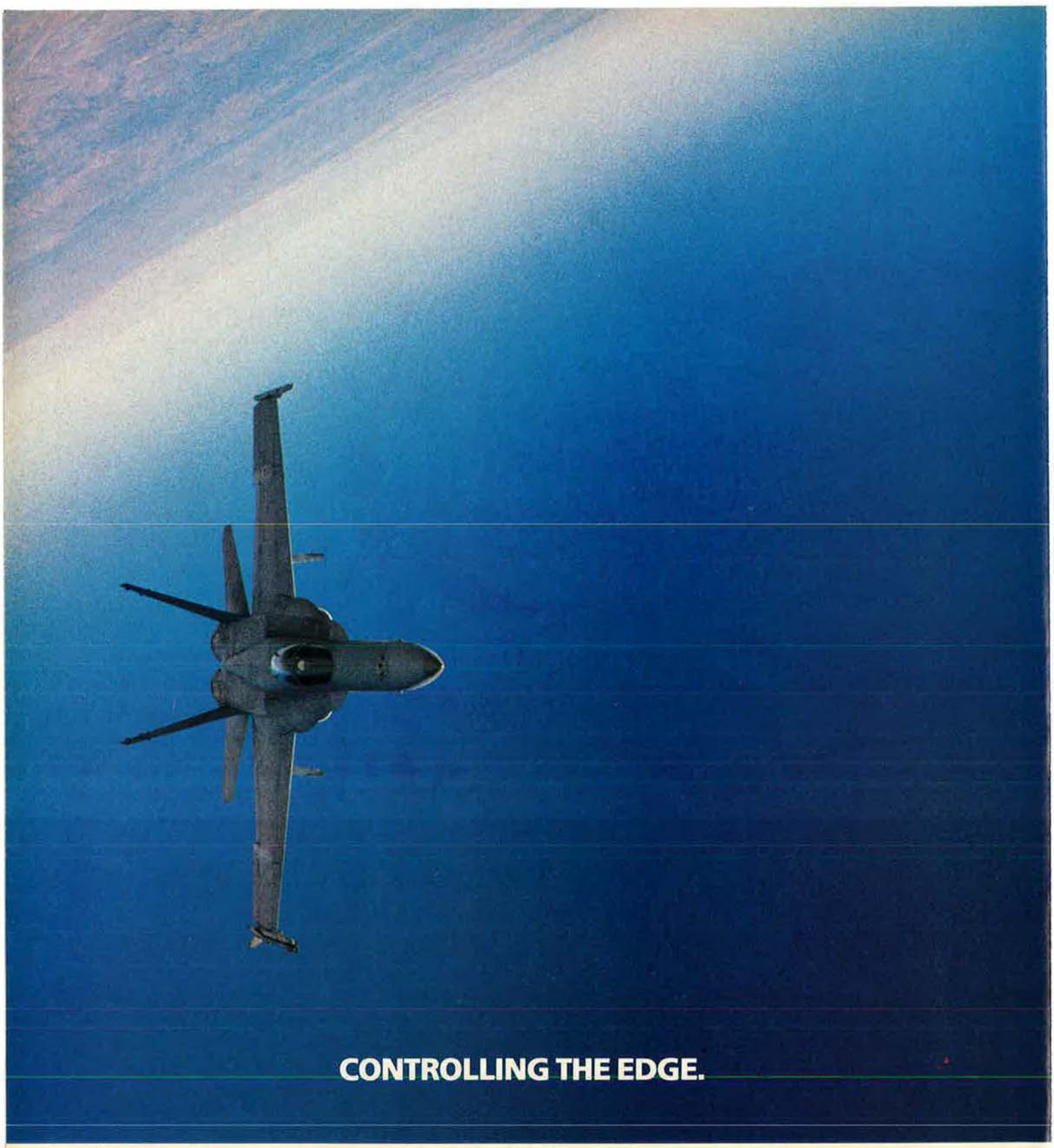

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Navy requirements, its version of the Hawk, designated T-45A Goshawk, has new main and nose landing gear, an arrester hook, and airframe strengthening to make it carrier compatible. The nose gear is twin-wheel, and steerable, with a catapult launch bar/nosewheel tow. Two fuselage-side airbrakes replace the Hawk's single large underfuselage airbrake. Twin ventral strakes are replaced by a single surface serving also as a fairing for the arrester hook. The avionics and cockpit displays are different, and weapons delivery capability for advanced training is standard. Douglas Aircraft Company manufactures the front fuselage of the T-45A at Long Beach, California. The remainder of the airframe is supplied by its principal subcontractor, British Aerospace. Flight testing was begun by the first of two pre-production Goshawks on 16 April 1988. IOC with 12 aircraft, simulators, and associated equipment is scheduled for the fourth quarter of 1990. Present plans envisage delivery of 300 production T-45As by 1997.

Contractor: McDonnell Douglas Corporation, USA.
Power Plant: one Rolls-Royce Turbomeca F405-RR-400L (Adour Mk 861-49) turbofan; 5,450 lb st.
Dimensions: span 30 ft 9¾ in, length (including probe) 39 ft 3¼ in, height 13 ft 5 in.
Weights: empty 9,394 lb, gross 12,758 lb.
Performance: max speed 620 mph at 8,000 ft, max Mach number in dive 1.2, 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: two crew 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 or drop fuel tank. Provision for centreline stores pylon.

McDonnell Douglas T-45A Goshawk prototype

T67M FIREFLY

The original Slingsby T67A was a licence-built version of the French Fournier RF6B light aircraft of wooden construction. All subsequent models, including T67M Firefly two-seat military basic trainers, have airframes built of glassfibre reinforced plastics. The basic Firefly 160, first flown on 5 December 1982, has a 160 hp Textron Lycoming AEIO-320-D1B engine, and a new canopy with fixed windscreen and upward hinged/rearward opening rear section, instead of the one-piece canopy of the civil T67s. The uprated Firefly 200, flown for the first time on 16 May 1985, differs in having an AEIO-360-A1E engine. Customers for the Firefly 200 include the Royal Hong Kong Auxiliary Air Force, and the Turkish Aviation Institute at Ankara. All versions of the T67 are aerobatic. (Data for Firefly 200.)

Contractor: Slingsby Aviation Ltd, England.
Power Plant: one Textron Lycoming AEIO-360-A1E piston engine; 200 hp.
Dimensions: span 34 ft 9 in, length 24 ft 0¼ in, height 8 ft 3 in.
Weights: empty 1,510 lb, gross 2,150 lb.
Performance: max speed at S/L 161 mph, max cruising speed 153 mph at 8,000 ft, stalling speed (flaps down) 59 mph, T-O run 550 ft, landing run 810 ft, max range (with reserves) 575 miles, *g* limits +6/−3.
Accommodation: two seats side by side.
Armament: none.

Slingsby T67M Firefly 200, Royal Hong Kong Auxiliary Air Force

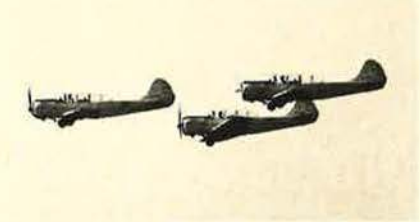
UTVA-75A

There are three current versions of this Yugoslav light aircraft. The basic version, as described in detail, is the two-seat UTVA-75A21, which was first flown in prototype form on 19 May 1976. More than 100 have since been delivered to the Yugoslav Air Force and civilian flying clubs for basic training, glider towing, and utility duties. Light weapon loads can be carried on a pylon under each wing. The UTVA-75A41 is generally similar, but has four seats, in pairs, with no provision for armament. It entered production about two years ago, with a gross weight of 2,564 lb and slightly reduced overall performance. The UTVA-75A11 is an agricultural version, with a chemical hopper forward of a high-set single-seat cabin in the centre-fuselage, upgraded landing gear for operation at higher gross weight from grass, and a 300 hp Textron Lycoming IO-540-L1A5D engine. It was scheduled to fly for the first time this year. (Data for UTVA-75A21.)

Contractor: UTVA—Sour Metalne Industrije, Ro Fabrika Aviona, Yugoslavia.
Power Plant: one Textron Lycoming IO-360-B1F piston engine; 180 hp.
Dimensions: wing 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 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, or machine-gun pod.

UTVA-75A21 (Air Portraits)

UTVA Lasta prototype



Yak-52s built by IAv Bacau, Romania, flying over Moscow (TASS)

UTVA LASTA

The first of two prototypes of this primary trainer and light attack aircraft flew for the first time in 1985, at which time tooling was being prepared for manufacturing a preseries of ten Lastas (Swallows) for the Yugoslav Air Force. Designed to FAR Pt 23 standards, the Lasta has a similar configuration and power plant to the French Epsilon, but is larger and heavier. Pupils are intended to progress from the Lasta directly to the G-4 Super Galeb jet trainer, and the cockpits of the two types are fundamentally similar. UTVA claims that the Lasta is suitable for a wide range of training duties, including basic, aerobatic, navigation, instrument and night flying training, basic instruction in gunnery, rocket firing and bombing, formation flying, and training in combat manoeuvres.

Contractor: UTVA–Sour Metalne Industrije, Ro Fabrika Aviona, Yugoslavia.
Power Plant: one Textron Lycoming AEIO-540-Z1B5D piston engine; 300 hp.
Dimensions: span 27 ft 4½ in, length 26 ft 4½ in, height 14 ft 7¼ in.
Weights: empty 2,337 lb, gross 3,593 lb.
Performance: max speed at S/L 214 mph, T-O run 1,050 ft, landing run 1,017 ft.
Accommodation: two seats in tandem. Rear seat raised.
Armament: two underwing hardpoints for total of 882 lb of bombs, rocket packs, or pods containing twin machine-guns.

YAK-52

The Yakovlev Yak-52 primary trainer is likely to represent the ultimate development of the lengthy series of aircraft that began more than 42 years ago with the venerable Yak-18. In addition to serving as two-seat trainers throughout the air forces of the Warsaw Pact nations and their friends, these aircraft set the standard for international aerobatic competition flying for many years in single-seat forms. Configuration and structure have changed little through the years, except for the switch from fabric covered to metal semi-monocoque rear fuselage, the use of more powerful engines, and the adoption in the Yak-52 of a unique tricycle landing gear in which all three wheels remain almost totally exposed under the fuselage and wings when retracted, to offer greater safety in a wheels-up emergency landing. Production of the Yak-52 is centred at the IAv Bacau plant in Romania, which delivered the 1,000th example in 1987. This plant is expected to manufacture also the Yak-53 single-seat counterpart of the Yak-52.

Contractor: Intreprinderea de Avioane Bacau, Romania.
Power Plant: one Vedeneyev M-14P nine-cylinder radial engine; 360 hp.
Dimensions: span 30 ft 6¼ in, length 25 ft 5 in, height 8 ft 10¼ in.
Weights: empty 2,205 lb, gross 2,844 lb.
Performance: max speed 186 mph at 1,640 ft, max cruising speed 167 mph at 3,280 ft, stalling speed (gear and flaps down) 53–56 mph, service ceiling 19,685 ft, T-O run 558 ft, landing run 984 ft, max range 341 miles, *g* limits +7/−5.
Accommodation: two seats in tandem.
Armament: none.

AFA's 1988 Gerrity Award for logistics excellence recognizes the Randolph team that made aging T-37s and T-38s look and behave like new.

The Troops Behind the Trainers

BY SUSAN KATZ-KEATING

THE T-37s and T-38s at Randolph AFB, Tex., never have an easy day. On their way to becoming instructor pilots, the students of the 12th Flying Training Wing (FTW) put these planes through a taxing schedule. The planes they train in are at least sixteen years old. Some are pushing twenty-five.

It's impressive enough that the crews of the 12th Organizational Maintenance Squadron (OMS) keep those Tweets and Talons up to fulfilling their grueling schedule. But the unit accomplishes much more than that. Under the leadership of Lt. Col. Mary B. Hamlin, the 12th OMS rewrote the book on maintenance productivity and logistics performance. If awards are any indication, the 12th may be the best maintenance squadron in the Air Force.

Colonel Hamlin was honored this year by AFA for making the most outstanding contribution in the field of logistics during 1987. In recognition of her work as Commander of the 12th OMS, she received the prestigious Thomas P. Gerrity Award for logistics management.

In 1987, the 12th OMS was named

tops in ATC, receiving the Command's Maintenance Effectiveness Award. It also earned the 1987 USAF Maintenance Effectiveness Award—the highest maintenance honor in the Air Force. Individual crew members reaped honor after honor for excellence on duty and off. Citations included 12th FTW Civilian of the Year; Family Services Volunteer Award; ATC Commander's Trophy; 12th FTW First Sergeant of the Year; and Rotary Award for Excellence, NCO Leadership School.

In January 1987, Colonel Hamlin's unit achieved a 95.3 percent average monthly mission-capable rate for T-37s—the highest T-37 readiness rate in ATC history—and a T-38 readiness rate of 88.7 percent, the highest in a quarter-century.

The list of "bests" goes on. Colonel Hamlin motivated her personnel to high training achievement. Not one person failed the Career Development Course final exams during her term as Commander, and 39.6 percent received outstanding scores on their course exams—the highest scores earned at any ATC base and more than double the command average.

An especially telling score is in safety. In 1987, the unit enjoyed more than 50,000 accident-free hours. In addition, the unit has had no T-38 Class A accidents in more than five years, and no T-37 Class A mishaps ever. What's their secret for success? Education. "We talk about safety constantly," says Colonel Hamlin.

Compressing Turnaround Time

A striking example of the 12th OMS's commitment to mission accomplishment is Colonel Hamlin's innovative approach to the unexpected. Randolph was caught in a record winter rainfall, causing the squadron to fall eight days behind the training schedule. Faced with a personnel logjam of staggering proportions, Colonel Hamlin carved a solution from what was available: the turnaround time between sorties. There wasn't much to work with, since ATC already works at a faster pace than other commands. On the first day of turnaround reduction, the 12th FTW increased its normal T-38 work load from ninety to 133 primary training sorties.

This was accomplished without adding extra aircraft or extra hours to the schedule. Colonel Hamlin's method has become an established sortie-surge technique, adopted for use by all of ATC. The command jumped on the technique, not only for its ability to increase sorties by fifty percent, but also for its value in simulating the momentum of combat turnarounds.

The surge technique has proved that big problems often need big solutions. The 12th OMS knows that little things can make a big difference, too. Colonel Hamlin instituted the use of mobile tool cabinets that could be rolled to the aircraft, thereby eliminating the time spent fetching and returning items. Snack machines and water fountains were relocated closer to work areas.

Miracle Workers

The 12th FTW turns out the instructor pilots (IPs) who train the Air Force's undergraduate pilots. If Randolph falls behind schedule, the other training wings also fall behind. At the apex of this pyramid, the 12th OMS faces a stiff challenge: coping with the aging training planes themselves. Characteristically, this is also the area of the unit's greatest achievements.

Randolph's fifty-four T-37s and seventy-five T-38s are no picnic to

The 12th Organizational Maintenance Squadron at Randolph AFB, Tex., garnered an impressive array of honors over the last year, including the Air Force Maintenance Effectiveness Award. Hard work was the main reason. Here, A1C Mark Foster (right), a crew chief with the 12th OMS, helps 2d Lt. Jim Grandy, an instructor pilot trainee, strap up in his T-37.

—USAF photo by 1st Lt. John Skinner

—Photo by Eddie McCrossan

Lt. Col. Mary B. Hamlin, shown here in the cockpit of Learjet's proposed Tanker/Transport Training System aircraft at the AFA National Convention, provided leadership and guidance for the 12th OMS in winning AFA's Thomas P. Gerrity Award for logistics management.

maintain. They contain few line-replaceable units; the technology is pulley-and-cable; the cockpits are full of round-dial instruments. The Tweet's and Talon's engines are old ones. They have no computer controls or digital readouts that can tell their keepers what is ailing them. The engines have to be looked at. The squadron must also be especially watchful for corrosion and fatigue among the metal—not composite—parts.

Faced with a rising number of T-38 landing gear incidents, Colonel Hamlin concluded that preventive maintenance measures were insufficient. She developed a program to ensure that each landing gear part would hold up for 450 flying hours. At that point, each part was reinspected. Parts that were technically usable but suspect were considered likely failures.

This maintenance plan reduced the number of failures from twenty-seven in 1986 to eight in 1987. A similar program, designed to thwart problems with worn-out flight controls on T-38s, dropped the number of in-flight failures from nineteen in 1986 to five in 1987.

Personnel from the 12th OMS tested a T-38 formation strip light modification to enhance night flying visibility and safety. Other 12th OMS projects include modification prototypes such as horsecollar rib doublers, throttle gates, landing gear actuator rod ends, radio override switches, jack pad cradles, and throttle interconnect cables. All of these modifications will increase aircraft reliability and maintainability while decreasing operating costs and equipment downtime. Aside from the long-range benefits of these projects, 12th OMS has saved ATC millions of dollars in contractor support.

Where contract support was needed, though, Colonel Hamlin managed ATC's resources carefully. She oversaw ATC's Queen Bee program, the largest contract field team in the Air Force. Its 500-some personnel perform heavy maintenance on all USAF, Department of Defense, and NASA T-38 aircraft. They are currently working on a project called Pacer Classic that will extend the useful life of the T-38 into the next century.

Secrets of Success

Colonel Hamlin, who has since been reassigned as Chief of the Maintenance Procedures Division at ATC headquarters, heaps praise on the airmen of the 12th OMS. "Nobody ever wins an award like the Gerrity Award alone," she says. "I had a superb organization behind me. It's incredible how hard they work. It's cold out there, [sometimes] hot, wet, and noisy—and still they work hard. Those young people are intelligent and dedicated. They love their aircraft."

Colonel Hamlin attributes the squadron's excellence to two things: hard work and USAF incentives. "Our people are so good. But you can't always promote them, and you can't give them more money, so we looked for a way to provide incentives. We developed programs to recognize them for what they do."

The 12th OMS approached the awards with a simple strategy. "We never let an award pass when we had people who were eligible."

Moving among the troops, Colonel Hamlin says, enabled her to learn directly about little things that could have a potentially big effect on morale. It also helped her disseminate information "from the horse's mouth," thereby squelching rumors or misinformation. "I made sure information was getting to the troops," she says. "Young people like to know what's going on, and I like to tell them, to the degree that I can do that.

"I try to get out to the flight line often—and at least one night per week. Fifty percent of my people work at night, and there is nothing that will replace the presence of the commander among the people. They like the support . . . you can't do anything without them. No matter how good you are, you must depend on the people who are out there turning the bolts. It's your airmen who will give you a better way to do something."

Colonel Hamlin and the 12th OMS have given ATC so many "better ways to do something" that any other OMS might envy the airmen of the 12th their aging airplanes. Thanks to their innovations and inspiration, the 12th FTW will produce superior instructor pilots for years to come. ■

Susan Katz-Keating has been a writer for Insight *Magazine since 1985. From 1982 to 1985, she was editor of the Dixon, Calif.,* Tribune.

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General Defense Corp., Ordnance Div.
General Dynamics Corp.
General Dynamics, Electronics Div.
General Dynamics, Fort Worth Div.
Genisco Peripheral Systems
Gentry & Associates, Inc.
Geodynamics Corp.
GMC, Allison Gas Turbine Div.
GMC, Delco Systems Operations
Government Employees Insurance Co. (GEICO)
Grumman Corp.
Grumman Data Systems Corp.
GTE Government Systems Corp.
GTE Government Systems Corp., Communications Systems Div.
GTE Government Systems Corp., Electronic Defense Sector
GTE Government Systems Corp., Strategic Systems Div.
Gulfstream Aerospace Corp.
Harris Government Communication Systems Div.
Harris Government Support Systems Div.
Harris Government Systems Sector
H. B. Maynard & Co.
Hercules Missiles, Ordnance and Space Group
Honeycomb Co. of America, Inc.
Honeywell Inc., Aerospace and Defense Group
Honeywell Inc., Defense and Marine Systems
Honeywell Inc., Space and Aviation Systems
Howell Instruments, Inc.
HR Textron, Inc.
Hughes Aircraft Co.
IBM Corp., National Federal Marketing Div.
IBM Corp., Systems Integration Div.
Information Systems & Networks Corp.
Ingersoll-Rand Co.
Intermetrics, Inc.
ISC Defense & Space Group
Israel Aircraft Industries Int'l, Inc.
Italian Aerospace Industries (U.S.A.), Inc. (Aeritalia)
Itek Optical Systems, A Division of Litton Industries
ITT Defense Communications Div.
ITT Defense Technology Corp.
Jane's
John Deere Technologies Int'l, Inc.
Kilgore Corp.
Kollmorgen Corp., Electro-Optical Div.
Kollsman
Lear Astronics Corp.
Learjet Corp.
Lewis Engineering Co., Inc.
Link Flight Simulation
Litton-Amecom
Litton Applied Technology
Litton Data Systems
Litton Guidance & Control Systems
Litton Industries
Lockheed Aeronautical Systems Co.—Burbank
Lockheed Aeronautical Systems Co.—Georgia
Lockheed Aeronautical Systems Co.—Ontario
Lockheed Corp.
Lockheed Engineering & Management Services Co., Inc.
Lockheed Missiles & Space Systems Group
Lockheed Space Operations Co.
Logicon, Inc.
Loral Corp.
Loral Systems Group
LTV Aircraft Products Group
LTV Missiles and Electronics Group, Sierra Research Div.
Lucas Industries Inc.
Magnavox Government & Industrial Electronics Co.
Martin-Baker Aircraft Co. Ltd.
Martin Marietta Astronautics Group
Martin Marietta Corp.
Martin Marietta Electronics & Missiles Group
Martin Marietta Energy Systems, Inc.
Martin Marietta Information Systems Group
MBB
McDonnell Aircraft Co.
McDonnell Douglas Astronautics Co.
McDonnell Douglas Corp.
McDonnell Douglas-INCO, Inc.
McGuire, Woods, Battle & Boothe
MITRE Corp., The
Morton Thiokol, Inc.
Moser Corp.
Motorola, Inc., Government Electronics Group
NORDAM
Northrop Advanced Systems Div.
Northrop Corp.
Northrop Corp., Aircraft Div.
Northrop Corp., Electro-Mechanical Div.
Northrop Corp., Electronics Div.
OEA, Inc.
O. Miller Associates
Orbital Sciences Corp.
Oshkosh Truck Corp.
PACCAR Defense Systems
Pan Am World Services, Inc., Aerospace Div.
Parker Hannifin Corp., Parker Bertea Aerospace
Perkin-Elmer Corp.
Pilatus Aircraft, Ltd.
Planning Research Corp.
Plessey Electronic Systems, Inc.
Pneumo Abex Corp.
Products Research & Chemical Corp.
RAND Corp., The
Raytheon Co.
RBI, Inc.
RCA Aerospace & Defense
RECON/OPTICAL, Inc., CAI Div.
Rediffusion Simulation, Inc.
Reflectone, Inc.
Republic Electronics Co.
Rockwell Int'l Collins Government Avionics Div.
Rockwell Int'l Corp.
Rockwell Int'l Electronics Operations
Rockwell Int'l North American Aircraft Operations
Rockwell Int'l North American Space Operations
Rohr Industries, Inc.
Rolls-Royce plc
Rosemount Inc.
Sabreliner Corp.
Sanders Associates, Inc.
Schneider Services International
Schwem Technology
Science Applications Int'l Corp.
Short Brothers USA, Inc.
Smiths Industries, Aerospace & Defence Systems Co.
Snap-On Tools Corp.
SofTech
Software AG
Southwest Mobile Systems Corp.
Space Applications Corp.
Standard Manufacturing Co., Inc.
Stewart & Stevenson Services, Inc.
Sundstrand Corp.
Sverdrup Corp.
Syscon Co.
Systematic Management Services, Inc.
Systems Control Technology, Inc.
Systems Research Laboratories/ Defense Electronic Systems
Systron Donner, Safety Systems Div.
Talley Defense Systems
Tandem Computers Inc., US Federal Operations
Technology Applications, Inc.
Teledyne CAE
Teledyne, Inc.
Teledyne Ryan Aeronautical
Texas Instruments, Defense Systems & Electronics Group
Textron Defense Systems
Textron, Inc.
Thomson-CSF, Inc.
Titan Systems, Inc.
Tracor Aerospace, Inc.
Trident Data Systems
TRW Defense Systems Group
TRW Federal Systems Group
TRW Inc., Electronic Systems Group
TRW Space & Defense Sector
TRW Space & Technology Group
Unisys Corp., Defense Systems
United Technologies Corp.
UTC, Advanced Systems Div.
UTC, Hamilton Standard
UTC, Norden Systems, Inc.
UTC, Pratt & Whitney
UTC, Research Center
UTC, Sikorsky Aircraft
UTC, Space Transportation Systems
Universal Propulsion Co., Inc.
UTL Corp.
Varo, Inc.
Vega Precision Laboratories
V. Garber Int'l Associates, Inc.
Vitro Corp.
Walter Kidde Aerospace Operations
Watkins-Johnson Co.
Westinghouse Electric Corp., Baltimore Div.
Williams International
ZF Industries, Inc.

How Secure Is Space?

By Gen. T. R. Milton, USAF (Ret.), CONTRIBUTING EDITOR

It takes a very gullible military planner to assume that our satellites will remain untouched by a gracious enemy, particularly if we have no retaliatory capability.

Back in the days before paperwork outweighed the product itself, Clarence "Kelly" Johnson, the resident genius of Lockheed's so-called Skunk Works, turned out the U-2 a few months after receiving the order. During the next four years, that strange-looking bird, essentially a glider with a J57 engine, floated over the USSR, in full view of Soviet radar but safely above fighters and missiles. Then came the unhappy day, May 1, 1960, when the Soviets knocked Francis Gary Powers's U-2 out of the sky, almost on the eve of the Paris summit.

Under the best of circumstances, that summit would not have done much toward thawing the Cold War, but the U-2 shootdown gave Khrushchev a chance to perform at his worst before an infuriated President Eisenhower. Eisenhower came home to a warm US welcome, but US-Soviet relations had reached a low point.

Still, no one questioned the right of the Soviets to shoot down an airplane clearly on an intelligence-gathering mission in their airspace. After a lame cover-up story failed, the United States accepted responsibility for the flight. It was done, our side said, to lessen the danger of surprise attack, and the US reserved the right, if necessary, to take another look.

The U-2 went on to a varied and useful career—it is, in fact, still around—but the Powers flight ended that phase of its activity.

Instead, we began to observe the USSR by means of satellites carrying high-resolution cameras and other sensors. So, of course, do the Soviets peer at us. While the question of what constitutes sovereign airspace continues to be a matter of argument, thus far, objects in orbit are tolerated, no matter what they may be doing in the way of spying.

It is no secret that we have become dependent on satellites for military effectiveness. Communications, intelligence, and—with the global positioning system—navigation are geared to satellites. Space, in short, is a military theater of operations. Whether it is also a potential battlefield is a question that stirs up emotions but provides little in the way of answers. Shuttle crews are far better equipped to observe than Gary Powers was, but they, like the Soviet cosmonauts, are universally viewed with affection rather than suspicion. Shooting them down would be a despicable act, like strafing a man in a parachute.

Although Shuttle missions give the rest of us a vicarious glow, there appears to be no serious military role for men in space. Or, at least, no role that cannot be undertaken by unmanned vehicles. Shooting down such vehicles presents no serious moral problem, since we are only contemplating the destruction of robots.

Even that prospect, however, sets off an alarm in Congress, in segments of the scientific community, and among arms controllers—an occupation that leans heavily on wishful thinking. Because of this alarm, the United States is in the uncomfortable position of having no operational antisatellite weapon, while the USSR has that capability well in hand. Our side is vulnerable; their side is not. If space is to remain, by mutual consent, off limits to hostile behavior, then it doesn't matter. It takes a very gullible military planner to assume that our satellites will remain untouched by a gracious enemy, particularly if we have no retaliatory capability.

Antisatellite weapons are destabilizing, the opposition says, and up to this point, the opposition is winning. A congressional injunction against testing resulted in the cancellation of our only antisatellite weapon, a device fired from an F-15. In its one test against a space target, the ASAT worked, but the project died of discouragement even though the congressional edict against testing was eventually removed.

Soviet triumphs in manned spaceflight have captured the admiration of the world and the apparent envy of NASA, all of which has diverted attention from a truly important Soviet space achievement—the capability of putting satellites into orbit in a fraction of the time we require. The US holds to a deliberate R&D approach: If a satellite goes down, a new one will be designed, tested, and put into orbit, all in good time. Our launch facilities, limited, fragile, and vulnerable, also reflect the R&D mentality. The Soviets, on the other hand, have hundreds of satellites in orbit, an ample supply in reserve, and redundant, secure, and operational launch facilities.

There is some resemblance, from a military point of view, between space and the world's oceans. No one contests a nation's right to its territorial waters. Sometimes, as in the case of Libya, claims exceed the boundaries of common sense and are therefore ignored, but the principle is not disputed. Trawlers and other maritime spy ships must keep their distance outside territorial waters, whereas the high seas are uncontested.

Airspace has similar territorial restrictions up to limits not yet established. On the evidence so far, an air/overhead object, if it is in range, is vulnerable to attack, or at least to interception. If it is in orbit, no matter what its purpose, it can pass unchallenged.

That isn't a very reassuring reason to conclude that our satellites will be safe in the future, especially if we have no means of retaliation. ■

Performance of US and allied crews at RAM '88 indicates that the state of the art in reconnaissance is even better than it used to be.

Photo Finish

BY GAIL F. PHILLIPS
PHOTOS BY DANIEL ROJAS, JR.

From the time the first set of scores was posted, it was clear that this year's Reconnaissance Air Meet (RAM '88), sponsored by Tactical Air Command, was headed for a "photo finish." All of the crews—USAF, Air National Guard, Navy, Marine Corps, German Air Force, and Royal Australian Air Force—that had come to Bergstrom AFB, Tex., for the ten-day event (August 17–26) did very well.

Despite a steady diet of 100-degree heat and high humidity, maintenance teams excelled in graded areas of aircraft appearance, management procedures, and scheduling effectiveness. Flying crews proved they could keep out of sight of "aggressor" aircraft while locating small, camouflaged targets positioned in tricky landscapes. Photo interpreters easily made sense out of the brush-covered images brought back on film, showing the results of solid training.

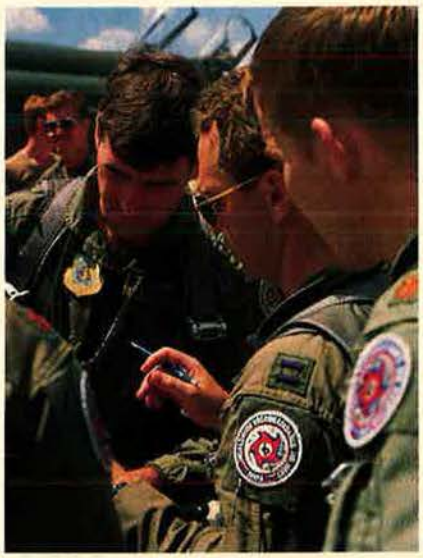
Even the aging dedicated reconnaissance aircraft and equipment used in the meet proved reliable, with only one ground abort marring an otherwise perfect record. The forty-five competing RF-4s, F-111s, and F-14s, outfitted with the Tactical Air Reconnaissance Pod System (TARPS), sustained few mechanical problems.

TAC officials are satisfied that recce troops are well prepared to face any challenge. "The scores were very tight," notes Lt. Col. Bill Bowman, 67th Tactical Reconnaissance Wing (TRW) Project Officer. "That tells me that we're all very capable and competitive—that our training is obviously very good."

Competition judges saw plenty of on-altitude, center-framed photographs in each of twelve day and night operations. This year's contestants, armed with refined skills and fresh tactics culled from lessons learned in past meets, set a new standard of proficiency with near-perfect scores.

Four active-duty Air Force teams (including representatives from PACAF and USAFE) battled it out against five ANG units, four active-duty and Reserve Navy and Marine Corps units, and German and Australian allies for nine major awards.

The 26th TRW, of Zweibrücken AB, Germany, captured overall top honors. The USAFE unit edged out



Aircrews with the 18th TFW (PACAF), Kadena AB, Japan, exchange stories about their daytime operations. The 18th won the meet's Arrival Competition, arriving closest to its assigned time. At right, SSgt. Jon A. Zanone, 12th TRS/67th TRW, Bergstrom AFB, Tex., processes film taken by RAM '88 competitors.


ZANONE

top multiservice American teams and allies from West Germany and Australia for the coveted overall "Top Team" distinction. *(See "RAM '88 Award Winners" p. 102.)*

Aircrews were judged on five night missions, seven low-level, high-speed day missions, and visual recognition of US, NATO, Soviet, and Warsaw Pact equipment.

Imagery interpreters were tested in equipment identification and evaluated on mission and reconnaissance exploitation reporting.

Maintenance teams came under scrutiny for aircraft appearance, toolbox condition, sortie generation, and daily and weekly schedules.

Turning On the Heat

"You have plus or minus fifteen seconds to make your takeoff time, you have a window to enter and exit the [military operating area] where the low-level routes are, and you have two time-over-targets where you have plus or minus fifteen seconds to make them. If you don't, you're done," explains competition pilot Lt. Jeff Turney, a member of the 152d Tactical Reconnaissance Group (TRG), which was the ANG "Top Team" winner in RAM '86.

RAM '88 aircrews flew under simulated combat conditions during daytime runs. Contest planners turned on the heat with antiaircraft artillery scattered throughout eight low-flight areas in Texas, Oklahoma, and Arkansas and with F-4 and F-15 "Red air" overhead. Predictably, a good number of the protests lodged with arbitration chiefs dealt with the validity of "aggressor kills."

"The whole controversy centered around the fact that the recce crews say they saw the adversary air before the adversary air called a kill," explains Colonel Bowman. "The adversary carries head-up display photography that shows the competitor in the picture, and we have AWACS that monitor the Red air situation. The competitor is required to make a call that he sees the bogie, and he's also required to maneuver the airplane—a wing rock, a hard turn—to acknowledge that the adversary has not surprised him." Colonel Bowman concedes that this aspect of the competiton needs clarification.

Aircrews and maintenance teams from No. 6 Squadron, Amberley, Australia, kept in close communication throughout the contest. No. 6 carried home the "Top Crew," "Top Night Team," and "Top Allied Team" honors.

For daytime RAM '88 operations, flying crews had the option of employing single- or two-ship launches. Four sets of eyes are better than two when navigating from less-than-ideal landmarks (road intersections, as opposed to streams or mountain peaks) and locating and photographing undersized and concealed targets (military trucks and equipment).

"The targets here are not nearly the type of targets that we would expect to fly against in wartime," says Colonel Grimsley. "In wartime, we'd be looking at an airfield with large interdiction points, marshaling areas, and large lines of communication. The targets these guys are flying here are very small, in order to challenge their skills, and they're finding the targets!"

Continual target hits were no small task for Australian aircrews, who didn't take advantage of the "extra eyes" privilege.

"We operate basically as a single airplane, whereas everybody here operates as a pair, for cross-cover to see the bad guys," explains Squadron Leader Noel Furber with No. 6 Squadron, Amberley, Australia. His team flew the only F-111s in this year's competition. "We have to rely on speed, stealth, and cunning, and whatever else is available to us—we very rarely practice as a pair," Squadron Leader Furber says, adding, "We've attempted it a couple of times, and it just doesn't work in a side-by-side airplane."

Capturing Images

But No. 6 Squadron distinguished itself in five night operations, where the concern was finding and capturing images of targets on film without the added worry of being tapped by air and ground threats. The Australians won the "Top Night Team" trophy, with a ninety percent mission-accuracy rating. They attribute their success to a long-standing and intensive night-training program. But RF-4 aircrews point to one other advantage that, they feel, put No. 6 Squadron over the top. "The F-111s have a superior radar capability," says Lieutenant Turney. "Their inertial navigation system capability far, far exceeds ours."

In contrast to the first TAC-sponsored international competition two years ago, this year's night operations were mandatory. The challenge of working in the dark seemed almost insurmountable for one group of competitors that barely got its feet wet in reconnaissance before going up against the best.

"We do reconnaissance as a secondary mission with a multirole fighter," explains Lt. Cmdr. J. H. "Dutch" Bouman, an F-14 radar intercept officer with VF-202 (USNR), NAS Dallas. "Our squadron just received the TARPS airplane in May [1988], and we schedule only twenty to thirty percent of our training at night." Because of its aircrews' limited exposure to night recce operations and, for that matter, to reconnaissance in general, VF-202, along with other naval entries, expected only to hone skills, not to beat out teams with a rich history of recce know-how.

Commander Bouman's unit placed last in overall standings, but the lessons learned, especially about night operations, took much of the sting out of losing. "It actually works!" exclaims Commander Bouman. "When you go out at night, you hit an initial point, and you pick up a heading. Then you realize that if you fly it off time and heading, you can still get the picture."

Getting the Picture

Technicians with the 12th TRS/67th TRW Photo Processing and Interpretation Facility (PPIF) processed 65,000 feet of film during the eleven-day meet. "That equates to about twelve and a half miles of film," says Captain Doug Wier, PPIF Supervisor, "and we only lost thirty inches of unimportant footage."

The unit used relatively new high-speed Kodak processors, capable of running up to fifty feet of film per minute. The thirty-six-member team was not graded on its work at RAM '88 but, like everyone else, the 12th gained valuable knowledge from the experience. "During a regular workday," explains Captain Wier, "we would probably process somewhere in the neighborhood of 2,500 feet for two of the four squadrons here on base. While we tested only half our ability [PPIF technicians normally perform imagery interpretation duties in addition to film processing], we've still gotten a lot of practice in doing what we would do in combat."

Mastery in identifying all forty-eight targets, if available, on film guaranteed competing Imagery Interpreters (IIs) 960 of the 4,000 points needed to earn a 100 percent overall accuracy rating. Two standardized tactical target exercise packages accounted for 1,040 points, and 2,000 points were assigned to equipment identification tests.

"The tests had fifty annotations [each]," explains SSgt. Steve Eiser, an II with the 67th TRW. "We were given ninety minutes to identify all fifty pieces of equipment. We had to identify it, write the name, put down any variance or modifications it might have, its function, and whether it's friend or foe." The 67th TRW IIs took first place in the '86 meet. This year, the team came in second.

Sgt. Nick Horishny, SSgt. Jeff Morell, and SSgt. Tony Jordan of 363d TFW, Shaw AFB, S. C., download a camera after a daytime mission.

Maintenance Strategy

Long before the clock signaled the start of RAM '88, competing maintenance teams had already put a lot of effort into what they hoped would be a winning strategy.

First, there was the process of selecting aircraft to be used in the contest (two primary, one backup), followed by major overhauls, both inside and out, and flight and repair work.

There was no shortage of steel wool, polishing rags, and touchup paint as crews labored to capture all 445 points available for aircraft appearance. But SMSgt. James Long, NCOIC of maintenance judging, says the emphasis was on the functional—does it work, and is it within regulations? "That makes it easier for the judges, because we're not

RAM '88 AWARD WINNERS

Award	Given for	Winner	Score (Possible Points)
Top Team	Unit achieving the most points in night and day reconnaissance, visual recognition, maintenance, and imagery interpretation.	26th TRW Zweibrücken AB, Germany	17,656 (20,000)
Top Crew	Crew achieving the highest normalized score on two night and three day missions and two visual recognition tests.	Flt. Lt. Mike Sinclair Flt. Lt. Kym Osley No. 6 Squadron (RAAF) Amberley, Australia	4,554 (5,080)
Top Night Crew	Crew achieving the higest score while flying two graded night missions as the primary crew.	Capt. Chris Kasselder Capt. Mike Darrell 67th TRW Bergstrom AFB, Tex.	1,399.44 (1,480)
Top Night Team	Unit receiving the highest scores in maintenance, imagery interpretation, and ops during the night phase of RAM.	No. 6 Squadron (RAAF) Amberley, Australia	4,744.62 (5,265)
Top Day Crew	Crew achieving the highest score while flying three graded day missions as the primary crew.	Capt. John M. Bell Capt. Eddy Payne 124th TRG (ANG) Boise, Idaho	3,142 (3,300)
Top Day Team	Unit receiving the highest scores in maintenance, imagery intepretation, and ops during the day phase of RAM.	155th TRG (ANG) Lincoln, Neb.	9,714 (10,550)
Top Photo-Interpretation Team	Unit achieving the highest point total from the combined scores of mission RECCEXREPs, four Equipment Identification Exercises, and two standardized RECCEXREPs.	152d TRG (ANG) Reno, Nev.	3,417 (4,000)
Best Maintenance Team	Unit receiving the highest point total for scheduling, management, and sortie generation.	155th TRG (ANG) Lincoln, Neb.	3,995 (4,000)
Top Allied Crew	Allied crew receiving the highest normalized score on two night and three day missions and two visual recognition tests.	Flt. Lt. Mike Sinclair Flt. Lt. Kym Osley No. 6 Squadron (RAAF) Amberley, Australia	4,554 (5,080)
Top Navy Crew	USN/USMC active-duty or Reserve crew achieving the highest normalized score on two night and three day missions and two visual recognition tests.	Lt. Cmdr. Dave Pollard Cmdr. Bill Logan VF-302 (USNR) NAS Miramar, Calif.	3,683 (5,080)
Top ANG Crew	ANG crew achieving the highest normalized score on two night and three day missions and two visual recognition tests.	Lt. Col. Phillip Eddy Maj. Raymond Terry 155th TRG (ANG) Lincoln, Neb.	4,424 (5,080)
Top Active-Duty Air Force Crew	Active-duty Air Force crew achieving the highest normalized score on two night and three day missions and two visual recognition tests.	Capt. Mike Weldon Capt. Bobby Crandall 26th TRW Zweibrücken AB, Germany	4,492 (5,080)
Top Allied Team	Allied unit achieving the most points in night and day reconnaissance, visual recognition, maintenance, and imagery interpretation.	No. 6 Squadron (RAAF) Amberley, Australia	17,457 (20,000)
Top Navy Team	USN/USMC active-duty or Reserve unit achieving the most points in night and day reconnaissance, visual recognition, maintenance, and imagery interpretation.	VF-302 (USNR) NAS Miramar, Calif.	15,498 (20,000)
Top ANG Team	ANG unit achieving the most points in night and day reconnaissance, visual recognition, maintenance, and imagery interpretation.	152d TRG (ANG) Reno, Nev.	17,300 (19,740*)
Top Active-Duty Air Force Team	Active-duty Air Force unit achieving the most points in day and night reconnaissance, visual recognition, maintenance, and imagery interpretation.	26th TRW Zweibrücken AB, Germany	17,398 (19,740*)
Arrival Competition	Unit arriving closest to its assigned time.	18th TFW Kadena AB, Japan	.068 seconds early
Download Competition	Unit downloading two sensors in the shortest elapsed time.	67th TRW Bergstrom AFB, Tex.	13.08 seconds total time

* Internal competition for these branches varied slightly from the others, resulting in a lower possible point level.

dazzled with a lot of glitter," Sergeant Long says.

Maintenance crews took great care to satisfy the requirements of graded scheduling proficiency (660 points) and sortie generation (2,480 points). The category of maintenance management (860 points), comprising aircraft appearance, tools and equipment inspections, and aircraft inspections, gave team members the chance to display the pride that goes hand in hand with their jobs.

SMSgt. Bobby Cobb of the 67th TRW says that daily inspections at RAM '88 were nerve-wracking. "You know you've looked at the airplane a hundred times, and the judge walks up there and starts looking at the [camera bay] window, and there's a speck of dust in there, and you say, 'Oh, man, we can't get it out, I sure hope he doesn't see it.'"

The 155th Tactical Reconnaissance Group (ANG), Lincoln, Neb., which was the winner of the Best Maintenance Team trophy, amassed 3,995 points—just five points shy of a perfect overall score. But it wasn't a runaway victory. The second-place finisher, the 186th TRG (ANG), Meridian, Miss., barely lost out to its rivals, earning 3,993 out of 4,000 points available. The 117th TRW (ANG), Birmingham, Ala., logged 3,992 points—a "speck of dust" away from taking home an award.

The race was tight right down the line. The result reinforced TAC officials' high confidence that the maintenance leg of the mission runs like a finely tuned machine.

"It's dazzling," said Sergeant Long. "When you start talking about a jet that's a '66 or '68 model, and it looks good and runs good, you know someone is taking care of this equipment."

Intensive Training

"It would really be nice if we could train everybody at the intensity [that] we did these teams over the past few months," says Col. Roger Grimsley, Director of Operations for the 67th TRW, which hosted RAM '88. "But, I think, by and large, you can take any group of two to three crews, put them through the same intensive training, and they all would be very, very competitive."

With that in mind. Lt. Cmdr. Rich Carey, a competition pilot with VF-302 (USNR), NAS Miramar, Calif., underlines the "domino effect" of the competition on future training. "When you go home, you don't walk away from this," Commander Carey says. "You work internally on what you can do—everybody benefits."

Maintenance crew member A1C Leslee Lenoch of the 363d TFW confers with a pilot following a day mission.

Before leaving for RAM '88, Commander Carey's squadron completed plans with competing ANG crews from Reno, Nev. (152d TRG), to test newly formulated theories. "We're going to get together with guys we probably wouldn't have had an opportunity to meet before, and do some air-to-air work with them," Carey says.

Without question, everyone taking part in the meet, including support units back home, gained considerable ground in the search for the best training methods possible to support the national defense intelligence program.

In the final analysis, RAM '88 let TAC planners know they're on the right track. Overall scores in this year's meet showed a steady increase in proficiency from that displayed in 1986.

Of the fifteen competing teams, one active-duty Air Force, two Air National Guard, and one allied unit achieved mission accuracy ratings of eighty-five to eighty-eight percent; two active-duty Air Force, two Air National Guard, and one allied unit earned ratings of eighty-two to eighty-four percent; one active-duty Air Force, one Air National Guard, and one naval Reserve unit finished with ratings of seventy-five to seventy-nine percent; and three Navy and Marine Corps entries rounded out the list with mission accuracy ratings of sixty-one to sixty-seven percent.

The 26th TRW (USAFE) of Zweibrücken, Germany, is now a proud holder of the Worldwide Reconnaissance Air Meet 1988 "Top Team" trophy.

"You may not be able to say RAM directly caused a change in tactical air reconnaissance for the Air Force," says Colonel Grimsley, "but you can certainly say it had some impact. RAM, combined with other things we've done, has driven major changes in our training program for the reconnaissance mission." ■

Gail Phillips, a free-lance writer from Austin, Tex., has reported on military activities for more than six years as a television journalist. This is her first contribution to AIR FORCE *Magazine.*

Nobody in his unit ever called him "Stumpy." He flew through enemy fire with rare skill. When a chance round finally got him, he still made it home, mission accomplished.

The Battle Log of Birdman Silver

BY C. V. GLINES

IN THE World War I section of the Air Force Museum at Wright-Patterson AFB, Ohio, near the memorabilia of Frank Luke, Eddie Rickenbacker, and other famous aces, is a display about another of the famous flyers of that "war to end all wars." His real name is John (nmi) Silver. However, the information placard calling him "Stumpy" John Silver should be corrected. Here's why:

Silver had no rank, yet he flew many important courier missions over the front lines for the Allied forces. He received no pay, yet he served with the Army Signal Corps for almost eighteen years. He never received any formal flight training, yet he was respected throughout the Army for his extraordinary feats of airmanship and devotion to duty. He lost a leg while on a vital mission over enemy lines, yet received no compensation or awards and was never fitted with an artificial limb. When he died, he received no military funeral, yet his valor was memorialized in the *Congressional Record*.

We know that the Air Force isn't being ungrateful in the case of John Silver. John was only a homing pigeon, but the most outstanding homing pigeon the services ever had. His body has been perfectly preserved and has been on view at the museum for many years.

But there's the matter of that nickname, so let's review his service record.

Into the Air, Junior Birdmen!

John was hatched in January 1918 in a pigeon loft behind the lines in France. He spent his first few weeks learning the gentle art of takeoffs, landings, and "homing." He learned to carry a small, metal message tube strapped to his leg and to fly unerringly back to his loft despite gunfire, low ceilings, and poor visibility. After his training was completed, he was assigned to an infantry unit at the front for courier duty. His first messages were relatively unimportant so that if he became confused and fell into enemy hands, no vital information would be lost. When his company commander was satisfied that John had made the transition to combat duty satisfactorily, he was given more important messages.

From the beginning, it was noted that John possessed an exceptional talent for dodging artillery barrages. When the shelling was especially heavy during a mission, he always got through. On several occasions, he was the only survivor.

On October 21, 1918, at exactly 1435 hours, John was released from a front-line trench at Grandpré and flew into history. The Meuse-Argonne drive had just begun, and the rear headquarters at Rampont, forty kilometers away, had to be notified of the rapidly changing battle situation. Enemy forces were laying down an intense artillery barrage in preparation for a massive assault, and the American unit desperately needed help.

When the message tube was strapped to his leg and John was released, the American soldiers watched anxiously. John fluttered briefly along the ground, started toward the enemy lines for a few feet, then reversed his course and turned toward the rear at treetop level. The troops below shouted encouragement, but gasped when they saw a shell explode near him.

The blast threw John upward

amid a shower of earth and feathers. He plunged downward momentarily, but flapped wildly and managed, somehow, to regain flying speed and continue on his way. To the men who saw him, it seemed that he had been hit and would probably not make it back to his loft. There were no other pigeons available to carry a duplicate of the message.

A half hour later, John flopped onto his loft, more nearly dead than alive. A machine-gun bullet had pierced his breast, small shell fragments had ripped mercilessly into his body, and his right leg was missing. The message tube was dangling from what remained of his torn stump. The message was quickly relayed to headquarters, and troops being held in reserve were rushed to the front to save the day.

The men of John's signal company nursed him back to health. The stump healed, and he could still fly. His gallantry became an inspiration, and the men refused to let him be destroyed. They named him John Silver after the one-legged pirate of Robert Louis Stevenson's *Treasure Island*.

An Inspiration to the Others

After the war, John was assigned to the 11th Signal Company at Schofield Barracks, near Honolulu, Hawaii, where he became the special charge of Pigeon Sgt. Clifford A. Poutre, later a Signal Corps colonel.

"We kept John Silver in comfortable retirement in his later years," Col. John A. Ballard, then a major and commander of the company, told the author. "He was one of 240 pigeons we had in the lofts, but we didn't give him any duties and didn't let him fly. I couldn't say positively, but I think he was an inspiration to the other pigeons and gave them encouragement when we were pioneering in the training of night-flying birds."

John Silver remained in Hawaii until his death on December 6, 1935, at the age of seventeen years, eleven months—a remarkable age for a pigeon.

"I know how an old cavalryman felt when his horse died," Ballard said. "Losing John was like losing an old service buddy. There wasn't a dry eye in the company when the news got around, because we loved the old gentleman more than we realized."

Colonel Ballard had John Silver's body preserved by a local taxidermist. On January 1, 1936, he signed an order that stated in part: "The courage and devotion to duty displayed by John Silver and, above all, his will to accomplish his mission and reach his objective are attributes worthy of emulation by every soldier of this company.

"Hereafter, on each organization day of the 11th Signal Company, this order will be read and the name of John Silver will be added to the roll call. When his name is called, the senior noncommissioned officer present will respond, 'Died of wounds received in battle in the service of his country.'"

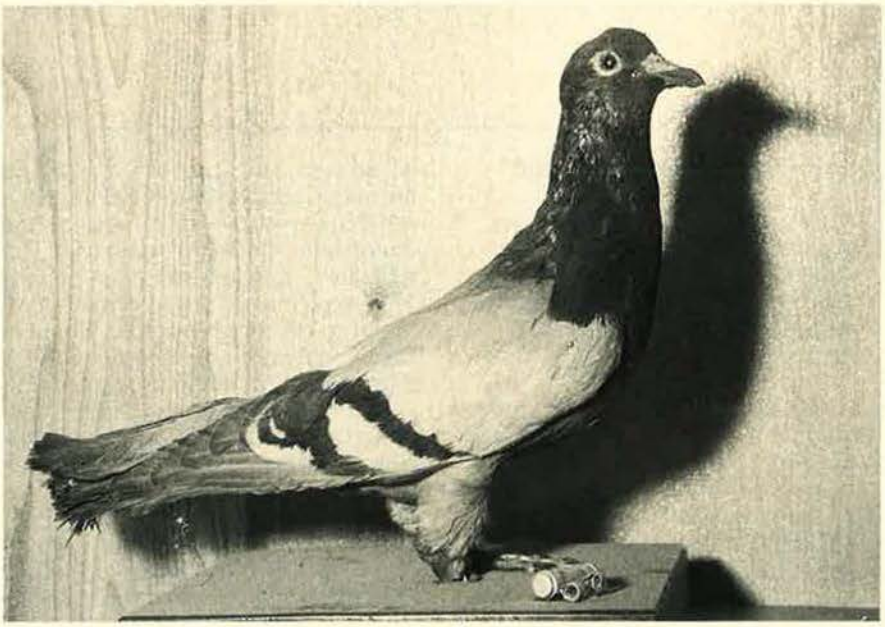
A few months later, a visiting congressman from Pennsylvania, impressed with John's war record and the tribute paid by his comrades, inserted the order in the *Congressional Record*.

The records are not clear as to what happened to John's body during World War II, but when Gen. H. H. "Hap" Arnold ordered the establishment of a permanent museum at Wright-Patterson, John Silver was presented to the museum by the Army's Chief Signal Officer, and John was one of the first items displayed.

"There's one thing I want to correct as far as the record of John Silver is concerned," Colonel Ballard said. "He should *not* be referred to as 'Stumpy' John Silver in any citation. I want to go on record as stating that the dignified mien of the old gentleman was certainly not conducive to calling him that. We never referred to him by that sobriquet, and I feel sure that if a visitor to the lofts had ever addressed him as that, that visitor would have been summarily thrown out."

The writeup on John Silver's display states: "Innumerable pigeons have been killed in line of duty. 'Stumpy' John Silver will symbolize their long and honorable service to the races of mankind."

So, to the Air Force Museum director and staff, now that you know the rest of the story and knowing of your passion for accuracy, I respectfully request that the placard be corrected and that the nickname "Stumpy" be removed from all records and informational handouts. ■



One of the first items placed on display at the Air Force Museum at Wright-Patterson AFB, Ohio, was "John Silver," the World War I homing pigeon whose remains had been lovingly preserved by his old unit.

C. V. Glines is a regular contributor to this magazine. A retired Air Force colonel, he is a free-lance writer, a magazine editor, and the author of numerous books. His by-line most recently appeared here with the September '88 issue feature "Prelude to Total Force."

Airman's Bookshelf

Airmobility: "A State of Mind"

Pleiku: The Dawn of Helicopter Warfare in Vietnam, by J. D. Coleman. St. Martin's Press, New York, N. Y., 1988. 315 pages with appendices, maps, photographs, and index. $19.95.

In *Pleiku: The Dawn of Helicopter Warfare in Vietnam*, we have a chance to look at the genesis of the US experience with the helicopter, as it matured as a weapon and as doctrine was developed for it in Vietnam. The book is the story of the beginning of the ground forces' airmobility, and therefore of the first halting steps to what has now become the *sine qua non* of modern NATO tactics: technologically enhanced maneuver warfare.

Specifically, this is the record of how the Army came to embrace the helicopter, to build a doctrine around it, and then to use it in the first hard contacts with NVA units in the Ia Drang valley in October 1965. The events described in the book took place around Pleiku. They were the first battles involving the NVA in South Vietnam.

Coleman's story has many elements. Those who study the military procurement process will relish the way that process can be made to work in one's particular interests when the time—and people—are right. It is a story of strong personalities and their effect on the building of the first "Air Cav" unit—the 1st Cavalry Division (Airmobile). Heartbreaking at times, uplifting at others, it is, above all, the story of soldiers in tough, merciless "contact" with a determined enemy.

The author writes from a position of authority as a former information officer with the 1st Air Cavalry, but his scholarship in assembling a mass of records shines through this work. Much of the information he has garnered appears here for the first time in print. The result is a thick, well-produced book, notable for its wealth of detail, the majority of it going far beyond helicopters.

Coleman seems to have striven—whenever possible—to detail the chronicle of people and events to the *n*th degree. At one point—during the march of units toward a spot called LZ ALBANY, subsequently a bloodbath—he makes an impressive attempt to tell us who walked where in the line of march. As it turns out, this detail is critical when it comes to divining what went wrong. Such painstaking scholarship is often essential when discussing military affairs and, therefore, in the development of doctrine.

The battlefield descriptions are no less than riveting, deriving their strength from such attention to detail. But the best chapter—in this reviewer's opinion—is the final one, "In the Final Analysis," in which Coleman attempts to make sense out of events and to give some idea of the arguments of the day that raged around the subject of cavalry operations.

By far the most harrowing of many detailed scenes is the description of the night after the ALBANY carnage, when gruesome NVA "mop-up" crews went out to execute wounded GIs. When one US trooper finds a wounded NVA soldier, he attempts to help him, only to become the victim of a hidden grenade. Of such details is war made.

If there is one disappointment with the book—for helicopter purists, if nobody else—it is that the machine as such fades into the background of the account. Coleman, you can tell, is not a flyer. His perspective emphasizes what you do *after* you dismount.

Despite the subtitle's promise that this book is about the "dawn of helicopter warfare in Vietnam," there is little detail to support the claim. Helicopters are too often just "lifts," "slicks," and "gunbirds." We learn little about helicopter repair and maintainability logistics, a crucial new way of doing business for the US Army in Vietnam. There is no attempt, for instance, to examine the technical performance of the aircraft involved or, indeed, to see things from the crews' viewpoint.

But it does not matter. That particular task will be performed by somebody else with the necessary background. What Coleman has produced is an extremely valuable book, based on the best scholarly principles of research, and a book that is a fitting tribute to the vaulting courage of the men who died exploring and establishing what has now become a time-honored principle: that airmobility is a "state of mind."

Another book about Vietnam, part of the excellent series "The Illustrated History of the Vietnam War," *Air Cav* by F. Clifton Berry, Jr., former Editor in Chief of AIR FORCE Magazine, provides some excellent supporting photographs for Coleman's account. Berry's story is, intentionally, broader than Coleman's, but his early chapters are an excellent complement to the latter's fine work. *(The Berry book was published by Bantam Books, New York, in August. It is fully illustrated, has 158 pages with glossary, and costs $6.95.*—THE EDITORS)

Military history is much better served now that the emotions surrounding Vietnam are settling down.

—Reviewed by David Harvey. Mr. Harvey is the Washington Bureau Chief for Rotor & Wing International *magazine.*

Fighter Pilot Legacy

Check Six: A Fighter Pilot Looks Back, by Maj. Gen. Frederick C. Blesse, USAF (Ret.). Champlin Fighter Museum Press, Mesa, Ariz., 1987. 178 pages with illustrations. $17.95.

The name Frederick "Boots" Blesse is synonymous with his classic fighter tactics manual *No Guts, No Glory* in the minds of untold thousands of USAF fighter pilots who have benefited from his experience, insight, and tactics training efforts over the years. As a major in the mid-1950s, he gave the fighter community *No Guts, No Glory;* now he has given us a look back over one fighter pilot's career and his experiences along the way.

If you admire the common-sense,

down-to-earth manner in which Blesse described the tactics of flying fighters, you won't be disappointed by the way in which he presents his own life story. General Blesse opens by describing the predicament he and his wife faced in November 1980 as they were trapped by a raging fire on the twenty-fifth floor of the MGM Grand Hotel in Las Vegas. Confronted by a seemingly hopeless situation, rather than his usual position of being fully in control and knowing what to do next, he probably thought back over many of the experiences that he would later share in this book.

"Boots" (a childhood nickname) Blesse was born to an Army family in 1921 and graduated from "the Point" in 1945, just as World War II ended. He had received flying training in the PT-19 and AT-6 during his Academy years, and the first "real" airplanes he flew were the P-40 and P-51.

Since airframes and flying opportunities in the immediate postwar period were hard to come by, a pilot took a flight any way he could get it. When he was the aerodrome officer one Friday, Blesse asked if he could fly a transient P-51 while it was there. The transient pilot said, "Fine." Blesse mentioned that he'd never flown the Mustang before, and the major replied that there was a manual in the cockpit. Over the weekend, Blesse put five hours on the aircraft.

Following his first operational assignment in the P-47 in Okinawa and an upgrade into the P-80 and the F-86, Blesse found himself headed to Korea in late 1950 as an F-51 Mustang pilot. Flying mostly air-to-ground missions while he was there, he also served as a ground forward air controller before transferring again to an F-80 jet fighter unit.

Blesse eventually moved into the F-86 with the 94th Tactical Fighter Squadron (TFS) at George AFB, Calif., and was one of the USAF pilots chosen to fly in the National Air Races. He won with a speed of 687.142 mph.

Blesse returned to Korea in 1952, at his request, for an air-to-air tour in F-86s. Throughout the chapter "MiG Alley," the author relates in detail his "coming out" as a fighter pilot as he progressed from the "Six O'Clock Club" (membership won by cleverly trapping a MiG at your six) to ten air-to-air kills. That experience laid the foundation for his later tactics training work.

Leaving Korea as a captain (even though he had served there with a spot promotion to major), Blesse headed to Nellis and the job of teaching tactics and fighter employment to other fighter pilots. In preparation for a tour of USAF fighter bases throughout Asia in 1955, *No Guts, No Glory* was born, followed by the 1955 USAF Worldwide Gunnery Meet in which Boots won every trophy offered for individual performance.

Following headquarters, European, and Stateside tours at Norton AFB and the National War College, Blesse got an opportunity to put into action one of the assigned papers he'd written—"How to Win in Vietnam." Going through F-4 transition training with men like Chappie James and Robin Olds, he headed to Danang Air Base in South Vietnam. His unit flew mostly "in-country" air-to-ground sorties, as well as some air-to-air missions "up north," particularly in Route Pack Six. During one six-week period, the 366th TFW bagged eleven MiGs over the North.

Unfortunately, the thrill of victories in the wing was also punctuated by the occasional tragedy of personal

loss when such men as Capt. Lance Sijan (recipient of the Medal of Honor) were downed in combat. Boots coined the 366th's name, "Gunfighters," which the wing continues to wear proudly today in the F-111 and EF-111 at Mountain Home AFB, Idaho.

Blesse rounded out his career with another tour at Nellis—this time in the F-111—and retired in 1975 as a major general and the Deputy Air Force Inspector General.

Boots Blesse spent twenty-eight of his thirty years in the Air Force actively flying fighters. Interspersed throughout the pages of this book are detailed descriptions of his air combat engagements and some very worthwhile thoughts on what makes a great fighter pilot. He also shares the insights of several other senior officers who served with him throughout his career.

Boots Blesse left a legacy to those who came after him during the Vietnam era through the pages of *No Guts, No Glory.* In the writing of *Check Six,* he has left another legacy for all fighter pilots who have served or will serve. By the way, he made it off the MGM Grand Hotel with the assistance of an Air Force helicopter from his former stomping ground, "the home of the fighter pilot"—Nellis.

—Reviewed by Maj. Don Rightmyer, USAF. Major Rightmyer is editor of Tactical Air Command's safety publication, TAC Attack, *and regularly reviews books for us.*

New Books In Brief

The Airman's Guide (1st Edition), by Wayne A. Valey. A companion volume to the long-published *The Air Officer's Guide, The Airman's Guide* has been prepared for new airmen, airmen-to-be, career airmen, and family members. It contains a wealth of information covering all areas of enlisted life: careers and goals, customs and courtesies, uniform wear, and the promotion system. Also included is a rundown of Air Force roles and missions, off-duty activities, and even a lexicon of common Air Force jargon such as "above my pay grade," "face time," and "in the loop." Author Valey is no stranger to the enlisted ranks; he rose to tech sergeant before earning his commission and retiring as a captain. With maps, charts, illustrations, and index. Stackpole Books, Harrisburg, Pa., 1988. 248 pages. $12.95.

Encyclopaedia of Military Models (1/72 Scale), by Claude Boileau, Huynk-Dinh Khuong, and Thomas A. Young. Almost every boy (and many a girl, too) between eight and eighteen has built at least one plastic model. For many, the "need" to glue two pieces of styrene together continues well into adulthood. This book is a real nostalgia trip for many, including me. It traces the evolution of the hobby from the first crude plastic offerings to today's kits that would be real airplanes if the average six-foot-tall modeller were one inch high. An ancillary benefit is the artistic merit of the color illustrations on the model box tops—some truly magnificent paintings have been done for box art over the years. This full-color volume has photos of completed models and dioramas, a twelve-page listing of model manufacturers, and an eighty-six-page listing of every model ever produced in 1/72 scale. Tab Books, Blue Ridge Summit, Pa., 1988. 201 pages. $19.95.

—Reviewed by Jeffrey P. Rhodes, Aeronautics Editor.

Courage, Heroism, Valor

Throughout his life, Eddie Rickenbacker overcame seemingly insurmountable obstacles to become a national hero and a major figure in American aviation.

BY JOHN L. FRISBEE

SOME of us think of *courage* as a quality that enables one to face the trials of life with firmness and resolution, *heroism* as an act performed in the face of danger but not necessarily in battle, and *valor* as extreme heroism in combat. If these are reasonable distinctions, the life of America's leading World War I ace is a text in all those virtues.

Edward V. Rickenbacker was born in Columbus, Ohio, in 1890. When he was thirteen, his father was killed in a construction accident. Young Eddie quit school, never to return, for a series of twelve-hour-a-day jobs to help support the family. He soon found his niche in the infant automobile industry. At seventeen, he was in charge of testing the Columbus Buggy Co.'s new models, some of which he helped design.

The path to success in the industry was the risky business of racing. Rickenbacker became a race driver while still in his teens and rapidly rose to national prominence. In 1916, his last year of racing, he won $60,000 in prizes—worth many times that in today's dollars.

The US entered World War I in April 1917. Rickenbacker applied for pilot training, but was past the age of twenty-five and lacked a college degree. A friend arranged for him to join General Pershing's staff as a sergeant driver. Contrary to legend, Rickenbacker never drove for Pershing, but he did drive for Col. Billy Mitchell, who was impressed by the young man's skill, mechanical knowledge, and determination to become a pilot. Mitchell arranged for Rickenbacker to enter flying training with the understanding that he would then be assigned to the American flying school at Issoudun, France, as engineering officer.

The school's commander, Maj. Tooey Spaatz, finally gave in to Rickenbacker's continual requests for combat and sent him off to the new 94th "Hat-in-the-Ring" Aero Squadron to fly obsolescent Nieuports. He completed his first combat mission on April 14, 1918, and won his first victory two weeks later. By the end of May, he was an ace with six confirmed. Then came nearly three months in and out of hospitals with an ear infection.

September was a turning point. The squadron began receiving Spads to replace their Nieuports, and Rickenbacker was given command of the 94th. Early the next morning, September 25, while on a solo patrol, Rickenbacker attacked a pair of two-seater photo planes escorted by five Fokkers. After downing one Fokker and scattering the others, he went in on the photo planes, under steady fire from their rear-seat gunners. In a running battle, he shot down one of the two-seaters before the Fokkers could rejoin the melee.

For that mission, Rickenbacker was recommended for the Medal of Honor. The recommendation, lost in the confusion of demobilization, was not approved until twelve years later. On November 6, 1930, President Herbert Hoover presented the Medal to Eddie Rickenbacker, still a national hero and probably the best-known veteran of the late war.

During October 1918, Rickenbacker's last month of combat, he shot down eleven more German planes and three balloons to end the war with twenty-six victories in less than six months of action—the top American ace until he was overtaken by Dick Bong in the Pacific in April 1944.

In the postwar years, Rickenbacker became an executive in the automobile, and later the aviation, industry. When his automobile company was forced out of business by the industry giants, Rickenbacker refused to file for bankruptcy and personally paid off the large sums owed his creditors.

Early in 1941, while president of Eastern Air Lines, Rickenbacker was gravely injured in a crash. He was not yet fully recovered when Gen. Hap Arnold and Secretary of War Henry L. Stimson sent him as a troubleshooter to every theater of war and to the USSR. One of the greatest tests of Rickenbacker's leadership came in October 1942. The B-17 in which he was traveling from Hawaii to Australia was forced to ditch at sea. Rickenbacker assumed leadership of the seven Air Force men who drifted with him for twenty-four days in liferafts, surviving on rain water and the few fish they were able to catch. The will of his companions to persevere was kept alive by Rickenbacker, who bullied, cajoled, encouraged, and prayed with them. All but one made it. After he and his men were rescued by the Navy, Rickenbacker completed his mission for Secretary Stimson.

For most of his remaining years, Eddie Rickenbacker continued to be a leading figure in American aviation and an inspiration to those who knew him. He died July 23, 1973, to the end a man of courage, heroism, and valor. ■

Announcing . . .

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The Buena Vista Palace Hotel
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The Buena Vista Palace Hotel
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1-800-327-2990
January 26 — 27, 1989

Registration closes *Monday, January 16, 1989.*
No refunds can be made for cancellations after that date.

MAIL THIS FORM TO: Air Force Association
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My check covering the Symposium fee for AFA individual or Industrial Associate member of $275, payable to the Air Force Association, is enclosed. The fee includes one (1) Reception/Buffet ticket. (NOTE: Fee for non-member is $300.)

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In conjunction with AFA's 1989 Tactical Air Warfare Symposium, the Central Florida Chapter is proud to offer other opportunities to enjoy the many sights and sounds of southern Florida.

GOLF TOURNAMENT

Wednesday, January 25, 1989 **12:00 noon**

Walt Disney World's Famous Magnolia Course

$85 per person, which includes golf, green fees, golf cart, and reception following the tournament. ($35 for reception only.)
Contact: Sal Belloise (407) 356-0543 for more information.

CENTRAL FLORIDA AIR FORCE GALA

On Friday, January 27, 1989, the Central Florida Chapter and the Aerospace Education Foundation will sponsor their fifth annual black-tie Gala. This year's theme is "The Twentieth Anniversary of the First Manned Lunar Landing." Proceeds will benefit the Aerospace Education Foundation. For more information, contact: Tommy Harrison (407) 886-1922 or Laura Ingle (703) 247-5839.

EXHIBITS AND DISPLAYS

For each table purchased, companies will be allowed 100 square feet of display space. Exhibits will be on display during the two-day Symposium. For more information on exhibits, contact: Nancy Blue (407) 356-8408.

Table prices: **$1,500**
Individual seats: **$125**

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Intercom

By John R. "Doc" McCauslin, CHIEF, FIELD ORGANIZATION DIVISION

Cross Country

AFA's newest Chapter, the **Belle Fourche Chapter in South Dakota,** was recently chartered with Robert L. Helmer as president. AFA North Central Regional Vice President John E. Kittelson presented the charter.

Several **new Senior Enlisted Advisors** were recently selected: **CMSgt. David Berrio,** Air Force Flight Test Center, Edwards AFB, Calif.; **CMSgt. David C. Collins,** 7020th Air Base Group, RAF Fairford, United Kingdom; **CMSgt. Robert Herrington,** 1st Strategic Air Division, Vandenberg AFB, Calif.; **CMSgt. Richard Robley,** 463d Tactical Airlift Wing, Dyess AFB, Tex.; and **CMSgt. William O. Smith,** 323d Flying Training Wing, Mather AFB, Calif.

New York State AFA held its spring meeting among several million dollars worth of paintings. Through the intercession of Daniel Porter, Secretary of the New York Historical Association, the statewide meeting was held at a historic site, the former home of nineteenth-century author James Fenimore Cooper. Following the meetings, dinner was held in the 200-year-old Tunnicliff Inn. Baseball Hall of Fame Librarian and AFA Member Tom Heitz was the evening's guest speaker.

With a current total of ninety-seven Community Partners, the **Langley, Va., Chapter** hosted an Annual Community Partner Day at nearby Langley AFB, Va. The Community Partners and their guests were briefed by the Tactical Air Command headquarters staff and visited an F-15 squadron before viewing a flight demonstration and attending a reception in their honor.

Shortly after the Community Partner Day at Langley, the Chapter hosted the **23d Annual Salute to TAC-Civic-Military** Reception. A capacity crowd of 500 Chapter members, Community Partners, and guests were briefed, saw flight demonstrations, met with Commander of Tactical Air Command Gen. Robert Russ, and participated in the formal dinner dance. The special guest speaker was

AFA Board Chairman Sam E. Keith, right, presents an AFA chapter charter to Lt. Col. Emerson "Tex" Byrd, President of the new Lufbery-Campbell Chapter at Ramstein AB, Germany. The new chapter is named after the first AEF ace of World War I, Douglas Campbell, and after the Lafayette Escadrille ace who trained him, Raoul Lufbery.

During the AFA National Convention in September, CMSgt. Bob Bieber (left) reenlists; AFA Executive Director Chuck Donnelly administers the oath. Chief Bieber, Assistant to CMSAF James C. Binnicker, has worked for the past three years with AFA in its sponsorship of the Outstanding Airman Program.

At a luncheon in his honor during the AFA National Convention, Secretary of the Air Force Edward "Pete" Aldridge (left) presents AFA's Dottie Flanagan with an Air Force Exceptional Service Award. Martin H. Harris, then Chairman of the Board, applauds AFA's Chief of Protocol for her thirty years of service.

John Welch, Assistant Secretary of the Air Force for Acquisition.

The **General B. A. Schriever Los Angeles Chapter's** annual awards banquet drew 550 participants, including Lt. Gen. Aloysius G. Casey, then Space Division Commander; Lt. Gen. Donald J. Kutyna, Commander of Air Force Space Command; and numerous aerospace industry executives. General Kutyna was the guest speaker. Shortly after that successful function, the Chapter participated in the 15th Annual Distinguished Public Service Awards Luncheon, where Space Division's civilian employees were honored. The Schriever Chapter also contributed a large donation to the Annual Los Angeles Air Force Base Enlisted Dining Out.

Illini AFA Chapter, Ill., participated in a gala retirement dinner for Brig. Gen. Joel M. McKean, USAF, Chanute Technical Training Center Commander. A special Commanders Award in honor of General McKean and the forty-eight commanders that preceded him was presented by the Chapter to the retiring commander.

The **Paul Revere AFA Chapter, Mass.**, recently supported Civil Air Patrol cadets at its Annual CAP Conference. The Chapter presented donated US Savings Bonds and Certificates of Merit to area cadets David Smith and Monique Gagda.

Oldest AFA Member?

The Roanoke, Va., AFA Chapter boasts ninety-three-year-old Chapter Charter Member George E. Black, Sr. Mr. Black's son, George E. Black, Jr., is a Chapter Charter Member and was the first President of the Roanoke Chapter. The senior Mr. Black's grandson is a Community Partner.

AFA Medicare Supplement Plan

The July 1, 1988, signing of HR 2470 by President Reagan established a new degree of financial security for Americans who are sixty-five and older. The bill, known as the "catastrophic cap" bill, improves benefits for Medicare enrollees as early as January 1, 1989. For AFA members covered under AFA's Medicare Supplement program, these improved benefits translate into lower Medicare Supplement premiums and improved Medicare Supplement benefits.

New rates, which reflect premium reductions of approximately ten percent, will go into effect with certifi-

At the Virginia AFA State Convention in Richmond, Virginia Lt. Gov. L. Douglas Wilder (center) prepares to address a capacity crowd on the Department of Defense and the Commonwealth of Virginia. Pictured with Mr. Wilder are Richmond, Va., Chapter President Bill Curry (left) and Virginia AFA State President Don Anderson.

AFA State Contacts

Following each state name are the names of the communities in which AFA chapters are located. Information regarding these chapters or any of AFA's activities within the state may be obtained from the appropriate contact.

ALABAMA (Birmingham, Gadsden, Huntsville, Mobile, Montgomery): **H. R. Case,** P. O. Box 16625, Mobile, Ala. 36616 (phone 205-639-0168).

ALASKA (Anchorage, Fairbanks): **William L. Pair,** 2517 Riverview Dr., Fairbanks, Alaska 99509 (phone 907-456-6833).

ARIZONA (Green Valley, Phoenix, Sedona, Sierra Vista, Sun City, Tucson): **Robert A. Munn,** 7042 Calle Bellatrix, Tucson, Ariz. 85710 (phone 602-747-9649).

ARKANSAS (Blytheville, Fayetteville, Fort Smith, Hot Springs, Little Rock): **Bud A. Walters,** 90 Dixie Dr., Blytheville, Ark. 72315 (phone 501-763-1825).

CALIFORNIA (Apple Valley, Camarillo, Edwards, Fairfield, Fresno, Los Angeles, Merced, Monterey, Novato, Orange County, Pasadena, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, Sunnyvale, Vandenberg AFB, Yuba City): **John W. Lynch,** 336 S. California St., Orange, Calif. 92666 (phone 714-639-8188).

COLORADO (Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Littleton, Pueblo): **William D. Croom,** 31 N. Tejon, Colorado Springs, Colo. 80003 (phone 719-550-5059).

CONNECTICUT (Brookfield, East Hartford, Middletown, Storrs, Stratford, Torrington, Waterbury, Westport, Windsor Locks): **Brad Day,** 16 Hemlock Trail, Trumbull, Conn. 06611 (phone 203-386-7221).

DELAWARE (Dover, Milford, Newark, Rehoboth Beach, Wilmington): **Robert M. Berglund,** 128 Loockerman St., Dover, Del. 19901 (phone 302-674-0200).

DISTRICT OF COLUMBIA (Washington, D. C.): **Denny Sharon,** 1501 Lee Highway, Arlington, Va. 22209-1198 (phone 703-247-5820).

FLORIDA (Avon Park, Broward County, Cape Coral, Daytona Beach, Fort Walton Beach, Gainesville, Homestead, Jacksonville, Leesburg, Miami, New Port Richey, Ocala, Orlando, Palm Harbor, Panama City, Patrick AFB, Port Charlotte, Redington Beach, Sarasota, Spring Hill, Tallahassee, Tampa, Vero Beach, West Palm Beach, Winter Haven): **Roy P. Whitton,** P. O. Box 1706, Lake Placid, Fla. 33852 (phone 813-465-7048).

GEORGIA (Athens, Atlanta, Columbus, Dobbins AFB, Rome, Savannah, St. Simons Island, Valdosta, Warner Robins): **Homer N. Childs,** Warner Robins, Ga. 31093 (phone 912-923-2623).

GUAM (Agana): **Michael C. Wilkins,** Box CV, Agana, Guam 96910 (phone 671-646-5259).

HAWAII (Honolulu, Maui): **Don J. Daley,** P. O. Box 3200, Honolulu, Hawaii 96847 (phone 808-525-6296).

IDAHO (Boise, Mountain Home, Twin Falls): **Chester A. Walborn,** P. O. Box 729, Mountain Home, Idaho 83647 (phone 208-587-7185).

ILLINOIS (Belleville, Champaign, Chicago, Elmhurst, Moline, Peoria, Rockford, Springfield-Decatur): **Glen W. Wensch,** R. R. #1, Box 54, Champaign, Ill. 61821 (phone 217-352-2777).

INDIANA (Bloomfield, Fort Wayne, Grissom AFB, Indianapolis, Lafayette, Marion, Mentone, South Bend, Terre Haute): **Don McKellar,** 2324 Pinehurst Lane, Kokomo, Ind. 46902 (phone 317-455-0933).

IOWA (Des Moines, Sioux City): **Carl B. Zimmerman,** 608 Waterloo Bldg., Waterloo, Iowa 50701 (phone 319-232-2650).

KANSAS (Garden City, Topeka, Wichita): **Cletus J. Pottebaum,** 6503 E. Murdock, Wichita, Kan. 67206 (phone 316-683-3963).

KENTUCKY (Lexington, Louisville): **Jo Brendel,** 726 Fairhill Dr., Louisville, Ky. 40207 (phone 502-897-7647).

LOUISIANA (Alexandria, Baton Rouge, New Orleans, Shreveport): **Paul J. Johnston,** 1703 W. Medalist Dr., Pineville, La. 71360 (phone 318-640-3135).

MAINE (Bangor, Loring AFB, North Berwick): **Richard F. Strelka,** 54 Country Rd., Caribou, Me. 04736 (phone 207-492-4381).

MARYLAND (Andrews AFB area, Baltimore, Rockville): **Vince duCellier,** 6650 Chesapeake Terrace, Dunkirk, Md. 20754 (phone 301-855-7661).

MASSACHUSETTS (Bedford, Boston, East Longmeadow, Falmouth, Florence, Hanscom AFB, Lexington, Taunton, Worcester): **William J. Lewis,** 36 Francis Wyman Rd., Burlington, Mass. 01803 (phone 617-863-8254).

MICHIGAN (Alpena, Battle Creek, Calumet, Detroit, East Lansing, Kalamazoo, Marquette, Mount Clemens, Oscoda, Petoskey, Southfield): **William L. Stone,** 7357 Lakewood Dr., Oscoda, Mich. 48750 (phone 517-724-6266).

MINNESOTA (Duluth, Minneapolis-St. Paul): **Doyle E. Larson,** 13509 York Ave., South, Burnsville, Minn. 55337 (phone 218-890-9140).

MISSISSIPPI (Biloxi, Columbus, Jackson): **Henry W. Boardman,** 10 Bayou Pl., Gulfport, Miss. 39503 (phone 601-896-8836).

MISSOURI (Kansas City, Richards-Gebaur AFB, Springfield, St. Louis, Whiteman AFB): **Garrett R. Crouch,** P. O. Box 495, Warrenbsburg, Mo. 64093 (phone 816-747-6141).

MONTANA (Bozeman, Great Falls): **Ronald Glock,** 321 N. 17th, Bozeman, Mont. 59715 (phone 406-586-5455).

NEBRASKA (Lincoln, Omaha): **Ralph Bradley,** 3902 Davenport, Omaha, Neb. 68131 (phone 402-554-6220).

NEVADA (Las Vegas, Reno): **Emery S. Wetzel, Jr.,** 2938 S. Duneville St., Las Vegas, Nev. 89102 (phone 702-362-1767).

NEW HAMPSHIRE (Manchester, Pease AFB): **Robert N. McChesney,** Scruton Pond Rd., Barrington, N. H. 03825 (phone 603-664-5090).

NEW JERSEY (Andover, Atlantic City, Belleville, Camden, Chatham, Cherry Hill, Forked River, Fort Monmouth, Jersey City, McGuire AFB, Middlesex County, Newark, Old Bridge, Trenton, Wallington, West Orange, Whitehouse Station): **Robert W. Gregory,** R. D. #2, Box 216, Wrightstown, N. J. 08562 (phone 609-758-2973).

NEW MEXICO (Alamogordo, Albuquerque, Clovis): **Louie T. Evers,** P. O. Box 1946, Clovis, N. M. 88101 (phone 505-762-1798).

NEW YORK (Albany, Bethpage, Brooklyn, Buffalo, Chautauqua, Griffiss AFB, Hudson Valley, Nassau County, New York City, Niagara Falls, Patchogue, Plattsburgh, Queens, Rochester, Rome/Utica, Suffolk County, Syosset, Syracuse, Westchester, Westhampton Beach, White Plains): **Gerald V. Hasler,** P. O. Box 5254, Albany, N. Y. 12205 (phone 518-785-5020).

NORTH CAROLINA (Asheville, Charlotte, Fayetteville, Goldsboro, Greensboro, Greenville, Havelock, Kitty Hawk, Littleton, Raleigh, Wilmington): **Robert C. Newman, Jr.,** 3037 Truitt Dr., Burlington, N. C. 27215 (phone 919-584-7069).

NORTH DAKOTA (Concrete, Fargo, Grand Forks, Minot): **George Christensen,** 15 Fairway, Minot, N. D. 58701 (phone 701-857-4750).

OHIO (Akron, Cincinnati, Cleveland, Columbus, Dayton, Mansfield, Newark, Youngstown): **Cecil H. Hopper,** 537 Granville St., Newark, Ohio 43055 (phone 614-344-7694).

OKLAHOMA (Altus, Enid, Oklahoma City, Tulsa): **Aaron C. Burleson,** P. O. Box 757, Altus, Okla. 73522-0757 (phone 405-482-0005).

OREGON (Eugene, Klamath Falls, Portland): **Barbara M. Brooks,** 7315 N. Curtis, Portland, Ore. 97217 (phone 503-283-4541).

PENNSYLVANIA (Allentown, Altoona, Beaver Falls, Bensalem, Coraopolis, Drexel Hill, Erie, Harrisburg, Homestead, Indiana, Johnstown, Lewistown, Mon Valley, Philadelphia, Pittsburgh, Scranton, Shiremanstown, State College, Willow Grove, York): **S. Ronald Chromulak,** 126 Phillips St., Charleroi, Pa. 15022 (phone 412-864-7220).

PUERTO RICO (San Juan): **Fred Brown,** 1991 Jose F. Diaz, Rio Piedras, P. R. 00928 (phone 809-790-5288).

RHODE ISLAND (Warwick): **Thomas R. Portesi,** 102d Tactical Control Squadron, North Smithfield ANG Station, Slatersville, R. I. 02889 (phone 401-762-9100).

SOUTH CAROLINA (Charleston, Clemson, Columbia, Myrtle Beach, Sumter): **George J. Thom,** 25 Calhoun Dr., Sumter, S. C. 29150-4738 (phone 803-775-6256).

SOUTH DAKOTA (Belle Fourche, Rapid City, Sioux Falls): **Jan M. Laitos,** 2919 Country Club Dr., Rapid City, S. D. 57702 (phone 605-394-6203).

TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tri-Cities Area, Tullahoma): **Ben Cole,** 5361 Egypt Central Rd., Memphis Tenn. 38135 (phone 901-372-7237).

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): **M. N. Dan Heth,** P. O. Box 748, MZ 9377, Fort Worth, Tex. 76101 (phone 817-882-5398).

UTAH (Bountiful, Clearfield, Ogden, Salt Lake City): **Glenn M. Lusk,** 2144 West 4000 South, Roy, Utah 84067 (phone 801-731-3366).

VERMONT (Burlington): **Ralph R. Goss,** 8 Summit Circle, Shelburn, Vt. 05482 (phone 802-985-2257).

VIRGINIA (Alexandria, Charlottesville, Danville, Dulles Airport Corridor, Harrisonburg, Langley AFB, Lynchburg, McLean, Norfolk, Petersburg, Richmond, Roanoke): **Don Anderson,** Box 54, 2101 Executive Dr., Hampton, Va. 23666 (phone 804-868-8756).

WASHINGTON (Seattle, Spokane, Tacoma, Yakima): **A. R. "Dick" Lewis,** 7435 Cooper Point Rd., Olympia, Wash. 98502 (phone 206-866-7135).

WEST VIRGINIA (Huntington): **Ron Harmon,** 1933 Ohio Ave., Parkersburg, W. Va. 26101 (phone 304-485-2088).

WISCONSIN (Madison, Milwaukee, Mitchell Field): **Gilbert M. Kwiatkowski,** 8260 W. Sheridan Ave., Milwaukee, Wis. 53218 (phone 414-463-1849).

WYOMING (Cheyenne): **Irene G. Johnigan,** 503 Notre Dame Court, Cheyenne, Wyo. 82009 (phone 307-775-3641).

cate renewals on and after December 31, 1988.

AFA's Medicare Supplement will also respond to planned improvements in Medicare benefits by expanding the range of expenses that are eligible for reimbursement under the plan. Such improvements will become effective concurrently with their effective date under Medicare.

While passage of the "catastrophic cap" bill strengthens Medicare's effort to cover the health care costs of older or disabled Americans, a substantial portion of medical bills will remain uncovered for most Medicare beneficiaries. There are many "Medigap" policies on the market to address this problem; AFA's Medicare Supplement, which undergoes frequent reviews of its effectiveness in meeting the needs of our membership for quality insurance coverage, should be considered by any AFA member who is eligible for Medicare. For further details on this or any other AFA-sponsored insurance programs, please contact AFA's Insurance Division, 1501 Lee Highway, Arlington, Va. 22209-1198. ■

Attending a Central Oklahoma (Gerrity) Chapter luncheon are (left to right) Maj. Gen. William P. Bowden, Commander, Oklahoma City Air Logistics Center; Mrs. Isobel Bowden; Moses Sirola, Chapter President; Mrs. Carolyn Donnelly; and AFA Executive Director Chuck Donnelly. General Donnelly was the guest speaker at the luncheon, which was attended by over 350 AFA members.

Unit Reunions

Reunion Notices

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, a time and location, and a contact for more information.

Air Force Musicians
The Air Force Drum and Bugle Corps and Bagpipe Band will hold a reunion on June 22–24, 1990, at the Ramada Inn in Oxon Hill, Md. The event will be held for members who served from 1950 through 1965. **Contact:** George W. or Linda Jansen, 120 Rincon Way, Vallejo, Calif. 94590. Phone: (707) 554-0500. Edward F. Brandt, Road #1, Box 454, Liverpool, Pa. 17045.

Arnold Air Society
The Arnold Air Society Area XIX Conclave will be held on January 20–23, 1989, in Buena Park, Calif. **Contact:** Lt. Col. Thomas R. Spellman, AAS, 2522 W. 156th St., Gardena, Calif. 90249.

Valiant Air Command
The Valiant Air Command will hold its annual air show on March 10–12, 1989, at the Space Center Executive Airport (near the Kennedy Space Center) in Titusville, Fla.

Contact: Vonda McDonald, Valiant Air Command, 6600 Tico Rd., Titusville, Fla. 32780. Phone: (407) 268-1941 or (407) 268-1942.

2d Bomb Group/Wing
Members of the 2d Bomb Group and 2d Bomb Wing will hold a reunion on November 1–5, 1989, in Tucson, Ariz. **Contact:** Maj. Gen. John W. Collens, USAF (Ret.), P. O. Box 735, El Dorado, Calif. 95623.

9th Strategic Recon Wing
The 9th Strategic Reconnaissance Wing will host the Blackbirds reunion on May 11–14, 1989, at the Nugget Hotel in Reno, Nev. **Contact:** Lt. Col. Bernie Smith, USAF, 9th SRW, Box 4004, Beale AFB, Calif. 95903. Phone: (916) 634-2175.

29th Air Service Group
Members of the 29th Air Service Group, Thirteenth Air Force, will hold their forty-third reunion on July 9–15, 1989, in Omaha, Neb. **Contact:** Frank Pace, 315 W. 15th St., Dover, Ohio 44622. Phone: (216) 343-7855.

Class 42-B
Pilot Class 42-B will hold a reunion on February 23–26, 1989, at the Westcourt Hotel in Phoenix, Ariz. **Contact:** Col. William H. Edwards, USAF (Ret.), Box 1272, Litchfield Park, Ariz. 85340. Phone: (602) 935-3538.

Class 49-B
Members of Class 49-B will hold their fortieth class reunion on July 1, 1989, at the Desert Inn in Las Vegas, Nev. **Contact:** Maj. Thomas D. Kendrick, USAF (Ret.), 3515 Holly Dr., Denison, Tex. 75020. Phone: (214) 465-8219.

99th Bomb Group
The 99th Bomb Group will hold a reunion in February 1989, in McAllen, Tex. **Contact:** Jeff Wagnespack, 1423 Tulip Ave., McAllen, Tex. 78504. Phone: (512) 631-6783.

401st Fighter-Bomber Group
Members of the 401st Fighter-Bomber Group/Tactical-Fighter Wing (612th, 613th, 614th, and 615th Tactical-Fighter Squadrons) who served at England AFB, La., from 1953 on will hold a reunion on June 1–3, 1989, in Alexandria, La.

Please send a legal-size, self-addressed, stamped envelope for information. **Contact:** Anthony J. Gagliano, 300 Holcomb Blvd., Ocean Springs, Miss. 39564.

448th Bomb Group
Members of the 448th Bomb Group will hold a reunion on May 17–21, 1989, in Fort Worth, Tex., in conjunction with the fiftieth anniversary celebration of the B-24 Liberator. **Contact:** Lt. Col. Leroy Engdahl, USAF (Ret.), 1785 Wexford Dr., Vidor, Tex. 77662.

461st Bomb Group
Members of the 461st Bomb Group, Fifteenth Air Force (WW II), will hold a reunion on October 11–15, 1989, at the Holiday Inn Westport in St. Louis, Mo. **Contact:** Harry Oglesby, 2758 W. Macon, Decatur, Ill. 62522. Phone: (217) 429-6892.

28th MAS/4677th DSES
In order to organize a reunion, we would like to hear from members of the 28th Military Airlift Squadron, the 4677th Defense Systems Evaluation Squadron, and friends who were stationed at Hill AFB, Utah (circa 1964–68).

Please contact:

Dick Knox
604 Widgeon Ct.
Roseville, Calif. 95661
or
Tim Scofield
4725 Bamboo Way
Fair Oaks, Calif. 95628

Phone: (916) 783-4664 (Knox)
(916) 966-5545 (Scofield)

Class 42-G
I would like to hear from former US/UK Class 42-G graduates who trained at Napier Field, Ala., who would be interested in holding a reunion in 1989.

Please contact the address below.

Lt. Col. Joseph S. Chimento, USAF (Ret.)
5018 LaCroix Ave.
Orlando, Fla. 32812
Phone: (407) 859-7895

Class 44-A
I would like to hear from former Class 44-A members (Williams Field, Ariz.) who would be interested in holding a reunion.

Please contact the address below.

George T. Irgens
5235 W. Cambridge Ave.
Phoenix, Ariz. 85035

MOVING?

Let us know your new address six weeks in advance so that you don't miss any copies of AIR FORCE.

Clip this form and attach your mailing label (from the plastic bag that contained this copy of your magazine), and send to:

Air Force Association
Attn: Change of Address
1501 Lee Highway
Arlington, VA
22209-1198

Please fasten your mailing label here

Please print your NEW address here:

NAME

ADDRESS

CITY, STATE, ZIP CODE

AFA's CHAMPLUS® . . . With the

Exceptional Basic Benefits

1. Four year basic benefit. Benefits for most injuries or illnesses are paid for up to a four-year period.

2. Up to 45 consecutive days of in-hospital care for mental, nervous or emotional disorders. Outpatient care for these disorders may include up to 20 visits by a physician or $500.00 per insured person each year.

3. Up to 30 days per year for each insured person confined in a Skilled Nursing Facility.

4. Up to 30 days per year (to a 60-day life-time maximum) for each insured person receiving care through a CHAMPUS-approved Residential Treatment Center.

5. Up to 30 days per year (to a 60-day life-time maximum) for each insured person receiving care through a CHAMPUS-approved Special Treatment Facility.

6. Up to five visits per year for each insured person to Marriage and Family Counselors under conditions defined by CHAMPUS.

And the New 'Expense Protector' Benefit

While CHAMPUS Supplement coverage was originally intended to cover the cost of medical services not provided by CHAMPUS, practitioners and service institutions may charge fees that are considerably greater than those approved for payment by CHAMPUS. And, because Supplement policies traditionally base their payments on the amount paid by CHAMPUS, the insured can be left with sizable out-of-pocket expenses. AFA's ChamPLUS® coverage includes a special feature which places a limit on these out-of-pocket expenses.

Called the 'Expense Protector' Benefit, this program limits out-of-pocket expenses for CHAMPUS covered charges in any single calendar year to $1,000 for any one insured person (or $2,000 for all insured family members combined). Once those out-of-pocket expense maximums are reached, ChamPLUS® will pay 100% of CHAMPUS covered charges for the remainder of that year.

An example of the way the 'Expense Protector' works follows. Assume you are hospitalized for 35 days, that the hospital charges you $330 per day and that this is $75 per day *more* than allowed by CHAMPUS. This would mean that you have an out-of-pocket expense of $2,625. With AFA's 'Expense Protector' benefit, your cost would be limited to $1,000. All covered costs over this amount—for the whole calendar year—would be paid by ChamPLUS®!

It's an important benefit that can mean significant savings to you and your family.

Who Is Eligible?

1. All AFA members under 65 years of age who are currently receiving retired pay based upon their military service and who are eligible for benefits under Public Law 89-614 (CHAMPUS), their spouses under age 65 and their unmarried dependent children under age 21, or age 23 if in college.

2. All eligible dependents of AFA members on active duty. Eligible dependents are spouses under age 65 and unmarried dependent children under age 21 (or age 23 if in college). (There are some exceptions for older age children. See "Exceptions and Limitations.")

Renewal Provision

As long as you remain eligible for CHAMPUS benefits and the Master Policy with AFA remains

AFA ChamPLUS® Benefit Schedule

Care	CHAMPUS Pays	AFA CHAMPLUS® PAYS
For Military Retirees Under Age 65 and Their Dependents		
Inpatient civilian hospital care	CHAMPUS pays 75% of allowable charges	CHAMPLUS® pays the 25% of allowable charges not paid by CHAMPUS . . . plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year.
Inpatient military hospital care	The only charge normally made is a $7.55 per day subsistence fee, not paid by CHAMPUS.	CHAMPLUS® pays the $7.55 per day subsistence fee.
Outpatient care	CHAMPUS covers 75% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS® pays the 25% of allowable charges not paid by CHAMPUS after the deductible has been satisfied . . . plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year.
For dependents of Active Duty Military Personnel		
Inpatient civilian hospital care	CHAMPUS pays all covered services and supplies furnished by a hospital less $25 or $7.55 per day, whichever is greater.	CHAMPLUS® pays the greater of $7.55 per day or the $25 hospital charge not paid by CHAMPUS.
Inpatient military hospital care	The only charge normally made is a $7.55 per day subsistence fee, not paid by CHAMPUS.	CHAMPLUS® pays the $7.55 per day subsistence fee.
Outpatient care	CHAMPUS covers 80% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS® pays the 20% of allowable charges not paid by CHAMPUS after the deductible has been satisfied . . . plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year.

NOTE: Outpatient benefits cover emergency room treatment, doctor bills, pharmaceuticals, and other professional services. There are some reasonable limitations and exclusions for both inpatient and outpatient coverage. Please note these elsewhere in the plan description.

New 'Expense Protector' Benefit!

in force, termination of your coverage can occur only if premiums for coverage are due and unpaid, or if you are no longer an AFA member. Your certificate cannot be terminated because of the number of times you receive benefits.

Exceptions and Limitations

Coverage will not be provided for conditions for which treatment has been received during the 12-month period prior to the effective date of insurance until the expiration of 12 consecutive months of insurance coverage without further treatment. After coverage has been in force for 24 consecutive months, pre-existing conditions will be covered regardless of prior treatment. Children of active duty members over age 21 (age 23 if in college) will continue to be eligible if they have been declared incapacitated and if they are insured under CHAMPLUS® on the date so declared. Coverage for these older age children will only be provided upon a) notification to AFA and b) payment of a special premium amount.

Plan 1
For Military Retirees and Dependents

QUARTERLY PREMIUM SCHEDULE

In-Patient Benefits Only

Member's Attained Age*	Member	Spouse	Each Child
Under 50	$22.97	$ 45.12	$16.34
50-54	$34.33	$ 56.21	$16.34
55-59	$50.32	$ 60.17	$16.34
60-64	$62.98	$ 69.27	$16.34

In-Patient and Out-Patient Benefits

Under 50	$33.90	$ 61.02	$40.84
50-54	$46.59	$ 69.87	$40.84
55-59	$64.41	$ 96.11	$40.84
60-64	$77.38	$102.15	$40.84

*Note: Premium amounts increase with the member's attained age

Plan 2
For Dependents of Active Duty Personnel

ANNUAL PREMIUM SCHEDULE

In-Patient Benefits Only

	Member	Spouse	Each Child
All Ages	None	$ 9.68	$ 5.94

In-Patient and Out-Patient Benefits

All Ages	None	$38.72	$29.70

CHAMPLUS®

Coverage After Age 65

Upon attainment of age 65, the coverage of members insured under CHAMPLUS® will automatically be converted to AFA's Medicare Supplement program so that there will be no lapse in coverage. Members not wishing this automatic coverage should notify AFA prior to their attainment of age 65.

Exclusions

This plan does not cover and no payment shall be made for:

- routine physical examinations or immunizations
- domiciliary or custodial care
- dental care (except as required as a necessary adjunct to medical or surgical treatment)
- routine care of the newborn or well-baby care
- injuries or sickness resulting from declared or undeclared war or any act thereof
- injuries or sickness due to acts of intentional self-destruction or attempted suicide, while sane or insane
- treatment for prevention or cure of alcoholism or drug addiction
- eye refraction examinations
- prosthetic devices (other than artificial limbs and artificial eyes), hearing aids, orthopedic footwear, eyeglasses and contact lenses
- expenses for which benefits are or may be payable under Public Law 89-614 (CHAMPUS)

APPLICATION FOR AFA CHAMPLUS®

Group Policy GMG-FC70
Mutual of Omaha Insurance Company
Home Office: Omaha, Nebraska

Full name of Member _____
Rank Last First Middle

Address _____
Number and Street City State ZIP Code

Date of Birth _____ Current Age ____ Height ____ Weight ____ Soc. Sec. No. _____
Month/Day/Year

This insurance coverage may only be issued to AFA members. Please check the appropriate box below:

☐ I am currently an AFA Member.

☐ I enclose $21 for annual AFA membership dues (includes subscription ($18) to AIR FORCE Magazine).

PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (Check One)
☐ AFA CHAMPLUS® PLAN I (for military retirees & dependents)
☐ AFA CHAMPLUS® PLAN II (for dependents of active-duty personnel)

Coverage Requested (Check One)
☐ Inpatient Benefits Only
☐ Inpatient and Outpatient Benefits

Person(s) to be insured (Check One)
☐ Member Only
☐ Spouse Only
☐ Member & Spouse
☐ Member & Children
☐ Spouse & Children
☐ Member, Spouse & Children

PREMIUM CALCULATION

All premiums are based on the attained age of the AFA member applying for this coverage. Plan I premium payments are normally paid on a quarterly basis but, if desired, they may be made on either a semi-annual (multiply by 2), or annual (multiply by 4) basis.

Quarterly (annual) premium for member (age ____) $_____

Quarterly (annual) premium for spouse (based on member's age) $_____

Quarterly (annual) premium for ____ children @ $ $_____

Total premium enclosed $_____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Dependents to be Insured	Relationship to Member	Date of Birth (Month/Day/Year)

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such pre-existing conditions will be covered after this insurance has been in effect for 24 consecutive months.

Date _____, 19 ____ _____
Member's Signature

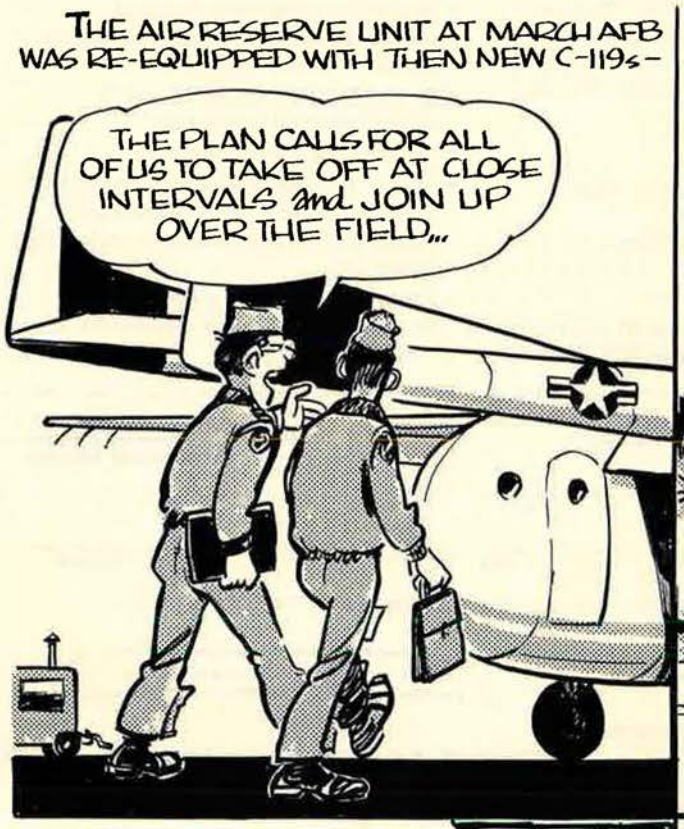
Form 6173GH App.
12-88

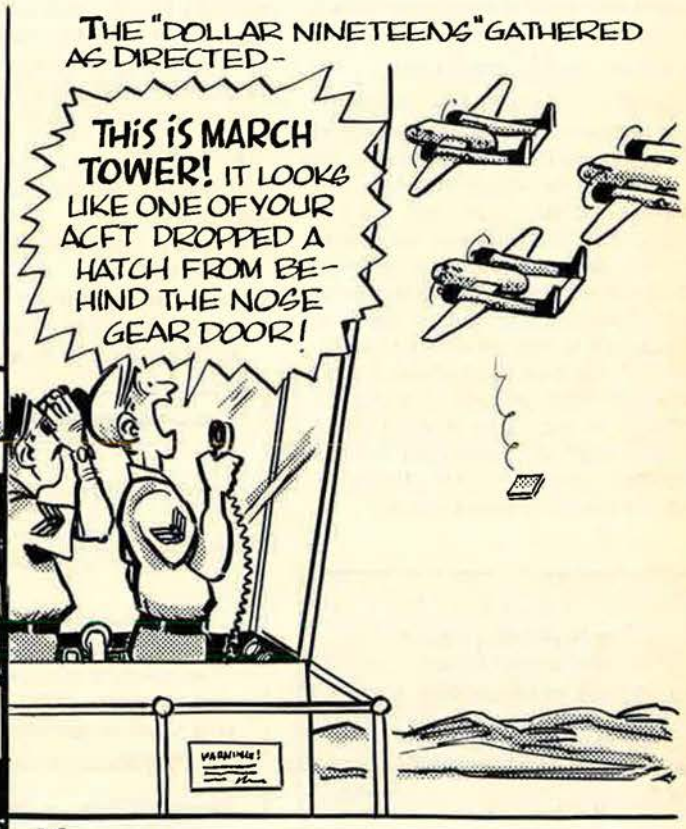
Application must be accompanied by a check or money order. Send remittance to: Air Force Association, Insurance Division, 1501 Lee Highway, Arlington, VA 22209-1198

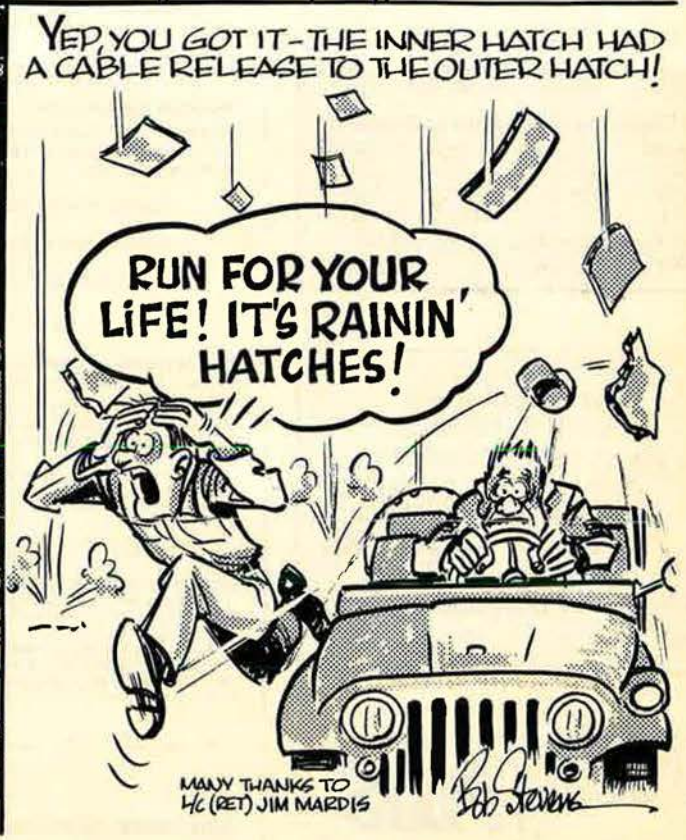
Bob Stevens'

"There I was..."

IN THE OLD DAYS, THOROUGHLY READING TECH MANUALS *BEFORE* CHECK OUT WAS CONSIDERED UNSPORTING BY A FEW OF THE CREWS (PILOTS WERE OFTEN ACCUSED OF JUST GETTING IN AND PUSHING BUTTONS UNTIL SOMETHING MEANINGFUL HAPPENED). THIS IS A TRUE STORY...







Collins Defense Communications experience in information transfer can help make C³I a reality. As specialists in communications and ECM/ECCM systems for air, sea and land battle scenarios, we know the intricacies of interconnectivity. ■ We are currently applying that expertise to our involvement in VLF/LF communications for the Navy's TACAMO relay link aboard the Navy's E-6, and for the Air Force's Airborne Command Post. ■ We are also participating in SAC's Scope Signal, MILSTAR, Project Overtake, the USN High Frequency Anti-Jam Programs, the SDI Integrated Defense Simulator, information switching systems and other major C³I programs. ■ We have the facilities in place to provide the products, systems analysis and integration, functional architecture, system partitioning, training and logistics support to meet your multi-platform/multi-service C³I needs. ■ Collins Defense Communications, Rockwell International, 350 Collins Road, N.E., MS 120-145, Cedar Rapids, Iowa 52498, U.S.A. Phone (319) 395-1600. Telex 464-435. **We Know C³I.**

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