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AIR FORCE

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MAGAZINE

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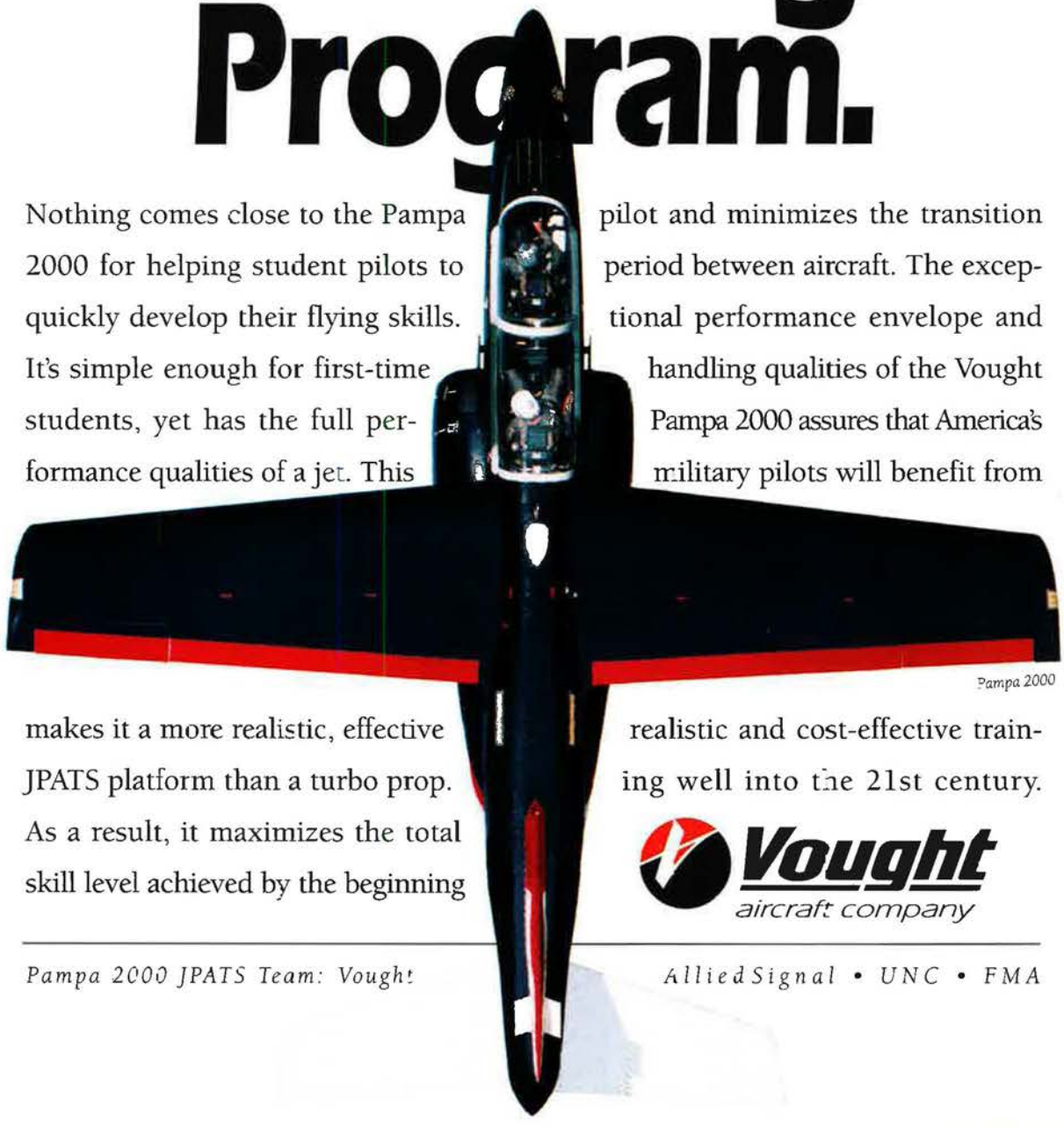

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December 1993, Vol. 76, No. 12

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

About the cover: A reproduction of the Wright Flyer sits on the site of the historic flight at Kitty Hawk, N. C. In the background is the Wright Brothers National Memorial at Kill Devil Hill, N. C. Photo © Jim Sugar/Black Star.

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Editorial

By John T. Correll, Editor in Chief

The Bottom-Down Review

In 1992, when he was chairman of the House Armed Services Committee, Rep. Les Aspin hammered the Pentagon relentlessly for "top-down planning." He complained that defense cuts were being implemented by percentage adjustments to the program rather than by a careful examination of requirements from the bottom up. When Mr. Aspin became Secretary of Defense in the Clinton Administration, he got a chance to do it his way. He launched a "Bottom-Up Review" that kept everybody hopping all summer.

Unfortunately, he began with two fateful flaws in the process. The major miscue was that on March 27—before the Bottom-Up Review started—the Aspin-Clinton team announced its defense budget totals for the next five years. The actual requirements and programs would await the Bottom-Up Review. As Sen. Sam Nunn (D-Ga.) said, the March 27 figures were simply "grabbed out of the air."

The second flaw was that the Administration's numbers were low. They set up a five-year cut, taking defense $104 billion lower than the final projection of the Bush Administration (and $245.2 billion below the 1990 budget summit baseline).

Sen. John McCain (R-Ariz.) was foremost among those who warned that such a funding level would fall short of supporting an adequate defense program. Thus, Mr. Aspin and the armed forces labored on their bottom-up requirements in the awareness that the Administration's budget credibility was on the line. The force-structure findings began leaking to the public in midsummer. The strong indication was that the review team had cut corners, trying to cover an optimistic strategy with too thin a force. *[See "Two at a Time," September 1993, p. 4.]*

Concern intensified with official publication of the force projections on September 1. Rep. Ike Skelton (D-Mo.) said the plan flunked "simple, third-grade arithmetic." He said the projected forces would have trouble responding quickly to one major regional contingency, much less the two contingencies the Bottom-Up Review expected them to handle nearly simultaneously.

Still more of the story emerged October 15 when Mr. Aspin revealed the financial bad news. The massive force cuts produced by the Bottom-Up Review were $13 billion short of satisfying the budget proclaimed in March. The Pentagon did not stand firm on the requirements it had so painstakingly identified. Instead, Mr. Aspin sent the reviewers back to find more cuts.

Mr. Aspin should take his own advice and let requirements determine the defense program.

Senator Nunn told Congress that Mr. Aspin was short by a lot more than $13 billion. Among other things, he said, the Bottom-Up Review forgot to reckon with $23 billion in military and civilian pay raises directed by law. Senator Nunn said the underfunded defense program is heading for a "train wreck" and that "our US military forces are not capable of carrying out the tasks assumed in the Bottom-Up Review with this kind of eroding defense budget."

Mr. Aspin's report on the Bottom-Up Review projected the military force structure for 1999 in considerable detail. The Air Force, for example, is allotted thirteen active fighter wings, seven reserve fighter wings, and "up to" 184 bombers. The report did not specify the number of airlifters—a curious lapse since airlift, more than anything else, constrains deployment to the kind of regional crises around which the Bottom-Up Review is built. Even more curious, cynics noted, were all the trial balloons for radical reduction in airlift procurement that floated around the Pentagon as a separate issue the same week the Bottom-Up Review was published.

In addition to the $13 billion clean-up review and whatever is happening with airlift, Mr. Aspin announced on October 29 yet another Bottom-Up Review, this one dealing with nuclear forces. He waved off questions about force numbers and budget consequences. "Numbers should derive from the policy," he said. "You don't start with the numbers. You start with the policy and then derive the numbers."

That is a familiar-sounding philosophy and one we've heard before from Mr. Aspin. He would do well to listen to it more closely himself. Defense planning *should* begin with requirements and strategy. That *should* determine the program numbers—including the budget numbers—instead of it working the other way around.

Sad to say, the process has been running backward. The blind budget projection made last March is driving the defense program. A perception is spreading that, no matter what Mr. Aspin claims, military requirements do not matter much. Only the money matters. Pressures are building already for more and deeper defense cuts.

We should brace ourselves, probably, for a continuing series of these Bottom-Up Reviews. It would be more descriptive to call them "Bottom-Down" reviews. The objective, it seems, has less to do with a review of requirements than it does with redefining the bottom in a more budgetarily pleasing way. ■

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Letters

Reducing Retirement Pay

As the cost-of-living adjustment (COLA) controversy heats up again, it is disappointing to read some of the arguments made by my fellow military retirees *["Willing to Take Less," by Brig. Gen. John W. Harrell, USAF (Ret.), October 1993 "Letters," p. 7].*

Some argue that our government is squandering money all over the globe for projects and causes of questionable propriety and efficacy. So, in the face of such largess, we retirees should get our fair share, too. Possibly true, but off the mark.

Others argue that we retirees are an affluent bunch and can well afford to do our part to resolve the national indebtedness spawned by the aforementioned squandering. Possibly true (for some of us), but also off the mark.

The hard and simple fact is that our military retirement is neither a gift nor an entitlement; it is repayment of an outstanding balance due, for services rendered, under a signed contract between career military people and the people of the United States. As an incentive to obtain and retain our services, the government repeatedly made it clear that although our monthly paycheck was lower than that of our civilian counterparts, our other benefits, including retirement, were part of our compensation.

Our military retirement pay is based on a formula established by law at the time of our retirement. To allow it to be eroded by inflation would eventually result in its reduction to a fraction of its agreed-upon worth. To allow this to happen, for any reason, would abrogate our contract and bring into question the veracity of similar promises being made to those still serving.

This is not a debatable issue. It is a matter of parity under law.

Lt. Col. David S. Harmon,
USAF (Ret.)
Greendale, Wis.

I'm mighty pleased that General Harrell thinks his retired pay is overly generous and can hardly wait to give some back. Fortunately, there is a way for him to do just that: first, write a check; second, send it in.

Meanwhile, in the same issue, you report on USAF Chief of Staff Gen. Merrill A. McPeak's concerns about loss of experience in the Air Force *["Readiness at Risk," October 1993 "Capitol Hill," p. 11]:* "He noted that the problem is compounded by congressional tinkering with the military retirement system, which is the top incentive to make the military a career, and that attacks on this system are especially destructive to retention."

I am puzzled by General Harrell's statement that "the retired pay of officers ranked O-5 and above is actually more than it needs to be." How did he decide that? What it needs to be is exactly what the government said it would be during the twenty or more years it was promised. It is an obligation for services rendered, not a gift. If the General feels a pressing need to return some of his, he is free to do so. But leave mine alone, General, I earned it.

Lt. Col. Thomas N. Thompson,
USAF (Ret.)
Hurst, Tex.

In reference to General Harrell's letter: How fortunate we are that even in retired life we can still receive words of wisdom from our generals.

General Harrell, I didn't know I had it so good. I didn't realize that I don't deserve all my retired pay. I guess I shouldn't be concerned with the high costs of supporting a widowed mother in a nursing home. I shouldn't give it a second thought when some of our children need our help. And I definitely need not save for the future when our medical care is eliminated by the Clinton health-care plan.

General Harrell, you retired before 1977, so you took advantage of those high COLAs. I retired in 1981, and my COLAs have not kept pace with inflation.

If the good General thinks he is getting too much money, he can donate some to the Bureau of Public Debt, Dept. G, Washington, DC 20239-0601.

I'll give up my COLA as long as there is a freeze on *all* retirement programs—civil service, congressional, and Social Security. We should include in this freeze the pork programs and perks.

Col. Franklin R. Fass,
USAF (Ret.)
Beavercreek, Ohio

I just finished reading General Harrell's letter. He's right on. I've had the same thoughts, particularly through the 1980s when it seemed that I received a COLA to my retired pay every other month. Like General Harrell, I haven't rushed to give the money back, but I think his solution has merit.

I have also wondered why AFA hasn't taken more reasonable stands on a number of issues, but what similar organization ever has? None that I know of. Experience dictates that one shouldn't give away the store at the beginning of a negotiation, and, with this administration, it's an experience that shouldn't be ignored.

Col. Robin Hansen,
USAF (Ret.)
Waltham, Mass.

Lucky Bomber Crews

"Against Regensburg and Schweinfurt" *[September 1993, p. 48]* brought back many vivid memories. I was a B-17 pilot and squadron commander in the 306th Bomb Group ("First Over Germany") flying from England. I flew my first mission in October 1942 and my last in April 1944.

On my first mission, I lost an engine over the target and could not maintain formation. About twenty of Field Marshal Hermann Göring's yellow-nosed Me-109s attacked my aircraft. Fortu-

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

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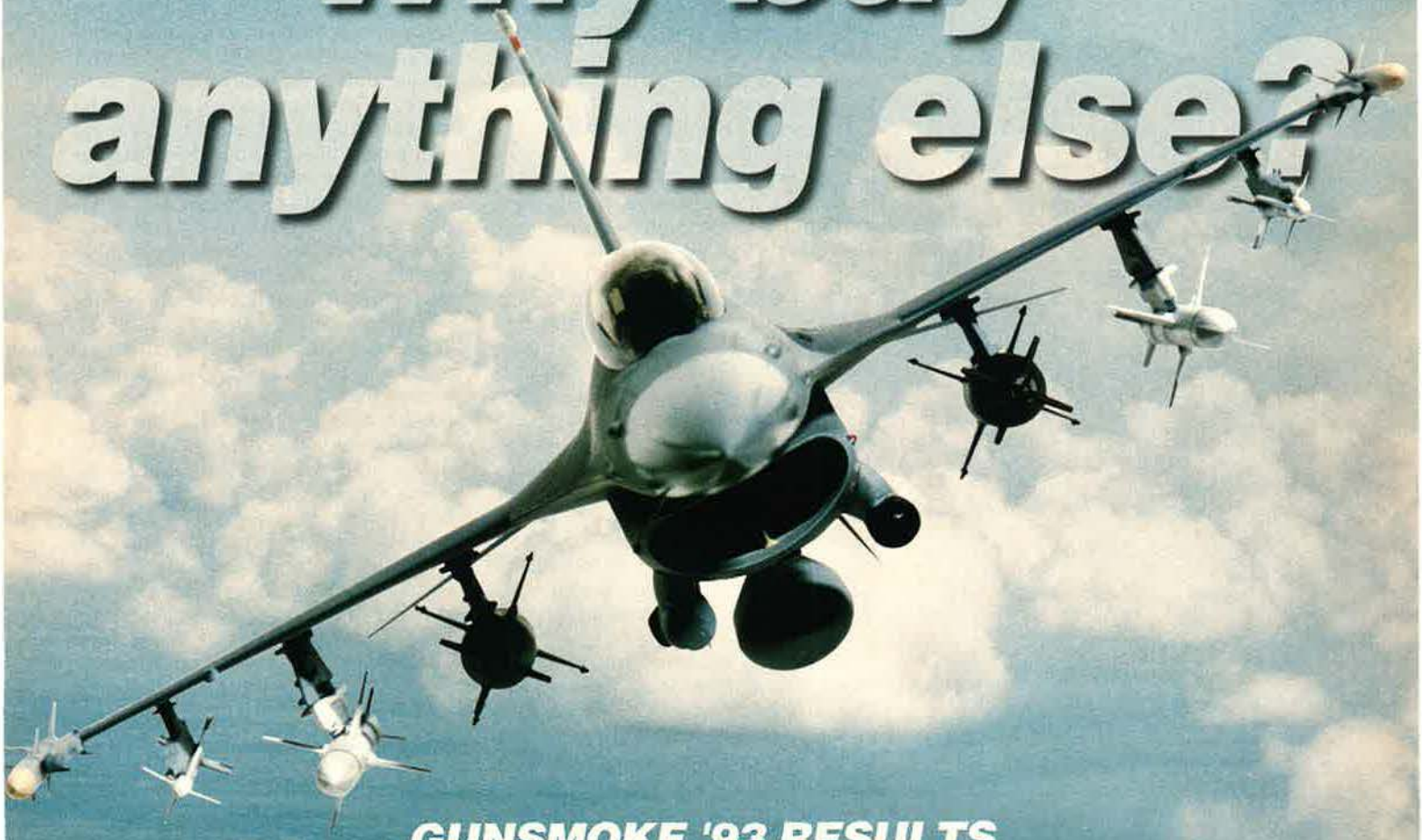

GUNSMOKE '93 RESULTS

	Bombing Finish	Overall Finish
1st	F-16	F-16
2nd	F-16	F-16
3rd	F-16	F-15E
4th	F-16	F-16
5th	F-15E	F-16
6th	F-16	F-16
7th	F-16	F-15E
8th	F-15E	A-10
9th	A-10	F-16
10th	F-16	A-10

F-16 Competition Awards

#1 – Overall Competition
#1 – Fighter Team
#1 – Operations Team
#1 – Top Gun
#1 – Dive Bombing
#1 – Low Angle Bombing
#1 – Navigation Attack
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Advertising Director
Patricia Teevan
1501 Lee Highway
Arlington, Va. 22209-1198
Tel: 703/247-5800
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Letters

nately for me, the German pilots were unfamiliar with the B-17 and had not yet devised proper attack tactics. Their efforts to shoot me down were fruitless. Had my engine failed later in the war, when the Germans had learned the success of head-on attack, I doubt I would be writing this.

It was interesting to watch the evolution of the German tactics in attacking our bomber formations. Since attacks from the rear were costly, they tried many other tactics (*e.g.,* strapping bombs to their fighters and dropping them on our group while other German pilots were making head-on attacks or dragging through the formations bombs that had been lowered on wires from aircraft flying well above us). None of these proved successful. Then they adopted head-on attacks, during which the rapid rate of closure negated the range advantage of the .50-caliber machine gun and the explosive power of their 20-mm cannon proved deadly.

The combat losses in our bomb group were high: during my tour, 110 aircraft and crews missing (1,110 men).

Among my missions were several mentioned in the article. I never saw a Bf-110 or heard of an Mk. 108 cannon or the 21-cm rocket. It would seem that their existence should have been mentioned in the many intelligence briefings we had.

I tip my hat to the US fighter pilots who, in 1944, finally wrested complete air supremacy from the Luftwaffe. It made life somewhat easier for the bomber crews. In particular, I tip my hat to the many bomber crewmen who, despite overwhelming odds, loss of many close friends, and difficult physical conditions, did their jobs.

We bomber crewmen who completed a combat tour and came home were simply damn lucky.

Col. John M. Regan,
USAF (Ret.)
San Mateo, Calif.

■ *Messerschmitt developed out of the Bayerische Flugzeugwerke. Therefore,* AIR FORCE *Magazine uses the earlier "Bf-" designation when referring to what Colonel Regan terms the "Me-109" and to what some call the "Me-110."*—THE EDITORS

The "Perfect" Jacket

As one who has spent the better part of the past twenty years developing a sense of what the "perfect" leather flight jacket ought to be, I was annoyed to find the ubiquitous A-2 jacket reverently eulogized in the pages of AIR FORCE Magazine *["The Jacket That Lives Forever," September 1993, p. 60].*

I have always firmly believed that form should follow function—especially when the subject is a leather jacket that ostensibly belongs in a cockpit. The hoary old A-2, while the stuff of many a reminiscence, belongs to the past. It is no secret that the so-called "authentic" A-2 is one of the most constricting garments in aviation history. The sleeve-shoulder junctures do not favor forward reaching motions (holding the yoke or stick) and bind in any posture more demanding than standing at attention. Those pathetic little pockets are anything but functional, and, in order to come close to a proper fit, a person must obtain a slightly larger size.

Heretical as it may sound, the Navy got it right with its comfortable "biswing" articulated sleeve-shoulder juncture, underarm gussets (G-1 and G-2 jackets), and larger, higher placed, far more functional pockets. In my opinion, the closest any service leather jacket ever came to being ideal was the G-2, which had all of the positive ergonomics of the G-1, but with a plain collar. Comparing the Navy G-2 and the Air Force A-2 is like comparing gold to lead.

More irksome yet, nostalgia for the "good old days"—the primary motivation for reinstating the "brown-shoe AAC" A-2—caused a unique opportunity to introduce a wholly new and carefully constructed leather jacket featuring style, fit, comfort, and functional design to be overlooked.

Promoting the exploits and traditions of the glory days of the Air Force is fine, but it is sad to think that such uncritical enthusiasm brought back an anachronistic garment that ought rightfully to have been replaced by a newer version of the "essential pilot look" more heedful of human factors.

Of course, if you *really* want to get sticky, by all modern flight-safety standards leather jackets have no place in a modern cockpit. Those who think that leather protects as well as Nomex have never seen an aviator who was wearing a leather jacket in a conflagration. (It melts like Velveeta before it chars.) But that would be taking the whole matter *too* seriously, and, after all, a certain calculated risk is required to make flying more challenging.

Thanks for a very entertaining article, but spare me the Boy Flying Ace fixation on items that rightfully belong to the hoary old AAC days. As for me, I'll continue to enjoy my leather version of the CWU-36/P, modified with a

biswing back, that feels so comfortable I practically forget I'm wearing it.

Christopher T. Carey
Aeolus Aerospace
Sacramento, Calif.

Whose *Esprit de Corps?*

I found "The Jacket That Lives Forever" an interesting look at an enduring piece of Air Force heritage. Nevertheless, I'm concerned by some of the implications of the A-2's revival.

Mr. Glines indicates that bringing back the jacket was a matter of *"esprit de corps."* Whose *esprit de corps?* Senior leaders of 9th Air Force, who initiated the revival, answer, "It's a beautiful jacket that we all ought to be able to wear," *we* in this case being strictly fighter pilots. A-2 privileges were subsequently extended to all sorts of aircrew billets, but what does that say about the value put on the *esprit de corps* of the rest of the Air Force?

Further, Mr. Glines quotes an internal Air Force source as justifying the A-2 because combat-ready aircrews are "not adequately recognized" by the Air Force. This assertion is hard to believe. Aircrews wear distinctive, functional uniforms. They are widely respected and applauded for doing a tough job. They enjoy the public acclaim of being the most prominent symbols of the Air Force. Finally, they are financially compensated for their efforts. How much recognition does a person need for doing his or her job?

We all like to see Air Force traditions flourish. But at $5 million, the A-2 seems an expensive way to reinforce the sad Air Force tradition of splitting us into "pilots and everybody else."

2d Lt. Peter J. Flores,
USAF
Whiteman AFB, Mo.

Mall-Bent for Leather

"The Jacket That Lives Forever" was excellent, but it was inaccurate in leading the reader to believe that all "combat-ready flyers" receive leather jackets. Mission crew members on such platforms as E-3 AWACS and EC-130E ABCCC aircraft do not receive leather jackets, although pilots, navigators, and flight engineers do.

Many of these mission crew members have been flying for most of their careers, and some have more than 3,000 flight hours. Many were directly responsible for the successful operations during Desert Shield and Desert Storm. Most continue to be deployed on flying assignments that take them away from home more than 200 days a year. Yet, since they are not considered "rated officers," Air Combat Command will not issue them leather jackets.

With the current drawdown of forces, many mission crew members count their blessings for still having a job doing something they love. Leather jackets are—and should be—the last item on any commander's agenda, considering the dynamic changes occurring in the Air Force today. Your readers should be aware, however, that those who fly daily, but who are not in the cockpit of the aircraft, must go to the nearest mall for their leather jackets.

Susan J. Young
Newport News, Va.

ACC Tankers

"Expeditionary Force" *[June 1993, p. 20]* did not mention the ACC tanker force. The KC-10s at Seymour Johnson AFB, N. C., ensure that "Global Reach, Global Power" is alive and well. Exercises like Fleetex 93-1 do not happen without air refueling.

"Tankers at the Rendezvous" alleviated much of my distress until I read the caption on p. 57: "The KC-10 Extender can also double as a transport, making it one of the most versatile airplanes in AMC's inventory." See my previous statement regarding ACC KC-10s. March AFB, Calif., and Barksdale AFB, La., KC-10s belong to AMC. The twenty KC-10s at Seymour Johnson AFB are all ACC.

Finally, "Mobility Central" *[p. 70]* did not mention that KC-10s from both AMC and ACC contributed to the Somalia relief effort. The ACC KC-10s (active-duty figures only) flew more than 250 sorties and airlifted more than 4.4 million pounds of cargo.

Capt. Fritz Linsenmeyer,
USAF
Goldsboro, N. C.

Brute-Force Solutions

Great consternation and profound grief were the only emotions I felt after reading "Mobility Central." Your fulsome praise for Tanker Airlift Control Center (TACC) was reminiscent of *Pravda. . . .*

As one who has been flying for more than seven years in a C-141B, I can assure you that TACC and the cargo-moving operations of AMC are anything but efficient. The constant knee-jerk reaction to every tasking and the brute-force solutions may complete the task, but only at the expense of squandered time and energy.

The attitude of the new fighter leadership does nothing to engender morale and elegant problem-solving. Recently, an AMC lieutenant general spoke to our Reserve C-141B unit. His repeated use of patronizing "heavy

transport aircrew" remarks mirrored the attitude that it's business as usual, and he in no way motivated the crews to greater efforts.

The Air Force is desperately inefficient at cargo-moving and will continue to be so with senior management using late-1950s methods of aircraft and crew utilization. Until we adopt the procedures used by successful commercial air freight operators, we will continue to treat every contingency as a high-level emergency with a shoot-from-the-hip solution.

Capt. Neal A. Schier, AFRES
Mechanicsburg, Pa.

A Seamless Organization

Those of us associated with the Tanker Airlift Control Center enjoyed "Mobility Central." We didn't realize how close we were to a seamless organization until we saw SSgt. Wally Patterson, one of our weather forecasters in the East Cell, identified on p. 73 as a scheduler. He is a member of our Tanker Airlift Weather Support Division, which was recently awarded the Moorman Award for best specialized weather support in the Air Force.

Lt. Col. Robert H. Allen, USAF
Scott AFB, Ill.

The C-17 ATS

After reading "The C-17 Fights the Headwinds" *[July 1993, p. 34],* I would like to present an aspect of the program that has gone unnoticed: the C-17 Aircrew Training System (ATS).

The C-17 ATS, used to train C-17 aircrews and engine-run maintenance personnel, was put into operation on schedule and has been training students for more than a year. The first training site at Charleston AFB, S. C., has state-of-the-art, computer-based training systems and two flight simulators. It also boasts, for the first time, a simulator station to train loadmasters. The successful concurrent development and fielding of the training system with the aircraft is also worth noting because it maximizes effectiveness.

We are especially proud that the training system has performed exceptionally well and has been producing trained crews who are ready to fly as aircraft arrive at the operational base.

Bill James
McDonnell Douglas
St. Louis, Mo.

B-29 or B-50?

Congratulations on a great magazine. Occasionally, you miss a putt like the rest of us mortals. For instance, the cover of the August issue has a picture of a B-50 cockpit, supposedly the cockpit of the B-29 *Enola Gay.*

The two red handles clearly shown in the middle of the throttle quadrant are a dead giveaway. Those are emergency brake controls used only on the B-50s, since they were the first bombers to use reversible props to slow the aircraft on its landing rollout. If you examine the B-29 cockpit module, you will see an entirely different type of window arrangement.

I was crew chief on both bombers, and I have the gray hair and wrinkles to prove it!

SMSgt. Ernest P. Morgan, USAF (Ret.)
Stone Mountain, Ga.

■ *Bernard Poppert of the Garber Facility replies:*

This is not a B-50 cockpit. Most B-29s used Hamilton Standard Hydromatic Propellers that were not reversible. The Enola Gay*'s 509th Bomb Group, however, wanted reversible-pitch propellers for safety and had Curtiss Electric Fully Reversible Propellers installed on all fifteen of its aircraft. The center console is not a throttle quadrant. It houses the pressurization controls, propeller controls, some communications controls, and the emergency brake handles. Throttles were located outboard of the pilot and copilot and at the flight engineer's station. The emergency brake handles were standard on B-29s according to the technical orders.*

The Fairchild Cornell

"In Aviation's Attic" *[August 1993, p. 44]* misidentifies the Fairchild PT-19 as the Ryan PT-19. According to the fifth revised edition of *The Air Force Museum,* p. 91, the Fairchild PT-19A Cornell was developed in 1938, entered quantity production in 1940, and had two variants. The PT-23 was powered by a Continental radial engine, and the PT-26 had a cockpit canopy.

Of course, the PT-22 was built by Ryan, as a further development of the Ryan S-T, and it was a real honey.

Maj. Gen. Jack K. Gamble, USAF (Ret.)
Tacoma, Wash.

The Politicians' Disdain

The "New Military Poor" *["Capitol Hill," August 1993, p. 11]* made me ill. The idea of any volunteer in the US military living below a middle-class standard or drawing food stamps should be repugnant to any citizen of this country.

I'd have to say that it makes sense when you consider the cowards we have in Washington. They always hurt the ones who can't or won't fight back. For 200 years, the military has fought the politicians' battles in war and endured their disdain in peacetime. The military has always stood at the ready and out of the political battles.

In "Rise of the Afghantsi" *[August 1993, p. 33],* Harriet Fast Scott told of how the Afghan war vets in the former USSR formed a Union to guarantee political influence. Sounds like a damned good idea to me. Maybe all our veterans' organizations and active military people ought to unify and form one huge voting bloc. It might even scare the cowards out of Washington.

Ron Petrosky
Valencia, Calif.

Refueling U-2s

In Capt. Penny A. Heiniger's letter *["Overrunning the Boom," September 1993 "Letters," p. 12],* she refers to the correct final placement of the refueling receiver during the rendezvous as being behind the tanker. Obviously, that is where you belong at the time refueling begins, but, for the rendezvous itself, there was an exception—the U-2F reconnaissance aircraft. As this aircraft flew down the refueling track, the tanker rendezvoused with it from behind. This was because the U-2 had such a small airspeed envelope that it could not close on a tanker (KC-97 or KC-135) progressing down track. Few people knew that the U-2 had a refuelable F model. It was rarely employed operationally by the Air Force.

I flew a thirteen-hour mission over Cuba using that capability, and some of my squadron mates (Steve Heyser, Chuck Stratton, and Gerry McIlmoyle) flew even longer to deliver U-2s to southeast Asia in 1964. The F held more than 1,300 gallons of fuel, good for nearly ten hours, and the refueling capability allowed more than 900 gallons to be replaced. That was more capability than the average bear, in a tiny cockpit and a pressure suit, could tolerate!

Maj. Gen. Patrick J. Halloran, USAF (Ret.)
Colorado Springs, Colo.

Erratum

AFMC's 4950th Test Wing at Wright-Patterson AFB, Ohio, commanded by Col. John K. Morris, was omitted from "Directory of Wing Commanders" in the November 1993 issue.

TOTAL SYSTEM SOLUTION.

The ITT Team can provide an integrated, non-developmental solution to protect the B-1B in its new conventional role.

The new, demanding conventional role of the B-1B requires a new approach to its defensive avionics.

The ITT Team Solution: Protect the B-1B with a complete, integrated package. Our combat-proven solution combines electronic countermeasures with radar and missile warning. The team, headed by ITT with its AN/ALQ-172 jammer, includes Loral and Westinghouse with the AN/ALR-56 radar warning receiver and AN/ALQ-153 missile warning system, respectively.

Since all components are fielded – with complete logistics support in place – our total system solution allows the lowest 20-year life-cycle cost.

What's more, the ITT Team Solution uses the most successful and technologically advanced defensive avionics systems in the USAF inventory. Our solution can provide the B-1B with the advanced countermeasures and situation awareness capabilities to meet its new conventional role.

The ITT Team Total Systems Solution...an effective, low-risk way to shield the B-1B.

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By Brian Green, Congressional Editor

Foreign Policy Schism

Congress questions the Clinton Administration on commitment of US troops, multilateralism, and the use of warmaking powers.

THE HEATED debate on Somalia, Bosnia, and Haiti revealed a major new foreign policy schism on Capitol Hill. At the heart of the controversy lay angry disputes over the most fundamental issues—how to define US national interests and when to use the armed forces—compounded by long-simmering disagreements over warmaking powers.

The split in Congress highlights divergent and sometimes startling views on how to properly define "national interest" and how to decide where the US fits into the "new world order." The dividing lines are not clear-cut, but one camp puts top priority on pursuing specific, traditional US national interests. Another maintains that US security lies more in ensuring the success of international bodies—in particular, the United Nations.

"The United Nations is . . . a universalist institution," stated Sen. William V. Roth, Jr. (R-Del.). "[Yet] some areas of the globe are vital for our national security [while] other regions are of virtually no relevance to us at all. In short, the interests of the United Nations cannot and should not be directly equated with the interests of the United States."

Many emphasize pursuit of traditional American interests—military security of allies, natural resources, and the like—as the primary reason to deploy US armed forces. These lawmakers are unenthusiastic about proposed peacekeeping missions and are even more suspicious of peacemaking missions—creating and enforcing a degree of comity between two sides not interested in peace—and nation-building missions.

For example, Sen. Byron Dorgan (D–N. D.) argued that the White House "should never commit American forces in hostile zones unless we employ overwhelming forces" and that, "lacking a clear and compelling mission for United States forces in Somalia, we should remove them from harm's way and bring them home." The US has an interest in promoting "peace, order, and development," but that, he said, should be the work of diplomacy and sanctions.

In an assessment of the Haitian venture, Senate Minority Leader Bob Dole (R-Kan.) maintained that restoring deposed Haitian President Jean-Bertrand Aristide is not worth the life of a single US soldier. Many other legislators stated similar views, reflecting specifically on the lack of any readily apparent national security interests in Somalia, Haiti, or Bosnia.

Others on Capitol Hill defined US interests more expansively and contended that the United Nations can and should play an essential role in supporting those interests.

Rep. Donald Payne (D–N. J.) declared that "many of my colleagues in the House are overlooking [the fact that] the United Nations could be the vehicle to keep the world orderly." He added, "If the United Nations fails . . . it's going to come back to one world power—the United States of America."

Rep. Charles Rangel (D–N. Y.) argued that there would be negative consequences from deciding *not* to use UN power to "stop the killings" in Haiti and restore President Aristide to power. The powerful message to "all the fragile democracies in this hemisphere" would be that they could not count on help in their struggles.

Still others in Congress identify a legitimate national interest in fulfilling humanitarian goals such as feeding the hungry of Somalia and restoring some kind of governmental stability to that east African nation.

The costly October 3 firefight between Somali irregular gunmen and US Army Rangers triggered a storm of criticism on Capitol Hill, most of it directed toward the concept of placing US troops under UN command. Lawmakers also were highly critical of "mission creep" in Somalia. They noted that the operation began as a humanitarian effort but grew to include peacekeeping, peacemaking, and nation building.

Furthermore, many said, the fighting in Somalia highlighted awkward command-and-control arrangements under which the multinational forces have been forced to operate. Many legislators pointed out that the UN is poorly equipped and staffed to run large peacekeeping, peacemaking, or combat operations.

These distinctions gave rise to some interesting political declarations. Some longtime supporters of presidential prerogatives in conducting American military operations overseas sought to enact legislation curbing presidential power to commit US troops, particularly under the auspices of the UN or in pursuit of goals not directly related to traditional US national security interests.

Senator Dole introduced a bill that would prevent President Clinton from introducing US troops in Haiti without congressional approval. The bill was turned aside, but Congress approved a nonbinding resolution making essentially the same case. Sens. Thad Cochran (R-Miss.) and Don Nickles (R-Okla.) introduced legislation to prevent assignment of US combat troops to UN command.

Sen. William Cohen (R-Me.) claimed that the President and his top advisors failed to clarify Administration policy goals or to repudiate earlier erroneous statements. Senator Cohen cited a January 1993 AIR FORCE Magazine editorial, written when "limited" use of force was under discussion: "These people are not dealing in abstract concepts. They are tinkering with deadly force. If their notions become policy, we may learn all over again that it is much easier to get into a fight than it is to get out of one."

Changes of attitude have also been evident among those who, so long as Republicans occupied the White House, strongly opposed unfettered presidential power to engage in military adventurism abroad. They now argue that the President should not be tied down by specific legislation and that Congress should not try to micromanage foreign policy. ■

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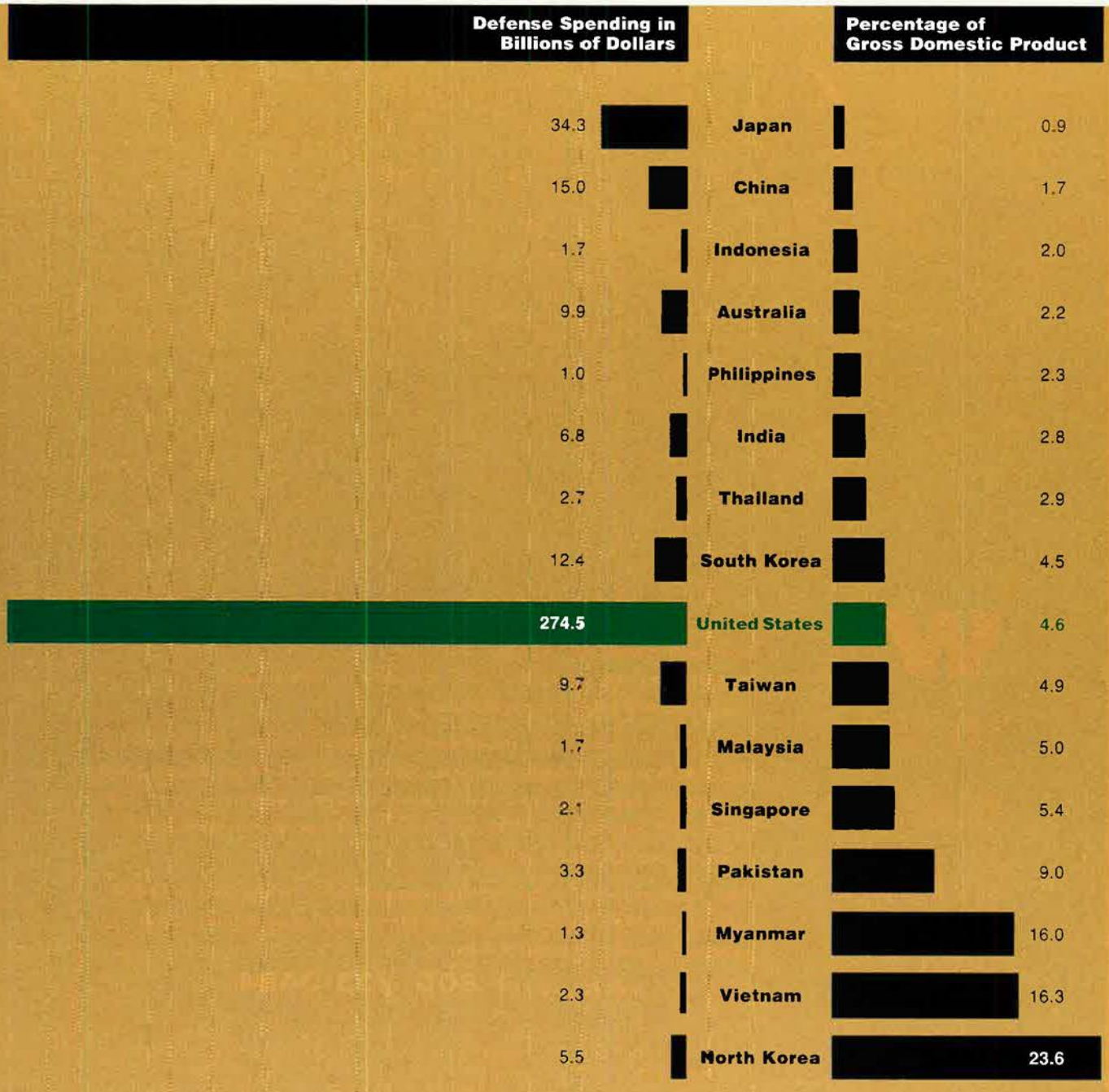
The Chart Page

By Tamar A. Mehuron, Associate Editor

Asian Defense Spending



Figures are for the most recent year available: 1992 in all cases but Vietnam (1989).

Adapted from Richard D. Fisher and Jason E. Bruzdzinski, eds., *US and Asia Statistical Handbook*, 1993 edition, The Heritage Foundation Asian Studies Center, Washington, D. C.

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NORTHROP

B-2 Division

Aerospace World

By Frank Oliveri, Associate Editor

Two generations of Lockheed trainers flew in formation for the first time recently over Clemson University, S. C.. The top plane is a vintage T-33A, one of the first jet trainers. The bottom plane is a T-Bird II, Lockheed's entry, with Aermacchi of Italy, in the Joint Primary Aircraft Training System competition. The T-Bird II is a derivative of Aermacchi's MB-339A, a tandem-seat trainer in service with the air forces of eight countries.

The F-22's $41 Billion Future

In its final version of the Bottom-Up Review, the Department of Defense approved spending $41 billion over the next sixteen years on the Air Force's new F-22 fighter. However, it foresees spending even more on the Navy's new F/A-18E/F strike fighter.

The "Report on the Bottom-Up Review," released in mid-October, provided new estimates of Pentagon aircraft expenditures during Fiscal Years 1994–2009.

According to the report, spending on the F-22 would peak in Fiscal 2000 at about $4 billion and then decline to about $2 billion per year and remain at that level through 2009. The report maintains that the Navy will spend $46 billion during the same period for the upgraded F/A-18 Hornet, with costs set to peak at $4 billion in Fiscal 2005.

The expense of the Navy plane raised eyebrows, in that the new carrier-based fighter will be derived from an existing plane. The theory is that this should hold down costs. The F-22 is a new design; its price tag, unlike the F/A-18E/F, includes heavy development costs.

Spending on the Joint Advanced Strike Technology program will hit $1 billion in Fiscal 2001 and will bulge to $2 billion a year between 2003 and 2006.

Somalia Venture Winding Down

In the wake of a disastrous firefight between US commandos and Somali irregular gunmen, President Clinton set a March 31 deadline for withdrawal of US ground forces from Somalia. The battle resulted in the deaths of nineteen US servicemen.

Nevertheless, the President increased the US presence in Somalia to 7,100 troops and deployed four more USAF AC-130 gunships to the scene. The troops and planes complement 18,000 UN troops already there.

Air Force C-5 and C-141 transport planes airlifted tanks and fighting vehicles to Somalia in early October. The transports flew out of Hunter Army Airfield, Ga. The AC-130 aircraft came from the 16th Special Operations Wing at Eglin AFB, Fla., and flew out of Brindisi, Italy.

Mogadishu Battle Examined

The bloody October 3 battle in the streets of Mogadishu cost not only nineteen US Army Ranger fatalities but also nearly eighty wounded. Somali casualties were estimated in the hundreds.

As an angry Congress sought an explanation, Defense Secretary Les Aspin acknowledged that the US commander in Somalia had earlier requested additional armor—four tanks and fourteen Bradley fighting vehicles. The Pentagon chief said he rejected the request because the move would have caused political problems in Congress. Lack of such vehicles on October 3 hindered efforts to rescue the Rangers, who were pinned down after an operation went awry.

Some 100 Rangers, carried by UH-60 Black Hawk helicopters, mounted a surprise raid to seize members of the clan of Mohamed Farah Aideed. As the Rangers were pulling out, Somalis shot down two Black Hawks. The Rangers encircled and protected the grounded crew members but had to wait nearly twelve hours to be relieved by a UN force equipped with armor.

US forces entered the African nation last December on a humanitarian mission to relieve widespread famine.

B-2 Off the Hooks

The B-2 bomber program worked itself free of twenty-eight congressional "hooks," special requirements holding up funding of the Air Force's long-

range stealth aircraft. The Air Force met congressional demands for proof that the B-2 would meet all program goals.

The accomplishment, which Defense Secretary Les Aspin announced in a formal report to Congress in mid-October, set the stage for lawmakers to unblock $2.2 billion in B-2 funding authorized in Fiscal 1992 and 1993. Congress still had to take a new vote on the release of the "fenced" production funds, earmarked to pay for the final five B-2 bombers.

Eight of the congressional hooks focused on the B-2's radar cross section and survivability. Tests in 1992 found the B-2 somewhat more survivable than had been anticipated as a result of a benchmark simulation in 1982. This was true even though the plane did not meet all of its 270 planned radar cross section values.

For three years, the Air Force has been working to meet the demands of fifty-eight congressional restrictions on the B-2. The recent package dealt with the last twenty-eight of these restrictions.

AFMC Wins Defender Challenge

Teams from Air Force Materiel Command took the crown jewel event of Peacekeeper Challenge at Kirtland AFB, N. M., winning the Defender Challenge combat tactics course.

The twelfth annual Peacekeeper Challenge competition, which lasted a full week, was held in September. Pitted against each other were sixteen top Security Police teams from the US Air Force, Royal Air Force, Royal Australian Air Force, and Canadian Air Force.

A team from US Air Forces in Europe took second in Defender Challenge. Third-place honors went to a team from Air Combat Command.

Winners in other events, in order of finish:

- Handgun—Air Force Space Command, USAFE, ACC.
- Machine gun—Air National Guard, Air Education and Training Command, ACC.
- Combat rifle—ACC, USAFE, AFSPACECOM.
- Grenade launcher—Air Mobility Command, Air Force Reserve, USAFE.
- Team physical fitness—ACC, AMC, AFMC.
- Individual physical fitness—ACC, RAF, USAFE.

B-1B Pilot Logs 2,000th Hour

Maj. Richard B. Witt, assigned to the 7th Wing at Dyess AFB, Tex., logged his 2,000th flight hour in the B-1B bomber in September. The achievement makes him the most experienced B-1B pilot in the Air Force.

Major Witt might never have reached his 2,000th hour had he demonstrated any lack of skill on December 19, 1990, when one of his engines caught fire during a no-flap, low-approach maneuver to practice a simulated emergency procedure.

The rule book on the B-1B suggests ejecting pilot and crew in such a situation. "We felt a bump, as the aircraft was pushed forward, up, and to the right, and a bright orange halo illuminated the sky in front of me," Major Witt said.

Instruments told the Major there was a problem with one of the right engines, and copilot Capt. Vernon Benton confirmed that the number three engine was on fire. "I started to turn back to the runway as the Runway Supervisory Officer called over guard frequency to report we were on fire," Major Witt said. "I made a somewhat colorful comment to the crew about the RSO's powers of observation and told the copilot to extend the slats. By then I could see the runway and called for flaps down. The copilot put the flaps down and sent the reserve agent [a fire-suppression system] into the engine compartment."

The RSO called to confirm that the aircraft would land on runway sixteen, but Major Witt said he would land on runway thirty-four—against traffic.

"We touched down 1,000 feet down the runway, and, as we rolled out, I told the crew to lock their ejection seats, go manual, but don't waste time putting their seat pins in. We were getting out on the runway," recalled Major Witt. The crew egressed safely, and the fire was put out.

Provide Promise Passes Milestone

Operation Provide Promise, the effort to bring food, fuel, and medicine to Sarajevo, Bosnia, has eclipsed in duration the historic Berlin Airlift of 1948–49.

In the foreground is the F/A-18D that recorded the two millionth flight hour flown in a Hornet. The milestone was achieved by Marine Corps Majs. Michael Sawyers and Steven Nedderson while flying over Bosnia-Hercegovina in September.

The Air Force announced that on October 8, 1993, the current airlift surpassed the 462-day Berlin Airlift.

By mid-October, the Air Force had flown about 2,000 missions into Sarajevo and moved more than 24,000 tons of cargo. In addition, the Air Force has air-dropped about 10,000 tons of supplies during 1,400 sorties over Bosnia.

The fighting in Bosnia has claimed 135,000 lives.

B-2 Blocks and Bomb Types

The Air Force said that its fleet of twenty B-2s will be produced in three progressive blocks of capability.

Block 10 aircraft will carry one type of nuclear bomb (the B83) and one type of conventional weapon (Mk. 84 2,000-pound munition).

Block 20 will carry one more nuclear weapon, the B61, plus CBU-87, CBU-89, and CBU-97 cluster bomb munitions. In addition, Block 20 planes will have a limited capability for the AGM-137 Triservice Standoff Attack Missile (TSSAM) and a Global Positioning System–aided munition called the GPS Advanced Targeting System/

Joint Direct Attack Munition. The aircraft can carry eight TSSAMs, four on each of the two B-2 rotary launchers.

Block 30 aircraft will carry the JDAM, the Mk. 82 500-pound general-purpose bomb, the M117 750-pound general-purpose bomb, the Mk. 62 aerial mine, and the JDAM-1.

Pentagon Stands Up "USA" Command

Secretary of Defense Les Aspin activated a new unified command in October, joining under one flag the Air Force's Air Combat Command and US-based combatant commands of the Army, Navy, and Marines.

The name of the new entity—US Atlantic Command—has been used for years by a command composed mainly of the US Navy's Second Fleet and associated Marine units. However, the officially approved nickname no longer will be "LANTCOM" but "USACOM," perhaps even "Americas Command."

Northrop's upgraded avionics suite for the F-5, which includes new radar, head-up display, inertial navigation system, and communications and fire-control management systems, is expected to extend the F-5's service life into the next century.

Adm. Paul David Miller is the first commander in chief of the new command, headquartered at Norfolk Naval Base, Va. Its mission is to be able to mount a deployment force package that can provide needed capabilities in distant conflicts.

The new command was formed after it was recommended in former Joint Chiefs of Staff Chairman Gen. Colin L. Powell's roles and missions report. It will blend service exercises into joint training to reduce costs of transportation, range use, and other support factors, while preparing officers for command on the joint battlefield, Mr. Aspin said.

USACOM will also be responsible for planning the defense of the US and Canada; supporting space operations, humanitarian assistance, and disaster relief; and responding to requests for military assistance to civil authorities in the US.

C-5s Bring Relief to India

A few days after an earthquake virtually destroyed a rural area in India, two Air Mobility Command C-5 Galaxys flew into Bombay, India, with relief supplies, the Air Force said.

One C-5 was from the 436th Airlift Wing at Dover AFB, Del., and the other from the 60th AW at Travis AFB, Calif.

The US Office of Foreign Disaster Assistance provided 1,000 rolls of plastic sheeting, 950 tents, and 18,550 five-gallon water containers. The Pentagon provided twenty-two air cargo pallets of blankets, litters, shelter halves, and medical supplies, such as bandages and orthopedic supplies for bone fractures.

More than 55,000 daily rations will be available for delivery to India if requested, DoD said.

New Medical System By 1995?

If Congress approves President Clinton's national health-care reform proposal, the Pentagon's Tricare plan could be in place by early 1995. Those eligible for military medical care would eventually have to enroll in the plan to receive care at a Defense Department medical facility.

Under Tricare, DoD would set up an integrated network of military medical treatment facilities and contracted civilian providers to offer health care in twelve regions of the US.

Key features of the plan:

- Active-duty members will be automatically enrolled at no cost and will receive medical care either at a military facility or through a contracted civilian doctor specified by the military at no cost.
- Families of active-duty members at E-4 and below can enroll in the plan at no cost. Families of higher-ranking active-duty members, including officers, can enroll for an annual fee of $35 per person or $70 per family. Retirees and their families can enroll for an annual fee of $50 per person or $100 per family.
- Active-duty members' families and retirees and their families can continue to use military medical facilities without charge.

If space-available appointments are not available at a military facility, patients can be referred to a doctor specially contracted to handle their needs.

Under other Tricare provisions, active-duty families of E-4s and lower grades will pay $5 per visit to a contracted doctor. Active-duty families of E-5s and above, including officers, will pay $10 per visit. Retirees and their dependents will pay $15 per visit.

Patients will not pay for prescriptions filled at military facilities, even if the contracted civilian doctor writes the prescription.

Families using contracted doctors will pay no deductibles. Cost-sharing fees will be less than under the standard CHAMPUS (Civilian Health and Medical Program of the Uniformed Services) plan. Currently, CHAMPUS deductibles range from $50 to $300, depending on sponsor's duty status and rank, with CHAMPUS paying seventy-five percent to eighty percent of cost-sharing fees.

Under Tricare, DoD will pay an average of eighty percent of insurance premiums for military beneficiaries not employed in the civilian sector.

In areas where Tricare is not available, DoD will pay up to 100 percent of the premium for active-duty members' families who choose the lower-cost civilian managed-care plan and up to eighty percent of the premium

for retirees and their families. Families can change from one primary care provider to another within the plan. However, once enrolled in Tricare, families cannot switch to another plan until the next year. This does not apply to people making a permanent change of station.

No Enlisted SERBs in 1994

There will be no enlisted Selective Early Retirement Boards in Fiscal 1994, according to the Air Force's senior enlisted man. CMSAF Gary R. Pfingston said the Air Force in 1994 will seek about 4,500 more separations than usual.

"I want to do everything we can to do this whole process voluntarily, to avoid an involuntary separation," Chief Pfingston said. "We've been able to do that all these years."

He said, however, that the service has managed to take cuts by eliminating spaces at the margins of the force and is now running out of flexibility. Much depends on what is included in the 1995 defense authorization bill, said Chief Pfingston, who still believes the force is unlikely to see an involuntary reduction.

USAF Will Lose 156 Combat Aircraft

Reductions in Fiscal 1994 funding will leave the USAF inventory with 156 fewer combat-coded fighters, the Air Force said in the Air Force Issues Book for 1993.

Of the 156, 132 will be cut outright and twenty-four will fall victim to accelerated reductions. Savings are being gained in mobility forces in Fiscal 1994 by accelerating the retirement of twenty-six KC-135A tankers and sixteen C-130s.

Thirteen Air National Guard Operational Support Transport Aircraft C-12s, nine ANGOSTA C-130s, and three VC-137Bs will retire in Fiscal 1993 and Fiscal 1994. Ten KC-135Rs will transfer to the Air Reserve Component in Fiscal 1994, and USAF will procure two fewer C-17s in Fiscal 1994.

In the mid-1980s, the Air Force maintained 211 wings of all types (166 active-duty, forty-five Guard and Reserve). By 1995, it will maintain 128 wings (eighty-three active-duty, forty-five Guard and Reserve).

Since 1986, the Air Force has reduced personnel by nearly 200,000 to 425,700.

Lackland Has Top Tech Team

Lackland AFB, Tex., won the top team trophy in Top Tech IV, Air Education and Training Command's technical training instructor competition held at Lackland last September. Top Tech is a semiannual instructor competition that highlights the skill necessary to train members of the Air Force. Thirty-three competitors from five major command bases made up the seven teams.

The one-day event is a short-notice competition during which selected AETC technical instructors and faculty development instructors each prepare and present fifty minutes of instruction. Military training managers compete by performing flight drills and conducting briefings.

Lackland AFB captured seven individual awards along with the top team trophy. Runner-up in the team competition was Lowry AFB, Colo., which also won seven individual awards. Sheppard AFB, Tex., took four individual awards.

Individual award winners:

Best overall: Capt. Jeffrey Carrothers, Lowry, officer instructor; Jere Hicks, Lackland, faculty development instructor; TSgt. Wilfredo Pagan, Lowry, senior enlisted instructor; SSgt. Patrick Stanford, Lowry, junior enlisted instructor; Joseph Whalen, Jr., Sheppard, civilian instructor; SSgt. Napoleon Willis, Lackland, military training manager.

Best use of training aids: TSgt. Dale Gram, Lackland, senior enlisted instructor; Ms. Hicks; 1st Lt. Daniel Pacheco, Lackland, officer instructor; Sgt. Reynaldo Sanchez, Sheppard, junior enlisted instructor; Mr. Whalen.

Best presentation: Captain Carrothers; Ms. Hicks; Patrick Hyde, Lowry, civilian instructor; Sergeant Pagan; Sergeant Stanford.

Best briefing: SSgt. Patricia Smith, Sheppard, military training manager.

Best flight: Sergeant Willis.

AMC Starts Third-Pilot Program

A shortage of navigators throughout the Air Force has led Air Mobility Command to form what it calls a Third-Pilot Program, designed to stem the exodus of "banked" pilots from USAF and to open career possibilities for navigators.

AMC has more than 900 banked pilots, with 300 programmed to enter the force in the next three years. The lull in navigator production from the undergraduate navigator training program results from the school's move from Mather AFB, Calif., to Randolph AFB, Tex.

Even when the school comes back on line, it will produce only about 100 navigators a year. By 1995 there will be a significant gap between production and demand.

"Rather than continue to increase the pilot bank, we are looking at moving some of our excess pilot capacity to the KC-135 flight deck as third pilots," said Gen. Ronald R. Fogleman, the AMC commander.

Trained as aviators, the third pilots would first attend KC-135 simulator and academic classes to learn about the plane's systems. Then they would be trained in key navigation

A B-52 carries AGM-142 Have Nap missiles under its wing. In September flight tests in New Mexico and Utah, the AGM-142, a precision guided, medium-range, conventional standoff missile, demonstrated "superior performance," according to AFMC.

"There I Was . . ." Winds Up After 360 Episodes

For the past 360 issues, the favorite page in AIR FORCE Magazine for most readers has been "There I Was . . ." by Bob Stevens. The long run ends this month. The cartoon on the last page of this issue will be the final one, since Bob Stevens's health will not allow him to continue.

It all began in September 1963, when Bob wrote to AIR FORCE Magazine saying he had "reams of material" and wondering if the magazine might be interested in publishing some of it. The first episode appeared in January 1964.

What Bob Stevens served up every month for the past thirty years was the texture and feel of the Air Force—what life was like in the cockpit, on the flight line, in the maintenance shops. The people in "There I Was . . ." had an uncanny way of reminding readers of people they knew. The scenes Bob Stevens drew often had a ring of truth.

It has been a fantastic run for thirty years and 362 pages (two episodes were double-page spreads), and it won't be quite the same now that Bob Stevens has hung up his pencil. The editors, along with everybody else, will now satisfy their "There I Was . . ." cravings by turning to one of the half-dozen or so cartoon collections published over the years. The best of these was a 300-pager, *There I Was . . . 25 Years,* which came out in 1990.

Of all the cartoonists who took the Air Force or flying as their subjects, only the great Milton Caniff was in the same league with Bob Stevens—and even there, most people would agree that Bob's ski-nosed aviators were a lot funnier than Steve Canyon.

skills. After training, they would report to their units to fly as third pilots, performing some navigator duties as they learn the aircraft and the mission. That would enable the service to move KC-135 navigators into the weapon systems where they are needed most.

General Fogleman said this is only a temporary remedy to a temporary problem. The KC-135 will be reconfigured and modernized over time to allow only two pilots and a boom operator to operate the airplane.

Reserve C-130s Transferred

The Air Force transferred authority over ten Reserve C-130 units from AMC to ACC, the service said.

The October reorganization fosters a closer working relationship between the two commands and gives theater commanders greater control of deployed C-130s.

In a letter to C-130 units, ACC Commander Gen. John M. Loh said, "The marriage of the C-130 community and Air Combat Command is a natural union and recognizes our common mission. Our command has the responsibility for providing versatile combat forces worldwide and delivering rapid, decisive airpower—any time, anywhere."

The units transferred are the 94th Airlift Wing, Dobbins ARB, Ga.; 302d AW, Peterson AFB, Colo.; 403d AW, Keesler AFB, Miss.; and 440th AW, General Mitchell International Airport/ARS, Wis. The airlift groups are the 908th AG, Maxwell AFB, Ala.; 910th AG, Youngstown Municipal Airport/ARS, Ohio; 911th AG, Pittsburgh IAP/ARS, Pa.; 913th AG, Willow Grove ARS, Pa.; 914th AG, Niagara Falls IAP/ARS, N. Y.; and 934th AG, Minneapolis–St. Paul IAP/ARS, Minn.

Progress in Repatriating Remains

During the first eight months of 1993, the US repatriated the remains of forty-two servicemen listed as missing in the Vietnam War, with another thirteen to fifteen sets of remains to be returned in the near future, the Pentagon said in September.

Secretary of Defense Les Aspin said that joint investigations in Vietnam into high-priority last-known-alive cases have determined the fate of an additional twelve individuals.

Mr. Aspin reasserted that any improvement in US-Vietnam relations will depend on further progress in accounting for POWs and MIAs.

New ANG Director Appointed

In September, Secretary of the Air Force Sheila E. Widnall appointed Brig. Gen. (Maj. Gen. selectee) Donald W.

Senior Staff Changes

RETIREMENT: L/G John B. **Conaway.**

PROMOTIONS: To be **Lieutenant General:** James E. **Chambers.**

To be **Major General:** Donald W. **Shepperd.**

To be **ANG Major General:** John R. **Haack,** Alan T. **Reid,** Glen W. **Van Dyke,** John M. **Wallace.**

To be **ANG Brigadier General:** Timothy J. **Griffith,** William A. **Henderson,** Kenneth U. **Jordan,** David L. **Ladd,** Daniel F. **Lopez,** Theodore F. **Mallory** III, Ronald E. **McGlothlin,** Ronald J. **Riach,** David M. **Rodrigues,** Guy S. **Tallent,** Irene **Trowell-Harris,** Larry R. **Warren,** Gale O. **Westburg.**

CHANGES: B/G Donald L. Peterson, from Cmd. Dir., NORAD Combat Ops. Staff, Cheyenne Mountain AFB, Colo., to Vice Dir., NORAD Combat Ops. Staff, Cheyenne Mountain AFB, Colo., replacing B/G James S. Savarda . . . **B/G James S. Savarda,** from Vice Dir., NORAD Combat Ops. Staff, Cheyenne Mountain AFB, Colo., to Dir., NORAD Planning Staff, Hq. NORAD, Peterson AFB, Colo., replacing retired B/G Timothy D. Gill . . . **B/G Ervin C. Sharpe, Jr.,** from Vice Cmdr., 7th AF, PACAF; Vice Cmdr., US Air Forces Korea; and C/S, ROK/US Air Comp. Cmd., CFC, Osan AB, South Korea, to Dep. Dir., Ops., J-3, Hq. USPACOM, Camp H. M. Smith, Hawaii, replacing M/G W. Thomas West . . . **M/G W. Thomas West,** from Dep. Dir., Ops., J-3, Hq. USPACOM, Camp H. M. Smith, Hawaii, to Spec. Ass't for Theater Defense, Hq. USAF, Washington, D. C.

SENIOR EXECUTIVE SERVICE (SES) CHANGES: Sheila C. Cheston, to Deputy, General Counsel, OSAF, Washington, D. C. . . . **Morris D. Goodrich,** to Dir., Contracting, Ogden ALC, AFMC, Hill AFB, Utah, replacing William Ernst.

SES RETIREMENTS: Maurice **LeBlanc,** Eva C. **Ugarkovich.** ■

Shepperd to be director of the Air National Guard.

General Shepperd replaced Maj. Gen. Philip G. Killey, who had headed the ANG since November 1988. The ANG director is responsible for the operational and administrative functions of the Guard's ninety-two flying units and more than 590 mission support units. These units, located in fifty-four states and territories, consist of more than 118,000 members.

General Shepperd was formerly deputy director of the Air National Guard. He is a 1962 graduate of the US Air Force Academy.

DoD Introduces HDR

The Pentagon introduced a new humanitarian daily ration (HDR) designed to meet the nutritional needs of civilians and to replace the meal, ready-to-eat (MRE) currently used in humanitarian relief operations.

Defense Secretary Les Aspin said that DoD consulted nutritional and relief experts as well as private volunteer organizations in developing the requirements for the new ration. An initial order of 2.15 million HDRs, at a cost of $8.5 million, was made using funding from DoD's International Disaster Relief account.

Approximately fifty-three million MREs have been delivered to numerous countries during the last two years. The MRE is a single-serving meal nutritionally designed for the US soldier. Three MREs per day provide about 3,600 calories and cost about $13.80.

One HDR is a full day's ration and includes two entrees and complementary products. Designed for relief of moderately malnourished people, one HDR provides between 1,900 and 2,000 calories per day and costs about $3.95. The HDR uses primarily vegetable products, making it universally acceptable. There are six varieties.

EIA Sees Procurement Stabilizing

The Pentagon's procurement budget is expected to stabilize in 1994, despite the continued decline in the defense budget, the Electronic Industries Association reported in its "Ten-Year Forecast of Defense Electronics" released in October.

EIA said in the report, "Our research told us that the US wants to maintain a ready and capable, albeit smaller, military force and is not ready to completely disarm. There is a minimum investment required to sustain such a military, and EIA predicts that in Fiscal 1994 we will have reached that minimum for the procurement budget."

EIA said that the Pentagon will continue to invest about fourteen to fifteen percent of its total budget in maintaining its technological edge. However, there is likely to be a twenty-two percent reduction in R&D funding over the next ten years as many programs are terminated or moved into procurement. "Most DoD reductions will come from the personnel and operations and maintenance accounts," EIA said.

Two Fighter Crashes; All Crews Survive

The two crew members of an F-111F safely ejected from their fighter before it crashed near the Melrose Bombing Range, about twenty-five miles west of Cannon AFB, N. M.

Pilot Capt. Robby A. Kyrouac and Capt. Gregory Wilson, the Weapon System Officer, were treated for minor injuries and released. Both are assigned to the 522d Fighter Squadron at Cannon.

The aircraft was flying a routine night mission in September with two other aircraft when the accident occurred. The accident is under investigation.

In another mishap, two F-16s from Luke AFB, Ariz., collided in midair. One aircraft crashed; the other landed safely. Neither pilot was injured, though one pilot was forced to eject.

The aircraft were assigned to the 944th Fighter Group (AFRES) and were on a routine training mission near Gila Bend, Ariz. The accident is being investigated.

Female Reservist Closes In on F-16s

1st Lt. Leslie DeAnn Crosby took another step toward becoming the first female fighter pilot in the Air Force Reserve when she entered F-16 fighter training in Tucson, Ariz., in mid-October.

Lieutenant Crosby graduated from the Introduction to Fighter Fundamentals course at Holloman AFB, N. M., in early October. She was the fourth woman to complete IFF. The Lieutenant is an Air Reserve technician and a full-time civil service employee and is attending F-16 school as a civilian. She will likely be assigned to the Reserve's 507th Fighter Group at Tinker AFB, Okla., in May, upon completion of the training course.

Lieutenant Crosby has taken part in Operations Desert Shield, Desert Storm, Desert Calm, and Southern Watch, earning the Humanitarian Service Medal and the Southwest Asia

Grace Lizzio Retires After Twenty-Two Years

After twenty-two years of helping to make AIR FORCE Magazine as accurate as possible, Editorial Associate Grace Lizzio retired in October. Ms. Lizzio's by-line never appeared in the magazine, but she performed dozens of tasks that helped make the publication a reality. Throughout a career that began in the era of upright Royal typewriters and carbon paper and ended in the era of computers and floppy disks, Ms. Lizzio remained a consummate professional, rigorously upholding the rules of grammar and punctuation and noting every textual discrepancy, no matter how slight.

Despite her longtime residence in the Washington, D. C., area, Ms. Lizzio never lost the sardonic skepticism (or the accent) of her native Brooklyn. That skepticism was valuable in her proofreading tasks, but even more valuable was the clockwork precision and methodical tenacity she employed in the battle against inaccuracy and error.

Everyone at AIR FORCE Magazine will have to work hard to uphold the professional standard she set.

Separations of Active-Duty Service Personnel, Fiscal 1992

Reason	Army	Navy	USMC	USAF	Total
Expired service term or contract	44,900	36,500	21,400	22,300	125,100
Early out release	34,700	3,700	0	1,800	40,200
Special Separation Benefit	25,500	3,600	700	15,000	44,800
Voluntary Separation Incentive	3,600	600	200	2,300	6,700
Selective Early Retirement Board	1,700	400	200	1,000	3,200
Regular retirement	18,200	9,200	2,700	16,800	47,000
Involuntary separation with pay	5,400	800	1,900	2,900	11,000
Involuntary separation without pay	11,500	20,400	5,400	100	37,300
Other	40,000	23,900	10,400	19,400	93,700
Total	185,400	99,000	42,900	81,600	409,000

Source: US General Accounting Office, "Military Downsizing," September 1993. "Other" category includes separations due to hardship, death, trainee losses, unsuitability, misconduct, desertion, and failure to meet physical requirements. Numbers are rounded.

Service Medal with two Bronze Stars. She is currently a KC-10 aircraft commander with more than 1,700 hours in military aircraft and 700 hours in civilian aircraft. She is also an aerobatics pilot and flies antique and veteran military aircraft.

News Notes

■ Defense Secretary Les Aspin announced that the nomination of Army Gen. George A. Joulwan as Supreme Allied Commander Europe and Commander in Chief, United States European Command, was approved by NATO in October. General Joulwan's most recent assignment was as commander in chief of US Southern Command at Quarry Heights, Panama.

■ The Air Force said in September that two Air National Guard units—the 184th Fighter Group at McConnell AFB, Kan., and the 116th Fighter Wing, which will relocate from Dobbins ARB to Robins AFB, Ga.—will convert to B-1B bomber units. The timing for the change has not yet been established. B-1Bs are located at four bases: McConnell; Grand Forks AFB, N. D.; Ellsworth AFB, S. D.; and Dyess AFB, Tex. McConnell will lose all of its sixteen active-duty B-1Bs. Grand Forks will also lose its sixteen B-1Bs. Both Ellsworth and Dyess will be assigned additional bombers.

■ A German Arado Ar-234B Blitz has been put on display at the Smithsonian Institution's National Air and Space Museum, becoming the second in the museum's "Airpower in World War II" series. The aircraft will be on display through September 1994. The jet-powered aircraft entered service in 1944 after the Normandy invasion but was developed too late to play a significant role in the German war effort.

■ The Air Force chose more than 2,100 captains for Regular Air Force appointments in mid-October, the service said. A total of 2,770 captains were considered by the calendar 1993C Regular Air Force Appointment Board, which met in August. The board selected eighty-five percent of the line

Index to Advertisers

officers and eighty percent of the chaplains considered. Health-profession captains with a 1988 date of rank had an eighty percent selection rate. Those with a 1991 date of rank had a fifty percent selection rate. Health-profession officers included those from the Nurse Corps, Medical Service Corps, and Biomedical Sciences Corps.

■ In October, the Air Force appointed the first woman ever to head a major weapon system program office (SPO). Col. Leslie F. Kenne, former deputy director of Tactical Programs, Assistant Secretary of the Air Force for Acquisition, was named director of Aeronautical Systems Center's F-16 SPO. Colonel Kenne replaces Brig. Gen. Ronald T. Kadish, who now heads the C-17 SPO. A twenty-two-year veteran from Shreveport, La., Colonel Kenne headed the Low-Altitude Navigation and Targeting Infrared for Night SPO in 1990.

Purchases

The Air Force awarded Pratt & Whitney a $15 million face-value increase to a cost plus award fee contract for an F-22 aircraft program by extending the life of the program. Expected completion: March 2001.

The Air Force awarded Lockheed a $361 million face-value increase to a firm fixed-price contract for eighteen C-130 aircraft. Expected completion: December 1994.

The Air Force awarded Northrop Corp. a $189 million face-value increase to a fixed-price incentive firm contract for funding action covering October 1993 through December 1993. It involves the application of $40.5 million in advanced procurement funds and $146.6 million in production funds to continue long-lead activities on the last five B-2 aircraft. Expected completion: January 1998.

Obituaries

CMSgt. Duane D. Hackney, USAF (Ret.), the most decorated enlisted man in Air Force history, died in September of a heart attack at his Trout Run, Pa., home. He was forty-six.

Chief Hackney served for twenty-two years as a pararescueman. On February 6, 1967, he volunteered to be lowered into the southeast Asian jungle to search for a downed pilot. *[See "Valor: USAF's Most Decorated PJ," March 1989, p. 119.]* The first attempt failed, but he went in a second time after being summoned by friendly radio signals.

This time he found the flyer. After they had been hoisted into the helicopter, it was hit by ground fire. Chief Hackney fit his own parachute around the wounded pilot and helped him out the door. He then located another parachute just as the helicopter was hit again, blowing him from the aircraft.

Despite severe wounds, he managed to pull the cord of the unbuckled parachute and made it to the ground. He was later picked up but was the only survivor of the rescue attempt. For that act he received the Air Force Cross. That same year he received the Cheney Award for valor and was recognized as the Military Airlift Command Airman of the Year.

Chief Hackney survived 199 combat missions in Vietnam. He left the Air Force in 1973, returning in 1977 as a pararescue instructor. In 1980, he was assigned to help rescue two British civilians lost while mountain climbing in northern Wales. An accident during the rescue left him with a broken hip, three broken ribs, a fractured skull, and a broken clavicle.

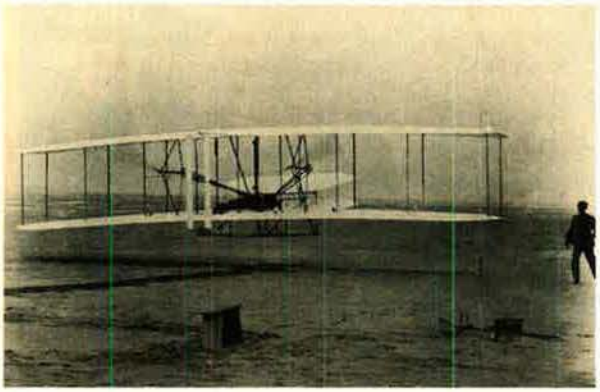
He later entered the intelligence field and took part in operations in Turkey and Grenada.

Chief Hackney retired from active duty in 1991. He earned the Air Force Cross, Silver Star, Distinguished Flying Cross with three oak leaf clusters, Airman's Medal, Purple Heart, and fifty-five other honors. He is survived by his wife and son.

Col. Erich Alfred Hartmann, German Air Force (Ret.), the highest-scoring fighter ace ever (352 confirmed aerial victories during World War II), died in September at his home in Weil im Schönbuch, Germany. Having been in poor health for several years, he died in his sleep at seventy-one.

Colonel Hartmann enlisted in the Luftwaffe in October 1940. After being trained as a fighter pilot, he was posted to the eastern front, where he first entered combat in October 1942. He flew more than 1,400 combat missions and was involved in more than 800 aerial battles. Most of his victories came against single-engine Soviet fighters. He also scored seven victories against USAAF P-51 Mustangs. His unit was forced to surrender to the US Third Army in Czechoslovakia in 1945 and was turned over to the Soviets.

Colonel Hartmann was imprisoned for the next ten years and stripped of all soldier's rights guaranteed by the Geneva Convention. He returned to Germany in 1955 and a year later joined the Bundesluftwaffe. During a tour at Luke AFB, Ariz., he refreshed his skills as a fighter pilot and commanded West Germany's first postwar fighter wing. He retired in 1973. He is survived by his wife and daughter. ■



Nine decades ago, the windy Outer Banks of North Carolina achieved landmark status when two brothers from Ohio took to the air in the first powered, sustained, controlled, heavier-than-air flight. At right is a reenactment of the event with the monument in the background.

Photo © Jim Sugar / Black Star

Up From Kitty Hawk

This chronology was compiled by Jeffrey P. Rhodes, a former Aeronautics Editor of Air Force *Magazine now employed in the aerospace industry. His most recent article for* Air Force *Magazine, "Changes Under the Canopy," appeared in the April 1991 issue.*

1903–1913

December 17, 1903. At Kitty Hawk, N. C., Orville Wright achieves the world's first manned, powered, sustained, and controlled flight by a heavier-than-air vehicle. His fourth and longest flight of the day is 852 feet in fifty-nine seconds. Three days earlier, Wilbur Wright achieved the world's first powered airplane flight—105 feet in 3.5 seconds—but crashed soon after takeoff, and his flight is not regarded as being either sustained or controlled.

January 13, 1905. The Wright Brothers open negotiations with the US government to build an airplane for the Army, but nothing comes of this first meeting.

February 8, 1905. T. S. Baldwin takes part in a ten-mile race between his dirigible and an automobile. The dirigible and its pilot win by a three-minute margin.

June 23, 1905. The first flight of the Wright Flyer III is made at Huffman Prairie, outside Dayton, Ohio. The Wright Brothers' first fully controllable aircraft is able to turn and bank and remain aloft for up to thirty minutes.

August 1, 1907. The Aeronautical Division of the US Army Signal Corps, forerunner of US Air Force, is established.

December 23, 1907. The Army's Chief Signal Officer, Brig. Gen. James Allen, issues the first specification for a military airplane.

January 13, 1908. Henri Farman wins the 50,000-franc Deutsch-Archdeacon Prize for the first officially observed one-kilometer circular flight in Europe.

May 19, 1908. Signal Corps Lt. Thomas E. Selfridge becomes the first soldier to fly a heavier-than-air machine.

July 4, 1908. Glenn H. Curtiss wins the *Scientific American* trophy with his *June Bug* biplane by flying for more than a mile over Hammondsport, N. Y. Speed for the trip is thirty-nine mph.

August 8, 1908. At Camp d'Auvours, France, Wilbur Wright surpasses French flight records for duration, distance, and altitude.

September 17, 1908. Lt. Thomas E. Selfridge becomes the first person killed in a powered aircraft accident when a Wright Flyer crashes at Fort Myer, Va. Orville Wright, at the controls, suffers serious injuries.

November 13, 1908. Wilbur Wright, in a Wright biplane at Camp d'Auvours, France, and Henri Farman, in a Voisin at Issy, France, concurrently set a world altitude record of eighty-two feet.

April 24, 1909. Wilbur Wright pilots a Wright biplane at Centocelle, Italy, from which the first aerial motion picture is taken.

July 27, 1909. Orville Wright, with Lt. Frank P. Lahm as passenger, makes the first official test flight of the Army's first airplane at Fort Myer, Va.

August 2, 1909. The Army accepts its first airplane, bought from the Wright Brothers for $25,000, plus a $5,000 bonus because the machine exceeds the speed requirement of forty mph.

The dangers of the new technology manifested themselves early in the US military's experiments with flight. Lt. Thomas E. Selfridge was the first person killed in a powered aircraft accident, which occurred September 17, 1908.

August 25, 1909. Land for the first Signal Corps airfield is leased at College Park, Md.

October 26, 1909. Lt. Frederick E. Humphreys becomes the first Army pilot to solo in the Wright Military Flyer at College Park, Md.

November 3, 1909. Lt. George C. Sweet becomes the first Navy officer to fly, as a passenger in the Wright Military Flyer.

January 19, 1910. Signal Corps Lt. Paul Beck, flying as a passenger with Louis Paulhan in a Farman biplane, drops three two-pound sandbags in a effort to hit a target at the Los Angeles Flying Meet. This is the first bombing experiment by an Army officer.

March 19, 1910. Orville Wright opens the first Wright Flying School at Montgomery, Ala., on a site that will later become Maxwell AFB.

July 10, 1910. Walter Brookins becomes the first airplane pilot to fly at an altitude greater than one mile. He reaches 6,234 feet in a Wright biplane over Atlantic City, N. J.

August 20, 1910. Army Lt. Jacob Fickel fires a .30-caliber Springfield rifle at the ground while flying as a passenger in a Curtiss biplane over Sheepshead Bay Track near New York, N. Y. This is the first time a military firearm has been discharged from an airplane.

September 2, 1910. Blanche Scott becomes the first American woman to solo, flying a Curtiss pusher at the Curtiss company field in Hammondsport, N. Y. She is not granted a pilot's license, however.

October 11, 1910. Former President Theodore Roosevelt becomes the first Chief Executive to fly. He goes aloft as a passenger in a Wright biplane over St. Louis, Mo.

November 7, 1910. Phillip O. Parmalee performs the world's first air cargo mission, flying a bolt of silk from Dayton to Columbus, Ohio.

November 14, 1910. Navy Lt. Eugene Ely, in a Curtiss biplane, takes off from the deck of a modified cruiser, USS *Birmingham.*

January 18, 1911. Navy Lt. Eugene Ely, flying a Curtiss pusher, makes the first landing on a ship. He touches down on a 119-foot-long wooden platform on the stern of the cruiser USS *Pennsylvania*, riding at anchor in San Francisco Bay.

September 17–December 10, 1911. Calbraith Perry Rodgers, in the Wright EX biplane *Vin Fiz*, makes the first transcontinental flight, from Sheepshead Bay, N. Y., to Long Beach, Calif. He makes seventy-six stops and crashes twenty times.

November 27, 1912. The Army Signal Corps purchases the first of three Curtiss-F two-seat biplane flying boats.

Even at a time when Army mules and horse cavalry were very much in evidence, the airplane was coming into its own. The 1916 punitive expedition against Pancho Villa employed all three.

December 11, 1912. A French pilot, Roland Garros, sets an altitude record of 18,406 feet in a Morane airplane at Tunis.

April 27, 1913. Pilot Robert G. Fowler and cameraman R. A. Duhem make the first flight across the Isthmus of Panama. They are arrested by Panamanian authorities upon publication in a newspaper of the story and pictures of the flight.

May 13, 1913. The first flight of the world's first four-engine airplane, *The Russian Knight,* affectionately called "Le Grand," takes place in Russia. The aircraft is designed by Igor I. Sikorsky.

May 30, 1913. The Massachusetts Institute of Technology begins teaching aerodynamics.

June 21, 1913. Eighteen-year-old Georgia "Tiny" Broadwick becomes the first woman to make a parachute jump in the US. Her 1,000-foot leap takes place over Los Angeles, Calif.

June 30, 1913. The first Navy aviator is killed: Ens. W. D. Billingsley is thrown from a seaplane.

July 19, 1913. In the skies over Seattle, Wash., Milton J. Bryant begins a new form of advertising—skywriting.

August 7, 1913. Lt. Petr Nikolaevich Nesterov of the Imperial Russian Army performs history's first inside loop while flying a Nieuport Type IV over Kiev.

1914–1923

January 20, 1914. The Navy's aviation unit from Annapolis, Md., arrives at Pensacola, Fla., to set up the first naval air station.

February 24, 1914. In the wake of a rash of accidents, an Army investigative board condemns all pusher-type airplanes.

April 25, 1914. Navy Lt. j.g. P. N. L. Bellinger, flying a Curtiss AB-3 flying boat from the battleship USS *Mississippi*, makes the first US operational air sortie against another country when he searches for sea mines during the Veracruz incident.

May 5, 1914. A patent is issued for hinged inset trailing-edge ailerons.

July 18, 1914. The Aviation Section of the Signal Corps is created by Congress. Sixty officers and students and 260 enlisted men are authorized.

August 25, 1914. Stephan Banic, a coal miner in Greenville, Pa., is issued a patent for a workable parachute design.

August 26, 1914. The first air battle of World War I on the eastern front takes place. Staff Capt. Petr Nikolaevich Nesterov records the first aerial ramming in combat.

December 1–16, 1914. Two-way air-to-ground radio communication is demonstrated in a Burgess-Wright biplane by Army Signal Corps Lts. H. A. Dargue and J. O. Mauborgne over Manila, the Philippines.

January 19–20, 1915. Germany launches the first zeppelin bombing raids on England. One airship, the L.6, turns back, but two others, the L.3 and L.4, drop their bombs on Great Yarmouth and King's Lynn.

March 3, 1915. Congress approves the act estab-

lishing the National Advisory Committee for Aeronautics. NACA is to "supervise and direct the scientific study of flight with a view to [its] practical solution." The committee, initially given a budget of $5,000, will evolve into the National Aeronautics and Space Administration.

April 1, 1915. French Lt. Roland Garros shoots down a German Albatros two-seater with a Hotchkiss machine gun fixed on the nose of his Morane-Saulnier Type L monoplane. The airplane's propeller is fitted with wedge-shaped steel deflector plates that protect the blades from damage as the rounds pass through the propeller arc.

March 15, 1916. The 1st Aero Squadron begins operations with Gen. John J. Pershing in a punitive expedition against Mexico and Pancho Villa.

March 21, 1916. The French government authorizes the formation of the *Escadrille Américaine.* The unit, made up of American volunteer pilots, is later renamed the Lafayette Escadrille.

November 27, 1917. Brig. Gen. Benjamin D. Foulois takes over as Chief of the Air Service for the American Expeditionary Force (AEF). He replaces Brig. Gen. William L. Kenly.

January 19, 1918. The US School of Aviation Medicine begins operations at Hazelhurst Field, Mineola, N. Y.

January 23, 1918. The first ascent by an AEF balloon is made at the balloon school in Cuperly, France.

February 5, 1918. While flying as a substitute gunner with a French squadron, Lt. Stephen W. Thompson becomes the first American to record an aerial victory while in a US uniform. He shoots down a German Albatros D.III but is credited with only half the victory, sharing the "kill" with the French pilot.

February 18, 1918. The first American fighter unit proper, the 95th Aero Squadron, arrives in France.

February 28, 1918. Regulation of the airways begins with an order by President Woodrow Wilson requiring licenses for civilian pilots or owners. More than 800 licenses are issued.

March 11, 1918. Lt. Paul Baer becomes the first AEF Air Service member awarded the Distinguished Service Cross.

March 19, 1918. The 94th Aero Squadron makes the first US operational flights across the front lines in France.

April 14, 1918. Lts. Alan Winslow and Douglas Campbell, flying Nieuport 28s of the 94th Aero Squadron, down two German fighters in a ten-minute battle. Lieutenant Winslow is the first pilot in the American sector of the front to down an airplane; Lieutenant Campbell is the first US-trained pilot to score a victory.

Bringing with them a lionhearted resolve, these Americans of the Lafayette Escadrille were flying for France a full year before President Wilson asked Congress to declare war.

April 21, 1918. *Rittmeister* Manfred von Richthofen, the Red Baron, is shot down in action over France by Capt. A. Roy Brown, a Canadian. The German ace, killed in the battle, had eighty aerial victories.

May 15, 1918. The Aviation Section of the Signal Corps begins regular airmail service from Washington, D. C., to New York, N. Y.

May 24, 1918. US Army Air Service organized.

June 12, 1918. The 96th Aero Squadron bombs the Dommary-Baroncourt railway yards in France in the first daylight bombing raid carried out by the AEF.

August 2, 1918. The 135th Corps Observation Squadron makes its first wartime patrol in US-assembled DH-4s powered by American-made Liberty engines.

September 25, 1918. Capt. Edward V. Rickenbacker of the 94th Aero Squadron attacks seven enemy aircraft, shooting down two of them near Billy, France, and wins the first Medal of Honor given for air activity.

November 7, 1918. Dr. Robert H. Goddard demonstrates tube-launched solid-propellant rockets at Aberdeen Proving Ground, Md.

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 to make the entire trip.

January 24, 1919. Army Air Service pilot 1st Lt. Temple M. Joyce makes 300 consecutive loops in a Morane fighter at Issoudun, France.

May 16–27, 1919. Navy Lt. Cmdr. Albert C. "Putty" Read and a crew of five fly from Trepassey Bay, Newfoundland, to Lisbon, Portugal, via the Azores, in the Curtiss NC-4 flying boat, spending fifty-three hours, fifty-eight minutes aloft. This is the first crossing of the Atlantic Ocean by air. Two other NCs start the trip but do not complete it.

June 14–15, 1919. Capt. John Alcock and Lt. Arthur Whitten Brown of the United Kingdom make the first nonstop flight across the Atlantic in sixteen hours, twelve minutes.

September 1, 1919. Dive bombing is demonstrated at Aberdeen Proving Ground, Md.

October 30, 1919. The reversible-pitch propeller is tested for the first time at McCook Field near Dayton, Ohio.

February 27, 1920. Maj. R. W. Schroeder sets a world altitude record of 33,114 feet in the Packard-LePere LUSAC-11 biplane over McCook Field.

June 5, 1920. A provision in the Fiscal Year 1921 appropriations bill restricts the Army Air Service to operating from land bases.

July 13–21, 1921. In a series of tests off the mouth of the Chesapeake Bay, Army airplanes from Langley Field, Va., sink three ships, including the captured German battleship *Ostfriesland,* demonstrating the vulnerability of naval craft to aerial attack.

November 12, 1921. Wesley May, with a five-gallon can of gasoline strapped to his back, climbs

Capt. Eddie Rickenbacker, the US ace of aces during the Great War, pauses before takeoff in his Nieuport 28C.1. Captain Rickenbacker was the first US flyer to win the Medal of Honor.

from the wing of one aircraft to the wing of another in the first "air-to-air" refueling.

March 20, 1922. USS *Langley,* the Navy's first aircraft carrier, is commissioned in Norfolk, Va. The ship is the converted collier *Jupiter.*

September 4, 1922. Lt. James H. Doolittle makes the first transcontinental crossing in an aircraft in a single day—2,163 miles in twenty-one hours, twenty minutes.

October 17, 1922. The first carrier takeoff in US Navy history is made by Lt. V. C. Griffin in a Vought VE-7SF from USS *Langley,* at anchor in the York River in Virginia.

October 18, 1922. Brig. Gen. Billy Mitchell sets a world speed record of 222.97 mph over a closed course in the Curtiss R-6 racing plane at the Pulitzer Trophy air race near Detroit, Mich.

May 2–3, 1923. Lt. Oakley G. Kelly and Lt. John A. Macready complete the first nonstop transcontinental flight. The trip from New York to San Diego takes twenty-six hours, fifty minutes, three seconds in a Fokker T-2.

September 4, 1923. First flight of the airship USS *Shenandoah* (ZR-1) is made at NAF Lakehurst, N. J. The airship will make fifty-seven flights in two years before it is destroyed by a storm near Marietta, Ohio.

1924–1933

February 5, 1924. 2d Lt. Joseph C. Morrow, Jr., qualifies as the twenty-fourth and last Military Aviator under the rules set up for that rating.

March 4, 1924. The Army Air Service takes on a new mission: aerial icebreaking. Two Martin bombers and two DH-4s bomb the frozen Platte River at North Bend, Neb., for six hours before the ice clears.

April 6–September 28, 1924. The Army Air Service completes the first circumnavigation of the globe. Four crews in Douglas World Cruisers begin the voyage in Seattle, Wash., but only two aircraft (*Chicago* and *New Orleans*) and their crews complete the trip.

October 12–15, 1924. As part of World War I reparations, the German zeppelin LZ-126 is flown from Friedrichshafen, Germany, to NAF Lakehurst, N. J. The Navy will later christen the airship USS *Los Angeles* (ZR-3).

October 28, 1924. Army Air Service airplanes break up cloud formations at 13,000 feet over Bolling Field, D. C., by "blasting" them with electrified sand.

January 24, 1925. The Navy airship USS *Los Angeles* (ZR-3), with twenty-five scientists and astronomers on board, is used to make observations of a solar eclipse.

February 2, 1925. President Calvin Coolidge signs the Kelly Act, authorizing the air transport of mail under contract. This is the first major legislative step toward the creation of a US airline industry.

July 15, 1925. The Dr. A. Hamilton Rice Expedition, the first group of explorers to use an airplane, returns to the US. The expedition, which used a Curtiss Seagull floatplane, discovered the headwaters of the Amazon River.

October 26, 1925. Lt. James H. Doolittle, flying the Curtiss R3C-2 floatplane racer, wins the Schneider Cup race in Baltimore, Md., with an average speed of 232.57 mph. The next day, he sets a world seaplane record of 245.713 mph over a three-kilometer course.

December 17, 1925. Airpower pioneer Billy Mitchell is found guilty of violating the 96th Article of War ("conduct of a nature to bring discredit on the military service") and is sentenced to a five-year suspension of rank, pay, and command. Already demoted from brigadier general, Colonel Mitchell decides instead to resign from the Army.

January 16, 1926. The Daniel Guggenheim Fund for the Promotion of Aeronautics is founded.

March 16, 1926. Dr. Robert H. Goddard launches the world's first liquid-fueled rocket at Auburn, Mass.

July 2, 1926. US Army Air Corps organized.

May 20–21, 1927. The first solo nonstop transatlantic flight is completed by Charles A. Lindbergh in the Ryan NYP *Spirit of St. Louis:* New York to Paris in thirty-three hours, thirty-two minutes.

November 16, 1927. The US Navy's second true aircraft carrier—USS *Saratoga* (CV-3)—is commissioned. The ship will later be deliberately destroyed during a 1946 atomic bomb test.

January 27, 1928. The Navy airship USS *Los Angeles* lands on the aircraft carrier USS *Saratoga* during a fleet exercise near Newport, R. I., and resumes its patrol after replenishment.

February 15, 1928. President Coolidge signs a bill authorizing acceptance of a new site near San Antonio, Tex., to become the Army Air Corps training center. This center is now Randolph AFB.

March 1–9, 1928. USAAC Lt. Burnie R. Dallas and Beckwith Havens make the first transcontinental flight in an amphibious airplane. Total flight time in the Loening Amphibian is thirty-two hours, forty-five minutes.

April 15–21, 1928. Sir George Hubert Wilkins and Lt. Carl B. Eielson fly from Point Barrow, Alaska, across the Arctic Ocean to Spitsbergen, Norway, in a Lockheed Vega. This first west-east trip over the top of the world takes only twenty-one hours of flying, but the duo is delayed by weather.

May 12, 1928. Lt. Julian S. Dexter of the Air Corps Reserve completes a 3,000-square-mile aerial mapping assignment over the Florida Everglades. The project takes sixty-five hours of flying, spread over two months.

June 15, 1928. Lts. Karl S. Axtater and Edward H. White, flying in an Air Corps blimp directly over an Illinois Central train, dip down and hand a mailbag to the postal clerk on the train, thus completing the first airplane-to-train transfer.

In an unheard-of demonstration of flying endurance, the crew of the Fokker C-2* Question Mark *stayed aloft for nearly a week in 1929.

September 22, 1928. The number of people whose lives have been saved by parachutes exceeds 100 when Lt. Roger V. Williams bails out over San Diego, Calif.

October 11–15, 1928. The German *Graf Zeppelin* (LZ-127) makes the first transoceanic voyage by an airship carrying paying passengers. *Graf Zeppelin* travels from Friedrichshafen, Germany, to NAF Lakehurst, N. J., in nearly 112 hours, with twenty passengers and a crew of thirty-seven.

November 11, 1928. In a Lockheed Vega, Sir George Hubert Wilkins and Lt. Carl B. Eielson make the first flight over Antarctica.

January 1–7, 1929. *Question Mark,* a Fokker C-2 commanded by Maj. Carl A. "Tooey" Spaatz and including Capt. Ira C. Eaker and Lt. Elwood R. Quesada among its crew, sets an endurance record for a refueled aircraft of 150 hours, forty minutes, fourteen seconds.

January 23–27, 1929. The aircraft carriers USS *Lexington* (CV-2) and USS *Saratoga* (CV-3) participate in fleet exercises for the first time.

February 10–11, 1929. Evelyn Trout sets a women's solo flight endurance record of seventeen hours, twenty-one minutes, thirty-seven seconds in the monoplane *Golden Eagle.*

April 24, 1929. Elinor Smith, seventeen years old, sets a women's solo endurance record of twenty-six hours, twenty-one minutes, thirty-two seconds in a Bellanca CH monoplane at Roosevelt Field, Long Island, N. Y.

May 16, 1929. At the first Academy Award ceremonies in Los Angeles, Calif., the Paramount movie "Wings" wins the Oscar for Best Picture for 1927–28. The World War I flying epic starred Richard Arlen, Buddy Rogers, and Clara Bow. A young Gary Cooper had a minor role.

September 24, 1929. Lt. James H. Doolittle makes the first blind, all-instrument flight.

September 30, 1929. At Frankfurt, Germany, Fritz von Opel travels just over a mile in the world's first flight of a rocket-powered airplane. The Rak-1 tops eighty-five mph but crashes.

November 23, 1929. After visiting Dr. Robert H. Goddard, Charles A. Lindbergh arranges a grant of $50,000 from the Daniel Guggenheim Fund for the Promotion of Aeronautics to support Dr. Goddard's work with rockets.

November 29, 1929. Navy Cmdr. Richard E. Byrd, Bernt Balchen, Army Capt. Ashley McKinley, and Harold June make the first flight over the South Pole. Mr. Balchen is the pilot of the Ford Trimotor *Floyd Bennett.*

December 31, 1929. The Daniel Guggenheim Fund for the Promotion of Aeronautics ends its activities.

April 12, 1930. Led by Capt. Hugh Elmendorf, nineteen pilots of the 95th Pursuit Squadron set an unofficial world record for altitude formation flying over Mather Field, Calif. The P-12 pilots reach 30,000 feet, shattering the old record of 17,000 feet.

May 3, 1930. Laura Ingalls performs 344 consecutive loops. Shortly afterward, she tries again and does 980. In another flight during 1930, she does 714 barrel rolls, setting a pair of records nobody has cared to challenge.

May 15, 1930. Ellen Church, a registered nurse, becomes the world's first airline stewardess as she serves sandwiches on a Boeing Air Transport flight between San Francisco, Calif., and Cheyenne, Wyo. She sits in the jumpseat of the Boeing Model 80A.

October 25, 1930. Transcontinental commercial air service between New York and Los Angeles begins.

October 3–5, 1931. Americans Clyde "Upside Down" Pangborn and Hugh Herndon, Jr., make the first nonstop transpacific flight from Japan to America, in a Bellanca monoplane. The trip takes forty-one hours, thirteen minutes.

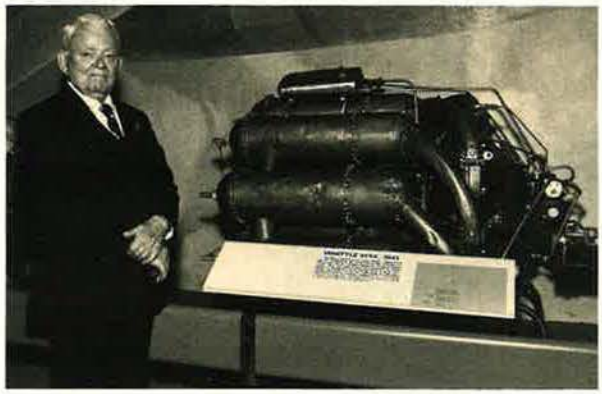
August 25, 1932. Amelia Earhart becomes the first woman to complete a nonstop transcontinental flight.

July 15–22, 1933. Famed aviator Wiley Post, flying the Lockheed Vega *Winnie Mae,* becomes the first person to fly around the world solo. The 15,596-mile flight takes seven days, eighteen hours, forty-nine minutes at an average speed of 134.5 mph.

September 4, 1933. Jimmy Wedell sets a world landplane speed record of 304.98 mph in the Wedell-Williams racer over Glenview, Ill.

December 31, 1933. The prototype Soviet Polikarpov I-16 Mosca is flown for the first time.

Photo by Mark Avino



British engineer Frank Whittle stands before his highly significant contribution to aviation: the first practical jet engine, which was bench-tested in 1937 and brought to the US in 1941.

When the type enters service in 1934, it is the first monoplane fighter to have an enclosed cockpit and fully retractable landing gear.

1934–1943

February 19, 1934. President Franklin D. Roosevelt issues an Executive Order canceling existing airmail contracts because of fraud and collusion. The Army Air Corps is designated to take over airmail operations.

May 1, 1934. Navy Lt. Frank Akers makes a blind landing in a Berliner-Joyce OJ-2 at College Park, Md., in a demonstration of a system intended for aircraft carrier use. In subsequent flights, he makes takeoffs and landings between NAS Anacostia, D. C., and College Park under a hood without assistance.

May 19, 1934. The first flight of the ANT-20 *Maxim Gorki,* at this time the world's largest aircraft, is made in the Soviet Union. The aircraft was designed by Andrei Tupolev.

June 18, 1934. Boeing begins company-funded design work on the Model 299, which will become the B-17.

February 12, 1935. The Navy airship USS *Macon* (ZRS-5) crashes off the California coast with two fatalities out of a crew of eighty-three. This loss effectively ends the Navy's rigid airship program.

March 9, 1935. *Reichsmarschall* Hermann Göring announces the existence of the Luftwaffe in an interview with London *Daily Mail* correspondent Ward Price.

December 17, 1935. First flight of the Douglas Sleeper Transport, the first of 10,654 DC-3s and derivatives Douglas will build between 1935 and 1947.

April 12, 1937. Frank Whittle bench-tests the first practical jet engine in laboratories at Cambridge University, England.

October 15, 1937. The Boeing XB-15 makes its first flight at Boeing Field in Seattle, Wash., under the control of test pilot Eddie Allen.

February 17, 1938. Six Boeing B-17 Flying Fortresses, under the command of Lt. Col. Robert Olds, leave Miami, Fla., on a goodwill flight to Buenos Aires, Argentina. The return trip to Langley Field, Va., is the longest nonstop flight in Air Corps history.

April 22, 1938. World War I ace Edward V. Rickenbacker buys a majority stake in Eastern Air Lines from North American Aviation for $3.5 million.

May 15, 1938. US Secretary of the Interior Harold L. Ickes refuses to allow inert helium to be exported to Germany for use in zeppelins. Secretary Ickes feels that the gas might be diverted to military purposes.

July 10–14, 1938. Howard Hughes, Harry H. P. Conner, Army Lt. Thomas Thurlow, Richard Stoddard, and Ed Lund set a round-the-world flight record of three days, nineteen hours, eight minutes, ten seconds in a Lockheed Model 14 Super Electra passenger aircraft. The crew travels 14,791 miles.

July 17–18, 1938. Ostensibly aiming for California, Douglas "Wrong-Way" Corrigan, flying a Curtiss Robin, lands in Dublin, Ireland, after a nonstop twenty-eight-hour flight from Floyd Bennett Field in Brooklyn, N. Y.

August 22, 1938. The Civil Aeronautics Act goes into effect. The Civil Aeronautics Authority will now coordinate all nonmilitary aviation. (The Federal Aviation Act, which created the Federal Aviation Administration, will be passed August 15, 1958.)

September 29, 1938. Brig. Gen. H. H. "Hap" Arnold is named Chief of the Army Air Corps, succeeding Maj. Gen. Oscar Westover, who was killed in a plane crash September 21.

October 14, 1938. Company test pilot Edward Elliott makes the first flight of the Curtiss XP-40 at Buffalo, N. Y. Almost 14,000 P-40s will be built before production ends in 1944.

December 31, 1938. The Boeing Model 307 Stratoliner, the first passenger plane to have a pressurized cabin, makes its first flight.

March 5, 1939. Using a hook trailing from their Stinson Reliant, Norman Rintoul and Victor Yesulantes demonstrate a nonstop airmail system by picking a mail sack off a pole in Coatesville, Pa.

March 30, 1939. *Flugkapitan* Hans Dieterle sets a world speed record of 463.82 mph in the Heinkel He-100V-8. The flight is made at Oranienburg, Germany.

April 3, 1939. President Roosevelt signs the National Defense Act of 1940, which authorizes a $300 million budget and 6,000 airplanes for the

Lt. Col. James H. Doolittle brought the war home to Japan by leading a flight of sixteen B-25s off USS* Hornet *to strike Tokyo and other targets.

Army Air Corps and increases AAC personnel to 3,203 officers and 45,000 enlisted troops.

May 20, 1939. Regularly scheduled transatlantic passenger and airmail service begins.

June 20, 1939. The German Heinkel He-176, the first aircraft to have a throttle-controlled liquid-fuel rocket engine, makes its first flight at Peenemünde with *Flugkapitan* Erich Warsitz at the controls.

August 27, 1939. The first jet-powered aircraft, the Heinkel He-178, makes its first flight. *Flugkapitan* Erich Warsitz is the pilot.

September 1, 1939. At 4:34 a.m., Lt. Bruno Dilley leads three Junkers Ju-87 Stuka dive bombers in an attack against the Dirschau Bridge. The German invasion of Poland, the first act of World War II, begins six minutes later.

October 13, 1939. Evelyn Pinchert Kilgore becomes the first woman to be issued a Civil Aeronautics Authority instructor's certificate.

December 29, 1939. The prototype Consolidated XB-24 Liberator makes a seventeen-minute first flight from Lindbergh Field in San Diego, Calif., with company pilot Bill Wheatley at the controls. More than 18,100 B-24s will be built in the next five and a half years, the largest military production run in US history.

February 21, 1940. Henry A. H. Boot and John T. Randall, working at the University of Birmingham, England, create the first practical magnetron. The magnetron, a resonant-cavity microwave generator, is vital in the development of airborne radar.

July 10, 1940. The Luftwaffe attacks British shipping in the English Channel and docks in South Wales. These actions are the first in what will become the Battle of Britain.

August 13–October 5, 1940. Against overwhelming odds, Royal Air Force pilots fend off the Luftwaffe during the Battle of Britain and ward off German invasion of the British Isles. The Luftwaffe loses 1,733 aircraft and crews.

October 8, 1940. The Royal Air Force announces formation of the first Eagle Squadron, a Fighter Command unit to consist of volunteer pilots from the US.

June 20, 1941. US Army Air Forces established.

December 1, 1941. Civil Air Patrol established.

December 7, 1941. Imperial Japanese forces attack Pearl Harbor.

December 16, 1941. Lt. Boyd "Buzz" Wagner becomes the first American USAAF ace of World War II by shooting down his fifth Japanese plane over the Philippines.

December 20, 1941. The American Volunteer Group (Claire Chennault's Flying Tigers), in action over Kunming, China, enters combat for the first time.

April 18, 1942. Sixteen North American B-25s, commanded by Lt. Col. James H. Doolittle, take off from USS *Hornet* (CV-8) and bomb Tokyo.

May 4–8, 1942. The Battle of the Coral Sea becomes the first naval engagement fought solely by aircraft.

June 3–4, 1942. In the Battle of Midway, three US carriers destroy four Japanese carriers while losing only one of their own, inflicting a major defeat on the Japanese fleet.

July 4, 1942. The first Army Air Forces bomber mission over western Europe in World War II is flown (in Douglas A-20s) against four airdromes in the Netherlands. Also on this date, the Flying Tigers are incorporated into the AAF as the 23d Pursuit Group.

August 17, 1942. The first American heavy bomber mission in western Europe in World War II is flown by B-17s of the 97th Bombardment Group against the Rouen-Sotteville railyards in France.

November 2, 1942. NAS Patuxent River, Md., is established as the Navy's test center for aircraft and equipment.

December 4, 1942. Ninth Air Force B-24 Liberator crews, based in Egypt, bomb Naples—the first American attacks in Italy.

December 9, 1942. The US Army is reorganized into three autonomous forces: Army Air Forces, Ground Forces, and Services of Supply.

January 5, 1943. Army Air Forces Maj. Gen. Carl A. Spaatz is appointed commander in chief of the Allied Air Forces in North Africa.

January 9, 1943. The Lockheed C-69 transport (a military version of the Model 49 Constellation) makes its first flight at Burbank, Calif.

January 27, 1943. The first American air raid on Germany is made by Eighth Air Force B-17 crews against Wilhelmshaven and other targets in the northwestern part of the country.

February 15, 1943. It is announced that Maj. Gen. Ira C. Eaker will succeed Maj. Gen. Carl A. Spaatz as commander of USAAF's Eighth Air Force.

February 27, 1943. RAF Bomber Command announces that the Allied air forces have made 2,000 sorties in the past forty-eight hours.

March 10, 1943. Fourteenth Air Force is formed under the command of Maj. Gen. Claire Chennault.

March 19, 1943. Lt. Gen. H. H. Arnold is promoted to four-star rank, a first for the Army Air Forces.

April 18, 1943. P-38 pilots from Henderson Field, Guadalcanal, intercept and shoot down two Mitsubishi "Betty" bombers over Bougainville. The aerial ambush kills Japanese Adm. Isoroku Yamamoto, who planned the Pearl Harbor attack.

June 15, 1943. The 58th Bombardment Wing, the Army Air Forces' first B-29 unit, is established at Marietta, Ga. Also on this day, the world's first operational jet bomber, the German Arado Ar-234V-1 Blitz, makes its first flight.

July 19, 1943. Rome is bombed for the first time. Flying from Benghazi, Libya, 158 B-17 crews and 112 B-24 crews carry out a morning raid. A second attack is staged in the afternoon.

August 1, 1943. Staging from Benghazi, 177 Ninth Air Force B-24s drop 311 tons of bombs from low level on the oil refineries at Ploesti, Romania, during Operation Tidal Wave. Forty-nine aircraft are lost, and seven others land in Turkey. This is the first large-scale, minimum-altitude attack by AAF heavy bombers on a strongly defended target. It is also the longest major bombing mission to date in terms of distance from base to target.

August 17, 1943. Eighth Air Force bombers attack the Messerschmitt works at Regensburg, Germany, and ball-bearing plants at Schweinfurt in a massive daylight raid. German fighters down sixty of the 376 American aircraft.

August 31, 1943. The Grumman F6F Hellcat goes into operational use with VF-5 off USS *Yorktown* (CV-10) in an attack on Marcus Island, 700 miles south of Japan. Hellcat pilots will account for nearly three-fourths of all Navy air-to-air victories in World War II.

September 27, 1943. P-47s with belly tanks go the whole distance with Eighth Air Force bombers for a raid on Emden, Germany.

October 14, 1943. Eighth Air Force conducts the second raid on the ball-bearing factories at Schweinfurt, Germany. As a result, the Germans will disperse their ball-bearing manufacturing, but the cost of the raid is high; sixty of the 291 B-17s launched do not return, and 138 more are damaged.

October 31, 1943. Over New Georgia in the Solomon Islands, a Chance Vought F4U-2 Corsair aviator accomplishes the Navy's first successful radar-guided interception.

December 5, 1943. P-51 pilots begin escorting US bombers to European targets. Ninth Air Force begins Operation Crossbow raids against German bases where secret weapons are being developed.

1944-1953

January 8, 1944. Developed in only 143 days, the prototype Lockheed XP-80 Shooting Star, *Lulu Belle,* makes its first flight at Muroc Dry Lake (later Edwards AFB), Calif., with Milo Burcham at the controls. It is the first American fighter to exceed 500 mph in level flight.

January 11, 1944. The first US use of forward-firing rockets is made by Navy TBF-1C Avenger crews against a German submarine.

January 22, 1944. Mediterranean Allied Air Forces fly 1,200 sorties in support of Operation Shingle, the amphibious landings at Anzio, Italy.

February 15, 1944. The Nazi-occupied Abbey of Monte Cassino, Italy, is destroyed by 254 American B-17 crews, B-25 crews, and B-26 crews attacking in two waves.

February 20, 1944. The first mission of "Big Week"—six days of strikes by Eighth Air Force (based in England) and Fifteenth Air Force (based in Italy) against German aircraft plants—is flown.

March 16, 1944. NACA proposes that a jet-propelled transonic research airplane be developed. This ultimately leads to the Bell X-1.

In one of history's most significant missions, the* Enola Gay *helped hasten the end of World War II and opened the atomic age by dropping "Little Boy" on Hiroshima in 1945.

June 9, 1944. Allied units begin operations from bases in France.

June 15, 1944. Forty-seven B-29 crews based in India and staging through Chengdu, China, attack steel mills at Yawata in the first B-29 strike against Japan.

June 19–20, 1944. "The Marianas Turkey Shoot": In two days of fighting, the Japanese lose 476 aircraft. American losses are 130 planes.

July 5, 1944. The Northrop MX-324, the first US rocket-powered airplane, is flown for the first time by company pilot Harry Crosby at Harper Dry Lake, Calif.

September 8, 1944. The German V-2, the world's first ballistic missile, is first used in combat. Two strike Paris, and two more are launched against London.

November 1, 1944. A Boeing F-13 (photoreconnaissance B-29) crew makes the first flight over Tokyo since the 1942 Doolittle Raid. The first XXI Bomber Command raid will be made on November 24, when eighty-eight B-29s bomb the city.

December 17, 1944. The 509th Composite Group, assembled to carry out atomic bomb operations, is established at Wendover, Utah.

December 21, 1944. Gen. H. H. Arnold becomes General of the Army—the first airman to hold five-star rank.

Maj. Richard I. Bong, shown here as a lieutenant in New Guinea early in the war, shot down forty enemy aircraft, becoming the leading US ace of all time.

January 20, 1945. Army Air Forces Maj. Gen. Curtis E. LeMay succeeds Brig. Gen. Haywood "Possum" Hansell as commander of XXI Bomber Command in the Mariana Islands.

February 3, 1945. A total of 959 B-17 crews carry out the largest raid to date against Berlin by American bombers.

February 20, 1945. Secretary of War Henry Stimson approves plans to establish a rocket proving ground near White Sands, N. M.

February 25, 1945. B-29 crews begin night incendiary raids on Japan; 334 aircraft drop 1,667 tons of firebombs and destroy fifteen square miles of Tokyo.

March 9, 1945. In a change of tactics in order to double bomb loads, Twentieth Air Force sends more than 300 B-29s from the Marianas against Tokyo in a low-altitude, incendiary night raid, destroying about one-fourth of the city.

March 11, 1945. The greatest weight of bombs dropped in a USAAF strategic raid on a single target in Europe falls on Essen, Germany, as 1,079 bomber crews release 4,738 tons of bombs.

March 14, 1945. The first Grand Slam (22,000-pound) bomb is dropped from an Avro Lancaster flown by Royal Air Force Squadron Leader C. C. Calder. Two spans of the Bielefeld railway viaduct in Germany are destroyed.

March 18, 1945. Some 1,250 US bombers, escorted by 670 fighters, deal Berlin its heaviest daylight blow—3,000 tons of bombs on transportation and industrial areas.

March 25, 1944. Fifteenth Air Force crews close the Brenner Pass between Italy and Austria. This mission, against the Aviso viaduct, is the first operational use of the VB-I Azon (Azimuth Only) radio-controlled bomb.

May 21, 1944. Operation Chattanooga Choo-Choo—systematic Allied air attacks on trains in Germany and France—begins.

June 2, 1944. The first shuttle bombing mission using Russia as the eastern terminus is flown. Lt. Gen. Ira C. Eaker, head of Mediterranean Allied Air Forces, flies in one of the B-17s.

June 6, 1944. Allied pilots fly approximately 15,000 sorties on D-Day. It is an effort unprecedented in concentration and size.

July 17, 1944. Napalm incendiary bombs are dropped for the first time by American P-38 pilots on a fuel depot at Coutances, near St.-Lô, France.

July 22, 1944. In the first all-fighter shuttle raid, Italy-based US P-38 Lightnings and P-51 Mustangs of Fifteenth Air Force attack Nazi airfields at Bacau and Zilistea, northeast of Ploesti, Romania. The planes land at Russian bases.

August 4, 1944. The first Aphrodite mission (a radio-controlled B-17 carrying 20,000 pounds of TNT) is flown against V-2 rocket sites in the Pas de Calais section of France.

August 28, 1944. Eighth Air Force's 78th Fighter Group claims the destruction of an Me-262, the first jet to be shot down in combat.

March 27, 1945. B-29 crews begin night mining missions around Japan, eventually establishing a complete blockade.

April 23, 1945. Flying Consolidated PB4Y-2 Privateers, Navy crews from VPB-109 launch two Bat missiles against Japanese ships in Balikpapan Harbor, Borneo. This is the first known use of automatic homing missiles during World War II.

May 9, 1945. V-E Day. The war ends in Europe.

June 26, 1945. B-29 crews begin nighttime raids on Japanese oil refineries.

August 6, 1945. The "Little Boy" (uranium) atomic bomb is dropped on Hiroshima from the B-29 *Enola Gay,* commanded by Col. Paul W. Tibbets, Jr. Also on this date, Maj. Richard I. Bong, America's all-time leading ace, is killed in a P-80 accident. He had forty confirmed victories.

August 9, 1945. The "Fat Man" (plutonium) atomic bomb is dropped on Nagasaki from the B-29 *Bockscar,* commanded by Maj. Charles W. Sweeney.

August 15, 1945. V-J Day.

September 2, 1945. On board USS *Missouri* (BB-63), Japanese Foreign Minister Mamoru Shigemitsu and Chief of Staff Gen. Yoshijiro Umezu sign the instruments of surrender ending World War II. The next day, USAAF Maj. G. E. Cain, flying a Douglas C-54, sets a Tokyo-to-Washington speed record of thirty-one hours, twenty-five minutes in getting film of the surrender ceremony to the US.

November 6, 1945. The first landing of a jet-powered aircraft on a carrier is made by Ens. Jake C. West in the Ryan FR-1 Fireball, a fighter propelled by both a turbojet and a reciprocating engine. The landing on USS *Wake Island* (CVE-65) is inadvertent; the plane's piston engine fails, and Ensign West comes in powered only by the turbojet.

February 4, 1946. The Air Force Association is incorporated.

April 24, 1946. The first flights of the Soviet-designed and -built Yak-15 and MiG-9 prototypes are made.

June 26, 1946. "Knot" and "nautical mile" are adopted by the Army Air Forces and the Navy as standard aeronautical units of speed and distance.

September 18, 1947. The US Air Force is established as a separate service, with W. Stuart Symington as first Secretary. Gen. Carl A. Spaatz, Commanding General of the AAF, becomes first Chief of Staff on September 26.

October 1, 1947. The North American XP-86 Sabre takes to the air for the first time at Muroc Dry Lake, Calif.

October 14, 1947. The first supersonic flight is made by Capt. Charles E. Yeager in the rocket-powered Bell XS-I (later redesigned X-1) over Muroc Dry Lake.

October 21, 1947. The first flight of the Northrop YB-49 flying wing jet bomber is made. The Air Force's Northrop B-2 Stealth bomber will bear a family resemblance to this plane.

November 2, 1947. Howard Hughes's wooden H-4 *Hercules* (the "Spruce Goose") makes its first (and only) flight over Los Angeles Harbor, Calif. Distance traveled is about a mile.

December 17, 1947. The prototype Boeing XB-47 Stratojet bomber makes its first flight from Boeing Field in Seattle, Wash., with company pilots Bob Robbins and Scott Osler at the controls.

December 30, 1947. The Soviet MiG-15 is flown for the first time.

January 30, 1948. Orville Wright dies in his hometown of Dayton, Ohio, at age seventy-six.

February 20, 1948. The first Boeing B-50 Superfortress is delivered to Strategic Air Command (SAC).

April 21, 1948. Secretary of Defense James V. Forrestal assigns the primary responsibility for air defense of the United States to the Air Force.

June 26, 1948. Operation Vittles, the Berlin Airlift, begins with Douglas C-47 crews bringing eighty tons of supplies into the city on the first day. By the time it ends on September 30, 1949, the Anglo-American airlift will have delivered a total of 2,324,257 tons of food, fuel, and supplies to the beleaguered city.

September 15, 1948. Air Force Maj. Richard L. Johnson, flying a North American F-86, recaptures the world speed record for the US, streaking over a three-kilometer course at Muroc AFB, Calif, at 670.981 mph.

In the newborn Air Force's first large-scale operation, more than two million tons of supplies were airlifted into the besieged city of West Berlin, Germany.

October 15, 1948. Maj. Gen. William H. Tunner assumes command of the newly created Combined Airlift Task Force during the Berlin Airlift.

December 17, 1948. The forty-fifth anniversary of the first powered flight is commemorated by the donation of the original Wright Flyer to the Smithsonian Institution. The Flyer was 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.

February 4, 1949. The Civil Aeronautics Administration sanctions the use of ground-controlled approach as a "primary aid" for commercial airline crews.

February 26–March 2, 1949. *Lucky Lady II,* a SAC B-50A, is flown on the first nonstop flight around the world. The 23,452-mile flight takes ninety-four hours, one minute and requires four midair refuelings.

March 15, 1949. Military Air Transport Service establishes Global Weather Central at Offutt AFB, Neb., for support of SAC.

May 9, 1949. The Republic XF-91 Thunderceptor jet/rocket hybrid successfully completes its first test flight at Muroc AFB, Calif. This unusual aircraft has variable incidence wings of inverse taper design (wider at the tips than at the roots).

May 11, 1949. President Harry S. Truman signs a bill providing for a 3,000-mile-long guided-missile test range for the Air Force. The range is subsequently established at Cape Canaveral, Fla.

June 2, 1949. Gen. H. H. Arnold is given the permanent rank of General of the Air Force by special act of Congress.

July 1, 1949. The Air Force becomes the first service to announce an end to racial segregation in its ranks.

August 9, 1949. Navy Lt. J. L. Fruin makes the first emergency escape with an ejection seat in the US near Walterboro, S. C. His McDonnell F2H-1 Banshee is traveling at more than 500 knots at the time.

September 23, 1949. President Truman announces that the Soviet Union has successfully exploded an atomic bomb.

October 4, 1949. A Fairchild C-82 Packet crew air-drops an entire field artillery battery by parachute at Fort Bragg, N. C.

November 18, 1949. A crew flying a Douglas C-74 Globemaster I, *The Champ,* lands at RAF Marham, England, after a twenty-three-hour flight from Mobile, Ala. On board are a transatlantic-record 103 passengers and crew.

January 23, 1950. USAF establishes Air Research and Development Command, which in 1961 will be redesignated Air Force Systems Command.

January 31, 1950. President Truman announces that he has directed the Atomic Energy Commission "to continue its work on all forms of atomic-energy weapons, including the so-called hydrogen or super bomb." This is the first confirmation of US H-bomb work.

March 15, 1950. The Joint Chiefs of Staff, in a statement of basic roles and missions, give the Air Force formal and exclusive responsibility for strategic guided missiles.

April 21, 1950. Piloted by Navy Lt. Cmdr. R. C. Starkey, a Lockheed P2V-3C Neptune weighing 74,668 pounds becomes the heaviest aircraft ever launched from an aircraft carrier. The Neptune is flown off USS *Coral Sea* (CV-43).

September 22, 1950. Air Force Col. David Schilling makes the first nonstop transatlantic flight in a jet aircraft, flying a Republic F-84E from Manston, England, to Limestone (later Loring) AFB, Me., in ten hours, one minute. The trip requires three in-flight refuelings.

November 8, 1950. USAF 1st Lt. Russell J. Brown, Jr., flying an F-80 Shooting Star, downs a North Korean MiG-15 in history's first all-jet aerial combat.

May 20, 1951. Capt. James Jabara becomes the Air Force's first jet-vs.-jet ace. He eventually downs fifteen enemy planes in Korea.

February 1, 1952. The Air Force acquires its first general-purpose computer (a Univac I).

April 15, 1952. The Boeing YB-52 Stratofortress bomber prototype makes its maiden flight from its facility in Seattle, Wash. Company pilot A. M. "Tex" Johnston is at the controls.

July 14, 1952. The Ground Observer Corps begins its round-the-clock skywatch program as part of a nationwide air defense effort.

January 2, 1953. Cessna Aircraft is declared the winner of the Air Force's primary jet trainer competition. This Cessna, later designated T-37, beats out fourteen entries.

January 26, 1953. Chance Vought Aircraft completes the last F4U Corsair. In production for thirteen years (and built by two other manufacturers during World War II), almost 12,700 Corsairs were built in a number of versions, one of the longest production runs in history.

March 16, 1953. Republic delivers the 4,000th F-84 Thunderjet to the Air Force. The F-84 has been in production since 1946.

June 16, 1953. North American delivers the 1,000th T-28 Trojan tandem-seat trainer to the Air Force.

July 29, 1953. Two days after the armistice ending the Korean War, the Air Force announces that the Far East Air Force shot down 839 MiG-15 jet fighters, probably destroyed 154 more, and damaged 919 others during the thirty-seven months of war. United Nations air forces lost 110 aircraft in air-to-air combat, 677 to enemy ground fire, and 213 airplanes to "other causes."

August 21, 1953. Flying the Douglas D-558-II Skyrocket, Marine Corps Lt. Col. Marion Carl sets an altitude record of 83,235 feet after being dropped from a Boeing P2B (B-29) flying at 34,000 feet over Edwards AFB, Calif.

September 1, 1953. The first jet-to-jet air refueling takes place between a Boeing KB-47 and a "standard" B-47.

September 11, 1953. A Grumman F6F-5K Hellcat drone is destroyed in the first successful interception test of the N-7 (AIM-9) Sidewinder air-to-air missile at China Lake, Calif.

Lt. Col. John Paul Stapp tested the limits of human endurance in this rocket sled, which subjected him to a force of more than thirty-five Gs during a 1954 experiment at Holloman AFB, N. M.

September 21, 1953. North Korean pilot Lt. Noh Kum Suk defects and flies his MiG-15 to Kimpo AB, South Korea. He is granted asylum and given $100,000.

October 3, 1953. Navy Lt. Cmdr. James B. Verdin establishes a world speed record of 752.94 mph in the Douglas XF4D-1 Skyray over the Salton Sea in California. This is the first time a jet-powered carrier plane has set the speed record.

October 19, 1953. Assistant Secretary of the Air Force Roger Lewis reveals that Boeing B-52 bombers will cost approximately $3.6 million each in production, but the first four aircraft will cost about $20 million each to amortize design, development, and tooling costs.

November 6, 1953. A Boeing B-47 Stratojet is flown from Limestone AFB, Me., to RAF Brize Norton, England, in four hours, fifty-three minutes to establish a new transatlantic speed record from the continental US.

November 20, 1953. NACA test pilot Scott Crossfield becomes the first pilot to exceed Mach 2. His Douglas D-588-II Skyrocket research plane is dropped from a Navy P2B-1S (B-29) at an altitude of 32,000 feet over Edwards AFB.

December 12, 1953. Maj. Charles E. Yeager pilots the rocket-powered Bell X-1A to a speed of Mach 2.435 (approximately 1,650 mph) over Edwards AFB.

1954–1963

February 15, 1954. President Dwight D. Eisenhower nominates Charles A. Lindbergh to be a brigadier general in the Air Force Reserve.

February 24, 1954. President Eisenhower approves the National Security Council's recommendation for construction of the Distant Early Warning (DEW) Line.

March 1, 1954. In the Marshall Islands, the US successfully explodes its first hydrogen bomb.

March 18, 1954. Boeing rolls out the first production B-52A Stratofortress at its plant in Seattle, Wash. Production will continue until 1962.

April 1, 1954. President Eisenhower signs into law a bill creating the Air Force Academy.

June 22, 1954. The Douglas A4D (A-4) Skyhawk makes its first flight from Edwards AFB with company pilot Robert Rahn at the controls.

July 15, 1954. The Boeing Model 367-80 makes its first flight, with company pilot A. M. "Tex" Johnston in command. The aircraft is the prototype for the Air Force's C/KC-135 series and the progenitor of the 707, which will become the first civilian jetliner to see wide use.

August 23, 1954. Lockheed pilots Stanley Beltz and Roy Wimmer crew the first flight of the YC-130 Hercules at Burbank, Calif.

August 26, 1954. Maj. Arthur "Kit" Murray reaches a record height of 90,443 feet in the Bell X-1A, which was released from a B-29 over Edwards AFB.

October 12, 1954. The Cessna XT-37 Tweet trainer is flown for the first time at Wichita, Kan. The T-37 will still be soldiering on, nearly forty years later, as the Air Force's primary trainer.

November 7, 1954. The Air Force announces plans to build a $15.5 million research laboratory for atomic aircraft engines. To be built in Connecticut, the plant is to be run by Pratt & Whitney and will be finished in 1957.

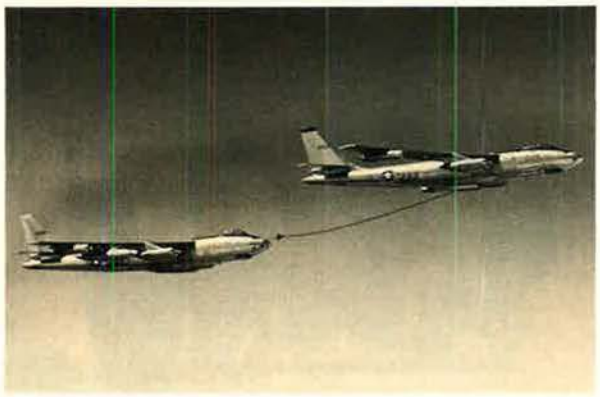
December 10, 1954. To determine if a pilot could eject from an airplane at supersonic speed and live, Lt. Col. John Paul Stapp, a flight surgeon, rides a rocket sled to 632 mph, decelerates to zero in 125 seconds, and survives more than thirty-five times the force of gravity.

February 23, 1955. The Army picks Bell Helicopter from a list of twenty competing companies to build its first turbine-powered helicopter. The winning design, designated XH-40, will become the HU-1 (and later still, UH-1) Iroquois, the renowned "Huey."

February 26, 1955. North American Aviation test pilot George Smith becomes the first person to survive ejection from an aircraft flying at supersonic speed. His F-100 Super Sabre is traveling at Mach 1.05 when the controls jam and he is forced to punch out.

July 11, 1955. The first class (306 cadets) is sworn in at the Air Force Academy's temporary location at Lowry AFB, Colo.

September 27, 1956. Capt. Milburn Apt, USAF, reaches Mach 3.196 in the Bell X-2, becoming the first pilot to fly three times the speed of sound.



Intercontinental missions emphasized the need for refueling, and the advent of the KB-47B, the first jet-powered tanker, helped meet that need.

Apt is killed, however, when the aircraft tumbles out of control.

October 4, 1957. The space age begins when the Soviet Union launches Sputnik 1, the world's first artificial satellite, into Earth orbit.

December 12, 1957. Flying a McDonnell F-101A Voodoo, USAF Maj. Adrian Drew sets a world record of 1,207.34 mph.

December 17, 1957. The Convair HGM-16 Atlas intercontinental ballistic missile (ICBM) makes its first successful launch and flight.

January 31, 1958. Explorer I, the first US satellite, is launched by the Army at Cape Canaveral.

February 4, 1958. The keel of the world's first nuclear-powered aircraft carrier, USS *Enterprise* (CVN-65), is laid at the Newport News Shipbuilding and Drydock Co. yards in Virginia.

February 27, 1958. Approval is given to USAF to start research and development on an ICBM program that will later be called "Minuteman."

March 6, 1958. The first production Northrop SM-62 Snark intercontinental missile is accepted by the Air Force after four previous successful launchings.

April 8, 1958. An Air Force KC-135 Stratotanker crew flies 10,229.3 miles nonstop and unrefueled from Tokyo to Lajes Field, Azores, in eighteen hours, fifty minutes.

May 7, 1958. USAF Maj. Howard C. Johnson sets a world altitude record of 91,243 feet in a Lockheed F-104A Starfighter. Nine days later, Capt. Walter W. Irwin sets a world speed record of 1,404.09 mph, also in an F-104.

May 27, 1958. The first flight of the McDonnell F4H-1 (F-4) Phantom II is made by company pilot Robert Little at the company's facility in St. Louis, Mo. On May 20, 1978, McDonnell Douglas will deliver the 5,000th F-4.

June 17, 1958. Boeing and Martin are named prime contractors to develop competitive designs for the Air Force's X-20 Dyna-Soar boost-glide space vehicle. This project, although later canceled, is the first step toward the space shuttle.

July 23, 1958. The Boeing Vertol VZ-2A tiltwing research aircraft makes the first successful transition from vertical to horizontal flight and vice versa.

July 26, 1958. Capt. Iven C. Kincheloe, Jr., USAF, holder of the world altitude record (126,200 feet, set in the Bell X-2, September 7, 1956), is killed in an F-104 crash.

October 1, 1958. The National Aeronautics and Space Administration (NASA) is officially established, replacing NACA.

December 18, 1958. Project Score, an Atlas booster with a communications repeater satellite, is launched into Earth orbit. The satellite carries a Christmas message from President Eisenhower that is broadcast to Earth, the first time a human voice has been heard from space.

January 8, 1959. NASA requests eight Redstone-type launch vehicles from the Army for Project Mercury development flights. Four days later, McDonnell Aircraft Co. is selected to build the Mercury capsules.

January 22, 1959. Air Force Capt. William B. Whiute sets a record for the longest nonstop flight between points in the US, as he flies a Republic F-105 Thunderchief 3,850 miles from Eielson AFB, Alaska, to Eglin AFB, Fla., in five hours, twenty-seven minutes.

April 2, 1959. Chosen from a field of 110 candidates, seven test pilots—Air Force Capts. L. Gordon Cooper, Jr., Virgil I. "Gus" Grissom, and Donald K. "Deke" Slayton; Navy Lt. Cmdrs. Walter M. Schirra, Jr., and Alan B. Shepard, Jr., and Lt. M. Scott Carpenter; and Marine Lt. Col. John H. Glenn, Jr.—are announced as the Project Mercury astronauts.

April 15, 1959. USAF Capt. George A. Edwards sets a speed record of 816.279 mph in a McDonnell RF-101C Voodoo on a 500-km closed course at Edwards AFB.

April 20, 1959. The prototype Lockheed UGM-27A Polaris sea-launched ballistic missile successfully flies a 500-mile trajectory in a Navy test. Three days later, the Air Force carries out the first flight test of the North American GAM-77 Hound Dog air-launched strategic missile at Eglin AFB.

May 28, 1959. Astrochimps Able and Baker are recovered alive in the Atlantic after their flight to an altitude of 300 miles in the nosecone of a PGM-19 Jupiter missile launched from Cape Canaveral Missile Test Annex, Fla.

June 3, 1959. The first class is graduated from the Air Force Academy.

June 8, 1959. After several attempts, North American Aviation pilot Scott Crossfield makes the first nonpowered flight in the X-15.

July 1, 1959. The first experimental reactor (Kiwi-A) in the nuclear space rocket program is operated successfully in a test at Jackass Flats, Nev.

August 7, 1959. First intercontinental relay of voice message by satellite. The voice is that of Maj. Robert G. Mathis, later USAF Vice Chief of Staff.

The X-15 eventually reached altitudes of more than fifty miles and speeds in excess of Mach 6, but several glitches delayed the program's first flight until June 1959.

September 12, 1959. The Soviet Union launches Luna 2, the first man-made object to reach the moon.

December 30, 1959. The first JS ballistic missile–carrying submarine, USS *George Washington* (SSBN-598), is commissioned at Groton, Conn.

January 25, 1960. In what is billed as the "first known kill of a ballistic missile," an Army MIM-23 HAWK antiaircraft missile downs an unarmed MGR-1 Honest John surface-to-surface unguided rocket.

April 1, 1960. The RCA-built TIROS 1 (Television Infrared Observation Satellite), the world's first meteorological satellite, is successfully launched from Cape Canaveral Missile Test Annex atop a Thor launch vehicle.

April 4, 1960. Project Ozma is initiated at the

National Radio Astronomy Observatory at Green Bank, W. Va., to listen for possible signal patterns from outer space other than "natural" noise.

April 22, 1960. A federal court of appeals upholds a Federal Aviation Administration order that automatically grounds pilots over sixty years old.

May 1, 1960. Central Intelligence Agency (CIA) pilot Francis Gary Powers, flying a Lockheed U-2 reconnaissance aircraft, is shot down over the Soviet Union near Sverdlovsk. He is captured and later put on trial for espionage.

May 20, 1960. The Air Force launches from Cape Canaveral Missile Test Annex a Convair HGM-16 Atlas ICBM that carries a 1.5-ton payload 9,040 miles to the Indian Ocean. This is the greatest distance ever flown by a US ICBM.

May 21, 1960. The last World War II North American B-25 Mitchell is retired from active Air Force service at Eglin AFB.

July 20, 1960. The first underwater launch of a Lockheed UGM-27 Polaris ballistic missile is successfully carried out from USS *George Washington* (SSBN-598) off Cape Canaveral Missile Test Annex.

August 16, 1960. At an altitude of 102,800 feet over Tularosa, N. M., Air Force Capt. Joseph W. Kittinger, Jr., makes the ultimate leap of faith. In the four and a half minutes between stepping out of the balloon's open gondola and opening his parachute, he free falls 84,700 feet, reaching a speed of 614 mph. Captain Kittinger lands unharmed thirteen minutes, forty-five seconds after jumping. This is the highest jump and longest free fall ever recorded.

February 3, 1961. SAC's Boeing EC-135 Airborne Command Post begins operations. Dubbed "Looking Glass," the planes and their equipment provide a backup means of controlling manned bombers and launching landbased ICBMs in case a nuclear attack wipes out conventional command-and-control systems.

April 12, 1961. The Soviet Union stuns the world with the first successful manned spaceflight. Cosmonaut Yuri Gagarin is not only history's first spaceman; he is also the first person to orbit the Earth.

May 5, 1961. Lt. Cmdr. Alan B. Shepard, Jr., USN, becomes the first Project Mercury astronaut to cross the space frontier. His flight lasts fifteen minutes, twenty-two seconds; reaches an altitude of 115 miles; and ends 303.8 miles downrange.

July 21, 1961. Capt. Virgil I. Grissom becomes the first Air Force astronaut in space. He attains an altitude of 118.3 miles on the second Mercury mission.

February 20, 1962. Marine Lt. Col. John H. Glenn, Jr., becomes the first US astronaut to orbit the Earth. His *Friendship 7* flight lasts nearly five hours.

July 17, 1962. USAF Maj. Robert White pilots the X-15 to an altitude of 314,750 feet, thus making the first spaceflight in a manned aircraft.

October 14, 1962. An Air Force reconnaissance flight photographs nuclear-armed Soviet missiles in Cuba. Moscow subsequently agrees to remove the missiles under threat of US invasion of Cuba.

December 14, 1962. NASA's Mariner II satellite scans the surface of Venus for thirty-five minutes as it flies past the planet at a distance of 21,642 miles.

January 17, 1963. NASA pilot Joe Walker qualifies for astronaut wings by flying the North American X-15 to an altitude of 271,700 feet, or 51.46 miles. He is the eleventh man to pass the fifty-mile mark.

During the Gemini 4 mission, Maj. Edward White became the first US astronaut to walk in space. Major White was later killed in the tragic Apollo 1 capsule fire.

February 28, 1963. The first Minuteman squadron, the 10th Strategic Missile Squadron (SMS) at Malmstrom AFB, Mont., is declared operational.

April 11, 1963. The first successful launch of a Boeing LGM-30 Minuteman I ICBM is conducted at Vandenberg AFB, Calif.

May 15, 1963. The first American to orbit Earth for more than a day, Air Force Maj. L. Gordon Cooper, is launched from Cape Canaveral, Fla. The thirty-four-hour, twenty-two-orbit flight is made in the MA-9 *Faith 7* Mercury capsule.

June 16–19, 1963. Cosmonaut Jr. Lt. Valentina Tereshkova, a former cotton mill worker, becomes the first woman in space. Her Vostok-6 flight lasts nearly three days.

August 22, 1963. NASA pilot Joe Walker achieves an unofficial world altitude record of 354,200 feet in the X-15.

October 17, 1963. The first LGM-30A Minuteman I operational test launch is carried out at Vandenberg AFB, Calif., by a crew from Malmstrom AFB, Mont. The shot is a partial success. The reentry vehicle overshoots the target.

December 17, 1963. The Lockheed C-141A StarLifter transport makes its first flight at Marietta, Ga., with company pilots Leo Sullivan and Hank Dees on the flight deck.

1964–1973

February 3, 1964. Four airmen locked in a spaceship simulator exhibit no ill effects after exposure to a pure oxygen atmosphere for thirty days.

February 29, 1964. President Lyndon B. Johnson announces the existence of the Lockheed A-11 (YF-12A), with a cruising speed of more than Mach 3 at altitudes above 70,000 feet. The plane was ordered as a single-seat reconnaissance aircraft for the CIA in 1960. Only three YF-12A interceptors are built, and the SR-71 program for the Air Force takes precedence.

May 11, 1964. The North American XB-70 Valkyrie is rolled out at Palmdale, Calif. Designed to fly at three times the speed of sound and at altitudes above 70,000 feet, the XB-70 is originally planned as a manned bomber, but funding limitations allow for only two aircraft, to be used strictly for testing and research.

August 19, 1964. The Hughes Syncom III satellite is launched by a Thor-Delta launch vehicle. After several weeks of maneuvers, it becomes the world's first geosynchronous satellite.

September 21, 1964. The North American XB-70A Valkyrie makes its first flight, with company pilot Alvin White and USAF pilot Col. Joseph Cotton at the controls.

September 28, 1964. USS *Daniel Webster* (SSBN-626), the first submarine equipped with the Lockheed UGM-27C (A3) Polaris sea-launched ballistic missile, departs Charleston, S. C., on its first patrol.

December 21, 1964. Company pilots Richard Johnson and Val Prahl make the first flight of the variable-geometry General Dynamics F-111A from Air Force Plant 4 in Fort Worth, Tex. The flight lasts twenty-two minutes.

December 22, 1964. Lockheed gets approval to start development for the Air Force of the CX-HLS transport, which will become the C-5A. Also on this date, the Lockheed SR-71A "Blackbird" strategic reconnaissance aircraft exceeds an altitude of 45,000 feet and a speed of 1,000 mph on its first flight, made from Palmdale, Calif.

February 1, 1965. The first Boeing LGM-30F Minuteman II ICBM unit, the 447th SMS at Grand Forks AFB, N. D., is activated.

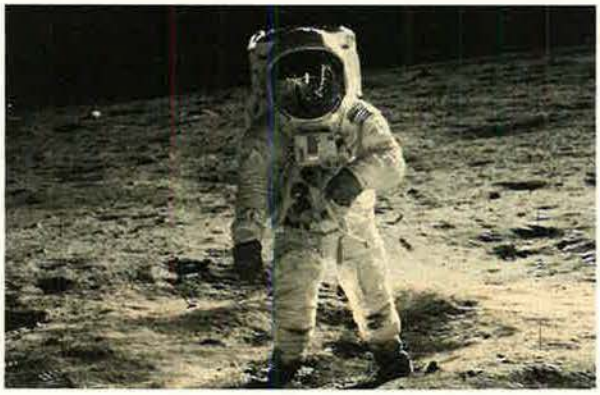
March 2, 1965. Capt. Hayden J. Lockhart, flying an F-100 in a raid against an ammunition dump north of the Vietnamese Demilitarized Zone, is shot down and becomes the first Air Force pilot to be taken prisoner by the North Vietnamese. He will not be released until February 12, 1973.

March 23, 1965. Air Force Maj. Virgil I. Grissom becomes the first astronaut in the manned spaceflight program to go aloft a second time, as he and

Navy Lt. Cmdr. John W. Young are launched on the first Gemini mission, Gemini 3.

June 3–7, 1965. Air Force Maj. Edward H. White makes the first US spacewalk. The Gemini 4 mission is the first US spaceflight to be controlled from the Manned Spaceflight Center in Houston, Tex., and the crew, which also includes Air Force Maj. James A. McDivitt, stays aloft for a record sixty-two orbits.

July 10, 1965. Two F-4C crews down two MiG-17s in the first Air Force air-to-air victories of the Vietnam War.



Just eight years after Alan Shepard became the first US astronaut to cross the space frontier, Neil Armstrong and "Buzz" Aldrin spent three hours exploring the lunar surface.

August 21–29, 1965. The Gemini 5 crew of Air Force Lt. Col. L. Gordon Cooper and Navy Lt. Cmdr. Charles Conrad carry out the US's first long-duration spaceflight, ending one orbit short of eight full days.

January 27, 1967. Astronauts USAF Lt. Col. Virgil I. Grissom, Navy Lt. Cmdr. Roger B. Chaffee, and Edward H. White are killed in a flash fire aboard their Apollo 1 command module during a ground test. The disaster sets the moon-landing effort back two years.

June 1, 1967. Two HH-3E crews complete the first nonstop transatlantic helicopter flight.

October 3, 1967. Maj. William Knight flies the North American X-15A-2 to the unofficial absolute world speed record of Mach 6.72 (4,534 mph) over Edwards AFB.

December 11, 1967. The Aerospatiale-built Concorde supersonic jetliner prototype rolls out at the company's plant in Toulouse, France.

March 2, 1968. The first of eighty C-5A Galaxy transports rolls out at Lockheed's Marietta, Ga., facility.

March 31, 1968. President Johnson announces a partial halt of bombing missions over North Vietnam and proposes peace talks.

August 16, 1968. The first test launch of a Boeing LGM-30G Minuteman III ICBM is carried out from Cape Kennedy AFS, Fla.

October 11–22, 1968. Apollo 7, the first test mission following the disastrous Apollo 1 fire, is successfully carried out. Navy Capt. Walter M. Schirra, Jr., USAF Maj. Donn F. Eisele, and R. Walter Cunningham stay in Earth orbit for ten days, twenty hours, nine minutes.

October 24, 1968. With NASA test pilot William H. Dana at the controls, the North American X-15 makes the type's 199th and final flight, completing ten years of flight testing. The plane reaches a speed of Mach 5.04 and an altitude of 250,000 feet.

December 21–27, 1968. Apollo 8 becomes the first manned mission to use the Saturn V booster. Astronauts USAF Col. Frank Borman, Navy Cmdr. James A. Lovell, and USAF Maj. William Anders become the first humans to orbit the moon.

December 31, 1968. The Soviet Union conducts the first flight of the Tu-144, the world's first supersonic transport.

February 9, 1969. Boeing conducts the first flight of the 747. The jumbo jet, with standard seating for 347 passengers, introduces high passenger volume to the world's airways.

March 3–13, 1969. Air Force astronauts Col. James A. McDivitt and Col. David R. Scott, along with civilian Russell L. Schweickart, carry out the first in-space test of the lunar module while in Earth orbit during the Apollo 9 mission. The flight also marks the first time a crew transfer is made between space vehicles using an internal connection.

May 18–26, 1969. In a dress rehearsal for the moon landing, Apollo 10 astronauts Col. Thomas P. Stafford, USAF, and Cmdr. Eugene Cernan, USN, fly the lunar module *Snoopy* to within nine miles of the lunar surface. Astronaut Cmdr. John W. Young, USN, remains in orbit aboard *Charlie Brown,* the command module.

July 20, 1969. Man sets foot on the moon for the first time. At 10:56 p.m. EDT, Apollo 11 astronaut Neil Armstrong puts his left foot on the lunar surface. He and lunar module pilot Col. Edwin "Buzz" Aldrin, Jr., USAF, spend just under three hours walking on the moon. Command module pilot Lt. Col. Michael Collins, USAF, remains in orbit.

November 3, 1969. The Air Force issues a request for proposal for a new bomber to meet its advanced manned strategic aircraft requirement. Its designation will be "B-1."

November 14–24, 1969. Apollo 12 is hit by lightning on liftoff, but Cmdrs. Charles Conrad and Alan Bean make the second manned lunar landing with pinpoint accuracy. The lunar module *Intrepid* touches down 1,000 yards from the Surveyor 3 probe, on the moon since 1967. The all-Navy crew, which also includes Cmdr. Richard F. Gordon, is recovered in the Pacific Ocean by USS *Hornet* (CVS-12).

December 17, 1969. Air Force Secretary Robert Seamans announces the termination of Project Blue Book, the service's program to investigate reports of unidentified flying objects (UFOs).

March 19, 1970. Air Force Maj. Jerauld Gentry makes the first successful powered flight of the Martin Marietta X-24A lifting-body research aircraft over Edwards AFB.

April 11–17, 1970. Thirteen proves an unlucky number for the Apollo program. An explosion in the service module cripples the spaceship and forces the crew to use the lunar module as a lifeboat to get back to Earth. After a tense four days, the Apollo 13 crew safely splashes down in the Pacific.

June 6, 1970. The first operational Lockheed C-5A Galaxy transport is delivered to the 437th Military Airlift Wing at Charleston, S. C.

August 24, 1970. Two Air Force crews complete the first nonstop transpacific helicopter flight as they land their Sikorsky HH-53Cs at Da Nang AB, South Vietnam, after a 9,000-mile flight from Eglin AFB.

February 6, 1971. Apollo 14 commander Alan B. Shepard, Jr., a Navy captain, becomes the first person to play golf on the moon, using a field-modified soil sample scoop as a club.

July 16, 1971. Jeanne M. Holm becomes the first female general officer in the Air Force.

Pilot Capt. Steve Ritchie (left) downed five MiG-21s during the Vietnam War. Weapon System Officer Capt. Chuck DeBellevue garnered six victories during his tour with the 555th Tactical Fighter Squadron.

April 27, 1972. Four Air Force fighter crews, releasing Paveway I "smart" bombs, knock down the Thanh Hoa bridge in North Vietnam. Previously, 871 conventional sorties resulted in only superficial damage to the bridge.

December 7–19, 1972. The Apollo 17 mission is the last of the moon landings. It is also the first US manned launch to be conducted at night. Mission commander Navy Cmdr. Eugene Cernan and lunar module pilot/geologist Harrison Schmitt spend a record seventy-five hours on the lunar surface.

December 18, 1972. The US begins Operation Linebacker II, the eleven-day bombing of Hanoi and Haiphong. Massive air strikes help persuade North Vietnam to conclude Paris peace negotiations, which will be finalized January 27, 1973.

February 12, 1973. Operation Homecoming, the return of 591 American POWs from North Vietnam, begins.

April 10, 1973. First flight of the Boeing T-43A navigation trainer occurs.

November 14, 1973. The US ends its major airlift to Israel. In a thirty-two-day operation during the Yom Kippur War, Military Airlift Command (MAC) airlifts 22,318 tons of supplies. First production McDonnell Douglas F-15A Eagle is delivered to the Air Force at Luke AFB, Ariz.

1974–1983

September 1, 1974. Maj. James V. Sullivan and Maj. Noel Widdifield set a New York to London speed record of 1,806.964 mph in a Lockheed SR-71A. The trip takes one hour, fifty-four minutes, fifty-five seconds. (The record will still stand in 1993.)

October 24, 1974. The Air Force's Space and Missile Systems Organization carries out a midair launch of a Boeing LGM-30A Minuteman I from the hold of a Lockheed C-5A.

December 23, 1974. The first prototype of the Rockwell B-1A variable-geometry bomber makes its first flight.

January 13, 1975. The General Dynamics YF-16 is announced as the winner of the Air Force's Lightweight Fighter technology evaluation program. The F-16 is also the leading candidate to become the Air Force's new air combat fighter.

January 26, 1975. The Force Modernization program, a nine-year effort to replace all Boeing LGM-30B Minuteman Is with either Minuteman IIs (LGM-30F) or Minuteman IIIs (LGM-30G), is completed.

February 1, 1975. Maj. Roger Smith sets a world time-to-climb record to 30,000 meters (98,425 feet) in three minutes, 27.8 seconds in the McDonnell Douglas F-15A Streak Eagle.

May 15, 1975. Carrying 175 Marines, Air Force special operations helicopters land on Kho Tang to begin rescue of the crew of the US merchant ship *Mayaguez*, which had been seized in international waters by the Cambodian Navy three days earlier.

July 15–24, 1975. US astronauts Brig. Gen. Thomas P. Stafford, USAF, Vance D. Brand, and Donald K. Slayton rendezvous, dock, and shake hands with Soviet cosmonauts Alexei Leonov and Valeri Kubasov in orbit during the Apollo-Soyuz Test Project.

August 20, 1975. The Viking 1 mission to Mars is launched from Cape Canaveral AFS, Fla., on a Titan III booster. The spacecraft enters Mars orbit on June 19, 1976, and the lander, which takes soil samples and performs rudimentary analysis on them, soft-lands on July 20, 1976.

November 29, 1975. The first Red Flag exercise at Nellis AFB, Nev., begins a new era of highly realistic training for combat aircrews.

July 27–28, 1976. An SR-71 crew sets three absolute world flight records over Beale AFB, Calif.: altitude in horizontal flight (85,068.997 feet), speed over a straight course (2,193.16 mph), and speed over a closed course (2,092.294 mph). (The records, set by Capt. Eldon W. Joersz and Maj. Adolphus H. Bledsoe, Jr., will still stand in 1993.)

February 22, 1978. The first test satellite in the Air Force's Navstar Global Positioning System is successfully launched into orbit.

March 23, 1978. Capt. Sandra M. Scott becomes the first female aircrew member to pull alert duty in SAC.

November 30, 1978. The last Boeing LGM-30G Minuteman III ICBM is delivered to the Air Force at Hill AFB, Utah.

January 6, 1979. The 388th Tactical Fighter Wing at Hill AFB, Utah, receives the first operational General Dynamics F-16A fighters. The first Air Force Reserve F-16s will be delivered to the 419th TFW at Hill on January 28, 1984.

June 12, 1979. Pilot/cyclist Bryan Allen makes the first human-powered flight across the English Channel in the *Gossamer Albatross*.

July 9, 1979. The Voyager 2 space probe, launched in 1977, flies within 399,560 miles of Jupiter's cloud tops. Voyager 2 will pass Neptune in 1989.

March 12–14, 1980. Two B-52 crews fly nonstop around the world in forty-three and a half hours, covering 21,256 statute miles, averaging 488 mph, and carrying out sea surveillance/reconnaissance missions.

April 24, 1980. In the middle of an attempt to rescue US citizens held hostage in Iran, mechanical difficulties force several Navy RH-53 helicopter crews to turn back. Later, one of the RH-53s collides with an Air Force HC-130 in a sandstorm at the Desert One refueling site. Eight US servicemen are killed.

May 28, 1980. The Air Force Academy graduates its first female cadets. Ninety-seven women are commissioned as second lieutenants. Lt. Kathleen Conly graduates eighth in her class.

Maj. Roger Smith, here flanked by fellow Project Streak Eagle pilots Maj. Willard Macfarlane (left) and Maj. David Peterson, shattered records in 1975 by flying his F-15 to 30,000 meters in three minutes, 27.8 seconds.

April 12, 1981. Space shuttle orbiter *Columbia*, the first reusable manned space vehicle, makes its first flight.

October 2, 1981. President Ronald Reagan reinstitutes the B-1 bomber program canceled by the Carter Administration in 1977.

February 9, 1983. At Lockheed's plant in Marietta, Ga., the first rewinged C-5A makes its first flight. It will be delivered to the Air Force at the end of the month.

February 10, 1983. The Cruise Pact is signed by the US and Canada, allowing testing of US cruise missiles in northern Canada.

March 23, 1983. Flight testing of the Rockwell B-1A resumes at Edwards AFB. This aircraft is modified for the B-1B development effort.

May 9, 1983. A C-141 crew from the 18th Military Airlift Squadron, McGuire AFB, N. J., becomes USAF's first all-woman crew to fly a round-trip mission across the Atlantic.

June 17, 1983. The first LGM-118A Peacekeeper (originally MX) ICBM is test-launched from Vandenberg AFB, Calif.

June 18, 1983. The first American woman to go into space, Sally K. Ride, s aboard *Challenger* on the seventh space shuttle mission (STS-7).

July 22, 1983. Australian Dick Smith, flying a Bell JetRanger, completes the first solo flight around the world in a helicopter. The 35,258-mile trip began August 5, 1982.

August 30, 1983. The oldest astronaut, William Thornton, fifty-four, and the first black astronaut, Lt. Col. Guion Bluford, USAF, are sent aloft on the space shuttle *Challenger* with three others.

1984–1993

February 3–11, 1984. Navy Capt. Bruce McCandless becomes the first human satellite as he takes the self-contained Manned Maneuvering Unit (MMU) out for a spin while in Earth orbit on space shuttle mission 41-B.

April 6–13, 1984. The eleventh US space shuttle mission (41-C) is a spectacular success as the defective Solar Maximum Mission satellite (Solar Max) is repaired in orbit. Terry J. Hart uses *Challenger's* remote manipulator arm to catch Solar Max on the fly. George Nelson and James van Hoften repair the satellite in the shuttle's payload bay before it is released.

September 4, 1984. The first production Rockwell B-1B bomber is rolled out at Air Force Plant 42 in Palmdale, Calif.

October 5–13, 1984. On the thirteenth space shuttle mission, *Challenger* lifts off for the first time with a crew of seven. Mission 41-G is the first to have two female astronauts (Sally K. Ride and Kathryn D. Sullivan, who will become the first American woman to make a spacewalk) and the first to have a Canadian astronaut aboard (Marc Garneau). Commander Robert L. Crippen becomes the first to fly on the shuttle four times. The crew refuels a satellite in orbit for the first time.

December 14, 1984. Grumman pilot Chuck Sewell makes the first flight of the X-29A forward-swept wing demonstrator at Edwards AFB. The X-29s, two of the most unusual aircraft ever built, are designed to prove the aerodynamic benefits of wings that appear to have been put on backwards.

January 24–27, 1985. The fifteenth space shuttle mission (51-C) is the first dedicated Department of Defense flight. The *Discovery* crew deploys a classified payload, believed to be a signals intelligence satellite.

September 13, 1985. The first test of the LTV-Boeing ASM-135A air-launched antisatellite weapon against a target is successfully carried out over the Western Missile Test Range. Launched from an F-15, the missile destroys a satellite orbiting at a speed of 17,500 mph approximately 290 miles above Earth.

January 28, 1986. The space shuttle *Challenger* explodes seventy-three seconds after liftoff, killing all seven astronauts, including schoolteacher Christa McAuliffe. Others on Mission 51-L included Francis R.Scobee, Navy Cmdr. Michael J. Smith, Judith Resnik, Ronald E. McNair, Air Force Lt. Col. Ellison S. Onizuka, and Gregory Jarvis.

April 15, 1986. F-111s based in Britain, along with US Navy carrier-based aircraft, conduct air strikes against Libya during Operation Eldorado Canyon.

December 23, 1986. Richard Rutan and Jeana Yeager complete the first nonstop unrefueled flight around the world in their experimental *Voyager*, starting and stopping at Mojave, Calif. The trip took nine days.

September 24, 1987. The Air Force's Thunderbirds fly for a crowd of 5,000 in Beijing. It has been nearly forty years since a US combat aircraft flew over and landed on Chinese soil.

January 1, 1988. SAC changes missile crew assignment policy to permit mixed male/female crews in Minuteman and Peacekeeper launch facilities.

January 20, 1988. The 100th and final B-1B bomber rolls off the line at Rockwell's plant in Palmdale, Calif.

February 10, 1988. The 2,000th F-16 fighter built is accepted by Singapore.

March 3, 1988. The Pioneer 8 solar orbiter, which was launched November 8, 1968, with a six-month life expectancy, is finally declared defunct.

May 23, 1988. The Bell-Boeing V-22 Osprey, the world's first production tiltrotor aircraft, is rolled out at Bell Helicopter Textron's plant in Arlington, Tex.

August 2, 1988. As evidence of thawing superpower relations, US Secretary of Defense Frank C. Carlucci is given the opportunity to inspect the Soviet Tu-160 "Blackjack" strategic bomber during a visit to Kubinka AB, near Moscow.

September 29, 1988. Launch of the space shuttle *Discovery* ends the long stand-down of the US manned space program in the wake of the *Challenger* disaster.

October 25, 1988. A US Navy S-3 Viking antisubmarine warfare aircraft from the carrier USS *Theodore Roosevelt* (CVN-71) is given a $21 parking ticket after the crew overshoots a runway at a base in southern England and lands on a public road.

November 10, 1988. The Air Force reveals the existence of the Lockheed F-117A Stealth fighter, operational since 1983.

The existence of the F-117A Stealth fighter was not revealed to the public until 1988, though it had been operational since 1983.

November 12, 1988. Soviet cosmonauts Vladimir Titov and Musa Manarov break the world space endurance record as they remain on board the space station Mir ("peace") for their 326th day in orbit.

November 19, 1988. Boeing KC-135R tanker crews from the 19th Air Refueling Wing (Robins AFB, Ga.), 340th ARW (Altus AFB, Okla.), 319th Bomb Wing (Grand Forks AFB, N. D.), and 384th BW (McConnell AFB, Kan.) set sixteen class time-to-climb records in flights from Robins AFB.

November 22, 1988. Northrop and the Air Force roll out the B-2 Stealth bomber at Air Force Plant 42 in Palmdale.

November 30, 1988. The Soviets roll out the An-225 transport, the world's largest airplane.

December 9, 1988. The first Sierra Research/de Havilland Canada E-9A airborne telemetry data relay aircraft is delivered to the Air Force's 475th Weapons Evaluation Group at Tyndall AFB, Fla.

December 29, 1988. The first operational dual-role (air superiority and deep interdiction) McDonnell Douglas F-15E fighter is delivered to the Air Force.

January 4, 1989. Two Libyan MiG-23 "Flogger" fighters, displaying hostile intentions, are shot down over international waters by an element of US Navy F-14 Tomcats operating from the carrier USS *John F. Kennedy* (CVN-67).

February 14, 1989. The first McDonnell Douglas Delta II space booster is launched from Cape Canaveral AFS. The 128-foot-tall rocket boosts the first operational NS-7 Navstar Block II Global Positioning System satellite into orbit.

February 16, 1989. Northrop completes the 3,806th and final aircraft in the F-5/T-38 series. The milestone aircraft, an F-5E, will later be delivered to Singapore.

March 1, 1989. The first General Dynamics F-16A modified under the Air Force's air defense fighter program is delivered to the Air National Guard's 114th Tactical Fighter Training Squadron at Kingsley Field, Ore.

March 19, 1989. Bell pilot Dorman Canon and Boeing pilot Dick Balzer make the first flight of the Bell-Boeing V-22 Osprey at Bell Helicopter Textron's Flight Research Center in Arlington, Tex.

March 21, 1989. NASA completes flight test of the Mission Adaptive Wing, a modification to the advanced fighter technology integration (AFTI) F-111 that allows the curvature of the aircraft's leading and trailing edges to be varied in flight. The MAW completed 144.9 hours on fifty-nine flights.

April 17, 1989. Lockheed delivers the fiftieth and last C-5B Galaxy transport to the Air Force in ceremonies at its plant in Marietta, Ga.

April 17–18, 1989. Lockheed pilots Jerry Hoyt and Ron Williams set sixteen class time-to-climb and altitude records in separate flights in a NASA U-2C at the Dryden Flight Research Facility at Edwards AFB. The thirty-two-year-old aircraft, which was loaned to NASA in 1971, is retired to a museum after the flights.

May 4, 1989. Air Force Maj. Mark Lee releases the Magellan probe from the payload bay of the

space shuttle orbiter *Atlantis* during the first day of the four-day STS-30 space mission. The twenty-one-foot-tall, 7,604-pound Magellan probe is designed to map Venus with its synthetic aperture radar.

June 10, 1989. Capt. Jacquelyn S. Parker becomes the first female pilot to graduate from the Air Force Test Pilot School at Edwards AFB.

June 14, 1989. The first Martin Marietta Titan IV heavy-lift space booster is successfully launched from Launch Complex 40 at Cape Canaveral AFS. The booster, nearly twenty stories tall, carries a classified military payload.

July 6, 1989. The nation's highest civilian award, the Presidential Medal of Freedom, is presented to retired Air Force Gen. James H. Doolittle in White House ceremonies. The 169th and last MGM-31 Pershing 1A intermediate-range ballistic missile is destroyed at the Longhorn Army Ammunition Plant near Karnack, Tex., under terms of the Intermediate Nuclear Forces Treaty.

Using thrust vectoring and advanced flight-control systems, the X-31, rolled out in 1990, has reached an angle of attack of seventy degrees.

Staff photo by Guy Aceto

The holder of many records during its storied career, the SR-71 set one on its last flight, making it from California to Maryland in slightly more than an hour.

July 17, 1989. Northrop Chief Test Pilot Bruce Hinds and Air Force Lt. Col. Richard Crouch, director of the B-2 Combined Test Force, make the first flight of the Northrop B-2A advanced technology bomber, flying from Air Force Plant 42 in Palmdale, Calif., to the Air Force Flight Test Center at Edwards AFB.

August 2, 1989. The Navy successfully carries out the first undersea launch of the Lockheed UGM-133A Trident II (D5) sea-launched ballistic missile. The missile is launched from USS *Tennessee* (SSBN-734) while cruising off Florida.

August 6, 1989. As further evidence of the thaw in US-Soviet relations, two MiG-29 fighters and the giant An-225 transport land and refuel at Elmendorf AFB, Alaska, on their way to an air show in Canada.

August 24, 1989. The Voyager 2 space probe completes its grand tour of the solar system as the 1,787-pound vehicle passes within 3,000 miles of Neptune. Voyager 2 was launched in August 1977.

September 15, 1989. McDonnell Douglas delivers the 500th AH-64 Apache helicopter to the US Army at the company's plant in Mesa, Ariz.

October 3, 1989. The last of thirty-seven Lockheed U-2R/TR-1A/B high-altitude reconnaissance aircraft is delivered to the Air Force.

October 4, 1989. A crew from the 60th Military Airlift Wing, Travis AFB, Calif., lands a Lockheed C-5B transport at McMurdo Station in Antarctica. This is the first time an aircraft so large has landed on the ice continent. The C-5B, carrying seventy-two passengers and 168,000 pounds of cargo (including two fully assembled Bell UH-1N helicopters), lands without skis.

December 3, 1989. Solar Max, the first satellite to be repaired in orbit, is destroyed as it reenters the atmosphere over Sri Lanka.

December 14, 1989. MAC approves a policy change that will allow female aircrew members to serve on C-130 and C-141 airdrop missions.

December 20, 1989. Operation Just Cause begins in Panama. The Air Force plays a major role, ranging from airlift, airdrops, and aerial refueling to bringing Panamanian dictator Manuel Noriega to the US. In Just Cause, the Lockheed F-117A Stealth fighter is used operationally for the first time.

January 25, 1990. The Lockheed SR-71 "Blackbird" high-altitude, high-speed reconnaissance aircraft is retired from SAC service in ceremonies at Beale AFB, Calif.

February 21, 1990. The Air Force returns to dual-track pilot training. The team of McDonnell Douglas, Beech, and Quintron is selected over two other teams to provide the Tanker/Transport Training System. This turnkey operation will train pilots going on to fly "heavies" using the T-1A Jayhawk.

March 6, 1990. Lt. Col. Ed Yielding (pilot) and Lt. Col. J. T. Vida (reconnaissance systems officer) set four speed records, including a transcontinental mark of 2,112.52 mph (one hour, eight minutes, seventeen seconds elapsed time) over the 2,404.05-statute-mile course from Oxnard, Calif., to Salisbury, Md., on the last Air Force flight of the Lockheed SR-71.

April 2, 1990. Air Force pilot Maj. Erwin "Bud" Jenschke demonstrates in-flight thrust reversing for the first time while flying the McDonnell Douglas NF-15B S/MTD (STOL/Maneuvering Technology Demonstrator) aircraft over Edwards AFB.

April 4, 1990. McDonnell Douglas turns over the last of sixty official KC-10A Extender tanker/cargo aircraft to the Air Force at its plant in Long Beach, Calif.

April 5, 1990. The first launch of the Orbital Sciences Corp./Hercules Aerospace Pegasus air-launched space booster, the first all-new booster in two decades, is successfully carried out off the California coast.

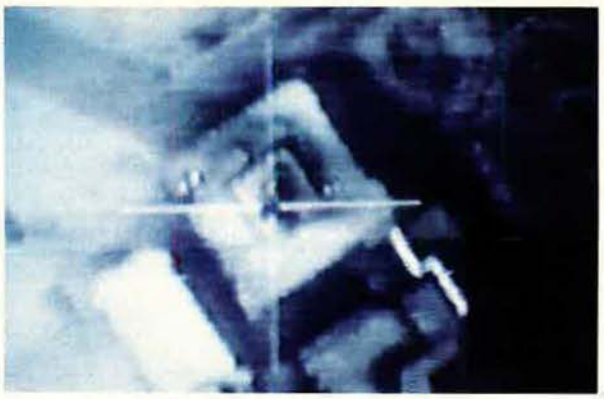
April 24, 1990. The space shuttle *Discovery*, with a crew of five, lifts off on the thirty-fifth mission in the shuttle program. The next day, astronaut Steven Hawley releases the Hubble Space Telescope, an on-orbit observatory with great scientific promise. Although the telescope gathers unprecedented images, it proves to be somewhat myopic (a two-micron-wide spherical aberration—less than the width of a human hair—is found) and will have to be repaired on a 1993 shuttle flight.

April 25, 1990. Boeing delivers the 200th reengined and upgraded KC-135R tanker to the Air Force. It is delivered to the 340th Air Refueling Group at Altus AFB, Okla.

April 30, 1990. USAF announces that Air Force Special Operations Command, the first new command since 1982, will be established by early summer. This component of the US Special Operations Command will be composed primarily of 23d Air Force assets.

May 4, 1990. The Hughes/Raytheon AIM-120A Advanced Medium-Range Air-to-Air Missile (AMRAAM) passes its "final exam"—demonstration of its ability to achieve multiple kills against multiple targets. There are three direct hits and a lethal near miss in the four missile vs. four target test near Eglin AFB.

May 22, 1990. Company pilot Larry Walker and Air Force pilot Maj. Erwin Jenschke land the



During the Persian Gulf War in 1991, precision bombing became a reality as the F-117 demonstrated its ability to hit specific buildings and even specific parts of buildings.

McDonnell Douglas NF-15B S/MTD test-bed in a mere 1,650 feet at the Air Force Flight Test Center at Edwards AFB. Pratt & Whitney two-dimensional, thrust-reversing engine nozzles are the main method of stopping the aircraft.

June 1, 1990. SAC turns over the first pair of General Dynamics FB-111As to Tactical Air Command (TAC). With one internal modification, the aircraft will be redesignated F-111Gs.

June 22, 1990. The Northrop/McDonnell Douglas YF-23A Advanced Tactical Fighter prototype is rolled out in ceremonies at the ATF Combined Test Force Facility at Edwards AFB. It is powered by two Pratt & Whitney YF119-PW-100 engines. Northrop pilot Paul Metz will make the first flight August 27, 1990.

July 11, 1990. Four Air National Guard F-16 pilots from the 177th Fighter-Interceptor Group at Atlantic City IAP, N. J., escort two Soviet MiG-29 fighters and an Il-76 transport in US airspace, flying from Kalamazoo, Mich., to Rockford, Ill., as part of the Soviet Union's first US air show tour.

July 12, 1990. The last of fifty-nine Lockheed F-117A Stealth fighters is delivered to the Air Force in ceremonies at the company's Palmdale facility.

July 13, 1990. Alaskan Air Command ceases to exist. The former command now becomes a numbered (11th) Air Force and is made part of Pacific Air Forces.

July 24, 1990. SAC ends "Looking Glass," more than twenty-nine years of continuous airborne alert, as a Boeing EC-135C Airborne Command Post aircraft lands at Offutt AFB, Neb.

August 7, 1990. The US begins Operation Desert Shield, the large-scale movement of US forces to the Middle East in response to Iraq's August 2 invasion of Kuwait and threat to Saudi Arabia.

August 17, 1990. The first stage of the Civil Reserve Air Fleet is activated for the first time to increase the availability of airlift to the Middle East.

August 21, 1990. By this date, one billion pounds of materiel have arrived in or are en route to Saudi Arabia. Six fighter wings are deployed, and SAC steps up refueling efforts and RC-135 reconnaissance flights in the area.

August 23, 1990. The first of two Boeing VC-25A Presidential transport aircraft is delivered to the 89th Military Airlift Wing at Andrews AFB, Md. The new aircraft, a modified 747-200B commercial transport, will replace the VC-137C aircraft currently used as "Air Force One."

August 29, 1990. The Lockheed/Boeing/General Dynamics YF-22A ATF prototype is unveiled in ceremonies at Lockheed Plant 10 in Palmdale. This aircraft is powered by two General Electric YF120-GE-100 turbofan engines. Lockheed pilot Dave Ferguson makes the first flight of the YF-22 September 29, 1990.

October 11, 1990. Rockwell pilot Ken Dyson makes the first flight of the Rockwell/MBB X-31A Enhanced Fighter Maneuverability (EFM) demonstrator at Air Force Plant 42. The flight lasts thirty-eight minutes.

November 9, 1990. Col. (Dr.) Thomas C. Cook, believed to be the Air Force's last World War II combat veteran still serving, retires. He saw action as a B-24 navigator in Europe and transferred to Reserve status in 1948. He returned to active duty in 1976.

December 17, 1990. The Lockheed/Boeing/General Dynamics YF-22 prototype is flown to an unprecedented 60° angle-of-attack (AOA) attitude and remains in full control in a test flight over Edwards AFB.

January 16, 1991. At 6:35 a.m. local time, B-52G crews from the 2d Bomb Wing, Barksdale AFB, La., take off to begin what will become the longest bombing mission in history. The bomber crews fly to the Middle East and launch their missiles against high-priority targets in Iraq.

January 17, 1991. War begins in the Persian Gulf Operation Desert Shield becomes Operation Desert Storm. More than 1,200 combat sorties are flown, and 106 cruise missiles are launched against targets in Iraq and Kuwait during the first fourteen hours of the operation.

January 18, 1991. Eastern Air Lines, one of the oldest US commercial carriers, goes out of business. The airline operated for sixty-four years.

February 6, 1991. Capt. Robert Swain of the 706th Tactical Fighter Squadron, NAS New Orleans, La., shoots down an Iraqi helicopter in the first air-to-air victory for the Fairchild A-10 Thunderbolt II attack aircraft. He uses the plane's 30-mm cannon for the kill.

February 14, 1991. In one of the most unusual air-to-air victories ever, Capts. Tim Bennett and Dan Bakke of the 4th Tactical Fighter Wing at Seymour Johnson AFB, N. C., shoot down an Iraqi helicopter (probably an Mi-24 "Hind") with a GBU-10 2,000-pound laser-guided bomb dropped from their F-15E.

February 22, 1991. Soviet cosmonaut Musa Manarov sets a record for accumulated time in space, amassing his 447th day in orbit. Cosmonaut Manarov is on the eighty-third day of his Soyuz TM-11 mission, working aboard the space station Mir, when he breaks the record.

February 28, 1991. Iraq surrenders to the US-led coalition. In the forty-three-day, around-the-clock war, the Air Force flew fifty-nine percent of all sorties with less than fifty percent of the assets, flew more than 50,000 combat sorties, offloaded more than 800 million pounds of fuel, and transported 96,465 passengers and 333 million pounds of cargo.

March 8, 1991. The first Martin Marietta Titan IV heavy-lift space booster to be launched from Vandenberg AFB, Calif., lifts off. The booster carries a classified payload.

April 18, 1991. The Air Force carries out the first successful flight test of the Martin Marietta/Boeing MGM-134A small ICBM. The missile flies 4,000 miles from Vandenberg AFB to its assigned target area in the Army's Kwajalein Missile Range in the Pacific Ocean.

April 23, 1991. Air Force Secretary Donald B. Rice announces that the Lockheed/Boeing/General Dynamics F-22 and the Pratt & Whitney F119 engine are the winners in the ATF competition.

June 6, 1991. The Air Force reveals the existence of the Northrop AGM-137A Triservice Standoff Attack Missile (TSSAM), a stealthy ground-

In an unusual air-to-air victory during the Gulf War, Capts. Tim Bennett (left) and Dan Bakke obliterated an Iraqi helicopter with a 2,000-pound bomb from their F-15E.

attack weapon with a range of less than 600 kilometers.

July 2, 1991. McDonnell Douglas Helicopter Co. announces the first flight of the first production helicopter built without a tail rotor. The MD520N uses a blown air system for antitorque and directional control.

September 15, 1991. The McDonnell Douglas C-17A transport makes its first flight. The crew of four takes off from the company's plant in Long Beach, Calif., and lands two hours, twenty-three minutes later at the Air Force Flight Test Center at Edwards AFB.

November 26, 1991. Clark AB, the Philippines, is officially turned over to the Philippine government, ending nearly ninety years of US occupancy. It was the largest overseas USAF base.

December 21, 1991. The first Rockwell new-generation AC-130U gunship is flown for the first time.

January 31, 1992. The Navy takes delivery of the last production Grumman A-6 Intruder attack aircraft, closing out thirty-one years of Intruder production.

February 10, 1992. Operation Provide Hope, the delivery of food and medical supplies to the former Soviet Union, begins.

April 9, 1992. The Air Force's new Variable Stability In-Flight Simulator Aircraft (VISTA), a modified General Dynamics F-16, designated NF-16, that will replace the forty-plus-year-old NT-33, is flown for the first time at the General Dynamics facility in Fort Worth, Tex. The flight lasts fifty-three minutes.

June 1, 1992. SAC, TAC, and MAC are deactivated. Bomber, fighter, attack, reconnaissance, and electronic combat/electronic warfare aircraft and all ICBMs regroup under Air Combat Command (ACC). Lifter and tanker aircraft regroup under Air Mobility Command (AMC).

July 1, 1992. Air Force Systems Command and Air Force Logistics Command are merged to create Air Force Materiel Command, which is to provide "cradle-to-grave" management of weapon systems.

December 9, 1992. Operation Restore Hope, an international humanitarian operation in Somalia, begins. More than 28,000 troops are sent to safeguard food, supplies, and aid workers from armed factions trying to seize power. Thirty-three Air Force active-duty and Reserve units take part in the initial deployment.

December 19, 1992. An AMC KC-135R crew from the 97th Air Mobility Wing, Altus AFB, Okla., flies more than 8,700 miles from Kadena AB, Japan, to McGuire AFB, N. J., to set an aircraft class record for nonstop, unrefueled flight.

December 27, 1992. While flying combat air patrol in Operation Southern Watch, two F-16 pilots from the 363d Fighter Wing, Shaw AFB, S. C., intercept two Iraqi MiG-25s flying in the United Nations–imposed "no-fly" zone over southern Iraq. One of the pilots, flying an F-16D, fires an AIM-120A AMRAAM and downs one of the MiGs, marking the first use of the AIM-120A in combat and the first USAF F-16 air-to-air victory.

March 9, 1993. A Lockheed SR-71A "Blackbird" reconnaissance aircraft comes out of retirement to fly its first scientific flight for NASA at the Dryden Flight Research Center at Edwards AFB. The aircraft, fitted with an ultraviolet video camera in the nose bay, is flown to an altitude of approximately 83,000 feet and collects more than 140,000 images of stars and comets.

April 28, 1993. Secretary of Defense Les Aspin lifts the long-standing ban on female pilots flying US combat aircraft, including Army and Marine Corps attack helicopters.

April 29, 1993. German test pilot Karl Lang makes the first demonstration of a high-angle-of-attack, post-stall, 180° turn known as a Herbst Maneuver while flying the Rockwell/MBB X-31A EFM demonstrator. The turn is completed in a 475-foot radius.

May 22, 1993. Lt. Cmdr. Kathryn P. Hire, the first woman in the Navy to be assigned to a combat unit, flies her first mission as a tactical crew member on a Lockheed P-3C Update III maritime patrol aircraft during a bombing exercise. Commander Hire flies with VP-62, a Reserve unit based at NAS Jacksonville, Fla. The first Air Force female combat pilot will be 1st Lt. Jeannie Flynn, who will take her place in an F-15E cockpit later in 1993.

May 25–August 3, 1993. The first successful demonstration of aerobraking (using atmospheric drag to slow a spacecraft) puts the Magellan Venus probe in a lower orbit. The probe suffers no ill effects.

June 14, 1993. The first operational McDonnell Douglas C-17A Globemaster III transport is delivered to the 437th Airlift Wing at Charleston AFB, S. C.

June 17, 1993. Lt. Col. Patricia Fornes becomes the first woman to lead an Air Force ICBM unit. She assumes command of the 740th Missile Squadron at Minot AFB, N. D., a squadron once commanded by her father.

July 2, 1993. President Bill Clinton nominates Sheila E. Widnall, associate provost and professor of aeronautics and astronautics at the Massachusetts Institute of Technology, to be Secretary of the Air Force. Dr. Widnall becomes the first female Secretary for any of the armed services.

July 8, 1993. Slingsby Aviation Ltd. rolls out the first T-3A Enhanced Flight Screener for the Air Force at its plant in York, England.

July 30, 1993. The multiaxis thrust-vectoring system installed on the VISTA NF-16 is employed for the first time in a test at the Air Force Flight Test Center. By September 1993, the aircraft will achieve a transient AOA of 110° and a sustained AOA of 80°.

August 5, 1993. The AFTI/F-16 completes its 600th mission at the Air Force Flight Test Center. The flight collects data for the AFTI/F-16 Ground Collision Avoidance System test effort.

August 11–14, 1993. Global Enterprise, an ACC exercise to train aircrews for long-distance power-projection missions, is carried out from Ellsworth AFB, S. D. Two Rockwell B-1B Lancers are flown to Europe, across the Mediterranean and Red Seas, and around the Arabian Peninsula and land at a staging base in southwest Asia. After exchanging crews, the B-1s are flown from southwest Asia, via Japan, over the Aleutians, and then back to South Dakota. Total flight time is 37.3 hours, and the twenty-four-hour first leg is the longest flight ever made by a B-1B crew.

Photo © Geoffrey Pearce

The 437th Airlift Wing received the first operational C-17A Globemaster III, Air Mobility Command's newest airlifter, in June 1993.

August 17, 1993. The first of 350 early model Boeing B-52 bombers is cut into five pieces with a 13,000-pound steel guillotine at Davis-Monthan AFB, Ariz. The bombers were destroyed under the terms of the Strategic Arms Reduction Talks II Treaty.

August 18, 1993. McDonnell Douglas's Delta Clipper Experimental (DC-X) subscale single-stage-to-orbit prototype makes a sixty-second first flight at the White Sands Missile Range, N. M. The forty-two-foot-tall vehicle takes off vertically, hovers at about 150 feet, moves laterally approximately 350 feet, and lands tail-down.

September 10, 1993. Boeing rolls out the 1,000th 747 commercial jetliner in ceremonies at its Seattle, Wash., plant. The milestone aircraft, a 747-400, will be delivered to Singapore Airlines. The first jumbo jet was rolled out in September 1968.

September 15, 1993. Boeing announces that work on the first B-52H bomber to be adapted for conventional warfare missions has been completed at its facility in Wichita, Kan.

December 17, 1993. On the ninetieth anniversary of the Wright Brothers' first sustained flight, the first operational Northrop B-2A is set for delivery to the 509th Bomb Wing at Whiteman AFB, Mo. ■

In Security Police work, there isn't much tolerance for mistakes.

The Blue Berets

By Frank Oliveri, Associate Editor

Staff photos by Guy Aceto

The Air Force's Security Police hone their apprehension techniques with many hours of hands-on training. Above, an airman takes down his instructor while his partner covers him with a sidearm. Amn. Basic Justin Naylor (opposite) has received instruction in dog handling from the 341st Military Working Dog Training Squadron, the only organization in the Department of Defense that trains dogs and handlers and provides comprehensive veterinary care for all MWDs.

THE BLUE beret of the Air Force Security Police is a common sight on Air Force bases here and abroad. Everyone sees them, and that's no accident. SPs scrutinize visitors at the gates and, by their presence, "encourage" everyone to obey traffic laws.

Guarding the gate and keeping an eye out for speeders are certainly important tasks, but the Air Force's 28,000 or so SPs have lots more work to do, much of it behind the scenes. They are supposed to prevent crime, catch suspects, and handle hostage and barricade incidents. They are called on to resolve potentially violent domestic quarrels yet be watchful enough to notice a wrench lying in the engine intake of a multimillion-dollar fighter.

Some duties require heavy lifting. The SPs—they refer to themselves as "cops"—are the shock troops of the Air Force. In peacetime, they guard Air Force fighters, bombers, transports, and tankers from saboteurs and other troublemakers. In war, they defend the base from close-in attack and even go on the offensive, if necessary, to eliminate threats.

SPs train for both the law enforcement and security specialist roles at the 37th Training Wing, Lackland AFB,

Tex., where the Air Force instructs not only its own cops but also those of the US Navy and various foreign militaries. Students learn that, in the law enforcement role, cops are often forced into a reactive crouch, encountering few clear-cut situations but many dilemmas, while security specialists work in a world of clear choices and must take a highly aggressive approach to their work.

The work of both types of cops, said Capt. Mike Buonaugurio, an SP instructor at Lackland, makes it possible for everyone on the base to do his or her job. "I think that escapes people sometimes. In Desert Storm, after a missile attack, it was our job to clear the threat and get everything quickly back to normal, creating an environment so that . . . the maintenance guy's paying attention to the engine he's bolting up."

The 341st trains its MWDs in the arts of explosives detection, drug detection, and security patrol. Below, Marine Lance Cpl. Lester Huckey leads his golden retriever through a mock luggage search for drugs.

Staff photos by Guy Aceto

The size of the SP unit deployed for ground defense depends on the size of the base, but it usually includes about ten police flights or 440 troops, plus mortar and military working dog detachments.

Don't Cross the Line

If you ever enter a flight line through an unauthorized entry point—if you cross the red line, in other words—it's a security specialist who most likely makes you hit the tarmac, checks your ID, and maybe puts you in handcuffs. His or her job is to protect that flight line and, in the process, protect those who bumble onto it. In some cases, security specialists will be assigned to a specific aircraft and, as the sign says, they are authorized to use deadly force.

All security specialists are qualified to carry an M16 rifle and are either qualified on or quite familiar with the M60 machine gun and M203 grenade launcher. Some security specialists also operate 81-mm mortars or .50-caliber machine guns.

Security specialists are well versed in the legal aspects of the job, military tactics and movement, when and where to use force, how to deal with terrorists, and physical apprehension and restraint techniques (PART). They even know how to perform CPR. When they leave Lackland, security specialists must complete a follow-on combat skills course at Fort Dix, N. J. This is primarily where they learn to work as fire teams and flights.

If an air base came under attack, SPs would be expected to detect, delay, and then destroy the enemy efficiently. Royal Air Force Squadron Leader Peter Kennedy teaches such skills at Lackland. He is part of the RAF Regiment, the organization responsible for air base defense in Britain. Squadron Leader Kennedy is on loan as an instructor in the Air Base Defense Command Course.

"Ideally," said the British officer, "you want to detect them [the enemy] as far out as possible because . . . when we're defending an air base, we don't just stop at the perimeter fence. It has no tactical significance. If the enemy can affect the base's mission by standing off outside the base with a direct fire weapon or an indirect fire weapon, then the security police have to drive them out. That could be as far out as five miles."

The territory within that zone is known as the area of responsibility. SPs would go out there in patrols of five or more. They would also use covert observation posts and sensors—all part of detection.

For the security specialists, threats are ranked on three levels. Level One is what on-duty cops can and should handle alone, principally saboteurs

or other kinds of infiltrators. These threats are likely to be inside the base perimeter. At Level Two, the threat ratchets up considerably and includes enemy special operations forces and main combat units up to battalion level—about 600 troops. The Level Three threat comprises anything larger than a battalion. The SPs would be required to delay such a force until a larger Army unit arrived.

Holding the Fort

That the Air Force is serious about this last duty was dramatized during Operation Desert Storm, said Capt. Brad Spacy, an instructor at Lackland. He said each US air base in Saudi Arabia had prepared an evacuation plan in case Iraqi forces managed to get close enough to attack it. Captain Spacy recalled looking for the Security Police part of the evacuation plan—"the load you are going to be getting out of there on. There was none." The SPs were to "stay and hold the place and wait for the response force to get there."

While airmen go to Fort Dix to learn tactics, midlevel and senior officers take the Air Base Defense Command Course at Lackland. It is not required, but it is recommended. "We teach the staff how to manage the war from within the operations room," Squadron Leader Kennedy said. "We train them in various things: the threat, map reading, patrolling, fundamentals of defense, how to defend an air base, and how to write operations plans. We take them over to Kelly AFB [in nearby San Antonio], where they walk the ground. Then we give them a number of critical resources, and they come up with a plan to defend that base.

"They then brief Captain Spacy and me and the rest of the class, and we critique them as necessary. Whenever they're ready, we move into another classroom, [which] we've turned into a simulated base defense operations center. We test our plan. We simulate all the other personnel."

Security Police must draw and fire their weapons quickly and accurately. Firearms proficiency is so important that the Air Force will provide one-on-one training for those who need extra instruction.

These exercises run for quite some time. A recent one lasted twenty-two hours. Captain Spacy said that, after a while, students almost believe that Kelly really is in danger.

Air base defense once depended on establishing concentric rings of defense: the screening force area, the main defense areas, and close defense areas. This was effective if the threat was expected to be a very large force, such as what the Soviet Union could have thrown into action. However, there was little integration among the rings.

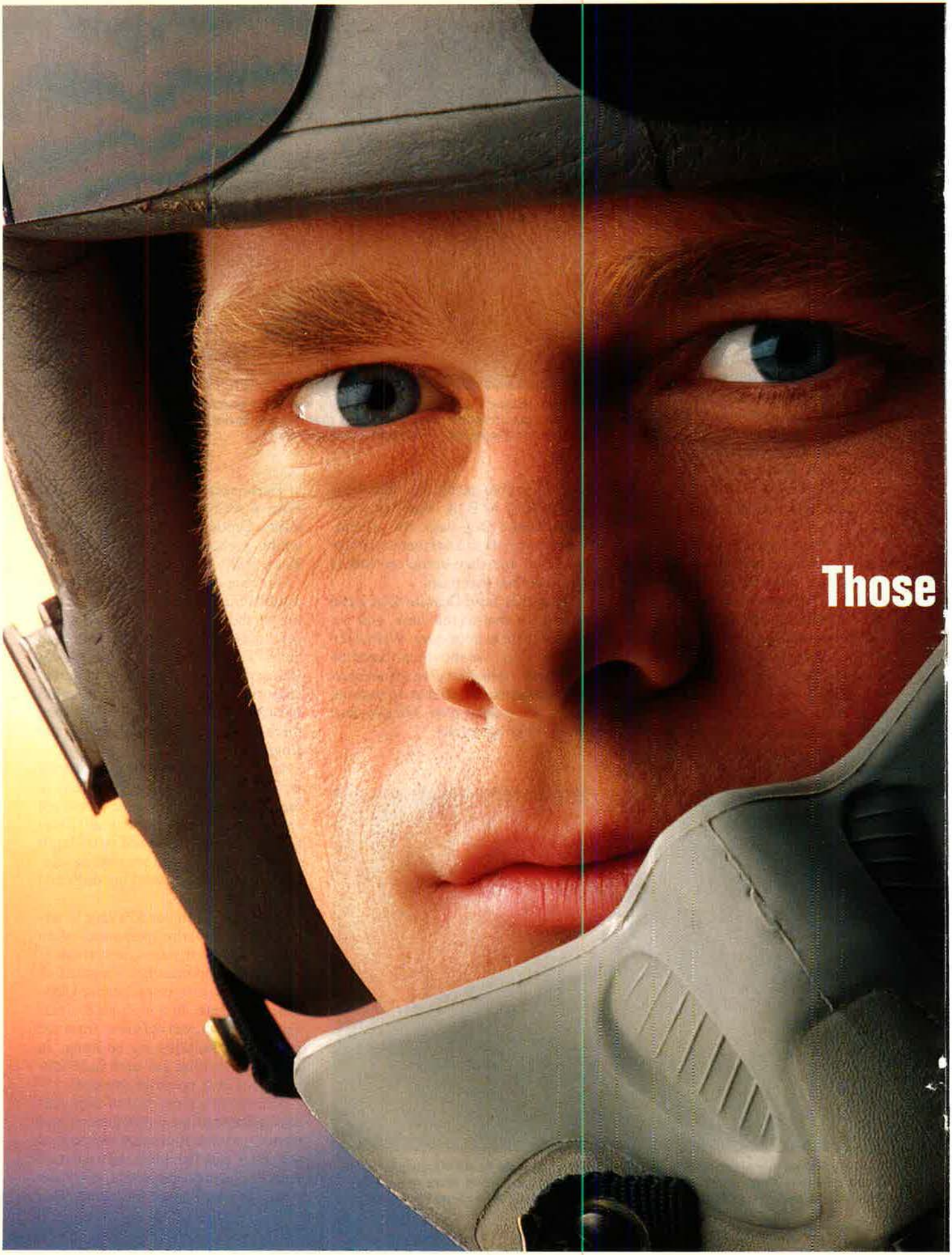
Captain Spacy said that planning for air base defense has changed greatly in the past four years. The new concept requires that defenses be totally integrated, working outward with depth defenses, patrols, and sensors, supplemented by military working dogs and observation posts.

The primary threat SPs face is terrorism. Host-nation personnel often work on US air bases, and there is always an opportunity for agents or guerrillas to mix in and cause damage. Therefore, in a high-alert situation, SPs must seal off areas from the inside out, building by building, in hopes of flushing out such individuals or limiting possible damage.

SPs spend a great deal of time preparing for wartime contingencies and training with such combat weapons as the M16 and the M60, but most of their day-to-day operations take place within the Air Force community. This

Staff photos by Guy Aceto

Security Police are responsible for countering all threats to Air Force bases, ranging from individual terrorists to battalion-strength forces. Here, a security specialist moves to protect a threatened convoy during an exercise.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Amn. Basic Amy Hutchinson demonstrates the proper technique during a traffic stop, a mundane duty that could become life-threatening in an instant. If a suspect becomes aggressive, SPs make effective use of their batons (below).

is the realm of the law enforcement specialist, who carries a 9-mm pistol and performs more traditional police tasks.

Emergency Teams

Law enforcement personnel are trained to know the laws of the air base and how to handle crisis intervention, crime-scene searches, traffic enforcement, and the like. The Emergency Services Team (EST), which usually deals with domestic disputes involving barricaded persons, is an integral part of the law enforcement organization.

MSgt. A. J. Hering, an EST instructor, said the job is dangerous and stressful. ESTs are on call twenty-four hours a day. They must be physically fit, mentally stable, highly motivated, and, above all, able to fit into and work as part of a police team.

Sergeant Hering described a typical situation calling for intervention by an EST: A military man living in base housing has been working twelve-hour shifts for a week. He has a wife and two children. His wife doesn't understand why he must work so much. They argue. He gets drunk. He slaps his wife and kicks her out of the house but keeps one of the children. The wife, knowing that her husband has a weapon in the house, calls the SPs. They try to talk to the husband, but he refuses to respond.

The SPs cordon off the area. The husband grows angrier. Shots are fired inside the house. The base commander orders the chief of Security Police to get EST members ready and standing by. The EST goes to a tactical command post and sends a reconnaissance team to check the base housing area, hoping to get a sense of what might happen during a forced entry. Then the team develops a detailed operations order.

Negotiations continue, buying the team valuable minutes and keeping the subject in a single location inside the house. The situation deteriorates, and the base commander calls for EST entry. After this, said Sergeant Hering, "whatever happens, happens. . . . It is no longer the base commander's call. He already gave that power to the team once entry was made."

Sergeant Hering went on, "The bad guy already knows what he is going to do. He has a weapon in his hand. He sees us, and he pulls a trigger. There is a lot going on in the mind of the EST guy. He cannot make indiscriminate shots into the room." Before using deadly force, the EST must see the subject display intent, opportunity, and capability. Confronted with all three, ESTs are empowered to shoot to kill.

Two Paramount Concerns

Each SP, whether in the law enforcement or security specialist track, must train for such a decision. SPs have two paramount concerns: protecting themselves and protecting their weapons, to keep them from falling into the hands of a suspect. How cops enter a room, approach a vehicle, or handle a crisis is designed to protect the patrolmen and their weapons.

Staff photos by Guy Aceto

Isaac Goodman, a US Navy civilian, teaches PART to SP trainees and Navy petty officers. "We teach it in several phases," said Mr. Goodman. "In the first phase, we teach defense. This is when the suspect tries to do something to the officer. Most of these contacts with the suspect take place when the police officer has to come close enough to identify the individual. If he has to take the ID card or something, that is when the police officer is in the most jeopardy, so a lot of the techniques are designed so that the

police officer can deal with that suspect" if the suspect grabs him.

SPs also learn offensive PART, also known as "come-along" techniques, and how to take down a suspect to handcuff him.

"The most important thing we teach is that the officer's actions are dictated by the individual," Mr. Goodman declared. "You have three types of people on the street. The 'yes' type—they do what you tell them to do, when you tell them, and how you tell them to do it. The 'maybe' type—they're contemptuous. They display a negative attitude, and you have to really use voice force to get them to do what you want them to do. Then you have the 'no' type—they're not going to do anything you tell them. With them, you have to do hands-on."

The decision to use deadly force is always grave and difficult, and law enforcement and security specialist personnel are thoroughly trained in this aspect of their work. MSgt. Greg Forche supervises the Firearms Training System (FATS), a computer-driven video exercise that confronts SPs with scenarios in which they must decide whether to use deadly force. The Air Force believes this to be the most critical area for basic SP trainees. It requires a perfect score to graduate.

Students are given a specially equipped pistol or M16, and they are told to watch the movements and expressions of actors performing on a life-size video screen. FATS determines the accuracy of any resulting fire and whether the student's response was correct. Then instructors question the students on their actions.

SPs can employ heavy firepower in base defense. Here, SSgt. Brian Miller and SrA. Matthew Council work with an 81-mm mortar. A .50-caliber machine gun is in the foreground and a 40-mm automatic grenade launcher in the background.

Stressful Scenarios

"This is probably the most critical training subject we have," Sergeant Forche said. "It requires one hundred percent [accuracy]. If you make one mistake, you fail. The lights are out. We tell him that this is a dangerous felon who is wanted for killing someone. These are live-action scenarios. You feel like you're out there. It's a very stressful situation. This is as close to real as possible."

Law enforcement personnel are trained to handle crisis and crime situations. A crisis situation often involves a domestic dispute. Law enforcement trainees take part in a workshop, playing the roles of both subject and police officer. Each scenario involves entering a room with activity in progress. It could be a crime investigation, a brawl, or a suicide attempt. Trainees are graded on their responses. Instructor Sgt. Bruce Thomas said, "This familiarizes them . . . with what they may face out there in the real world."

Sgt. John Shanks, another SP instructor, said that, in a crisis, the Security Policeman's safety is most important. "They don't leave their weapons exposed, and [they must] control the individuals without getting hurt or hurting anyone else."

In a crime investigation, the SP is dealing with facts, but, in a crisis, cops have to react to people who are behaving abnormally. Emotions run high. Instructors try to teach cops how to communicate and remain above the tension and stress of a crisis. If a situation should get out of hand, cops are encouraged to call for backup. If a brawl is taking place, cops are taught to wait until backup arrives.

"We call five police officers and one subject a fair fight," one SP said. "That way we control a situation much faster, and no one gets hurt." ■

Staff photos by Guy Aceto

Accident investigation also comes under the purview of SPs. Here, Air Force TSgt. Elizabeth Moore and Army Sfc. Frank Corona attempt to uncover and understand the events surrounding this "accident."

As targets go, bridges are easy enough to find—but that's about the only easy part.

Bridge Busting

By Alfred Price

Opposite is the Paul Doumer Bridge in Hanoi, which was bombed heavily during the Vietnam War. The bridge was put out of commission at least four times, the last in 1972 by F-4 Phantoms armed with the first generation of Electro-Optical Guided Bombs and laser-guided bombs. The lessons learned in Vietnam proved valuable in the Persian Gulf War, as F-111s armed with EOGBs and LGBs took out key Iraqi bridges. Above, an F-111F from the 48th Tactical Fighter Wing prepares for action.

IN TIME of war, bridges make attractive targets for air attack. They constitute seemingly vulnerable links in the enemy's lines of communication. As targets go, they are easy enough to locate: Just follow the river, road, or railroad line they cross, and you are bound to find them.

In the history of aerial warfare, however, some of the most difficult actions and most gallant failures have centered on bridge attacks. From the ground, big bridges look enormous, but from an aircraft running in to bomb at, say, 20,000 feet, they show up as extremely thin lines across the landscape.

Moreover, bridges intended to carry lots of traffic are strongly constructed from steel, masonry, reinforced concrete, or a combination of these materials. They can take several hits on nonvulnerable parts of the structure and still stand.

To put a bridge fully out of action, one has to drop a span, and that usually takes detonation of one or more large explosive charges close to a vulnerable point. To achieve such accuracy with an unguided bomb, the aircrew usually has to carry out deliberate attacks from low altitude.

There's the rub. If a bridge is important, it usually will be well defended. Accurate iron coming up invariably reduces the accuracy of iron going down, and if a bomb fails to score a direct hit, the bridge will usually remain in service. With most types of bombs, the bridge has to be attacked along its length or at a fine angle off it, which lessens the chance of tactical surprise.

The Stukas Strike

The first airplanes to carry out effective bridge-smashing operations as a matter of course were the German Junkers Ju-87 Stuka dive-bombers used during World War II. A fixed undercarriage gave this aircraft a decidedly dated look, and in horizontal flight its maximum speed was less than 250 mph. During its eighty-degree attack dive, however, with the dive brakes in high-drag position, the Ju-87 was an excellent aiming platform. Its terminal velocity never exceeded 350 mph.

German commanders expected Ju-87 pilots, on completion of training, to be able to put half their bombs within eighty feet of the target. The Stuka's dive typically commenced at 11,000 feet and lasted about twenty seconds, allowing the pilot plenty of time to align his reflector sight on the target. For bridge attacks, the plane carried one 1,100-pound bomb. Bomb release was at 2,275 feet, at which altitude an automatic mechanism initiated a six-G pullup. The dive would bottom out at 1,000 feet above the ground.

These aircraft first demonstrated their bridge-smashing ability in Poland in September 1939 when they destroyed crossings over the Vistula River, preventing Polish troops from fleeing eastward to escape the Nazi invasion.

During the German blitzkrieg in the early days of World War II, the Luftwaffe invariably achieved air superiority over enemy rear areas, and its opponents were poorly equipped with antiaircraft artillery (AAA) to counter the dive-bombers. Thus the Stukas were able to carry out deliberate bridge attacks with near impunity.

For the Luftwaffe's enemies, however, the story was quite different. Their bridge attacks, mounted in the face of German air superiority, proved extremely costly.

On May 12, 1940, two days after the German Army opened its all-out offensive in the west, its troops poured into Belgium over two bridges spanning the Albert Canal. Five light bombers of the RAF's No. 12 Squadron set out to attack the bridges, with orders to destroy the structures at all cost. Two planes delivered shallow-dive attacks on a concrete bridge at Vroenhoven, and the other three pressed home low-level attacks on the steel bridge at Veldwezelt. Both targets were surrounded by strong flak defenses, and the attackers suffered accordingly. Four planes were shot down. The fifth, riddled with flak, crashed on the way home.

During softening-up operations preparatory to the 1944 Normandy invasion, Ninth Air Force opened its campaign of bridge attacks on May 7, when P-47s attacked four bridges spanning the Seine. The next day, B-26 medium bombers joined in the attack, launching pattern-bombing strikes while flying in group formation. Some bridges went down relatively easily; others did not. The rail bridge over the Seine at Rouen, for example, absorbed five separate assaults before it went down.

On May 31, B-24 bombers of the 458th Bomb Group delivered an experimental attack on the bridge at

Beaumont-sur-Oise. They used Azon weapons, 1,000-pound bombs with radio guidance in azimuth. This first use of guided missiles against bridges was a failure: All fourteen weapons missed the target. The cause was judged to be lack of operator training.

By the time Allied troops landed in France on June 6, 1944, however, USAAF had learned enough about bombing bridges to destroy the Seine bridges almost completely. From the river's mouth on the Channel to the gates of Paris, German troops could find only one usable bridge. The bridges over the River Loire south of the beachhead then suffered a similar fate, as the Allies sought to isolate the battle area.

Relearning in Korea

During the war in Korea, US Air Force and Navy attack planners had to relearn many of the lessons of World War II.

Repeated attacks by carrier planes on the much-repaired rail bridges between Kilchu and Songjin inspired the famous novel *The Bridges at Toko-Ri.* Initially, B-29s knocked out the undefended bridges using conventional 1,000-pound bombs dropped from 10,000 feet. Then the AAA defenses improved, and the bombers were forced to attack from above 20,000 feet, with a consequent reduction in accuracy.

The 1,000-pound Razon weapon, a development of the earlier Azon but with guidance in both range and azimuth, was used to some effect. Far more impressive was the monster 12,000-pound Tarzon radio-guided bomb. Thirty of these weapons were dropped during the conflict, knocking out six bridges and damaging a seventh.

The Vietnam War was the arena for one of history's famous bridge attacks. Flying into North Vietnamese defenses, US forces mounted several major raids on the Paul Doumer highway and rail bridge over the Red River at Hanoi. The bridge was more than a mile long and contained nineteen spans. Of great strategic importance, it carried the only rail link between Hanoi and the main port of Haiphong.

The first attack was carried out on August 11, 1967. *[See "Valor: A Bridge Downtown," January 1992, p. 90.]* Thirty-six F-105 Thunderchiefs each delivered two 3,000-pound bombs in a shallow-dive attack and dropped three of the spans. All of the planes returned safely. Soon, however, the spans were repaired and, in early October, traffic resumed.

On October 21, 1967, an attack by twenty-one F-105s put the bridge out of action again, but within a month it had been returned to normal operations. During December 1967, two heavy attacks involving a total of fifty F-105 sorties dropped five consecutive spans. The bridge remained out of use until the bombing pause of March 1968. By May, repairs were complete, and the bridge was in use once more.

Smacked With "Smart" Bombs

For the next four years, the Paul Doumer Bridge was left alone, but when attacks on Hanoi resumed on May 10, 1972, it was targeted. Sixteen F-4 Phantoms of the 8th Tactical Fighter Wing delivered shallow-dive attacks using new, first-generation "smart" bombs. The four planes in the lead flight each carried two 2,000-pound Electro-Optical Guided Bombs (EOGBs), and each of the rest carried two 2,000-pound laser-guided bombs (LGBs).

Modern EOGBs are highly accurate, but the same could not always be said for their predecessors. During the initial attack all eight weapons missed the target, some by wide margins. The LGBs did much better, scoring several direct hits that displaced one span without dropping it but rendered the bridge impassable to wheeled traffic. The following day, a flight of four F-4s, concentrating their LGBs on the damaged section, dropped the span into the river.

The Doumer Bridge remained out of use until after the cessation of air attacks on North Vietnam in January 1973. Then repair work progressed rapidly, and the bridge was ceremoniously reopened for traffic March 4, 1973.

During the 1991 Persian Gulf War, Air Force F-111Fs, with their nighttime, precision-attack capability and heavy bomb capacity, bore the brunt of the initial coalition air offensive against key Iraqi bridges. Other USAF aircraft, notably F-16s, plus British and French planes, also contributed.

USAF Maj. Gen. John A. Corder was director of air operations for US Central Command Air Forces. In a postwar interview excerpted in the 1992 book *Airpower in the Gulf,* by James P. Coyne, he recalled the campaign. "We hit a few bridges here and there during the first couple of days," said General Corder. "After about the fourth day of the war, we started going hard against bridges, to seal everything off. . . .

"The F-111s were in after bridges at night, and the British and the French were in there in the daytime, dropping precision guided bombs. . . . Only occasionally would you see a miss. And that took care of the Iraqi bridge system."

The F-111Fs of the 48th Tactical Fighter Wing achieved a major success on the night of January 29, 1991, with a successful attack on the bridge over the Hawr al Hammar Lake northwest of Basra. By then, the coalition had secured air supremacy over Iraq, and F-111Fs were able to mount set-piece attacks with LGBs and EOGBs.

The usual attack force comprised four planes that established a "race track" pattern over the target at altitudes around 20,000 feet. The lead plane ran in and released one or two bombs, then turned through a semicircle and flew around the race track while the Weapon System Officer guided the weapons to impact. At intervals, the remaining planes in the force followed the initial attacker, each flying the same track.

When the lead aircraft completed its trip around the race track, it delivered a second attack, and the process was repeated until every plane had expended its ordnance or the structure was destroyed. It was a textbook example of the sort of deliberate action that is possible with air superiority but almost inconceivable without it.

Still Standing

Even when hit by 2,000-pound precision guided weapons, however, the bridges did not always fall. Spectacular television footage was broadcast of bridges first seen under aiming reticles and then disappearing in great clouds of dust and debris as bombs exploded. The bottom line for such attacks is what the bridges looked like after the dust had settled.

Lt. Dave Giachetti, the 48th TFW's specialist in bridge attacks, recalled the situation: "I thought that bridges would be pretty easy to knock out with PGMs [precision guided munitions]—until I tried it. We would

attack a bridge and get several hits, and then we'd discover—holy mackerel!—the bridge was still standing. With PGMs, hitting the bridge was not a problem. The problem was hitting it at a weak part, a point where the weapon would cause structural damage and drop a span. If you didn't hit it exactly on the abutment at either end, or where the supports were, the bomb would often go through the pavement leaving a neat round hole that they could easily repair."

Officers with the 48th TFW said that the wing used only 2,000-pound bombs in its antibridge operations, though it used many different types. These included the GBU-24 with a hardened bomb body, the GBU-10, and the GBU-15. The officers said the wing developed a number of different attack techniques and conducted many multiple bomb attacks, using two bombs per pass.

The most difficult spans to destroy were the two Basra Highway bridges, side by side over the Tigris River. Before the bridges were put out of action, the Air Force had to mount attacks over several days.

One F-111 pilot recalls that he first attacked the Basra complex on February 3, 1991, when it was "a virgin target." Since the bridges did not drop then, he went back against them two days later and again four days later, when the bridges finally fell into the river. Strangely, they were not well defended, having AAA emplacements but no surface-to-air missiles.

After a period of trial and error, the wing leaders found that the best technique usually was to use two GBU-24 LGBs to destroy the abutments at either end of a bridge, then hit the middle support sections with GBU-15 EOGBs. In several cases, this method succeeded in demolishing the structures.

Initially, the F-111s concentrated on a large number of bridges in the area around Basra. When these had fallen, they worked their way north and west. Once a bridge span had been dropped, the Iraqis usually did not attempt to make repairs because the war was still in progress. One exception was Iraq's frequent refurbishment of the bridge spanning the Hawr al Hammar Lake. It was, in fact, more of a dirt causeway and proved fairly easy to repair. The F-111s had to return several times to renew the damage and prevent the causeway from being brought back into use.

When coalition air forces dropped a bridge along a particularly important route, Iraqi engineers would usually erect a pontoon bridge alongside to carry the traffic. These flimsy structures posed little challenge to the F-111 crews. They did not need to use a penetrating weapon, just the GBU-10. They simply hit one end of the pontoon bridge, and, because it lacked strength, the whole thing would break apart.

General Corder recalled in his *Airpower in the Gulf* interview, "For three or four nights, [the Iraqis] were putting up pontoon bridges as fast as we could knock them down. Then they began to run out of bridges. So they'd put one up for a few hours at night and then take it down. To counter that, we put patrols every thirty minutes over the Tigris and the Euphrates and we'd catch them and . . . knock the bridges down."

New Tactics

About two weeks into the war, Royal Air Force crews joined in the attacks on Iraqi bridges. At that time, the Tornado GR. Mk. 1 force did not possess its own laser-designation capability, so elderly Buccaneers fitted with daytime-only AVQ-23E Pave Spike pods had to be flown into the theater to provide it.

The standard six-plane raiding force consisted of two elements, each comprising a Pave Spike Buccaneer and two Tornados, each carrying three 1,000-pound LGBs. If one Buccaneer became unserviceable, the other was to designate the targets for all four Tornados.

The new tactics were tested in action on February 2 against the As Samawah Road bridge over the Euphrates River. "The weather forecast was grobbley," recalled Wing Cmdr. Bill Cope, commander of the Buccaneer force and pilot of the leading designator. "It was touch and go whether we would even see the target. In fact, I had to go into Iraq . . . close on the first Tornado's wing, until we reached the IP [initial point]. There we were, over Iraq in cloud, listening to the RHWR [radar homing warning receiver] and thinking, 'This is one hell of a way to go to war for the first time!' But then the weather magically cleared, and there was our target."

The Tornados in each element flew in trail at altitudes around 20,000 feet, with their attendant Buccaneers behind and above. After releasing their bombs in salvos, the first two Tornados turned away from the target while the Buccaneer entered a shallow turn to keep the target within view of the Pave Spike pod under the port wing.

The second attack element followed the first with the laser designating the same point on the bridge. Of the twelve LGBs dropped, nine scored direct hits. One bomb failed to explode, but the detonation of eight 1,000-pounders within a few feet of each other was sufficient to demolish the central span.

During this and subsequent bridge attacks by RAF airplanes, the 1,000-pound LGBs were fitted with electronically programmed multifunction bomb fuses, which permitted highly accurate timing of detonation after impact and greatly increased the effectiveness of the weapons. Tornado-Buccaneer teams took out several bridges along the Tigris and Euphrates Rivers.

Several months after the war, the Air Force released a white paper that provided some details of the bridge-busting campaign. It said that, when hostilities commenced, there were fifty-four railroad and highway bridges in Iraq, most of them on roads running from Baghdad to Basra and Kuwait. By the end of the war, coalition aircraft had destroyed forty-three of these bridges. Most of those remaining were deemed of little military significance and had not been targeted. Coalition attackers also had dropped thirty-two temporary pontoon bridges built as replacements. By the third week of the war, said the paper, supplies reaching Basra, the major transshipment point for the Iraqi army in Kuwait, were insufficient to maintain combat effectiveness. ■

Alfred Price flew with the Royal Air Force for sixteen years. He has published some three dozen books, including Instruments of Darkness, The History of US Electronic Warfare *(two volumes), and* Air Battle Central Europe. *His most recent article for* Air Force *Magazine was "Against Regensburg and Schweinfurt" in the September 1993 issue.*

WE CAN'T PREDICT THE FUTURE, BUT WE CAN PREPARE FOR IT.

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The news isn't all bad on the Air Force personnel front, but stability is not yet in sight.

Some Breaks in the Cloud Cover

By Bruce D. Callander

WITH ANY luck, the Air Force will make it through 1994 without involuntary reductions in force (RIFs). That's not the only good news. Some pilots "banked" in nonflying jobs are returning to cockpits. Officers on a waiting list for flight training are entering classes. Promotions are holding up in most grades, retention has stayed strong, and assignment-preference programs are working.

No one claims the pain is over, but the Air Force is betting that these trends will continue through 1994. Most heartening is the evaporation, for the moment, of the danger of RIFs. The Air Force also canceled a January 1994 Selective Early Retirement Board for lieutenant colonels. "I don't have any reservations about making our [Fiscal 1994] numbers," said Lt. Gen. Billy J. Boles, deputy chief of staff for Personnel.

General Boles is the first to acknowledge that 1994 might prove something of an anomaly. "Fiscal 1995 [starting October 1, 1994] is a different story," the General said in a recent interview.

At the time General Boles made that remark, the Air Force had only begun analyzing the results of the Pentagon's Bottom-Up Review of defense needs and programs. "Once we sort out the numbers and the mission requirements associated with that," the General said, "I think we'll be able to give people a clearer picture. What still bothers me and everyone else is that I don't know anyone who can answer the questions, 'When do you bottom out and where? When do you start operating in a period of stability again?' "

Stability has been in short supply since the late 1980s, when the Air Force's active-duty strength began to drop. By next fall, it will be down to 425,700, including Air Force Academy cadets, which means that the Air Force will have lost thirty percent of its troops (182,500) in eight years and will be at its lowest end strength since 1950, before the Korean War buildup.

To get that small that fast, USAF has taken unprecedented steps to encourage separation. To avoid another RIF, for example, it offered members retirement at fifteen years of service, rather than the usual twenty years. Some may be forced to accept it. "In the case of officers not selected for lieutenant colonel," said General Boles, "we may have to deny continuation to those passed over the second time. If we do not offer continuation, they would be eligible for fifteen-year retirement."

Unpleasant Options

Technically, such separations are part of the up-or-out process and not a selecting-out move. The distinction surely is lost on the officers affected. That suggests how closely the Air Force is having to weigh its alternatives, often choosing among unpleasant options. It will face another such choice in Fiscal 1995, when further cuts are due in the enlisted career force.

"That could be done by adjusting high year of tenure," General Boles said, "or through early retirement screening of people with fifteen to twenty years of service and probably in the twenty-to-thirty-year groups as well."

So far, approximately 3,000 officers have been selected for early retirement, but that RIF has yet to be applied to the enlisted force. The alternative would be to lower the enlisted high year of tenure (HYT) and force enlisted men and women to separate or retire with fewer years of service. Enlisted HYTs were dropped four years ago; this netted 9,000 separations.

Lowering the force-out points further would cost the Air Force some of its most experienced noncommissioned officers. The question is whether more or less damage would be caused by a selecting-out process.

The Air Force faced other hard decisions regarding new pilots. The process has cut the acceptance of new pilots from 1,600 to 520. That left hundreds of newly graduated pilots without cockpit assignments and hundreds of Academy and AFROTC graduates waiting for flight school openings. Some of the pilots banked in nonflying jobs have returned to flying duty, but the Air Force will continue to bank others until next fall. Officials say the return of banked pilots won't be complete until Fiscal 1996.

It also will take that long to get all the waiting Academy graduates into flight training, and the service is still trying to resolve the status of "surplus" AFROTC graduates. Today's AFROTC classes have been cut, so most future graduates will enter flight school within a year of commissioning.

A similar leveling off is taking place in the drawdown itself. In Fiscal 1993, which ended September 30, the Air Force separated more than 6,000 officers and 11,000 airmen with early-out programs. This year, plans call for separating half as many, using the fifteen-year retirement option.

Such figures are good news not only to members worried about their careers but also to managers concerned about the cost of the drawdown. Most of the separations to date have been generated by offering members a lump-sum Special Separation Benefit (SSB) or an annuity under the Voluntary Separation Incentive (VSI). In Fiscal 1991 and Fiscal 1992, the Air Force spent $1.3 billion on such payments. The tab for Fiscal 1994 will be only about $278 million.

Hidden Costs

The Air Force has incurred other, less visible costs from programs to help veterans move into civilian life. It operates more than 100 transition assistance sites. It has continued commissary and exchange privileges for those eligible during the transition and let an average of ten separatees at each US base stay in government housing. Ninety-five percent of those eligible have continued to use military medical facilities or CHAMPUS (Civilian Health and Medical Program of the Uniformed Services). Thirty percent have signed up for continued care under the Uniformed Services Voluntary Insurance Program.

Some of the direct and indirect costs will be offset by the Air Force's saving on future salaries, but such savings will be a long time in coming. Meanwhile, the Air Force must absorb other costs and weather other disruptions.

One such disruption is the dramatic change in overseas strength. At last count, some 100,000 members were in overseas locations, a definition that includes Alaska, Hawaii, and various US territories. This represents a five-year drop of 50,000 troops. By Fiscal 1996, foreign-duty strength must drop by another 15,000 troops. Overseas withdrawals generated 4,462 moves last year and will spur 6,575 this year.

Traditionally, the Air Force has sent large numbers overseas on short spurts of temporary duty for unit rotations or exercises. The use of TDY continues, but the reasons for it are changing. "Folks from Air Combat Command are going TDY into the desert and into southeast Asia," General Boles said. "ACC and USAFE [US Air Forces in Europe] are on TDY into Turkey with Operation Provide Comfort and Operation Deny Flight. Air Mobility Command is in there with strategic airlift, tanker, and tactical support. The folks with AWACS [Airborne Warning and Control System aircraft] and the TR-1 reconnaissance people also are meeting themselves coming and going. So there is a lot of TDY, but it is tied with specific taskings now rather than the old rotational system."

These deployments keep some personnel away from home more than half the time, officials say, increasing the risk of "burnout" and putting a strain on their families. "It is the kind of issue that our combat commanders are working as hard as anything else," said General Boles. "They have to see that the burden is shared on an equitable basis and does not have an adverse impact on families. That's why you see so many initiatives in family support centers, in child development centers."

Providing such support is not easy in a period of tight budgets. One example is child care, which the Air Force provides for more than 50,000 youngsters, six weeks to twelve years old, in 250 child development centers and 3,600 licensed day-care homes. Along with youth programs, these care centers are considered "community support" activities, meaning that fees from Air Force families meet about half the cost, with congressionally appropriated funds making up the difference.

Mission Essential

Other morale, welfare, and recreation activities serve the troops directly and are therefore classed "mission essential." Such programs as basic recreation, fitness centers, and libraries are supported entirely by tax dollars. They are expensive, General Boles conceded, but they are a necessary cost of doing business.

Some MWR operations—clubs, golf courses, aero clubs, marinas, to name a few—have lost all government support. Making it on their own has been a particular challenge for clubs. The future for some still is in doubt, but about 200 of the Air Force's 232 clubs are operating in the black.

"It's amazing," said General Boles. "The managers have been creative and innovative. If they had to, they could compete with anybody in the civilian sector in many of those areas."

Because of the long lead times involved, the Air Force is just beginning to feel the effects of widespread base closings and realignments. In Fiscal 1993, closings generated about 3,800 permanent change of station moves. The figure this year will be about 5,800. Still to come is the impact of base closures announced last summer.

To ease that impact, the Air Force has developed quick-response procedures. "As soon as a base is announced for closing," General Boles said, "the command involved and MPC [Military Personnel Center] send a team in, and they brief as many people as want to be briefed. They say, 'At a certain point prior to the closing, we're going to stop people from leaving and stop people from coming in. Then we will come up with a drawdown schedule for the remaining people to leave.'

"When that time comes, we send in other teams to use computers tied into MPC and try, as far as possible, to match where people want to go and where we need them. One factor is how vulnerable that member is for overseas. If it looks as though he or she would be going in the next year or so, that person might as well go right then. Eliminating the uncertainty is the key element."

When the drawdown began, the Air Force worried about maintaining all the assignment-preference programs already in place. A particular concern was the "join-spouse" plan that allows service couples to seek assignments to the same base.

USAF officials say the assignment-preference plan is still working, including the join-spouse program. The Air Force matched sixty-four percent of the officers and 83.5 percent of the airmen with the assignments they requested. Both percentages are slightly higher than those for three years earlier. The figures do not include couples in which one spouse moved a month or two after the other or went to a different base in the same area.

A Brighter Picture

The promotion picture also is brighter than some officials feared it would be at this point. Airmen are being promoted to most grades at an acceptable pace. For officers, opportunities are at the minimums recommended: fifty percent for colonel, seventy percent for lieutenant colonel, and eighty percent for major.

The only problems today can be found in the actual promotion points for technical sergeant and major. In both cases, they are coming at about twelve years, not the desired ten years.

Although promotion rates remain about normal, the career advancement process is changing for some. Gen. Merrill A. McPeak, USAF Chief of Staff, announced new training initiatives last year. Some already are taking hold, including one to end the practice of sending some recruits directly to bases after basic training. By next fall, all new airmen will be taking technical training for their three-level skills. By then, NCOs will be required to take advanced training for their seven-level skills. Twenty such courses will come on line in Fiscal 1994 and another 188 by Fiscal 1996, when such training becomes mandatory for all NCOs.

To improve the quality of training outside the formal classroom, USAF is tightening on-the-job training (OJT) standards. Instructors and certifiers will receive formal training in how to train others. OJT packages will be standardized USAF-wide by specialty.

Professional military training also is being changed. Soon, an airman will have to complete an NCO academy for promotion to tech sergeant, be a senior master sergeant to attend the Senior NCO Academy, and complete that school for promotion to chief master sergeant. All professional military education will be "in residence" for active-duty NCOs. Correspondence courses will be allowed only for Guardsmen and Reservists.

For officers, USAF hopes to add about ninety more students to intermediate service schools beginning this year, when it will send another thirty to the Army and four to the Navy. It will give credit to National Defense Fellows and officers in RAND Corp. research programs toward their intermediate school requirements.

The Air Force also is looking carefully at the overall "mix" of forces. Such efforts as the Officer Requirements Review and the OSD/RAND Future Officer Study are probing not only the officer-enlisted ratio but also the mix of civilians, Guardsmen and Reservists, and contractors in the total force. Some changes are likely for the enlisted force, officials say, as traditional officer positions are restructured for conversion to enlisted or civilian jobs or eliminated altogether.

Officials have carefully monitored the morale of Air Force members. Two years ago, General Boles told a congressional committee that the anxiety level was "almost off the charts." He still isn't ready to say it has dropped to an acceptable range, but he does see some improvement.

Calming Down

"There's still a lot of uncertainty about what's going to happen to whom . . . and how long we go through this," said General Boles. "I can't answer all those questions, and there's still come concern about that, but we are in a period of some stability. People now understand the VSI/SSB. They have seen twice how we are applying it. They have seen how we are using the retirement boards for officers, and they understand about fifteen-year retirement.

"So I think things are calming down from the time when there was such uncertainty about those programs. Once we sort out the numbers associated with the Bottom-Up Review and the mission associated with it, I think we'll be able to give people a clearer picture."

Even when the drawdown has bottomed out, the Air Force probably will have to worry about retaining enough members for the future. The problem is that recruitment efforts have been curtailed. As recently as 1986, USAF was enlisting more than 64,000 new recruits per year and taking in almost 8,000 new officers. This year it will bring in only about 30,000 airmen and 4,900 officers. When this smaller cohort completes its initial obligation, the service will have to retain an unusually high percentage. Officials have tried to hold a balance by trimming both the career force and acquisition levels, but, General Boles concedes, retention promises to be a problem, particularly in some specialties.

Pilots are a prime example. Thanks to bonuses and other incentives, pilot retention actually improved from thirty-four percent two years ago to fifty-eight percent last year, but even a high retention rate will not suffice if the pool of potential career members is too small.

At the moment, competition from commercial airlines is not a major problem, but that too could change. "If the airlines start hiring again in a few years, as they may when their age problems creep up, we could have problems again," said General Boles. "That's why we continue to support pilot bonus payments. It's like fixing your roof while the sun is shining rather than waiting until it rains."

There are similar concerns about future enlisted retention, particularly in some critical skills. Even as the Air Force offers airmen incentives to separate or retire early, it dangles cash bonuses before those in about fifty key skill areas and presses for other improvements such as more realistic housing allowances. One reason, officials say, is that rapid improvement in the civilian economy could change the retention equation dramatically.

General Boles says that USAF personnel have to keep the uncertainties in perspective: "In my thirty-two years of service, I've never seen a level strength chart. I tell people that, in times like these, it's helpful to remember that there always have been times like these." ■

Bruce D. Callander, a regular contributor to AIR FORCE *Magazine, served tours of active duty during World War II and the Korean War. In 1952, he joined* Air Force Times, *becoming editor in 1972. His most recent article for* AIR FORCE *Magazine, "New Skill Codes for Everybody," appeared in the September 1993 issue.*

Economic problems have cut off some of Bonn's preferred approaches to national security.

Germany Seeks Its Course

By Stewart M. Powell

GERMANY, which benefited more than any other nation from the thunderous collapse of communism in Europe, is having a hard time adjusting to the freedom and uncertainty of a troubled peace.

With the end of the Cold War, the nation of eighty million escaped the danger of a general conflict that would have been fought house-to-house in German cities and in huge battles across the countryside. It has seen the rapid withdrawal of thousands of nuclear weapons stationed on its soil. West and East were reunited in a frenzy of German optimism.

Now, barely four years after the fall of the Berlin Wall, the wealthiest and most powerful nation in Europe is caught up in a spasm of anxiety brought on by abrupt, bewildering change.

The German economy is in shambles; its Gross Domestic Product is no longer expanding and has even begun to spin lazily downward. Bonn's heavy borrowing to underwrite the assimilation of East Germany has forced the inflation-conscious central Bundesbank to keep interest rates high—so high that it caused Europe's exchange rate system to unravel last summer.

The nation no longer maintains one of the largest, best-equipped, and most professionally trained armed forces in the world. It seeks a new security role both within and without the North Atlantic Treaty Organization, a quest that sometimes generates sharp conflict with long-standing allies.

The day-to-day burdens of taking in East Germany have all but wiped out the memories of the exhilarating, joyous embraces that welcomed East Berliners pouring through jagged gaps in the concrete wall on that glorious November day in 1989. In what used to be East Germany, there is smoldering resentment about low wages, low benefits, and political impotence in the new German state.

Germany's proud history of accepting refugees is being stained as the nation desperately tries to stem the flood of eastern European immigration that has brought more than one million refugees to German soil since 1989.

Nightmare Years

The onslaught has provoked a violent backlash, including racist attacks reminiscent of the nightmare years of the Nazis in the 1930s. The year 1992

Reuters / Bettmann

saw 2,584 assaults against the 1.8-million-strong Turkish community and other foreigners. These attacks claimed seventeen lives. The extremist campaign has continued this year on a somewhat reduced scale, with another 1,300 acts of violence and seven deaths.

Germany's estimated 47,000 neo-Nazis, who are mostly unorganized today, have begun preliminary efforts to forge a nationwide network. This step has prompted Germany's chief internal security agency, the Office for the Protection of the Constitution, to launch a "massive" undercover infiltration.

At the same time, Germany is struggling to identify its true national security interests in a way that goes beyond the clear-cut definitions of the Cold War. In those days, self-defense and territorial integrity constituted German security policy. Now, Bonn can ill afford to shy away from all risks of overseas conflict because German interests are frequently engaged.

Germany would like to have a greater role in international security affairs, as befits its status as a great economic and political power. It will not be easy.

Kurt Biedenkopf, premier of the eastern German state of Saxony, argued that Germany must be pulled out of a "niche" that has long shielded it from international responsibilities. "Germans were never particularly happy with the observation that Germans are economic giants and political dwarfs," said Mr. Biedenkopf, "but they felt rather comfortable with that position."

The rethinking takes place amid deep cutbacks in the German armed forces and sweeping structural changes that are leaving the revered Bundeswehr beset by the most serious self-doubts in its postwar history. Thousands of West German soldiers are separated from their families for long periods while serving at decaying East German bases. Budget cuts are impeding training and modernization.

Alfred Biehle, a member of the German parliament, summed up the situation in an annual report on the Army: "There may come a time when soldiers, who are already asking where all this is leading, will say: 'I cannot go on living like this.' "

Like many other national military establishments, the armed forces of Germany are being greatly reduced from their Cold War strengths. Chancellor Helmut Kohl announced last February that western Europe's most powerful armed forces would be trimmed from their 1990 peak of 525,000 soldiers, sailors, and airmen to barely 300,000 by 1996.

German authorities predict that the free fall will continue into the late 1990s, with German forces ultimately totaling as few as 200,000 troops.

Feeling the Pinch

The drawdown will have a depressing effect on defense spending. The German defense budget in 1990 stood at the deutsche mark equivalent of $30.6 billion, representing 17.1 percent of the national budget. Next year, defense spending will drop to $27.9 billion, a huge reduction once the effects of inflation are factored out. Defense will then consume only ten percent of government spending.

Each German service is feeling the pinch. By 1994, the Army's remaining 255,400 active-duty troops will be organized into eight divisions, with all but two East German units assigned to multinational corps within the Western Alliance.

The Luftwaffe's end strength is

being cut by about thirty percent, to 82,400 airmen. Moreover, its structure is now being cut from five to four divisions. The number of warplanes is being trimmed to fewer than 500—less than half its Cold War strength. Germany's combat aircraft continue to come under NATO command. Six wings of Tornado fighter-bombers will serve Alliance requirements, including three equipped for delivery of nuclear weapons.

Hopes for early upgrading of the Luftwaffe fleet with the planned Eurofighter have been dashed by budget cuts and wrangling within the four-nation fighter consortium, comprising Germany, Britain, Italy, and Spain. As a result, 1960s-era F-4F Phantoms will be upgraded to remain in service until 2005. A mixed wing of fighters based at Falkenberg Airport, a former Russian base in East Germany, will include MiG-29 fighters inherited from East Germany and a squadron of Phantoms.

The Navy is being reduced to 32,200 sailors as the mission shifts from Baltic Sea control and coastal defense against the Soviet fleet to less intense missions. The number of warships is being cut by fifty percent to about ninety vessels. The submarine force is being cut from twenty-four to ten.

All the German armed forces are engaged in a top-to-bottom restructuring to prepare them for the type of political-military crisis that is expected to afflict Europe and nearby regions in the future. Germany will keep a "main defense force" for national defense. In essence, this will be a cadre reinforced with reserve units mobilized in response to long-lead-time threats, such as a Russian military mobilization.

A far more robust "crisis reaction force" of about 50,000 troops is being prepared for service. It is expected to be ready by 2006 to carry out international missions supervised by the United Nations or by the Conference on Security Cooperation in Europe. The "go anywhere, any time" force will include two airborne brigades, two fighter squadrons, and five anti-aircraft squadrons. Forty percent of the force will be drawn from the German Navy, which will contribute six frigates, fifteen minesweepers, eight submarines, and thirteen patrol boats. Other services will contribute smaller numbers of troops and weapons.

Unanswered Questions

Defense Minister Volker Rühe readily acknowledged the deepening angst of his troubled nation. "While we have overcome the political division of Europe, our questions concerning the future have not yet found their answers," the German leader said. "The enthusiasm for the European revolution has partly been overshadowed by feelings of insecurity vis-à-vis the consequences of this fundamental change."

For Germany, the preeminent national security goal remains preventing a general conflict in Europe—a conflict that surely would be waged on German territory.

To avert that calamity, Bonn pours money and technical expertise into eastern Europe and into the new nations of the old Soviet empire to foster economic development. It leads efforts to extend the writ of the European Community to the East to bolster fledgling consumer-oriented democracies. It presses the sixteen-nation NATO to include former Warsaw Pact countries, such as Poland, Hungary, and the Czech Republic.

"In the past," said the German Defense Minister, "we committed ourselves to the human right of the people to leave their countries and not to accept dictatorship. Now, it is important for us to create the conditions that make it worthwhile for them to stay."

Germany's financial strength, however, has been severely pinched by the stupefying cost of assimilating East Germany and of underwriting the cost of housing for ex-Soviet troops pulling back from East Germany to Russia. German generosity toward the East is suffering, and Germany's economically strapped allies are hardly eager to make up the difference.

The effect of this situation was noted with alarm by Wolfgang F. Schlör of the University of Pittsburgh, author of "German Security Policy," a recent examination of trends in post–Cold War Germany. Said Mr. Schlör, "Germany no longer has the resources to pursue its security objectives by economic means—be it as compensation for a lack of military participation or as a measure to stabilize countries on the verge of economic chaos."

Other NATO nations balk at the German idea of expanding the Alliance to the East for fear of fanning Russian nationalism, stirring Russian fears of encirclement and invasion, and complicating prospects for Russia's Westward-looking president, Boris Yeltsin. "The prevailing wisdom is that bringing in Poland or any other state would be risky and self-defeating for the Alliance as a whole," said one senior NATO officer.

Germany is also engaged in a messy struggle to find a new balance between its desire for deeper integration with the rest of Europe and the need to maintain ties with the US.

Photo by Nathan Leong

The four-nation consortium slated to build the Eurofighter—Germany, Britain, Spain, and Italy—is struggling with problems of costs and requirements, forcing the Luftwaffe to upgrade its F-4F Phantoms for service until 2005.

Bonn is striking a more independent course. The German and French military establishments have formed a Franco-German army corps to respond to European security problems. The move concerned the United States, which worried that the unit would operate outside the Alliance. Such expressions of concern impelled Bonn and Paris to give the force a NATO commitment.

Germany counts on the symbolic commitment of US ground forces to serve as a deterrent to unforeseen threats, especially those from the east. Chancellor Kohl has declared unequivocally, "A substantial US military presence should remain in Europe in order to meet the Alliance's tasks—now and in the future."

USAF Combat Camera photo by SrA. Andy Dunaway

Widespread criticism of Germany's largely passive role in the Persian Gulf War has spurred Chancellor Kohl's government to greater activity in such trouble spots as Bosnia (above), Cambodia, and Somalia.

Gulf War Humiliation

The German quest for a wider role in world security affairs has roots in the 1991 Persian Gulf War, the first international crisis after World War II in which Germany was not shackled by East-West tension and the danger that German assertiveness could provoke Soviet-inspired retaliation against countrymen in East Germany.

In the Gulf War, Germany's major national interests were clearly at stake; forty-four percent of the country's oil imports originate in the Persian Gulf region. Even so, Bonn found itself handicapped by its perception that Germany's 1949 Constitution banned any deployment of armed forces beyond the boundaries of the North Atlantic Treaty area defended by NATO militaries.

Instead of playing a leading role in the thirty-three-nation coalition, Germany was forced to fall back on Cold War–style "checkbook" diplomacy, helping to bankroll the six-month buildup and forty-three-day campaign. Germany's national behavior in the crisis, wrote Europe expert Elizabeth Pond, "looked like appeasement," and most Germans felt the sting of this widespread Western assessment.

The Gulf War forced Germany to begin to shake off the military paralysis born of Cold War dangers. The resulting turnabout led Bonn to dispatch military doctors to assist the UN peacekeeping operation in Cambodia, Army engineers to northern Iraq to build tent cities for Kurdish refugees, Army helicopters to Iraq to ferry UN weapons inspectors, transport aircraft to Bosnia to distribute food, and a destroyer to the Adriatic to help enforce Allied sanctions against Serbia.

With public opinion divided and Germany's fractious political parties vying for power, Chancellor Kohl's step-by-step overseas military moves sparked a legal challenge. The opposition Social Democratic Party went to court to question the assignment of German specialists to NATO E-3 Airborne Warning and Control System aircraft monitoring the UN-declared no-fly zone over Bosnia. The Federal Constitutional Court, Germany's supreme court, came to Mr. Kohl's side with a five-to-three ruling that upheld his right to send German troops into potential combat aboard Alliance aircraft.

More Angst

With the court decision in his pocket, Chancellor Kohl quickly provoked agonized parliamentary debate on whether to send 1,600 German soldiers to Somalia to join the UN humanitarian relief operation. "It is an important decision for Germany's international solidarity," said Mr. Kohl, waving aside the objections of the Social Democrats that German military action had to be restricted to self-defense.

The leader of the Free Democrats, Foreign Minister Klaus Kinkel, endorsed the deployment after winning assurances from the UN that German troops would remain far from the warfare of Mogadishu. Said Mr. Kinkel, "Let us make our country the active and responsible partner that the international community and we ourselves want to be."

The gradually widening German participation in international military operations is the first step in "an educational process that has already mustered public support for a greater acceptance of German participation in such operations," explained Defense Minister Rühe. The process "has to develop organically after forty years of different orientation in foreign policy."

If Mr. Kohl's center-right coalition wins the December 1994 national elections, Germany can be expected to continue its cautious, step-by-step venture onto the world stage, taking on wider responsibilities in crisis intervention as part of its drive to gain worldwide influence and eventually win a permanent seat on the UN Security Council. ■

Stewart M. Powell, the White House correspondent for Hearst Newspapers, has covered security affairs from Washington, D. C., and London since 1980. His most recent article for Air Force *Magazine, "Britain's Defense Shakeup," appeared in the April 1993 issue.*

From feather-light bicycles to cancer research, the civilian world is receiving a windfall from Air Force scientific work.

Technologies Built for Two

By James Kitfield

AIR FORCE research has had a huge impact on civilian industry. The National Academy of Engineering has noted that many of the greatest civilian advances of the past twenty-five years originated in or were decisively advanced by USAF labs.

Innovations include satellites, microprocessors, lasers, composite materials, and fiber-optic communications. In the past, however, civilians wanting to capitalize on Air Force achievements had to wait. The service always gave top priority to military needs and protected key technologies accordingly.

Those days are over, claims Gen. Ronald W. Yates, commander of Air Force Materiel Command. "While our labs have always transferred technology, what's different at AFMC today is that we look at tech transfer [to civilian industry] as a core part of our job," the General said in remarks delivered at AFA's National Convention last September in Washington, D. C.

In an era of tight budgets and global economic competition, he said, the Air Force must leverage its technology by contributing to the nation's economic security. "Today," he added, "the most promising technologies are those that meet the needs both of our warfighters and of the civil sector."

The kinds of dual-use technologies General Yates cited were on display at AFA's latest Aerospace Technology Exposition. Examples that he noted:

- An optical data storage unit no larger than a sugar cube but powerful enough to store an entire library of information.
- Computer-aided image-processing systems that might revolutionize target acquisition and radically improve detection of breast cancer.
- Compact phased-array radars that can warn pilots of approaching enemy aircraft and alert school bus operators to unseen children.
- Oxygen-generating systems equally useful in cockpits and hospital operating rooms.
- New alloys developed for the National Aerospace Plane that could herald the introduction of feather-light bicycles and wheelchairs.

Almost as revolutionary as the technology are mechanisms now in place to transfer it smoothly to the marketplace. Every USAF operating location, for instance, has established an Office of Research and Technology Application (ORTA) to ease technology transfer.

When a major US auto maker found problems with a cruise-control fuel system, it approached the ORTA at Wright Laboratory, Wright-Patterson AFB, Ohio. Because the Air Force had solved a similar problem years earlier, the ORTA was able to deliver a solution to the auto maker within seventy-two hours.

Medical researchers visiting Wright Lab's ORTA were intrigued by fiber-optic sensors that the Air Force developed to better handle high temperature levels at critical points in the operation of a jet engine. That technology is now being used in inducing hypothermia to treat cancerous tumors.

"Where we've really seen a payoff with these offices is in helping small companies, dozens of whom have come to us with problems that in many cases the Air Force has already worked," said Brig. Gen. Richard R. Paul, the AFMC director of Science and Technology. "There are cases where we've helped them reopen production lines that had been shut down and [we've] saved jobs."

AFMC recently added a technology hot line to encourage crosstalk between the service and private industry. Operators answered calls from more than 125 customers in the first few months of operation. Officials say the hot line represents one more way the command is throwing open the doors of its labs and research facilities.

"By establishing these interfaces, I become more aware of companies' needs in terms of commercial applications, and in many cases we can change our technological approach slightly to accommodate both Air Force and civil sector requirements," General Yates said. "Before, I had no idea what they needed."

Ironically, when it comes to open access to Air Force research and technology, industry executives have said they need a little less of a good thing. No company wants to invest heavily in bringing a new technology to the marketplace without getting a jump on likely competitors. The Air Force has responded to those concerns by guaranteeing companies some exclusive rights while crafting individual cooperative research and development agreements. Their goal in tailoring the CRDAs, say AFMC officials, is to give a company willing to invest in a technology a competitive edge. Because the agreements are not contracts, they are not subject to federal acquisition regulations.

"Typically, in crafting these CRDAs on a case-by-case basis, we allow a period during which we'll work exclusively with a particular company to give it a profit-making head start," said General Paul. Regardless of the time frame, the government retains the right to use the technology for its own purposes. "After a certain period of time, our goal is to release the technology on a wider basis."

New Dimensions in Data Storage

To understand the intense interest in exploiting Air Force technology, consider the sugar-cube-sized optical data storage device being developed by Rome Laboratory, Griffiss AFB, N. Y.

Rome Lab is AFMC's research and development center for command, control, communications, and intelligence. These disciplines rely heavily on fast retrieval of vast amounts of stored data, a capability also integral to the vision of a new information age, when high-speed computers across the nation are networked via "information superhighways."

During the 1970s, Rome Lab pioneered research in optical data storage techniques that today represent the state of the art. That technology was spun off into the compact disc player, which revolutionized home entertainment. Today, such data storage systems as optical discs, magnetic tape, and magnetic disks store information on two-dimensional media.

However, the capability of computers using highly parallel electronic processors has outdistanced these memory technologies. Given the exploding demand for memory storage, memory systems have come to dominate processors in terms of overall cost, power consumption, and volume. Because information stored in this mode can only be accessed sequentially, increases in memory have also bloated access times.

Enter three-dimensional memory. Using photochromic materials that change color when excited by lasers, Rome Lab researchers were able to compress two-dimensional information into "binary planes," which are then stacked into a third dimension. Processing is performed not in sequence but on the entire plane of bits at once. The result is ultrahigh-density memory storage that can be accessed in nanoseconds. Translation: a magic cube the size of a finger tip, capable of storing the equivalent of 2.4 million floppy disks or 100,000 books—all retrievable at the speed of light.

According to Al Jamberdino of Rome Lab, potential applications of three-dimensional memory media range from military simulators and electronic intelligence data processing to data storage for banks, insurance companies, or any other enterprise requiring a large database. The project has enticed academic institutions and private contractors, including Syracuse University, the University of Southern California, Call/Recall, Hughes, SRI, Quantex, and Northrop Corp.

"Because you can potentially store twenty hours of video and 4,000 hours of audio on a single cube, this could also lead to an era of entertainment on demand," said Mr. Jamberdino. "These cubes will make CD-ROM [compact disc read-only memory] obsolete."

Versatile Image Processing

Another emerging Air Force technology was designed to protect US soldiers on the battlefield but may one day save the lives of women threatened by breast cancer.

The original challenge facing researchers at the Wright Laboratory Armament Directorate, Eglin AFB, Fla., was to reduce "friendly fire" incidents of the types that led to casualties during Operation Desert Storm. Imaging sensors and processors for "smart" weapons had to be fast enough not only to spot a target but also to identify it as friend or foe.

The first step for the researchers at Wright Lab's Advanced Guidance Division was to develop a new computer language for high-speed, high-resolution image processing. For more than nine years, the Air Force had also worked on developing three-dimensional computer technology. A prototype 3-D computer, initially built for the Strategic Defense Initiative, was already on loan to the Armament Directorate for evaluation. Researchers believed that the multiple processing computer, coupled with the image algebra in the new computer language, could provide one of the fastest methods of image processing in the world.

As it turned out, improved resolution and faster image-processing are major goals for medical researchers hoping to improve on current mammogram technology. Mammograms, or breast X rays, play a major role in early cancer detection and treatment. Unfortunately, because of the density

of breast tissue, especially in younger women, small tumors are often difficult to detect in normal X rays. Carefully scanning an X ray can take a radiologist up to forty-five minutes.

Researchers at the University of Florida believe they can use the Air Force's new image-processing language to enhance greatly the fidelity of mammograms. In an experimental process, mammograms have been scanned electronically, converting the X-ray information to digital data. The new image-processing language uses those data to produce a high-resolution image, which reveals many subtleties not normally visible on X-ray film. With multiple processor computers, medical researchers hope to cut processing time for such improved images down to ten minutes.

"To acquire, track, and identify targets, the computers on smart weapons typically have to update information every hundredth of a second," says Dr. Patrick Coffield, senior research analyst at the Advanced Guidance Division. "A radiologist who screens forty to fifty mammograms a day also needs image enhancements in real time. This technology may be the missing link."

Another technology finding its way from advanced military aircraft to the commercial sector is radar detection. The "Forewarn" near-obstacle detection system, for instance, has been approved for sale and installation on school buses in thirty-five states. Designed to alert bus drivers to children in their blind spots, the system has already been credited with saving the life of at least one child.

The outgrowth of thirty years of research on phased-array radar conducted by Aeronautical Systems Center's Wright Laboratory, Forewarn uses advanced microwave radar technology to detect motion via sensors on the front and rear of a bus. Drivers are warned by a flashing light and beeping alarm on their dashboards.

An offshoot of World War II radar development, work on phased-array radars began at Wright in the early 1960s. The goal was to design radars that scanned electronically rather than mechanically, making them far more effective and reliable. That work eventually resulted in the passive phased-array radar installed on the B-1B.

With the advent of solid-state electronics, researchers immediately saw the potential advantages of a solid-state phased-array radar. Tube transmitters tended to fail catastrophically, shutting down the whole system. A solid-state radar would degrade in increments, with a single failure only marginally affecting performance.

A Tiny Wonder

The transition to solid state required intensive research into miniaturizing microwave circuits. Typical silicon-based circuits did not operate at the right frequencies. Researchers began to experiment with gallium arsenide. That work eventually led to monolithic integrated circuits requiring no wires—each based entirely on the gallium arsenide chip.

The result is the monolithic microwave radar chip, a tiny wonder roughly one-eighth the size of older chips, yet capable of generating eight to ten times the power. These chips are used in radars for the LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) system, the Advanced Medium-Range Air-to-Air Missile, and the F-15 ALQ-135 electronic countermeasures system. They will also be at the center of the phased-array radar planned for the next-generation F-22 aircraft.

On the commercial side, the chip is also at the heart of the Forewarn system. Officials at Wright Lab have been approached by air traffic control planners, small manufacturers of satellites, cellular telephone companies, and automobile manufacturers looking to incorporate automatic collision-avoidance systems in their cars.

"The monolithic microwave integrated circuit is a fundamental breakthrough," says Capt. Randy Richards, a project engineer at the Solid-State Electronics Directorate, Wright Laboratory. Many observers believe it will one day help drivers see through snow and fog, avoid traffic jams, and pinpoint their position by communicating with satellites. "This is a building block of the intelligent highway system of the future," says Captain Richards.

The challenge facing researchers at Armstrong Laboratory, Brooks AFB, Tex., was handling the ubiquitous green oxygen cylinders found on air bases, on hospital loading docks, and inside chemical plants across the country. While the oxygen is relatively cheap, these man-sized cylinders represent a logistics nightmare. "It costs more to transport the oxygen bottles than it does for the oxygen itself," says 2d Lt. Jerold Fenner, chief of Oxygen Systems Function at Armstrong.

The Air Force's answer is the Molecular Sieve Oxygen-Generating System. Deceptively simple, the MSOGS is essentially a sieve through which engine bleed air is passed at high pressure. A chemical inside the sieve extracts nitrogen molecules from the air like a magnet, leaving oxygen to pass through. The nitrogen is vented overboard, and the concentrated oxygen produced by the system is delivered to the aircrew for breathing.

The B-1B, B-2, and F-15E are equipped with the MSOGS, and the Air Force has signed a joint research and development objective document with the Navy to incorporate the system into the AV-8B Harrier ground support unit. Systems now under development are expected one day to both generate and liquefy oxygen in a self-contained process, with the liquefied oxygen available for troops in a transport aircraft or as medical oxygen during aeromedical evacuation.

Maximum oxygen purity from the system is ninety-three to ninety-five percent, due to the inability of the zeolite sieve to distinguish between oxygen and argon. A new MSOGS developed at Armstrong and now under patent, however, introduces a carbon sieve that extracts argon, leaving 99.7 percent pure oxygen. That satisfies requirements in the medical community for oxygen that is more than 99 percent pure, and Armstrong has already announced plans to license the technology to a commercial company.

The true cost-effectiveness of the oxygen generating systems, says Lieutenant Fenner, lies in their simplicity. "Because the main materials involved are just crystals that attract nitrogen from the air, we expect these units to last about twenty years."

"Our primary mission is still to meet military needs through technology, but there are dozens and dozens of commercial spinoffs from the work we do," says General Paul. "If we're just a little innovative in making the private sector aware of what we're doing, and in leveraging the resources they bring to the table, I think it's a win-win situation." ■

James Kitfield is a defense correspondent for Government Executive *magazine in Washington, D. C. His most recent article for* Air Force *Magazine was "New Drill at Lakenheath" in the October 1993 issue.*

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World Gallery of Trainers

By John W. R. Taylor and Kenneth Munson

Jet Trainers

Alpha Jet

The prototype of this Franco-German design flew on October 26, 1973, and was followed in 1978–85 by 176 trainers for the French Air Force and 175 close-support Alpha Jets for the German Air Force. Subsequently, the German aircraft were retrofitted with 3,175 lb thrust Larzac 04-C20 engines, improved instrumentation, provision for two Sidewinder self-defense missiles, a podded 27-mm Mauser gun, and other refinements. Export orders were received from Belgium (33), Egypt (30, designated **MS1**), Ivory Coast (seven), Morocco (24), Nigeria (24), Qatar (six), and Togo (six). Dassault offered an alternative close-support version, with inertial platform, head-up display (HUD), laser rangefinder, and radar altimeter; Egypt ordered 15 (as **MS2**s) and Cameroon seven. Most Egyptian Alpha Jets were assembled by the Arab Organization for Industrialization at Helwan.

Most of Germany's surviving aircraft are now up for sale, including 30 destined for the French Air Force, to replace 40 older examples at Cazaux for weapons and tactics training. Germany is to retain only 35, to refamiliarize pilots with the European climatic environment after training in the US, before they convert to the Tornado.

Contractors: Dassault Aviation, France, and Dornier Luftfahrt GmbH, Germany.
Power Plant: two SNECMA/Turbomeca Larzac 04-C6 turbofans standard; each 2,976 lb thrust. Two 3,175 lb thrust Larzac 04-C20s retrofitted in German close-support aircraft, optional for other variants.
Dimensions (trainer): span 29 ft 10¾ in, length 38 ft 6½ in, height 13 ft 9 in.
Weights: empty 7,374 lb, gross 11,023–17,637 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 on internal fuel, 901 miles with external tanks, *g* limits (ultimate) +12/−6.4.
Accommodation: crew of two, in tandem, on zero height/104 mph or zero/zero ejection seats.
Armament: centerline stores pylon, or pod for 30-mm DEFA or 27-mm Mauser gun. Provision for two hardpoints under each wing for 18-tube rocket packs, bombs of up to 882 lb, cluster bombs, 30-mm gun pods, Sidewinder or Magic AAMs, Maverick ASMs, a reconnaissance pod, drop tanks, and other stores. Max load on five pylons 5,510 lb.

AT-3 Tzu-Chung

Two versions of this twin-turbofan aircraft serve with the Republic of China Air Force. A prototype was first flown on September 16, 1980, and the **AT-3A** entered service as Taiwan's standard basic and advanced military trainer in 1984. Of 60 built, 20 were converted to **AT-3B** standard, to use the 6,000 lb external stores-carrying capability in a ground-attack role. Smiths Industries was contracted in 1989 to upgrade the avionics of the first two aircraft with Westinghouse APG-66 radar and fire-control system; the AT-3Bs now equip a single RoCAF night attack squadron.

A surprise development in August of this year was the appearance at Taipei's Aerospace Technology Exhibition of a single-seat ground and maritime attack version of the AT-3 known as the **Lui-Meng**. Although offering increased payload/range, its production is considered unlikely. *(Data for AT-3B.)*

Contractor: Aero Industry Development Center, Taiwan.
Power Plant: two Garrett TFE731-2-2L turbofans, each 3,500 lb thrust.
Dimensions: span 34 ft 3¾ in, length 42 ft 4 in, height 14 ft 3¾ in.
Weights: empty 8,500 lb, gross 11,500–17,500 lb.
Performance (at max gross weight): max speed at S/L 558 mph, max cruising speed at 36,000 ft 548 mph, stalling speed (gear and flaps down) 104 mph, service ceiling 48,000 ft, T-O run ',500 ft, landing run 2,200 ft, max range on internal fuel 1,416 miles.
Accommodation: crew of two, in tandem; zero/zero ejection seats. Rear seat raised.
Armament: two hardpoints under each wing and one under fuselage for up to 6,000 lb of single, cluster, or fire bombs, flare dispensers, cr rocket launchers. Centerline hardpoint can be occupied instead by a semirecessed machine-gun pack or (in conjunction with outboard underwing pylons) an aerial target system. Provision for infrared AAM at each wingtip.

Alpha Jet, Qatar Emiri Air Force

AT-3, Republic of China Air Force (P. Steinemann)

Cessna 526

C-101 Aviojet

Four air forces fly versions of the Aviojet, which was developed with assistance from MBB of Germany and Northrop of the US. The first of four prototypes flew on June 27, 1977. Ninety-two **C-101EB** fully aerobatic basic and advanced trainers for the Spanish Air Force followed, under the designation **E.25 Mirlo**. These aircraft have 3,500 lb thrust Garrett TFE731-2-2J engines. An armed export version, with a 3,700 lb thrust TFE731-3-1J turbofan, was ordered by Chile (14 **C-101BB-02**s) and Honduras (four **C-101BB-03**s). All but the first four of the BB-02s were assembled under license by Empresa Nacional de Aeronáutica de Chile (ENAER), with partial local manufacture, and have the official Chilean Air Force designation **T-36 Halcón**. During 1982, ENAER and CASA initiated development of a dedicated light attack version of the Aviojet, designated **C-101CC-02** in Spain and **A-36 Halcón** by the Chilean Air Force. The first of two prototypes flew on November 16, 1983, and 23 similar production A-36s, with more powerful TFE731-5-1J engines, were manufactured for the Chilean Air Force. All Halcóns now have a nose-mounted ranging radar, ventral gun pod, and six underwing weapon pylons. Sixteen basically similar **C-101CC-04**s serve with the Royal Jordanian Air Force. An enhanced training version, with the TFE731-5-1J engine and additional avionics, including a GEC Ferranti HUD, Alenia mission computer, Litton inertial platform, and Doppler velocity sensor, flew for the first time on May 20, 1985, as the **C-101DD**. No orders for it have yet been announced, but the prototype was modernized in 1992. *(Data for C-101CC.)*

Contractor: Construcciones Aeronauticas SA, Spain.
Power Plant: one Garrett TFE731-5-1J turbofan; 4,300 lb thrust, with military power reserve (MPR) rating of 4,700 lb thrust.
Dimensions: span 34 ft 9½ in, length 41 ft 0 in, height 13 ft 11¼ in.
Weights: empty 7,716 lb, gross 11,023 lb (trainer, clean), 13,890 lb (max).
Performance (at 9,590 lb weight, except where indicated): max speed at 15,000 ft with MPR 518 mph, stalling speed (gear and flaps down) 102 mph IAS, service ceiling 44,000 ft, T-O run 1,835 ft, landing run 1,575 ft, ferry range (with reserves) 2,303 miles, *g* limits at 10,802 lb weight +7.5/−3.9.
Accommodation: crew of two, in tandem on zero/zero ejection seats. Rear seat raised.
Armament: bay beneath rear cockpit for quick-change packages, including a 30-mm DEFA gun with 130 rds, twin 12.7-mm Browning machine guns, reconnaissance camera, ECM package, or laser designator. Six underwing hardpoints for up to 4,960 lb of stores, including four LAU-10 rocket packs, six 550-lb bombs, two Maverick ASMs, or Sidewinder or Magic AAMs.

Cessna 526

The only all-American entry for the JPATS competition, Cessna's Model 526 is also unique in embodying many components of a civil jet, the company's six/seven-seat CitationJet business aircraft. The wings

are shortened and strengthened but retain the latter's supercritical laminar-flow airfoil. The fuselage is new and is designed to meet the JPATS requirement of accommodating 80 percent of pupil pilots, from 5 ft, 100 lb females to 6 ft 6 in, 240 lb males; but the landing gear and systems are adapted from off-the-shelf CitationJet components. UPCO SIIIS 3RW seats, with active stabilization, are specified. The engines are military versions of the CitationJet's FJ44s. Cessna is aiming at FAR Pt 23 aerobatic category certification by March 1994, in time for the Model 526 to participate in the JPATS flight evaluation phase.

Contractor: Cessna Aircraft Company, USA.
Power Plant: two Williams/Rolls-Royce F129 turbofans; each 1,500 lb thrust.
Dimensions: not available.
Weights: empty 4,920 lb, gross 7,400 lb.
Performance (estimated): max speed 311 mph, stalling speed (50 percent fuel) 88 mph, service ceiling 35,000 ft, range (with reserves) 1,209 miles.
Accommodation: crew of two, in tandem, with zero/zero ejection system.
Armament: none specified.

CM 170 Magister

Forty years after production of the Magister began, more than 300 of these tandem two-seat trainers and light attack aircraft remain in service. France operates more than 160, including 16 navalized **CM 175 Zéphyrs**. Israel has about 80, based at Hatzerim. Belgium has 18, Lebanon five, and Morocco 22; others still serve with the air forces of Algeria, Bangladesh, Cameroon, El Salvador, Gabon, Ireland, Libya, and Senegambia, often in both training and counterinsurgency roles.

The basic **CM 170** has 880 lb thrust Marboré IIA turbojets, but the last 137 production aircraft were fitted with uprated Marboré VIs and are known as **Super Magisters**. Between 1981 and 1986 Israel's Magisters, which have the local name **Tzukit**, were rebuilt and upgraded by IAI's Bedek Aviation Division under a program known as AMIT (Advanced Multimission Improved Trainer). *(Data for Super Magister.)*

Contractor: Aerospatiale (originally Fouga), France.
Power Plant: two Turbomeca Marboré VI turbojets; each 1,058 lb thrust.
Dimensions: span over tiptanks 39 ft 10 in, length 33 ft 0 in, height 9 ft 2 in.
Weights: empty 5,093 lb, gross 6,280–7,187 lb.
Performance: max speed at S/L 435 mph, at 30,000 ft 451 mph, service ceiling 13,125 ft, T-O run 1,970 ft, range (with reserves) 870 miles.
Accommodation: crew of two, in tandem, on ejection seats.
Armament: two 7.62-mm machine guns, with 200 rds/gun, in nose; hardpoint under each wing for rocket launcher, wire-guided missile, or bomb.

G-2A Galeb and G-4 Super Galeb

A few of the 200 straight-winged **G-2A Galebs** built for the Yugoslav Air Force during 1963–83 remain in service, but most have been replaced by sweptwing G-4 Super Galebs. Two of the six G-2As exported to Zambia in 1971 are believed to continue in service, and about 30 of the G-2A-Es supplied to Libya in 1975 and 1983–84 are also thought to survive, with both training and light attack roles.

The **G-4 Super Galeb** has a much more formidable light attack capability and has been used in combat during the civil war in former Yugoslavia, together with **J-1 Jastreb** single-seat light attack counterparts of the G-2A. The first of two G-4 prototypes flew in July 1978, and six preseries aircraft followed. The Yugoslav Air Force ordered about 150 production G-4s, with anhedral tailplanes, to replace T-33s and to reequip G-2A units on a one-to-one basis. G-4s were also flown, in happier times, by the Air Force's Letece Zvezde aerobatic display team. The Air Force of Myanmar has at least 12, possibly 20.

After the Soko ("falcon") factory in Mostar, Bosnia-Hercegovina, closed in May 1992, some G-4 plant and machinery was transferred to the Utva facility at Pančevo, Serbia, whence reports have emerged of a **G-5** development program. Optimized for ground attack, this version is said to have the GSh-23L gun built in, freeing the centerline station for other weapons, and wingtip rails for R-60 ("Aphid") AAMs. *(Data for G-4 Super Galeb.)*

Contractor: Vazduhoplovna Industrija Soko, Yugoslavia.
Power Plant: one Rolls-Royce Viper Mk 632-46 turbojet; 4,000 lb thrust.
Dimensions: span 32 ft 5 in, length 40 ft 2¼ in, height 14 ft 1¼ in.
Weights: empty 6,993 lb, gross 10,379–13,889 lb.
Performance (at 10,379 lb gross weight): max speed at 13,120 ft 565 mph, max cruising speed at 19,700 ft 525 mph, stalling speed (gear and flaps down) 112 mph, service ceiling 42,160 ft, T-O run 1,877 ft, landing run 2,674 ft, range with two drop tanks (with reserves) 1,553 miles.

CM 170 Magister, French Air Force (Paul Jackson)

G-4 Super Galeb, Yugoslav Federal Air Force (Brian M. Service)

Hawk Mk 53, Indonesian Air Force (P. Steinemann)

HJT-16 Kiran Mk IIs, Indian Air Force (P. Steinemann)

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

Hawk

Seventeen years after the Royal Air Force began taking delivery of 176 **Hawk T. Mk 1**s as Britain's standard basic/advanced flying and weapons trainers, a new generation of Hawks has entered service. In early 1993, British Aerospace handed over the first of 18 Mk 102s ordered by the Abu Dhabi component of the Air Force of the United Arab Emirates. At the Paris Air Show in June, a £500 million order for 24 Hawks for Indonesia, probably of the same 100 series, was announced. Both nations were already longtime operators of earlier Hawk variants.

Eighty-nine of the original RAF T. Mk 1s, with 5,200 lb thrust Adour 151 turbofans, initiated development of combat-capable Hawks when they were upgraded to **T. Mk 1A** standard to accompany radar-equipped Tornados on air defense missions. A pylon was wired under each wing to carry a Sidewinder AAM, supplementing the standard underbelly 30-mm gun pack. For the past two years, 15 T. Mk 1s and T. Mk 1As have also succeeded Canberras of No. 100 Squadron for target-towing and as "silent targets" for electronic warfare training. For export, the **Hawk 50** series, with 5,200 lb thrust Adour 851, offered a 70 percent greater disposable load and 30 percent longer range. Customers were Finland (57 Mk 51/51A, with a 12.7-mm centerline gun), Kenya (12 Mk 52), and Indonesia (20 Mk 53). The further improved **Hawk 60** series, with four-position flaps, modified wing leading-edge devices, and other refinements, has been bought by Zimbabwe (13 Mk 60/60A), Dubai (nine Mk 61), Abu Dhabi (16 Mk 63), Kuwait (12 Mk 64), Saudi Arabia (30 Mk 65), Switzerland (20 Mk 66), and South Korea (20 Mk 67). Fifteen of the Abu Dhabi aircraft have been upgraded to Mk 63A, with Adour 871 and new wings with wingtip Sidewinders.

The two-seat **Hawk 100** and single-seat **200** series are more specialized, high-performance strike versions. To date they have been ordered by Malaysia (10 Mk 108, 18 Mk 208) and Oman (four Mk 103, 12 Mk 203), in addition to Abu Dhabi and Indonesia, most with wingtip rails for Sidewinders. A further large order is anticipated from Saudi Arabia, under the Al Yamamah II program. *(Data for Hawk 60 series.)*

Contractor: British Aerospace plc, UK.
Power Plant: one Rolls-Royce Turbomeca Adour 861 turbofan; 5,700 lb thrust.
Dimensions: span 30 ft 9¾ in, length (incl probe) 38 ft 11 in, height 13 ft 1¼ in.
Weights: empty 8,845 lb, gross 20,061 lb.
Performance: max Mach number in dive 1.2, max speed at S/L 632 mph, stalling speed (gear and flaps down) 110 mph, service ceiling 46,500 ft, T-O run 2,330 ft, landing run 1,800 ft, ferry range with two drop tanks 1,842 miles, *g* limits +8/–4.
Accommodation: crew of two, in tandem on zero/zero ejection seats. Rear seat elevated.
Armament: centerline pack for 30-mm Aden gun with 120 rds, or pylon, plus two pylons under each wing. Within overall max of 6,614 lb, typical loads can include centerline gun pack or reconnaissance pod and four underwing rocket packs; 1,000-lb bombs; 36 x 80-lb runway denial bombs; five 600-lb cluster bombs; four Sidewinder/Magic AAMs; two Maverick ASMs and two drop tanks.

HJT-16 Kiran

The original Kiran prototype flew for the first time in September 1964. Delivery of 118 Viper-engined **Mk I**s for basic flying training with the Indian Air Force began in the spring of 1968. They were followed by 72 **Mk IA**s, for the IAF and Indian Navy, with a hardpoint under each wing to carry armament for weapons training. On July 30, 1976, Hindustan Aeronautics Ltd flew the first of the more powerful **Kiran Mk II**s, with an Orpheus turbojet, updated instruments and avionics, an improved hydraulic system, and an additional pair of underwing weapon stations for either training or counterinsurgency roles. Sixty-one Mk IIs were built for the Indian Air Force and Navy between 1982 and 1989. A Kiran replacement is now being sought, with the Hawk (which see) reportedly among the front-runners. *(Data for Mk II.)*

Contractor: Hindustan Aeronautics Ltd (Bangalore Complex), India.
Power Plant: one Rolls-Royce Orpheus 701-05 turbojet; 4,200 lb thrust.
Dimensions: span 35 ft 1¼ in, length 34 ft 9½ in, height 11 ft 11 in.
Weights: empty 6,603 lb, gross 9,369–11,023 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: crew of two, on side-by-side zero-height ejection seats.
Armament: two 7.62-mm machine guns in nose; two hardpoints under each wing for 551-lb bombs, 18-tube rocket pods, or drop tanks.

I-22/M-92 Iryda

Now in preseries production (nine ordered) to replace the TS-11 Iskra (which see) and LiM-6 (MiG-17) basic and advanced trainers of the Polish Air Force, the **I-22** Iryda ("iridium") was designed from the outset to have considerable potential for reconnaissance and close-support missions. It can operate from unprepared airfields and tolerate substantial battle damage. The first of five prototypes flew March 5, 1985. These should have been followed by six of the nine preseries I-22s by the end of this year, and 1994 should see the introduction of the **M-92** initial production model with more powerful 3,307 lb thrust Polish K-15 turbojets. The Polish Air Force has a requirement for 50 or more

Irydas. In service, they will cover the entire spectrum of pilot, navigation, air combat, reconnaissance, and ground-attack training, with day/night and adverse weather capability.

PZL Mielec has projected a number of future variants. The **M-93** would be a combat trainer with strengthened airframe, increased weapons capability, and Western engines, avionics, and zero/zero seats. A two-seat reconnaissance/close-support variant, the **M-95,** would be an M-93 derivative with larger, slightly swept wings and an internal 30-mm gun. Single-seat ground-attack or dual-role fighter/ground-attack derivatives of the M-95, designated **M-97S** and **M-97MS,** respectively, are also envisaged. *(Data for I-22.)*

Contractor: WSK-PZL Mielec, Poland.
Power Plant: two PZL-5 turbojets; each 2,425 lb thrust.
Dimensions: span 31 ft 6 in, length 43 ft 4½ in, height 14 ft 1¼ in.
Weights: empty 10,053 lb, gross 14,594–15,212 lb.
Performance (at 12,897 lb clean gross weight): max speed at 16,400 ft 519 mph, at S/L 488 mph, stalling speed (gear and flaps down) 126 mph, service ceiling 39,375 ft, T-O run 2,395 ft, landing run (with brake-chute) 4,400 ft, max range 714 miles, *g* limits +8/–4.
Accommodation: crew of two, on tandem zero-height/94 mph ejection seats. Rear seat raised.
Armament: one centerline 23-mm twin-barrel GSh-23L gun with 50–200 rds; two multiple stores carriers under each wing for up to 2,425 lb of bombs (up to 1,102-lb size), gun pods, AAMs, guided or unguided rockets, or (inboard stations only) 100-gallon drop tanks.

IA 63 Pampa

Design of the Pampa started in 1979, to develop a replacement for the Argentine Air Force's elderly Morane-Saulnier Paris IIIs in the basic, advanced, and weapons training roles. The first of three prototypes made its initial flight on October 6, 1984, and delivery of the 18 **IA 63 Pampas** so far ordered by the AAF began in April 1988. All are due to be retrofitted with a podded 30-mm gun and underwing weapon pylons. Subsequent aircraft will have these as standard, as well as a more powerful Garrett TFE731-3G engine, an AAF-developed HUD (already fitted in the first six aircraft), and a new Elbit weapon delivery and navigation system. A further 46 IA 63s are expected to be ordered after FMA's privatization is completed. A version for the Argentine Navy is also being developed.

To enter the US JPATS competition, FMA is teamed with Vought Aircraft Co. in offering the **Pampa 2000.** This has Bendix/King digital avionics, an AiResearch environmental control system, and a modified fuel management system. The first of two JPATS-configured aircraft made its initial flight May 25, 1993. *(Data for IA 63.)*

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

IAR-99 Soim and IAR-109 Swift

Design of this indigenous Romanian jet trainer began in the early 1980s, the aircraft's existence being revealed publicly at the 1983 Paris Air Show. The initial flight, by the first of two **Soim** prototypes, was made December 21, 1985. The Romanian Air Force ordered an initial 50, at least half of which have been delivered; roles include intermediate and advanced training.

Efforts to promote the IAR-99 for export first emerged in 1991, and in early 1992 Avioane revealed that it was discussing an upgrade package with Israel Aircraft Industries, under the designation **IAR-109 Swift.** Two versions are available: the **IAR-109T** "all-through" jet trainer and the **IAR-109TF** combat trainer/light attack version. Avionics, compatible with a MIL-STD-1553B multiplex data bus, include HUD, a ring-laser gyro INS, HOTAS (hands on throttle and stick) controls, radar altimeter, IFF, and laser rangefinder. The underwing stations can accept East European or Western weapons, including infrared AAMs and precision guided munitions. *(Data for IAR-99.)*

Contractor: Avioane SA, Romania.
Power Plant: one Rolls-Royce Viper Mk 632-41M turbojet; 4,000 lb thrust.
Dimensions: span 32 ft 3¾ in, length 36 ft 1½ in, height 12 ft 9½ in.
Weights: empty 7,055 lb, gross 9,700–12,258 lb.
Performance (at 9,700 lb clear gross weight): max speed at S/L 537 mph, service ceiling 42,325 ft, T-O run 1,477 ft, landing run 1,805 ft, max range 683 miles, *g* limits +7/–3.6.
Accommodation: crew of two, on tandem zero/zero ejection seats. Rear seat raised.
Armament: centerline 23-mm GSh-23 gun pod with 200 rds; two hardpoints under each wing for up to 2,756 lb of 550-lb or smaller bombs, two twin 7.62-mm gun pods, four 16 x 57-mm or 32 x 42-mm rocket pods, drop tanks (inboard stations only), or other stores.

K-8 Karakorum 8

The K-8 (originally L-8) program started in China but quickly became international when Pakistan agreed to take a 25 percent share in mid-1987. The K-8 is now being developed as a jet trainer and light ground-attack aircraft. It made its public debut at the February 1992 Asian Aerospace show in Singapore. The first of three flying prototypes made its initial flight November 21, 1990. The second followed on October 18, 1991, and by the beginning of this year the three then flying had completed nearly 500 test flights. According to Chinese sources in September 1992, limited production—believed to be an initial batch of 15 aircraft—had then already started, with Pakistani component manufacture (of tailplanes and elevators) due to begin with the ninth of these. Early production is for the air forces of Pakistan (reported requirement for up to 75) and China, but interest has been shown by other countries.

Contractors: Nanchang Aircraft Manufacturing Company, People's Republic of China, and Pakistan Aeronautical Complex, Pakistan.
Power Plant: one Garrett TFE731-2A-2A turbofan; 3,600 lb thrust.
Dimensions: span 31 ft 7¼ in, length (incl nose pitot) 38 ft 0¾ in, height 13 ft 9¾ in.
Weights: empty 5,924 lb, gross 8,003–9,546 lb.
Performance (at 8,003 lb clean gross weight): max speed at S/L 497 mph, landing speed (gear and flaps down) 103 mph, service ceiling 42,650 ft, T-O run 1,345 ft, landing run 1,680 ft, max range on internal fuel 870 miles, *g* limits +7.33/–3.
Accommodation: crew of two, on tandem zero/zero ejection seats. Rear seat raised.
Armament (optional): one 23-mm gun pod under centerfuselage; two hardpoints under each wing for gun or rocket pods, bombs, missiles, drop tanks (inboard pylons only), or a single reconnaissance pod.

IA 63 Pampa 2000

IAR-99 Soim, Romanian Air Force (Brian M. Service)

K-8 Karakorum 8

L-39 Albatros, Slovak Air Force (Paul Jackson)

L-29 Delfin

The **L-29 Delfin** ("dolphin") first flew April 5, 1959, powered by a Viper turbojet. The Czech M 701 engine was fitted in the second prototype and became standard in the 3,600 or so Delfins built between 1961 and 1974. Two-thirds of the production aircraft were delivered to the USSR, the bulk of the remainder being supplied as the standard jet basic trainer of all other members of the former Warsaw Pact except Poland. Estimates of current strengths are Bulgaria 84, the Czech and Slovak Air Forces 20, Hungary 24+, and Romania 30+. Russia's current UTS program, for which the MiG-AT and Yak-130 (which see) have been designed, is primarily to find a replacement for that country's L-29s. At least nine other nations received L-29s, of which Afghanistan (24), Ghana (eight), Mali (six), and Syria (60) still have the Delfin in their active inventories. An **L-29R** version was produced for light attack duties, with underwing stores pylons and nose-mounted cameras. *(Data for standard L-29.)*

Contractor: Aero Vodochody National Corporation, Czechoslovakia.
Power Plant: one Motorlet Walter M 701c 500 turbojet; 1,960 lb thrust.
Dimensions: span 33 ft 9 in, length 35 ft 5½ in, height 10 ft 3 in.
Weights: empty 5,027 lb, gross 7,231–7,804 lb.
Performance (at 7,165 lb gross weight): max speed at S/L 382 mph, stalling speed (flaps down) 81 mph, service ceiling 36,100 ft, T-O run 1,805 ft, landing run 1,444 ft, max range with underwing tanks 555 miles.
Accommodation: crew of two, on tandem ejection seats. Rear seat elevated.
Armament: single attachment point under each wing for rocket pod, 7.62-mm machine-gun pod, 220-lb bomb, or drop fuel tank.

L-39/59/139 Albatros

Since entering service in 1974, the L-39 production run has exceeded 2,800 (including 2,094 of the **L-39C** basic and advanced flying trainer for the former USSR). Apart from the Czech and Slovak Air Forces (36), other L-39C customers have included the air forces of Afghanistan (12), Cuba (30), Ethiopia (20), and Vietnam (24). Four ex-Soviet L-39Cs were acquired by Lithuania in 1992. The **L-39Z0,** with strengthened wings for additional stores carriage, has been exported in large numbers to the former German Democratic Republic (52), Iraq (81), Libya (181, of which 10 later transferred to Egypt), and Syria (55). The ground-attack/reconnaissance **L-39ZA,** which adds a centerline 23-mm gun pod to the capability of the Z0, has been produced for Algeria (32), Bulgaria (55), Nigeria (51), Romania (32), and Syria (44). Thirty-six others (designated **L-39ZE** due to their Elbit avionics suite) are due to complete delivery to Thailand in early 1994. Other potential customers, including the Philippines (18) and Estonia (eight), were negotiating purchases earlier this year. Eight examples of the **L-39V,** a specialized target-towing version, were built for Czechoslovakia in 1976. All of these models have a 3,792 lb thrust Progress (Ivchenko) AI-25TL turbofan.

The Albatros is now being offered in Westernized form for world markets as the **L-139.** Principal differences are a 4,080 lb thrust Garrett TFE731-4 turbofan, Flight Visions HUD, and Bendix/King avionics. First flown May 10 this year, the L-139 is expected to enter production in 1994.

The principal change in the **L-59** is the use of a new and more powerful DV-2 turbofan. The airframe and avionics have also been upgraded, and the ailerons and elevators have irreversible power controls. The first of three prototypes flew September 30, 1986, and

the first production L-59 October 1, 1989. Deliveries of 48 **L-59Es** to the Egyptian Air Force began in January 1993 and are due to be completed shortly. Six of the **L-39MS**, a similar model with Czech avionics, are being built for the Czech Air Force. *(Data for L-59.)*

Contractor: Aero Vodochody Aeronautical Works Ltd, Czech Republic.

Power Plant: one ZMKB Progress DV-2 turbofan; 4,850 lb thrust.

Dimensions: span incl tiptanks 31 ft 3½ in, length 40 ft 0¼ in, height 15 ft 7¾ in.

Weights: empty 8,885 lb, gross 11,883–15,432 lb.

Performance (at 11,883 lb clean gross weight): max speed at 16,400 ft 537 mph, stalling speed (gear and flaps down) 115 mph, service ceiling 38,725 ft, T-O run 1,936 ft, landing run 2,527 ft, range with external fuel 1,243 miles, *g* limits +8/–4.

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

Armament: one 23-mm GSh-23 twin-barrel gun in centerline pod; four underwing pylons for a total of 2,425 lb of stores, including bombs of up to 1,102 lb, four 16 x 57-mm rocket pods, or two 92.5-gallon drop tanks.

AT-26 Xavantes, Paraguayan Air Force (P. Steinemann)

MB-339 T-Bird II

MB-326, Impala, and AT-26 Xavante

The original tandem-seat trainer versions of the MB-326, with a 2,500 lb thrust Viper 11 turbojet, were bought for the air forces of Italy (**MB-326** and **326E**), Australia (**326H**), Ghana (**326F**), South Africa (**326M**), and Tunisia (**326B**). The strengthened wings of the E (each with three pylons) were combined with the more powerful Viper 540 to produce the trainer/light attack **MB-326GB** built by Aermacchi for Argentina, Zaïre, and Zambia, and by Embraer of Brazil for the air forces of that country, Paraguay, and Togo. The Brazilian version is known as the **AT-26 Xavante**. Final Italian-built variants, bought by several of the earlier customers and Dubai, were the single-seat **MB-326K** for operational training/ground attack and two-seat **MB-326L** advanced trainer; both have a 4,000 lb thrust Viper 632. Atlas Aircraft Corp. in South Africa built 151 MB-326Ms under license as **Impala Mk 1** trainers and a further quantity of MB-326Ks as **Impala Mk 2**s. All versions continue in service, but the aging Australian aircraft have encountered wing-fatigue problems and are scheduled for replacement. *(Data for MB-326GB.)*

Contractor: Aermacchi SpA, Italy.

Power Plant: one Rolls-Royce Viper 20 Mk 540 turbojet; 3,410 lb thrust.

Dimensions: span 35 ft 7¼ in, length 35 ft 0¼ in, height 12 ft 2 in.

Weights: empty 5,920 lb, gross 10,090 lb (training), 11,500 lb (max, with external stores).

Performance (trainer at 8,680 lb gross weight, internal fuel only): max speed 539 mph, max cruising speed 495 mph, service ceiling 47,000 ft, T-O run 1,350 ft, landing from 50 ft 2,070 ft, range (with reserves) 1,150 miles.

Accommodation: crew of two, on tandem ejection seats.

Armament: three attachment points under each wing for up to 4,000 lb of gun or rocket pods, bombs, wire-guided missiles, camera pack, or drop fuel tanks.

MB-339 and T-Bird II

Building on experience gained in 14 years of service with the air forces of Italy (101 delivered), Argentina (Navy, 10), Dubai (seven), Ghana (two), Malaysia (13), New Zealand (18), Nigeria (12), and Peru (16), Aermacchi now offers upgraded versions of this tandem-seat basic/advanced trainer and attack aircraft. First exhibited at the Paris Air Show, last June, was a demonstrator fitted with a fixed in-flight refueling probe and with two ADC/Grimes Aerospace active-matrix liquid-crystal EFIS displays. For the JPATS competition, Lockheed, Aermacchi, Rolls-Royce, and AAI Corp. have teamed to enter a "missionized" version of the MB-339 known as the **T-Bird II**. This name recalls Lockheed's T-33, familiar as the "T-Bird" to pilots trained on it worldwide during four decades. A 4,000 lb thrust Rolls-Royce RB582 engine is specified for the JPATS aircraft.

MiG-AT model (Brian M. Service)

The first production **MB-339A** for the Italian Air Force flew July 20, 1978; the total of 101 delivered included four **MB-339RM** (radiomisure) calibration aircraft and 20 **MB-339PAN**s for the Frecce Tricolori aerobatic display team, with added smoke generator but with the normally standard wingtip tanks deleted to aid formation keeping. Italian MB-339As are camouflaged for use as an emergency close-support force. One of them has been converted into the prototype **MB-339AM**, with Marte ASMs and special avionics for antiship missions. Production of the A ended in 1987. It was succeeded by the **MB-339C**, with new vertical tail surfaces, HOTAS controls, and advanced systems including GEC-Marconi Avionics radar and nav/attack computer, Kaiser HUDWAC, Litton INS, Honeywell radar altimeter, FIAR laser rangefinder, Tracor chaff/flare dispenser, and Elettronica active ECM pod. The New Zealand aircraft are of this version. *(Data for MB-339C.)*

Contractor: Aermacchi SpA, Italy.

Power Plant: one Rolls-Royce Viper Mk 680-43 turbojet; 4,400 lb thrust.

Dimensions: span over integral tiptanks 36 ft 9¾ in, length 36 ft 10½ in, height 13 ft 1¼ in.

Weights: empty 7,297 lb, gross 10,767 lb (training), 14,000 lb (max).

Performance (at training gross weight): max speed at S/L 558 mph, at 30,000 ft 508 mph, stalling speed 93 mph, service ceiling 46,700 ft, T-O run 1,608 ft, landing run 1,493 ft, ferry range with two drop tanks (with reserves) 1,266 miles, *g* limit +7.33.

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

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

MiG-AT

Five Russian OKBs produced designs for a two-seat advanced jet trainer to replace the L-29 Delfin and L-39 Albatros, which are standard equipment throughout CIS air forces. The two finalists, awaiting selection, are the MiG-AT and Yak-130. Of these, the MiG is the more conventional design, with unswept, low-mounted wings, twin turbofans in pods above the wingroots, and T-tail. Under an October 1992 agreement, engines for the first two prototypes will be supplied by SNECMA of France, with the first flight scheduled for early 1995. Avionics will include two multifunctional CRT displays with buttons, a HUD with input from color video and TV camera, laser rangefinder, HSI/ADI, automatic control system, INS, Tacan, ILS, RWR, and IFF. Armament will be optional. Design objectives include maneuverability comparable with front-line combat aircraft, and a service life of 10,000 flying hours or 25 years, with 20,000–25,000 landings. The Russian requirement is for 700 trainers in this category.

Contractor: Mikoyan OKB, Russia.

Power Plant: two Turbomeca-SNECMA Larzac 04-R20 turbofans; each 3,175 lb thrust.

Dimensions: span 34 ft 9½ in, length 36 ft 6¾ in, height 14 ft 0 in.

Weights: normal T-O 10,185 lb, gross 14,990 lb.

Performance (estimated): max speed 528 mph, service ceiling 49,200 ft, normal range 745 miles, *g* limits +8/–3.

Accommodation: crew of two, in tandem on zero/zero ejection seats.

Armament: up to 4,410 lb of guided and unguided missiles, guns, and bombs, on four underwing hardpoints.

Ranger 2000

Known originally as the Fan Ranger, this contender for the JPATS contract was developed from the German turboshaft-powered Fantrainer. DASA's US partner, the North American Aircraft division of Rockwell, redesigned the fuselage to raise the rear seat, embody new US military standard com/nav systems and Collins Pro Line 2 EFIS-85 displays based on those in the T-1 Jayhawk, and use a Universal Propulsion Co. lightweight ejection system. The aircraft's Pratt & Whitney JT15D engine has the advantage of being already in the USAF inventory. The first prototype flew January 15, 1993; the second was lost in July.

Like the Fantrainer, the Ranger 2000 has a cabin section based on a single structural keel beam. The wings, center-fuselage and engine housing are made of carbonfiber- and glassfiber-reinforced plastics.

Contractors: Rockwell International Corporation, USA, and Deutsche Aerospace, Germany.

Power Plant: one Pratt & Whitney Canada JT15D-5C turbofan; 3,190 lb thrust.

Dimensions: span 34 ft 4 in, length 25 ft 9¼ in, height 12 ft 10 in.

Weight: gross 5,291 lb.

Performance: max speed at S/L 379 mph, at 30,000 ft 451 mph, service ceiling 35,000 ft, range on internal fuel 1,118 miles.

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

Armament: none specified.

S.211

The two JPATS candidates that originated in Italy represent opposite extremes. The T-Bird II has the highest performance of all seven aircraft; the S.211 is the smallest. The original **S.211** prototype flew for the first time April 10, 1981; this version is in service with the air forces of Singapore (30) and the Philippines (18). The design is simple and inexpensive to manufacture, making it possible for the first six aircraft for Singapore to be delivered as kits and the remainder to be produced locally. Fourteen of the Philippine S.211s were assembled in Manila by PADC, with at least six more planned. In partnership with Grumman, Agusta has developed an uprated version, the **S.211A**, with a more powerful (3,190 lb thrust) JT15D-5C turbofan and supercritical wings, for the JPATS competition. Two examples of this trainer have been delivered to Grumman, in 1992 and early 1993. Each embodies a modified front fuselage, with the floor lowered to meet

JPATS accommodation requirements, and with Rockwell Collins EFIS displays in the second aircraft. The ejection seats are by Martin-Baker. Compared with the original S.211, the A has higher gross weights (6,393–7,716 lb) and a max speed of 472 mph at 25,000 ft. New wing fittings raise the *g* limits to +7/–3.5. *(Data for basic S.211.)*

Contractor: Agusta SpA (Sesto Calende Works) (formerly SIAI-Marchetti SpA), Italy.
Power Plant: one Pratt & Whitney Canada JT15D-4C turbofan; 2,500 lb thrust.
Dimensions: span 27 ft 8 in, length 30 ft 6½ in, height 12 ft 5½ in.
Weights: empty 4,078 lb, gross 6,063–6,944 lb.
Performance (at 5,511 lb gross weight): max cruising speed at 25,000 ft 414 mph, stalling speed (gear and flaps down) 86 mph, service ceiling 40,000 ft, T-O run 1,280 ft, landing run 1,185 ft, max range on internal fuel 1,036 miles, *g* limits (clean) +6/–3.
Accommodation: crew of two, in tandem; zero/zero ejection seats. Rear seat raised.
Armament: two hardpoints under each wing for up to 1,455 lb of gun pods (single or twin guns), rocket launchers, bombs, napalm tanks, cartridge throwers, two camera/IR reconnaissance pods, or two drop tanks.

Saab 105 (SK60)

The Saab 105 first flew in June 1963. Between 1966 and 1969, a total of 150 production versions were delivered to the Swedish Air Force, under the overall designation SK60. Of these, 140 remain operational in five slightly different versions: **SK60A** two-seat primary/basic/advanced trainer; **SK60B** two-seat light attack/advanced trainer; **SK60C** two-seat light attack/reconnaissance/advanced training aircraft; **SK60D** four-seater for liaison duties; and **SK60E** four-seater for liaison, with civil avionics. Since 1987, the SK60 has been unique in that it is the only training aircraft in the Swedish Air Force, used for everything from primary to tactical training. It is intended to continue in use until at least 2010, and a life extension program started in 1987. The wings of all 140 aircraft have been strengthened. New parachutes and a more comfortable harness have also been introduced. Under a further program, new Williams/Rolls-Royce FJ44 turbofan engines are planned for at least 100 SK60s during 1994–98, plus updated avionics.

Also in service is the Saab **105XT** special export version, with more powerful (2,850 lb thrust) and lighter General Electric J85-17 engines, strengthened structure, more internal fuel, more advanced avionics, and much greater weapon carrying capability. The Austrian Air Force acquired 40 during 1970–72, under the designation **105OE**. These, too, are expected to remain operational until 2010 after a life extension and upgrade program. *(Data for SK60A; 105OE in parentheses.)*

Contractor: Saab Military Aircraft, Sweden.
Power Plant: two Turbomeca/SNECMA RM9B Aubisque turbofans; each 1,636 lb thrust.
Dimensions: span 31 ft 2¼ in, length 35 ft 5¼ in, height 8 ft 10½ in.
Weights: empty 6,404 lb (6,281 lb), gross 9,085 lb (10,218 lb).
Performance (trainer): max speed at S/L 453 mph (602 mph), at 20,000 ft 478 mph (578 mph), service ceiling 39,370 ft (44,950 ft), T-O run 3,002 ft (1,247 ft), landing run 1,640 ft (1,969 ft), ferry range 1,180 miles (1,430 miles).
Accommodation: crew of two, side by side on ejection seats (four fixed seats in SK60D/E).
Armament (SK60B/C): up to 1,764 lb on six underwing hardpoints. Two 30-mm Aden gun pods or 12.7-mm practice gun pods; up to 12 x 135-mm rockets or six 60-mm practice rockets. (Up to 4,410 lb on 105OE.)

T-2 and T-2A

First flown July 20, 1971, the XT-2 prototype was the first supersonic aircraft designed and built by the Japanese aerospace industry. Ninety production aircraft were built for the Japan Air Self-Defense Force, of which 28 were configured as **T-2** advanced trainers and the remaining 62 as **T-2A** combat proficiency trainers. The T-2 also formed the basis for the Mitsubishi F-1 single-seat close air support fighter, which was put into series production for the JASDF. Production of the T-2 and T-2A ended in 1988.

Contractor: Mitsubishi Heavy Industries Ltd, Japan.
Power Plant: two Ishikawajima-Harima TF40-IHI-801A (license Rolls-Royce Turbomeca Adour Mk 801A) turbofans; each 7,305 lb thrust with afterburning.
Dimensions: span 25 ft 10¼ in, length 58 ft 7 in, height 14 ft 5 in.
Weights: empty 13,905 lb, gross 28,219 lb.
Performance (clean): max speed Mach 1.6, service ceiling 50,000 ft, T-O run 2,000 ft.
Accommodation: crew of two, in tandem on zero/zero ejection seats. Rear seat raised.
Armament: one Vulcan JM61 multibarrel 20-mm gun in lower fuselage, aft of cockpit on port side. Hardpoints on centerline and two under each wing for drop tanks or weapons. Wingtip attachments for AAMs.

T-2C Buckeye

The US Navy got 14 years' service (1959–73) from the single-engine **T-2A** and 27 years (1965–92) from the twin-engine **T-2B**, but the only version now in service is the **T-2C**, which so far has clocked nearly 25 years since the first of 231 examples were delivered in April 1969. As of February this year, there were still 142 in the USN's active inventory, most of them with training squadrons VT-4, VT-10, and VT-86 at NAS Pensacola, Fla., VT-19 at Meridian, Miss., and VT-23 at Kingsville, Tex., with whom they provide not only pilot, navigator, NFO, and weapons training but also the all-important carrier qualification part of the strike training syllabus. A few T-2Cs are also flown by the "aggressor" training unit VF-43 at NAS Oceana, Va., and the Naval Test Pilots' School at Patuxent River, Md. The T-2C is generally similar to its T-2B predecessor except for the adoption of the J85 engine as power plant instead of the latter's twin 3,000 lb thrust Pratt & Whitney J60-P-6 turbojets.

Contractor: Rockwell International Corporation, USA.
Power Plant: two General Electric J85-GE-4 turbojets; each 2,950 lb thrust.
Dimensions: span over tiptanks 38 ft 1½ in, length 38 ft 3½ in, height 14 ft 9½ in.
Weights: empty 8,115 lb, gross 13,191 lb.
Performance: max speed at 25,000 ft 522 mph, stalling speed 100 mph, service ceiling 40,415 ft, max range 1,070 miles.
Accommodation: crew of two, on tandem ejection seats. Rear seat raised.
Armament: two underwing hardpoints for up to 640 lb of practice bombs, gun pods, or rocket launchers.

T-4

Under major budget cuts, the number of T-4 intermediate trainers to be built for the Japan Air Self-Defense Force in the current three-year program was cut from 90 to 68 aircraft. How this will affect the originally planned production total of 200 T-4s is not known. Up to April of this year, 135 had been ordered and 95 delivered since production began in FY 1986 to replace Lockheed T-33As and Fuji T-1A/Bs.

Fuji and Mitsubishi each have a 30 percent share in manufacture of the T-4, under Kawasaki's leadership. The first of four prototypes flew July 29, 1985; a batch of 12 entered service with the 31st Flying Training Squadron of the 1st Air Wing at Hamamatsu, near Tokyo, in September 1988. Eventually, nine wings are intended to fly T-4s. The basic requirements of the specification to which they were designed called for high subsonic maneuverability and provisions to carry external stores under the fuselage and wings. Four underwing hardpoints can carry drop tanks or other stores; an underfuselage pylon can be used for target towing equipment, an ECM/chaff dispenser pod, or air sampling pack. Some T-4s will be deployed for liaison and other support duties under present plans. An enhanced-capability version has been proposed as a replacement for the Mitsubishi T-2.

Contractor: Kawasaki Heavy Industries Ltd, Japan.
Power Plant: two Ishikawajima-Harima F3-IHI-30 turbofans; each 3,660 lb thrust.
Dimensions: span 32 ft 7½ in, length 42 ft 8 in, height 15 ft 1¼ in.
Weights: empty 8,356 lb, gross 12,544 lb (clean), 16,535 lb (max).
Performance (at clean gross weight): cruising speed Mach 0.75, service ceiling 50,000 ft, T-O run 2,000 ft, landing run 2,100 ft, max range with two drop tanks 1,036 miles, *g* limits +7.33/–3.
Accommodation: crew of two, in tandem on ejection seats. Rear seat raised.
Armament: no built-in armament.

Saab 105 (SK60), Swedish Air Force

T-2, Japan Air Self-Defense Force (P. Steinemann)

T-4, Japan Air Self-Defense Force (Shojiro Ootake)

T-33A Shooting Star

This tandem-seat adaptation of America's first operational jet fighter is still active with 13 air forces, making it the world's longest-serving jet trainer. As well as **T-33A** pilot trainers, **AT-33A** counterinsurgency and **RT-33A** tactical reconnaissance versions continue in use. Largest fleets are those of Canada, whose more than 50 **CT-133A Silver Stars** have 5,100 lb thrust Rolls-Royce Nene engines; Greece (nearly 50); Japan (100+); Thailand (35+); and Turkey (75+). Other operators are the air forces of Bolivia, Ecuador, Guatemala, Iran, Mexico, Pakistan, the Philippines, and South Korea. Japan's T-33As are no longer used for training but are being retained for liaison and other duties pending replacement by T-4s. Canada's CT-133As serve with combat support squadrons. Ten of them are being modified as **ET-133** "electronic aggressors"; others are used for maritime support. *(Data for T-33A.)*

Contractor: Lockheed Aircraft Corporation, USA.
Power Plant: one Allison J33-A-35 turbojet; 4,600 lb thrust.
Dimensions: span 38 ft 10½ in, length 37 ft 9 in, height 11 ft 4 in.
Weights: empty 8,084 lb, gross 11,965 lb.
Performance: max speed at S/L 600 mph, at 25,000 ft 543 mph, service ceiling 47,500 ft, range 1,345 miles.
Accommodation: crew of two, in tandem.
Armament: none in T-33A.

T-37 Tweet

Next October will mark the 40th anniversary of the first flight of Cessna's Model 318, which became more familiar as the T-37A Tweet to USAF pilots trained in its side-by-side cockpit. All of the As were reengined to the standard of later **T-37B**s, and combined production of the two models reached almost 1,000. Of these, the May 1993 AIR FORCE Magazine shows 504 then operational, with an average age of 29.8 years. They are being upgraded by SLEP kits manufactured by Sabreliner Corp., but a replacement is expected to be selected next year under the JPATS program.

The **T-37C**, delivered to fill MAP orders only, was generally similar to the B in its primary and intermediate training roles but also had provision for underwing armament and tiptanks. T-37Bs and/or Cs are operated today by the air forces of Chile (20+), Colombia (eight), Germany (34), Greece (31), Pakistan (50+), South Korea (40+), Thailand (15+), and Turkey (65+). Also in service with several air forces is the **A-37B Dragonfly** attack version, with more powerful J85 engines and heavier armament. *(Data for T-37B.)*

Contractor: Cessna Aircraft Company, USA.
Power Plant: two Continental J69-T-25 (license Turbomeca Marboré) turbojets; each 1,025 lb thrust.
Dimensions: span 33 ft 9¼ in, length 29 ft 3 in, height 9 ft 2¼ in.
Weights: empty 3,870 lb, gross 6,575 lb.
Performance: max speed at 25,000 ft 426 mph, cruising speed at 35,000 ft 360 mph, service ceiling 35,100 ft, T-O to 50 ft 2,000 ft, landing from 50 ft 2,545 ft, range at 360 mph with standard fuel 870 miles.

Accommodation: crew of two, side by side on ejection seats.
Armament (T-37C): provision for two 250-lb bombs under wings, or four Sidewinder AAMs, and for fuselage-mounted camera.

T-38 Talon

As USAF's first supersonic trainer, the YT-38 first flew in April 1959. In all, 1,187 production **T-38A**s were delivered over the next decade. More than 1,100 of these were for USAF, which still had 638 at the start of this year; the original total included 46 allocated for US-based training of West German pilots. NASA received 24, the US Navy 18 (of which about six remain). Other current T-38A operators are Portugal (12), Taiwan (21), and Turkey (20).

More than 130 of the USAF aircraft were modified to **T-38B** (unofficially AT-38B) configuration for specialized weapon training, with an underfuselage gun pod or practice bomb dispensers; 47 of these also remained at the beginning of this year.

A SLEP named Pacer Classic, to enable USAF's T-38As to extend their service life until at least 2010, is currently under way, as is a "T-38X" concept study to reengine the T-38A with a pair of Williams/Rolls RB586 turbofans or a single Garrett F125 and fit modified wings and new avionics. If the latter proves viable, the T-38A could "replace itself" as USAF's post-2000 BFTS (Bomber/Fighter Training System) aircraft. *(Data for T-38A.)*
Contractor: Northrop Corporation, USA.
Power Plant: two General Electric J85-GE-5A turbojets; each 3,850 lb thrust with afterburning.
Dimensions: span 25 ft 3 in, length 46 ft 4½ in, height 12 ft 10½ in.
Weights: empty 7,164 lb, gross 12,093 lb.
Performance: max speed at 36,000 ft more than 812 mph, typical cruising speed at 43,400 ft 578 mph, stalling speed (gear and flaps down) 156 mph IAS, service ceiling above 55,000 ft, T-O run 2,500 ft, landing run 3,000 ft, range (with reserves) 1,093 miles.
Accommodation: crew of two, on tandem ejection seats. Rear seat raised.
Armament: none in T-38A; SUU-11 0.30-in gun pod or SUU-20/A rocket/practice bomb carrier in T-38B.

T-45A Goshawk

The Navy set high standards when it initiated its VTXTS (later T45TS) program for an undergraduate jet pilot trainer to replace the T-2C Buckeye and TA-4J Skyhawk. A development of the British Aerospace Hawk was selected from five other candidates November 18, 1981. It then took nearly 12 years of intense development before 13 of the resulting T-45A Goshawks appeared on the flight line of VT-21 Squadron at Kingsville, Tex. Although further small modifications have delayed the start of student pilot training until January 1994, the Navy is already confident that the Goshawk will cut advanced training time by 15 percent, as planned, with an operating cost one-third that of the T-2 and one-sixth that of the TA-4J.

Initial changes introduced by the US prime contractor, McDonnell Douglas, by comparison with the basic Hawk, included a new main and nose landing gear, an arrester hook, and airframe strengthening to make the aircraft carrier-compatible. The Hawk airbrake and ventral strakes were replaced, avionics and cockpit displays changed for compatibility with USN front-line fighters, and a derated version of the Adour installed to prolong engine life. The handling characteristics suffered from these modifications, leading to the addition of full-span slats, airbrakes, and use of a more powerful model of the engine. The first flight was made on April 16, 1988. Production was initiated by an FY 1988 Lot 1 contract for 12 production T-45As on January 26, 1988. At present, 268 T-45As are planned to enter USN service by 1999, to train around 300 pilots each year. A prototype with a digital/"glass" cockpit will fly in 1994, and this upgrade is intended to be standard from the 73d production aircraft, in 1996. Engine manufacturers will also be entitled to enter into competition with Rolls-Royce to provide power plants for the later aircraft.
Contractors: McDonnell Douglas Corporation, USA, and British Aerospace plc, UK.
Power Plant: one Rolls-Royce Turbomeca F405-RR-401 (Adour Mk 871) turbofan; 5,845 lb thrust.
Dimensions: span 30 ft 9¾ in, length (incl probe) 39 ft 4 in, height 13 ft 4¾ in.
Weights: empty 10,184 lb, gross 14,028 lb.
Performance: max speed at 8,000 ft 625 mph, max Mach number in dive 1.04, service ceiling 40,000 ft, T-O to 50 ft 3,610 ft, landing from 50 ft 3,310 ft, ferry range, internal fuel 952 miles, *g* limits +7.33/–3.
Accommodation: crew of two, in tandem on zero/zero ejection seats. Rear seat raised.
Armament: one pylon under each wing for practice multiple bomb rack, rocket pod, or drop fuel tank. Provision for centerline stores pod.

TS-11 Iskra-Bis

Poland's first indigenous jet trainer, the Iskra was developed for use by the Polish Air Force in preference to the Czechoslovak L-29 Delfin. The first of four prototypes flew in February 1960, and the Iskra entered service in 1964. The initial **Iskra 100** (31 built) had a 1,720 lb thrust HO-10 turbojet, which was replaced from 1967 by the 2,205 lb thrust SO-1, from 1969 by the identically rated SO-3, and finally by the SO-3W. In addition to these engine variations, the Iskra was built in four other models. The Iskra **100-Bis A** (45 built) and **B** (134 built) were two-seat primary trainers, with two and four underwing hardpoints, respectively; the Iskra **200 ART-Bis C** (five built) was a single-seat reconnaissance version; the **200 SB-Bis DF** (208 built) was similar to the B but with a wider range of weapons and three Soviet AFA-39 cameras in the nose. It is not yet clear whether these 423 Iskras include the 50 built in 1982–87 for the Indian Air Force. More recently, six DFs were converted to **TS-11R** configuration for the Polish Naval Air Force's 7th Regiment as replacements for a small number of coastal reconnaissance MiG-15UTIs. They have a Bendix/King RDS-81 weather radar in the nose, and the rear cockpit dual controls are replaced by a radar display screen and artificial horizon. *(Data for Iskra 200 SB-Bis DF.)*
Contractor: WSK-PZL Mielec, Poland.
Power Plant: one Instytut Lotnictwa SO-3W turbojet; 2,425 lb thrust.
Dimensions: span 33 ft 0 in, length 36 ft 7 in, height 11 ft 5½ in.
Weights: empty 5,655 lb, gross 8,232–8,465 lb.
Performance (at 8,232 lb gross weight): max speed at 16,400 ft 478 mph, normal cruising speed 373 mph, stalling speed (gear and flaps down) 114 mph, service ceiling 37,725 ft, T-O run 2,150 ft, landing run 2,330 ft, range 783 miles, *g* limits (ultimate) +8/–4.
Accommodation: crew of two, on tandem lightweight ejection seats.
Armament: 23-mm gun in starboard side of nose; two hardpoints under each wing for gun or rocket pods, or small bombs of up to 220 lb.

Yak-130

In partnership with Aermacchi of Italy, the Yak-130 is competing with the MiG-AT to replace L-29 and L-39 jet trainers of the Russian Air Force. A prototype is expected to fly within the next six months, equipped with a modified version of the quadruplex digital fly-by-wire control system of the Yak-141 supersonic V/STOL fighter. It will be inherently stable, but production Yak-130s are intended to have five percent longitudinal instability, to reproduce the handling characteristics of the MiG-29/Su-27 families of combat aircraft. They are intended to offer IOC in 1998.

The advanced configuration of the Yak-130 is designed to permit flight at angles of attack up to 35°. Basic power plant will comprise new Klimov-modified DV-2S turbofans, with Rafale-like kidney-shaped underfuselage air intakes, but Garrett TFE731s are among alternatives under study for the Western market, which Aermacchi estimates at a potential 1,200 aircraft. The tandem cockpits will be equipped from the start with CRT displays. Roles will include everything from advanced pilot training to weapons training, and aircraft carrier deck training with folding wings.
Contractor: Yakovlev OKB, Russia.
Power Plant: two Klimov-modified ZMKB Progress DV-2S turbofans; each 4,852 lb thrust.
Dimensions: span 36 ft 11 in, length 40 ft 8¼ in, height 15 ft 1 in.
Weight: gross 13,225–18,740 lb.
Performance (estimated): max speed at height 620 mph, service ceiling 39,375 ft, max ferry range 1,365 miles, *g* limits +8/–3.
Accommodation: crew of two, in tandem on zero/zero ejection seats; rear seat raised.
Armament: provision for large-caliber gun and seven pylons for weapons training and attack stores.

T-45A Goshawks, US Navy

TS-11 Iskras, Indian Air Force (P. Steinemann)

Yak-130 model (Linda Jackson)

Piston-Engine Trainers

Air Beetle

When AIEP sought an easy-to-build type with which to inaugurate an aircraft manufacturing capability in Nigeria, it chose a specially modified version of US Van's RV-6A homebuilt lightplane for its requirement. Named Air Beetle, the AIEP version was developed as a fully aerobatic military and civil primary trainer having a flat-four engine that could run on either avgas or mogas. It is of all-metal construction, with conventional three-axis flying controls all equipped with electric trim, and is IFR-equipped. First flight was made in 1989, and by the beginning of 1992 the three prototypes had among them accumulated more than 1,000 hours of flying. Series production for the Nigerian Air Force was expected to begin shortly afterward.
Contractor: Aeronautical Industrial Engineering and Project Management Company Ltd, Nigeria.
Power Plant: one Textron Lycoming O-360-A1A piston engine; 180 hp.
Dimensions: span 23 ft 0 in, length 20 ft 2¼ in, height 7 ft 6½ in.
Weights: empty 1,050 lb, gross 1,800 lb.
Performance: max speed at S/L 173 mph, max cruising speed at 10,000 ft 178 mph, stalling speed (flaps down) 58 mph, service ceiling 20,000 ft, T-O run 656 ft, landing run 673 ft, range 679 miles.
Accommodation: crew of two, side by side; baggage space aft of seats.
Armament: none.

Airtrainer CT4

Following the completion of six **CT4B**s for the Royal Thai Air Force, series manufacture of the Airtrainer has again ended, although development continues. The six aircraft were to supplement the remaining 18 of 24 **CT4A**s delivered in the 1970s, and which are being modified by RTAF personnel to extend their wing-fatigue life. Australia has retired its 37 CT4As, leaving the Royal New Zealand Air Force, which purchased 19 CT4Bs, as the only other military operator of this small primary trainer. Twelve other CT4Bs were acquired by the BAe/Ansett Flying College.

Current development by PAC centers on the **CT4E**, certificated to FAR Pt 23 in May 1992 with a 300 hp Textron Lycoming AEIO-540 aerobatic engine, and the **CT4C**, which has a 420 shp Allison 250-B17D turboprop. *(Data for CT4B.)*
Contractor: Pacific Aerospace Corporation Ltd, New Zealand.
Power Plant: one Teledyne Continental IO-360-HB9 piston engine; 210 hp.
Dimensions: span 26 ft 0 in, length 23 ft 2 in, height 8 ft 6 in.
Weights: empty approx 1,600 lb, gross 2,650 lb.
Performance: max speed at S/L 166 mph, max cruising speed at S/L 161 mph, stalling speed (flaps

down) 51 mph, service ceiling 14,500 ft, T-O run 733 ft, landing run 510 ft, max range (no reserves) 691 miles.
Accommodation: two seats, side by side. Space to rear for third seat or 115 lb of baggage.
Armament: none.

AS 202 Bravo

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

Bulldog

The prototype of this military primary trainer first flew in May 1969. The first 98 production Bulldogs were **Series 100**s for Sweden (Model 101, known as **SK61**s in Swedish Air Force service), Malaysia (Model 102), and Kenya (Model 103). Model 121 for Britain's Royal Air Force marked the introduction of the **Series 120,** with a strengthened wing center-section and higher aerobatic takeoff weight. The RAF acquired 130 as Bulldog **T. Mk 1**s. Ten of these remain with the Central Flying School and four with No. 6 Flying Training School; most of the others have been passed on to University Air Squadrons. Other current Bulldog operators are Ghana (10 Model 122), Jordan (20 Model 125), Kenya (12 Model 127), Lebanon (five Model 126), Malaysia (11 Model 102), Nigeria (25+ Model 123), and Sweden (60+ SK61s). The Swedish aircraft are used for liaison and other nontraining duties. *(Data for Series 120.)*
Contractor: British Aerospace plc, UK.
Power Plant: one Textron Lycoming IO-360-A1B6 piston engine; 200 hp.
Dimensions: span 33 ft 0 in, length 23 ft 3 in, height 7 ft 5¾ in.
Weights: empty 1,430 lb, gross 2,238–2,350 lb.
Performance: max speed at S/L 150 mph, max cruising speed at 4,000 ft 138 mph, stalling speed (flaps down) 61 mph EAS, service ceiling 16,000 ft, T-O run 900 ft, landing run 500 ft, max range 621 miles, *g* limits +6/–3.
Accommodation: crew of two, side by side; optional third seat or 220 lb of baggage at rear.
Armament: normally none, but provision for four underwing points for up to 640 lb of air-to-surface weapons, machine-gun pods, bombs, grenade launchers, or other stores.

CAP 10

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

AS 202 Bravo, Royal Air Force of Morocco (Press-Office Sturzenegger)

CAP 10B, Mexican Air Force (Paul Jackson)

T-41, Colombian Air Force (P. Steinemann)

HPT-32 Deepaks, Indian Air Force (P. Steinemann)

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

Cessna 150/152/172 and T-41 Mescalero

The smallest of this widely used family of all-metal high-wing lightplanes is the side-by-side two-seat **Model 150,** first flown in 1957. Versions up to the 150E had an unswept fin and 100 hp Continental O-200-A engine. A swept fin was introduced on the Model 150F in 1966. From 1977, the 150s were superseded by the **Model 152** range, with a 110 hp Textron Lycoming O-235 engine. The four-seat **Model 172,** first flown in 1955, has a 145 hp Continental O-300-A in its basic form. It, too, acquired a swept fin, in 1960, when the deluxe Skyhawk version also appeared. A more powerful **R172E** (210 hp Continental IO-360) was introduced in 1964. The basic Model 172 was uprated with a 150 hp Lycoming O-320 in 1968; the standard Skyhawk engine was the 160 hp O-320 from 1977.

The **T-41A Mescalero** represented off-the-shelf procurement of 204 Cessna 172s for USAF. It was followed by 255 **T-41B**s for the US Army, 52 **T-41C**s for USAF, and 238 **T-41D**s for MAP export to friendly nations, all based on the civil R172E. About 100 of the USAF trainers remain in the inventory. Other nations train with about 165 T-41s (mostly Ds), some 65 Cessna 150/152s, and 45 or so Model 172s, including Angola, Argentina, Bangladesh, Bolivia, Botswana, Burundi, Chile, Ciskei, Colombia, Dominican Republic, Ecuador, El Salvador, Greece, Haiti, Honduras, Ivory Coast, Madagascar, Mexico, Peru, the Philippines, Saudi Arabia, the Seychelles, Somalia, South Korea, Sri Lanka, Turkey, Uruguay, and Zaïre. *(Data for R172E/T-41D.)*
Contractor: Cessna Aircraft Company, USA.
Power Plant: one Teledyne Continental IO-360-D piston engine; 210 hp.
Dimensions: span 35 ft 10 in, length 26 ft 11 in, height 8 ft 9½ in.
Weights: empty 1,405 lb, gross 2,550 lb.
Performance: max speed at S/L 153 mph, max cruising speed at 5,500 ft 145 mph, service ceiling 17,000 ft, T-O run 740 ft, landing run 620 ft, max range 1,010 miles.
Accommodation: four seats, in two pairs; up to 200 lb of baggage aft of rear seats.
Armament: none.

CJ-6A

The Soviet Yak-18 primary trainer was one of the first aircraft mass-produced in post-1949 China, 379 being license-built at Nanchang as the CJ-5 between 1954 and 1958. Work on the **CJ-6** derivative started at Shenyang in 1956, a prototype with a 145 hp Mikulin M-11ER engine flying August 27, 1958. Disappointing performance led to its replacement by a 260 hp Ivchenko AI-14R, with which a new prototype made its first flight July 18, 1960. The project was then transferred to Nanchang, where further redesign was followed by flight of the first production-standard aircraft October 15, 1961. More than 2,000 CJ-6s had been built by 1993, of which probably at least 1,500 are still in Chinese service. Standard version since December 1965 has been the **CJ-6A,** although 10 armed **CJ-6Bs** were built in 1964–66. The CJ-6A retains the general configuration of the Yak-18A/CJ-5 but has an all-metal airframe with fully retractable landing gear, fitted with low-pressure tires for operation from grass strips. Export examples, which have the Westernized designation **PT-6A,** totaled about 200; these are currently operated by Bangladesh (35), North Korea (100 or more, including some CJ/PT-5s), and Zambia (12). *(Data for PT-6A.)*
Contractor: Nanchang Aircraft Manufacturing Company, People's Republic of China.
Power Plant: one SMPMC (Zhuzhou) HS6A radial piston engine; 285 hp.
Dimensions: span 33 ft 6½ in, length 27 ft 9 in, height 10 ft 8 in.
Weights: empty 2,414 lb, gross 3,086 lb.
Performance: max speed 185 mph, landing speed 72 mph, service ceiling 20,500 ft, T-O run 920 ft, landing run 1,150 ft, max range 429 miles.
Accommodation: crew of two, in tandem.
Armament: none.

HPT-32 Deepak

The prototype of this fully aerobatic side-by-side two-seat basic trainer flew for the first time January 6, 1977. Production was delayed, and the first 22-week student grading course on HPT-32s did not begin at the Indian Air Force Academy until 11 years later. The key design requirement was to perform two consecutive training missions 50 km (31 miles) from base before needing to refuel. As well as fulfilling the roles of *ab initio*, aerobatic, night flying, instrument flying, and navigation training, the aircraft had to be suitable for such secondary duties as liaison, observation, glider and target towing, and search and rescue. Initial orders were placed for 80 HPT-32s for the Indian Air Force and eight for the Indian Navy. Delivery of a further 54 for the IAF/IN is now under way.
Contractor: Hindustan Aeronautics Ltd (Kanpur Division), India.
Power Plant: one Textron Lycoming AEIO-540-D4B5 piston engine; 260 hp.
Dimensions: span 31 ft 2 in, length 25 ft 4 in, height 9 ft 5½ in.
Weights: empty 1,962 lb, gross 2,756 lb.
Performance: max speed at S/L 164 mph IAS, max cruising speed at 10,000 ft 132 mph, stalling speed (flaps down) 69 mph, service ceiling 18,045 ft, T-O run 1,132 ft, landing run 720 ft, max range 462 miles, *g* limits +6/–3.
Accommodation: two seats, side by side.
Armament: none.

Iak-52 (Yak-52) and Condor

Yakovlev's **Yak-52** tandem-seat primary trainer entered production immediately after World War II and

has been manufactured under license at Bacau since 1979, the Romanian prototype having flown for the first time in May 1978. The majority of more than 1,700 so far built were for the air forces of Romania and the former Soviet Union. Basic configuration and structure of the **Iak-52** (the Romanian designation) differ little from those of the Yak-18, but a metal semimonocoque rear fuselage replaces the original fabric-covered one, and a smooth cowling encloses the more powerful engine. In addition, all three wheels of the tricycle landing gear remain totally exposed when retracted, to offer greater safety in a wheels-up emergency landing.

A Westernized version known as the **Condor,** with a 300 hp Textron Lycoming AEIO-540-L1B5D engine, simplified cockpit canopy, and square-tipped rudder, is under development at Bacau. *(Data for Iak-52.)*

Contractor: Aerostar SA (formerly IAv Bacau), Romania.
Power Plant: one VMKB (Vedeneyev) M-14P radial piston engine; 360 hp.
Dimensions: span 30 ft 6¼ in, length 25 ft 5 in, height 8 ft 10¼ in.
Weights: empty 2,238 lb, gross 2,877 lb.
Performance: max speed at S/L 177 mph, at 3,280 ft 167 mph, stalling speed (flaps down) 56 mph, service ceiling 13,125 ft, T-O run 558 ft, landing run 985 ft, max range (with reserves) 341 miles, *g* limits +7/–5.
Accommodation: two seats, in tandem.
Armament: none.

Iak-52 (Yak-52), DOSAAF (Piotr Butowski)

MD3-160 Swiss Trainer (Roland Eichenberger)

L-70 Vinka

The Vinka has been operational at the Finnish Air Force's Air Academy at Kauhava since October 1981, as the lead-in trainer to that service's jet-powered Hawks. It first flew in prototype form, as the Leko-70, March 23, 1973. Only 30 production aircraft were built, all for the Air Force. Their major roles are primary, aerobatic, night, instrument, and tactical training, but they can be used also for casevac, search and rescue, supply dropping, weapons training, target towing, and reconnaissance. Fatigue life is better than 8,000 hours, and they are easily adaptable for ski takeoffs and landings.

Contractor: Valmet Aviation Industries Inc, Finland.
Power Plant: one Textron Lycoming AEIO-360-A1B6 piston engine; 200 hp.
Dimensions: span 31 ft 7¼ in, length 24 ft 7¼ in, height 10 ft 10¼ in.
Weights: empty 1,691 lb, gross 2,293–2,756 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 (no reserves) 590 miles, *g* limits +6/–3.
Accommodation: crew of two, side by side; space behind these for two more seats or up to 617 lb of baggage.
Armament: two hardpoints under each wing for (as two-seater) total of up to 661 lb of bombs, flare pods, rocket pods, machine-gun pods, antitank missiles, TV or still camera pods, or life raft/rescue packs and a searchlight.

MD3-160

First flown August 12, 1983, the prototype **MD3-160 Swiss Trainer** was the outcome of a design concept that originated in the late 1960s. Its lengthy gestation reflects the careful thought applied by designer Max Dätwyler to achieving the maximum possible component commonality in its mainly metal construction.

Mushshak, Pakistan Air Force (Denis Hughes)

Even further refinement deferred the second prototype's first flight until 1990, but FAR Pt 23 certification was finally obtained in September 1992, a few weeks after the initial flight of the first preproduction example.

The MD3 is probably unique in the modular interchangeability of its main wing and tail components. Nine identical pieces make up the ailerons, inboard and outboard flaps, elevators, and rudder; five others the aileron, elevator, and rudder tabs; three more the tailplane halves and fin; and another three the tailplane/fin tips. The wing inner and outer spar sections can be used on either wing, as can the wingtips and the four sections that make up the leading-edge. Primary controls are actuated mechanically, the flaps electrically, and the nonretractable landing gear has nosewheel steering.

The MD3 was always intended for series production outside Switzerland, and earlier this year it was announced that the program and production rights had been sold to SME Aerospace of Malaysia, which is to produce an initial batch comprising 20 for the Royal Malaysian Air Force and 10 for Malaysian Airlines, the first of which should be completed in mid-1994. The Swiss Trainer name is expected to be changed to something more appropriate. Earlier Swiss activity had included refitting the first prototype to **MD3-116** standard, with a 116 hp Lycoming O-235-N2A engine, for 1991 trials; and this summer a fourth MD3 was under construction by MDB with an aerobatic AEIO-320 engine and inverted oil system.

Contractors: MDB Flugtechnik AG, Switzerland, and SME Aerospace, Malaysia.
Power Plant: one Textron Lycoming O-320-D2A piston engine; 160 hp.
Dimensions: span 32 ft 9¾ in, length 23 ft 3½ in, height 9 ft 7 in.
Weights: empty 1,411 lb, gross 1,852–2,028 lb.
Performance (at 1,852 lb aerobatic gross weight): max cruising speed at 5,000 ft 159 mph, stalling speed (flaps down) 53 mph, T-O run 453 ft, landing run 443 ft, max range (no reserves) 677 miles, *g* limits +6/–3.
Accommodation: crew of two, side by side; space to rear for up to 110 lb of baggage.
Armament: none.

Mushshak

Following Pakistan's import of 15 Saab **Safari/Supporter** two/three-seat light aircraft from Sweden, 92 more were assembled from kits at Risalpur for the Pakistan Army and Air Force between 1975 and 1982. Meanwhile, in 1981 the Aircraft Manufacturing Factory (AMF) of the Pakistan Aeronautical Complex had been set up as a license production center for the aircraft, known locally by the Urdu name **Mushshak** ("proficient"). Subsequent manufacture has been from raw materials, and by January 1992 a further 120 had been delivered to the Pakistani services, with production then continuing at about 24–30 a year. Twenty-five were ordered by the Iranian Pasdaran Revolutionary Guard; the remainder serve with the Pakistan Army (130+) and Air Force (80+). The wing's 5° of sweepforward enhances the view from the cockpit, and provision is made for full IFR instrumentation, radio, and armament.

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

Contractor: Pakistan Aeronautical Complex, Pakistan.
Power Plant: one Textron Lycoming IO-360-A1B6 piston engine; 200 hp.
Dimensions: span 29 ft 0½ in, length 22 ft 11½ in, height 8 ft 6½ in.
Weights: empty 1,424 lb, gross 1,984–2,645 lb.
Performance (at 2,205 lb utility gross weight): max speed at S/L 130 mph, stalling speed (flaps down) 63 mph, service ceiling 15,750 ft, T-O run 493 ft, landing run 460 ft, endurance (with reserves) 5 h 10 min, *g* limits (aerobatic) +6/–3.
Accommodation: two seats, side by side; provision for rearward-facing seat or 220 lb of baggage to rear.
Armament: six underwing hardpoints for up to 660 lb of external stores; typical loads can include two 7.62-mm or 5.56-mm machine-gun pods, two pods of 7 x 75-mm or 2.75-in rockets, four pods of 7 x 68-mm rockets, 18 x 75-mm rockets, or six wire-guided antitank missiles.

SF.260

More than 860 of these elegant piston-engine aircraft, in various forms, have been delivered to civilian customers and to 24 air forces worldwide, with production continuing. The basic military **SF.260M** is an improved and strengthened version of the civil SF.260A. It flew for the first time October 10, 1970, and subsequently became the Italian Air Force's standard primary trainer, capable of basic flying training, instrument flying, aerobatics including deliberate spinning, night flying, navigation instruction, and formation flying. From the SF.260M was developed the **SF.260W Warrior** dual-role trainer/tactical support version, with underwing pylons for up to 661 lb of weapons or other stores. Countries now operating the M, the W, or a mix of both include Belgium, Brunei, Burkina Faso, Burundi, Chad, Dubai, Ireland, Italy, Libya, Nicaragua, the Philippines, Singapore, Somalia, Thailand, Tunisia, Uganda, Zaïre, Zambia, and Zimbabwe. Forty of the current improved and updated civil **SF.260Ds** are being supplied to the Turkish Air Force. In a reorganization of its flying training system, the Belgian Air Force has ordered 15 SF.260Ds to supplement survivors of its original 36 SF.260MBs. *(Data for SF.260M.)*

Contractor: Agusta SpA (Sesto Calende Works) (formerly 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 2,425 lb (aerobatic), 2,645 lb (max). (SF.260W, max gross 2,866 lb.)
Performance: max speed at S/L 207 mph, max cruising speed at 4,925 ft 186 mph, stalling speed (gear and flaps down) 79 mph, service ceiling 15,300 ft, T-O run 1,260 ft, landing run 1,132 ft, max range 1,025 miles, *g* limits (aerobatic) +6/–3.
Accommodation: two seats, side by side, with third seat to rear.
Armament: none on SF.260M.

T-25 Universal

First flown April 29, 1966, the Universal had been designed, as the Neiva N 621, to meet a Brazilian Air Force requirement for a basic trainer. Of all-metal

construction, it has side-by-side seating under a rearward-sliding canopy. A total of 140 were built for the Brazilian Air Force, of which about 100–120 are still in service in two versions. The **T-25** basic and advanced trainer serves with the 2° Esquadrão de Instrução Aérea and the Academia da Força Aérea, plus some utility units, while the **T-25A** is used in light attack and reconnaissance roles. Neiva also built 10 T-25s for Chile; five of these were later passed on to the Paraguayan Air Force.

Contractor: Sociedade Construtora Aeronáutica Neiva Ltda, Brazil.

Power Plant: one Textron Lycoming IO-540-K1D5 piston engine; 300 hp.

Dimensions: span 36 ft 1 in, length 28 ft 2½ in, height 9 ft 9¾ in.

Weights: empty 2,535 lb, gross 3,306–3,747 lb.

Performance (at 3,306 lb aerobatic gross weight): max speed at S/L 186 mph, max cruising speed at S/L 177 mph, stalling speed (flaps down) 65 mph, service ceiling 20,000 ft, T-O run 1,148 ft, landing from 50 ft 1,970 ft, range (with reserves) 621 miles.

Accommodation: crew of two, side by side; space for baggage or optional third seat at rear.

Armament: two underwing hardpoints for 7.62-mm machine-gun pods.

T-35 Pillán

This fully aerobatic and instrument flying trainer was designed by Piper as a spinoff from its Cherokee family, embodying many components of the PA-28 Dakota and PA-32 Saratoga. The first of two Piper-built prototypes made its initial flight March 6, 1981. Production was then started in Chile by ENAER. Three were assembled from kits delivered from the US, and, after changes to the tail unit and deepening of the canopy, series manufacture began in September 1984. Sixty **T-35A** primary trainers and 20 **T-35B** instrument trainers for the Chilean Air Force had been delivered by the spring of 1990. ENAER also supplied kits for 41 **T-35Cs** to Spain, where they were assembled by CASA for the Spanish Air Force; equipped as primary trainers, they have the Spanish designation and name **E.26 Tamiz**. Ten **T-35D** instrument trainers were delivered to the Panamanian Air Force in 1988–89 and 15 to the Paraguayan Air Force in 1991.

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

Contractor: Empresa Nacional de Aeronáutica de Chile (ENAER), Chile.

Power Plant: one Textron Lycoming IO-540-K1K5 piston engine; 300 hp.

Dimensions: span 29 ft 0 in, length 26 ft 3 in, height 8 ft 8 in.

Weights: empty 2,050 lb, gross 2,900–2,950 lb.

Performance: max speed at S/L 193 mph, max cruising speed at 8,800 ft 166 mph IAS, stalling speed (gear and flaps down) 72 mph, service ceiling 19,160 ft, T-O run 940 ft, landing run 780 ft, max range (with reserves) 748 miles, *g* limits +6/–3.

Accommodation: two seats, in tandem. Rear seat raised.

Armament: none.

T67M and T-3A Firefly

First flight of a **T-3A** Firefly on July 4 this year, and delivery of two of these aircraft to the US in September, mark the start of USAF's Enhanced Flight Screening (EFS) program to replace T-41s used in this role. Up to 78 more T-3As will follow in the next 18 months, with options to increase the total bought to 113. The first few aircraft are being assembled and test-flown at Slingsby's Yorkshire factory in England. The others will be shipped as kits for assembly by Northrop Worldwide Aircraft Services at Hondo Airport, Tex.

The current basic **T67C3** version of the GFRP Firefly, with a carburetor version of Textron Lycoming's 160 hp engine and fixed-pitch propeller, is used for primary training of Canadian military and Dutch naval pilots. The lowest-powered model of the military M versions is the **T67M Mk II**, with 160 hp fuel-injected Textron Lycoming AEIO-320-D1B, constant-speed propeller, 42-gallon increased fuel capacity, and fuel and oil systems suitable for inverted flight. Seventeen have been delivered to RAF Topcliffe, North Yorkshire, where a civilian company, Hunting Aircraft Ltd, operates a Joint Elementary Flying Training School for student pilots of the RAF and Royal Navy. Bulldogs and Chipmunks used previously for this task have been retired. The intermediate **T67M200**, serving the Royal Netherlands Air Force, has a 200 hp AEIO-360-A1E. The top-of-the-range **T67M260** was designed specifically to meet the EFS requirement. A representative airframe completed dynamic fatigue tests simulating 90,000 flight hours. In T-3A form, the T67M260 can carry a 500-lb load of two pilots plus full fuel on training flights of more than three hours. It is air-conditioned for worldwide operation. *(Data for T67M260.)*

T-35A Pilláns, Chilean Air Force (P. Steinemann)

T67C3 Firefly, Canadian Department of National Defence

TB 30 Epsilon, French Air Force (Paul Jackson)

EMB-312H Super Tucano

Contractor: Slingsby Aviation Ltd, UK.

Power Plant: one Textron Lycoming AEIO-540-D4A5 piston engine; 260 hp.

Dimensions: span 34 ft 9 in, length 24 ft 10 in, height 7 ft 9 in.

Weights: empty 1,780 lb, gross 2,520 lb (aerobatic and max).

Performance: max speed at S/L 175 mph, normal cruising speed at 8,500 ft 173 mph, stalling speed (flaps down) 68 mph, T-O run 450 ft, landing run 970 ft, max range (with reserves) 405 miles, *g* limits +6/–3.

Accommodation: two seats, side by side.

Armament: none.

TB 30 Epsilon

The French Air Force ordered 150 Epsilons in the expectation that a propeller-driven aircraft could best improve the cost-effectiveness of its basic pilot training. The prototype flew for the first time December 22, 1979, followed by the first production Epsilon in June 1983. Deliveries began a year later, and Epsilons amassed more than 100,000 flying training hours with Groupement École 315 at Cognac/Châteaubernard in their first five years of service.

Pupils are able to complete full *ab initio* and basic training on these aircraft, then progress directly to an operational type without needing intermediate transition training.

Esquadrão 104 of the Portuguese Air Force received 18 Epsilons, of which 17 were assembled locally by OGMA, and four armed examples were supplied to the Air Force of Togo. Performance of the armed version includes the ability to loiter for 30 min at low altitude over a combat area 195 miles from base.

The December 1992 "World Gallery of Trainers" included details of a turboprop trainer known as the Socata TB 31 Oméga, offering 60 percent commonality with the Epsilon. No orders for this have been announced. *(Data for Epsilon.)*

Contractor: Socata (subsidiary of Aerospatiale), France.

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

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

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

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

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

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

Turboprop Trainers

EMB-312 Tucano and Super Tucano

The first prototype **Tucano** flew August 16, 1980, and deliveries to the Brazilian Air Force (designation **T-27**) began in September 1983. In the same month, Egypt placed an initial order for 120 for its own Air Force and that of Iraq. Excluding British-built **S312s** (described separately), 495 Tucanos had been ordered from Embraer by the fall of this year, most of which had been delivered. Customers now include the air forces of Argentina (30), Brazil (133), Egypt (54), France (80), Honduras (12), Iran (25), Iraq (80), Paraguay (six), Peru (30), and Venezuela (32). Options for a further 81 are held by Brazil (35), Egypt (26), and Iraq (20). The French version has a strengthened airframe and ventral airbrake like those of the S312, improved deicing and demisting, and French avionics.

On September 9, 1991, Embraer flew a proof-of-concept prototype of the **EMB-312H Super Tucano.** Compared with the standard Brazilian trainer, this had a 1,220 shp PT6A-67R turboprop, 5-ft-longer fuselage, modified wings and tail, zero/zero seats, pressure refueling, and OBOGS (On-Board Oxygen Generating System). Able to cover the whole primary and half of the advanced training syllabus of a jet trainer, the Super Tucano is the Embraer/Northrop entry in the USAF/USN JPATS competition. A production-standard aircraft, with a more powerful PT6A (see data), five-blade propeller, and "glass" cockpit, flew for the first time May 15, 1993, followed by a second in the fall. *(Data for standard EMB-312, with Super Tucano in parentheses.)*

Contractor: Empresa Brasileira de Aeronáutica SA, Brazil.

Power Plant: one Pratt & Whitney Canada PT6A-25C (PT6A-68/1) turboprop; 750 shp (1,600 shp).

Dimensions: span 36 ft 6½ in (both), length 32 ft 4¼ in (37 ft 5¾ in), height 11 ft 1¾ in (12 ft 9½ in).

Weights: empty 3,991 lb (5,269 lb), gross 5,622–7,000 lb (6,944–8,356 lb).

Performance (EMB-312 at 5,622 lb clean gross weight): max speed at 10,000 ft 278 mph, stalling speed (gear and flaps down) 77 mph EAS, service ceiling 30,000 ft, T-O run 1,250 ft, landing run 1,214 ft, max range on internal fuel (with reserves) 1,145 miles, *g* limits +6/–3.

Performance (Super Tucano at 6,944 lb clean gross weight): max speed at 20,000 ft 350 mph, stalling speed (gear and flaps down) 87 mph EAS, service ceiling 35,000 ft, T-O run 890 ft, landing run 1,414 ft, max range on internal fuel (with reserves) 944 miles, *g* limits +7/–3.5.

Accommodation: crew of two, on tandem zero height/81 mph (zero/zero) ejection seats. Rear seat raised.

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

Fantrainer 400, 600, and 800

Developed originally under a 1975 German Defense Ministry contract, in production form the Fantrainer emulated the second prototype in having an Allison turboprop to drive its centrally mounted five-blade ducted fan. The only customer to date is Thailand, which in August 1982 ordered 47 in two versions: the **400** with a 420 shp 250-C20B and the higher-powered **600** (see data). First flight of a production Fantrainer (a 600) was made August 12, 1984. Two complete aircraft (one of each model), with GFRP wings and metal fuselages, were delivered from Germany, followed by 15 Fantrainer 600 kits without wings. The GFRP wings were bought under separate contract, and the aircraft were assembled on arrival by Royal Thai Air Force engineers. For the remaining 30 Fantrainer 400s, the RTAF developed its own metal wings, the rest of each airframe being supplied in kit form by RFB. The 600s entered service as pilot trainers at Kampensaeng in January 1987; assembly of the 400s began in 1986 and was completed in 1991.

At this year's Paris Air Show, RFB announced the Fantrainer **800** as a more powerful version of the 600, with its Allison 250-C30 uprated to 800 shp. The other major change would be a GFRP keel and forward fuselage, only the rear fuselage and tail remaining as metal structures, resulting in an empty weight saving of 320 lb. At an aerobatic gross weight of 3,527 lb, max speed would increase to 298 mph at 15,000 ft, with no adverse effect on range or runway requirements. A prototype has been converted, and in June RFB stated that an unnamed customer was expected to place an order by the end of this year. *(Data for RTAF-built Fantrainer 600; see December 1990 Gallery for 400.)*

Contractors: Rhein-Flugzeugbau GmbH, Germany, and Royal Thai Air Force, Thailand.
Power Plant: one Allison 250-C30 turboprop; 650 shp.
Dimensions: span 31 ft 11½ in, length 31 ft 1¼ in, height 10 ft 4½ in.
Weights: empty 2,921 lb, gross 3,637–4,122 lb.
Performance (at 4,122 lb gross weight): max cruising speed at 3,000 ft 214 mph, stalling speed (flaps down) 95 mph, service ceiling 25,000 ft, T-O and landing run 820 ft, range on internal fuel (with reserves) 645 miles, *g* limits (aerobatic) +6/–3.
Accommodation: crew of two, in tandem. Rear seat raised. Rocket-assisted escape system standard.
Armament: none, but provision for four underwing drop tanks.

KTX-1 Korint

Although the first of five prototypes flew two years ago, in December 1991, prime contractor Daewoo has released very few details of this nationally designed primary trainer for the RoKAF (Korint = Korean Indigenous Trainer). Its design is conventional, with low-mounted wings, tricycle landing gear, stepped cockpits, and an angular vertical tail. Daewoo builds the wings and tail unit, fuselage construction being shared by Samsung and Korean Air. Development is expected to continue through 1997, with a production start probably in 1998. The second and subsequent aircraft may have more powerful engines than the first prototype, to which the following brief details apply.

Contractor: Daewoo Heavy Industries Company Ltd, South Korea.
Power Plant: one Pratt & Whitney Canada PT6A-25A turboprop; 550 shp.
Dimensions, Weights, and **Performance:** not yet released.
Accommodation: crew of two, in tandem. Rear seat raised.

L-90 TP RediGO

Two prototypes of the RediGO were flown, one with an Allison 250 engine (July 1, 1986) and the other with a similarly rated Turbomeca TP 319 turboprop (in December 1987). Production aircraft have the Allison engine and new unswept vertical tail surfaces. Valmet optimized the design to cover primary and basic, aerobatic, night, instrument, navigation, formation, and tactical flying training, drawing on experience gained with the earlier, piston-engine L-70 Vinka. The Finnish Air Force, however, has allocated its 11 RediGOs to replace Piper Arrows in the liaison and communications roles; its primary flying training continues to be conducted on the Vinka (which see).

Initial exports of 18 RediGOs to three then-unnamed customers were announced in 1992. One is now known to be the Mexican Naval Aviation School at Bajadas, Veracruz (four), and 10 have been purchased by McDonnell Aircraft Co. The first pair for Mexico were delivered this spring, and the other two customers were due to have received their first RediGOs by the end of this year. In June, production was being increased to meet additional orders from existing and new export customers.

Contractor: Valmet Aviation Industries Inc, Finland.
Power Plant: one Allison 250-B17F turboprop; 420 shp (flat rated).
Dimensions: span 34 ft 9¼ in, length 27 ft 11¾ in, height 10 ft 6 in.
Weights: empty 2,094 lb, gross 2,976–4,189 lb.
Performance (at max gross weight with external stores): max speed 258 mph CAS, max cruising speed at 7,875 ft 219 mph, stalling speed (flaps down) 63 mph, service ceiling 25,000 ft, T-O and landing run 788 ft, max range (with reserves) 870 miles, *g* limits (aerobatic) +7/–3.5.
Accommodation: crew of two, side by side; space behind these for two more seats or 440 lb of baggage. Zero/zero rocket escape system optional.
Armament: none specified, but three hardpoints under each wing can (when aircraft is flown solo) carry up to 1,764 lb of photographic, TV, radar, or reconnaissance pods and two flares, or other stores appropriate to role.

Fantrainer, Royal Thai Air Force (Chris Pocock)

KTX-1 Korint, Republic of Korea Air Force

L-90 TP RediGO, Finnish Air Force (Kenneth Munson)

PC-9 Mk II

PC-7 Turbo-Trainer

More than 400 PC-7s have been delivered, to 18 countries, and further orders have been received during the past year. Most significant of these is a contract to supply 60 **PC-7 Mk IIs** to replace the South African Air Force's veteran T-6 Harvard primary trainers. Swiss government approval was delayed by the fact that, although its law does not permit the export of aircraft equipped for combat duties, PC-7s operated by some air forces can be seen carrying a wide variety of stores on underwing weapon pylons that have been installed under separate contract by armament manufacturers. To avoid any conflict with UN sanctions then in force, Pilatus developed the Mk II version of the PC-7 with two (instead of six) underwing hardpoints, plumbed only for auxiliary fuel tanks. Martin-Baker CH-11A ejection seats are fitted, instead of the usual fixed or optional CH-15A ejection seats.

The original **PC-7** version first flew August 18, 1978. Customers have included the air forces of Abu Dhabi (24), Angola (18), Austria (16), Bolivia (36), Bophuthatswana (three), Botswana (seven), Chad (two), Chile (Navy, 10), France (five), Guatemala (12), Iran (35), Iraq (52), Malaysia (44), Mexico (75), Myanmar (17), the Netherlands (10), Switzerland (40), and Uruguay (six). The PC-7 is a fully aerobatic trainer suitable for primary, transition, and aerobatic training and, with added equipment, for IFR and tactical training.

Contractor: Pilatus Flugzeugwerke AG, Switzerland.
Power Plant: one Pratt & Whitney Canada PT6A-25A turboprop; 550 shp (flat rated).
Dimensions: span 34 ft 1 in, length 32 ft 1 in, height 10 ft 6 in.
Weights: empty 2,932 lb, gross 4,188 lb (aerobatic), 5,952 lb (max).
Performance (at 4,188 lb weight): max cruising speed at 20,000 ft 256 mph, stalling speed (gear and flaps down) 74 mph, service ceiling 33,000 ft, T-O run 787 ft, landing run 968 ft, max range (with reserves) 745 miles, *g* limits +6/–3.
Accommodation: two seats, in tandem; lightweight ejection seats optional. Space for 55 lb of baggage aft of seats.
Armament: see above.

PC-9

The overall configuration of the **PC-9** owes much to the proven success of the earlier PC-7, but structural commonality is only 10 percent. The PC-9 has a more powerful turboprop, raised rear cockpit, ejection seats as standard, a ventral airbrake, modified wing airfoils and tips, new ailerons, a longer dorsal fin, larger wheels with high-pressure tires, and mainwheel doors. The first of two preseries aircraft flew May 7, 1984. Customers have included the air forces of Angola (four), Australia (67 PC-9/As), Iraq (20), Myanmar (six), Saudi Arabia (30), Switzerland (eight), and Thailand (20); the Cyprus National Guard has two. South Korea and Slovenia are likely future operators.

The RAAF **PC-9/As** have Bendix EFIS cockpit displays, PC-7 low-pressure tires, and bulged mainwheel doors. Two were supplied in flyaway form, the next 17 as kits; the remaining 48 were built in Australia by Hawker de Havilland and AeroSpace Technologies of Australia. The German Air Force leases 10 **PC-9Bs** from a private company to provide target-towing services. For the USAF/USN JPATS competition, Pilatus is teamed with Beech in offering the **PC-9 Mk II.** Beech has built two "missionized" production prototypes, with a 1,250 shp flat-rated PT6A-68 engine, single-point fueling, new digital avionics, and a pressurized cockpit with birdstrike-proof canopy and zero/zero ejection seats. These were first flown December 23, 1992, and July 29, 1993. *(Data for basic PC-9.)*

Contractor: Pilatus Flugzeugwerke AG, Switzerland.

Power Plant: one Pratt & Whitney Canada PT6A-62 turboprop; 950 shp (flat rated).
Dimensions: span 33 ft 2½ in, length 33 ft 4¾ in, height 10 ft 8¼ in.
Weights: empty 3,715 lb, gross 4,960 lb (aerobatic), 7,055 lb (max).
Performance (at 4,960 lb weight): max speed at S/L 311 mph, at 20,000 ft 345 mph, stalling speed (gear and flaps down) 81 mph, service ceiling 38,000 ft, T-O run 745 ft, landing run 1,368 ft, max range (with reserves) 1,020 miles, *g* limits +7/–3.5.
Accommodation: crew of two, in tandem, on zero height/70 mph ejection seats. Rear seat raised. Space for 55 lb of baggage aft of seats.
Armament: see remarks under PC-7 entry.

PZL-130 Turbo Orlik

The original piston-engine Orlik ("spotted eaglet"), last described in the December 1990 edition of this Gallery, was abandoned that year in favor of its turboprop derivative, development of which had begun five years earlier with Canadian assistance. Flight testing of the third Orlik, with a PT6A-25A turboprop, began July 13, 1986, but received a setback when this prototype was lost the following January. Two further Turbo Orlik prototypes, designated **PZL-130TM** and **PZL-130TP,** were completed with, respectively, a Czech 750 shp Motorlet M 601 E power plant and a 550 shp PT6A-25A. These made their first flights in January 1989 and early 1990. From them emerged, with increased wingspan and incidence, two extra underwing stations, stronger landing gear with nosewheel steering, double-slotted flaps, ejection seats under a modified canopy, and other airframe refinements, the first two production models. The **PZL-130TB,** first flown September 18, 1991, based on the TM, has an M 601 E (optionally M 601 T) engine and is aimed at the Polish, east European, and other air forces accustomed to Russian/Soviet equipment; the **PZL-130TC,** with a more powerful (950 shp) PT6A-62, Bendix/King avionics, Martin-Baker seats, a Flight Visions HUD, and a Hamilton Standard environmental control system, first flew June 2, 1993, and is seen primarily as a potential export version for Western-oriented markets. The Warsaw manufacturer has also projected two cheaper export versions: the **PZL-130TD** (as TC but with a 750 shp PT6A-25C) and the "economy" **PZL-130TE** with PT6A-25A, less comprehensive avionics, and no ejection seats.

The two prototypes were handed over to the Polish Air Force Academy at Deblin in October 1992, followed two months later by the first two of an initial eight TBs. The current PAF order, for up to 48 Turbo Orliks, is believed to consist of 20 TBs and 28 TCs. Reports of a possible Hungarian Air Force order had not been confirmed at press time. *(Data for PZL-130TB.)*
Contractor: WSK-PZL Warszawa-Okecie, Poland.
Power Plant: one Motorlet M 601 E turboprop; 750 shp.
Dimensions: span 29 ft 6¼ in, length 29 ft 6¼ in, height 11 ft 7 in.
Weights: empty 3,527 lb, gross 4,409–5,952 lb.
Performance (at 4,409 lb aerobatic gross weight): max speed at 19,685 ft 311 mph, max speed at S/L 282 mph, service ceiling 33,000 ft, T-O run 729 ft, landing run 604 ft, range on internal fuel (no reserves) 602 miles, *g* limits +6/–3.
Accommodation: crew of two, on tandem zero height/81 mph ejection seats. Rear seat raised.
Armament: six underwing hardpoints for up to 1,764 lb of 220-lb bombs, twin 7.62-mm gun pods, launchers for 57-mm or 80-mm rockets, or Strela infrared AAMs.

S312 Tucano

The S312 has only some 25 percent commonality with the Embraer-designed EMB-312 (which see). It has a different engine, ventral airbrake, strengthened structure, new cockpit layout, and extensive British internal equipment. The first of 130 production **T. Mk 1**s for Britain's Royal Air Force flew for the first time December 30, 1986. Deliveries began in June 1988, and were completed in January this year. Principal units are the Central Flying School and Nos. 1, 3, and 6 Flying Training Schools, where they have replaced the elderly Jet Provost.

Strengthened flying controls, modified com/nav equipment, and structural improvements to extend fatigue life to 12,000 hours were introduced during the production run, and the first 50 aircraft are being upgraded to the same standard.

Twelve Shorts-built **T. Mk 51**s were delivered to the Kenyan Air Force in 1990–91, followed by 16 **T. Mk 52**s for No. 19 Squadron of the Kuwait Air Force. Shorts actually built 160 S312s, but one was destroyed by an IRA bomb at the factory and one destined for Kenya was lost during a predelivery test flight.
Contractor: Short Brothers plc, UK.
Power Plant: one Garrett TPE331-12B-701A turboprop; 1,100 shp.

PZL-130TB Turbo Orlik, Polish Air Force (Grzegorz L. Holdanowicz)

S312 Tucano T. Mk 1, Royal Air Force

T-5, Japan Maritime Self-Defense Force

T-34C-1, Gabon Presidential Guard (Paul Jackson)

Dimensions: span 37 ft 0 in, length 32 ft 4¼ in, height 11 ft 1¾ in.
Weights: empty 4,872–4,920 lb, gross 6,470–7,937 lb.
Performance (at 6,393 lb clean gross weight): max speed at 10,000 ft 319 mph, at S/L 310 mph, stalling speed (flaps and gear down) 81 mph EAS, service ceiling 34,000 ft, T-O run 1,190 ft, landing run 1,180 ft, range on max internal fuel 1,099 miles, *g* limits +6.5/–3.3.
Accommodation: crew of two, on tandem zero height/81 mph ejection seats. Rear seat raised.
Armament (export versions, optional): up to 2,315 lb of stores on four underwing hardpoints: typically two 550-lb or four 290-lb bombs, four 7 x 70-mm rocket launchers, four practice bombs, two 0.50-in or two twin 0.30-in machine-gun pods. Aircraft for Kenya equipped with FN Herstal rocket pods and Forges de Zeebrugge 12.7-mm gun pods.

SF.260TP

First flown in July 1980, the SF.260TP is identical to the piston-engine SF.260 (which see) except for the power plant, automatic fuel feed system, and an inset rudder tab. More than 60 have been sold to military operators, most of them with a secondary light attack role. Customers are reported to include the air forces of Brunei (four), Burundi (four), Dubai (five), Ethiopia (19), Haiti (six), the Philippines (16), and Sri Lanka (nine). Some of Zimbabwe's SF.260s may have been converted to SF.260TPs. *(Data as for SF.260, except as follows.)*
Power Plant: one Allison 250-B17D turboprop; 350 shp.
Dimensions: length 24 ft 3¼ in.
Weights: empty 1,654 lb, max gross 2,866 lb.
Performance: max speed at 10,000 ft 262 mph, max cruising speed at 8,000 ft 248 mph, stalling speed (gear and flaps down) 79 mph, service ceiling 24,600 ft, T-O run 978 ft, landing run 1,007 ft, max range (with reserves) 589 miles.

T-5

This two/four-seat turboprop primary trainer is the latest of a series of training and utility aircraft developed by Fuji from the Beech T-34 Mentor. The prototype was produced by replacing the standard piston engine of a company-owned KM-2 primary trainer version with an Allison 250 turboprop. First flown June 28, 1984, as the KM-2D, this aircraft persuaded the Japan Maritime Self-Defense Force to replace its existing fleet of 31 KM-2s with a KM-2Kai version of the KM-2D, embodying additional changes to the cabin structure and equipment. Deliveries to the JMSDF, under the designation T-5, began in August 1988. Twenty-nine T-5s had been funded by March of this year, of which 15 had been delivered; three more were approved in the FY 1993 budget.
Contractor: Fuji Heavy Industries Ltd, Japan.
Power Plant: one Allison 250-B17D turboprop; 350 shp (flat rated).
Dimensions: span 32 ft 11¼ in, length 27 ft 8¼ in, height 9 ft 8½ in.
Weights: empty 2,385 lb, gross 3,494 lb (aerobatic), 3,979 lb (max).
Performance (at aerobatic gross weight except where indicated): max speed at 8,000 ft 222 mph, econ cruising speed at 8,000 ft 178 mph, stalling speed (gear and flaps down) 65 mph, service ceiling 25,000 ft, T-O run 990 ft, landing run 570 ft, range (at max gross weight, with reserves) 587 miles.
Accommodation: crew of two side by side in aerobatic configuration. Second pair of seats behind these in utility version.
Armament: none.

T-34C

About 90 of the original piston-engine T-34A/Bs remain in service with eight air forces, mostly in Central and South America. The first YT-34C turboprop-powered prototype flew in September 1973. The US Navy subsequently received 353 production **T-34C**s, the survivors of which are planned to be replaced by the winner of the JPATS competition in due course. Beech also built 139 **T-34C-1** armament systems trainers, with FAC and light attack capability, for Argentina, Ecuador, Gabon, Indonesia, Morocco, Peru, Taiwan, and Uruguay, most of which remain operational. *(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 optional).
Dimensions: span 33 ft 4 in, length 28 ft 8½ in, height 9 ft 7 in.
Weights: empty 2,960 lb, gross 4,300 lb.
Performance: max cruising speed at 17,000 ft 246 mph, stalling speed (gear and flaps down) 61 mph, service ceiling 30,000 ft, T-O run 1,155 ft, landing run 740 ft, max range 814 miles, *g* limits +6/–3.
Accommodation: crew of two, in tandem.
Armament (T-34C-1): four underwing hardpoints for total of 1,200 lb of stores, including practice bomb/flare containers, LAU-32 or LAU-59 rocket launchers, Mk 81 bombs, SUU-11 Minigun pods, BLU-10/B incendiary bombs, AGM-22A wire-guided antitank missiles, and target-towing equipment.

T-35DT Turbo Pillán

The **T-35DT** follows an earlier program in which Soloy Corp. of Olympia, Wash., converted a **T-35TX** prototype of the piston-engine Pillán known as **Aucán** by installing a 420 shp Allison 250-B17D turboprop. This flew for the first time in February 1986, but trials were suspended in 1987 after about 500 flight hours. The **T-35DT,** which has the same engine, was converted, also by Soloy, under a 1990 contract to develop a production-ready conversion kit to be offered to existing Pillán operators, including the Chilean Air Force. It first flew in March 1991. *(Data as for T-35A except as follows.)*
Power Plant: one Allison 250-B17D turboprop; 420 shp.
Dimensions: length 28 ft 2½ in.
Weight: empty 2,080 lb.
Performance: max speed at S/L 264 mph, max cruising speed at 7,600 ft 209 mph, stalling speed (gear and flaps down) 71 mph, service ceiling 25,000 ft, T-O run 640 ft, landing run 420 ft, max range (with reserves) 472 miles. ■

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EXCELLENCE IN ENGINEERING

The General Staff believes a future war would open with a huge air offensive against strategic targets.

Russia's Vision of Air-Space War

By Mary C. FitzGerald

WHILE political instability threatens Russia from within, the General Staff continues to prepare for an air-space war against a major foreign adversary. Military and civilian leaders alike appear to believe that this step constitutes Russia's main chance to preserve its superpower status.

Russia's Defense Minister, Gen. Pavel Grachev, said earlier this year that the next major war "will be an air-space offensive operation by both sides," meaning "strikes on the main facilities and troops will be made from space and from the air." Other generals echoed this statement, a dramatic downgrading of the future utility of ground forces.

General Grachev noted that, in this type of war, initial strikes would be directed at nuclear facilities, chemical plants, dams, hydroelectric centers, and the like. The attacks would create vast zones of radiation, chemical contamination, and flooding. There would be no "front" in the classic sense.

Acceptance of this new image of war touched off shifts in Russian military plans. For the near term, the General Staff has developed sophisticated technical and operational counters to US air-space technologies—stealth, cruise missiles, space sensors, and the like. For the long term, it has begun to shift resources to create an infrastructure capable of producing advanced technologies for the Russian armed forces. For the transition period, it has dusted off the concept of limited nuclear warfighting to deter or defeat worst-case threats.

Russian military scientists present a comprehensive and impressive catalog of sophisticated technical means—both existing and prospective—for countering operations of US stealth aircraft, conventionally armed cruise and ballistic missiles, electronic warfare weapons, "information weapons," and "nontraditional" air- and space-based systems.

Undaunted by Stealth

For example, the Russians express confidence that their forces would be able to detect and track stealthy Western fighter and bomber aircraft systems by using a wide variety of radar, acoustic, infrared, and laser sensors. This effort would include combinations of many types of radars—multipositional and multifrequency, over-the-horizon, holographic, airborne, and spacebased—and solid radar fields.

Russia believes it will be able to defend against air attack by a major adversary. Front-line fighters like this Su-27 are being upgraded with a wide array of technologies to counter Western systems. Russia will use a variety of radar and other sensors in an effort to track stealthy Western aircraft.

Staff photo by Guy Aceto

Russian technologists and officers assert that US stealth planes, once detected, would be only too easy to track and destroy. The most effective weapons, they say, would be Russia's latest generation of surface-to-air missiles (S-300 and "Buk" complexes) and front-line fighters (the MiG-31, the Su-27, and their next-generation successors).

In late 1992, Russian military scientists publicly began describing a new "defensive fire-strike operation" designed to counter weapon systems based on the new technologies of what they call the military-technical revolution. They noted that, by analyzing the development of the armed forces of leading nations and how they are deployed in military conflicts, it is possible to forecast how an armed conflict is likely to begin and develop.

The consensus is that the "aggressor" likely will open a war with a huge offensive air operation, which could develop into a full air campaign.

In general, say Russian military thinkers, such attacks would seek to neutralize an opponent's air defense system, destroy combat aircraft, gain command of the air, disorganize command and control of a nation's armed forces, disrupt mobilization and deployment of border defense troops, destroy stores of arms and supplies, damage the state's military-economic potential, destroy industrial infrastructure, inflict significant losses on the armed forces, and create the main conditions for victory by the aggressor's ground forces.

In this view, the enemy's commanders would then strive to achieve final war objectives either by offensive operations carried out by ground troops, with large-scale landing and raiding forces, or simply by presenting ultimatums backed by the threat of limited (*i.e.*, regional) use of nuclear weapons.

As Russian military strategists see it, the military-technical revolution makes possible a fundamentally different threat in the central European theater by the late 1990s. If NATO reequips with high-quality air-space weapon systems, it might well be able to win a war against Russia through fire effects only, without having to deploy large ground forces.

This possibility has sparked the search for countermeasures, including the development of effective methods to hit the enemy with "fire destruction."

Initially, Russian thinking now goes, the defense's most important operational mission would be repelling early, massive strikes by the enemy's precision weapons and aircraft. In fulfilling this demanding requirement, Russia's troops would have to solve problems of preserving so-called centers of front operational stability. They would have to protect aircraft in such areas, ensure prompt notification of key military personnel of the start of a massive strike, and conduct effective air defense and electronic warfare.

Under this plan, it would be critical to preserve Russian aviation in the first hours and days of the war so that it would be available to support subsequent attacks. This will be extremely difficult for the front commander because he will have at his disposal an insufficient number of dispersal fields and reinforced concrete shelters.

Strategic Redeployment

Some top Russian military thinkers believe the solution to this problem lies in a number of redeployment measures. First would be to redeploy, long

before the outbreak of a war, a large share of strike aircraft from Russia's western regions to the interior, where they would be relatively secure from attacks by Western tactical aircraft and cruise missiles. The second step would be to disperse the remaining fighter, close-support, and army aviation assets in the border zone to airfields recently denuded of strike aircraft. This would permit stronger defense of these aircraft with hardened shelters and dummy aircraft.

The latter is especially important in Russian planning. In the Persian Gulf War, the Iraqi military displayed thousands of mockups—made from synthetic materials, coated with metallic paint, and supplied with thermal emitters—which became dummy targets. Coalition aircraft wasted many sorties attacking these targets.

The General Staff believes that repelling massive enemy strikes will require, at a minimum, disrupting the enemy's tactical airborne command-and-control and navigation systems. The Russians believe they must set up special elements of fighter aviation and airborne jammers to destroy, above all, the E-3 Airborne Warning and Control System aircraft.

Russian attack aviation would concentrate on finding and striking ground elements of the enemy's tactical air command-and-control system, which might be deployed near Russian borders several days before the onset of an attack. Destruction of these systems, so the thinking goes, would hamper enemy strike aircraft in approaching targets, substantially weakening their attacks.

The Russians say that, in areas where centers of front operational stability are located, it is desirable to distort the radar map of the terrain by making returns of objects similar to the natural background, concealing reference points, and changing configurations of bodies of water, river channels, and so forth.

Russian air defense and electronic warfare systems and personnel would play a critical role in repelling the first massive strike. Russian officers now think these assets should cover centers of front operational stability, rather than being evenly distributed throughout the defense zone. This would strengthen air defense specifically in those areas that the enemy would target with precision weapons and tactical aircraft.

"Fire Superiority"

Russian planners maintain that the air defense–electronic warfare group can be counted on to destroy a large share of the enemy's offensive air weapons and might disrupt the offensive by itself. Increased cover of air defense system elements by electronic warfare equipment will improve the effectiveness of this system.

For the Russians, "fire superiority" means the existence of conditions in which troops at the front can successfully perform their operational missions without substantial fire opposition from the enemy. To achieve this, Russian forces must first destroy the enemy's vital assets, including command posts, ground command-and-control centers, reconnaissance and air defense system elements, and various jammer systems.

These targets are connected in one way or another to systems that receive and process information. Therefore, say Russian planners, it makes sense to include among the most important targets those that ensure the enemy's "information saturation." In modern warfare, the side having information also has the initiative and, consequently, fire superiority. From all appearances, special fire destruction methods are required for such important targets.

Officers on the General Staff know, of course, that the adversary likely will conduct similar operations, resulting in a kind of "information fire duel" for seizing and holding the initiative and, subsequently, fire superiority. The totality of information fire engagements, as well as of massive (single) fire and electronic strikes conducted for a certain time under a unified concept and plan, can represent a new form of military operation—a "fire-strike operation."

Area and point fire destruction to the full depth of the sides' operational alignment is coming to replace successive fire destruction on the line of contact. The outcome of an operation can therefore be decided long before ground forces make contact.

Future Systems

The General Staff does not expect to remain indefinitely at a disadvantage in weapons. It is shifting investment away from production of heavy ground, sea, and air platforms and funding development and production of technologies better suited to the new image of war.

The Russian military-industrial complex, known by the Russian-language acronym "VPK," comprises about eighty percent of the facilities administered by the old Soviet VPK, or Military Industrial Commission. The remaining twenty percent is in new, non-Russian nations carved out of the Soviet empire. The VPK boasts eighty-five percent of former Soviet defense production facilities and ninety percent of the old VPK's defense research and development potential. The VPK is a huge part of Russia's total industrial infrastructure—fifty percent. It employs twenty-five percent of Russian workers.

The Russian military leadership is acutely aware of the nation's economic and social problems and has shaped its weapons program accordingly. The Defense Ministry has defined the main avenues for improving military-technical policy. They include transfer of all defense appropriations to the Defense Ministry; use of the contract system and competitive bidding in purchases of weapons; conservation of intellectual talent in military enterprises, scientific research institutes, and design bureaus; and the removal from production of all weapons that fail to meet modern requirements.

One critical change, institutionalized in the new Defense Law, prohibits the expenditure of defense funds without explicit approval from the Defense Ministry. Once, powerful officials within the VPK could dictate the requirements for a piece of hardware and thereby confront the uniformed military with a *fait accompli,* a practice that ensured the constant flow of Soviet revenues to the defense industry. This is now illegal, so the Defense Ministry should be able to invest its money more productively. In addition, all profits from arms sales are channeled directly to the Russian Defense Ministry. According to military spokesmen, these funds will be plowed back into R&D.

In August 1992, Russia enacted a law barring foreigners from all regions where weapons of mass destruction are developed, produced, or stored; where radioactive materials are processed; or where research and development or other facilities require a special security regime. The law provides certain benefits and social guarantees to workers in such regions and thus attempts not only to stem the "brain

Russia and the "Near Abroad"

Does Russia have special rights to meddle in the internal affairs of the independent, ex-Soviet nations on its rim? Is it entitled to limit the involvement of other foreign powers?

If the words of Russian Foreign Minister Andrei V. Kozyrev are any guide, the answer to both questions is "yes."

Mr. Kozyrev, in a tough September 28 speech to the UN, declared Moscow's intent to protect ethnic Russian minorities in and preserve the stability of the lands on Russia's border—areas Moscow refers to as "the near abroad." His remarks struck some as an articulation of a kind of Russian Monroe Doctrine.

"Russia has made peacemaking and the protection of human rights—particularly [those] of national minorities—the priority of its foreign policy, first of all in the territory of the former USSR," he said. He added that, although Moscow welcomes financial support, "no international organization or group of states can replace our peacemaking efforts in this specific, post-Soviet space."

Wars in what was once Yugoslavia and in the Transcaucasus region have revealed "the real abyss of barbarism and the new major threat of aggressive nationalism," said Mr. Kozyrev, calling this "no less serious than the threat of a nuclear war was yesterday." He maintained that Russian involvement in conflicts in Moldova, Georgia, and Tajikistan has yielded positive results—an assertion that many vigorously dispute.

The Foreign Minister dismissed any qualms about Russia's assertiveness. "All these problems are too serious and tragic to speculate about 'neo-imperial' plans of Russia," said Mr. Kozyrev. When it comes to financing these operations, he said, "it is necessary to lighten the burden, . . . which is carried only by Russia. It could mean establishing a voluntary fund for this purpose."

Washington recognizes no special Russian political, defense, or economic rights in the ex-Soviet republics. There seems little question that Mr. Kozyrev's target audience was the Clinton Administration, which in recent months has sought a mediating role for the US in these countries.

drain" but also to isolate limited resources from the rest of the economy for high-priority R&D programs.

In an interview late last year, Dr. Andrei Kokoshin, the civilian deputy defense minister in charge of VPK matters, addressed the subject of industrial change. He noted that the Russian military is trying to change the entire cycle of fundamental research and serial production of a piece of military equipment.

According to Dr. Kokoshin, a main objective of military-technical policy is to create a "scientific-technical reserve" in "critical technologies," including dual-purpose technologies. This scientific-technical reserve is equivalent to the Western concept of "hovering," which permits defense industries to leap over a generation of weaponry by focusing on the development of prototypes and avoiding production. The R&D establishment would fully develop a new technology or system concept without proceeding to the next stage of acquisition until the situation warrants it.

Thus the May 1992 draft of Russia's new military doctrine calls for reducing serial production of weapons, maintaining R&D and production capacities, and ensuring the capability for the development and "rapid surge production" of emerging combat technologies.

"When We Are Richer"

In June 1993, Defense Minister Grachev announced that the Russian Defense Ministry now has "prototype development plans for all types of armaments." As Dr. Kokoshin has noted, "We are also planning . . . the establishment of a scientific and technical capability that would permit us to achieve a qualitative leap and to expand mass production of the most modern equipment at a time when we are a little richer."

In 1991, the Soviet military began to call for a public repudiation of the USSR's pledge never to use nuclear weapons first. Military leaders pointed to the enhanced combat capabilities of Western conventional systems employed during the Persian Gulf War. The Russian military has not only continued this call but has also articulated specific scenarios involving a resort to first use of nuclear weapons.

Russian thinkers note that the combat capabilities of conventional weapons—specifically, US weapons—make it possible during a purely conventional war to strip the defender of the power to inflict massive damage with nuclear weapons. The danger of such a loss could in turn pose a dilemma for the defender: Either risk losing nuclear retaliatory forces or take the fateful step of using them in the context of a conventional war. The former course could make Russia vulnerable to nuclear blackmail. The latter could lead to nuclear catastrophe.

The Russians appear to have concluded that retaliatory actions using nuclear-tipped, multiwarhead, ballistic missiles may be their sole means of inflicting adequate damage on an aggressor using precision conventional weapons for strategic attack. In fact, some officers argue that, in future arms reduction talks, the negotiators will have to allow for the US advantage in precision conventional weapon systems. They concede that Washington is unlikely to agree to this, and so Russia may have to apply the brakes to a further reduction of nuclear arms.

Besides threatening to mount a nuclear response to conventional strikes on nuclear or "ecologically dangerous" targets, the Russian military's leading thinkers have warned that tactical nuclear weapons could be used against "multimillion-man armies" in such countries as China. In addition, prominent Russian military scientists have recently begun to discuss the possibility of launching preemptive "limited and strategic" nuclear strikes against nations aspiring to become members of the nuclear club. Among the potential targets: Algeria, Argentina, Brazil, Chile, Egypt, Iran, Iraq, Israel, Japan, Libya, North Korea, Pakistan, South Africa, South Korea, Syria, and Taiwan.

To deal with these nations, Russian military officers are pursuing exotic weapons such as spacebased "mininukes," earth-penetrating nuclear munitions, and other so-called "clean" third-generation nuclear weapons. In the Russian view, they would be useful in striking hardened underground nuclear facilities in medium-size nuclear states, many of which can be found either on or very near Russia's borders. ■

Mary C. FitzGerald is a research fellow at the Hudson Institute in Washington, D. C. Her most recent article for AIR FORCE *Magazine, "A Russian View of Russian Interests," appeared in the October 1992 issue.*

Evacuating the base when the volcano erupted was just the beginning of the problem.

Cleanup at Clark

By Doug Stucki, Editorial Associate

Twin natural disasters—the eruption of Mount Pinatubo followed by Typhoon Yunya—forced the evacuation of USAF's largest overseas base, Clark AB, the Philippines. Lt. Col. Kenneth V. Feaster rose to this daunting logistical challenge, earning AFA's Thomas P. Gerrity Award for excellence in logistics.

On June 15, 1991, Mount Pinatubo erupted, sending a five-mile-wide wall of ash and soot thousands of feet into the air over the Philippines. The ash from the long-dormant volcano, washed down by seven inches of rain from Typhoon Yunya, blanketed nearby Clark AB, forcing the evacuation of more than 20,000 US servicemen and their dependents.

The eruption also created what Gen. Jimmie V. Adams, Pacific Air Forces commander in chief at the time, termed "the greatest peacetime logistics task since the withdrawal from southeast Asia."

Lt. Col. Kenneth V. Feaster, commander of the 633d Supply Squadron, 633d Air Base Wing, Andersen AFB, Guam, volunteered to take charge of Clark AB's cleanup and the redistribution of its personnel and equipment. For his efforts in the ensuing months, Colonel Feaster received the 1993 Thomas P. Gerrity Award, AFA's highest honor in logistics, at AFA's National Convention in Washington, D. C., in September.

Over an arduous eleven-month period, through tropical heat and

monsoons, Colonel Feaster led the 633d Squadron, assisted by personnel from the 2854th Combat Logistics Support Squadron from Tinker AFB, Okla., in the operation to return Clark's cargo and equipment to the Air Force logistics pipeline. The squadron cataloged, stored, and redistributed more than 350 sea van loads of unmanifested items, recovering more than $200 million worth of equipment for the Air Force inventory.

Colonel Feaster established a separate account for the recovered items, thereby leaving a proper audit trail for all of the government property received and redistributed. His knowledge of the wholesale supply system ensured the proper redistribution of these assets to the correct Air Force depots and Navy/Defense Logistics Agency Inventory Control Points and bases with requirements for specific items. Much of this property was shipped directly to more than 100 military bases worldwide, saving more than $34 million in assets and $500,000 in transportation costs, plus $300,000 in storage fees.

Colonel Feaster's recommendation to ship forty-five sea van loads of expendable items to Sacramento Air Logistics Center, McClellan AFB, Calif., saved another estimated $1 million.

Before the eruption of Mount Pinatubo, the US and Philippine governments had been conducting delicate negotiations over continuing US access to Clark AB and Subic Bay Naval Facility after the expiration of leasing agreements in late 1991. The closure of Clark led to increased Philippine pressure on the Navy to abandon Subic Bay. The Navy's Fleet Logistics Resupply Squadron was reassigned to Andersen AFB. Colonel Feaster helped in the smooth transition of more than 700 Navy personnel to Andersen. He resolved difficulties in providing refueling and storage for the Navy squadron's eighteen aircraft, as well as related cost reimbursement issues.

Keeping the Fuel Flowing

One of the most important missions for PACAF's 13th Air Force, based at Clark, was providing refueling support for aircraft flying from Guam or Japan to Diego Garcia, a British territory in the Indian Ocean. With the closing of Clark, 13th Air Force was forced to relocate to Andersen AFB. Colonel Feaster and the 633d Squadron set up satellite supply support for forward operating locations in Singapore and Thailand, which assumed Clark's old refueling role. In May 1992, Colonel Feaster assumed logistics support responsibility for the 497th Fighter Training Squadron, based in Singapore, which supports the Commando Sling exercise, the quarterly deployment of F-15s and F-16s to that country.

Colonel Feaster's experience in the wake of Mount Pinatubo came in handy in late 1992, when Typhoon Omar brought 150-mph winds and sixteen inches of rain to Guam, causing more than $80 million in damage to Andersen and more than $250 million in damage to the island. The Colonel played a key role in the relief and recovery operation as mission director of the crisis action team that coordinated logistics relief, recovery, and redeployment efforts.

He identified critical shortages of supplies and equipment and coordinated the arrival of 700 relief personnel with more than 1,500 tons of supplies earmarked for the civilian and military sectors. This entailed refueling nearly 100 aircraft bringing relief supplies, with more than 800,000 gallons of jet fuel dispensed over a six-day period. In addition, more than 70,000 gallons of diesel fuel were provided to power 200 emergency generators on base after the typhoon knocked out main power.

Colonel Feaster instituted a program to renovate facilities and equipment damaged by the typhoon, with no interruption in service to flightline operations. The same concern for safety that resulted in 300 tons of materiel being transferred without mishap in the Philippines led him to initiate a program to reduce the amount of hazardous materiel in stock. Colonel Feaster's program identified nontoxic substitutes for toxic items and reduced the amount of dangerous substances stored at the base by thirty percent. The Colonel also was able to get additional funds from the Department of Defense for the disposal of hazardous waste.

For his efforts in helping Guam's civilian population recover from the destruction caused by Typhoon Omar, Colonel Feaster received personal letters of appreciation from Joseph Ada, the governor of Guam, and Ben Blaz, Guam's congressional delegate.

As commander and chief of supply of the 633d Supply Squadron, Colonel Feaster is responsible for 65,000 items of inventory valued at $208 million and annual sales of more than $57 million. The unit provides supply, equipment, and fuel support to the 633d Air Base Wing at Andersen AFB, the 497th Fighter Training Squadron, Singapore, and Detachment 1 of the 633d Logistics Group, Diego Garcia, as well as eighteen tenant units. The unit also maintains the largest fuel storage, pipeline, and hydrant system in PACAF, distributing some ninety million gallons of fuel to 2,750 transient aircraft annually.

Deployment Support

As part of his day-to-day mission, Colonel Feaster and his unit provided outstanding logistics support to twenty-seven Air Force and Joint Chiefs of Staff exercises and deployments during 1992. He sent a fuel liaison officer to Thailand to coordinate the refueling of more than 860 aircraft sorties in support of Cobra Gold '92, ensuring the success of that deployment of PACAF and allied assets.

In 1992, the 633d Supply Squadron, under Colonel Feaster's leadership, was honored with the Air Force Outstanding Unit Award, Joint Meritorious Unit Award, and Humanitarian Service Medal. In addition, the 633d received the PACAF Daedalian Award and the 1992 USAF Supply Effectiveness Award, Non-Aircraft Category.

Colonel Feaster has been awarded the Meritorious Service Medal with one oak leaf cluster and the Air Force Commendation Medal with three oak leaf clusters. While serving in the Air Force, he has continued his education, earning master's degrees in international studies and logistics management. On completing his current assignment, Colonel Feaster will serve as a National Defense Fellow at the Center for Foreign Policy Studies at the Brookings Institution, Washington, D. C. ■

Valor

By John L. Frisbee, Contributing Editor

The Pioneers

Hundreds of airmen have risked their lives in peacetime to build an Air Force able to defend our national interests.

NINETY years ago this month, on December 17, 1903, the Wright brothers made the first sustained, controlled, heavier-than-air flight at Kitty Hawk, N. C. It was an event both portentous and perilous. They and other pioneers risked, and too often lost, their lives to realize an age-old dream of mankind.

Often we think of valor as signifying extraordinary heroism in combat, but countless acts of peacetime heroism have been performed by aviation pioneers, many by early military aviators after the Army bought its first airplane in 1909. Among the earliest pioneers were Lt. Benjamin D. Foulois, who taught himself to fly in 1910, and Lt. H. H. "Hap" Arnold, who, thirty years later, commanded the Army Air Forces of World War II. The hazards confronting these men were enormous. In 1912, eight of the Army's fourteen aviators were killed in crashes.

There will be pioneers so long as the drive to push back the frontiers of air and space continues. Many of their names are well known today—Jimmy Doolittle; Chuck Yeager; astronauts Neil Armstrong, Edwin "Buzz" Aldrin, Jr., and Michael Collins—but hundreds are forgotten or only dimly remembered.

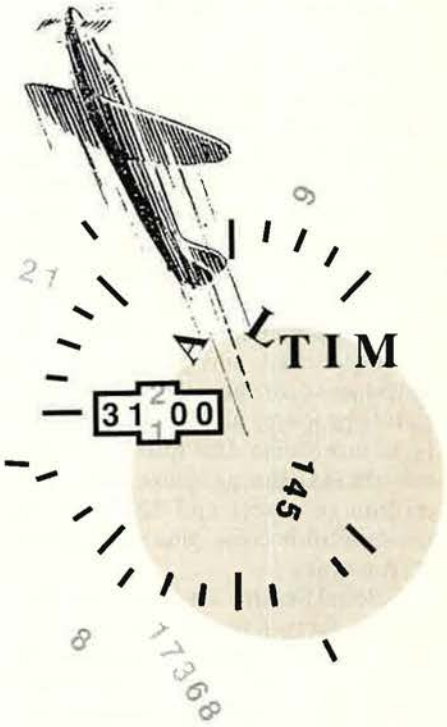
This may be particularly true of the 1920s, when a handful of dedicated airmen were absorbing the lessons of World War I in order to create a modern air force. These pioneers were handicapped by the meagerness of annual congressional appropriations. With what little support was available, these few remained dedicated to developing planes that would fly higher, faster, and further. Individual acts of heroism perhaps are best illustrated in high-altitude exploration.

In September 1919, Maj. Rudolph W. Schroeder twice flew a LePere open-cockpit biplane to around 30,000 feet. On February 27, 1920, he took the plane to 33,114 feet, where the temperature was –67° Fahrenheit. At that altitude he ran out of oxygen. Gasping for breath, he tore off his oxygen mask and put the LePere in a power-off dive before losing consciousness. Major Schroeder recovered partially at about 8,000 feet and glided to a landing at McCook Field, Ohio. Covered with ice, his eyes frozen wide open, he was lifted from the cockpit and hospitalized until he recovered from his ordeal several days later.

The assault on altitude continued throughout the 1920s. On May 31, 1928, Army Lt. William Bleakley climbed to 34,000 feet. Discovering that he had only a minute's supply of oxygen, he placed his elbow against his body to keep the control stick forward in case he passed out. When he tried to pull the throttle back, he couldn't move his arm or raise his head. At 25,000 feet, Bleakley recovered enough to land, but it was two weeks before he regained his strength and was allowed by the flight surgeons to make a successful flight to 35,509 feet.

Other altitude flights were made to test aerial photography equipment. In October 1928, Capt. St. Clair Streett flew Capt. Albert W. Stevens and his cameras to 40,000 feet, where their instruments registered –76° Fahrenheit. When oxygen began to run low, Captain Streett couldn't retard the throttle or move the supercharger control. The light construction of the aircraft ruled out diving at more than 115 miles an hour. They were stuck at 34,000 feet. Finally the throttle came free, just as the engine died of fuel starvation. Captain Streett made a dead-stick landing in a pasture.

High-altitude flights also were made in Army Air Corps open-basket balloons. In March 1927, Capt. Hawthorne C. Gray lost consciousness during an ascent to 28,500 feet. Coming to at 17,000 feet, he crash-landed with only minor injuries. Two months later, Captain Gray took a balloon above 41,000 feet but had to parachute from the balloon when it descended too rapidly. In November of



the same year, Captain Gray climbed to 42,470 feet but apparently ran out of oxygen. His body was found in the balloon's basket near Sparta, Tenn. For his three ascents, Captain Gray was posthumously awarded the Distinguished Flying Cross, a rare decoration in those days.

Why these dangerous high-altitude flights in open-cockpit planes and balloons with rudimentary oxygen systems? Among the objectives were to study the physical and psychological effects of high altitude on humans, to learn about what now is known as the jet stream, and to help determine the requirements for airframes, engines, and equipment to function in combat at high altitude.

To some extent, these men probably were impelled by the prestige associated with establishing records, but their work and that of many other Air Force pioneers helped create an Air Force second to none. They voluntarily laid their lives on the line for that vision. They stand, along with our combat heroes, as a vital part of the Air Force tradition of valor. ■

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

State Conventions

This year's Tennessee State Convention was hosted by the **Lt. Gen. Frank Maxwell Andrews Chapter** in Nashville. The chapter has since been renamed the **General Dan F. Callahan Chapter** in honor of the longtime chapter stalwart and retired Air Force major general.

The convention's highlight was an address by Lt. Col. Greg Gonyea, the commander of the 416th Tactical Fighter Squadron during the Persian Gulf War, who discussed F-117 ground-attack operations. The next day, Tennessee Assistant Commissioner for Veterans Affairs Don Samuels addressed a business session at the convention.

Chapter President Mark Johnson expressed appreciation for Colonel Gonyea's remarks and was particularly impressed by the NCO Academy Graduates Association's flag ceremony that opened the convention.

The late Everett E. Stevenson, a former National Vice President (South Central Region), presided at the convention, greeting National Director and chapter namesake Dan F. Callahan; National Director Daniel F. Callahan III and former Under-40 National Director Nancy Blanchard; 118th Airlift Wing Commander Brig. Gen. Allen J. "Jack" Newcomb, ANG; National Vice President (South Central Region) Bud Walters; former Tennessee State Presidents Leo Bolster and Jack Westbrook; and Maj. Thomas Rich, who represented the AFROTC detachment at Tennessee State University. Mr. Westbrook has since been elected to succeed Mr. Stevenson as state president.

Members of the host **Quad Cities (Ill.) Chapter** witnessed an electrifying performance by the USAF Air Demonstration Squadron, better known as the Thunderbirds, during this year's Illinois State Convention. The Thunderbirds performed nearby at the annual Quad City Air Show, and Lt. Col. Dan Darnell, squadron commander, received an eagle sculpture from State President Richard W. Asbury on behalf of Illinois AFA for the team's crowd-pleasing demonstration.

From left, 62d Airlift Wing Commander Brig. Gen. Richard C. Marr, 15th Air Force Commander Lt. Gen. Walter Kross, and Tacoma (Wash.) Chapter President Lt. Col. (Chaplain) Richard A. Seiber, USAF (Ret.), help the chapter commemorate the Air Force's forty-sixth birthday in fine style.

Crawford in Kansas City

AFA National Board Chairman O. R. Crawford was on hand prior to the first annual air races at Johnson County Industrial Airport, Kan., near Kansas City, Mo. Mr. Crawford, who flies a restored World War II P-40 Warhawk, gave advice to and discussed racing strategy with the organizers of the national series of competitions, which has a purse totaling $400,000.

Chapter News

Although Altus AFB, Okla., has seen some changes in the past year—the most prominent being its transfer from Air Mobility Command to Air Education and Training Command—one thing has remained constant: the unstinting support of the **Altus (Okla.) Chapter.** Quarterly, the chapter recognizes outstanding performers from the base's 97th Air Mobility Wing with an annual membership in AFA and a copy of the Air Force Almanac.

The most recent winners were Outstanding Senior NCO SMSgt. Larry C. Spruill, 97th Maintenance Squadron; Outstanding NCO TSgt. William C. Cooley, 97th Security Police Squadron; and Outstanding Airman SrA. Michelle C. Alombro, 97th Communications Squadron. Chapter Vice President (Aerospace Education) Bob Ottman represented AFA at the presentation.

The **Pioneer Valley (Mass.) Chapter** sought to brighten the day of young patients at the Shriners Hospital in Springfield, Mass., with an assist from Westover ARB's Chiefs Council. The two organizations undertook a Get Well Tour of the hospital, bringing with them a motorized scale model of an F-16. SSgt. Jerry Loyselle, an Air Force recruiter, "piloted" the model with delighted young copilots sitting in the cockpit. Chiefs Council Chapter President CMSgt. Lawrence B. Lose made a substantial donation to the hospital on behalf of his organization, and Chapter President Lt. Col. Forrest D. Price, Jr., AFRES, honored Allen G. Zippin, chairman of the hospital's board of governors, with a Presidential Citation for the hospital's outstanding work with handicapped and severely burned children.

Elwood Stein, a member of the

At the Air Force Ball of Mid-America, CMSgt. Bill Warren, USAF (Ret.), of the Scott Memorial Chapter accepts his Eaker Fellowship (one of four AEF fellowships presented at the ball) from President James McCoy and Board Chairman O. R. Crawford.

Panhandle (Tex.) Chapter, is another volunteer who knows the challenges and rewards of hospital work. Mr. Stein, a retired chief master sergeant, donated 1,720 hours of his time to the VA Medical Center in Amarillo, Tex. Chapter President Bob Balliett expressed pride in Mr. Stein's "distinctive accomplishments."

Former National Vice President (Far West Region) H. A. Strack traveled to California to preside over the installation of new officers for the **Robert H. Goddard Chapter** with State President Cheryl Waller. President Paul A. Maye, Vice President (North) Victor Bouquet, Vice President (South) TSgt. Catherine Finch, Secretary 1st Lt. Tammy Cobb, and Treasurer Dennis Masson are the chapter's new leaders.

Mr. Strack also presented the chapter's 1992 Community Partners Gold Award, which goes to chapters that have Community Partners totaling at least two percent of overall membership. Lt. Gen. Arlen D. Jameson, commander of 20th Air Force at Vandenberg AFB, Calif., spoke at the event, praising the chapter and its efforts as an integral part of "Team Vandenberg."

Pease AFB, N. H., may have closed as an active-duty Air Force installation, but the good work of the **Pease Chapter** on behalf of aerospace power and education continues. Chapter President Baldwin Domingo, who also serves as state president, presented a $300 scholarship award to Christopher B. Jette, in honor of his status as the outstanding AFROTC cadet at the University of New Hampshire. The award was made during a ceremony held in conjunction with several military, veterans, and other patriotic organizations.

The chapter did not ignore cadets at the AFJROTC level. It did its part in honoring outstanding cadets at Spaulding High School, Rochester, N. H., with the help of aerospace instructors Maj. Salvatore DeVincenzo and CMSgt. P. Fred Ross. President Domingo congratulated Outstanding Cadet Kimbly L. Swink.

The **Lt. Col. B. D. "Buzz" Wagner (Pa.) Chapter** participated in a highly successful Armed Forces Day observance last spring. Chapter President Jerome Ashman greeted the return of area native Maj. Richard Racosky, Michigan ANG, who impressed the crowd with a flyover in his F-16 during the festivities. President Ashman also welcomed newly appointed USAF recruiter Sgt. Tony Ricco.

Also in the Keystone State, the **Joe Walker–Mon Valley Chapter** recently installed new officers in conjunction with an awards ceremony. National Director Robert L. Carr conveyed the congratulations of National President James M. McCoy to Westmoreland County Commissioner Richard F. Vidmer, who was named Distinguished Pennsylvanian of 1993. New officers President Jim Cain, Vice President Karen Hartman, Vice President (Veterans Affairs) Angelo Leone, Secretary Nancy Smith, and Treasurer Dale Smith were installed by State Western Region Director Tillie Metzger. Seven Community Partners were honored for their support of the chapter's efforts.

Have AFA/AEF News?

Contributions to "AFA/AEF Report" should be sent to Dave Noerr, AFA National Headquarters, 1501 Lee Highway, Arlington, VA 22209-1198. ■

The Nation's Capital Chapter held a reception to welcome Air Force Secretary Sheila E. Widnall to Washington. From left, Chapter President Paul McManus, Secretary Al Barbero, Treasurer Fred Rhodes, former President Grant Miller, and President McCoy extend their greetings to the new Secretary.

Unit Reunions

Arc Light/Young Tigers
SAC Arc Light and Young Tiger participants will hold a reunion June 9–12, 1994, at the Marriott Quorum Hotel in Dallas, Tex. Aircrew, staff, PCS, and TDY personnel from all bases are invited. **Contact:** Gerald T. Horiuchi, 1223 E. Mesa Ave., Fresno, CA 93710. Phone: (209) 435-4312.

Readers wishing to submit reunion notices to "Unit Reunions" should mail their notices well in advance of the event to "Unit Reunions," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Please designate the unit holding the reunion, time, location, and a contact for more information.

Hq. BALTAP (NATO)
Personnel from the US, UK, Denmark, Germany, and Norway who were assigned between 1964 and 1968 to Hq. BALTAP (NATO), Karup AB, Denmark, are planning to hold a reunion August 2–6, 1994, in Denver, Colo. **Contact:** Col. Rio G. Lucas, USAF (Ret.), 7676 S. Ivanhoe Way, Englewood, CO 80112. Phone: (303) 741-1945.

11th Bomb Group Ass'n
Veterans of the 11th Bomb Group (Heavy) will hold a reunion June 15–19, 1994, in Des Moines, Iowa. **Contact:** Robert E. May, P. O. Box 637, Seffner, FL 33584-0637. Phone: (813) 681-3544.

20th Space Surveillance Squadron
The 20th Space Surveillance Squadron (AN/FPS-85 phased-array radar, site C-6) is hosting its twenty-fifth-anniversary reunion April 28–29, 1994. Past and present personnel and anyone else associated with this radar operation are invited. **Contact:** Shirley Smith, 207 W D Ave., Suite 125, Eglin AFB, FL 32542-6848. Phone: (904) 883-7861 or DSN: 875-7861.

Class 42-B Ass'n
Members of Aviation Cadet Class 42-B will hold a reunion May 4–7, 1994, in Seattle, Wash. **Contacts:** Roger E. Monroe, 19056 Singing Wood Cir., Trabuco Canyon, CA 92679. Phone: (714) 589-0200 or (602) 935-3538 (Bill Edwards).

49th Fighter Group Ass'n
Veterans of the 49th Fighter Group will hold a reunion April 21–24, 1994, in Atlanta, Ga. **Contact:** Col. K. B. Clark, USAF (Ret.), 8247 Lower Thomaston Rd., Macon, GA 31210. Phone: (912) 935-2178.

Class 54-G
Members of Aviation Cadet Class 54-G will hold a reunion August 30–September 4, 1994, at the St. Anthony Hotel in San Antonio, Tex. **Contact:** Lt. Col. Eric N. Hellberg, USAF (Ret.), 484 St. James Ct., Yuba City, CA 95991. Phone: (916) 673-6527.

75th/55th MATS
Flight attendants and radio personnel of the 75th/55th Military Air Transport Squadron stationed at Travis AFB, Calif., between 1956 and 1958 will hold a reunion June 10–12, 1994, in Las Vegas, Nev. **Contact:** Dick Ritter, 6659 Williams Rd., Rome, NY 13440. Phone: (315) 337-2694.

307th Bomb Group/Wing
Veterans of the 307th Bomb Group and 307th Bomb Wing (B-29 unit) who served between 1946 and 1954 will hold a reunion April 7–10, 1994, in San Antonio, Tex. **Contact:** Lt. Col. Joseph Karol, USAF (Ret.), 3816 Winslow Dr., Fort Worth, TX 76109. Phone: (817) 921-0687.

Class 42-J
I am trying to locate members of Aviation Cadet Class 42-J who trained at Randolph and Brooks AFBs, Tex., and who are interested in holding a reunion in San Antonio, Tex., in May or June 1994. **Contact:** T. E. Yarbrough, 1764 Acorn Ln., Hurst, TX 76054-3702. Phone: (817) 282-0069.

Class 44-A
CORRECTION: In our October 1993 issue we failed to include Stockton AFB, Calif., for Class 44-A. The notice should have read: Seeking contact with members of Aviation Cadet Class 44-A (Stockton AFB, Calif.) for the purpose of planning a reunion. **Contact:** Eugene R. McCutchan, 16220 N. 7th St., Apt. 2034-61, Phoenix, AZ 85022. Phone: (602) 548-9722.

Class 44-I
Seeking contact with members of Pilot Class 44-I (Eastern Flying Training Command) for the purpose of organizing a fiftieth-anniversary reunion. **Contact:** Joe King, 210 Snow Ln., Lexington, SC 29513. ■

Bulletin Board

Collector seeking **No. 9** of the **Fine Art Series,** Air Force Collection. **Contact:** Diane Kosloske, 3248 Independence Ave. N., New Hope, MN 55427.

Seeking the serial numbers and the corresponding four-digit codes of the following **fighters** and **transport aircraft** supplied to the **Republic of China Air Force:** the F-84, F-86, F-100, RF-101, F-5, F-104, C-123, C-119, RB-57D, and U-2. **Contact:** W. Yip, 535 Diana Pl., Arroyo Grande, CA 93420.

Seeking contact with the following persons who were stationed at Page AAF, Fla., in 1945: **1st Lt. John L. Redd; 2d Lts. Dale Hertel, Robert E. Hodson,** and **William A. Huggins;** and **Flight Officers Robert B. Millard** and **William H. Taft. Contact:** Maj. Angus Reid, 13726 Starshine Dr., Victorville, CA 92392.

Seeking information on **1st Lt. Leo M. Mayo,** of the 432d Fighter Squadron, 475th Fighter Group, and **1st Lt. Enrique Provencio,** of the 431st FS, 475th FG. Both were killed in action in late 1943—Mayo over Rabaul, New Guinea, and Provencio possibly near Clark Field, the Philippines. Also interested in any Mexican-Americans or Mexican nationals who served in the southwest Pacific area with the USAAF. **Contact:** Santiago A. Flores, P. O. Box 430910, San Ysidro, CA 92143-0910.

Collector seeks **patches** and other memorabilia related to the 351st Strategic Missile Wing, Whiteman AFB, Mo., during 1972–76, or to the 1975–76 Olympic Arena competitions. **Contact:** Michael Fabbri, 77 Shore Rd., Ashland, MA 01721.

Seeking the whereabouts of **Clifford K. Emory (or Ennory),** from Missouri, who was stationed at Camp Iha Gushikawa, Okinawa, Japan. He was attached to the 546th Supply Squadron, Kadena AFB, Japan, from 1951 to 1953. He had a sister named Judy, who attended Eugene Field School, and a brother. **Contact:** John S. Rhodes, 3628 350th Ave. W., Oak Harbor, WA 98277.

Collector seeks the following **patches:** 20th Tactical Fighter Wing, RAF Wethersfield, UK; 40th Tactical Group, Aviano AB, Italy; 98th Bomb Wing, Lincoln AFB, Neb.; 405th TFW, Clark AB, the Philippines; and 3d, 16th, and 17th Air Forces. **Contact:** Robert A. Hambury, 609 N. Division St., Salisbury, MD 21801-4119.

Seeking contact with members of the **424th Bomb Squadron,** 307th Bomb Group, 13th Air Force, who were stationed at Morotai, Indonesia, in July 1945 and then moved to Clark Field, the Philippines, after World War II. Also seeking a drawing and colors of the 424th and 307th insignia. Also seeking a photo of B-24J ***Purple Heart*** from that squadron. **Contact:** Walter H. Pierson, 717 Running Creek, Seguin, TX 78155.

Seeking anecdotes, photos, or other memorabilia from **USAF Explosive Ordnance Disposal** or **Army Air Corps Bomb Disposal** personnel for a history of USAF EOD, 1947–92. **Contact:** CMSgt. Marshall B. Dutton, USAF (Ret.), 150 Grand View Ave., Valparaiso, FL 32580-1602.

Seeking contact with personnel from the **12th Combat Crew Replacement and Training Center** stationed at RAF Cheddington, England, during 1943–45. **Contact:** Martin L. Bremer, P. O. Box 907036, Gainesville, GA 30501.

Seeking contact with **Lt. Arthur F. Reibe, Jr.,** from New York, who served with the 444th Bomb Group, 58th Bomb Wing, 20th Air Force, at Great Bend AAF, Kan., during 1943–44. **Contact:** Arthur F. Reibe, Jr., 2111 Metairie Heights Ave., Metairie, LA 70001.

Seeking information on the crew of a **B-24** of the **720th Bomb Squadron,** 450th Bomb Group, 15th Air Force, that was shot down over the Adriatic Sea near Pula, Yugoslavia, on March 24, 1944. **Contact:** John G. Morgan, 1071 Cedar Rd., Southport, CT 06490.

Bulletin Board

Seeking the whereabouts of **MSgt. Norman P. Kendrick,** whose last known address as of 1975 was Tumon Heights, Guam. **Contact:** Mark Kendrick, 15 S. Monson Rd., Hampden, MA 01036.

Seeking correspondence with personnel stationed at **Maxwell Field, Ala.,** during 1940–42, especially those of the **82d, 83d,** and **91st School Squadrons. Contacts:** Robert C. Moore, 4819 Pecan Grove, San Antonio, TX 78222. Harvey S. Manis, 251 S. Westwind Ct., Melbourne, FL 32934.

Author seeks contact with personnel of the **3d, 17th,** and **452d Bomb Wings** stationed in Korea during 1950–53. Photos and recollections are needed for a book on the B-26 in Korea. **Contact:** John Horne, 8/4 Chalmers St., Belmore, N. S. W. 2192, Australia.

Collector seeks scarves and patches from F-111 or EF-111 squadrons assigned to the **366th Tactical Fighter Wing "Gunfighters"** at Mountain Home AFB, Idaho, and patches from the **474th TFW "Roadrunners"** at Nellis AFB, Nev. Also interested in patches, scarves, and stickers from the **393d BMS** when it participated in the NATO Tiger Meets at Montijo, Portugal, in 1987 and Klein Brogel, Belgium, in 1978. **Contact:** Curtis J. Lenz, 32 June St., Nashua, NH 03060-5345.

Veterans and active-duty personnel are invited to register their names and addresses on the **American War Library's** 24-hour, on-line computer locator. The library provides addresses of veterans associations, names of Americans killed or missing in action, and information on films, books, surveys, war correspondents, and much more. Listing and access are free. **Contact:** The American War Library and Veteran Registry, 25601 Narbonne, Suite 6, Lomita, CA 90717-2513.

Collector seeks **474th Tactical Fighter Wing** Roadrunner, Harvest Reaper, and Combat Lancer patches. Also interested in any F-111 decals, Christmas cards, etc. **Contact:** TSgt. Robert E. Styger, USAF, 15 Genesee Ln., Willingboro, NJ 08046-3319.

Seeking information on **CMSgt. Richard Amburgey,** who was stationed at Eielson AFB, Alaska, from 1965 to 1970. His last known assignment was at Pease AFB, N. H. **Contact:** Raymond W. Johnson, 4725 W. Larchwood Ct., Spokane, WA 99208.

Military historian seeks information on and maps and photos of World War II Army Air Fields and installations in **Rufisque** and **Dakar, Senegal. Contact:** George A. VanSant, 25 Bayberry Dr., Lanoka Harbor, NJ 08734.

Seeking the whereabouts of **Lt. Sam Holland,** who survived a crash in Magdeburg, West Germany, in 1965. **Contact:** Capt. Donald F. Henry, USAF, 4880 E. 29th St., #9203, Tucson, AZ 85711.

Individual wishing to purchase World War II and Korean War **recognition models** used for training gunners and pilots requests a price list. **Contact:** Ben Heinlein, 3908 Morman Ln., Dallas, TX 75244.

Seeking contact with members of **Alex Dallas's B-17 crew** of the 414th Bomb Squadron, 97th Bomb Group, Foggia, Italy, in 1944. Also seeking contact with **Bombardier Class 43-13,** San Angelo, Tex. **Contact:** Paul R. DeFrancis, 12 Fayson Lakes Rd., Kinnelon, NJ 07405.

Seeking a 1965–70 **345th Tactical Fighter Squadron** (Bulldogs) patch for a museum-quality display of Vietnam-era fighter squadron memorabilia. **Contact:** Dale R. Messimer, 38408 Redwood Terr., Fremont, CA 94536.

Seeking patches, for a museum display, from the following squadrons of the **551st Airborne Early Warning and Control Wing:** 79th, 960th, 961st, 962d, 963d, 964th, 966th, and 4759th AEW&C Squadrons. **Contact:** Steven R. Marques, 15 Grandview Ave., Peabody, MA 01960.

Seeking the whereabouts of **James Griffey,** who served in the Air Force in England around 1974. After leaving the Air Force, he became a policeman. **Contact:** Sheri M. Clouting, 114 Campbell Rd., Ipswich, Suffolk IP3 9RE, England.

Seeking contact with members of the **82d Fighter Group,** 15th Air Force, which flew P-38s during World War II. **Contact:** Ward Stakem, 220 37th St., Pittsburgh, PA 15201.

Seeking **Desert Storm patches** for a book on Persian Gulf War memorabilia. Also interested in **Vietnam War patches,** especially from F-105s and units based in Thailand. **Contact:** Paul Mathias, 65 Lynmere Rd., Welling, Kent DA16 1DP, England.

Seeking the whereabouts of **CMSgt. G. "Ed" Ober,** an engineer on C-97s and C-54s at Kelly AFB, Tex., and Hickam AFB, Hawaii. His last

known assignment was Dover AFB, Del., in the 1960s. **Contact:** Meg Braden, 22713 W. Copper Hill Dr., #41, Saugus, CA 91350.

Seeking the whereabouts of **Charles Marcus Mann,** born in 1921 in Tampa or Jacksonville, Fla., who served with 8th Air Force during World War II, possibly with the military police. He was stationed near Bedford, England, from August 1943 to May 1945. **Contact:** Sylvia Lover, 3 Rutherford Close, Sutton, Surrey SM2 5DP, England.

Historian seeks the identity of the **pilot shot at Sukchon, North Korea,** on October 20, 1950. Also seeking information on **Capt. James A. Stuart, Jr., Cpl. Lawrence Meredith, Pfc. Michael Mascara,** and **Pfc. Henry Lampert** of the 187th ARCT. **Contact:** C. P. George Joyce, 5 Norman St., Clinton, MA 01510-3409.

If you need information on an individual, unit, or aircraft, or if you want to collect, donate, or trade USAF-related items, write to "Bulletin Board," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Letters should be brief and typewritten; we reserve the right to condense them as necessary. We cannot acknowledge receipt of letters. Unsigned letters, items or services for sale or otherwise intended to bring in money, and photographs will not be used or returned.—THE EDITORS

Seeking the whereabouts of the father of **Susan Bailey,** who was born June 29, 1944, in Northampton, England. He may have remained with the Air Force in Northampton for several years after World War II. **Contact:** Karen Pearson, 16 Booth Close, Pattishall, Towcester, Northamptonshire NN12 8JP, England.

Collector and historian seeking **USAAF (and predecessor organizations) memorabilia** from World War I through World War II: flight jackets, uniforms, flight equipment, and photo albums. **Contact:** Jon Cerar, 425 John St., Carlinville, IL 62626.

Historian seeks photos of and information on **F-4 Phantom** units in southeast Asia. **Contact:** MSgt. Gary James, USAF (Ret.), 6313 S. Robinson Ave., Oklahoma City, OK 73139.

Seeking information on the various incarnations of the **90th Aero Squadron,** also known as the Pair-O-Dice, from 1917 to the present. Also seeking contact with the 90th Aero Squadron Association. **Contact:** Tom Hazlebeck, 90th Fighter Squadron, 43-450 Hubble Rd., Elmendorf AFB, AK 99506.

Seeking the whereabouts of **Lt. Miles McFann,** in order to give him or his family a photo of him with Winston Churchill and Lt. Gen. Ira C. Eaker. **Contact:** David Belk, 53 Park View Rd., Four Oaks, Birmingham B74 4PQ, England.

Seeking contact with **Capt. Michael John Milton,** a B-17 pilot stationed in Ogden, Utah, and Pottet, Tex., and later with 8th Air Force in England in 1944–45. **Contact:** Durward J. Church, 157 Palmer Rd., Monson, MA 01057.

Seeking photos, patches, and memorabilia from the following bases and airfields: **Del Valle/Bergstrom AFB, Tex.; Naha AB, Okinawa, Japan;** and **Stinson Field, Tex.** Also seeking autographs, signed photos, and letters from **famous military and pioneer aviators. Contact:** Tom Shane, 6109 Bridlington Cir., Austin, TX 78745.

Seeking members of **Pilot Class 49-C** at Randolph AFB, Tex., and Barksdale AFB, La. **Contact:** Col. Milton A. Arneson, USAF (Ret.), 1110 28th Ave. S., Moorhead, MN 56560.

Seeking historical items from the **19th Transport Squadron, 19th Troop Carrier Squadron,** and **19th Airlift Squadron** for a squadron history. Interested in photos, patches, duty rosters, flight orders, and other documents, especially from November 1940 to January 1955. **Contact:** SMSgt. David R. Welz, USAF, 905 Westwind Ct., Suisun, CA 94585.

Researcher seeks **German, Japanese,** and **USAAF** World War II memorabilia to be used in a collector's guide and public displays. Interested in photos, badges, medals, patches, uniforms, and the like. **Contact:** TSgt. Mark Conrad, USAF, 86CG, PSC 1 Box 4844, APO AE 09009.

Seeking several copies, with jacket covers, of ***The Look of Eagles,*** by Capt. John T. Godfrey of the famed World War II fighter ace team of Capts. Gentile and Godfrey. Will pay original cost plus shipping. **Contact:** Walter T. Prybyla, 29 Bentley St., Woonsocket, RI 02895.

Seeking contact with members who served in the **49th Fighter Group** or **49th Fighter Wing** at any time from their activation in 1941 to the present. **Contact:** Bill Shultz, P. O. Box 1270, Phoenix, AZ 85001. ■

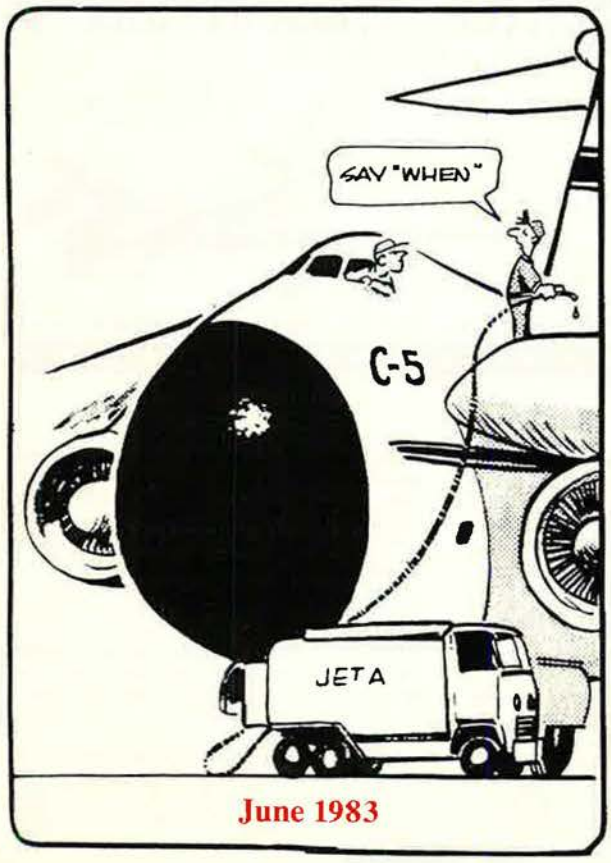
Bob Stevens'

"There I was..."

For the 360th—and final—episode of "There I Was . . ." (see tribute, p. 18), we assembled this sampling of Bob Stevens panels from over the years, including one (directly below) from his very first page to appear in AIR FORCE Magazine.

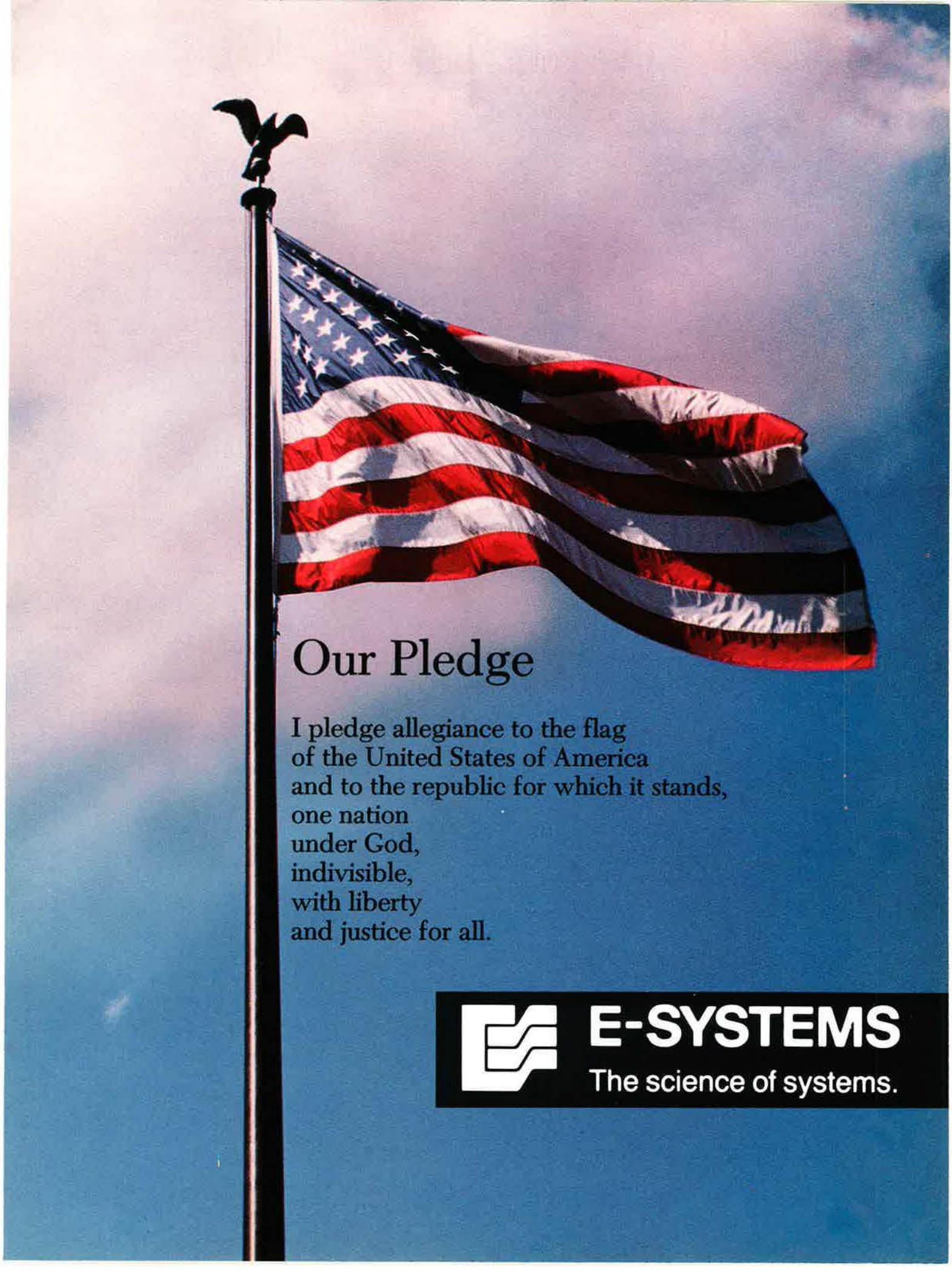
May 1966

January 1964



June 1983

Here's Bob Stevens as he drew himself. Readers everywhere will join us in saying thanks, Bob, for thirty great years.


Our Pledge
I pledge allegiance to the flag
of the United States of America
and to the republic for which it stands,
one nation
under God,
indivisible,
with liberty
and justice for all.
E-SYSTEMS
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2 Carries up to 23,000 lb of Payload
3 Delivers Precision-Guided Munitions
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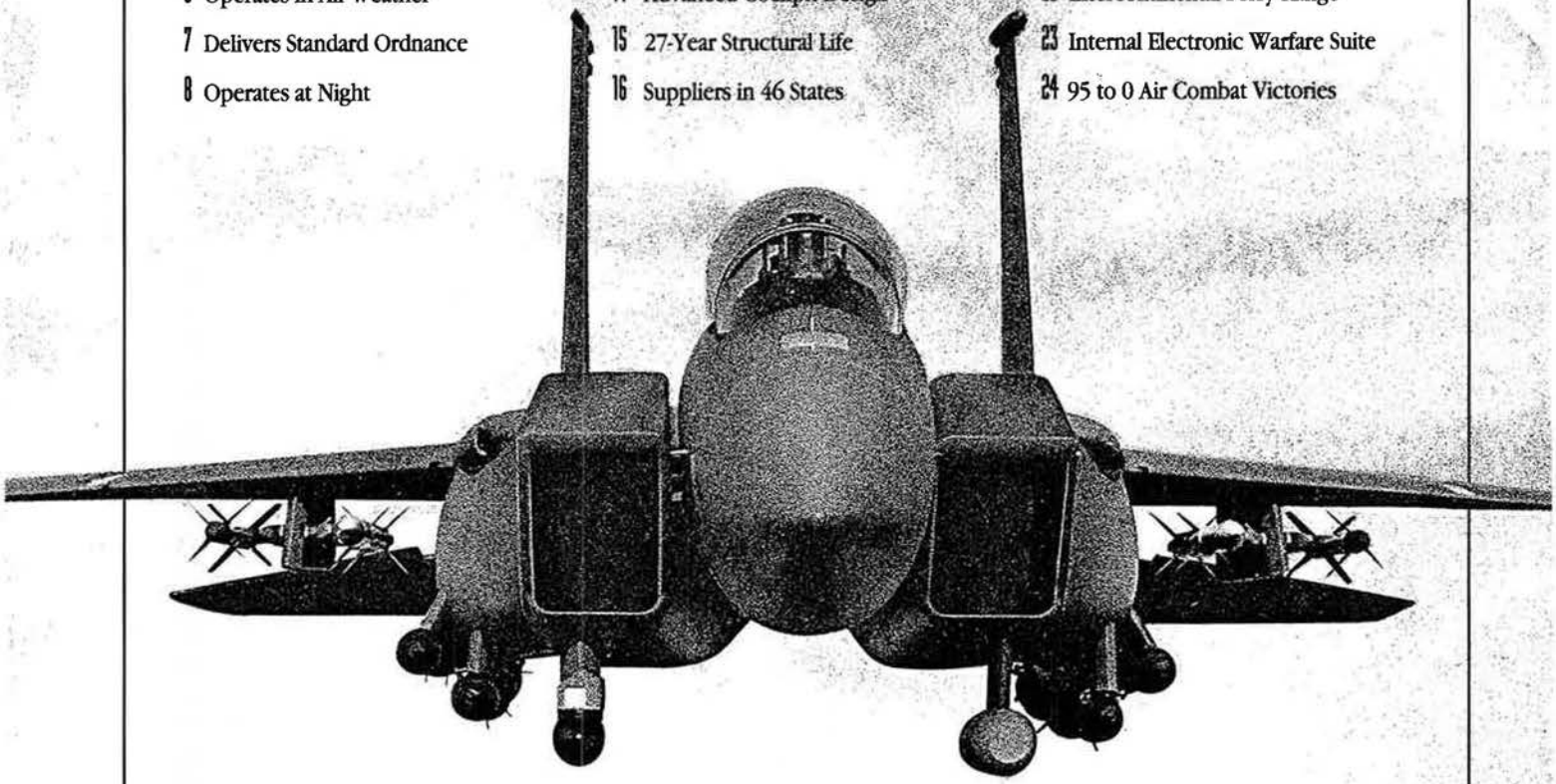
5 Round-the-Clock Operations With High Fly Rates
6 Operates in All Weather
7 Delivers Standard Ordnance
8 Operates at Night
9 Deep Strike of High-Value Targets
10 95.5% Mission-Capable Rates in Operation Desert Storm
11 Infrared Accurate Targeting Sensor
12 High Resolution Radar Ground Maps
13 99% Made in the U.S.A.
14 Advanced Cockpit Design
15 27-Year Structural Life
16 Suppliers in 46 States
17 Safest Fighter in USAF History
18 USAF's Most Modern Fighter
19 Capability to Grow to More Missions
20 Unequalled Air Superiority
21 Carries 4 Medium-Range and 4 Short-Range Air-to-Air Missiles
22 Intercontinental Ferry Range
23 Internal Electronic Warfare Suite
24 95 to 0 Air Combat Victories



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