MAY 1990/$5

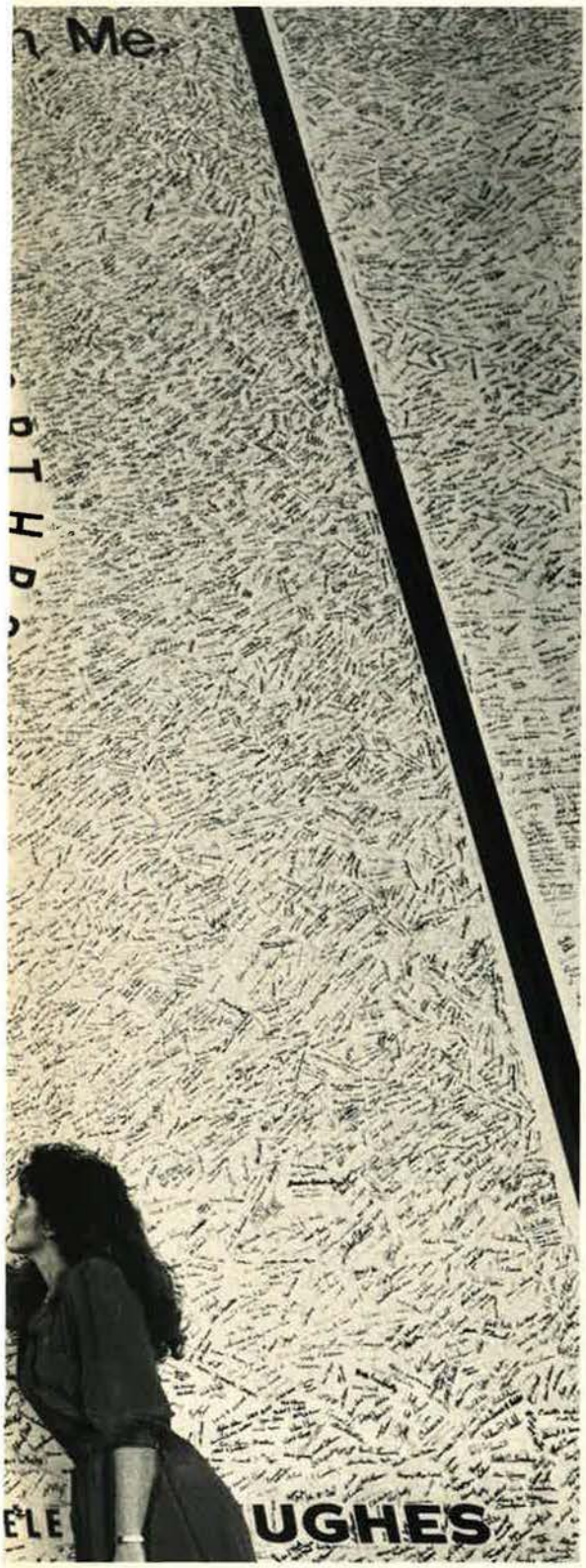
AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

State of the Force
The 1990 USAF Almanac

THE B-2. WE TAKI

: IT PERSONALLY.



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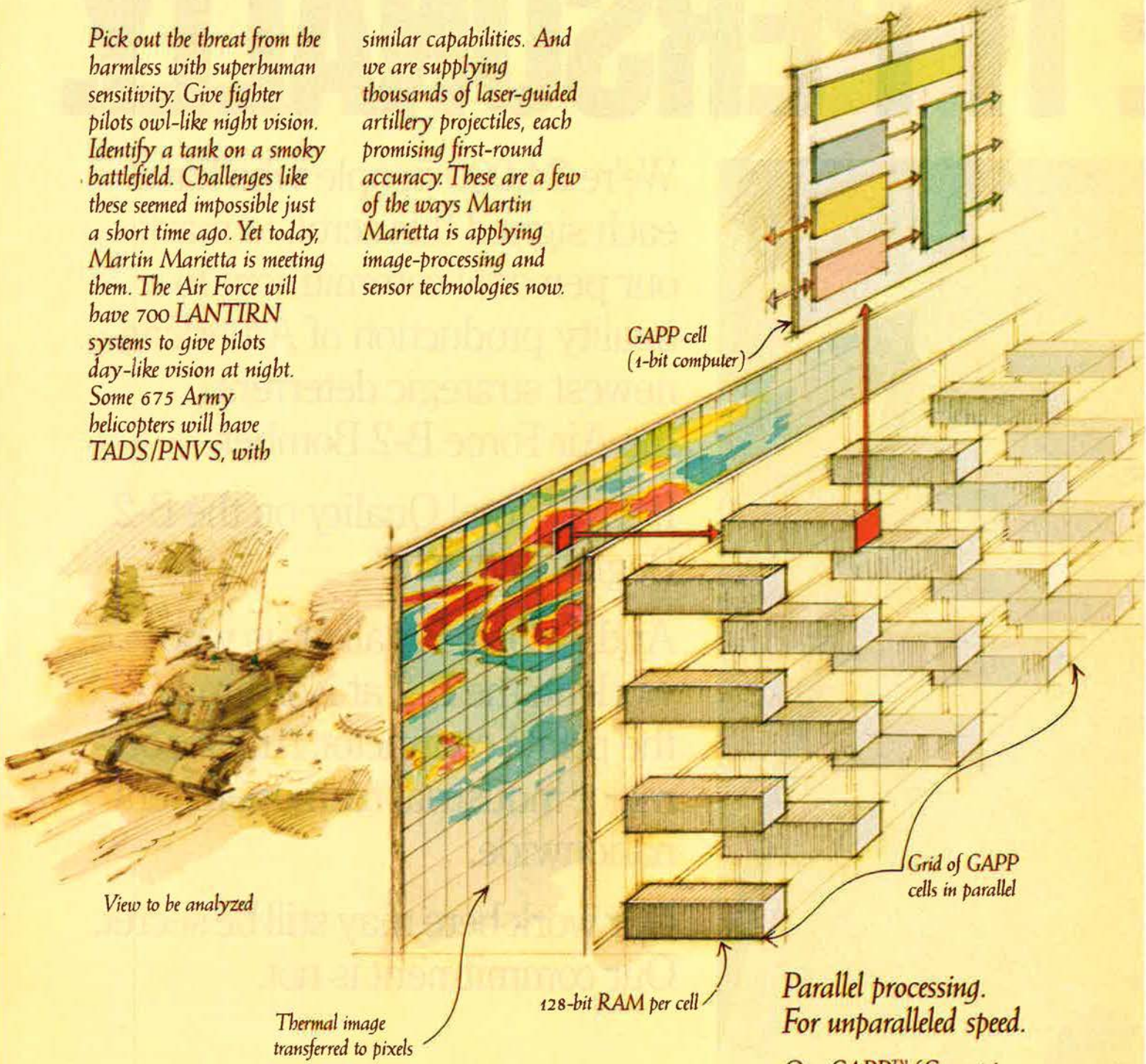

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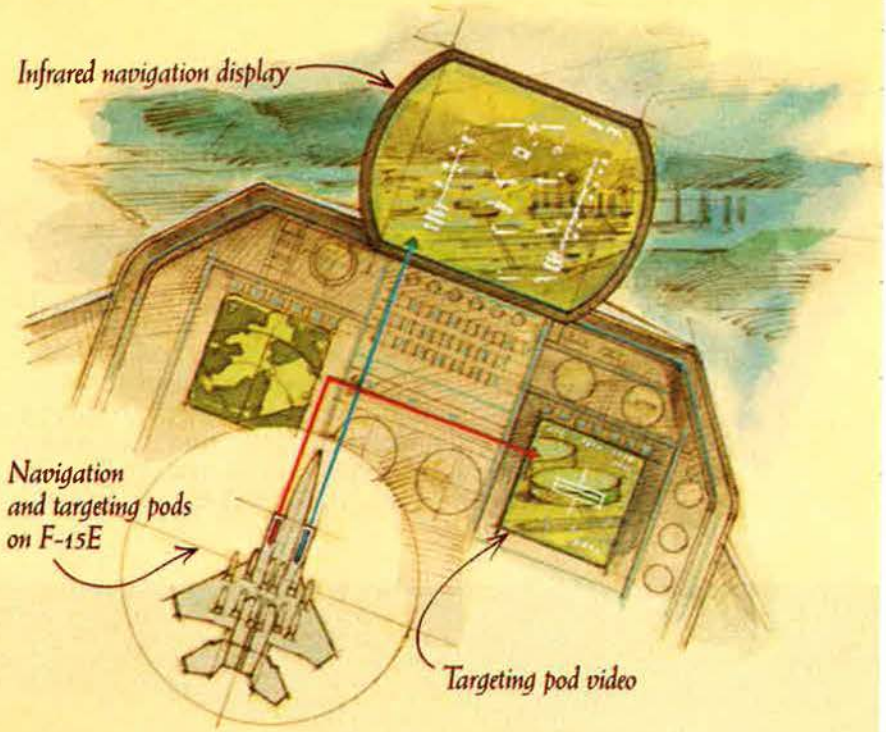

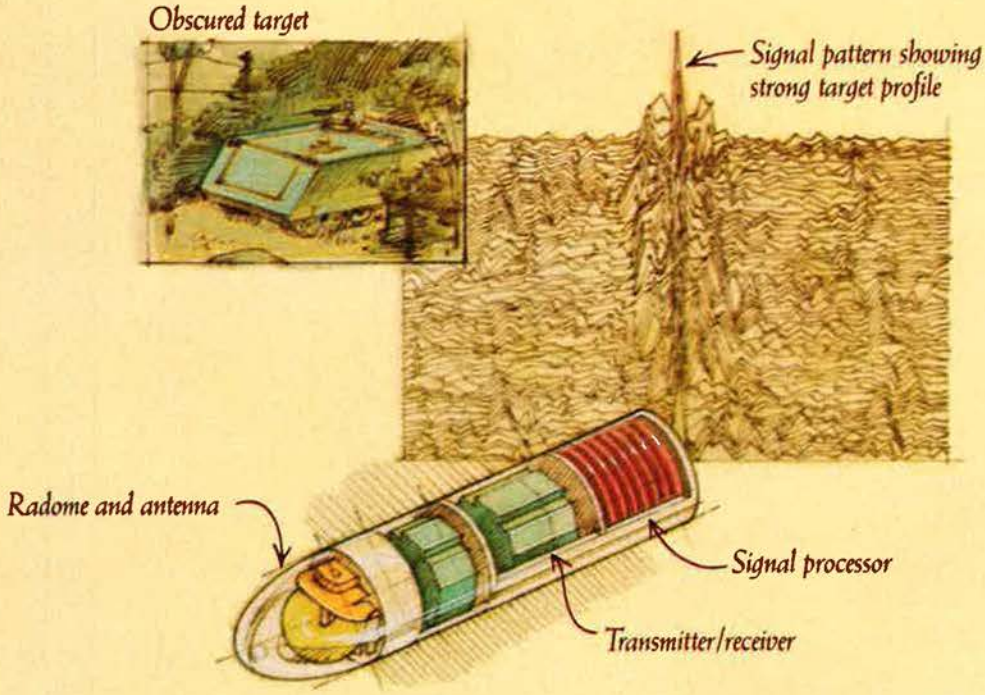

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MAY 1990
VOLUME 73, NUMBER 5

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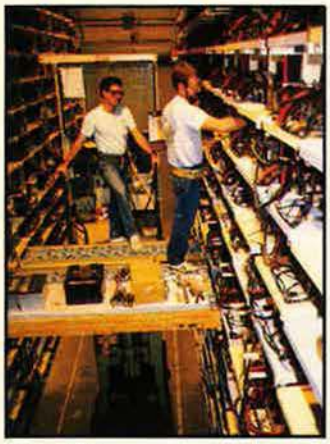

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About the cover: A quality assurance evaluator uses a dipstick to check his aircraft's oil, symbolically taking the measure of the force. Cover photo by Guy Aceto.

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Chairman of the Board & CEO
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Editorial

By John T. Correll, Editor in Chief

Visionaries and Their Visions

SAM Goldwyn may have been on to something when he warned against making forecasts, especially about the future. The history of prediction is not impressive. Consider these examples, collected by Christopher Cerf and Victor Navasky in *The Experts Speak*:

- "Germany has no desire to attack any country in Europe. . . ." *David Lloyd George, former British Prime Minister, 1936.*
- "The modern German theory of victory by *blitzkrieg* [lightning war] is untried and, in the opinion of many experts, unsound." Time *Magazine, 1939.*
- "Only hysteria entertains the idea that . . . Japan contemplates war upon us." *John Foster Dulles, US diplomat and later Secretary of State, 1941.*
- "The Hawaiian Islands are overprotected; the entire Japanese fleet and Air Force could not seriously threaten Oahu." *Capt. William T. Pulleston, former Chief of US Naval Intelligence, 1941.*
- "Iran is an island of stability in the Middle East." *President Jimmy Carter, 1977.*
- "No matter what happens, the US Navy is not going to be caught napping." *Secretary of the Navy Frank Knox, December 4, 1941.*
- "It is significant that despite claims of air enthusiasts, no battleship has yet been sunk by bombs." *Caption to photo of USS* Arizona *in program for Army-Navy football game, November 29, 1941.* (Eight days later, the *Arizona* went to the bottom at Pearl Harbor after taking a direct bomb hit.)

The spirit expressed in these happy assessments from the past lives on today in what is shaping up as a new Golden Age of Optimism. Each week's newspaper columns propose deeper cuts in US armed forces on the grounds that there is insufficient danger to justify their upkeep.

The forecasters have surveyed the future and see nothing that alarms them. Ironically, they project peace and stability mainly on the basis of spectacular changes in the past year—changes that surprised the forecasters and everybody else.

It does not satisfy these visionaries that the Pentagon has cut 60,000 troops and taken $231 billion out of the Five-Year Defense Plan in the last twelve months, or that the most threatening forces of our potential adversaries remain largely intact. As the optimists tell the story, the Pentagon is cast as the Unrelenting Pessimist, refusing to recognize and accept change.

The forecasters survey the future with confidence, but their predictions are based mainly on upheaval and change that neither they nor anyone else predicted.

A different picture, however, emerges from the assumptions that Secretary of Defense Dick Cheney says the services have been instructed to use as their planning base for programs through 1995.

The official *assumptions*—a term of considerable significance in the structuring of forces—are these: that Soviet leader Mikhail Gorbachev will remain in power, and his domestic policies will be at least partly successful; that Soviet foreign policy will be less hostile to the US than it was in the past; that the superpowers will agree on conventional and strategic arms control; that the Soviets will withdraw all their forces from eastern Europe; that the Warsaw Pact will become "a relic of history"; and that eastern Europe will be governed by democratic, non-Communist regimes.

When Mr. Cheney says that this is "a rosy scenario," he will get no argument here. He gets plenty of argument elsewhere, though, from those who regard the resulting defense program—which will cost four percent of GNP by 1995—as unrealistic and excessive.

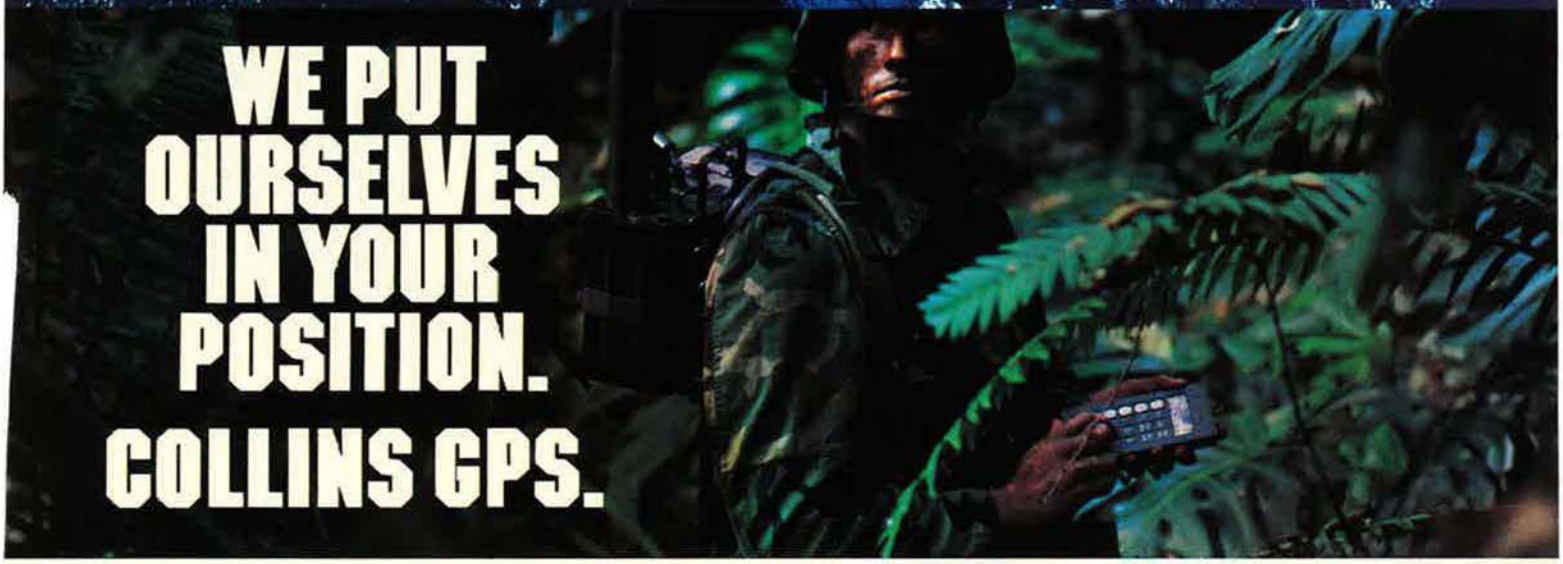
Former Secretary of Defense Robert S. McNamara says we could reduce defense spending to three percent of GNP. His theory rests on two optimistic conditions: that the US and the Soviet Union will not "increase or extend their political or military power beyond their borders" and that they will conduct relations between themselves by "rules that preclude the use of force."

Well, yes, and if we were sure of the same deal with other nations, we could perhaps cut defense to *zero* percent of GNP. And how should we interpret Mr. McNamara's first condition, which seems to forfeit the use of military force to protect interests beyond our own borders, no matter what?

The Oakland *Tribune* assures us we can rest easy about Asia, too. It concurs with studies that "see no big security problems arising," and, besides, "no American President is ever again likely to send US troops to fight another insurgency, or even foreign invasion, in that distant part of the world."

The fact is, today's forecasters do not know, any more than yesterday's forecasters did, what will happen next. This is not to say that optimists have a monopoly on prediction error. When the pessimists are wrong, however, we breathe a sigh of relief. When the optimists are wrong, lights burn late in high places.

It is not hysteria (to borrow Mr. Dulles's word from 1941) to imagine that new surprises, some of them threatening, might lie ahead. Are we sufficiently confident to bet the nation's welfare—and perhaps its security—on the premise that history has taken its last wrenching turn? ■



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Letters

Not the First

With regard to C. V. Gliness's article on College Park Airport *[see "Eighty Years at College Park," January 1990 issue, p. 98]*, I would like to point out that [College Park] cannot claim to be the site where the first bombs were dropped from an aircraft. We have tried valiantly to clear up this claim, which was made by several well-meaning historians years ago and which we now know is not true. However, this "first" seems to have stuck to us. Actually, the Airport is the site where the first bomb-dropping device was tested from an airplane, but the "bombs" were not real. Sorry. . . .

Catherine Wallace Allen
History Division
Maryland–National Capital
Park and Planning Commission
Bladensburg, Md.

In a (Blue) Pickle

I really enjoyed "The Third Lieutenants," by J. H. MacWilliams and Bruce Callander, in the March issue *[see p. 100]*. It brought back memories of my struggling through my time as a cadet, wondering if I would get the gold bar or the blue pickle.

In the interest of historical accuracy, there are two statements in the story that need clarification:

First is the statement that a high school diploma was needed to enter the cadet corps. This is not true. When I enlisted in December 1942, the only requirement was to pass the 200-question, four-hour test. You needed two letters of recommendation from local businessmen, attesting to your moral character, and you had to pass the standard Army physical examination. I should know, because I dropped out of high school at the end of my junior year to enter the cadet corps.

Second is the statement that there was no standard for deciding who became a 2d lieutenant and who became a flight officer. When I arrived at Advanced Flight Training at Ellington Field, Tex., in 1944, one of the first things we were required to do was to take a 150-question test to determine what grade we would receive. The test was designed solely to test leadership ability. They assumed that if you had made it through the cadet program, you could fly an airplane. . . .

I must have done well on the test. I sure wasn't what you'd call a hot pilot, and I didn't have a high school diploma, but I got the gold bars.

Robert A. Tonnies
Cincinnati, Ohio

"The Third Lieutenants" brought back long-forgotten memories. Real good stuff.

The authors, however, did forget one group of flight officers that should be honored. As World War II was winding down in Europe, I was at Randolph Field, Tex., as a tac officer, nursemaiding a squadron of captains, majors, and colonels who had flown their combat missions and were taking their hated instructor training. Their morale was low, and as a 1st lieutenant, I had my hands full keeping them happy.

My routine was interrupted when the brass told me that a large batch of brand-new flight officers had arrived on base and that I was designated to instruct them in close-order drill. You can't imagine what a woebegone, raunchy, poorly uniformed bunch of disillusioned, middle-aged characters faced me with hostility. It turned out that several primary pilot schools had been closed, and, instead of being able to go home, the civilian trainers were given two options. One: Accept warrants as flight officers. Two: Accept warrants as flight officers. The crowning insult was to have an officer subject them to close-order drill. Their bitching was picturesque.

Fortunately, no brass was on hand. So I let them unburden themselves. Then I explained why drill was necessary. I said that there were two ways to do it—the usual, boring way and the fun way. I assured them that the basics were easy and that trick-drill, though frowned on, was fun. After a few days, there were no more sad sacks. They were having fun and smiling. These once-raunchy misfits could have done well in competition fancy routines. They left Randolph in reasonably good spirits [and went on to distinguish themselves in the China-Burma-India theater].

I wish the talented authors would follow up and write something about those unsung heroes.

Richard S. Croker
Laguna Niguel, Calif.

"The Third Lieutenants" filled in some gaps and answered some hard, previously unspoken questions.

Having been involved in the "military caste system" as a twenty-year-old "third lieutenant," I now comprehend more than I did at eighteen, when I was accepted by the Army Air Corps as an aviation cadet. Perhaps it may be of interest to other readers to hear from another person who graduated as a flight officer with a "blue pickle," who served during World War II, and who was proffered a second lieutenancy after peace was declared. I refused to apply for a second lieutenancy for definite reasons. First, if I accepted the commission, I would have had to remain in service without enough points to go home and back to college. In addition, most of the second lieutenants with whom I had graduated were being offered first lieutenancies. As a result, although we were "more or less" equal as flight officers and second lieutenants, there would be additional "low man on the totem pole" duties that would gravitate unmercifully to the *new* second lieutenants.

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 are sorry 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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Publisher
John O. Gray

Associate Publisher
Charles E. Cruze

Editor in Chief
John T. Correll

Executive Editor
Robert S. Dudney

Senior Editor
James W. Canan

Aeronautics Editor
Jeffrey P. Rhodes

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Colleen A. Nash

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Charles E. Cruze
1501 Lee Highway
Arlington, Va. 22209-1198
Tel: 703/247-5800
Telex: 44-0487 COURTESY
Telefax: 703/247-5855

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

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

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Richard E. Ewin
David Harrison
Powers-Overseas Ltd.
46 Keyes House, Dolphin Square
London SW1V 3NA, England
Tel: (44) 71-834-5566
Telex: 24924 OPLIM G
Telefax: (44) 71-630-5878

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

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Letters

If more incentive to refuse a second lieutenancy were required, I considered that as a "warrant officer" (or even as an enlisted man), I did not have to file income tax forms, which would not have been the case if I were a second lieutenant.

There was some indication by superior officers that we *might* be commissioned as second lieutenants and immediately thereafter be awarded first lieutenancy. I did not believe this "carrot and stick."

Additionally, if I accepted the commission, I could not be separated from service permanently, and I could have been recalled to active duty.

In my experience, all of my fellow flight officers were "saddled with numerous additional duties when they were not flying," just as the second lieutenants were. Contrary to what was stated in the article, there was absolutely no difference in those duties, including court-martial assignments.

At the end of the war, I wanted to return to college, so I declined to apply for the second lieutenancy. Frankly, I did not believe the promises of the Army Air Forces.

While I revere my youthful military experiences in the Army Air Forces, I am happy that I made the decision to remain under the symbol of the "blue pickle."

Dr. Robert V. Vaughn
St. Croix, Virgin Islands

Biased Reporting

I would like to take this opportunity to point out major discrepancies in the "Deliveries" subsection of "Aerospace World" in the February 1990 issue *[see p. 23]*.

The first point I wish to make is that the delivery information with respect to the F110-GE-129 engine is not correct. The article states that the first GE delivery was not expected until late December. In fact, the first F110-GE-129 engine was scheduled for delivery to the Air Force in November 1989. General Electric met this delivery requirement, thereby preceding the F100-PW-229's first delivery by one week.

Second, the article casts a negative light on the General Electric Co. I base this point on the fact that "Pratt & Whitney" is in boldface type while "General Electric" is in normal type.

Last, the article does not accurately reflect the differences in maturity of the two engines. The article mentions that the F100-PW-229 will be used in both the F-15 and F-16. Further on, the article states that the F110-GE-129 will "first be used in F-16s." The reader could infer from these statements that the F100-PW-229 is the more mature engine because it was selected for both of America's front-line fighter aircraft and the F110-GE-129 was selected for one. In actuality, the F110-GE-129 has proven its capability in the F-15E in flight test at Edwards AFB, Calif., this past summer. The F110-GE-129 engine was the first Increased Performance Engine (IPE) to fly with two engines in the F-15, the first IPE to complete altitude qualification, and the first IPE delivered to the Air Force.

While Pratt & Whitney and General Electric are in a yearly competition for a share of the annual fighter engine buy, [Aeronautical Systems Division] works very hard to ensure that we are not biased toward either contractor. The article is a conceptually good idea; however, only factual statements should be printed and any biases should be eliminated.

Capt. Oscar Moseley III, USAF
Aeronautical Systems Div.
Wright-Patterson, Ohio

• *While we thank Captain Moseley for his clarifications and apologize if any readers were misled about the relative maturity of the two engines, we deny showing any bias in favor of the Pratt & Whitney engine. The sole reason that Pratt & Whitney's name appeared in boldface type was that its was the delivery being reported. Had it been GE's delivery, the emphasis would have been reversed.*—THE EDITORS

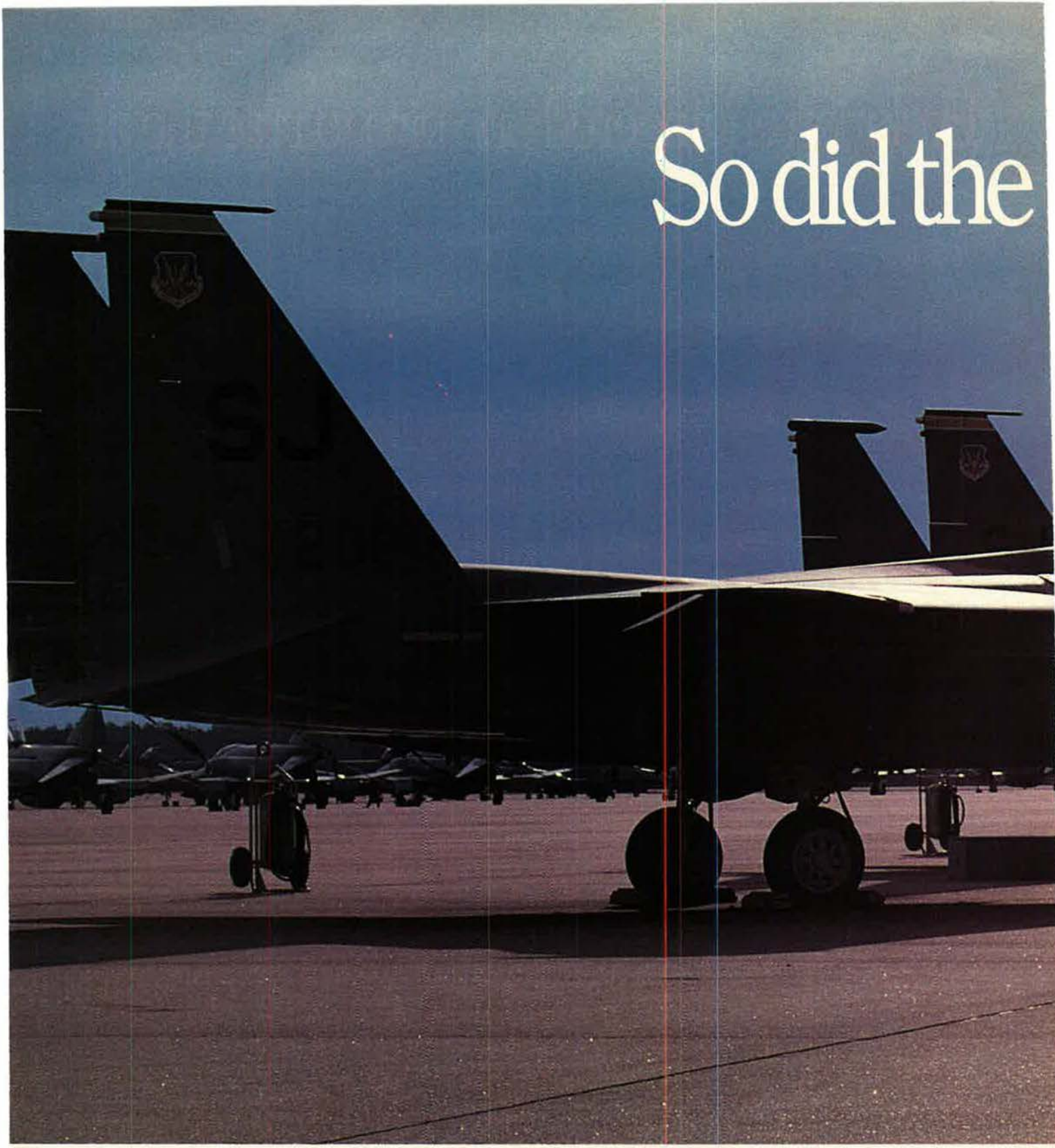
Overlooking Shortcomings

As an avid reader of AIR FORCE Magazine since World War II, I sincerely hope that you will make every effort to survive under the occasional outcry regarding editorial misquotes or incorrect references. After all, referring to a photo of an F-86E as an F-86F may be considered serious; or identifying an occurrence as taking place on September 19, 1944, when it actually took place on September 20, 1944, may seem by some to be inexcusable. Now, in your March 1990 issue you are taken to task by a reader for referring to a graduate of a program as the first "female" when in reality she was simply the first "female pilot" graduating.

I sincerely hope that you will be publishing AIR FORCE Magazine for another fifty years, and I will make every effort to overlook your shortcomings.

Lt. Col. Gerald W. Vath, USAF (Ret.)
Shillington, Pa.

Evolution engineered one bird to rule the air.

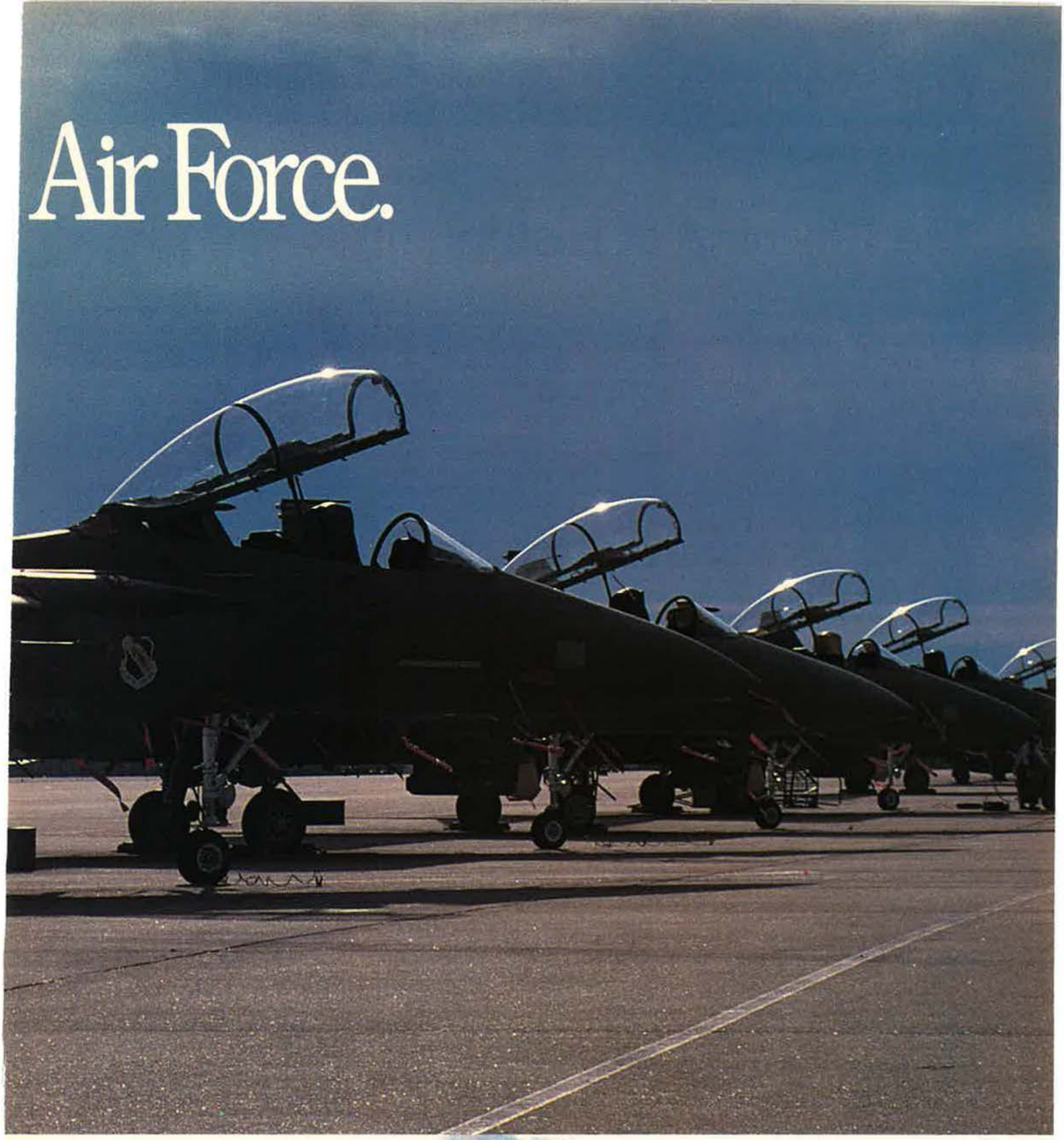


America's Eagle, the F-15E. Newer than any other combat aircraft in our country's arsenal. More capable than any single fighter or attack aircraft in the sky. And ready now to fly side by side with the most advanced weapon systems of the 21st century.

That's the way the Air Force designed America's new Eagle. From fully missionized crew stations to completely flexible weapon-loading capability, this bird has been engineered to rule the air—not just in air-to-ground missions but up against the toughest air-to-air challenges as well.

Built to exacting standards by McDonnell Douglas, this plane's performance in the air is equaled only by its performance on the balance sheet. At a time when fewer defense dollars are

Air Force.



being spent, every aircraft bought must work harder. With the first 75 of these newest Eagles already flying for the USAF, the dual-role F-15E is proving that it fills that order like no other.

America's Eagle. Engineered by the Air Force for double duty, it's twice the plane compared to any single-mission aircraft.

THE F-15E

EAGLE

Viewpoint

By Gen. T. R. Milton, USAF (Ret.), Contributing Editor

The Rhyming of History

Those first years after World War II were an aimless time to be in uniform. If the force drifts to such aimlessness in the 1990s, we're in for trouble.

Henry Ford supposedly said that history is bunk. The creator of the Model T, neither by education nor inclination a philosopher or historian, probably said something less outrageous than this attribution would indicate. Perhaps he meant that we should not look backward for all our guidance, that history doesn't necessarily repeat itself. It does, however, come close now and then, or, as an anonymous philosopher said, it occasionally rhymes.

Most of us who celebrated the end of World War II were too young to have remembered the Armistice of 1918. In any case, the euphoria of 1945 was a repeat performance, with a different cast of characters. Once again, we had made the world safe for democracy and faced a future devoid of enemies. Now, with the end of the cold war, the old familiar glow has returned, and once more, as in 1945, the enemy may turn out to be ourselves.

In the past, we learned all too painfully the penalty for a neglected military. A frightening omen of coming neglect is the current impasse between the House of Representatives and the Pentagon over fund reprogramming to cover personnel costs. It brings to mind uneasy memories of other meat-ax assaults on the defense budget and their sorry consequences. If this reprogramming argument is not soon resolved in favor of the Pentagon, we will be well on the way toward demoralized and second-rate armed forces.

We have been there before. When V-J Day brought an end to World War II, the last thing anyone wanted to hear was a cautionary word about the need for continued preparedness. The overriding priority was a frantic demobilization. New airplanes were bulldozed and outposts evacuated without so much as a gesture toward an orderly tidying up. A year after V-J Day, in places like Greenland, one could run across scenes that might have appeared in a Hitchcock movie: saws halfway through boards, beds that looked just slept in, and half-eaten bowls of cereal, without a sign of life.

When there seem to be no enemies, as was the case in 1945, our statesmen tend to forget a major and continuing responsibility of the federal government: to provide for the national defense.

The euphoria of 1945 lasted not quite three years before a belligerent Soviet Union began to exploit the unpreparedness of the United States. The Berlin crisis ended as an allied victory through the unlikely combination of our nuclear supremacy and an airlift that required the use of all of our transport resources.

Uncomfortably soon after that came the Korean War, when our sad state of readiness brought us to the very brink of disaster. The US monopoly on the atomic bomb and the means to deliver it was an equalizer of sorts, but it was no substitute for adequate conventional strength. The bomb was the effective threat that made the Berlin Airlift possible, but it played no role in Korea, not even as a deterrent.

Following that stalemated war, still technically not over, the Soviet threat to Europe provided the main justification for US force planning during most of the next forty years.

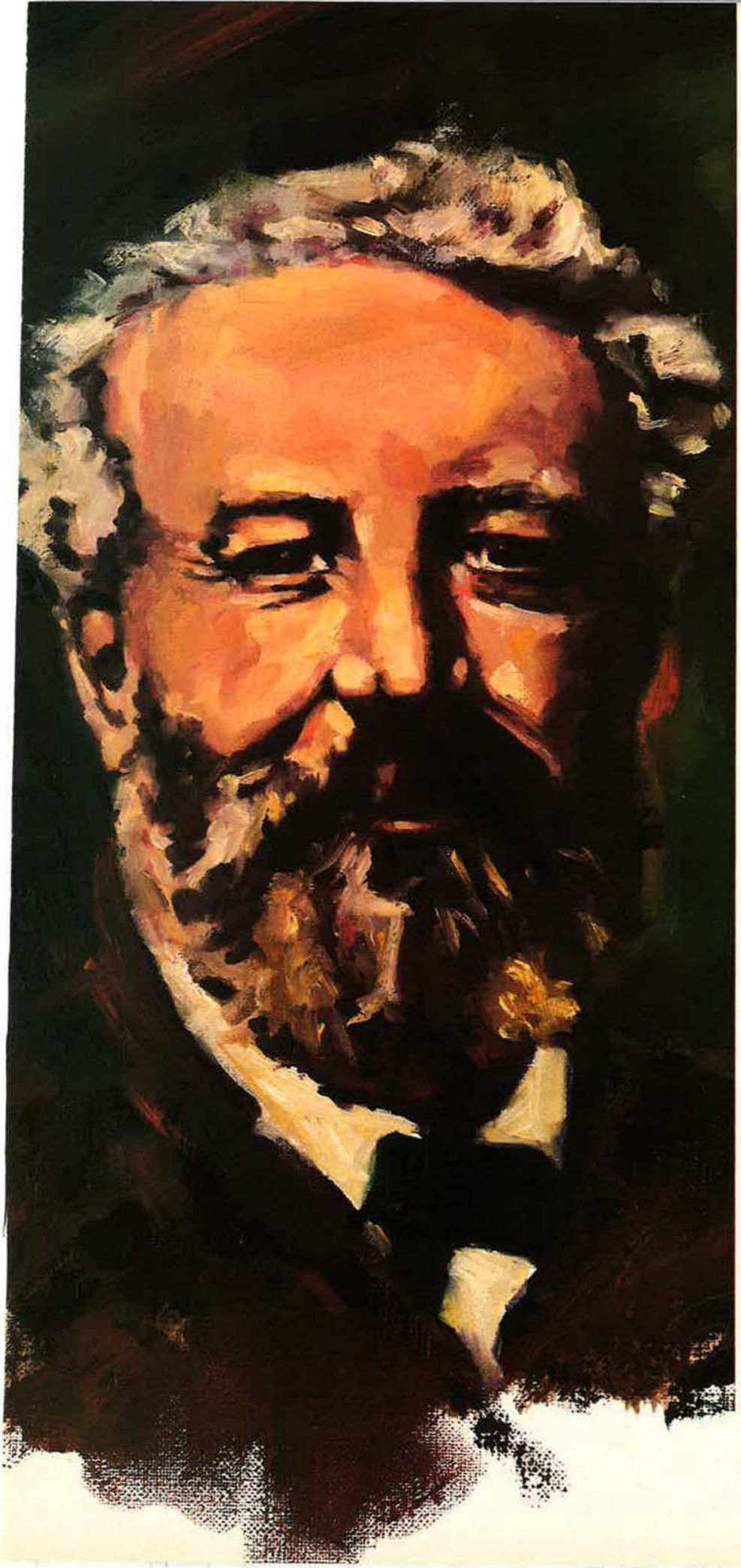
With the implosion of the Soviet empire, we now presumably have won the cold war and find ourselves once again with no enemy—or at least no menacing one—to support defense budget requests. No one can argue sensibly against substantial reductions in defense outlays, but the headlong approach of some legislators, urged on by defense gadflies, goes well beyond the point of responsibility.

When the United States shed its isolationist shell after Pearl Harbor, it set its course, irreversibly, toward becoming a world superpower. Communism's apparent collapse—still by no means a certainty in Russia—does not relieve the United States of its superpower responsibilities. NATO is still, as it has always been, a fragile Alliance utterly dependent on US commitment. Although the threat has undeniably diminished, there are still many uncertainties in Europe, not least the outcome of German unification. A sensible drawdown is plainly in order, but it must be reasonable and bear no resemblance to the hasty exodus of forces after World War II.

The forces that emerged from that postwar debacle were hollow in the true sense of the word. There was much talk about the need for a seventy-group Air Force, but little about the need for a high-quality force of whatever size. Those first years after World War II were an aimless time to be in uniform. We cannot afford such aimlessness again, or, by the end of this new decade, the US may find itself with trouble it can't handle.

The Pacific region will continue to grow in significance as a focus for our national interests. What is sometimes forgotten in our concentration on Europe is how important US military presence has been to the nations around the Asian perimeter. In all probability, our bases in the Philippines are considered more essential in Singapore and Jakarta than in Washington. It's not that anyone is threatening anyone else at the moment, although Vietnam is still a problem, but southeast Asia would be very uneasy if the US were to move back across the horizon.

The watchwords, as these defense cutbacks take place, must be quality and readiness. It is almost too obvious to say that neither can exist without high morale and a sense of purpose. If the defense structure is hacked away in the pursuit of savings without clear purpose, no one should expect anything to emerge from the wreckage but a uniformed job corps. The achievers will have moved on. ■



"Anything that one man can imagine, other men can make real."

Jules Verne
French Writer & Visionary
1828-1905

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AEROSTRENGTH
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Capitol Hill

By Brian Green, Congressional Editor

Back to Hollow Forces?

An AFA white paper asks Congress and the Administration to call off an internal power struggle before it damages 200,000 military careers.

An Air Force Association white paper published in March warned that a power struggle between Congress and the Administration was putting the careers of more than 200,000 military members in jeopardy and might lead back—in the span of a few months—to the "hollow forces" that became a national scandal in the late 1970s.

"Incredible as it may seem," the white paper said, "the power struggle is strictly over the Pentagon's authority to reprogram funds from one of its budget accounts to another." In last year's episode of the annual Gramm-Rudman-Hollings deficit reduction crisis, the government decided to implement a "part-year sequester" of funds, reducing Fiscal Year 1990 outlays accordingly.

To protect members of the armed forces from the worst effects of the reduction, the Pentagon requested authority—as it has in the past—to transfer money into the Military Personnel accounts from other accounts. The total amount of Pentagon outlays was not in question.

Rep. Les Aspin (D-Wis.), Chairman of the House Armed Services Committee (HASC), announced on February 26 that he did "not intend to take up" the reprogramming request, accusing the Administration of "playing chicken" over control of the budget.

Unlike the Reagan Administration in previous Gramm-Rudman crises, the Bush Administration made a point last year of announcing that it would not exempt military personnel from sequestration. Only later was the reprogramming requested to protect military personnel.

AFA acknowledged that "there is an element of truth to Representative Aspin's accusation" but said the game is too devastating to continue and "must be called off now."

Among the specific results cited by the white paper as stemming from a denial of reprogramming:

- Heavy losses in the enlisted force. All 5,800 first-term airmen due for reenlistment between June and September would be forced out of service. Also denied reenlistment would be 8,500 second-term airmen and 7,800 career airmen. Trained veterans would be turned away without regard to their desires or the service's need for them. The losses would exacerbate the shortage of critical skills—a shortage of 12,000 even if reprogramming were approved. "It has been forgotten, apparently, that the most difficult aspect of recovering from the 'hollow forces' fiasco of the 1970s was the slow, painful rebuilding of the junior noncommissioned officer corps," the report says.
- Cessation of enlistments. Virtually all officer and enlisted accessions would stop abruptly. Recruiters would not recruit, and the government would default on enlistment contracts. Graduates of Officer Training School (OTS) and Reserve Officer Training Corps (ROTC) would not be commissioned. The training establishment would also be idled, leaving 2,000 Air Training Command instructors without students.
- Frozen promotions. In the Air Force, 9,300 officers and 18,300 airmen in the grades of staff sergeant through chief master sergeant would be denied promotion. Christopher Jehn, Assistant Secretary of Defense for Force Management and Personnel, told Congress that "those service members we have judged most productive—those selected for promotion" would be penalized.

Mr. Jehn told Rep. Beverly Byron (D-Md.), who chairs the House Armed Services Committee's Military Personnel and Compensation Subcommittee, that these steps "could well be the beginning of a series of events leading to the eventual loss of much of the gain in force quality we have experienced in the last eight years."

The Air Force would be reduced by 43,600—eight percent of the force—over a period of just five months, and would, according to Capitol Hill sources, be reduced further in FY 1991. More than 76,000 people in the Air Force alone would be directly affected by a denial of reprogramming.

Personnel hearings held by the Senate and House Armed Services Committees have been dominated by the reprogramming issue, and FY 1991 budget considerations have been delayed. Service and DoD witnesses stressed the need to approve reprogramming to avoid precipitous personnel reductions, to keep faith with those who enlisted with the expectation of making the military a career, and to permit a sensible structuring of the force. Some concern was also expressed that deep cuts in this fiscal year would undermine the conventional forces in Europe (CFE) arms-control negotiations.

Of the four committees that could block reprogramming—the HASC, the Defense Subcommittees of the House and Senate Appropriations Committees, and the Senate Armed Services Committee, all chaired by Democrats—only the HASC stood in direct opposition.

Other issues, however, complicated the resolution of the conflict. The various committees indicated disagreement with some of the sources for the funds to be reprogrammed. These included programs of congressional interest and congressional add-ons to the FY 1990 defense budget. Personnel reprogramming also became politically intertwined with two other issues: the Administration's aid package to Nicaragua and Panama and its attempt to defer spending on congressionally approved defense programs.

Many in Congress believe the deferrals infringe on congressional prerogatives, and almost all were deemed illegal by the General Accounting Office (an investigative arm of Congress). The Chairman of the Senate Appropriations Committee, Sen. Robert Byrd (D–W. Va.), announced that he would not take up the aid package or reprogramming until the deferral issue was settled. ■

Aerospace World

By Jeffrey P. Rhodes, Aeronautics Editor

★ Lockheed Executive Vice President Ben Rich and the joint Lockheed/Air Force team that designed, developed, produced, and fielded the F-117A Stealth fighter have been named the winners of the Robert J. Collier Trophy for 1989. The Collier Trophy, the most prestigious award in American aviation, has been presented annually since 1911 by the National Aeronautic Association. It is awarded for the greatest achievement in aeronautics or astronautics in America, as demonstrated by actual use the previous year.

At a February 27 presentation before the Aero Club of Washington, Mr. Rich, who also serves as the general manager of Lockheed's Advanced Development Projects section (the "Skunk Works"), shed a little more light on the F-117A program. Here are some highlights from Mr. Rich's speech and the Air Force's Collier Trophy nomination package:

The F-117A was developed in significantly less time and at less cost than comparable fighter aircraft. Development started in the late 1970s in response to the rapidly increasing sophistication and effectiveness of the Soviet air defense system. Air Force Systems Command's Aeronautical Systems Division and Skunk Works personnel worked in a nonadversarial, problem-solving atmosphere and used a minimum number of people. Proven components from other aircraft, including engines, avionics, hydraulics, and flight controls, were used to reduce risk.

Developed under extraordinarily tight security, the aircraft first flew on June 18, 1981, and became operational only twenty-eight months later, in October 1983. As of late February, fifty-seven of the planned fifty-nine F-117s had been delivered, with the other two scheduled for later this year.

The 37th Tactical Fighter Wing, the unit that flies the F-117, differs from the typical fighter wing only in that most of its flying is done at night, up to about sixty-five percent of the time for a combat-ready pilot. Pilots practice night refueling two or three times a month and get roughly twenty hours of flight time per month. All of the pilots are volunteers and must have 1,000 hours of flight time. Approximately 175 pilots have flown the aircraft to date. There are two operational squadrons at the Tonopah Test Range Airfield in Nevada, where the planes are based.

The aircraft is about the size of an F-15 and has a redundant fly-by-wire flight-control system that makes the F-117 very responsive and maneuverable. Mr. Rich said that the F-117 is not a "Wobbly Goblin" as has been reported in the media. He also noted that mission reliability is up forty-eight percent and that the rate of maintenance hours per flight hour has improved sixty-nine percent since IOC. Maintenance is entirely a USAF-run operation.

The F-117's all-black color scheme was ordered by former Tactical Air Command Commander Gen. W. L. Creech. Mr. Rich (who calls himself "the head skunk") said that the color selection "was a prime example of the golden rule—whoever has the gold makes the rules."

★ The Rockwell/Messerschmitt-Bölkow-Blohm X-31A Enhanced Fighter Maneuverability (EFM) demonstrator, the world's first multinational experimental aircraft, was rolled out on March 1 in ceremonies at Rockwell's facility at Air Force Plant 42 in Palmdale, Calif. A joint venture between the US and West Germany, the X-31 is designed to prove technologies that will allow close-in aerial combat beyond normal flight envelope parameters, such as maneuvers below stall speed.

The X-31 design will integrate several technologies to expand the maneuvering envelope, including vectored thrust, integrated control systems, and aircrew assistance. These concepts are expected to enable extremely rapid target acquisition and roll-coupled fuselage pointing for future low-speed, transonic, and supersonic engagements.

The US Defense Advanced Research Projects Agency serves as the lead agency on the EFM project and has funded the X-31 through Naval Air Systems Command, which in turn

An emergency response team sprays fire-retardant foam on the right wing of a C-141 after its rough landing at Robins AFB, Ga., on March 9. The StarLifter lost its right main landing gear, strut, and wheel assembly shortly after takeoff from Howard AFB, Panama. Its nine-member AFRES crew (assigned to the 514th Military Airlift Wing, McGuire AFB, N. J.) jettisoned cargo and were able to land despite a flash fire that ignited when the number four engine scraped the runway.

funds Rockwell. The US contribution to the project is approximately $135 million. The West German Ministry of Defense is funding the rest of the project ($59 million) directly through MBB.

Rockwell's North American Aircraft Operations has overall system responsibility, as well as responsibility for the aircraft's fuselage, canards, and vertical tail. MBB is responsible for developing the flight-control system and for design and fabrication of the wings and thrust-vectoring paddles. Once the X-31 is in the air, Rockwell is responsible for conventional and agility performance testing, while MBB is responsible for post-stall performance.

The aircraft is forty-three feet long, nearly fifteen feet tall, and has a wingspan of just under twenty-four feet. It has a maximum takeoff weight of just over 15,000 pounds. Much of the equipment on the X-31 comes off the shelf (forty-three percent of the aircraft's empty weight, in fact). Seventeen of its major components were originally developed for such existing aircraft as the F/A-18, F-16, V-22, and Citation III. The X-31 is powered by a single General Electric F404-GE-400 engine that will give the aircraft a top speed of Mach 1.3.

The first X-31 was scheduled to fly by late April and will be joined by the second aircraft later this year. After initial testing with both Rockwell and MBB pilots around Palmdale, the aircraft will be transferred to the Naval Air Test Center at NAS Patuxent River, Md. More than 400 hours of flight testing are planned during the next two years.

★ With $7.7 billion worth of prime contracts and more than $889 million more to its divisions in FY 1989, McDonnell Douglas has retained the top spot in the Department of Defense's annual listing of its top 100 contractors. McDonnell Douglas, headquartered in St. Louis, Mo., garnered the top spot for the third consecutive year and has now ranked first in five out of the last six listings.

Fiscal 1988's biggest gainer, Tenneco, which had moved from thirteenth to third, suffered FY 1989's biggest drop, as the company fell to twenty-first. Tenneco's contract values fell from $5.06 billion in FY 1988 to $915 million last year, mainly because of its failure to get new shipbuilding contracts. Among the top ten companies, General Motors, Lockheed, and United Technologies each rose two spots in the rankings, while Raytheon, Boeing, and Grumman moved up one spot each. Six top ten firms did more business (in terms of dollars) with DoD in FY 1989 than they did in FY 1988.

The top ten firms of FY 1989, with dollar value of all contracts awarded to the parent company and its divisions and that firm's FY 1988 rank, are shown in the box above.

Total value of the FY 1989 DoD contract awards was $128,958,161,000, about six percent less than the $137,049,236,000 awarded in FY 1988. Of that total, $85,604,136,000 was awarded to the top 100 firms, about five percent less than the $90,129,842,000 awarded to the top 100 in FY 1988.

The Top Ten of FY 1989

Firm	Contract Values (000 $s)	FY 1988 Rank
1. McDonnell Douglas Corp.	8,617,202	1
2. General Dynamics Corp.	6,899,209	2
3. General Electric Co.	5,771,028	3
4. Raytheon Co.	3,760,681	5
5. General Motors Corp.	3,691,507	7
6. Lockheed Corp.	3,651,547	8
7. United Technologies Corp.	3,556,292	9
8. Martin Marietta Corp.	3,336,555	6
9. The Boeing Co.	2,868,416	10
10. Grumman Corp.	2,373,139	11

Nineteen firms did more than $1 billion in business with DoD in FY 1989, a dropoff of one member from the "billion dollar club" of FY 1988. Eighteen firms not listed in the FY 1988 tally made the top 100 in FY 1989. The 100th-ranked company, Nisshin Service Co. Ltd., received contracts totaling $109,861,000.

★ The STS-36 space shuttle mission had a black cloud over its head, both literally and figuratively. The liftoff of the orbiter *Atlantis* on the sixth dedicated Department of Defense mission was postponed five times (one short of tying the record set in January

1986), with three of the delays caused solely by either high winds or thunderstorms.

High winds also contributed to a fourth delay that came about mainly because mission commander John Creighton, a Navy captain, developed an upper respiratory infection on February 21, the day before the original launch date. NASA no longer selects and trains backup crews for the shuttle missions, so no other astronaut was immediately available to replace him. The fifth delay came because of a computer malfunction thirty-one seconds before a liftoff attempt on February 25.

The thirty-fourth shuttle mission finally got under way at 2:52 a.m. on February 28. The launch, which was made between two lines of thundershowers, was the fourth night liftoff in the shuttle program. The orbiter made a severe roll maneuver after clearing the tower and flew up the Eastern Seaboard at a sixty-two-degree inclination above the equator, the highest inclination ever for a shuttle mission.

The orbiter's classified payload, believed to be a digital imaging and signals intelligence satellite called AFP-731, was delivered to orbit roughly twenty-seven hours into the mission. A secondary payload was an instrumented human skull that measures how solar radiation enters the human head during a space mission. This was the second trip into space for the skull.

The mission's misfortunes continued during the approach to landing at Edwards AFB, Calif., on March 4, as an inch-long rupture developed in a hydraulic line. The crew resorted to a backup, although pressure in the main line was later restored. Beating bad weather in, *Atlantis* touched down on Runway 23 at Edwards at 1:08 p.m. EST.

The troubles didn't end there. On March 16, it was announced that "hardware associated with the STS-36 mission will reenter the atmosphere" by late April. Observers believe that the 37,300-pound, $500 million satellite has broken into six pieces, probably during an attempt to boost the satellite into a higher orbit. Two pieces had reentered by late March.

Other than Captain Creighton, STS-36 was crewed by Air Force Col. John Casper (pilot), Marine Lt. Col. David Hilmers, Air Force Col. Richard Mullane, and Navy Lt. Cmdr. Pierre Thuot (mission specialists). Colonel Casper and Commander Thuot were space rookies.

★ **APPOINTED—Lt. Col. Chuck Simpson** has been selected to be the new Commander/Leader of the Air Force's Air Demonstration Squadron, the Thunderbirds, for the 1990 and 1991 seasons. A seventeen-year Air Force veteran, he has more than 3,000 flight hours in the cockpit. Colonel Simpson, a thirty-nine-year-old native of San Antonio, Tex., comes to the team from the Air Force Fighter Weapons School at Nellis AFB, Nev., where he commanded the F-16 division. The Thunderbirds have more than seventy shows scheduled this year.

★ **HONORS**—The 18th Tactical Fighter Wing's **67th Tactical Fighter Squadron** has been named the winner of the **Hughes Achievement Trophy** for 1989. The trophy, sponsored by Hughes Aircraft, is presented annually to the top Air Force squadron with an air defense mission. The F-15 squadron, based at Kadena AB, Japan, also claimed the trophy in 1983 and 1986 and becomes only the fourth squadron to win the award three times. The Hughes Trophy was first awarded in 1953.

Air Force Systems Command's **Space Systems Division's Launch Systems Directorate** at Los Angeles AFB, Calif., was announced in mid-February as the 1989 winner of the **Gen. Thomas D. White USAF Space Trophy.** The annual award, sponsored by the National Geographic Society, is presented to individuals or organizations making the year's outstanding contribution to the nation's progress in aerospace. The directorate was cited for development and procurement of a diverse array of expendable launch boosters and satellite systems for military and civilian applications.

A second award named after the

May Anniversaries

- *May 5, 1910:* A world kite altitude record of 23,800 feet is set at the Mount Weather (Va.) Observatory.
- *May 25, 1910:* In Dayton, Ohio, Wilbur and Orville Wright fly together for the first time.
- *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 sat in the jumpseat of the Boeing Model 80A.
- *May 28, 1940:* Operation Dynamo, the evacuation of Allied forces from Dunkirk, France, begins. Altogether, 338,226 British, Belgian, and French troops are rescued by June 3. Royal Air Force fighters and bombers provide air cover throughout the operation.
- *May 7, 1945:* At 1:41 a.m., German *Generaloberst* Alfred Jodl signs the articles of unconditional surrender at Gen. Dwight D. Eisenhower's headquarters (a converted schoolhouse) in Rheims, France. The next day, President Harry Truman proclaims May 9 V-E (Victory in Europe) Day.
- *May 12, 1950:* Over Edwards AFB, Calif., Air Force Capt. Chuck Yeager pilots the number one Bell X-1 research aircraft on its last flight in order to get footage for the movie "Jet Pilot."
- *May 10, 1955:* The General Electric XJ79 turbojet engine is flown for the first time on an NB-45 test-bed over Schenectady, N. Y. The J79 would be used to power the Convair B-58, Lockheed F-104, and McDonnell Douglas F-4.
- *May 1, 1960:* Central Intelligence Agency pilot Francis Gary Powers, flying a Lockheed U-2 reconnaissance aircraft, is shot down over the Soviet Union near Sverdlovsk. Mr. Powers is captured and later put on trial for espionage. The incident created an international furor, and a superpower summit scheduled for later in the month was canceled. In 1962, Mr. Powers was exchanged for Soviet KGB agent Rudolf Abel. Mr. Powers died in 1977.
- *May 20, 1960:* The Air Force launches from Cape Canaveral AFS, Fla., a Convair HGM-16 Atlas intercontinental ballistic missile (Atlas 56D) 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, Fla. The aircraft was a VB-25J, an aircraft modified for use as a staff transport.
- *May 12–14, 1975:* Cambodian Communists seize the US merchantman SS *Mayaguez* in the Gulf of Siam and take the crew of thirty-nine prisoner. President Gerald Ford sends US military forces to Tang Island to recapture the crew and ship, which is accomplished. Fifteen Marines are killed in the fighting.
- *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.

fourth Air Force Chief of Staff, the **Thomas D. White National Defense Award,** was presented to retired Navy **Adm. William J. Crowe, Jr.,** in ceremonies at the Air Force Academy in Colorado Springs, Colo., on March 8. This award is presented annually to the American citizen judged to have contributed most significantly to the defense and security of the US during the previous year. Admiral Crowe was cited for his many contributions as Chairman of the Joint Chiefs of Staff.

★ **PURCHASES—Rockwell's Autonetics Division** received a $134.9 million Air Force Systems Command's Ballistic Systems Division contract on March 13 for the FY 1990 buy of **Advanced Inertial Reference Sphere Measurement Units (IMUs) for intercontinental ballistic missile programs.** The winner-take-all contract calls for fifty IMUs (twenty-nine for LGM-118A Peacekeeper ICBMs, nineteen for MGM-134A Small ICBMs, and two spares) to be delivered between 1991 and 1993. The IMU, a basketball-sized sphere containing more than 19,000 parts, provides constant updates to the missile's guidance system for determining velocity and position. This is the last production buy of IMUs for the LGM-118A. Rockwell was named the second-source contractor to Northrop for the IMUs in 1988.

Rockwell's Missile Systems Division won 100 percent of the FY 1990 buy of **AGM-114 Hellfire tactical missiles.** The company received a $125.2 million Army Missile Command contract for 4,864 missiles on March 7. The contract also includes options for FY 1991–93 production. This buy will be the last for current AGM-114 production. Martin Marietta, which had competed with Rockwell for Hellfire production over the last six years, will start development work on an improved Hellfire that will be fielded in the mid-1990s.

Ford Aerospace received a $21.4 million Naval Air Systems Command contract modification **for production of a low-cost seeker for** the Texas Instruments AGM-88 High-Speed Anti-radiation Missile **(HARM)** on March 6. The contract moves the low-cost seeker program out of engineering development and into production. Also included in the contract are engineering support, a technical data package, and quality assurance testing. A total of 100 seekers (to be split between Navy and Air Force missiles) will be built for the new variant of HARM, the AGM-88C. In a related purchase, **Thiokol** received a $12.6 million NAVAIR contract in March for 500 HARM rocket motors.

★ **DELIVERIES**—The **first Sikorsky MH-60K Black Hawk** special operations helicopter for the Army **was rolled out** in ceremonies at the company's Stratford, Conn., plant on March 14. The MH-60K features a terrain following/terrain avoidance radar in the nose-mounted radome, a radar and laser warning system, chaff and flare dispensers, an internal jammer, and the IBM-developed Integrated Avionics Subsystem that combines navigation, communications, and other aircraft systems to reduce pilot work load. Many of the avionics boxes are interchangeable with those of the Army's MH-47E. The MH-60K also features an air refueling probe, provisions for two .50-caliber machine guns, a rescue hoist, and two 230-gallon external tanks plus additional internal tankage. The new helicopter also has a folding stabilator, tie-downs, and a rotor brake similar to those of the Navy's SH-60 to facilitate air transportability and shipboard operations. Current plans call for the production of twenty-three MH-60Ks,

with an option for thirty-eight more. First flight of the MH-60K is expected this summer, with deliveries set to begin in 1991.

LTV delivered the first vertical stabilizer for the first C-17 airlifter to McDonnell Douglas in ceremonies on February 28. The nearly forty-eight-foot-tall and thirteen-foot-wide structure was shipped from LTV's plant in Dallas, Tex., to the Douglas Aircraft Co. plant in Long Beach, Calif., in specially configured railroad boxcars. LTV is also building the horizontal stabilizers, engine nacelles, and universal aerial refueling receptacle slipway installation for the C-17. The entire C-17 empennage will weigh 10,234 pounds and will have 9,117 parts and 144,575 fasteners.

Martin Marietta delivered 116 Low-Altitude Navigation and Targeting Infrared for Night **(LANTIRN) navigation pods** to the Air Force on February 26. The production pods will be sent to Luke AFB, Ariz., Lowry AFB, Colo., Nellis AFB, Nev., Moody AFB, Ga., and Seymour Johnson AFB, N. C. Seventeen navigation pods were delivered to SeymourJohnson AFB last fall to allow the 4th Tactical Fighter Wing to reach initial operational capability with the F-15E. The LANTIRN targeting pod will become operational later this year. In all, 561 navigation pods, 441 targeting pods, and twenty-six sets of support equipment have been bought since the first production buy in 1985. In other LANTIRN news, Tactical Fighter Weapons Center crews from Nellis AFB, Nev., recently completed a successful cold-weather LANTIRN demonstration with F-15Es at Eielson AFB, Alaska.

Boeing delivered the nineteenth and final Pan Am 747-200 aircraft modified for Civil Reserve Air Fleet **(CRAF)** duties to the airline on February 21. The first modified Pan Am CRAF 747 was delivered in 1985. Upon arrival at Boeing's plant in Wichita, Kan., the interiors of the 747s were removed and strengthened floor beams were installed, along with a cargo handling system. The planes have twenty-nine pallet positions. Ten-foot-high cargo doors were also installed in the planes' port fuselage aft of the wing. Full interiors were reinstalled, and the planes were then returned to Pan Am for passenger service. The CRAF 747s carry the military designation C-19A.

CFM International, the joint venture company formed by General Electric and SNECMA of France, **delivered the 1,000th F108-CF-100 high-bypass-ratio turbofan engine** in early February. The F108 is being used in both USAF's KC-135R and the French Air Force's C-135FR tanker reengining programs. Since entering service in 1984, the F108 has accumulated more than 655,000 engine flight hours with only seventeen engine-caused removals, or a shop-visit rate of 0.02^. CFM International has 310 more engines on order, and USAF has options for 410 additional F108s.

★ **MILESTONES—Four speed records, including the transcontinental mark, were set** on March 6 **by the Lockheed SR-71A "Blackbird" crew** flying the reconnaissance aircraft into retirement at the National Air and Space Museum in Washington, D. C. Taking off from Palmdale, Calif., the crew of Lt. Col. Ed Yeilding (pilot) and Lt. Col. J. T. Vida (reconnaissance systems officer) first refueled before passing the starting radar gate near Oxnard, Calif. Just over an hour later, the crew passed through the final gate near Salisbury, Md., refueled, and landed at Dulles International Air-

port near Washington. The crew flew the 2,404.05 statute mile course in 1:08.17 at an average speed of 2,112.52 mph. Records were also set for the runs from Los Angeles to Washington (1:04.05 at a speed of 2,153.24 mph); Kansas City, Mo., to Washington (26.36 minutes at a speed of 2,200.94 mph); and St. Louis, Mo., to Cincinnati, Ohio (8.20 minutes at a speed of 2,242.48 mph). The St. Louis–Cincinnati run exceeds the previous absolute speed record over a straight course, but the necessary documentation for an absolute record attempt was not filed with the National Aeronautic Association prior to the flight, as Air Force officials did not want the crew to break existing records held by the SR-71. The SR-71 flown on this flight, serial number 64-17972, also holds the New York–London and London–Los Angeles speed records.

The **Pioneer 11 spacecraft became the fourth spacecraft to leave the solar system** on February 23. The TRW-built spacecraft, launched in 1973, was 2.8 billion miles from Earth when it crossed the orbit of Neptune. (Because of Pluto's unusual orbit, Neptune is currently the farthest planet from the sun.) Pioneer 11 will now join Pioneer 10, Voyager 1, and Voyager 2 in the search for the heliopause, the point at which the solar winds no longer have any effect. Pioneer 11 is now expected to remain functional until 1995, approximately twenty-one years longer than initially expected at liftoff.

A McDonnell Douglas **F-15 that can automatically repair its own flight-control system completed several test flights** in early March at NASA's Dryden Flight Research Center at Edwards AFB, Calif. Working under a $6.3 million, three-year Air Force contract, McDonnell Douglas equipped the F-15 with unique software that detects faults and determines which component caused them. The system then alters the flight controls to aid the pilot in regaining full control of the aircraft. The system can also diagnose electronic and hydraulic failures, enabling ground crews to make repairs faster.

The Grumman **E-8A Joint STARS** (Joint Surveillance and Target Attack Radar System) **aircraft completed its first deployment to Europe** on February 28. The aircraft was flown to RAF Mildenhall, England, in mid-February, and more than twenty flight-test hours were accumulated. The primary purpose of this exercise (called Early Look) was to make sure the system could function in the electromagnetic interference spectrum found in Europe. All of the tests were successful. A second European deployment is planned for next year, when tests will include joint operations with Army ground modules.

The **Navy conducted the last certification test of** the Lockheed UGM-133A **Trident II,** or D5, sea-launched ballistic missile on March 11. The missile was launched from USS *Pennsylvania* (SSBN-735), submerged off the Florida coast near Cape Canaveral AFS. This was the first shot from the *Pennsylvania* and was the second demonstration and shakedown launch. The Navy was then able to reach initial operational capability with Trident II on schedule in late March.

Raymond Dudley, a senior guard on the Air Force Academy's men's basketball team, **ended his four-year career with a host of accolades.** The Warner Robins, Ga., native ended his 109-game career with 2,178 points to become the only Falcon player ever to score more than 2,000 points and only the seventh Western Athletic Conference player to reach that milestone.

His career scoring average of 20.0 points per game is the second best in the school's history. His 21.4 ppg average this season gave him his second consecutive WAC scoring title. Named a first-team member of the All-WAC team the last two years, Cadet Dudley now holds thirty-five school and conference single-game, single-season, or career marks and three Cadet Field House marks. The Academy's women's basketball coach, **Marti Gasser, was named as the Continental Divide Conference Coach of the Year** for the 1989–90 season. The Lady Falcons claimed the CDC title this winter with an 8–4 conference record. They were 20–8 overall.

★ **NEWS NOTES**—The **two crew positions on operational Northrop B-2A bombers will be designated "pilot" and "mission commander."** The pilot will sit in the left seat and be responsible for flying the airplane, while the mission commander, who will be dual-qualified as a pilot and as a navigator/weapon systems officer, will sit in the right seat. The MC will serve as the aircraft commander and will have weapons control responsibilities.

Military Airlift Command has lowered the security priority on C-5 aircraft based in the continental US as a cost-saving measure. By lowering the C-5 flight line security level from Priority B to Priority C, the need for entry-point controllers is eliminated. Officials stress that the measure still provides adequate, but reduced, security for the assets. The giant airlifters will retain a Priority B status when they are deployed overseas.

The **first underground nuclear test of 1990 was successfully conducted** on March 10. The device, code-named Metropolis, was listed as having an explosive force of 20,000–150,000 tons of TNT. The test registered 5.1 on the Richter scale, however, which indicates that the device's force was on the high end of the explosive scale. Metropolis was exploded at the bottom of a 1,500-foot shaft at Yucca Flats, Nev. This was the 700th announced nuclear test in Nevada since testing began there in 1951.

In missile test news, the Air Force **successfully carried out the 142d follow-on operational test of** the Boeing LGM-30G **Minuteman III** intercontinental ballistic missile on February 6. The missile was launched from

Senior Staff Changes

RETIREMENTS: M/G G. Wesley **Clark;** M/G Charles P. **Skipton;** B/G John D. **Wood.**

CHANGES: Col. (B/G selectee) George T. Babbitt, Jr., from Dep. Dir., Log. Plans & Prgms., DCS/L&E, Hq. USAF, Washington, D. C., to DCS/Log., Hq. ATC, Randolph AFB, Tex., replacing retiring B/G John W. Soper . . . **Col. (B/G selectee) Albert D. Jensen,** from Exec. Officer to the CINC, Hq. SAC, Offutt AFB, Neb., to CINCSAC Rep. to JCS, and Dep. Dir., AC&S, JSTPS, Hq. SAC, Offutt AFB, Neb., replacing B/G Kenneth L. Hagemann, Sr. . . . **B/G Jean E. Klick,** from Dep. Dir., Communications, Ops. Spt. & Control Sys., Space Sys. Div., AFSC, Los Angeles AFB, Calif., to Vice Cmdr., Space Sys. Div., AFSC, Los Angeles AFB, Calif., replacing M/G Robert R. Rankine, Jr.

B/G (M/G selectee) Walter Kross, from DCS/Plans & Req., Hq. ATC, Randolph AFB, Tex., to Dir., Ops. & Logistics, J-3/J-4, Hq. USTRANSCOM, Scott AFB, Ill., replacing retiring M/G John E. Griffith . . . **Col. (B/G selectee) Michael D. McGinty,** from Cmdr., 10th TFW, USAFE, RAF Alconbury, UK, to DCS/Plans & Req., Hq. ATC, Randolph AFB, Tex., replacing B/G (M/G selectee) Walter Kross . . . **Col. (B/G selectee) Kenneth G. Miller,** from Vice Cmdr., Acq. Log. Div., Hq. AFLC, Wright-Patterson AFB, Ohio, to Cmdr., Contract Mgmt. Div., AFSC, Kirtland AFB, N. M., replacing retired M/G Charles P. Skipton.

M/G Robert R. Rankine, Jr., from Vice Cmdr., Space Sys. Div., AFSC, Los Angeles AFB, Calif., to DCS/Tech. and Req. Planning, Hq. AFSC, Andrews AFB, Md., replacing M/G (L/G selectee) Thomas R. Ferguson, Jr. . . . **Col. (B/G selectee) James C. Roan, Jr.,** from Staff Judge Advocate, ESD, AFSC, Hanscom AFB, Mass., to Staff Judge Advocate, Hq. AFSC, Andrews AFB, Md., replacing retiring B/G Thomas G. Jeter, Jr. . . . **Col. (B/G selectee) William L. Worthington, Jr.,** from Cmdr., 554th Ops. Spt. Wing, TAC, Nellis AFB, Nev., to Vice Cmdr., San Antonio ALC, AFLC, Kelly AFB, Tex., replacing retired B/G John D. Wood.

SENIOR EXECUTIVE SERVICE (SES) CHANGES: Jerry W. Dorris, from Dep. Ass't Auditor Gen. (Fld. Act.), (GM-15), AFAA, Norton AFB, Calif., to Ass't Auditor General (Fld. Act.), (SES), AFAA, Norton AFB, Calif. . . . **Dr. Helmut Hellwig,** to the newly established position of Dir., AFOSR, Bolling AFB, D. C. . . . **John K. Scott** resigned from the SES position of Deputy Ass't Sec'y (Accounting, Finance, and Banking), OSAF, Washington, D. C. . . . **Frank O. Tuck,** from Supervisory Acq. Mgmt. Engineer (GM-15), ASD/SDM, AFSC, Wright-Patterson AFB, Ohio, to Dep. Prgm. Dir., Systems SPO (SES), ASD, AFSC, Wright-Patterson AFB, Ohio. ■

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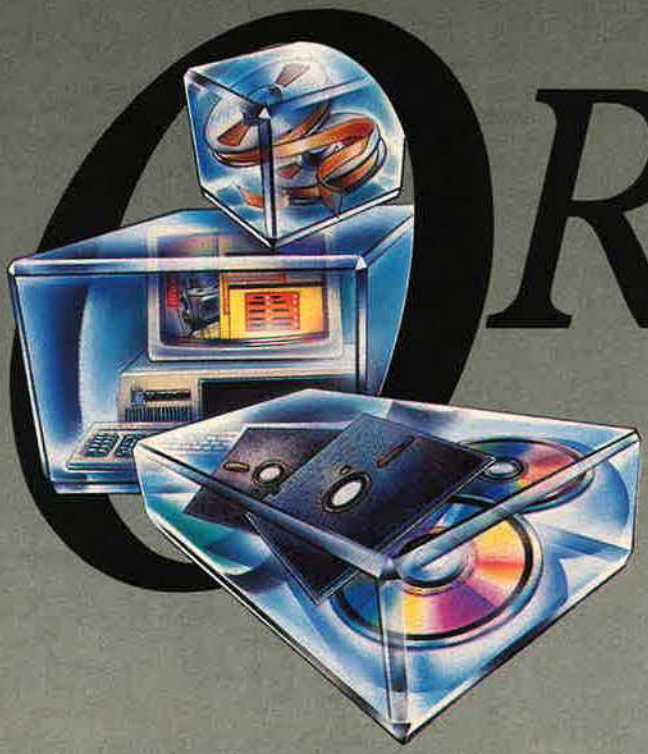

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Vandenberg AFB, Calif., by a crew from the 321st Strategic Missile Wing at Grand Forks AFB, N. D. The **second operational test of** the Martin Marietta LGM-118A **Peacekeeper** ICBM **was successfully carried out** from Vandenberg on March 8 by a crew from the 90th SMW at F. E. Warren AFB, Wyo. Both missiles carried unarmed reentry vehicles and flew the 4,200 miles to the Kwajalein Missile Test Range in the Pacific in about thirty minutes. The **sixth consecutive successful test launch of** the AGM-129A Advanced Cruise Missile **(ACM) was carried out** on February 15. The missile was launched from a B-52H over the Pacific and hit its target area in the Utah Test and Training Range. This was the ACM's thirteenth success in twenty-one tries.

Martin Marietta successfully launched the second commercial Titan III space booster from Launch Complex 40 at Cape Canaveral AFS, Fla., on March 14, **but its payload, Intelsat 6 (F-3), failed to separate from the booster's second stage.** The 10,179-pound satellite was marooned in a useless low-Earth orbit and was in danger of reentering the atmosphere. Ground controllers were later able to establish contact and nudge the satellite into a safe orbit. INTELSAT, an international, not-for-profit, commercial cooperative, had not insured the $150 million Hughes-built satellite. Robert Crippen, NASA's space shuttle program director, said on March 23 that using the shuttle to rescue the satellite was possible if the rescue could be combined with an already scheduled shuttle mission. The cost of a separate mission to rescue Intelsat 6 would be prohibitive.

The **Air Force was awarded its seventy-eighth campaign streamer for its service flag** by President George Bush in ceremonies at Fort Myer, Va., on March 8. The streamer, which was also presented to each of the other services, was given for participation in Operation Just Cause, the US military action in Panama last December.

Some old soldiers (actually some old sailors) just faded away last year, as **the Navy struck three World War II vintage *Essex*-class aircraft carriers from the Naval Vessel Register.** The ships, which had been mothballed at the Puget Sound Naval Shipyard in Bremerton, Wash., were USS *Oriskany* (CV-34), USS *Bennington* (CVS-20), and USS *Bon Homme Richard* (CVA-31). A fourth *Essex*-class carrier, USS *Hornet* (CVS-12), which served as the recovery ship for the Apollo 11 crew after the 1969 moon landing, remains at the shipyard in inactive status. The only *Essex*-class carrier still on active duty is the Navy's training carrier, USS *Lexington* (AVT-16). Two other carriers exist as museums. The twenty-four *Essex*-class ships were the largest class of fleet carriers ever built. The ships served in three wars.

★ **DIED**—Retired Army **Lt. Gen. James M. Gavin,** famed World War II veteran, Commander of the 82d Airborne Division, and cocreator of the Peace Corps, of Parkinson's disease at a Baltimore, Md., nursing home on February 23. He was eighty-two. A 1929 graduate of West Point, Colonel Gavin saw plenty of action in World War II. His regiment jumped in the airborne invasions of Sicily and Salerno in 1943. He was promoted and then led the 82d's D-Day jump as assistant division commander. As Commander of the 82d, he was injured upon landing during the Arnhem invasion. General Gavin later served as Army Deputy Chief of Staff and was instrumental in the development of helicopter tactics and employment. He retired in 1958 and served two brief stints as US Ambassador to France. His decorations included the Distinguished Service Cross with oak leaf cluster, Silver Star with oak leaf cluster, Bronze Star, and Purple Heart.

★ **UPDATE**—The **likely cause of the midair explosion of a KC-135A tanker over Maine last October** *[see "Aerospace World," December 1989 issue]* **was determined to be an overheated fuel pump.** The accident report, released February 23, indicated that one of the aircraft's four fuel pumps reached a temperature of at least 1,435 degrees Fahrenheit, which set off an explosion in the fuel tank. The fuel pumps are designed to operate while immersed in fuel; according to the report, the pump could not have reached such a high temperature if it had been immersed. Crews had been allowed to pump all of the fuel out of the tank during aerial refueling operations, but were cautioned not to operate the pump in an empty tank for longer than two minutes. Crews are now required to keep a minimum of 3,000 pounds of fuel in each KC-135 body tank to prevent the pump's overheating. ■

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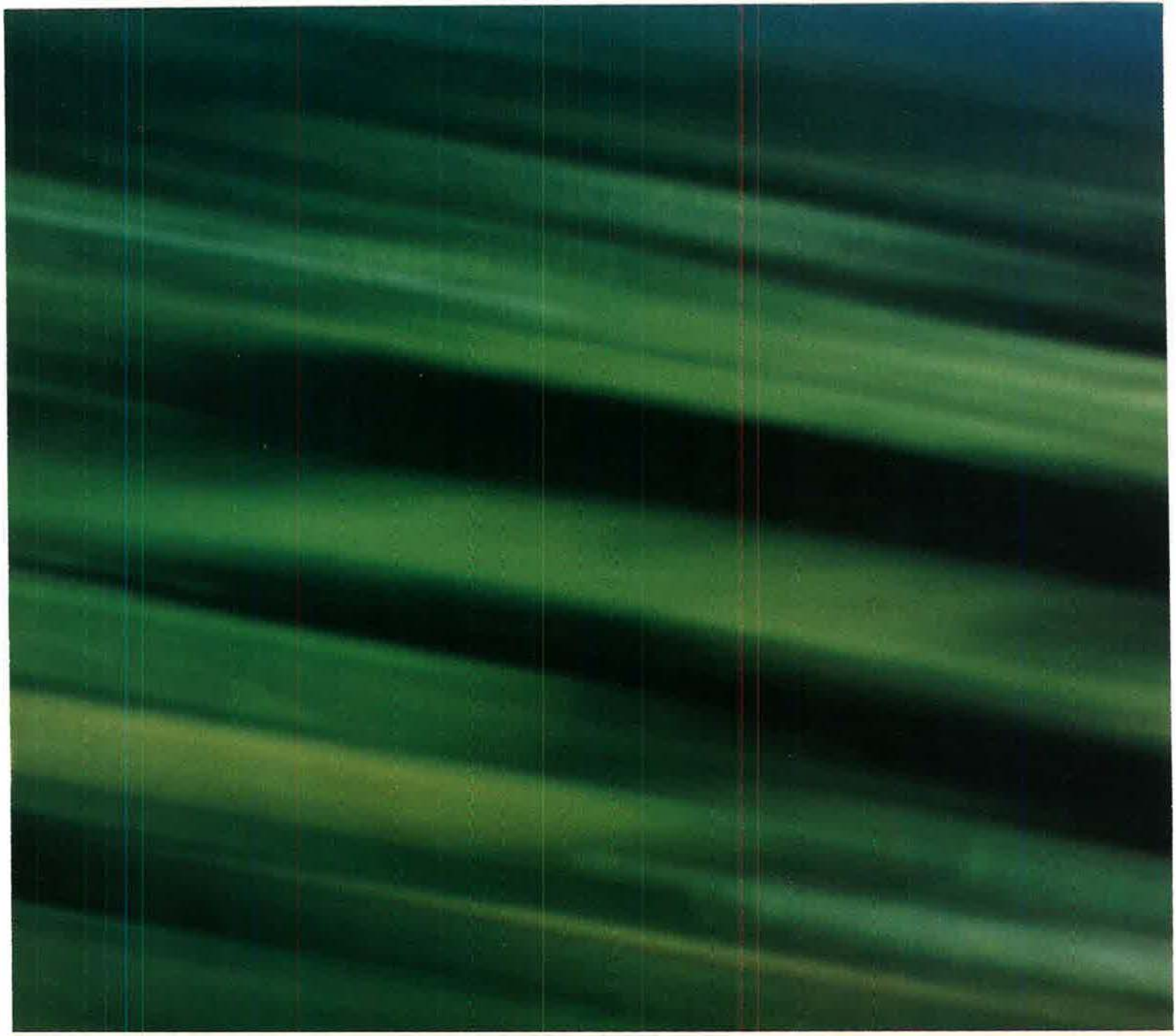

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And because the ALQ-184 uses multiple mini-tubes instead of a single big one, even the loss of several tubes will not disable the system.

Fully maintainable by Air Force personnel, the ALQ-184 and its support needs are now in production. It's another example of how Raytheon's

the ALQ-184.

long experience with system fundamentals can improve an older system's capabilities.

For more information, write Raytheon Company, Government Marketing, 141 Spring Street, Lexington, MA 02173.

The ALQ-184 jamming pod is being deployed on U.S. Air Force F-4s and F-16s.

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State of the Force
The 1990 USAF Almanac

USAF in Facts and Figures

On the following pages appears a variety of information and statistical material about the US Air Force—its people, organization, equipment, funding, activities, bases, and heroes. This "Almanac" section was compiled by the staff of AIR FORCE Magazine. We especially acknowledge the help of the Secretary of the Air Force Office of Public Affairs in its role as liaison with Air Staff agencies in bringing up to date the comparable data from last year's "Almanac."

A word of caution: Personnel figures that appear in this section in different forms will not agree (nor will they always agree with figures in command, separate operating agency, and direct reporting unit reports or in the "Guide to Major USAF Installations Worldwide") because of different cutoff dates, rounding, differing methods of reporting, or categories of personnel that are excluded in some cases. These figures do illustrate trends, however, and may be helpful in placing force fluctuations in perspective.

—THE EDITORS

—Staff photo by Guy Aceto

While providing the symbolism for this month's cover, SSgt. Robert Sassman, a quality assurance evaluator with the 375th Military Airlift Wing's consolidated aircraft maintenance squadron, is actually checking the oil level in one of the turbofan engines of a C-21A based at Scott AFB, Ill. The full-color insignia are somewhat rare now, as the national insignia on most aircraft are subdued.

USAF—EVOLUTION OF THE NAME AND THE SERVICE'S LEADERS[1]

DESIGNATION	FROM	TO	COMMANDER (at highest rank)	TITLE	FROM	TO
Aeronautical Div., US Signal Corps	Aug. 1, 1907	July 18, 1914	Brig. Gen. James Allen	Chief Signal Officer	Aug. 1, 1907	Feb. 13, 1913
			Brig. Gen. George P. Scriven	Chief Signal Officer	Mar. 5, 1913	July 18, 1914
Aviation Section, US Signal Corps	July 18, 1914	May 20, 1918	Brig. Gen. George P. Scriven	Chief Signal Officer	July 18, 1914	Feb. 13, 1917
			Maj. Gen. George O. Squier	Chief Signal Officer	Feb. 14, 1917	May 20, 1918
Air Service	May 20, 1918	July 2, 1926	Maj. Gen. William L. Kenly	Director, Div. of Military Aeronautics	May 20, 1918	Aug. 28, 1918
			John D. Ryan	Director of Air Service	Aug. 28, 1918	Nov. 27, 1918
			Maj. Gen. Charles T. Menoher	Director of Air Service	Jan. 2, 1919	June 4, 1920
			Maj. Gen. Charles T. Menoher	Chief of Air Service	June 4, 1920	Oct. 4, 1921
			Maj. Gen. Mason M. Patrick	Chief of Air Service	Oct. 5, 1921	July 2, 1926
Air Corps	July 2, 1926	June 20, 1941	Maj. Gen. Mason M. Patrick	Chief of Air Corps	July 2, 1926	Dec. 13, 1927
			Maj. Gen. James E. Fechet	Chief of Air Corps	Dec. 14, 1927	Dec. 19, 1931
			Maj. Gen. Benjamin D. Foulois	Chief of Air Corps	Dec. 20, 1931	Dec. 21, 1935
			Maj. Gen. Oscar Westover	Chief of Air Corps	Dec. 22, 1935	Sept. 21, 1938
			Maj. Gen. Henry H. Arnold	Chief of Air Corps	Sept. 29, 1938	June 20, 1941
Army Air Forces	June 20, 1941	Sept. 18, 1947	Lt. Gen. Henry H. Arnold	Chief, Army Air Forces	June 20, 1941	Mar. 9, 1942
			Gen. of the Army[2] Henry H. Arnold	Commanding General, AAF	Mar. 9, 1942	Feb. 9, 1946
			Gen. Carl A. Spaatz	Commanding General, AAF	Feb. 9, 1946	Sept. 26, 1947
United States Air Force	Sept. 18, 1947		Gen. Carl A. Spaatz	Chief of Staff,[3] USAF	Sept. 26, 1947	Apr. 29, 1948

[1]For USAF leaders since 1948, see "USAF Leaders Through the Years."
[2]Changed to "General of the Air Force" by Act of Congress, May 7, 1949.
[3]DoD approved Army–Air Force Transfer Order establishing position of Chief of Staff not issued until Sept. 26, 1947.

UNITED STATES AIR FORCE PERSONNEL STRENGTH—1907 THROUGH 1991

YEAR	STRENGTH	YEAR	STRENGTH
1907	3	1950	411,277
1908	13	1951	788,381
1909	27	1952	973,474
1910	11	1953	977,593
1911	23	1954	947,918
1912	51	1955	959,946
1913	114	1956	909,958
1914	122	1957	919,835
1915	208	1958	871,156
1916	311	1959	840,028
1917	1,218	1960	814,213
1918	195,023	1961	820,490
1919	25,603	1962	883,330
1920	9,050	1963	868,644
1921	11,649	1964	855,802
1922	9,642	1965	823,633
1923	9,441	1966	886,350
1924	10,547	1967	897,426
1925	9,670	1968	904,759
1926	9,674	1969	862,062
1927	10,078	1970	791,078
1928	10,549	1971	755,107
1929	12,131	1972	725,635
1930	13,531	1973	690,999
1931	14,780	1974	643,795
1932	15,028	1975	612,551
1933	15,099	1976	585,207
1934	15,861	1977	570,479
1935	16,247	1978	569,491
1936	17,233	1979	559,450
1937	19,147	1980	557,969
1938	21,089	1981	570,302
1939	23,455	1982	582,845
1940	51,165	1983	592,044
1941	152,125	1984	597,125
1942	764,415	1985	601,515
1943	2,197,114	1986	608,199
1944	2,372,292	1987	607,035
1945	2,282,259	1988	576,446
1946	455,515	1989	570,880
1947	305,827	1990	545,000
1948	387,730	1991	530,000[1]
1949	419,347		

[1]Programmed

USAF TOTAL ACTIVE-DUTY STRENGTH BY GRADE

(As of September 30, 1989)

OFFICERS

GRADE	NUMBER
General	13
Lieutenant General	38
Major General	115
Brigadier General	167
Colonel	5,304
Lieutenant Colonel	12,415
Major	19,712
Captain	43,254
First Lieutenant	12,755
Second Lieutenant	9,924
TOTAL	**103,697**

AIRMEN

GRADE	NUMBER
Chief Master Sergeant	4,626
Senior Master Sergeant	9,231
Master Sergeant	39,218
Technical Sergeant	57,617
Staff Sergeant	111,395
Sergeant/Senior Airman	130,893
Airman First Class	67,480
Airman	26,242
Airman Basic	16,129
TOTAL	**462,831**

Officers	103,697
Cadets	4,352
Airmen	462,831
TOTAL STRENGTH	**570,880**

AIR FORCE MILITARY PERSONNEL DISTRIBUTION BY GEOGRAPHIC AREA

(As of September 30, 1989)

TOTAL MILITARY PERSONNEL	**570,880**
US TERRITORY AND SPECIAL LOCATIONS	**444,446**
TOTAL IN FOREIGN COUNTRIES	**126,434**

Western and Southern Europe (Major concentrations in Germany—40,031 UK—24,567 Italy—5,652 Spain—4,836 Turkey—3,572)	86,383
East Asia and Pacific (Major concentrations in Japan/Okinawa—15,970 South Korea—11,486 Philippines—8,659)	36,472
Africa, Near East, S. Asia (Major concentrations in Saudi Arabia—183 Egypt—38)	344
Western Hemisphere (Major concentrations in Panama—2,858 Canada—131)	3,218
Eastern Europe	17

USAF PERSONNEL STRENGTH BY COMMANDS, SOAs, AND DRUs

MAJOR COMMANDS	MILITARY	CIVILIAN	TOTAL
Air Force Communications Command (AFCC)	46,497	8,027	54,524
Air Force Logistics Command (AFLC)	11,998	84,449	96,447
Air Force Space Command (AFSPACECOM)	6,192	1,794	7,986
Air Force Systems Command (AFSC)	23,746	28,753	52,499
Air Training Command (ATC)	59,911	12,840	72,757
Air University (AU)	5,632	1,552	7,184
Alaskan Air Command (AAC)	7,468	1,222	8,690
Electronic Security Command (ESC)	12,434	1,211	13,645
Military Airlift Command (MAC)	75,195	15,022	90,217
Pacific Air Forces (PACAF)	28,413	9,742	38,155
Strategic Air Command (SAC)	103,026	12,264	115,290
Tactical Air Command (TAC)	94,133	11,562	105,695
United States Air Forces in Europe (USAFE)	60,471	9,982	70,453
TOTAL	**535,116**	**198,420**	**733,536**
SEPARATE OPERATING AGENCIES (SOAs)			
Air Force Accounting and Finance Center (AFAFC)	198	2,261	2,459
Air Force Audit Agency (AFAA)	204	730	934
Air Force Commissary Service (AFCOMS)	1,072	8,373	9,445
Air Force Engineering and Services Center (AFESC)	381	537	918
Air Force Inspection and Safety Center (AFISC)	342	123	465
Air Force Intelligence Agency (AFIA)	646	215	861
Air Force Legal Services Center (AFLSC)	466	146	612
Air Force Management Engineering Agency (AFMEA)	186	93	279
Air Force Military Personnel Center (AFMPC)	1,519	554	2,073
Air Force News Center (AFNEWS)	650	174	824
Air Force Office of Medical Support (AFOMS)	101	161	262
Air Force Office of Security Police (AFOSP)	68	64	132
Air Force Office of Special Investigations (AFOSI)	1,963	506	2,469
Air Force Operational Test and Evaluation Center (AFOTEC)	508	176	684
Air Force Reserve (AFRES)	301	13,560	13,861
Air Reserve Personnel Center (ARPC)	118	567	685
DIRECT REPORTING UNITS (DRUs)			
Air Force Civilian Personnel Management Center (AFCPMC)	4	1,463[1]	1,467
Air Force Cost Center	20	29	49
Air Force District of Washington (AFDW)	1,517	1,096	2,613
Air Force Technical Applications Center (AFTAC)	1,264	98	1,362
Office of the Secretary of the Air Force/Air Staff/Air National Guard Support Center	1,556	1,424	2,980
United States Air Force Academy (USAFA)[2]	2,704	1,578	4,282
USAF Historical Research Center (USAFHRC)	21	72	93
Other Direct Reporting Units			
Air Force Center for Studies and Analyses (AFCSA)	99	41	140
Air Force Combat Operations Staff (AFCOS)	260	24	284
Air Force Review Boards Office (AFRBO)	17	60	83
Other	15,227	28,030	43,257
TOTAL, SOAs and DRUs	**31,412**	**62,155**	**93,567**
TOTAL, COMMANDS, SOAs, and DRUs	**566,528**	**260,575**	**827,103**

[1]Includes Palace Acquire interns assigned to various major commands.
[2]4,352 cadets not included.

USAF Grade and Insignia

Officer

Second Lieutenant (0-1)

First Lieutenant (0-2)

Captain (0-3)

Major (0-4)

Lieutenant Colonel (0-5)

Colonel (0-6)

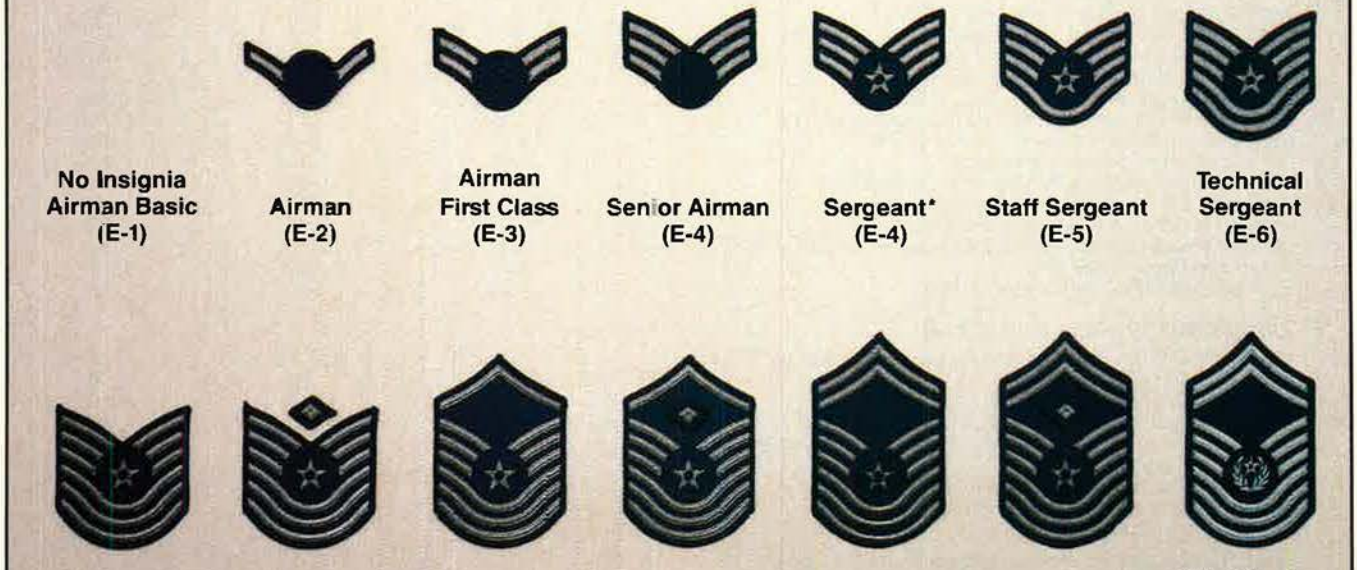
Brigadier General (0-7)

Major General (0-8)

Lieutenant General (0-9)

General (0-10)

Enlisted



No Insignia Airman Basic (E-1)

Airman (E-2)

Airman First Class (E-3)

Senior Airman (E-4)

Sergeant* (E-4)

Staff Sergeant (E-5)

Technical Sergeant (E-6)

Master Sergeant (E-7)

First Sergeant (E-7)

Senior Master Sergeant (E-8)

First Sergeant (E-8)

Chief Master Sergeant (E-9)

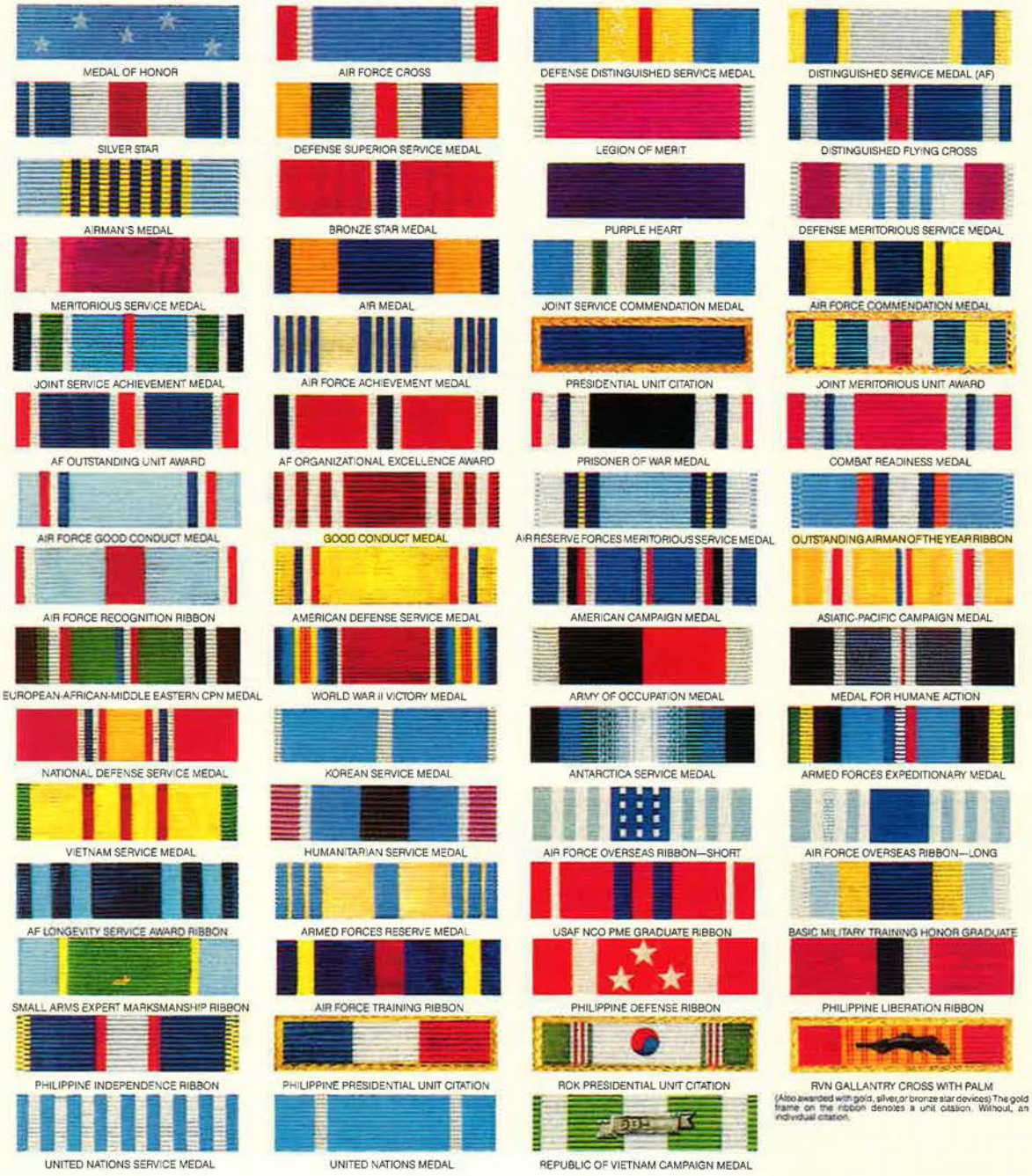
First Sergeant (E-9)

Chief Master Sergeant of the Air Force (There is only one.)

*Noncommissioned Officer (NCO) grades begin with E-4 Sergeant.

Awards and Decorations

This display represents,in correct order of precedence, ribbons and devices most likely to be worn by members of today's Air Force. For information regarding ribbons or devices not depicted, refer to AFR 35–10 and AFR 900–48



Placement of Devices on Ribbons

NOTE: A maximum of four devices may be worn on any ribbon. Devices to be worn on ribbons must be worn in a specific manner. Oak leaf clusters are worn with the stem pointing to the right of the wearer; arrowheads and stars should point straight up. AFR 35–10 describes the proper placement and wear of these and other devices. AFR 900–48 describes the devices and criteria for their wear.

BRONZE STAR
The bronze five-pointed star represents participation in campaigns or operations, multiple qualification, or an additional award to any of the various ribbons on which it is authorized.

SILVER STAR
The silver star is worn in the same manner as the bronze star, but each silver star is worn in lieu of five bronze service stars.

BRONZE & SILVER STARS
When worn together on a single ribbon, the silver star or stars will be worn to the wearer's right of any bronze star or stars.

BRONZE OAK LEAF CLUSTER
The bronze oak leaf cluster represents second and subsequent entitlements or awards.

SILVER OAK LEAF CLUSTER
A silver oak leaf cluster is worn for the sixth, eleventh, etc., entitlements, or in lieu of five bronze oak leaf clusters.

BRONZE/SILVER CLUSTERS
Silver oak leaf clusters are worn to the wearer's right of all bronze oak leaf clusters on the same ribbons.

THE VALOR DEVICE
The "V" device represents valor and does not denote an additional award. Only one may be worn on any ribbon.

VALOR DEVICE & CLUSTERS
The "V" device, when worn on the same ribbon with clusters, is worn to the wearer's right of such clusters.

BRONZE, SILVER & GOLD CLASPS
Bronze, silver, or gold clasps are authorized for successive periods of service on any of several ribbons.

HOURGLASS DEVICE
Hourglass device represents each succeeding award of the Armed Forces Reserve Medal.

MONTHLY MILITARY BASIC RATES OF PAY

(Effective January 1, 1990)

PAY GRADE	YEARS OF SERVICE: UNDER 2	2	3	4	6	8	10	12	14	16	18	20	22	26
COMMISSIONED OFFICERS[1]														
O-10	$5,916	$6,125	$6,125	$6,125	$6,125	$6,359	$6,359	$6,712	$6,712	$7,123	$7,123	$7,125	$7,125	$7,559
O-9	5,243	5,381	5,495	5,495	5,495	5,635	5,635	5,870	5,870	6,359	6,359	6,712	6,712	7,123
O-8	4,749	4,892	5,008	5,008	5,008	5,381	5,381	5,635	5,635	5,870	6,125	6,359	6,516	6,516
O-7	3,946	4,214	4,214	4,214	4,403	4,403	4,659	4,659	4,892	5,381	5,751	5,751	5,751	5,751
O-6	2,925	3,214	3,424	3,424	3,424	3,424	3,424	3,424	3,540	4,100	4,310	4,403	4,659	5,053
O-5	2,339	2,747	2,937	2,937	2,937	2,937	3,026	3,188	3,402	3,657	3,866	3,983	4,123	4,123
O-4	1,972	2,401	2,561	2,561	2,609	2,724	2,910	3,073	3,214	3,355	3,447	3,447	3,447	3,447
O-3[2]	1,832	2,049	2,190	2,423	2,539	2,630	2,773	2,910	2,981	2,981	2,981	2,981	2,981	2,981
O-2[2]	1,598	1,745	2,096	2,167	2,212	2,212	2,212	2,212	2,212	2,212	2,212	2,212	2,212	2,212
O-1[2]	1,387	1,444	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745
COMMISSIONED OFFICERS WITH MORE THAN 4 YEARS OF ACTIVE ENLISTED OR WARRANT OFFICER SERVICE														
O-3E	–	–	–	2,423	2,539	2,630	2,773	2,910	3,026	3,026	3,026	3,026	3,026	3,026
O-2E	–	–	–	2,167	2,212	2,282	2,401	2,493	2,561	2,561	2,561	2,561	2,561	2,561
O-1E	–	–	–	1,745	1,864	1,933	2,003	2,073	2,167	2,167	2,167	2,167	2,167	2,167
ENLISTED MEMBERS														
E-9	–	–	–	–	–	–	2,172	2,221	2,271	2,323	2,375	2,421	2,548	2,796
E-8	–	–	–	–	–	1,821	1,873	1,923	1,973	2,025	2,072	2,122	2,247	2,497
E-7	1,271	1,373	1,424	1,473	1,523	1,572	1,622	1,673	1,749	1,798	1,848	1,872	1,998	2,247
E-6	1,094	1,192	1,242	1,295	1,343	1,392	1,443	1,517	1,565	1,616	1,640	1,640	1,640	1,640
E-5	960	1,045	1,096	1,143	1,218	1,268	1,319	1,367	1,392	1,392	1,392	1,392	1,392	1,392
E-4	896	946	1,001	1,079	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121
E-3	844	890	926	962	962	962	962	962	962	962	962	962	962	962
E-2	812	812	812	812	812	812	812	812	812	812	812	812	812	812
E-1[3]	724	724	724	724	724	724	724	724	724	724	724	724	724	724

NOTES: Amounts have been rounded to the nearest dollar.
Basic pay while serving as Chairman of the Joint Chiefs of Staff or as Chief of Staff of the Air Force is $8,340.60, regardless of cumulative years of service.
Basic pay while serving as Chief Master Sergeant of the Air Force is $3,398.70, regardless of cumulative years of service.

[1]Basic pay is limited to $6,516.60, regardless of cumulative years of service.
[2]Does not apply to commissioned officers who have been credited with more than 4 years' active service as an enlisted member or warrant officer.
[3]Basic pay for E-1s with less than four months of service is $669.60.

USAF PERSONNEL BY GRADE, RACE, AND SEX

(As of September 30, 1989)

GRADE	FORCE	BLACK[1]	OTHER[2]	WOMEN[3]
OFFICERS				
General	333	4	1	2
Colonel	5,304	113	90	122
Lieutenant Colonel	12,415	274	188	587
Major	19,712	1,117	314	2,016
Captain	43,254	3,000	1,040	6,106
First Lieutenant	12,755	702	428	2,665
Second Lieutenant	9,924	549	536	1,905
TOTAL	**103,697**	**5,759**	**2,597**	**13,403**
AIRMEN				
Chief Master Sergeant	4,626	631	63	36
Senior Master Sergeant	9,231	1,378	168	232
Master Sergeant	39,218	7,359	1,087	2,098
Technical Sergeant	57,617	10,772	1,951	5,570
Staff Sergeant	111,395	21,133	4,424	14,434
Sergeant/Senior Airman	130,893	24,598	6,606	20,336
Airman First Class	67,480	9,623	3,311	12,224
Airman	26,242	3,306	1,101	5,021
Airman Basic	16,129	1,983	645	3,224
TOTAL	**462,831**	**80,783**	**19,356**	**63,175**
TOTAL USAF PERSONNEL	**566,528[4]**	**86,542**	**21,953**	**76,578**

[1]Includes 16,212 women.
[2]Includes 3,021 women.
[3]Includes women from "Black" and "Other" categories.
[4]Does not include 4,352 Academy cadets.

MONTHLY BASIC ALLOWANCE FOR QUARTERS (BAQ)

(Effective January 1, 1990)

PAY GRADE	WITHOUT DEPENDENTS		WITH DEPENDENTS
	FULL[1]	PARTIAL[2]	
O-10	$635.40	$50.70	$781.80
O-9	635.40	50.70	781.80
O-8	635.40	50.70	781.80
O-7	635.40	50.70	781.80
O-6	582.90	39.60	704.40
O-5	561.30	33.00	678.60
O-4	520.20	26.70	598.50
O-3	417.00	22.20	495.30
O-2	330.90	17.70	422.70
O-1	278.80	13.20	377.70
E-9	385.00	18.60	508.20
E-8	354.30	15.30	468.30
E-7	302.40	12.00	435.30
E-6	273.60	9.90	402.90
E-5	252.30	8.70	361.50
E-4	219.60	8.10	314.40
E-3	215.70	7.80	292.50
E-2	175.20	7.20	278.40
E-1	155.70	6.90	278.40

[1]Payment of the full rate of basic allowance for quarters at these rates to members of the uniformed services without dependents is authorized by 37 USC 403 and Part IV of Executive Order 11157, as amended.

[2]Payment of the partial rate of basic allowance for quarters at these rates to members of the uniformed services without dependents who, under 37 USC 403(b) or 403(c), are not entitled to the full rate of basic allowance for quarters is authorized by 37 USC 1009(c)(2) and Part IV of Executive Order 11157, as amended.

AVIATION CAREER INCENTIVE PAY RATES[1]

PHASE I

MONTHLY RATE	YEARS OF AVIATION SERVICE AS AN OFFICER[2]
$125	2 or less
156	more than 2
188	more than 3
206	more than 4
650	more than 6

PHASE II

$585	more than 18
495	more than 20
385	more than 22
250	more than 25[3]

NOTE: An officer in pay grade O-7 may not be paid at a rate greater than $200 a month. An officer in pay grade O-8 or above may not be paid at a rate greater than $206 a month. Officers with more than 18 years of commissioned service and less than 6 years of aviation service are entitled to Phase I rates.

[1]For rated officers, flight surgeons, and other designated medical officers, except as noted.

[2]Including flight training.

[3]O-6 and below.

BASIC ALLOWANCE FOR SUBSISTENCE (BAS)

Officers (Monthly)	Enlisted (Daily)		
	Separate Rations	Rations in Kind Not Available	Emergency Rations
$119.61	$5.91 5.46[1]	$6.67 6.16[1]	$8.84 8.17[1]

[1]Applies to E-1s with less than four months of active-duty service.

HAZARDOUS DUTY INCENTIVE PAY (HDIP)[1]

PAY GRADE	MONTHLY RATE	PAY GRADE	MONTHLY RATE
O-10	$110	E-9	$200
O-9	110	E-8	200
O-8	110	E-7	200
O-7	110	E-6	175
O-6	250	E-5	150
O-5	250	E-4	125
O-4	225	E-3	110
O-3	175	E-2	110
O-2	150	E-1	110
O-1	125		

NOTE: Hazardous duty incentive pay for noncrew members is $110 a month.

[1]Excepting AWACS crew members.

AIR FORCE CIVILIAN PERSONNEL AVERAGE AGE AND LENGTH OF SERVICE

(As of September 30, 1989)

Average age	43 years
Average length of service (overall)	14 years
General Schedule	14 years
Federal Wage System	14 years

AVERAGE AGES OF MILITARY PERSONNEL

(As of September 30, 1989)

Officers	Average 34 years of age
Airmen	Average 28 years of age

FEDERAL CIVILIAN PAY SCALE

General Schedule

(Effective January 1, 1990)

GRADE	1	2	3	4	5	6	7	8	9	10
GS-1	$10,581	$10,935	$11,286	$11,637	$11,990	$12,197	$12,544	$12,893	$12,910	$13,232
GS-2	11,897	12,180	12,574	12,910	13,053	13,437	13,821	14,205	14,589	14,973
GS-3	12,982	13,415	13,848	14,281	14,714	15,147	15,580	16,013	16,446	16,879
GS-4	14,573	15,059	15,545	16,031	16,517	17,003	17,489	17,975	18,461	18,947
GS-5	16,305	16,849	17,393	17,937	18,481	19,025	19,569	20,113	20,657	21,201
GS-6	18,174	18,780	19,386	19,992	20,598	21,204	21,810	22,416	23,022	23,628
GS-7	20,195	20,868	21,541	22,214	22,887	23,560	24,233	24,906	25,579	26,252
GS-8	22,367	23,113	23,859	24,605	25,351	26,097	26,843	27,589	28,335	29,081
GS-9	24,705	25,529	26,353	27,177	28,001	28,825	29,649	30,473	31,297	32,121
GS-10	27,206	28,113	29,020	29,927	30,834	31,741	32,648	33,555	34,462	35,369
GS-11	29,891	30,887	31,883	32,879	33,875	34,871	35,867	36,863	37,859	38,855
GS-12	35,825	37,019	38,213	39,407	40,601	41,795	42,989	44,183	45,377	46,571
GS-13	42,601	44,021	45,441	46,861	48,281	49,701	51,121	52,541	53,961	55,381
GS-14	50,342	52,020	53,698	55,376	57,054	58,732	60,410	62,088	63,766	65,444
GS-15	59,216	61,190	63,164	65,138	67,112	69,086	71,060	73,034	75,008	76,982
GS-16	69,451	71,766	74,081	76,396	78,190	79,438[1]	81,708[1]	83,978[1]	85,470[1]	
GS-17	79,762[1]	82,420[1]	85,078[1]	85,470[1]	85,500[1]					
GS-18	86,682[1]									

Senior Executive Service[2]

LEVEL	1	2	3	4	5	6
	$71,200	$74,400	$77,600	$79,200	$81,400	$83,600

[1]The rate of basic pay payable to employees at these rates may be limited.
[2]Basic pay for employees at these rates is limited to $83,600, in accordance with Title 5, USC 5832(b).

AIR FORCE FULL-TIME CIVILIAN EMPLOYMENT BY GRADE

(As of September 30, 1989)

GENERAL SCHEDULE/ OTHER		WAGE GRADE POSITIONS		WAGE GRADE LEADER POSITIONS		WAGE GRADE SUPERVISORY POSITIONS	
GRADE	POPULATION	GRADE	POPULATION	GRADE	POPULATION	GRADE	POPULATION
1	103	1	250	1	1	1	39
2	412	2	1,100	2	46	2	47
3	3,769	3	819	3	2	3	129
4	14,216	4	1,027	4	50	4	219
5	24,406	5	4,195	5	60	5	293
6	10,641	6	3,352	6	48	6	533
7	15,353	7	5,615	7	121	7	981
8	2,457	8	6,561	8	130	8	1,161
9	20,367	9	6,652	9	273	9	1,596
10	1,255	10	18,860	10	970	10	2,229
11	21,492	11	5,695	11	148	11	760
12	22,307	12	2,004	12	26	12	400
13	10,288	13	343	13	2	13	248
14	4,017	14	151	14	1	14	376
15	1,284	15	2	15	0	15	205
16	1					16	126
17	0					17	58
18	1					18	9
ST	16						
SES	230						
TOTAL	**152,615**		**68,128**		**1,878**		**9,409**

NOTE: Table does not include ANG technicians, local national employees, or nonappropriated fund employees.
ST = Scientific and Professional
SES = Senior Executive Service

DoD BUDGET AUTHORITY BY COMPONENT FOR FYs 1988–91

COMPONENT	FY 1988 $ BILLION	FY 1988 % SHARE	FY 1989 $ BILLION	FY 1989 % SHARE	FY 1990 $ BILLION	FY 1990 % SHARE	FY 1991 $ BILLION	FY 1991 % SHARE
Army	75.8	26.7	78.1	26.9	77.6	26.6	75.8	25.7
Navy/Marine Corps	100.3	35.3	97.7	33.6	99.6	34.2	99.5	33.7
Air Force	88.3	31.1	94.7	32.6	92.9	31.9	94.8	32.1
Defense Agencies, DoD-wide	19.3	6.8	20.4	7.0	21.2	7.3	25.0	8.5
TOTAL	**283.8**		**290.8**		**291.4**		**295.1**	

NOTE: Numbers are rounded and may not sum to totals. Numbers reflect 1991 Amended President's Budget.

AIR FORCE BUDGET AND FINANCE—FYs 1982–91

(Figures in millions of dollars)

	FY 1982	FY 1987	FY 1988	FY 1989	FY 1990[1]	FY 1991[1]
GROSS NATIONAL PRODUCT	$2,986,400	$4,430,200	$4,792,200	$5,151,300	$5,488,900	$5,892,400
Federal Budget, Outlays (Current $)	745,706	1,383,000	1,644,400	1,142,600	1,197,200	1,233,300
DoD Budget, Outlays (Current $)	184,520	274,007	281,935	294,880	286,791	292,145
DoD Percent of: GNP	6.2%	6.2%	5.9%	5.7%	5.2%	5.0%
Federal Budget	24.7%	19.8%	17.1%	25.8%	24.0%	23.7%
AIR FORCE BUDGET OUTLAYS						
Current Dollars	$55,676	$91,114	$93,060	$94,676	$92,592	$92,929
Constant FY 1991 Dollars	74,420	104,521	103,832	101,645	96,605	92,929
AF Percent of: GNP	1.9%	2.1%	1.9%	1.8%	1.7%	1.6%
Federal Budget	7.5%	6.6%	5.7%	8.3%	7.7%	7.5%
TOTAL OBLIGATIONAL AUTHORITY						
DoD—Current Dollars	$210,667	$282,506	$288,607	$292,190	$292,333	$297,333
Constant FY 1991 Dollars	286,999	325,849	320,999	312,785	303,925	297,333
AF—Current Dollars	65,017	93,869	90,545	95,286	92,805	95,686
Constant FY 1991 Dollars	85,990	107,906	100,724	102,093	96,637	95,686
(Current Dollars)						
Aircraft Procurement	13,640	16,416	12,810	15,651	15,360	14,217
Missile Procurement	4,478	7,767	7,204	7,146	6,590	9,006
Other Procurement	5,408	9,176	7,950	8,193	8,255	8,307
Procurement Subtotal	23,526	33,359	27,964	30,990	30,205	31,530
Military Construction—USAF	1,533	1,207	1,240	1,247	1,227	1,376
AFRES	37	59	79	71	46	38
ANG	105	149	151	158	199	67
Military Construction Subtotal	1,675	1,415	1,470	1,476	1,472	1,481
RDT&E	8,893	14,871	15,031	14,668	13,497	13,276
Family Housing Construction	96	103	160	187	200	183
Stock Fund	79	140	226	187	126	1,340
TOTAL, INVESTMENT	**34,269**	**49,888**	**44,851**	**47,508**	**45,500**	**47,810**
Military Personnel	11,467	19,693	20,010	20,167	20,027	20,047
Reserve Personnel	327	569	615	654	663	684
National Guard Personnel	478	948	988	1,033	1,058	1,089
Military Personnel Subtotal	12,272	21,210	21,613	21,854	21,748	21,820
Operation & Maintenance—USAF	16,133	19,082	20,313	22,063	21,788	22,049
AFRES	676	925	1,000	1,073	1,009	1,043
ANG	1,669	1,788	1,958	2,022	2,021	2,175
Operating Subtotal	18,478	21,795	23,271	25,158	24,818	25,267
Family Housing Operations & Debt	—	730	733	768	740	789
TOTAL, OPERATING	**30,750**	**43,735**	**45,617**	**47,780**	**47,306**	**47,876**

NOTE: Totals may not add due to rounding.
[1]Figures based on the FY 1991 Amended President's budget.

USAF AND AIR RESERVE FORCES PERSONNEL BY CATEGORIES

CATEGORY	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990[1]	FY 1991[1]
AIR FORCE MILITARY							
Officers	108,400	109,000	107,300	105,126	103,697	100,300	98,800
Airmen	488,600	494,700	495,200	466,856	462,831	440,300	426,800
Cadets	4,500	4,500	4,400	4,464	4,352	4,400	4,400
TOTAL, AIR FORCE MILITARY	**601,500**	**608,200**	**606,900**	**576,446**	**570,880**	**545,000**	**530,000**
Career Reenlistments (Second Term)	36,000	38,900	41,500	51,600	39,500	40,400	40,100
Rate	89%	88%	89%	88%	93%	90%	90%
First-Term Reenlistments	25,700	23,500	25,700	26,600	18,200	22,500	19,500
Rate	54%	58%	58%	55%	68%	60%	60%
CIVILIAN PERSONNEL							
Direct Hire (including Technicians)	250,400	249,604	251,771	241,120	248,666	252,918	255,187
Indirect Hire—Foreign Nationals	13,468	13,644	12,559	12,041	11,909	13,240	12,500
TOTAL, CIVILIAN PERSONNEL	**263,868**	**263,248**	**264,330**	**253,161**	**260,575**	**266,158**	**267,687**
TOTAL, MILITARY AND CIVILIAN[2]	**865,368**	**871,448**	**871,230**	**829,607**	**831,455**	**811,158**	**797,687**
Technicians (included above as Direct Hire Civilians)							
AFRES Technicians	8,064	8,348	8,772	9,111	10,061	10,124	9,923
ANG Technicians	22,671	22,497	23,221	23,409	23,644	24,310	23,949
AIR RESERVE FORCES							
Air National Guard, Selected Reserve	109,398	112,592	114,600	115,221	114,975	116,200	116,300
Air Force Reserve, Paid	75,214	78,519	80,415	82,116	83,214	84,900	85,200
Air Force Reserve, Nonpaid[3]	42,317	44,568	43,783	51,658	49,553	53,000	51,700
TOTAL, READY RESERVE[3]	**226,929**	**235,679**	**238,798**	**248,995**	**247,742**	**245,100**	**253,200**
Standby	28,321	25,823	24,479	21,772	17,299	17,000	17,000
TOTAL, AIR RESERVE FORCES[4]	**255,250**	**261,502**	**263,277**	**270,767**	**265,041**	**271,100**	**270,200**

[1]President's Budget Request.
[2]FYs 1985–89 are actual figures; FYs 1990–91 are estimates; excludes nonchargeable personnel.
[3]Excludes training/pay categories J, K, and L.
[4]Excludes Retired Air Force Reserve.

NOTE: Numbers are rounded and may not sum to totals.

ACTIVE-DUTY MILITARY PERSONNEL, RESERVE COMPONENT MILITARY PERSONNEL, AND CIVILIAN PERSONNEL STRENGTH

(Figures in thousands)

	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990[1]	FY 1991[1]
ACTIVE-DUTY MILITARY								
Army	780	781	781	781	772	770	744	728
Navy	565	571	581	587	593	593	591	585
Marine Corps	196	198	199	200	197	197	197	197
Air Force	597	602	608	607	576	571	545	530
TOTAL	**2,138**	**2,151**	**2,169**	**2,174**	**2,138**	**2,131**	**2,077**	**2,039**
RESERVE COMPONENTS (SELECTED RESERVE)								
Army National Guard	434	440	446	452	455	457	447	447
Army Reserve	275	292	310	314	313	319	309	309
Naval Reserve	121	130	142	149	149	152	153	150
Marine Corps Reserve	41	42	42	42	44	44	44	44
Air National Guard	105	109	113	115	115	116	116	116
Air Force Reserve	70	75	79	80	82	83	85	85
TOTAL	**1,046**	**1,088**	**1,130**	**1,152**	**1,158**	**1,171**	**1,154**	**1,152**
DIRECT HIRE CIVILIAN								
Army[2]	344	359	354	358	337	347	334	334
Navy	332	342	332	343	336	343	337	330
Air Force[2]	240	250	250	252	241	249	249	246
Defense Agencies	85	91	92	96	95	97	96	102
TOTAL[2]	**1,000**	**1,043**	**1,027**	**1,049**	**1,010**	**1,037**	**1,018**	**1,012**

[1]Programmed manpower.
[2]Includes Army and Air National Guard Technicians, who were converted from State to Federal employees in FY 1969.

NOTE: Numbers are rounded and may not sum to totals.

EDUCATIONAL LEVELS—USAF LINE OFFICERS

(As of September 30, 1989)

LEVEL	NUMBER	PERCENT
Below baccalaureate/unknown	81	0.1
Baccalaureate, no master's degree	47,553	54.9
Master's degree, no doctorate	37,770	43.6
Doctoral and professional degrees	1,207	1.45
TOTAL	**86,591**	**100.0**

EDUCATIONAL LEVELS—USAF ENLISTED FORCE

(As of September 30, 1989)

LEVEL	NUMBER	PERCENT[1]
Below high school	224	0.04
High school	170,798	36.9
Some college (less than two years)	204,972	44.35
AA/AS degree	31,029	6.7
Two to three years of college	40,059	8.7
Baccalaureate, no master's	14,271	3.1
Master's or higher	1,478	0.3
TOTAL	**462,831**	**100.0**

[1]Percentages have been rounded.

NUMBER OF OFFICERS IN EACH MAJOR CAREER FIELD[1]

CODE	UTILIZATION FIELD TITLE	ASSIGNED
00[2]	Commanders and Directors	2,871
02	International-Politico-Military Affairs	312
05	Disaster Preparedness	167
09[2]	Special Duty	1,771
10–14	Pilot	19,811
15, 22	Navigator	8,375
16	Air Traffic Control	375
17	Air Weapons Director	2,166
18	Missile Operations	2,697
19	Operations Management	1,222
20	Space Operations	1,474
23	Visual Information	101
25	Weather	1,290
26	Scientific	1,510
27	Acquisition Program Management	2,737
28	Development Engineering	5,887
31	Missile Maintenance	342
40	Aircraft Maintenance & Munitions	3,578
49	Communications-Computer Systems	6,499
55	Civil Engineering	2,180
60	Transportation	966
62	Services	428
64	Supply Management	1,152
65	Acquisition Contracting/Manufacturing	1,557
66	Logistics Plans & Programs	1,001
67	Financial	1,431
70	Information Management	2,065
73	Personnel	1,464
74	Manpower Management	490
75	Education & Training	441
76	Mission Support	64
79	Public Affairs	508
80	Intelligence	3,323
81	Security Police	1,096
82	Special Investigations	508
87	Band	28
88	Legal	1,368
89	Chaplain	823
90	Health Services Management	1,279
91, 92, 99	Biomedical Sciences	2,529
93–96	Physician	4,006
97	Nurse	5,408
98	Dental	1,473

[1]These figures do not include general officers or UPT/UNT/medical/law students.
[2]Includes specialties in various career fields, e.g., operations, logistics, programming, etc.

NUMBER OF ENLISTED IN EACH MAJOR CAREER FIELD

CODE	CAREER FIELD TITLE	ASSIGNED
10	First Sergeant	1,756
11	Aircrew Operations	8,653
12	Aircrew Protection	2,804
20	Intelligence	12,915
22	Geodetic	110
23	Visual Information	2,722
24	Safety	1,388
25	Weather	3,134
27	Command Control Systems Operations	16,287
30	Communications-Electronics Systems	23,266
31	Instrumentation	525
32	Precision Measurement	2,647
34	Training Devices	347
36	Wire Communications Systems Maintenance	4,181
39	Maintenance Management Systems	2,988
40	Intricate Equipment Maintenance	290
41	Missile Systems Maintenance	5,038
45	Manned Aerospace Maintenance	103,255
46	Munitions & Weapons	25,016
47	Vehicle Maintenance	5,550
49	Communications-Computer Systems	20,386
54	Mechanical/Electrical	10,033
55	Structural/Pavements	11,619
56	Sanitation	1,624
57	Fire Protection	6,112
59	Marine	37
60	Transportation	13,403
61	Commissary Services	1,004
62	Services	6,283
63	Fuels	6,599
64	Supply	23,708
65	Contracting	1,610
66	Logistics Plans	1,017
67	Financial	5,583
70	Information Management	21,471
73	Personnel	13,849
74	Morale, Welfare, & Recreation	1,723
75	Education & Training	3,538
79	Public Affairs	1,264
81	Security Police	37,884
82	Special Investigations	933
87	Band	1,129
88	Paralegal	886
89	Chaplain Management	684
90–92	Medical	25,492
98	Dental	3,581
99	Miscellaneous (Special Duty, Patients, Unclassified, etc.)	12,196

USAF'S AIRCRAFT—HOW MANY, HOW OLD?

(Current as of September 30, 1989)

	0–3 YRS.	3–6 YRS.	6–9 YRS.	9–12 YRS.	12–15 YRS.	15–18 YRS.	18–21 YRS.	21–24 YRS.	24+ YRS.	TOTAL NUMBER	AVERAGE AGE (YRS.)
A-7	–	–	1	–	–	2	6	2	–	11	18.4
A-10	–	15	260	121	51	–	–	–	–	447	8.9
A-37	–	–	–	–	20	2	1	1	–	24	14.7
B-1	79	17	–	–	–	–	–	–	–	96	2.3
B-2	1	–	–	–	–	–	–	–	–	1	2.0
B-52	–	–	–	–	–	–	–	–	254	254	29.0
FB-111	–	–	–	–	–	–	60	1	–	61	18.9
C-5	43	7	–	–	–	25	8	–	–	83	8.0
C-9	–	–	–	–	3	9	8	3	–	23	18.5
C-10 (KC-10)	23	24	11	–	–	–	–	–	–	58	3.8
C-12	–	45	–	1	27	–	–	–	–	73	8.2
C-18 (EC-18)	–	–	7	–	–	–	–	–	–	7	7.4
C-20	10	2	1	–	–	–	–	–	–	13	3.1
C-21	–	79	–	–	–	–	–	–	–	79	4.7
C-22	–	1	–	–	–	–	–	–	–	1	5.6
C-23	–	18	–	–	–	–	–	–	–	18	4.4
C-130	13	9	–	1	50	24	54	24	161	336	20.3
C-131	–	–	–	–	–	–	–	–	1	1	34.5
C-135	–	–	–	–	–	–	–	2	592	594	28.1
C-137	–	2	–	–	–	1	–	–	4	7	20.3
C-140	–	–	–	–	–	–	–	–	3	3	26.9
C-141	–	–	–	–	–	–	–	213	41	254	23.0
E-3	–	3	8	14	9	–	–	–	–	34	9.9
E-4	–	–	–	–	2	2	–	–	–	4	15.3
F-4	–	–	–	–	82	67	200	101	20	470	18.7
F-15	124	105	163	261	98	5	–	–	–	756	7.9
F-16	461	327	144	42	3	–	–	–	–	977	3.6
F-100	–	–	–	–	–	–	–	–	1	1	31.6
F-106	–	–	–	–	–	–	–	–	5	5	30.0
F-111	–	–	2	–	13	142	135	35	–	327	18.4
G-4	1	–	3	6	–	–	–	–	–	10	9.0
G-7	4	1	5	–	–	–	–	–	–	10	4.2
G-9	5	–	–	–	–	–	–	–	–	5	2.6
H-1	–	–	–	–	–	24	69	–	–	93	18.1
H-3	–	–	–	–	–	–	9	20	6	35	21.9
H-53 (MH-53)	8	–	–	–	1	5	27	8	–	49	16.4
H-60	15	2	8	–	–	–	–	–	–	25	3.4
TR-1	7	12	4	–	–	–	–	–	–	23	3.9
T-33	–	–	–	–	–	–	–	–	1	1	37.9
T-37	–	–	–	–	–	–	84	72	450	606	27.3
T-38	–	–	–	–	–	14	167	229	397	807	23.5
T-39	–	–	–	–	–	–	–	–	14	14	27.7
T-41	–	–	–	–	–	–	6	72	22	100	22.3
T-43	–	–	–	–	–	14	–	–	–	14	15.6
U-6	–	–	–	1	–	–	–	–	–	1	9.0
U-26	–	–	1	–	–	–	–	–	–	1	6.0
OV-10	2	–	–	–	–	–	38	38	–	78	20.5
UV-18	1	–	–	–	2	–	–	–	–	3	8.6
TOTALS	**785**	**675**	**624**	**447**	**361**	**336**	**872**	**821**	**1,972**	**6,893**	**16.5**
PERCENT[1]	**11**	**10**	**9**	**6**	**5**	**5**	**13**	**12**	**29**		

NOTE: ARF not included in calendar age.
Less than 9 years old: 2,084 aircraft (30%).
More than 9 years old: 4,809 aircraft (70%).

[1]Percentages have been rounded.

AIR FORCE RESERVE AIRCRAFT—HOW MANY, HOW OLD?

(Current as of November 30, 1989)

	0–3 YRS.	3–6 YRS.	6–9 YRS.	9–12 YRS.	12–15 YRS.	15–18 YRS.	18–21 YRS.	21–24 YRS.	24+ YRS.	TOTAL NUMBER	AVERAGE AGE (YRS.)
A-10A	–	–	–	97	–	–	–	–	–	97	11.2
AC-130A	–	–	–	–	–	–	–	–	10	10	34.3
C-130A	–	–	–	–	–	–	–	–	2	2	32.2
C-130B	–	–	–	–	–	–	–	–	35	35	29.0
C-130E	–	–	–	–	–	–	–	–	49	49	26.2
C-130H	24	10	6	–	–	–	–	–	–	40	3.5
HC-130H[1]	–	–	–	–	–	–	–	2	2	4	24.5
HC-130N	–	–	–	–	–	–	4	–	–	4	20.0
HC-130P	–	–	–	–	–	–	–	–	4	4	25.0
WC-130E	–	–	–	–	–	–	–	–	2	2	28.0
WC-130H	–	–	–	–	–	–	–	2	–	2	24.5
C-141B	–	–	–	–	–	–	–	–	8	8	24.1
KC-135E	–	–	–	–	–	–	–	–	24	24	31.3
F-4E	–	–	–	–	–	21	–	26	–	47	18.8
F-16	26	–	20	72	–	–	–	–	–	118	8.0
UH-1	–	–	–	–	–	–	5	–	–	5	19.0
H-3E	–	–	–	–	–	–	2	12	3	17	23.0
C-5A	–	–	–	–	–	–	25	7	–	32	20.8
TOTAL	**50**	**10**	**26**	**169**	**0**	**21**	**36**	**49**	**139**	**500**	**22.5**
PERCENT[2]	**10**	**2**	**5**	**34**	**0**	**4**	**7**	**10**	**28**		

NOTE: Less than 9 years old: 86 aircraft (17%).
More than 9 years old: 414 aircraft (83%).

[1]Two HC-130Hs (not included here) are being reconfigured and will be assigned back to AFRES as HC-130Ps.
[2]Percentages have been rounded.

AIR NATIONAL GUARD AIRCRAFT—HOW MANY, HOW OLD?

(Current as of September 30, 1989)

	0–3 YRS.	3–6 YRS.	6–9 YRS.	9–12 YRS.	12–15 YRS.	15–18 YRS.	18–21 YRS.	21–24 YRS.	24+ YRS.	TOTAL NUMBER	AVERAGE AGE (YRS.)
A-7D/K	–	2	27	–	46	176	103	–	–	354	16.1
A-10A	–	–	1	99	–	–	–	–	–	100	10.0
OA-37	–	–	–	–	18	7	18	–	–	43	16.7
C-5A	–	–	–	–	–	2	10	–	–	12	18.5
C-12	6	7	–	–	–	–	–	–	–	13	2.9
C-21A	4	–	–	–	–	–	–	–	–	4	2.0
C-22A	–	4	–	–	–	–	–	–	–	4	4.7
C-130	17	26	14	16	–	–	–	8	155	236	21.0
C-131	–	–	–	–	–	–	–	–	1	1	34.4
KC-135	–	–	–	–	–	–	–	–	113	113	30.5
C-141B	–	–	–	–	–	–	–	5	3	8	23.3
F-4	–	–	–	–	–	–	119	235	35	389	22.2
F-15A/B	–	–	–	11	100	–	–	–	–	111	13.1
F-16A/B	–	48	227	63	–	–	–	–	–	338	7.6
H-3	–	–	–	–	–	–	3	5	1	9	22.1
C-26A	7	–	–	–	–	–	–	–	–	7	0.3
T-43A	–	–	–	–	–	4	–	–	–	4	15.5
TOTALS	**34**	**87**	**269**	**189**	**164**	**189**	**253**	**253**	**308**	**1,746**	**16.8**
PERCENT[1]	**2**	**5**	**15**	**11**	**9**	**11**	**15**	**14**	**17**		

NOTE: Less than 9 years old: 390 aircraft (22%).
More than 9 years old: 1,356 aircraft (78%).

[1]Percentages have been rounded.

NUMBER OF AIRCRAFT PER ACTIVE-DUTY USAF SQUADRON

(End FY 1989)

AIRCRAFT TYPE	NUMBER[1]
A-10A	18 or 24
B-1B	11, 15, or 16
B-52	13, 14, 15, 16, or 19
C-5	17 or 18[2]
C-9A	3 or 11
C-130	8, 10, 16, or 19
AC-130	10
KC-10A	19
KC-135	13 to 25
C-141B	12 to 17
E-3	4 or 9
F-4	18 or 24
RF-4	18
F-5	20
F-15	15, 18, or 24
F-16	18 or 24
F-111	12, 18, or 24
FB-111A	8 or 10
F-117A	18

[1]For some types of aircraft, squadrons vary in size as shown here. HC-130, WC-130, T-39, and T-38 aircraft are counted as Total Unit Equipment, not by squadrons.
[2]Reflects ongoing transfer of assets to Air Reserve Forces.

USAF FLYING SQUADRONS BY MISSION TYPE[1]

ACTIVE FORCES	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990[2]
Strategic Bomber	20	21	24	25	24	21
Air Refueling	35	36	36	35	35	34
Strategic Command and Control	6	6	6	6	6	6
Intelligence	3	3	3	3	3	3
Strategic Reconnaissance	1	1	1	1	1	0
Strategic Interceptor	4	4	3	2	2	1
Fighter	78	78	81	79	79	81
Tactical Reconnaissance	8	8	7	5	5	5
Tactical Electronic Warfare	3	3	4	4	4	4
Special Operations Forces	5	5	5	10	11	11
Tactical Air Command Control Systems[3]	3	3	3	3	3	3
Tactical Air Control Systems[3]	7	7	7	7	7	7
Weather	2	2	2	1	1	1
Rescue	8	9	9	6	7	7
Tactical Airlift	14	14	13	13	12	12
Strategic Airlift	17	17	17	19	20	20
Special Mission	1	1	1	1	1	1
Aeromedical Airlift	3	3	3	3	3	3
GLCM[4]	3	4	6	5	3	3
ICBM	23	22	20	20	20	20
TOTAL	**244**	**247**	**251**	**248**	**247**	**243**
RESERVE FORCES						
ANG Selected Reserve	91	91	91	91	91	91
Air Force Reserve[5]	56	57	57	58	58	58
TOTAL	**147**	**148**	**148**	**149**	**149**	**149**
GRAND TOTAL	**391**	**395**	**399**	**397**	**396**	**392**

[1]Excludes training, support, and OT&E units.
[2]Estimated.
[3]Includes consolidation of certain functional groups.
[4]GLCM Tactical Missile Wings. GLCMs are assigned by flights, not by squadrons.
[5]Includes Associate Squadrons.

NUMBER OF ACTIVE AIRCRAFT AND FLYING HOURS

TYPE OF AIRCRAFT	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990
Bomber, Strategic	328	330	346	393	422	412	335
Tanker	556	559	572	576	567	578	569
Fighter/Interceptor/Attack	3,019	3,057	3,046	3,033	3,027	2,896	2,859
Reconnaissance/Electronic Warfare	404	418	394	432	424	416	380
Cargo/Transport	863	859	855	848	859	825	814
Search & Rescue (Fixed Wing)	35	37	37	35	33	35	32
Helicopter (includes Rescue)	237	234	232	191	200	205	201
Trainer	1,622	1,613	1,643	1,595	1,543	1,540	1,538
Utility/Observation/Other	191	180	120	110	120	140	132
TOTAL, USAF	**7,255**	**7,287**	**7,245**	**7,213**	**7,195**	**7,047**	**6,860**
Air National Guard total	1,688	1,688	1,782	1,732	1,730	1,735	1,749
Air Force Reserve total	458	468	467	502	491	497	524
TOTAL, ACTIVE AIRCRAFT, USAF, ANG, AFRES	**9,401**	**9,443**	**9,494**	**9,447**	**9,416**	**9,279**	**9,133**
Active aircraft including foreign-government owned	9,489	9,529	9,578	9,501	9,500	9,355	9,217
FLYING HOURS (000)							
USAF	2,888	2,914	2,905	2,883	2,752	2,830	2,763
Air National Guard	417	423	408	431	437	427	449
Air Force Reserve	136	140	143	149	151	155	155
TOTAL FLYING HOURS	**3,441**	**3,477**	**3,456**	**3,463**	**3,340**	**3,412**	**3,367**

NOTE: FY 1984–89 numbers are actual; FY 1990 numbers are programmed.

USAF AIRCRAFT TAIL MARKINGS

CODE	AIRCRAFT	UNIT, LOCATION, AND COMMAND
AK	F-15C/D	21st TFW, Elmendorf AFB, Alaska (AAC)
AK	A-10A, OA-10A	343d TFW, Eielson AFB, Alaska (AAC)
AL	F-16A/B	187th TFG, Dannelly Field, Ala. (ANG)
AR	A-10A	10th TFW, RAF Alconbury, UK (USAFE)
AZ	A-7D, F-16A/B	162d TFG, Tucson IAP, Ariz. (ANG)
BA	RF-4C	67th TRW, Bergstrom AFB, Tex. (TAC)
BC	OA-37B	110th TASG, Battle Creek ANGB, Mich. (ANG)
BD	A-10A	917th TFG, Barksdale AFB, La. (AFRES)
BH	RF-4C	117th TRW, Birmingham MAP, Ala. (ANG)
BT	F-15C/D	36th TFW, Bitburg AB, West Germany (USAFE)
CC	F-111D	27th TFW, Cannon AFB, N. M. (TAC)
CO	A-7D	140th TFW, Buckley ANGB, Colo. (ANG)
CR	F-15C/D	32d TFG, Soesterberg AB, Netherlands (USAFE)
CT	A-10A	103d TFG, Bradley ANGB, Conn. (ANG)
DC	F-16A/B	113th TFW, Andrews AFB, Md. (ANG)
DM	A-10A	355th TTW, Davis-Monthan AFB, Ariz. (TAC)
DM	EC-130H	41st ECS, Davis-Monthan AFB, Ariz. (TAC)
DO	F-16A/B	906th TFG, Wright-Patterson AFB, Ohio (AFRES)
ED	Various	Air Force Flight Test Center, Edwards AFB, Calif. (AFSC)
EG	F-15C/D	33d TFW, Eglin AFB, Fla. (TAC)
EL	A-10A	23d TFW, England AFB, La. (TAC)
ET	Various	3246th Test Wing, Eglin AFB, Fla. (AFSC)
FF	F-15C/D	1st TFW, Langley AFB, Va. (TAC)
FM	F-16A/B	482d TFW, Homestead AFB, Fla. (AFRES)
FS	F-16A/B	188th TFW, Fort Smith MAP, Ark. (ANG)
FW	F-4E	122d TFW, Fort Wayne MAP, Ind. (ANG)
GA	F-4E	35th TFW, George AFB, Calif. (TAC)
GU	RF-4C	460th TRG, Taegu AB, Korea (PACAF)
HA	A-7D	185th TFG, Sioux City, Iowa (ANG)
HAFB	F-16A, F-4E	Ogden ALC, Hill AFB, Utah (AFLC)
HF	F-4E	181st TFG, Hulman RAP, Ind. (ANG)
HI	F-16A/B/C/D	419th TFW, Hill AFB, Utah (AFRES)
HL	F-16A/B	388th TFW, Hill AFB, Utah (TAC)
HM	AT-38B	479th TTW, Holloman AFB, N. M. (TAC)
HO	F-15A/B	49th TFW, Holloman AFB, N. M. (TAC)
HR	F-16C/D	50th TFW, Hahn AB, West Germany (USAFE)
HS	F-16A/B	31st TTW, Homestead AFB, Fla. (TAC)
HW	OA-37B	24th CompW, Howard AFB, Panama (TAC)
IA	A-7D	132d TFW, Des Moines MAP, Iowa (ANG)
IL	OA-37B	182d TASG, Greater Peoria Airport, Ill. (ANG)
IN	A-10A	930th TFG, Grissom AFB, Ind. (AFRES)
IS	F-15C/D	57th FIS, NAS Keflavik, Iceland (TAC)
KC	A-10A	442d TFW, Richards-Gebaur AFB, Mo. (AFRES)
KE	RF-4C	186th TRG, Key Field, Miss. (ANG)
KS	EC-130E	7th ACCS, Keesler AFB, Miss. (TAC)
LA	F-15A/B/C/D/E	405th TTW, Luke AFB, Ariz. (TAC)
LF	F-16A/B/C/D	58th TTW, Luke AFB, Ariz. (TAC)
LN	F-111F	48th TFW, RAF Lakenheath, UK (USAFE)
LR	F-16C/D	944th TFG, Luke AFB, Ariz. (AFRES)
LY	F-15A/B	48th FIS, Langley AFB, Va. (TAC)
MA	A-10A	104th TFG, Barnes MAP, Mass. (ANG)
MB	A-10A	354th TFW, Myrtle Beach AFB, S. C. (TAC)
MC	F-16A/B/C/D	56th TTW, MacDill AFB, Fla. (TAC)
MD	A-10A	175th TFG, Martin Airport, Md. (ANG)
MI	A-7D	127th TFW, Selfridge ANGB, Mich. (ANG)
MJ	F-16C/D	432d TFW, Misawa AB, Japan (PACAF)
MO	F-111A, EF-111A	366th TFW, Mountain Home AFB, Idaho (TAC)
MY	F-16A/B	347th TFW, Moody AFB, Ga. (TAC)
NF	OV-10A, OA-10A	602d TACW, Davis-Monthan AFB, Ariz. (TAC)
NJ	F-4E	108th TFW, McGuire AFB, N. J. (ANG)
NM	A-7D	150th TFG, Kirtland AFB, N. M. (ANG)
NO	A-10A	926th TFG, NAS New Orleans, La. (AFRES)
NT	T-43A	323d FTW, Mather AFB, Calif. (ATC)
NY	F-16A/B	174th TFW, Hancock Field, N. Y. (ANG)
OH	A-7D	121st TFW, Rickenbacker ANGB; 178th TFG, Springfield; 180th TFG, Toledo, Ohio (ANG)
OK	A-7D	138th TFG, Tulsa IAP, Okla. (ANG)
OS	F-16C/D	51st TFW, Osan AB, Korea (PACAF)
OT	Various	TAWC, Eglin AFB, Fla. (TAC)
PA	OA-10A	111th TASG, Willow Grove ARFF, Pa. (ANG)
PA	EC-130H	193d SOG, Harrisburg IAP, Pa. (ANG)
PN	F-4E/G	3d TFW, Clark AB, Philippines (PACAF)
PR	A-7D	156th TFG, Muniz ANGB, Puerto Rico (ANG)
PT	A-7D	112th TFG, Greater Pittsburgh IAP, Pa. (ANG)
RG	F-15B	Warner Robins ALC, Robins AFB, Ga. (AFLC)
RS	F-16C/D	86th TFW, Ramstein AB, West Germany (USAFE)
SA	F-16A/B	149th TFG, Kelly AFB, Tex. (ANG)
SB	EC-130H	66th ECW, Sembach AB, West Germany (USAFE)
SD	A-7D	114th TFG, Joe Foss Field, S. D. (ANG)
SH	F-16A/B	507th TFG, Tinker AFB, Okla. (AFRES)
SI	F-16A/B	183d TFG, Springfield Airport, Ill. (ANG)
SJ	F-15E, F-4E	4th TFW, Seymour Johnson AFB, N. C. (TAC)
SL	F-4E	131st TFW, Bridgeton, Mo. (ANG)
SP	F-4G, F-16C/D	52d TFW, Spangdahlem AB, West Germany (USAFE)
SR	OV-10A	507th TACW, Shaw AFB, S. C. (TAC)
SU	OA-10A	5th TACG, Suwon AB, Korea (PACAF)
SW	F-16C/D	363d TFW, Shaw AFB, S. C. (TAC)
TH	F-4E	301st TFW, Carswell AFB, Tex. (AFRES)
TJ	F-16C/D	401st TFW, Torrejon AB, Spain (USAFE)
TR	F-117A, AT-38B	37th TFW, Tonopah Test Range, Nev. (TAC)
TX	F-4E	924th TFG, Bergstrom AFB, Tex. (AFRES)
TY	F-15A/B	325th TTW, Tyndall AFB, Fla. (TAC)
UH	F-111E, EF-111A	20th TFW, RAF Upper Heyford, UK (USAFE)
VA	A-7D	192d TFG, Byrd Field, Va. (ANG)
VT	F-16A/B	158th FIG, Burlington IAP, Vt. (ANG)
WA	Various	TFWC, Nellis AFB, Nev. (TAC)
WI	A-10A	128th TFW, Truax ANGB, Wis. (ANG)
WP	F-16C/D	8th TFW, Kunsan AB, Korea (PACAF)
WR	A-10A	81st TFW, RAF Bentwaters, UK (USAFE)
WW	F-4E/G	561st, 562d TFS (35th TFW), George AFB, Calif. (TAC)
ZR	RF-4C	26th TRW, Zweibrücken AB, West Germany (USAFE)
ZZ	F-15C/D	18th TFW, Kadena AB, Okinawa (PACAF)

—Staff photo by Guy Aceto

The tail fin of a tactical aircraft (and of other types, too) reveals a lot of information. "MO" shows that this EF-111A is stationed at Mountain Home AFB, Idaho. The serial number (67-042) indicates that this was the forty-second aircraft bought in FY 1967. The wing designation (366th TFW) is an optional marking usually applied only to the wing commander's aircraft. The "AF," of course, indicates that this is not a Navy aircraft.

AIR DEFENSE UNIT FIN FLASHES

COLOR CODE	AIRCRAFT	UNIT AND LOCATION
AIR NATIONAL GUARD UNITS		
Sea-blue wedge	F-15A/B	102d FIW, Otis ANGB, Mass.
Rainbow	F-4D[1]	107th FIG, Niagara Falls IAP, N. Y.
Red stripe with "Happy Hooligans" logo	F-16A/B	119th FIG, Hector Field, N. D.
Blue triangle and two blue stripes bearing "Montana" and "Big Sky Country" logos	F-16A/B	120th FIG, Great Falls IAP, Mont.
Red hawk	F-15A/B	123d FIS (142d FIG), Portland IAP, Ore.
Blue/white lightning bolt	F-16A/B	125th FIG, Jacksonville IAP, Fla.
Blue stripe with "California" logo	F-16A/B	144th FIW, Fresno Air Terminal, Calif.
Texas star on red/white jagged stripes	F-16A/B	147th FIG, Ellington ANGB, Tex.
Stars of Little Dipper constellation	F-4D[1]	148th FIG, Duluth IAP, Minn.
Red dart	F-16A/B	177th FIG, Atlantic City Airport, N. J.
Yellow and black checkerboard	F-4D, F-16A/B	191st FIG, Selfridge ANGB, Mich.
AIR DEFENSE TRAINING UNITS (ANG)		
Black hawk	F-16A/B	114th TFTS (142d FIG), Kingsley Field, Ore.

[1]Scheduled to convert to F-16A/B.

—Staff photo by Guy Aceto

INSTALLATIONS OF THE US AIR FORCE

Major Installations, including Air Force Bases, Air Bases, Air Reserve Bases, and Air Guard Bases, are self-supporting centers of operations for actions of importance to Air Force combat, combat support, or training. Each is operated by an active, Reserve, or Guard unit of group size or larger with all land, facilities, and organic support needed to accomplish the unit mission. A major installation must have real property accountability through ownership, lease, permit, or other written agreement for all real estate and facilities. Agreements with foreign governments giving USAF jurisdiction over real property meet this requirement. Shared-use agreements (as opposed to joint-use agreements, wherein USAF owns the runway), do not meet this requirement. **Minor Installations** (Air Force Stations, Air Stations, Air Reserve Stations, and Air Guard Stations) are operated by active, Reserve, or Guard units of at least squadron size but do not otherwise satisfy the criteria for a major installation. Examples: Reserve and Guard flying operations located at civilian-owned airports. **Support sites** are facilities operated by active, Reserve, or Guard units that provide general support to the Air Force mission and do not satisfy the criteria for a major or minor installation. Examples: missile tracking sites; radar bomb scoring sites; USAF-owned, contractor-operated plants; radio relay sites. **Other Activities** include USAF units or activities that have little or no real property accountability for the real estate they occupy. Examples: active, Guard, or Reserve Air Force units located on installations belonging to other services; leased office space supporting recruiting detachments or Civil Air Patrol.

Major Installations	
US and Possessions[1]	102
Foreign	38
Worldwide	**140**
Minor Installations	
US and Possessions[1]	107
Foreign	13
Worldwide	**120**
Support Sites	
US and Possessions[1]	130
Foreign	120
Worldwide	**250**
Other Activities	
US and Possessions[2]	424
Foreign	404
Worldwide	**828**

[1]Includes Air Force Reserve and Air National Guard.
[2]Includes USAF presence at non-USAF installations and other sites.

USAF Leaders Through the Years

SECRETARIES OF THE AIR FORCE

Stuart Symington	Sept. 18, 1947	Apr. 24, 1950
Thomas K. Finletter	Apr. 24, 1950	Jan. 20, 1953
Harold E. Talbott	Feb. 4, 1953	Aug. 13, 1955
Donald A. Quarles	Aug. 15, 1955	Apr. 30, 1957
James H. Douglas, Jr.	May 1, 1957	Dec. 10, 1959
Dudley C. Sharp	Dec. 11, 1959	Jan. 20, 1961
Eugene M. Zuckert	Jan. 24, 1961	Sept. 30, 1965
Harold Brown	Oct. 1, 1965	Feb. 15, 1969
Robert C. Seamans, Jr.	Feb. 15, 1969	May 14, 1973
John L. McLucas	July 18, 1973	Nov. 23, 1975
James W. Plummer (acting)	Nov. 24, 1975	Jan. 1, 1976
Thomas C. Reed	Jan. 2, 1976	Apr. 6, 1977
John C. Stetson	Apr. 6, 1977	May 18, 1979
Hans Mark	July 26, 1979	Feb. 9, 1981
Verne Orr	Feb. 9, 1981	Nov. 30, 1985
Russell A. Rourke	Dec. 9, 1985	Apr. 7, 1986
Edward C. Aldridge, Jr.	June 9, 1986	Dec. 16, 1988
James F. McGovern (acting)	Dec. 16, 1988	Apr. 29, 1989
John J. Welch, Jr. (acting)	Apr. 29, 1989	May 21, 1989
Donald B. Rice	May 22, 1989	

USAF CHIEFS OF STAFF

Gen. Carl A. Spaatz	Sept. 26, 1947	Apr. 29, 1948
Gen. Hoyt S. Vandenberg	Apr. 30, 1948	June 29, 1953
Gen. Nathan F. Twining	June 30, 1953	June 30, 1957
Gen. Thomas D. White	July 1, 1957	June 30, 1961
Gen. Curtis E. LeMay	June 30, 1961	Jan. 31, 1965
Gen. John P. McConnell	Feb. 1, 1965	July 31, 1969
Gen. John D. Ryan	Aug. 1, 1969	July 31, 1973
Gen. George S. Brown	Aug. 1, 1973	June 30, 1974
Gen. David C. Jones	July 1, 1974	June 20, 1978
Gen. Lew Allen, Jr.	July 1, 1978	June 30, 1982
Gen. Charles A. Gabriel	July 1, 1982	June 30, 1986
Gen. Larry D. Welch	July 1, 1986	

CHIEF MASTER SERGEANTS OF THE AIR FORCE

CMSAF Paul W. Airey	Apr. 3, 1967	Aug. 1, 1969
CMSAF Donald L. Harlow	Aug. 1, 1969	Oct. 1, 1971
CMSAF Richard D. Kisling	Oct. 1, 1971	Oct. 1, 1973
CMSAF Thomas N. Barnes	Oct. 1, 1973	Aug. 1, 1977
CMSAF Robert D. Gaylor	Aug. 1, 1977	Aug. 1, 1979
CMSAF James M. McCoy	Aug. 1, 1979	July 1, 1981
CMSAF Arthur L. Andrews	Aug. 1, 1981	Aug. 1, 1983
CMSAF Sam E. Parish	Aug. 1, 1983	June 30, 1986
CMSAF James C. Binnicker	July 1, 1986	

AIR FORCE COMMUNICATIONS COMMAND

Maj. Gen. Harold W. Grant	July 1, 1961	Feb. 15, 1962
Maj. Gen. Kenneth P. Bergquist	Feb. 16, 1962	June 30, 1965
Maj. Gen. J. Francis Taylor, Jr.	July 1, 1965	Oct. 31, 1965
Maj. Gen. Richard P. Klocko	Nov. 1, 1965	July 2, 1967
Maj. Gen. Robert W. Paulson	July 15, 1967	Aug. 1, 1969
Maj. Gen. Paul R. Stoney	Aug. 1, 1969	Oct. 31, 1973
Maj. Gen. Donald L. Werbeck	Nov. 1, 1973	Aug. 24, 1975
Maj. Gen. Rupert H. Burris	Aug. 25, 1975	Oct. 31, 1977
Maj. Gen. Robert E. Sadler	Nov. 1, 1977	July 1, 1979
Maj. Gen. Robert T. Herres	July 1, 1979	July 27, 1981
Maj. Gen. Robert F. McCarthy	July 27, 1981	June 1, 1984
Maj. Gen. Gerald L. Prather	June 1, 1984	Aug. 28, 1986
Maj. Gen. John T. Stihl	Aug. 28, 1986	Mar. 29, 1988
Maj. Gen. James S. Cassity, Jr.	Mar. 29, 1988	May 16, 1989
Maj. Gen. Robert H. Ludwig	May 16, 1989	

Formerly Air Force Communications Service.
Redesignated Air Force Communications Command Nov. 15, 1979.

AIR FORCE LOGISTICS COMMAND

Gen. Joseph T. McNarney	Oct. 14, 1947	Aug. 31, 1949
Lt. Gen. Benjamin W. Chidlaw	Sept. 1, 1949	Aug. 20, 1951
Gen. Edwin W. Rawlings	Aug. 21, 1951	Feb. 28, 1959
Lt. Gen. William F. McKee	Mar. 1, 1959	Mar. 14, 1959
Gen. Samuel E. Anderson	Mar. 15, 1959	July 31, 1961
Gen. William F. McKee	Aug. 1, 1961	June 30, 1962
Gen. Mark E. Bradley, Jr.	July 1, 1962	July 31, 1965
Gen. Kenneth B. Hobson	Aug. 1, 1965	July 31, 1967
Gen. Thomas P. Gerrity	Aug. 1, 1967	Feb. 24, 1968
Lt. Gen. Lewis L. Mundell (acting)	Feb. 24, 1968	Mar. 28, 1968
Gen. Jack G. Merrell	Mar. 29, 1968	Sept. 11, 1972
Gen. Jack J. Catton	Sept. 12, 1972	Aug. 31, 1974
Gen. William V. McBride	Sept. 1, 1974	Aug. 31, 1975
Gen. F. Michael Rogers	Sept. 1, 1975	Jan. 27, 1978
Gen. Bryce Poe II	Jan. 28, 1978	July 31, 1981
Gen. James P. Mullins	Aug. 1, 1981	Nov. 1, 1984
Gen. Earl T. O'Loughlin	Nov. 1, 1984	July 31, 1987
Gen. Alfred G. Hansen	July 31, 1987	Oct. 31, 1989
Gen. Charles C. McDonald	Oct. 31, 1989	

Formerly Air Materiel Command.
Redesignated Air Force Logistics Command Apr. 1, 1961.

AIR FORCE SPACE COMMAND

Gen. James V. Hartinger	Sept. 1, 1982	July 30, 1984
Gen. Robert T. Herres	July 30, 1984	Oct. 1, 1986
Maj. Gen. Maurice C. Padden	Oct. 1, 1986	Oct. 29, 1987
Lt. Gen. Donald J. Kutyna	Oct. 29, 1987	Mar. 29, 1990
Lt. Gen. Thomas S. Moorman, Jr.	Mar. 29, 1990	

AIR FORCE SYSTEMS COMMAND

Maj. Gen. David M. Schlatter	Feb. 1, 1950	June 24, 1951
Lt. Gen. Earle E. Partridge	June 24, 1951	June 20, 1953
Lt. Gen. Donald L. Putt	June 30, 1953	Apr. 14, 1954
Lt. Gen. Thomas S. Power	Apr. 15, 1954	June 30, 1957
Maj. Gen. John W. Sessums, Jr.	July 1, 1957	July 31, 1957
Lt. Gen. Samuel E. Anderson	Aug. 1, 1957	Mar. 9, 1959
Maj. Gen. John W. Sessums, Jr.	Mar. 10, 1959	Apr. 24, 1959
Gen. Bernard A. Schriever	Apr. 25, 1959	Aug. 31, 1966
Gen. James Ferguson	Sept. 1, 1966	Aug. 30, 1970
Gen. George S. Brown	Sept. 1, 1970	July 31, 1973
Gen. Samuel C. Phillips	Aug. 1, 1973	Aug. 31, 1975
Gen. William J. Evans	Sept. 1, 1975	July 31, 1977
Gen. Lew Allen, Jr.	Aug. 1, 1977	Mar. 13, 1978
Gen. Alton D. Slay	Mar. 14, 1978	Feb. 1, 1981
Gen. Robert T. Marsh	Feb. 1, 1981	Aug. 1, 1984
Gen. Lawrence A. Skantze	Aug. 1, 1984	July 17, 1987
Gen. Bernard P. Randolph	July 17, 1987	Apr. 1, 1990
Gen. Ronald W. Yates	Apr. 1, 1990	

Formerly Air Research and Development Command.
Redesignated Air Force Systems Command Apr. 1, 1961.

AIR TRAINING COMMAND

Lt. Gen. John K. Cannon	Apr. 15, 1946	Oct. 15, 1948
Lt. Gen. Robert W. Harper	Oct. 14, 1948	June 30, 1954
Maj. Gen. Glenn O. Barcus	July 1, 1954	July 25, 1954
Lt. Gen. Charles T. Myers	July 26, 1954	July 31, 1958
Lt. Gen. Frederic H. Smith, Jr.	Aug. 1, 1958	July 31, 1959
Lt. Gen. James E. Briggs	Aug. 1, 1959	July 31, 1963
Lt. Gen. Robert W. Burns	Aug. 1, 1963	Aug. 10, 1964
Lt. Gen. William W. Momyer	Aug. 11, 1964	June 30, 1966
Lt. Gen. Sam Maddux, Jr.	July 1, 1966	Aug. 30, 1970
Lt. Gen. George B. Simler	Sept. 1, 1970	Sept. 9, 1972
Lt. Gen. William V. McBride	Sept. 9, 1972	Aug. 31, 1974
Lt. Gen. George H. McKee	Sept. 1, 1974	Aug. 31, 1975
Gen. John W. Roberts	Sept. 1, 1975	Apr. 1, 1979
Gen. B. L. Davis	Apr. 1, 1979	July 29, 1981
Gen. Thomas M. Ryan, Jr.	July 29, 1981	June 30, 1983
Gen. Andrew P. Iosue	July 1, 1983	Aug. 28, 1986
Gen. John A. Shaud	Aug. 28, 1986	June 6, 1988
Lt. Gen. Robert C. Oaks	June 6, 1988	

AIR UNIVERSITY

Maj. Gen. Muir S. Fairchild	Mar. 15, 1946	May 17, 1948
Maj. Gen. Robert W. Harper	May 17, 1948	Oct. 15, 1948
Gen. George C. Kenney	Oct. 16, 1948	July 27, 1951
Lt. Gen. Idwal H. Edwards	July 28, 1951	Feb. 28, 1953
Lt. Gen. Laurence S. Kuter	Apr. 15, 1953	May 31, 1955
Lt. Gen. Dean C. Strother	June 1, 1955	June 30, 1958
Lt. Gen. Walter E. Todd	July 15, 1958	July 31, 1961
Lt. Gen. Troup Miller, Jr.	Aug. 1, 1961	Dec. 31, 1963
Lt. Gen. Ralph P. Swofford, Jr.	Jan. 1, 1964	July 31, 1965
Lt. Gen. John W. Carpenter III	Aug. 1, 1965	July 31, 1968
Lt. Gen. Albert P. Clark	Aug. 1, 1968	July 31, 1970
Lt. Gen. Alvan C. Gillem II	Aug. 1, 1970	Oct. 31, 1973
Lt. Gen. F. Michael Rogers	Nov. 1, 1973	Aug. 31, 1975
Lt. Gen. Raymond B. Furlong	Sept. 1, 1975	July 1, 1979
Lt. Gen. Stanley M. Umstead	July 1, 1979	July 24, 1981
Lt. Gen. Charles G. Cleveland	July 24, 1981	Aug. 1, 1984
Lt. Gen. Thomas C. Richards	Aug. 1, 1984	Nov. 6, 1986
Lt. Gen. Truman Spangrud	Nov. 6, 1986	July 12, 1988

Lt. Gen. Ralph E. Havens	July 12, 1988	Oct. 6, 1989
Maj. Gen. David C. Reed	Oct. 6, 1989	Jan. 4, 1990
Lt. Gen. Charles G. Boyd	Jan. 4, 1990	

Air University was part of Air Training Command between May 1978 and July 1983.

ALASKAN AIR COMMAND

Brig. Gen. Joseph H. Atkinson	Oct. 1, 1946	Feb. 25, 1949
Brig. Gen. Frank A. Armstrong, Jr.	Feb. 26, 1949	Dec. 27, 1950
Maj. Gen. William D. Old	Dec. 27, 1950	Oct. 14, 1952
Brig. Gen. W. R. Agee	Oct. 27, 1952	Feb. 26, 1953
Maj. Gen. George R. Acheson	Feb. 26, 1953	Feb. 1, 1956
Lt. Gen. Joseph H. Atkinson	Feb. 24, 1956	July 16, 1956
Maj. Gen. Frank A. Armstrong, Jr.	July 17, 1956	Oct. 23, 1956
Maj. Gen. James H. Davies	Oct. 24, 1956	June 27, 1957
Lt. Gen. Frank A. Armstrong, Jr.	June 28, 1957	Aug. 18, 1957
Brig. Gen. Kenneth H. Gibson	Aug. 19, 1957	Aug. 13, 1958
Maj. Gen. C. F. Necrason	Aug. 14, 1958	July 19, 1961
Maj. Gen. Wendell W. Bowman	July 26, 1961	Aug. 8, 1963
Maj. Gen. James C. Jensen	Aug. 15, 1963	Nov. 14, 1966
Maj. Gen. Thomas E. Moore	Nov. 15, 1966	July 24, 1969
Maj. Gen. Joseph A. Cunningham	July 25, 1969	July 31, 1972
Maj. Gen. Donavon F. Smith	Aug. 1, 1972	June 5, 1973
Maj. Gen. Charles W. Carson, Jr.	June 18, 1973	Mar. 2, 1974
Maj. Gen. Jack K. Gamble	Mar. 19, 1974	June 30, 1975
Lt. Gen. James E. Hill	July 1, 1975	Oct. 14, 1976
Lt. Gen. M. L. Boswell	Oct. 15, 1976	June 30, 1978
Lt. Gen. Winfield W. Scott, Jr.	July 1, 1978	Apr. 1, 1981
Lt. Gen. Lynwood E. Clark	Apr. 1, 1981	Aug. 31, 1983
Lt. Gen. Bruce K. Brown	Sept. 1, 1983	Sept. 26, 1985
Lt. Gen. David L. Nichols	Sept. 27, 1985	May 22, 1988
Lt. Gen. Thomas G. McInerney	May 22, 1988	

ELECTRONIC SECURITY COMMAND

Col. Roy H. Lynn	Oct. 26, 1948	July 5, 1949
Col. Travis M. Hetherington	July 6, 1949	Feb. 21, 1951
Maj. Gen. Roy H. Lynn	Feb. 22, 1951	Feb. 13, 1953
Maj. Gen. Harold H. Bassett	Feb. 14, 1953	Jan. 3, 1957
Maj. Gen. Gordon L. Blake	Jan. 4, 1957	Aug. 5, 1959
Maj. Gen. John B. Ackerman	Aug. 6, 1959	Sept. 20, 1959
Maj. Gen. Millard Lewis	Sept. 21, 1959	Aug. 31, 1962
Maj. Gen. Richard P. Klocko	Sept. 1, 1962	Oct. 15, 1965
Maj. Gen. Louis E. Coira	Oct. 16, 1965	July 18, 1969
Maj. Gen. Carl W. Stapleton	July 19, 1969	Feb. 23, 1973
Maj. Gen. Walter T. Galligan	Feb. 24, 1973	May 16, 1974
Maj. Gen. Howard P. Smith	May 17, 1974	July 31, 1975
Maj. Gen. K. D. Burns	Aug. 1, 1975	Jan. 18, 1979
Maj. Gen. Doyle E. Larson	Jan. 19, 1979	July 31, 1983
Maj. Gen. John B. Marks	Aug. 1, 1983	Apr. 16, 1985
Maj. Gen. Paul H. Martin	Apr. 17, 1985	Aug. 14, 1989
Maj. Gen. Gary W. O'Shaughnessy	Aug. 15, 1989	

Formerly USAF Security Service.
Redesignated Electronic Security Command Aug. 1, 1979.

MILITARY AIRLIFT COMMAND

Lt. Gen. Laurence S. Kuter	June 1, 1948	Oct. 28, 1951
Lt. Gen. Joseph Smith	Nov. 15, 1951	June 30, 1958
Lt. Gen. William H. Tunner	July 1, 1958	May 31, 1960
Gen. Joe W. Kelly, Jr.	June 1, 1960	July 18, 1964
Gen. Howell M. Estes, Jr.	July 19, 1964	July 31, 1969
Gen. Jack J. Catton	Aug. 1, 1969	Sept. 12, 1972
Gen. Paul K. Carlton	Sept. 20, 1972	Mar. 31, 1977
Gen. William G. Moore, Jr.	Apr. 1, 1977	June 30, 1979
Gen. Robert E. Huyser	July 1, 1979	June 26, 1981
Gen. James R. Allen	June 26, 1981	June 30, 1983
Gen. Thomas M. Ryan, Jr.	July 1, 1983	Sept. 19, 1985
Gen. Duane H. Cassidy	Sept. 20, 1985	Sept. 20, 1989
Gen. H. T. Johnson	Sept. 20, 1989	

Formerly Military Air Transport Service.
Redesignated Military Airlift Command Jan. 1, 1966.

PACIFIC AIR FORCES

Lt. Gen. Ennis C. Whitehead	Dec. 30, 1945	Apr. 25, 1949
Lt. Gen. George E. Stratemeyer	Apr. 26, 1949	May 20, 1951
Lt. Gen. Earle E. Partridge (acting)	May 21, 1951	June 9, 1951
Gen. O. P. Weyland	June 10, 1951	Mar. 25, 1954
Gen. Earle E. Partridge	Mar. 26, 1954	May 31, 1955
Gen. Laurence S. Kuter	June 1, 1955	July 31, 1959
Gen. Emmett O'Donnell, Jr.	Aug. 1, 1959	July 31, 1963
Gen. Jacob E. Smart	Aug. 1, 1963	July 31, 1964
Gen. Hunter Harris, Jr.	Aug. 1, 1964	Jan. 31, 1967
Gen. John D. Ryan	Feb. 1, 1967	July 31, 1968
Gen. Joseph J. Nazzaro	Aug. 1, 1968	July 31, 1971
Gen. Lucius D. Clay, Jr.	Aug. 1, 1971	Sept. 30, 1973
Gen. John W. Vogt	Oct. 1, 1973	June 30, 1974
Gen. Louis L. Wilson, Jr.	July 1, 1974	May 31, 1977
Lt. Gen. James A. Hill	June 1, 1977	June 14, 1978
Lt. Gen. James D. Hughes	June 15, 1978	July 1, 1981
Lt. Gen. Arnold W. Braswell	July 1, 1981	Sept. 30, 1983
Gen. Jerome F. O'Malley	Oct. 8, 1983	Nov. 1, 1984
Gen. Robert W. Bazley	Nov. 1, 1984	Dec. 16, 1986
Gen. Jack I. Gregory	Dec. 16, 1986	July 22, 1988
Gen. Merrill A. McPeak	July 22, 1988	

Formerly Far East Air Forces.
Redesignated Pacific Air Forces July 1, 1957.

STRATEGIC AIR COMMAND

Gen. George C. Kenney	Mar. 21, 1946	Oct. 18, 1948
Gen. Curtis E. LeMay	Oct. 19, 1948	June 30, 1957
Gen. Thomas S. Power	July 1, 1957	Nov. 30, 1964
Gen. John D. Ryan	Dec. 1, 1964	Jan. 31, 1967
Gen. Joseph J. Nazzaro	Feb. 1, 1967	July 28, 1968
Gen. Bruce K. Holloway	July 29, 1968	Apr. 30, 1972
Gen. John C. Meyer	May 1, 1972	July 31, 1974
Gen. Russell E. Dougherty	Aug. 1, 1974	July 31, 1977
Gen. Richard H. Ellis	Aug. 1, 1977	July 31, 1981
Gen. B. L. Davis	Aug. 1, 1981	July 31, 1985
Gen. Larry D. Welch	Aug. 1, 1985	June 30, 1986
Gen. John T. Chain	July 1, 1986	

TACTICAL AIR COMMAND

Lt. Gen. E. R. Quesada	Mar. 21, 1946	Nov. 23, 1948
Maj. Gen. Robert M. Lee	Dec. 24, 1948	June 20, 1950
Maj. Gen. Glenn O. Barcus	July 17, 1950	Jan. 25, 1951
Gen. John K. Cannon	Jan. 25, 1951	Mar. 31, 1954
Gen. O. P. Weyland	Apr. 1, 1954	July 31, 1959
Gen. Frank F. Everest	Aug. 1, 1959	Sept. 30, 1961
Gen. Walter C. Sweeney, Jr.	Oct. 1, 1961	July 31, 1965
Gen. Gabriel P. Disosway	Aug. 1, 1965	July 31, 1968
Gen. William W. Momyer	Aug. 1, 1968	Sept. 30, 1973
Gen. Robert J. Dixon	Oct. 1, 1973	Apr. 30, 1978
Gen. W. L. Creech	May 1, 1978	Nov. 1, 1984
Gen. Jerome F. O'Malley	Nov. 1, 1984	Apr. 20, 1985
Gen. Robert D. Russ	May 22, 1985	

US AIR FORCES IN EUROPE

Brig. Gen. John F. McBain	Aug. 15, 1947	Oct. 20, 1947
Lt. Gen. Curtis E. LeMay	Oct. 20, 1947	Oct. 15, 1948
Lt. Gen. John K. Cannon	Oct. 16, 1948	Jan. 20, 1951
Gen. Lauris Norstad	Jan. 21, 1951	July 26, 1953
Lt. Gen. William H. Tunner	July 27, 1953	June 30, 1957
Gen. Frank F. Everest	July 1, 1957	July 31, 1959
Gen. Frederic H. Smith, Jr.	Aug. 1, 1959	June 30, 1961
Gen. Truman H. Landon	July 1, 1961	July 31, 1963
Gen. Gabriel P. Disosway	Aug. 1, 1963	July 31, 1965
Gen. Bruce K. Holloway	Aug. 1, 1965	July 31, 1966
Gen. Maurice A. Preston	Aug. 1, 1966	July 31, 1968
Gen. Horace M. Wade	Aug. 1, 1968	Jan. 31, 1969
Gen. Joseph R. Holzapple	Feb. 1, 1969	Aug. 31, 1971
Gen. David C. Jones	Sept. 1, 1971	June 30, 1974
Gen. John W. Vogt	July 1, 1974	Aug. 31, 1975
Gen. Richard H. Ellis	Sept. 1, 1975	July 31, 1977
Gen. William J. Evans	Aug. 1, 1977	Aug. 1, 1978
Gen. John W. Pauly	Aug. 1, 1978	Aug. 1, 1980
Gen. Charles A. Gabriel	Aug. 1, 1980	June 30, 1982
Gen. Billy M. Minter	July 1, 1982	Nov. 1, 1984
Gen. Charles L. Donnelly, Jr.	Nov. 1, 1984	May 1, 1987
Gen. William L. Kirk	May 1, 1987	Apr. 12, 1989
Gen. Michael J. Dugan	Apr. 12, 1989	

USAF ACADEMY SUPERINTENDENTS

Lt. Gen. Hubert R. Harmon	July 27, 1954	July 27, 1956
Maj. Gen. James E. Briggs	July 28, 1956	Aug. 16, 1959
Maj. Gen. William S. Stone	Aug. 17, 1959	June 30, 1962
Maj. Gen. Robert H. Warren	July 9, 1962	June 30, 1965
Lt. Gen. Thomas S. Moorman	July 1, 1965	July 31, 1970
Lt. Gen. Albert P. Clark	Aug. 1, 1970	July 31, 1974
Lt. Gen. James R. Allen	Aug. 1, 1974	June 27, 1977
Lt. Gen. Kenneth L. Tallman	June 28, 1977	June 15, 1981
Maj. Gen. Robert E. Kelley	June 16, 1981	June 15, 1983
Lt. Gen. Winfield W. Scott, Jr.	June 16, 1983	June 25, 1987
Lt. Gen. Charles R. Hamm	June 26, 1987	

AIR FORCE RESERVE

Maj. Gen. Rollin B. Moore, Jr.	Aug. 1, 1968	Jan. 26, 1972
Brig. Gen. Alfred Verhulst (acting)	Jan. 27, 1972	Mar. 15, 1972
Maj. Gen. Homer I. Lewis	Mar. 16, 1972	Apr. 8, 1975
Maj. Gen. William Lyon	Apr. 16, 1975	Apr. 16, 1979
Maj. Gen. Richard Bodycombe	Apr. 17, 1979	Oct. 31, 1982
Maj. Gen. Sloan R. Gill	Nov. 1, 1982	Oct. 31, 1986
Maj. Gen. Roger P. Scheer	Nov. 1, 1986	

Since Mar. 16, 1972, the Chief of Air Force Reserve has been dual-hatted as Commander, Hq. Air Force Reserve (AFRES). The earlier chief of Hq. Air Force Reserve was Maj. Gen. Tom E. Marchbanks, Jr., from Jan. 18, 1968, to Feb. 1, 1971.

AIR NATIONAL GUARD

Col. William A. R. Robertson	Nov. 28, 1945	Oct. 1948
Maj. Gen. George G. Finch	Oct. 1948	Sept. 25, 1950
Maj. Gen. Earl T. Ricks	Oct. 13, 1950	Jan. 4, 1954
Maj. Gen. Winston P. Wilson	Jan. 26, 1954	Aug. 5, 1962
Maj. Gen. I. G. Brown	Aug. 6, 1962	Apr. 19, 1974
Maj. Gen. John J. Pesch	Apr. 20, 1974	Jan. 31, 1977
Maj. Gen. John T. Guice	Feb. 1, 1977	Apr. 1, 1981
Maj. Gen. John B. Conaway	Apr. 1, 1981	Nov. 1, 1988
Maj. Gen. Philip G. Killey	Nov. 1, 1988	

The head of the Air National Guard was Chief, Aviation Group, National Guard Bureau until 1948, when the title changed to Chief, Air Force Division, NGB. In Dec. 1969 the title was changed to the present Director, Air National Guard.

AIR FORCE Magazine's Guide to Aces

In compiling this list of aces who flew with USAF and its predecessor organizations (the Air Service and the Army Air Forces), AIR FORCE Magazine has relied on USAF's official accounting of aerial victory credits, which is the responsibility of the USAF Historical Research Center at Maxwell AFB, Ala.

Air Force historians have kept the official records of aerial victories by USAF pilots and crew members since 1957. A few foreign pilots are also listed. Most aerial victory credits have been earned by fighter pilots who have destroyed enemy aircraft in the air. The Office of Air Force History had previously published four separate listings—one for each of the major wars (World War I, World War II, Korea, and Vietnam). Recently, the four volumes have been corrected, updated, and combined into one comprehensive volume.

The USAF Historical Research Center is not authorized, nor has it ever attempted, to verify aerial victories claimed by Americans who flew with the air forces of other nations. Therefore, this list no longer contains World War I victory credits for Americans serving in the Lafayette Escadrille, French Flying Corps, Royal Flying Corps, or Royal Navy. Similarly, it no longer contains World War II victory credits for Americans in the Eagle Squadrons or the Flying Tigers (American Volunteer Group). However, victories were awarded to members of the Army Air Service if they were flying with British or French units when they shot down enemy aircraft. Some World War I pilots (notably Frank Luke) were credited with victories for destroying balloons. —THE EDITORS

AMERICAN ACES OF WORLD WAR I

Rickenbacker, Capt. Edward V.	24.33	Stenseth, 1st Lt. Martinus	6.47
		Wright, 1st Lt. Chester E.	6.33
Luke, 2d Lt. Frank, Jr.	15.83	Jones, 2d Lt. Clinton	6.16
Kindley, 1st Lt. Field E.	11.00	Burdick, 2d Lt. Howard	6.00
Springs, 1st Lt. Elliott W.	10.75	Chambers, 1st Lt. Reed M.	6.00
Landis, 1st Lt. Reed G.	10.00	Creech, 1st Lt. Jesse O.	6.00
Vaughn, 1st Lt. George A.	9.50	Putnam, 1st Lt. David E.	6.00
Swabb, 1st Lt. Jacques M.	8.50	Cook, 1st Lt. Harvey W.	5.66
Donaldson, 2d Lt. John O.	8.00	Meissner, Capt. James A.	5.66
Baer, 1st Lt. Paul P.	7.75	Coolidge, Capt. Hamilton	5.58
Clay, 1st Lt. Henry R., Jr.	7.00	Campbell, 1st Lt. Douglas	5.50
Hamilton, 1st Lt. Lloyd A.	6.83	Knotts, 2d Lt. Howard C.	5.50
White, 2d Lt. Wilbert W.	6.66	Rummell, 1st Lt. Leslie J.	5.16
Cassady, 1st Lt. Thomas G.	6.63	Bissell, 1st Lt. Clayton L.	5.00
Holden, 1st Lt. Lansing C.	6.50	Luff, 1st Lt. Frederick E.	5.00
Hunter, 1st Lt. Frank O'D.	6.50	Ponder, 2d Lt. William T.	5.00

SOME FAMOUS US FIGHTER FIRSTS

May 30, 1918	First US-trained AEF Ace: Capt. Edward V. Rickenbacker.
Dec. 7, 1941	First AAF Victories of WW II: Six pilots at Pearl Harbor.
Dec. 16, 1941	First AAF Ace of WW II: 1st Lt. Boyd D. Wagner.
June 27, 1950	First USAF Victories in the Korean War.
Nov. 8, 1950	First Jet-to-Jet Victory of the Korean War.
May 20, 1951	First USAF Ace of the Korean War: Capt. James Jabara.
Nov. 30, 1951	First USAF Ace of Two Wars (WW II and Korea): Maj. George A. Davis, Jr. (7 in WW II and 14 in Korea).
Jan. 2, 1967	First (and Only) USAF Ace with Victories in WW II and Vietnam: Col. Robin Olds (12 in WW II and 4 in Vietnam).

LEADING ARMY AIR FORCES ACES OF WORLD WAR II

(Fourteen and a half or more victories)

Bong, Maj. Richard I.	40	Lynch, Lt. Col. Thomas J.	20	Anderson, Capt. Clarence E., Jr.	16.25
McGuire, Maj. Thomas B., Jr.	38	Westbrook, Lt. Col. Robert B.	20	Dunham, Lt. Col. William D.	16
Gabreski, Lt. Col. Francis S.	28*	Gentile, Capt. Donald S.	19.83	Harris, Lt. Col. Bill	16
Johnson, Capt. Robert S.	27	Duncan, Col. Glenn E.	19.50	Welch, Capt. George S.	16
MacDonald, Col. Charles H.	27	Carson, Capt. Leonard K.	18.50	Beerbower, Capt. Donald M.	15.50
Preddy, Maj. George E.	26.83	Eagleston, Maj. Glenn T.	18.50*	Brown, Maj. Samuel J.	15.50
Meyer, Lt. Col. John C.	24*	Beckham, Maj. Walter C.	18	Peterson, Capt. Richard A.	15.50
Schilling, Col. David C.	22.50	Green, Maj. Herschel H.	18	Whisner, Capt. William T., Jr.	15.50*
Johnson, Lt. Col. Gerald R.	22	Herbst, Lt. Col. John C.	18	Bradley, Lt. Col. Jack T.	15
Kearby, Col. Neel E.	22	Zemke, Lt. Col. Hubert	17.75	Cragg, Maj. Edward	15
Robbins, Maj. Jay T.	22	England, Maj. John B.	17.50	Foy, Maj. Robert W.	15
Christensen, Capt. Fred J.	21.50	Beeson, Capt. Duane W.	17.33	Hofer, 2d Lt. Ralph K.	15
Wetmore, Capt. Ray S.	21.25	Thornell, 1st Lt. John F., Jr.	17.25	Homer, Capt. Cyril F.	15
Voll, Capt. John J.	21	Varnell, Capt. James S., Jr.	17	Landers, Lt. Col. John D.	14.50
Mahurin, Maj. Walker M.	20.75*	Johnson, Maj. Gerald W.	16.50	Powers, Capt. Joe H., Jr.	14.50
		Godfrey, Capt. John T.	16.33		

*Aces who added to these scores by victories in the Korean War. Ranks are as of last vistory in World War II.

America's leading ace of all time is Maj. Richard Bong, a P-38 pilot. All of Major Bong's victories occurred in the Pacific theater during World War II.

LEADING AIR SERVICE/ AAF/USAF ACES OF ALL WARS

Bong, Maj. Richard I.	40	WW II	Kearby, Col. Neel E.	22	WW II
McGuire, Maj. Thomas B., Jr.	38	WW II	Robbins, Maj. Jay T.	22	WW II
Gabreski, Col. Francis S.	34.50	WW II, Korea	Christensen, Capt. Fred J.	21.50	WW II
Johnson, Lt. Col. Robert S.	27	WW II	Wetmore, Capt. Ray S.	21.25	WW II
MacDonald, Col. Charles H.	27	WW II	Davis, Maj. George A., Jr.	21	WW II, Korea
Preddy, Maj. George E.	26.83	WW II	Voll, Capt. John J.	21	WW II
Meyer, Col. John C.	26	WW II, Korea	Whisner, Maj. William T., Jr.	21	WW II, Korea
Rickenbacker, Capt. Edward V.	24.33	WW I	Eagleston, Col. Glenn T.	20.50	WW II, Korea
Mahurin, Col. Walker M.	24.25	WW II, Korea	Lynch, Lt. Col. Thomas J.	20	WW II
Schilling, Col. David C.	22.50	WW II	Westbrook, Lt. Col. Robert B.	20	WW II
Johnson, Lt. Col. Gerald R.	22	WW II	Gentile, Capt. Donald S.	19.83	WW II

SOME FAMOUS FIRSTS AMONG US BOMBARDMENT UNITS

June 12, 1918 First AEF bombing mission of WW I: 6 Breguet 14s of the 96th Aero Sqdn., led by Maj. Harry M. Brown, flying from Amanty, attacked railyards at Dommary-Baroncourt, France.

Dec. 10, 1941 First AAF bombing mission of WW II: 5 B-17s of the 93d Bomb Sqdn., 19th Bomb Group, led by Maj. Cecil Combs, flying from Clark Field, attacked Japanese ships near Vigan in the Philippines.

Apr. 18, 1942 First AAF bombing of Japan: 16 B-25s and crews picked from the 17th Bomb Gp. and the 89th Recon Sqdn., led by Lt. Col. James H. Doolittle, launched from the carrier *Hornet*, attacked targets in the Tokyo area.

June 12, 1942 First AAF bombing mission against a European target: 12 B-24s of the HALPRO Detachment, led by Col. Harry A. Halverson, flying from Fayid, Egypt, attacked oil refineries at Ploesti, Romania.

Jan. 27, 1943 First AAF bombing of Germany: 55 B-17s from 4 groups (91st, 303d, 305th, and 306th) of the 1st Bomb Wing (Eighth Air Force), flying from England, attacked naval targets at Wilhelmshaven and Emden.

June 28, 1950 First USAF bombing mission of the Korean War: 12 B-26s of the 13th Bomb Sqdn., 3d Bomb Gp., flying from Ashiya, Japan, attacked rail and road targets at Munsan.

Dec. 26, 1961 First USAF bombing mission of the Vietnam War: 2 T-28s of the Farm Gate Detachment (4400th Combat Crew Training Sqdn.), flying from Tan Son Nhut in support of 2 Vietnamese AD-6s, attacked Viet Cong facilities north of Saigon.

Jun. 18, 1965 First USAF heavy bombing mission of the Vietnam War: 27 B-52s (Arc Light) of the 7th and 320th Bomb Wgs., flying from Andersen AFB, Guam, attacked a Viet Cong base at Ben Cat.

USAF ACES OF THE KOREAN WAR

McConnell, Capt. Joseph, Jr.	16	Hagerstrom, Maj. James P.	8.50*	Whisner, Maj. William T., Jr.	5.50*
Jabara, Maj. James	15*	Risner, Capt. Robinson	8	Baldwin, Col. Robert P.	5
Fernandez, Capt. Manuel J.	14.50	Ruddell, Lt. Col. George I.	8*	Becker, Capt. Richard S.	5
Davis, Maj. George A., Jr.	14*	Buttlemann, 1st Lt. Henry	7	Bettinger, Maj. Stephen L.	5
Baker, Col. Royal N.	13*	Jolley, Capt. Clifford D.	7	Creighton, Maj. Richard D.	5*
Blesse, Maj. Frederick C.	10	Lilley, Capt. Leonard W.	7	Curtin, Capt. Clyde A.	5
Fischer, 1st Lt. Harold E.	10	Adams, Maj. Donald E.	6.50	Gibson, Capt. Ralph D.	5
Garrison, Lt. Col. Vermont	10*	Gabreski, Col. Francis S.	6.50*	Kincheloe, Capt. Iven C., Jr.	5
Johnson, Col. James K.	10*	Jones, Lt. Col. George L.	6.50	Latshaw, Capt. Robert T., Jr.	5
Moore, Capt. Lonnie R.	10	Marshal, Maj. Winton W.	6.50	Moore, Capt. Robert H.	5
Parr, Capt. Ralph S., Jr.	10	Kasler, 1st Lt. James H.	6	Overton, Capt. Dolphin D., III	5
Foster, Capt. Cecil G.	9	Love, Capt. Robert J.	6	Thyng, Col. Harrison R.	5*
Low, 1st Lt. James F.	9			Westcott, Maj. William H.	5

*These are in addition to World War II victories.

The leading Air Force ace of the Korean War was Capt. Joseph McConnell. His sixteen victories, all over MiG-15s, came while flying F-86s.

USAF ACES OF THE VIETNAM WAR

DeBellevue, Capt. Charles B. (USAF)	6
Feinstein, Capt. Jeffrey S. (USAF)	5
Ritchie, Capt. Richard S. (USAF)	5

Capt. Richard S. "Steve" Ritchie (right) was the first USAF ace of the Vietnam conflict. Capt. Chuck DeBellevue (left), a weapon systems officer, later became the leading American ace of that war.

AAF/USAF ACES OF WORLD WAR II AND LATER WARS

	WW II	KOREA	TOTAL		WW II	KOREA	TOTAL
Gabreski, Col. Francis S.	28	6.50	34.50	Johnson, Col. James K.	1	10	11
Meyer, Col. John C.	24	2	26	Ruddell, Lt. Col. George I.	2.50	8	10.50
Mahurin, Col. Walker M.	20.75	3.50	24.25	Thyng, Col. Harrison R.	5	5	10
Davis, Maj. George A., Jr.	7	14	21	Colman, Capt. Philip E.	5	4	9
Whisner, Maj. William T., Jr.	15.50	5.50	21	Heller, Lt. Col. Edwin L.	5.50	3.50	9
Eagleston, Col. Glenn T.	18.50	2	20.50	Chandler, Maj. Van E.	5	3	8
Garrison, Lt. Col. Vermont	7.33	10	17.33	Hockery, Maj. John J.	7	1	8
Baker, Col. Royal N.	3.50	13	16.50	Creighton, Maj. Richard D.	2	5	7
Jabara, Maj. James	1.50	15	16.50	Emmert, Lt. Col. Benjamin H., Jr.	6	1	7
Olds, Col. Robin	12	4*	16	Bettinger, Maj. Stephen L.	1	5	6
Mitchell, Col. John W.	11	4	15	Visscher, Maj. Herman W.	5	1	6
Brueland, Maj. Lowell K.	12.50	2	14.50	Liles, Capt. Brooks J.	1	4	5
Hagerstrom, Maj. James P.	6	8.50	14.50	Mattson, Capt. Conrad E.	1	4	5
Hovde, Lt. Col. William J.	10.50	1	11.50	Shaeffer, Maj. William F.	2	3	5

*Colonel Olds's 4 additional victories came during the Vietnam War.

UNITED STATES AIR FORCE MEDAL OF HONOR RECIPIENTS

NAMES, ALPHABETICALLY BY WARS, AND RANK AT TIME OF ACTION	HOME TOWN	DATE AND PLACE OF ACTION	PRESENT ADDRESS OR DATE OF DEATH
WORLD WAR I			
Bleckley, 2d Lt. Erwin R.	Wichita, Kan.	Oct. 6, 1918, Binarville, France	KIA, Oct. 6, 1918
Goettler, 2d Lt. Harold E.	Chicago, Ill.	Oct. 6, 1918, Binarville, France	KIA, Oct. 6, 1918
Luke, 2d Lt. Frank, Jr.	Phoenix, Ariz.	Sept. 29, 1918, Murvaux, France	KIA, Sept. 29, 1918
Rickenbacker, Capt. Edward V.	Columbus, Ohio	Sept. 25, 1918, Billy, France	Died, July 23, 1973
WORLD WAR II			
Baker, Lt. Col. Addison E.	Chicago, Ill.	Aug. 1, 1943, Ploesti, Romania	KIA, Aug. 1, 1943
Bong, Maj. Richard I.	Poplar, Wis.	Oct. 10–Nov. 15, 1944, Southwest Pacific	Killed, Aug. 6, 1945, Burbank, Calif.
Carswell, Maj. Horace S., Jr.	Fort Worth, Tex.	Oct. 26, 1944, South China Sea	KIA, Oct. 26, 1944
Castle, Brig. Gen. Frederick W.	Manila, P. I.	Dec. 24, 1944, Liège, Belgium	KIA, Dec. 24, 1944
Cheli, Maj. Ralph	San Francisco, Calif.	Aug. 18, 1943, Wewak, New Guinea	Died as POW, Mar. 6, 1944
Craw, Col. Demas T.	Traverse City, Mich.	Nov. 8, 1942, Port Lyautey, French Morocco	KIA, Nov. 8, 1942
Doolittle, Lt. Col. James H.	Alameda, Calif.	Apr. 18, 1942, Tokyo, Japan	Carmel, Calif. (Ret. Gen.)
Erwin, SSgt. Henry E.	Adamsville, Ala.	Apr. 12, 1945, Koriyama, Japan	Leeds, Ala.
Femoyer, 2d Lt. Robert E.	Huntington, W. Va.	Nov. 2, 1944, Merseburg, Germany	KIA, Nov. 2, 1944
Gott, 1st Lt. Donald J.	Arnett, Okla.	Nov. 9, 1944, Saarbrücken, Germany	KIA, Nov. 9, 1944
Hamilton, Maj. Pierpont M.	Tuxedo Park, N. Y.	Nov. 8, 1942, Port Lyautey, French Morocco	Died, Mar. 4, 1982
Howard, Lt. Col. James H.	Canton, China	Jan. 11, 1944, Oschersleben, Germany	Belleair Bluffs, Fla. (Ret. Brig. Gen.)
Hughes, 2d Lt. Lloyd H.	Alexandria, La.	Aug. 1, 1943, Ploesti, Romania	KIA, Aug. 1, 1943
Jerstad, Maj. John L.	Racine, Wis.	Aug. 1, 1943, Ploesti, Romania	KIA, Aug. 1, 1943
Johnson, Col. Leon W.	Columbia, Mo.	Aug. 1, 1943, Ploesti, Romania	McLean, Va. (Ret. Gen.)
Kane, Col. John R.	McGregor, Tex.	Aug. 1, 1943, Ploesti, Romania	Booneville, Ark. (Ret. Col.)
Kearby, Col. Neel E.	Wichita Falls, Tex.	Oct. 11, 1943, Wewak, New Guinea	KIA, Mar. 5, 1944, Wewak, New Guinea
Kingsley, 2d Lt. David R.	Portland, Ore.	June 23, 1944, Ploesti, Romania	KIA, June 23, 1944
Knight, 1st Lt. Raymond L.	Houston, Tex.	Apr. 25, 1945, Po Valley, Italy	KIA, Apr. 25, 1945
Lawley, 1st Lt. William R., Jr.	Leeds, Ala.	Feb. 20, 1944, Leipzig, Germany	Montgomery, Ala. (Ret. Col.)
Lindsey, Capt. Darrell R.	Jefferson, Iowa	Aug. 9, 1944, Pontoise, France	KIA, Aug. 9, 1944
Mathies, SSgt. Archibald	Scotland	Feb. 20, 1944, Leipzig, Germany	KIA, Feb. 20, 1944
Mathis, 1st Lt. Jack W.	San Angelo, Tex.	Mar. 18, 1943, Vegesack, Germany	KIA, Mar. 18, 1943
McGuire, Maj. Thomas B., Jr.	Ridgewood, N. J.	Dec. 25–26, 1944, Luzon, P. I.	KIA, Jan. 7, 1945, Negros, P. I.
Metzger, 2d Lt. William E., Jr.	Lima, Ohio	Nov. 9, 1944, Saarbrücken, Germany	KIA, Nov. 9, 1944
Michael, 1st Lt. Edward S.	Chicago, Ill.	Apr. 11, 1944, Brunswick, Germany	Fairfield, Calif. (Ret. Lt. Col.)
Morgan, 2d Lt. John C.	Vernon, Tex.	July 28, 1943, Kiel, Germany	Marina del Rey, Calif. (Ret. Col.)
Pease, Capt. Harl, Jr.	Plymouth, N. H.	Aug. 7, 1942, Rabaul, New Britain	KIA, Aug. 7, 1942
Pucket, 1st Lt. Donald D.	Longmont, Colo.	July 9, 1944, Ploesti, Romania	KIA, July 9, 1944
Sarnoski, 2d Lt. Joseph R.	Simpson, Pa.	June 16, 1943, Buka, Solomon Is.	KIA, June 16, 1943
Shomo, Maj. William A.	Jeannette, Pa.	Jan. 11, 1945, Luzon, P. I.	Russell, Pa. (Ret. Lt. Col.)
Smith, Sgt. Maynard H.	Caro, Mich.	May 1, 1943, St. Nazaire, France	Died, May 11, 1984
Truemper, 2d Lt. Walter E.	Aurora, Ill.	Feb. 20, 1944, Leipzig, Germany	KIA, Feb. 20, 1944
Vance, Lt. Col. Leon R., Jr.	Enid, Okla.	June 5, 1944, Wimereaux, France	Killed, July 26, 1944, near Iceland
Vosler, TSgt. Forrest L.	Lyndonville, N. Y.	Dec. 20, 1943, Bremen, Germany	Memphis, N. Y.
Walker, Brig. Gen. Kenneth N.	Cerrillos, N. M.	Jan. 5, 1943, Rabaul, New Britain	KIA, Jan. 5, 1943
Wilkins, Maj. Raymond H.	Portsmouth, Va.	Nov. 2, 1943, Rabaul, New Britain	KIA, Nov. 2, 1943
Zeamer, Maj. Jay, Jr.	Carlisle, Pa.	June 16, 1943, Buka, Solomon Is.	Stoneham, Mass. (Ret. Lt. Col.)
KOREA			
Davis, Maj. George A., Jr.	Dublin, Tex.	Feb. 10, 1952, Sinuiju-Yalu River, N. Korea	KIA, Feb. 10, 1952
Loring, Maj. Charles J., Jr.	Portland, Me.	Nov. 22, 1952, Sniper Ridge, N. Korea	KIA, Nov. 22, 1952
Sebille, Maj. Louis J.	Harbor Beach, Mich.	Aug. 5, 1950, Hamch'ang, S. Korea	KIA, Aug. 5, 1950
Walmsley, Capt. John S., Jr.	Baltimore, Md.	Sept. 14, 1951, Yangdok, N. Korea	KIA, Sept. 14, 1951
VIETNAM			
Bennett, Capt. Steven L.	Palestine, Tex.	June 29, 1972, Quang Tri, S. Vietnam	KIA, June 29, 1972
Day, Col. George E.	Sioux City, Iowa	Conspicuous gallantry while POW	Shalimar, Fla. (Ret. Col.)
Dethlefsen, Maj. Merlyn H.	Greenville, Iowa	Mar. 10, 1967, Thai Nguyen, N. Vietnam	Died, Dec. 14, 1987
Fisher, Maj. Bernard F.	San Bernardino, Calif.	Mar. 10, 1966, A Shau Valley, S. Vietnam	Kuna, Idaho (Ret. Col.)
Fleming, 1st Lt. James P.	Sedalia, Mo.	Nov. 26, 1968, Duc Co, S. Vietnam	Active duty, Col. McGuire AFB, N. J.
Jackson, Lt. Col. Joe M.	Newnan, Ga.	May 12, 1968, Kham Duc, S. Vietnam	Kent, Wash. (Ret. Col.)
Jones, Col. William A. III	Warsaw, Va.	Sept. 1, 1968, Dong Hoi, N. Vietnam	Killed, Nov. 15, 1969, Woodbridge, Va.
Levitow, A1C John L.	South Windsor, Conn.	Feb. 24, 1969, Long Binh, S. Vietnam	South Windsor, Conn.
Sijan, Capt. Lance P.	Milwaukee, Wis.	Conspicuous gallantry while POW	Died while POW, Jan. 1968
Thorsness, Lt. Col. Leo K.	Seattle, Wash.	Apr. 19, 1967, N. Vietnam	Seattle, Wash. (Ret. Col.)
Wilbanks, Capt. Hilliard A.	Cornelia, Ga.	Feb. 24, 1967, Dalat, S. Vietnam	KIA, Feb. 24, 1967
Young, Capt. Gerald O.	Anacortes, Wash.	Nov. 9, 1967, Da Nang area, S. Vietnam	Anacortes, Wash. (Ret. Lt. Col.)

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The 1990 USAF Almanac
Reports from the Major Commands

Air Force Communications Command

AIR Force Communications Command (AFCC) provides the communications, computer, integration, interoperability, and air traffic services vital to the Air Force mission to fly, fight, and win. "Warfighting commanders rely on AFCC services to deliver the right fighting force to the right place at the right time," says Maj. Gen. Robert H. Ludwig, AFCC Commander. "That's what we're all about."

With headquarters at Scott AFB, Ill., AFCC provides the telephone systems, base communications centers, computer facilities, radio and satellite stations, and air traffic control services needed by the Air Force. AFCC people acquire, engineer, install, operate, and maintain these systems at locations around the world.

In a world driven by communications and computers, AFCC's motto, "Providing the Reins of Command," is a reality. Operational commanders constantly rely on AFCC services by picking up a telephone to alert flying crews; by sending or receiving operational orders through the base communications center; by managing funds, supply inventories, and personnel matters using base computer services; and by operating aircraft using ground navigational aids to guide flights and air traffic control towers that coordinate takeoffs and landings.

Some 55,000 military and civilian AFCC people are assigned to 700 units at 430 locations. Completing the total force structure for the command are more than 17,000 members of the Air National Guard and Air Force Reserve. Last year, they contributed nearly 85,000 work-days in support of AFCC programs.

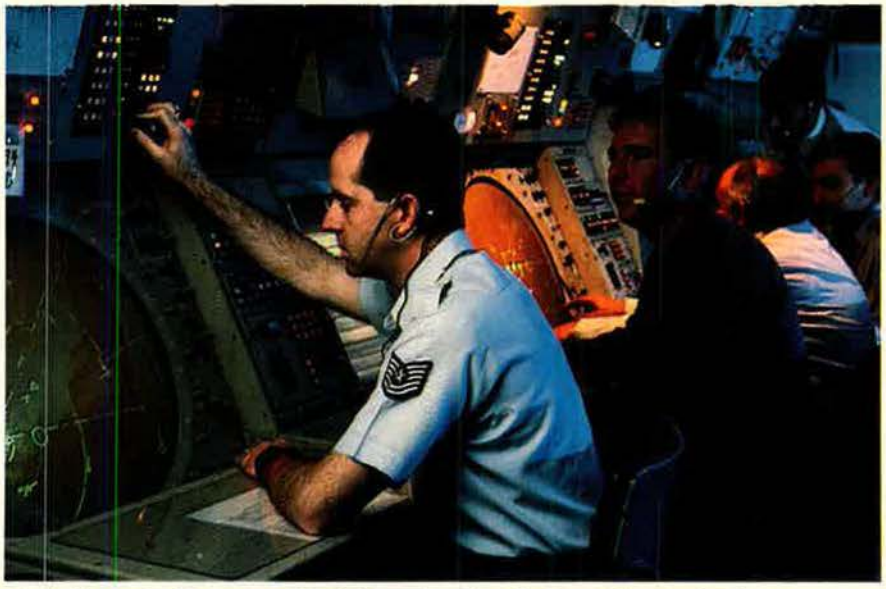
Eleven divisions form the nucleus of AFCC (see chart). With the exception of the Computer Systems Division and the Engineering Installation Division, all of the division commanders work under a unique "dual-hat" arrangement—as an AFCC division commander and as a member of another major command staff. Many of the command's base-level organizations also work under this dual-hat concept. These organizations are supported administratively by AFCC but are operationally controlled by the command they support.

Harnessing and processing information quickly are paramount functions in today's information-age explosion. "Both demand constant vigilance in seeking new and better ways to exploit today's technology to the advantage of the operational commands. AFCC people provide that vigilance," says General Ludwig.

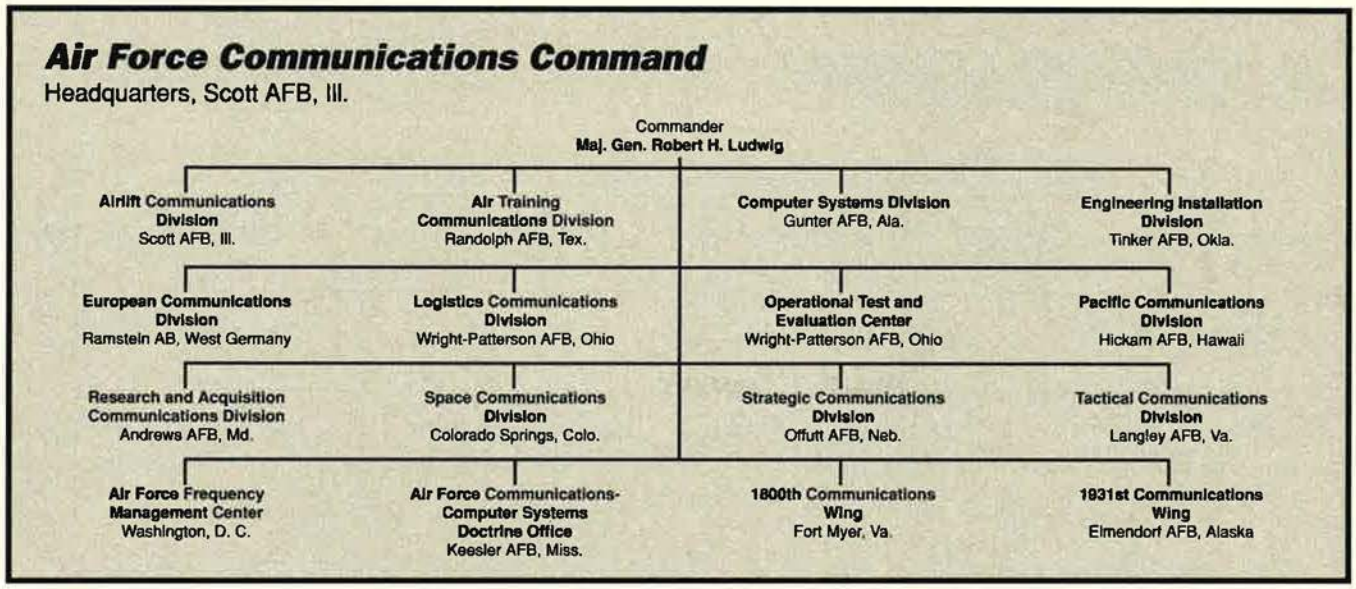
This need for information creates an increasing need for computer software. Reliable and efficient software is essential to the Air Force mission. Within AFCC's Computer Systems Division, the Standard Systems Center's Software Center of Excellence at Gunter AFB, Ala., is striving to meet this need. Use of improved software development tools is helping programmers at the center write and change software programs faster. More important, the programs being written will be more reliable, easier to maintain, and reusable.

Reusability is a primary concern for AFCC. Shrinking budgets demand that AFCC personnel work smarter with the resources available. The key function of ensuring the integration

USAF photo by SSgt. F. Lee Corkran



Air traffic control is among the vital services that Air Force Communications Command (AFCC) provides to USAF locations around the world. Above, AFCC ground control approach controllers monitor air traffic with their Spanish counterparts at Torrejon AB, Spain.



of communications and computer systems is the job of the Air Force Communications-Computer Systems Integration Office (AFCSIO). AFCC administers the AFCSIO and works in concert with it to integrate new communications-computer systems into the existing architecture and to ensure that different computer systems can exchange information.

Major new systems are field-tested in an operational environment at AFCC's Model Base, soon to be moved from Mather AFB, Calif., to Barksdale AFB, La. This prototyping is an important step toward integrating the new system with systems currently in operation and will influence future communications-computer architecture at Air Force bases around the world.

Whenever possible, AFCC satisfies its customers' needs by buying off-the-shelf systems. By taking advantage of existing technology, many research and development expenses are eliminated. One example of this is the Base Information Digital Distribution System, which will integrate voice and data switching and distribution systems at Air Force bases worldwide.

AFCC installs most of these acquired systems. Many AFCC engineering and installation people are on the road as many as 300 days a year, anywhere in the world, in every terrain and climate, providing millions of dollars' worth of services to their customers.

Members of AFCC's special-purpose and combat-communications units are also "road warriors." They routinely provide support during exercises and contingencies. Their job is to deploy, operate, and maintain such mobile communications as telephone, satellite, air traffic control, and landing systems, all necessary to the operational commanders' mission. ■

Air Force Logistics Command

AIR Force Logistics Command (AFLC), with headquarters at Wright-Patterson AFB, Ohio, heads into the 1990s with new challenges.

The command is confronted by dramatically reduced funding, but the work force of 84,000 civilians and 12,000 military people will meet the challenges of the future and continue to fulfill AFLC's mission of buying, supplying, maintaining, repairing, and transporting everything needed to keep the Air Force ready for combat.

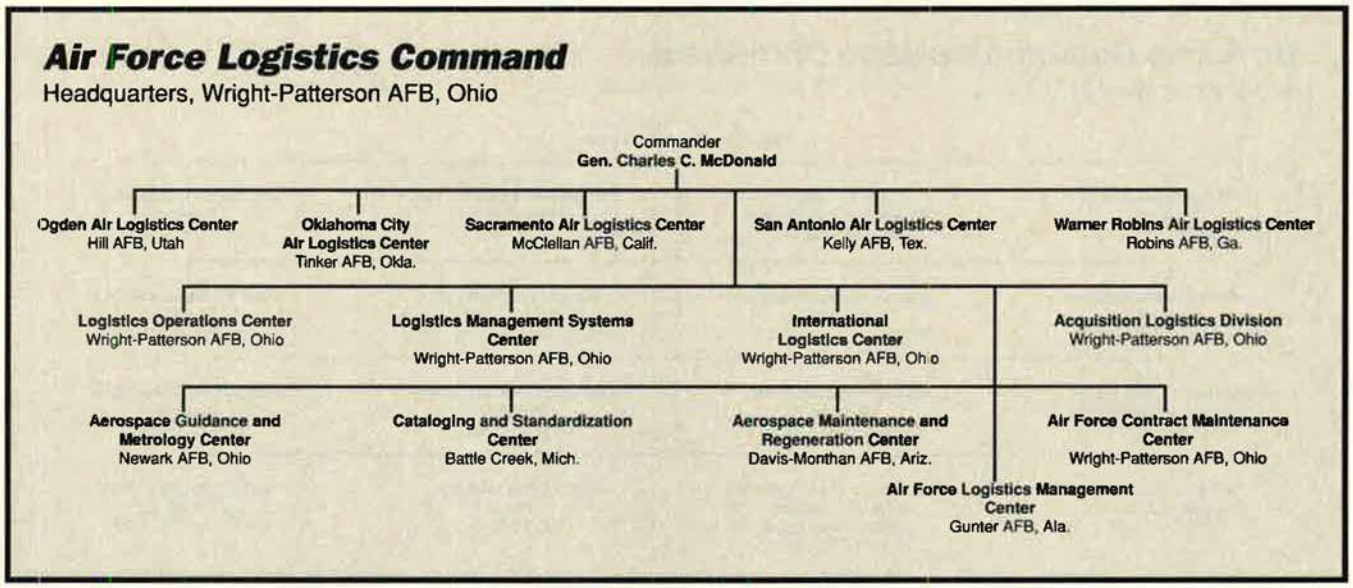
The cornerstone of AFLC's success in carrying out its mission has been and will continue to be "quality." High quality is the goal of every AFLC endeavor, from its people to its maintenance of weapon systems to the way it carries out even the most routine day-to-day business.

"Quality must be maintained at all levels," says Gen. Charles C. McDonald, AFLC Commander. "This means . . . the right things at the right place at the right time and, hopefully, at the lowest possible cost. Also, we must strive for quality in management—enlightened, involved, and accountable."

Despite having fewer dollars, AFLC continues to support its customers, the operational commands such as Strategic Air Command and Tactical Air Command. With assets comparable to those of a top Fortune 500 company, AFLC is committed to getting the most for its money without sacrificing quality.

The command's Blue Ribbon Contracting Program ensures that AFLC ultimately gets the best product for its dollar. It allows the command, which awarded $10 billion in contracts in Fiscal 1989, to award spare-parts contracts based not just on price but also, more important, on a supplier's past performance. These are contractors AFLC knows will provide products that may not always be the cheapest but that will last longer and save in replacement and repair costs.

AFLC is improving its logistics support through a command-wide, $1.7 billion computer modernization program. The modernization is improving the way AFLC manages its four core functions—maintenance, materiel management, distribution, and



acquisition. Nine modern systems will provide faster, more accurate information on supplies, readiness, and weapon system capabilities. The modernization will be completed in 1994.

AFLC performs its mission through a worldwide network that includes five huge air logistics centers (ALCs). Each center is constantly undertaking programs that keep the Air Force fleet flying.

Warner Robins ALC, Robins AFB, Ga., keeps the F-15 fleet in top shape. The first F-15 to undergo regularly scheduled depot maintenance left the center in early 1989, and thirty-nine fighters were completed by the end of the year. Fixtures manufactured at the center are used for F-15 wing repairs in the Pacific and Europe. The result is a significant reduction in down-time for F-15s undergoing repairs.

In November 1989, maintenance workers at Oklahoma City ALC, Tinker AFB, Okla., reached a milestone in support of the F-111 aircraft as they completed the 8,000th F-111 engine to go through the center's repair program. The center began maintaining the TF30 engine in 1967.

AFLC is a leader in DoD's efforts to clean up and control hazardous wastes. At Ogden ALC, Hill AFB, Utah, aircraft are maintained through a technique that protects the environment from chemical waste. Workers spray tiny plastic beads instead of chemical strippers to remove old paint from F-4 and F-16 aircraft. The new process cuts down on maintenance time and eliminates some 25,000 gallons of waste water for each aircraft stripped.

The AFLC of today is far from just a wrench-turning, nuts-and-bolts operation. It has some 4,000 scientists and engineers engaged in a variety of high-tech programs.

One such program is at Sacramento ALC, McClellan AFB, Calif., where workers actually X-ray whole aircraft to detect corrosion and structural defects. A maneuverable X-ray system uses two of the world's largest gantry robots to scan intact aircraft. By detecting minute cracks and early corrosion, AFLC can extend the life of aircraft, reduce risk of crashes, and ultimately lower maintenance costs.

Computer scientists and engineers at San Antonio ALC, Kelly AFB, Tex., are making use of a new software development center. The 80,000-square-foot Integration Support Facility provides AFLC researchers with facilities to develop software used in the electronics and avionics of today's most complex weapon systems as well as in weapon systems of the future. ■

—USAF photo by Kenneth Hackman

At San Antonio Air Logistics Center, Kelly AFB, Tex., Reynaldo Pentoja welds F100 engine parts. San Antonio ALC, system program manager for the Pratt & Whitney F100 engine, is one of AFLC's five air logistics centers whose programs keep the Air Force flying.

Air Force Space Command

THE Air Force Space Command (AFSPACECOM) operates forces in support of strategic aerospace defense, space control, and space operations.

Created in September 1982 as the Air Force operational command for space, AFSPACECOM is the newest major command. It is also the largest component of the US Space Command and, as such, manages resources to provide national warning of space or missile attack, support ground forces from space, and provide on-orbit support to a wide variety of DoD space systems.

Under the command of Lt. Gen. Thomas S. Moorman, Jr., AFSPACECOM has 8,500 Air Force military and civilian men and women and some 5,500 contractor personnel. They operate space-surveillance, missile-warning, satellite-control, and communications sites worldwide.

To operate and manage these assets, the command employs the 1st and 2d Space Wings, the 3d Space Support Wing, a Space and Warning Systems Center, the 1013th Combat Crew Training Squadron, and a Command Inspection Center.

Headquartered at Peterson AFB, Colo., the 1st Space Wing is the Air Force's first operational space wing. It operates twenty missile-warning, space-surveillance, and communications sites worldwide. Systems and personnel at these sites provide tactical warning and attack assessment of sea-launched and intercontinental ballistic missile attacks and space attacks, in addition to tracking man-made objects in space.

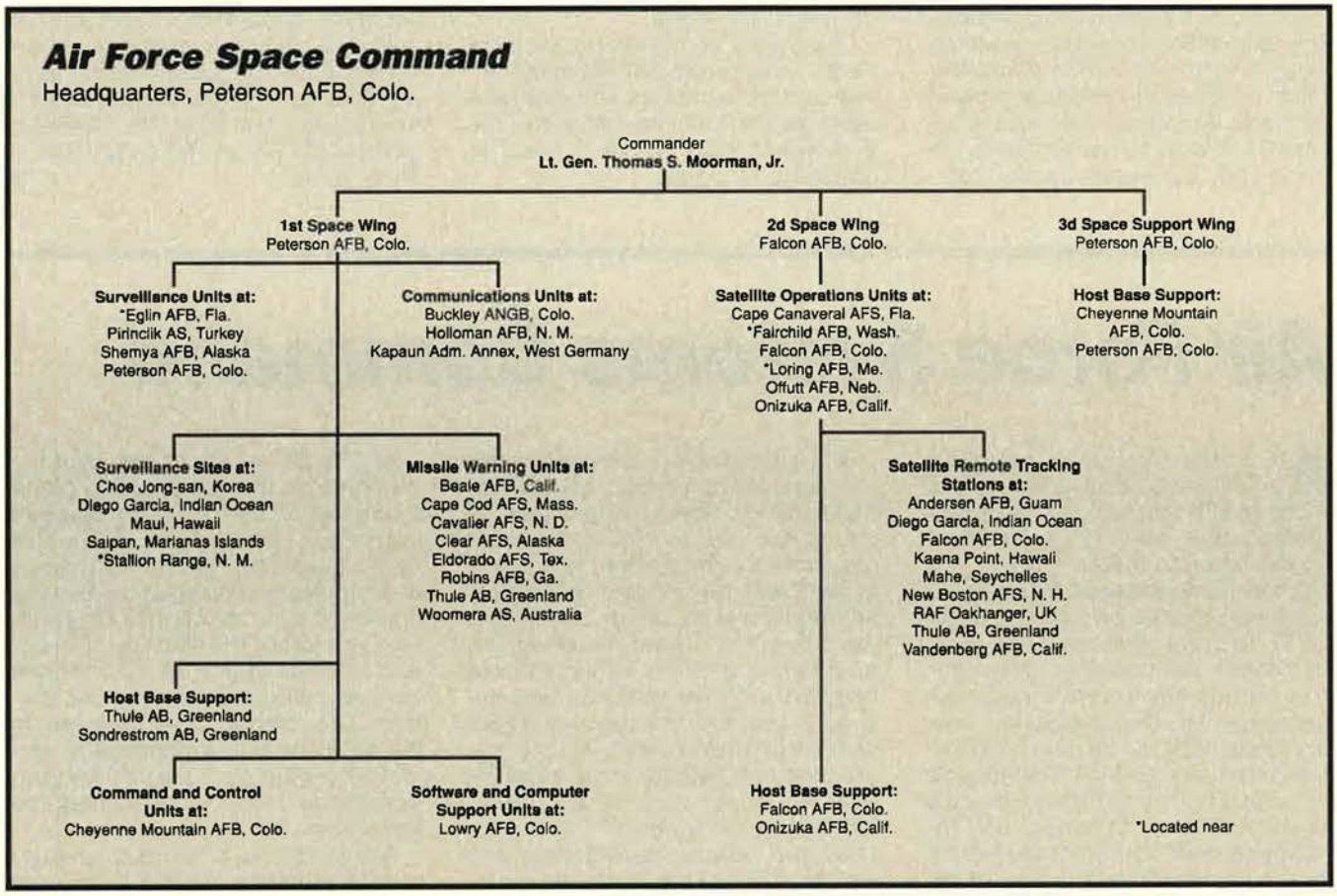
For the missile-warning mission, the 1st Space Wing uses a space-based early warning system, phased-array radars, and mechanical radars. Data from the network would be the first indication of an aerospace attack aimed at North America.

The data are transmitted to command centers at AFSPACECOM's Cheyenne Mountain AFB, Colo., where the Commander in Chief of NORAD assesses the warning information to determine whether it indicates an attack.

The 1st Space Wing also operates a worldwide space-surveillance system to provide launch detection, tracking, reporting, and cataloging of objects in space. The system, which includes radars, cameras, and telescopes, provides more than 48,000 observations daily to keep track of some 7,000 man-made objects in space.

The 2d Space Wing is located at Falcon AFB, Colo., ten miles east of Peterson AFB. Its mission is to provide command and control of operational DoD satellite systems and to operate and manage the Air Force Satellite Control Network (AFSCN).

The wing's 1st Satellite Control Squadron supports satellites of the Defense Support Program (DSP), the Navstar Global Positioning System (GPS), and the Defense Meteorological Satellite Program (DMSP). The squadron's two mission-control complexes at Falcon AFB perform routine



health-status checks on the spacecraft, monitor launches, perform early orbit checkout, and provide major anomaly resolution.

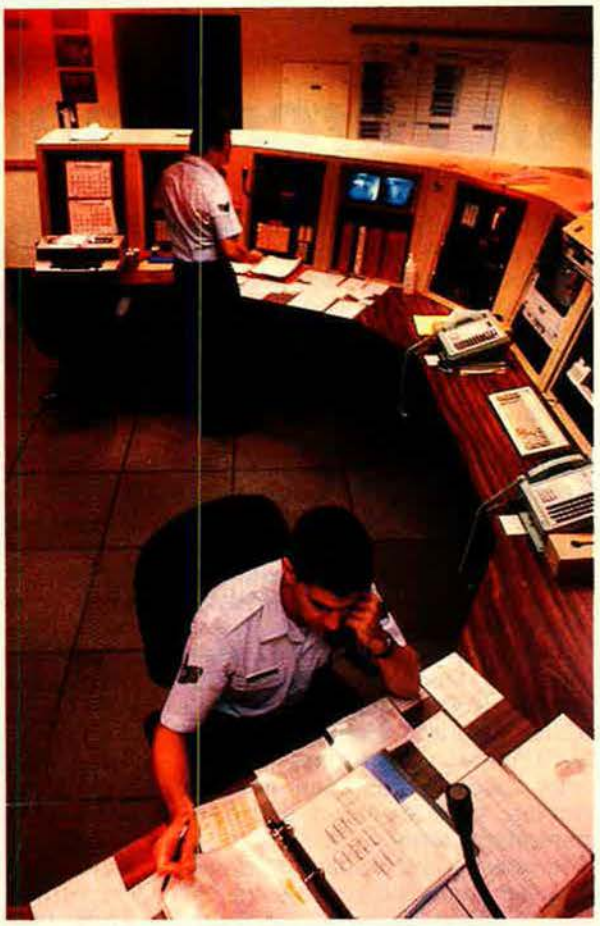
The 2d Satellite Control Squadron at Falcon is responsible for the mission and command and control of the Navstar GPS constellation, ensuring that its navigational signals are accurate.

The 2d Satellite Tracking Group, a 2d Space Wing unit at Onizuka AFB, Calif., is responsible for the daily operation of the common-user element of the Air Force Satellite Control Network. The worldwide network of eight tracking stations currently supports about seventy satellites. The AFSCN mission is to track, command, and receive telemetry data from on-orbit satellites in support of DoD, NASA, and other selected programs.

The wing's other major subordinate unit, the 1000th Satellite Operations Group, is located at Offutt AFB, Neb. Its mission is to command and control DMSP satellites. Data from these satellites are collected at four command stations and relayed to the Air Weather Service's Global Weather Central at Offutt and to the Navy's Fleet Numerical Oceanography Center in Monterey, Calif., where weather information is compiled for use by DoD units worldwide.

The 3d Space Support Wing, located at Peterson AFB, is the host wing for both Peterson and Cheyenne Mountain AFBs. It provides operating support to the Peterson Complex, which includes the Headquarters of the North American Aerospace Defense Command, United States Space Command, Air Force Space Command, Army Space Command, and the 1st Space Wing.

The Space and Warning Systems Center, also located at Peterson, develops and maintains software and oversees computer operations for the command and control centers in Cheyenne Mountain.



—USAF photo by Dennis Chapin

SSgt. Mark Utz (front) and SrA. Terry Pope are controllers assigned to the command post of AFSPACECOM's 2d Satellite Tracking Group at Onizuka AFB, Calif. The Air Force Satellite Control Network of tracking stations currently supports about seventy satellites.

Designated to hand over "mission-capable" graduates to operational units, the 1013th Combat Crew Training Squadron provides missile-warning, space-surveillance, and satellite-operations training for NORAD, USSPACECOM, and 1st and 2d Space Wing crews. ■

Air Force Systems Command

AIR Force Systems Command (AFSC), with its headquarters at Andrews AFB, Md., begins the 1990s building upon forty years of delivering the future to the Air Force.

The command believes that an innovative Science and Technology (S&T) program, the cornerstone of the nation's defense since World War II, is still the key to providing an affordable, qualitatively superior, military force. AFSC is the only USAF organization charged with identifying and acquiring emerging technologies for the Air Force. Its current S&T investments define the limits of systems the Air Force will field in the future.

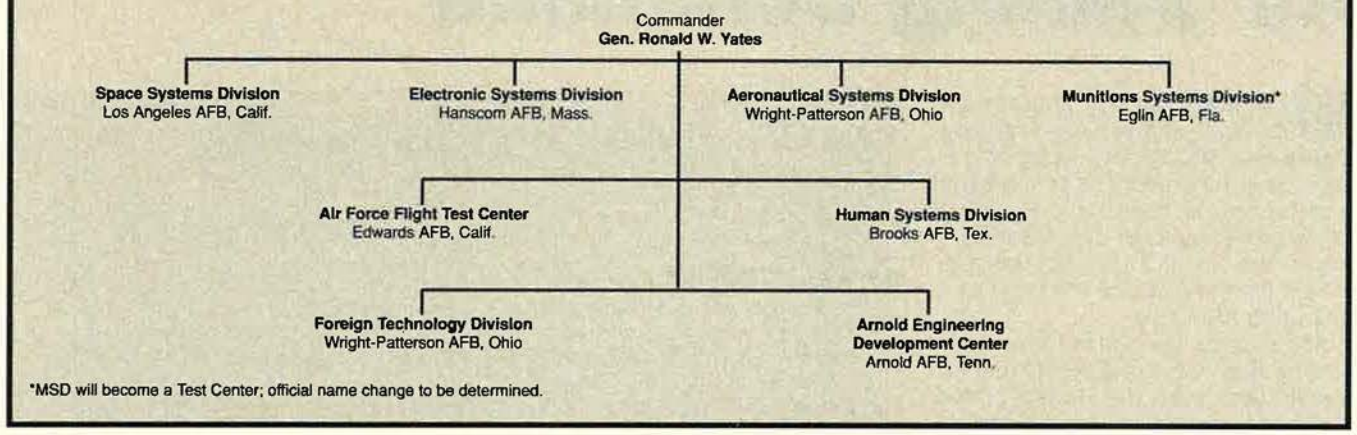
AFSC is reshaping its organizations and operations as part of Defense Management Review acquisition restructuring. Responsibility for major programs was transferred to six Program Executive Officers, who manage and serve as senior acquisition executives for a portfolio of related major programs and act as the links between program directors and the service acquisition executive. AFSC works with users at early stages of a program to develop critical, initial requirements and program acquisition strategies. The command then provides the people, laboratories, and test facilities to support the program.

AFSC's S&T program has kept the Air Force on the leading edge of the technological surge. New weapon systems, such as the B-2 Stealth bomber, generally rely on technology developments that began on drawing boards and in laboratories ten to fifteen years ago. The lead time is needed to develop, prove, and incorporate key technologies into advanced systems. The command then implements the breakthrough technologies critical to providing superior weapon systems for the Air Force of today and the future.

Applying the principles of total quality management (TQM) to every

Air Force Systems Command

Headquarters, Andrews AFB, Md.



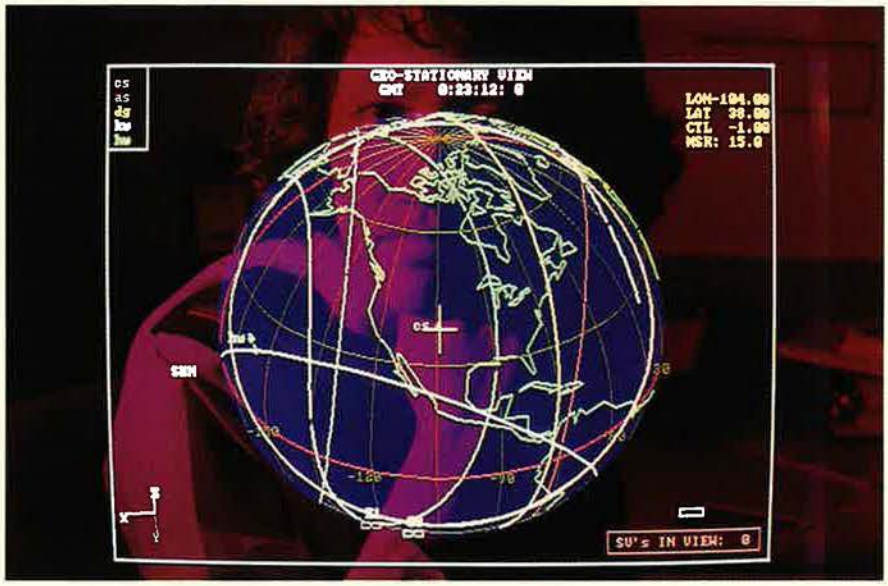
*MSD will become a Test Center; official name change to be determined.

process and action, AFSC personnel continuously search for better ways to do their jobs, seeking to streamline, simplify, and use critical resources to the fullest. This commitment to the TQM philosophy enables AFSC to accomplish its goal of meeting the needs of the operational forces, incorporating producibility, reliability, maintainability, and supportability into every system developed.

To harness emerging technologies for the fighting forces, AFSC employs more than half of all the scientists and engineers in the Air Force. Its work force of 10,700 officers, 13,100 enlisted personnel, and 29,000 civilians manages about one-third of the entire Air Force budget, about $30 billion annually, and more than 50,600 contracts, valued at approximately $350 billion.

Technological advances during the last fifty years have accelerated military capabilities at a rate unprecedented in history. To meet the challenge imposed by our adversaries in this changing environment, Systems Command aggressively develops revolutionary enabling technologies that will change the nature of defense and deterrence. For instance:

- Fiber-optic material is being considered for use in "smart skins" for future aircraft. The fiber-optic material would be imbedded in a composite material, where it would be used either as an antenna or as a replacement for wire cables carrying electronic signals. Smart skins technology is being developed by AFSC for the Air Force of the twenty-first century. Outer aircraft skins will contain embedded phased arrays to permit the aircraft to sense and communicate in optical and other frequency bands in any direction and from any aircraft altitude.



—USAF photo by Lou Hernandez

At AFSC's Space Systems Division, Los Angeles AFB, Calif., 2d Lt. Joanna Schultz studies a computer graphic display of geostationary satellite coverage. AFSC identifies and acquires emerging technologies for USAF and provides staff, laboratories, and test facilities to support each science and technology program.

- The National Aerospace Plane (NASP) will give the nation a made-in-the-US aircraft capable of taking off from any major airport, flying into space, and reentering the atmosphere to land at any other airport in less than three hours. In addition to its military applications, the NASP will transport humans to and from space stations and will be a test vehicle for the research of new materials. While providing a technological boost to aerospace development, the NASP will firmly put the country back in the space leadership role.
- The high-performance turbine engine, with a thrust-to-weight ratio double that of any engine currently on the drawing boards, will revolutionize aircraft maneuverability, range, payload, and basing capabilities. High-energy-density propellant research is expected to lead to a twofold increase in launch vehicle lift capability and a threefold to fivefold increase in upper-stage orbit transfer capability.

Such advanced materials as carbon/carbon and ceramic composites, photonic devices that will revolutionize battle management by offering tremendously increased processing of real-time data, and superconductivity applications are nearing reality at AFSC product divisions and laboratories.

AFSC continues to demonstrate the decisive roles that science and technology are playing in shaping the military capabilities of the Air Force. ■

Air Training Command

With the changing military defense posture, Air Training Command (ATC) continues to redefine the fundamentals of its flying and technical training programs. While providing state-of-the-art training in the finest blue-suit tradition, the command is at the forefront of a changing Air Force.

ATC recruits and trains tomorrow's Air Force leaders—the highly trained people who keep the United States Air Force second to none. Recruits are better than ever, with ninety-nine percent holding high school diplomas. Major emphasis is placed on technical interests, as more than ninety-five percent of Air Force enlisted jobs require people who can learn to operate highly sophisticated systems and equipment. Air Force Recruiting Service's goal for FY 1990 is 36,000 accessions.

The "Gateway to the Air Force," Lackland AFB, Tex., graduated 46,572 men and women in FY 1989 from Basic Military Training School. The USAF Officer Training School, also at Lackland, commissioned 1,236 officers during the same period. Another 2,823 new lieutenants were commissioned through 148 Air Force Reserve Officer Training Corps units nationwide.

ATC's six technical training centers, eight flying training wings (including six undergraduate pilot training wings, one instructor pilot training wing, and one navigator training wing), the survival schools of the 3636th Combat Crew Training Wing, and the 3785th Field Training Wing's ninety-four worldwide detachments make up the free world's largest specialized training system. More than 350,000 people received training last year in more than 5,000 active courses and 350 technical specialties.

Pilot training, a top priority for ATC, will take on a more mission-specific orientation in the coming decade. Specialized Undergraduate Pilot Training (SUPT) will provide pilot training tailored to the operational aircraft that students will fly after graduation. SUPT will include a common core of fundamental flying training in the T-37, followed by specialized training in either of two tracks: Tanker/Transport (TT) or Bomber/Fighter (BF).

The Department of Defense Trainer Master Plan, developed by ATC, is the

Recruiting: Top Quality in FY 1989

More than 46,000 young Americans entered the Air Force in FY 1989. Across America and at more than a dozen overseas locations, Air Force recruiters brought in the highest-quality officers and enlisted people in the history of the Air Force.

Those accessions included 43,450 nonprior service and 300 prior service enlistees. In addition, 1,236 men and women graduated from the USAF Officer Training School at Lackland AFB, Tex., and 1,270 health-care professionals entered the Air Force Medical Service. Air Force health-professions scholarships were awarded to 316 students in FY 1989.

Last year's new officers and enlistees brought with them the high marks of scholastic accomplishment. Officer Training School candidates ranked in the top one-third of all college graduates, with a grade point average of 3.1. Ninety-nine percent of nonprior service enlistees entered the Air Force with their high school diplomas. While the average US high school graduate reads at the ninth-grade level, Air Force recruits averaged at the eleventh-grade level. Fifty-three percent of FY 1989 Air Force enlistees scored in the top two mental categories on qualifying tests.

To broaden its recruiting efforts, the Recruiting Service and USAF Reserve Officers Training Corps (AFROTC) implemented a new, team approach to officer recruitment. By year's end, USAF recruiters had exceeded the AFROTC scholarship application goal of 8,000 by more than 4,000.

Air Force recruiters are seeking approximately 39,000 new members this year. That goal includes 36,000 nonprior service and 300 prior service enlistees, 694 officer trainees, and 1,646 health-care professionals, which includes 280 health-professions scholarships. In addition, AFROTC is seeking approximately 10,000 four-year scholarship applications and thirty-nine four-year nursing scholarships. Emphasis continues to be on physician recruiting, with a requirement of 373. The program's goals will continue to be difficult to achieve because of competition from the civilian sector.

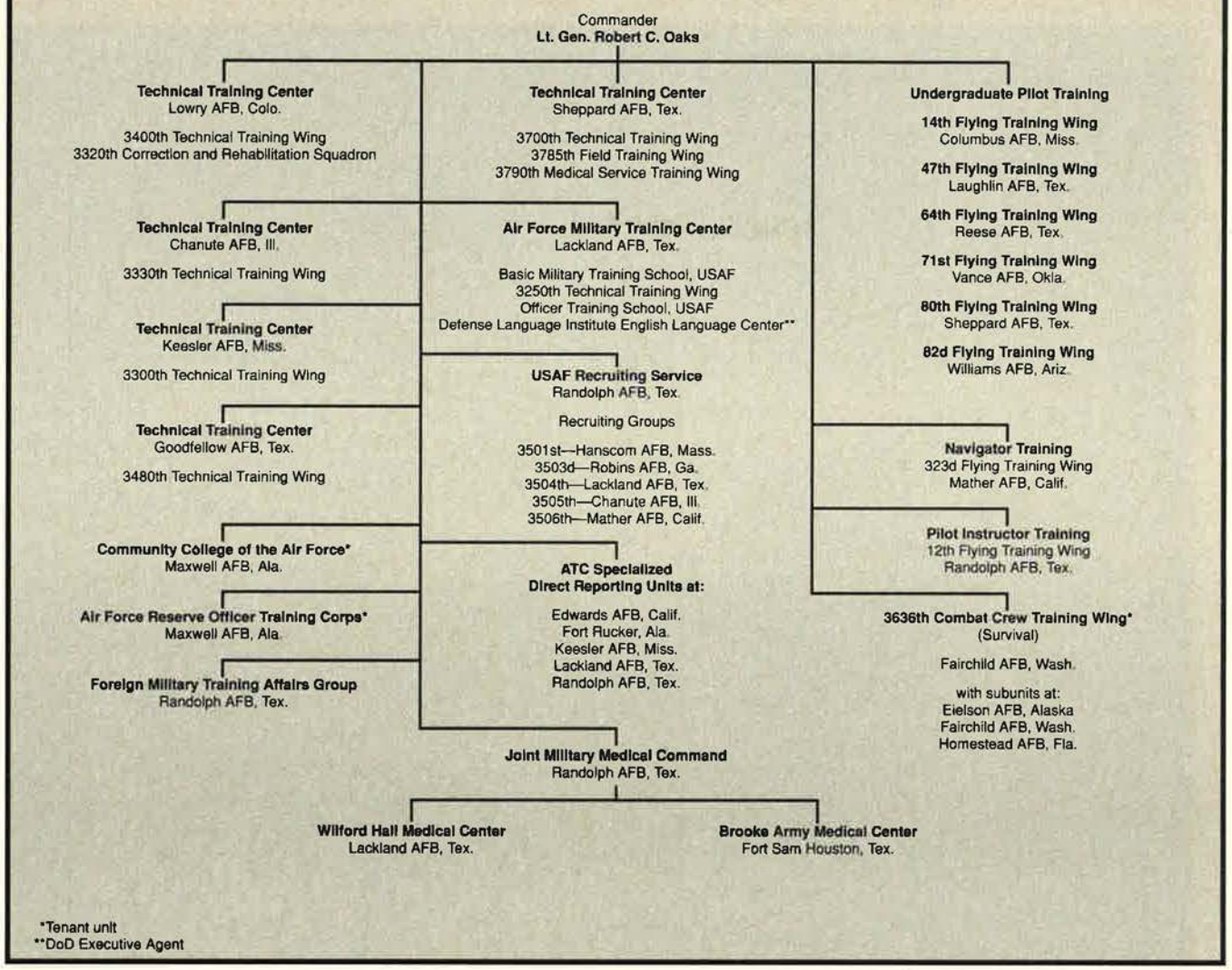
From its headquarters at Randolph AFB, Tex., the USAF Recruiting Service, with its five regional recruiting groups and thirty-three squadrons, directs the efforts of recruiters in more than 1,300 offices in every state, Puerto Rico, Guam, and locations in Europe and the Pacific.

—USAF photo by TSgt. Michael J. Haggerty

SSgt. Larry A. Williams, a Training Instructor with the 3706th Basic Military Training Squadron, Lackland AFB, Tex., inspects Air Force Basic Trainees during a morning formation. Lackland, the "Gateway to the Air Force," graduated 46,572 enlistees from Basic Military Training School in Fiscal 1989.

Air Training Command

Headquarters, Randolph AFB, Tex.



*Tenant unit
**DoD Executive Agent

roadmap for achieving Air Force pilot requirements into the twenty-first century. SUPT is only one facet of the plan. Three new trainer aircraft will be integrated into training over the next twenty-five years. The first new acquisition will be the Tanker/Transport Training System (TTTS) needed to implement SUPT. A contract for the TTTS was awarded in February 1990. The TTTS will be a missionized version of the Beechjet 400T (the T-1A) and will focus tanker/transport pilot training in areas unique to flight-deck-configured aircraft. Other trainers will follow to replace ATC's aging fleets of T-37 and T-38 aircraft.

In 1989, ATC became the only command whose aircraft maintenance was accomplished almost entirely by civilians. All aircraft maintenance functions, excluding T-37 and T-38 maintenance at Randolph AFB, Tex., are now performed or scheduled to be performed by civilians—by civilian companies at four bases and by the Civil Service at another, with two more scheduled for transition to civilian contractor maintenance during 1990.

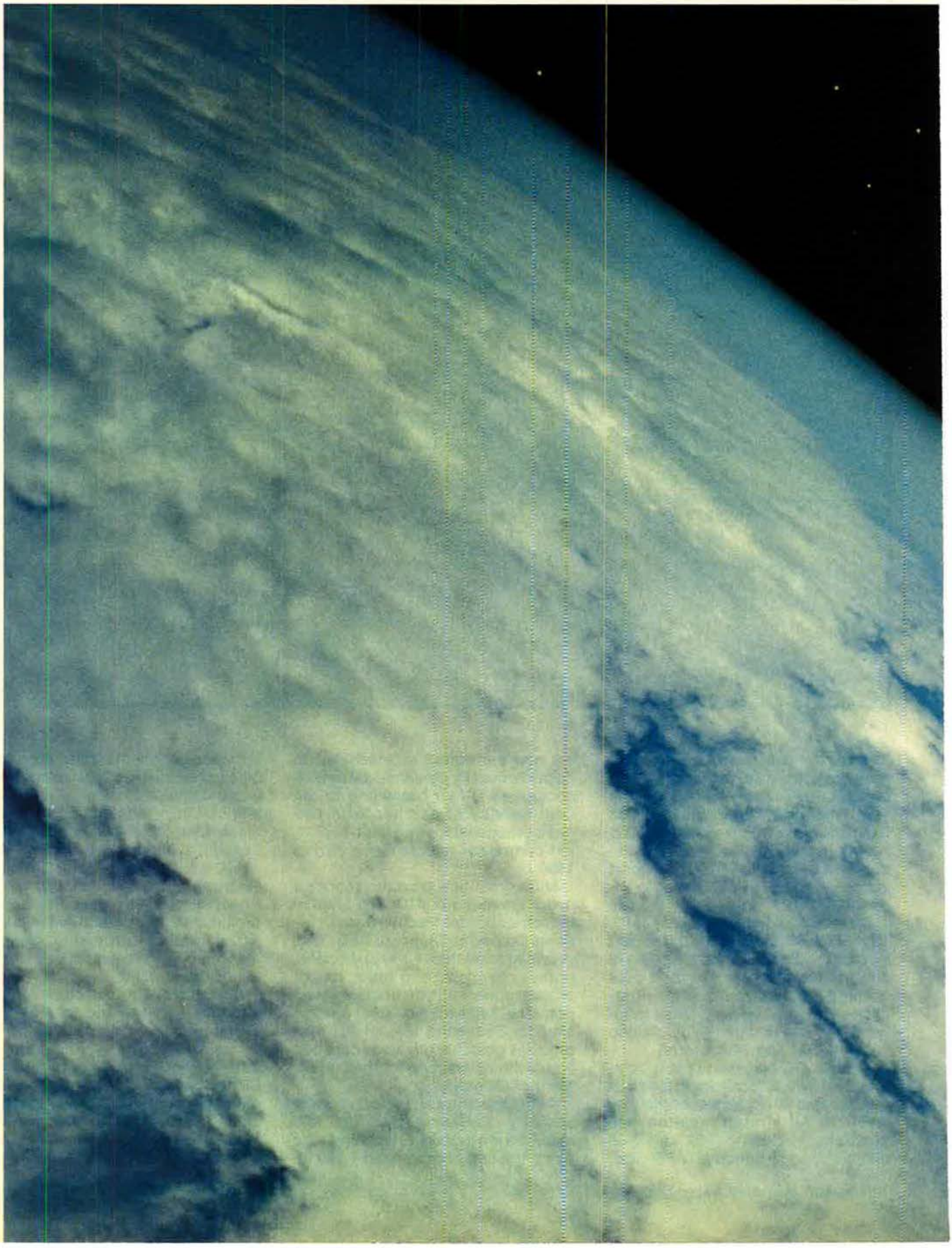
Military medical training receives a major emphasis in ATC. The Military Indoctrination for Medical Service Officers Course at Sheppard AFB, Tex., provided more than 1,780 physicians, nurses, dentists, and other health professionals with officer training last year. The San Antonio–Joint Military Medical Command (SA-JMMC) also provides graduate medical education and technical training for the Department of Defense.

As the executive agent for Air Force security assistance training, ATC manages the language, technical, and flying training of more than 4,000 international students from more than ninety countries. Last year, some 2,422 international students, both military and civilian, graduated from the Defense Language Institute's English Language School at Lackland AFB.

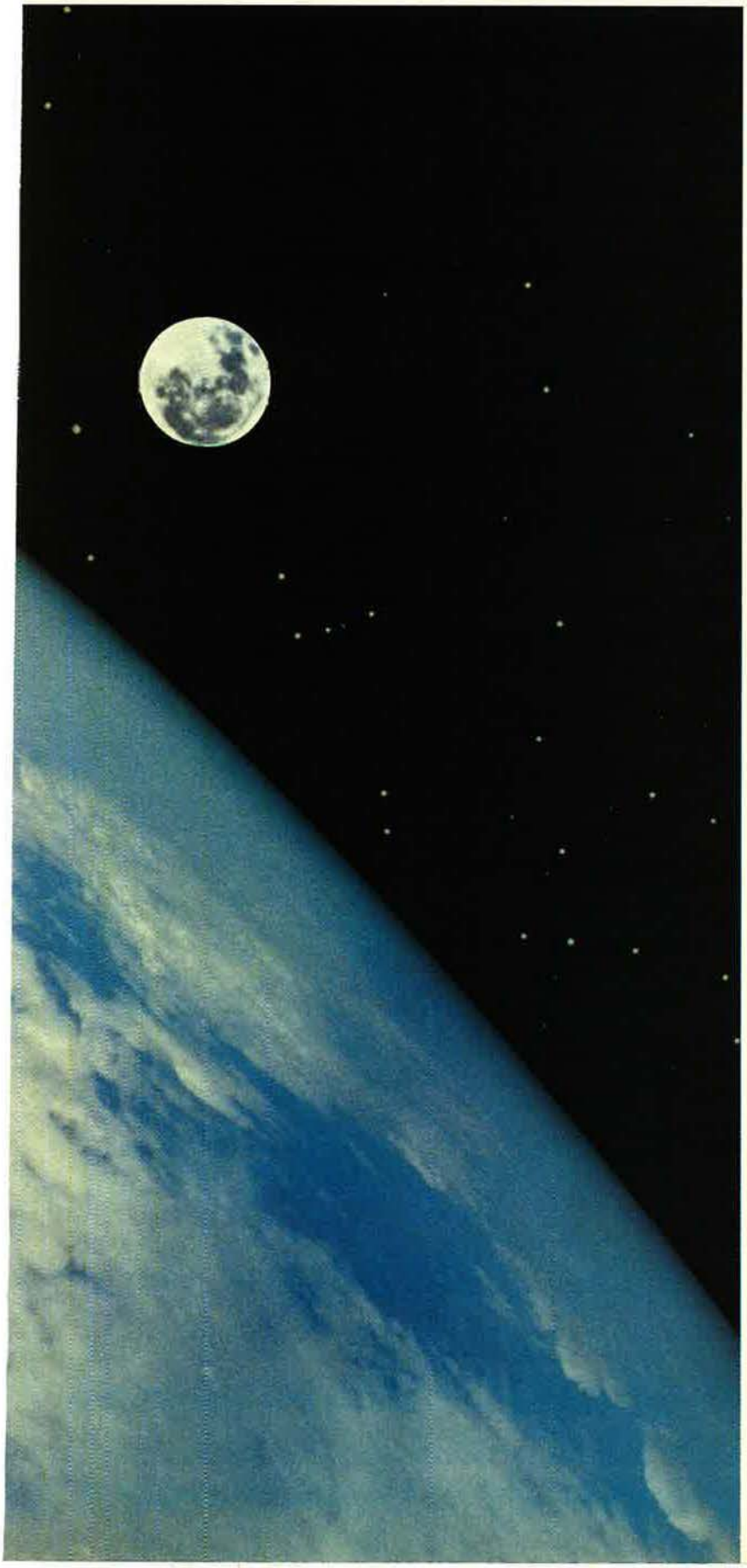
ATC's Euro-NATO Joint Jet Pilot Training Program, conducted at Sheppard AFB last year, trained approximately 300 US and Allied pilots. ATC's Aviation Leadership Program also offers T-37 training to Latin American student pilots.

ATC works with the other military services through the Interservice Training Review Organization (ITRO) to increase training efficiencies through joint training opportunities. Current side-by-side training for soldiers, sailors, marines, and airmen include intelligence, law enforcement, and fire fighting, with additional opportunities being explored. ■

Our quality has been out of this w



orld for thirty years.



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Air University

Air University (AU), with headquarters at Maxwell AFB, Ala., is responsible for providing professional military education (PME) and degree-granting professional continuing education (PCE) for officers, NCOs, and DoD civilians.

Nearly 2,700 military and 1,800 civilian personnel are permanently assigned to AU. Close to 25,000 military members and civilians completed resident AU classes last year, and thousands more completed courses through nonresident programs. All AU schools operate under the Air Force's education philosophy, "The right PME at the right time with the right focus."

The Air War College (AWC), located at Maxwell AFB, is the Air Force's premier professional military education school. Its mission is to enhance the Air Force's warfighting capability by emphasizing the unique skills, perspectives, knowledge, and analytical thinking required of senior officers through a curriculum emphasizing joint and combined operations. The school's Air University National Security Briefing Team, in its seventh year of operation, gave more than 300 presentations in forty-nine states.

Air Command and Staff College (ACSC) at Maxwell provides the intermediate level of professional military education. Its mission is to broaden the knowledge and increase the professional qualifications of future commanders and staff officers, with an emphasis on combat and combat-support operations. The school has incorporated joint-service specialties into its curricula and emphasizes the employment of aerospace forces in joint operations.

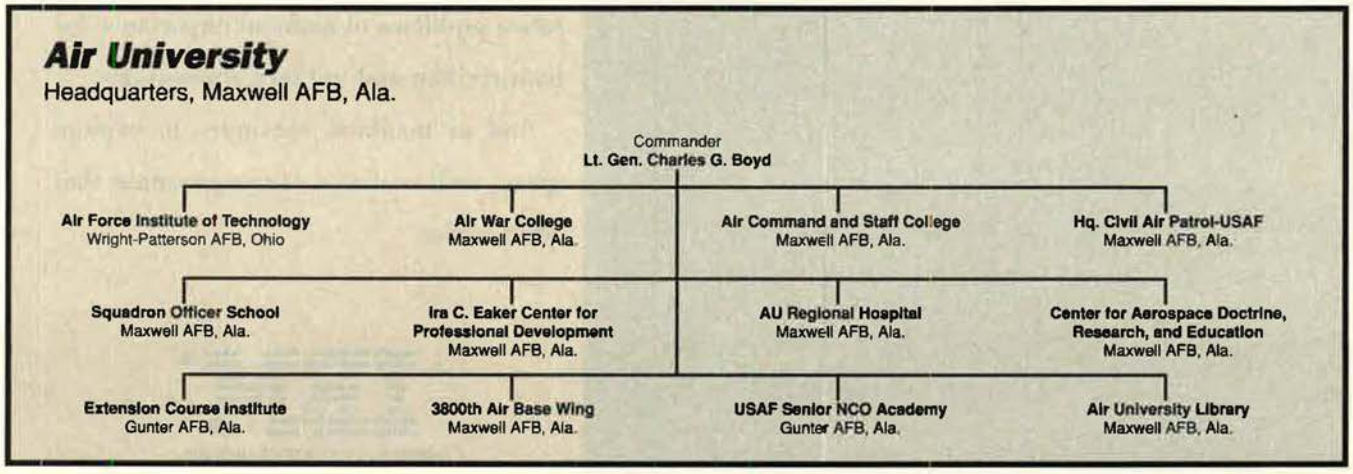
In order to provide increased opportunity for company-grade officers to attend Squadron Officer School (SOS) in residence, the course was shortened. This allows the school, also located at Maxwell, to provide all captains an opportunity to attend in residence.

The Senior Noncommissioned Officer Academy (SNCOA), located at Gunter AFB, Ala., now allows master sergeants to attend the in-residence school. The number of classes has been increased from five per year to six. This will increase the SNCOA's current attendance rate of 1,500 students per year to 2,000 per year by 1991.

The Ira C. Eaker Center for Professional Development (CPD) at Maxwell AFB provides professional development through eight schools with fifty-six courses of study. Last year, more than 5,000 students graduated from comptroller, academic instructor, judge advocate, chaplain, personnel, resource management, systems information, base commander, and other courses. The center also provided resource materials for Air Force chapel programs worldwide through the USAF Chaplain Service Resource Board.

—USAF photo by MSgt. Larry A. Wolfe

At the Air Force Wargaming Center, Maxwell AFB, Ala., Air War College and Joint Service PME students do battle against members of the staff. Here, Marine Corps Lt. Col. Jim Conway, Air Force Col. Daniel Clark, and Army Lt. Col. Chuck Posta plot artillery positions.



The Center for Aerospace Doctrine, Research, and Education (CADRE) at Maxwell conducts several courses, including the Joint Flag Officer Warfighting Course, the Combined Air Warfare Course, and the Contingency Wartime Planning Course, designed to provide attendees with unique, operational, combat-oriented experiences to enhance their understanding of wartime operations in a joint context. The Air Force Wargaming Center supports Air Force PME, Joint PME, and operational wargaming while serving as the focal point for USAF wargaming efforts. The Airpower Research Institute publishes *Airpower Journal,* performs research on the employment of airpower, and develops USAF doctrine. The AU Press continues to support the research, writing, and PME missions of the service. CADRE also directs the newly established School of Advanced Airpower Studies.

The Air Force Institute of Technology (AFIT), located at Wright-Patterson AFB, Ohio, provides graduate-level education in support of Air Force and DoD requirements by providing accredited resident degree and PCE programs in its School of Engineering and Services and its School of Systems and Logistics. AFIT saves the government approximately $26 million a year through student and faculty research projects.

The Extension Course Institute (ECI) at Gunter is the center for the Air Force's distance education programs. It serves more than 263,000 students enrolled in career development, specialized, and professional military education courses.

The Air University Library at Maxwell—the most comprehensive library devoted to military science and research in the Western world—has upgraded and extended automated access to its 2.5 million books, documents, newspapers, periodicals, and microforms. The Integrated Library System, which provides access to all books and most documents, became available to remote dial-in customers during the past year.

Also active under the AU umbrella is Headquarters Civil Air Patrol–USAF (CAP-USAF), the Air Force organization that advises and assists CAP with its primary missions of emergency services and aerospace education and with a youth cadet program. The US Customs Service, Drug Enforcement Agency, and US Forest Service used Civil Air Patrol aircraft and aircrews to support the antidrug effort through passive, aerial reconnaissance. ■

Alaskan Air Command

A DEMANDING Arctic environment, vast distances, and a changing threat challenge the men and women of Alaskan Air Command (AAC) as they fulfill their command's motto, "Top Cover for North America." AAC provides, trains, and equips tactical air forces to preserve the national sovereignty of United States lands, waters, and airspace.

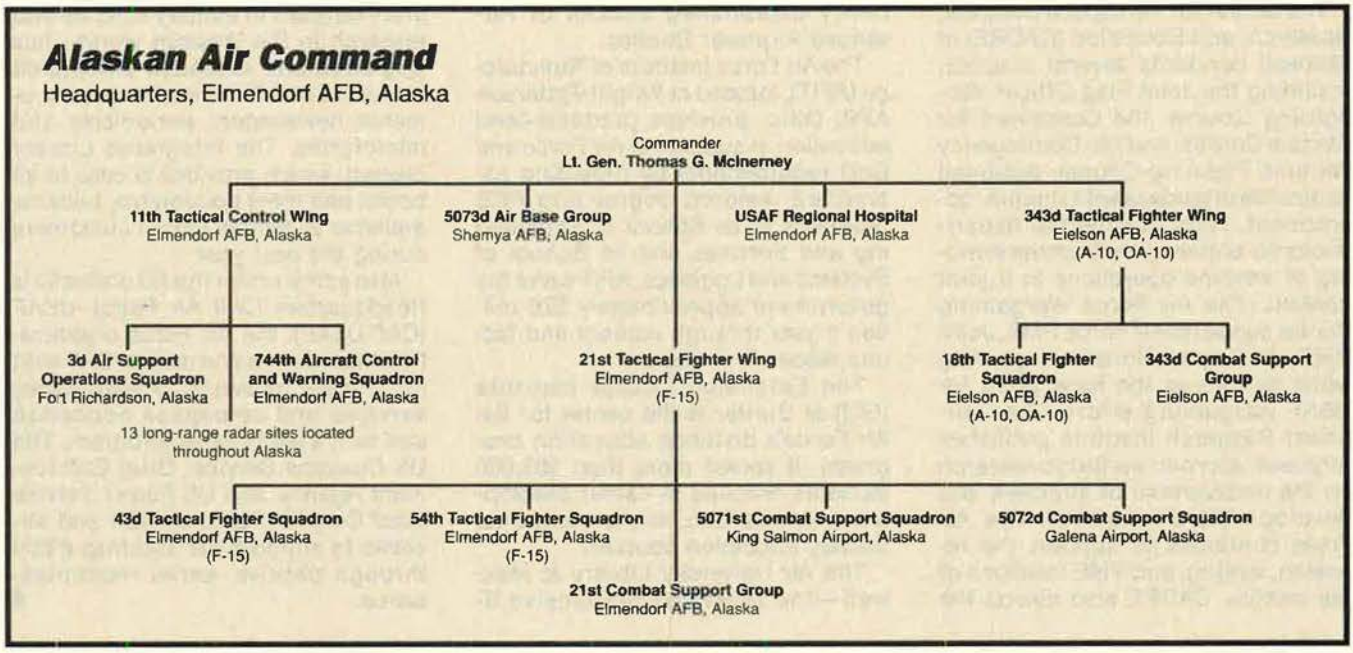
Alaska's strategic location has been recognized for many years. The state lies across the most frequently flown routes connecting the Orient with Europe and North America, making Alaska an ideal location for deployment or refueling of aircraft flying polar routes. The Alaskan and Soviet landmasses are separated by only fifty miles at the Bering Strait.

Alaskan Air Command provides "Top Cover for North America" from Elmendorf AFB, Alaska. Here, an F-15 from the 43d Tactical Fighter Squadron, 21st Tactical Fighter Wing, patrols Alaskan airspace. In 1989, AAC F-15s on NORAD alert intercepted thirty-three Soviet aircraft, including twenty-three "Bear-G" bombers.

The forty-ninth state's strategic importance was reemphasized when the AAC Commander added a new responsibility with the activation of Alaskan Command in July. A subordinate unified command of the US Pacific Command, Alaskan Command is responsible for the unified defense of Alaska's land and territorial waters, including the Aleutian Islands. The new command again placed the defense of Alaska under the leadership of one commander, providing a unity of command absent from the state since 1971.

The air defense of Alaska remains the responsibility of the Alaskan North American Aerospace Defense (NORAD) Region, also headed by the AAC Commander. In this capacity, he is responsible to the NORAD Commander in Chief for the defense of North America against atmospheric attack and for accomplishing assigned operational missions. AAC F-15s on NORAD alert intercepted thirty-three Soviet aircraft in 1989, of which twenty-three were Bear-G bombers.

AAC, operating as part of Joint Task Force–Alaska, hosted the biennial exercise Brim Frost '89. Brim Frost '89 was the coldest on record. During the last two weeks of January, the 25,000 participants faced temperatures that averaged minus-forty degrees Fahrenheit. Although the extreme cold took its toll on some exercise activi-



ties, Alaska-based units proved they could operate effectively under harsh Arctic conditions.

AAC's 9,300 military and civilian personnel are assigned to three main bases and two forward operating bases. The main bases are Elmendorf AFB, adjacent to Anchorage; Eielson AFB, twenty-six miles southeast of Fairbanks; and Shemya AFB, near the tip of the Aleutian chain. Galena and King Salmon Airports are forward operating bases where F-15s from Elmendorf sit NORAD alert.

AAC is headquartered at Elmendorf, also home to the 11th Tactical Control Wing, 21st Tactical Fighter Wing (host unit), and 21st Combat Support Group. The 21st TFW, flying the F-15C Eagle, is charged with air superiority and strategic air defense missions for America's first line of defense.

In the spring of 1989, Elmendorf served as a transport hub for more than 1,100 tons of equipment sent to clean up the *Exxon Valdez* oil spill in Prince William Sound. In the summer, the 21st made history, welcoming two Soviet MiG-29 fighters and an An-225 transport on a refueling stop en route to the Abbotsford Air Show in Canada. The event marked the first time those aircraft had landed on North American soil and the first time since 1945 that Soviet fighters had flown in Alaskan airspace.

The 11th TCW is responsible for the Alaskan NORAD Region Operations Control Center. The ROCC maintains surveillance around the clock to protect air sovereignty of the Alaskan NORAD Region. In addition, the wing provides airborne battle staff members aboard E-3 AWACS aircraft supporting NORAD F-15 missions and is responsible for the command's thirteen long-range radar sites. The wing also operates the Alaskan Tactical Air Control System and the command's rail Alternate Command Post and is working to integrate an over-the-horizon backscatter radar into the Alaskan defense system.

Eielson AFB is headquarters for the 343d Tactical Fighter Wing and the 343d Combat Support Group. The wing flies the A-10 Thunderbolt II in the demanding close air support role, with particular emphasis on antiarmor capability in supporting friendly ground forces in an Arctic environment. The oldest air combat unit in Alaska, the 343d has conducted deployments to such foreign locations as Korea, Norway, and Canada.

Alaska plays a key role in the defense of North America. With the activation of Alaskan Command, the state's importance to defense strategy in the Pacific has increased. Its strategic location, in relation to potential enemies as well as to allies, provides a forward basing capability for allied operations. Alaska's strategic importance can only increase in the future. The men and women of Alaskan Air Command, performing in a variety of defense roles, are meeting the challenges of today while preparing for the future. ■

Electronic Security Command

ELECTRONIC Security Command (ESC) is an Air Force major command with headquarters at Kelly AFB, Tex. ESC has an all-source intelligence function and provides electronic combat support and operations security (OPSEC) support to Air Force units.

ESC units provide rapid radio relay; command, control, and communications countermeasures (C³CM); computer security (COMPUSEC); and communications security (COMSEC) support to US and allied forces worldwide.

The command plays an important role in developing Air Force electronic combat (EC) and C³CM capabilities, techniques, and systems. By providing C³CM training to operational support elements during exercises, the command helps prepare the Air Force for combat operations in hostile electromagnetic environ-

Electronic Security Command

Headquarters, Kelly AFB, Tex.

Commander
Maj. Gen. Gary W. O'Shaughnessy

Hq. Air Force Electronic Warfare Center
San Antonio, Tex.

Hq. Air Force Cryptologic Support Center
San Antonio, Tex.

Hq. Continental Electronic Security Division
San Antonio, Tex.

694th Electronic Security Wing
San Antonio, Tex.

695th Electronic Security Wing
Langley AFB, Va.

6940th Electronic Security Wing
Fort Meade, Md.

6960th Electronic Security Support Group
San Antonio, Tex.

Hq. European Electronic Security Division
Ramstein AB, West Germany

690th Electronic Security Wing
Tempelhof Central Airport AS, Berlin, West Germany

691st Electronic Security Wing
Lindsey AB, West Germany

693d Electronic Security Wing
RAF Chicksands, UK

6917th Electronic Security Group
San Vito Dei Normanni AB, Italy

Hq. Pacific Electronic Division
Hickam AFB, Hawaii

6981st Electronic Security Group
Elmendorf AFB, Alaska

6903d Electronic Security Group
Osan AB, Korea

6920th Electronic Security Group
Misawa AB, Japan

6924th Electronic Security Group
Wheeler AFB, Hawaii

6990th Electronic Security Group
Kadena AB, Japan

ments. To help combat commanders satisfy their C³CM requirements, ESC develops, maintains, updates, and disseminates the Air Force C³CM support database, Constant Web.

To fulfill mission requirements, ESC formulates all-source intelligence systems to ensure connectivity with national databases. The command also provides database support and services to the multiservice Joint Electronic Warfare Center, which is collocated with Hq. ESC. As part of the all-source intelligence function, the command prepares threat assessments to support Air Force and ESC mission systems and develops and disseminates unique information on the tactics and capabilities of potential adversaries.

Closely supporting the efforts of ESC field units are the Air Force Electronic Warfare Center (AFEWC) and the Air Force Cryptologic Support Center (AFCSC).

The AFEWC is a primary source of EC and C³CM analysis. It provides battle commanders with analytical reports on EC systems' effectiveness. AFEWC assists strategic and tactical commanders in making combat decisions. The center also performs analyses to support the planning, developing, testing, acquisition, and use of EC equipment.

The AFCSC is responsible for the Air Force's communications and computer systems security programs, including COMSEC and emanations security (Tempest). AFCSC also provides analytical and engineering services in support of these programs to Air Force activities worldwide. The center manages and accounts for cryptologic devices, codes, call signs, and documents that protect Air Force communications and computer systems and performs depot-level maintenance and life-cycle support of cryptologic equipment and systems.

AFCSC is also the executive agent for the Air Force operations security program, with the responsibility of strengthening and supporting the OPSEC program for the entire Air Force.

ESC is dedicated to supporting other Air Force commands, sister services, Department of Defense agencies, and allied military forces in accomplishing their missions.

Combat elements depend heavily on ESC support during exercises and real-world operations. ESC forces participate in the role of adversaries in more than 100 exercises annually around the world, including Red Flag, Green Flag, Team Spirit, Reforger, Global Shield, Bright Star, and Cope Thunder. To train aircrews, ESC personnel disrupt transmissions and issue false transmissions to degrade communications.

ESC also monitors US radio and telephone communications to determine whether information of value is being exposed.

Looking toward the twenty-first century, planning for ESC's missions

—USAF photo by MSgt. Tyra Ohlenkamp

ESC provides electronic combat support and operations security support to USAF units worldwide. Here, a receiver operator of the 6920th Electronic Security Group, Misawa AB, Japan, monitors transmissions.

will address such changes as technology, arms control and treaty monitoring, troop reductions, diminishing overseas access, and the changing dimensions of the threat. ESC will develop methods and forums to demonstrate its intelligence, security, and electronic combat missions and enhance its ability to provide the full range of vulnerability services to the Air Force through a central, knowledgeable focal point.

The command will continue to develop procedures, concepts, and systems to improve ESC support to Air Force operations. ESC will explore ways to expand the command's involvement in space operations and to prepare for its potential role in the counternarcotics war.

In achieving these goals, ESC will continue to adapt to the changing world environment, living up to its motto, "Freedom Through Vigilance." ■

Military Airlift Command

AFTER Hurricane Hugo swept through the islands of the Caribbean and stormed up the United States' Eastern Seaboard last September, Military Airlift Command (MAC) transported more than 8,100 tons of emergency supplies and more than 3,000 relief workers to the storm-ravaged areas.

When a killer earthquake struck northern California in October, MAC's people searched for survivors and delivered supplies to the shaken cities.

When the worst oil spill in North American history caused environmental havoc last year, MAC crews rushed more than 1,000 tons of equipment and 150 people to aid in the cleanup.

MAC's mission—the airlift of people and supplies—is the same during peacetime or war. MAC crews stand ready to deliver combat troops and their battle equipment anywhere in the world by airland or airdrop. MAC prominently displayed those abilities at the end of 1989 as the command stepped up its daily airlift tempo to move troops and cargo into Panama to support Operation Just Cause. The success of this short-notice, complex airlift testifies to MAC's readiness and professionalism.

MAC's missions are accomplished through a worldwide airlift system comprising some 90,000 people and 1,000 aircraft at 287 locations in twenty-five countries. The Air National Guard and the Air Force Reserve add an additional 71,000 people and 400 aircraft to MAC forces.

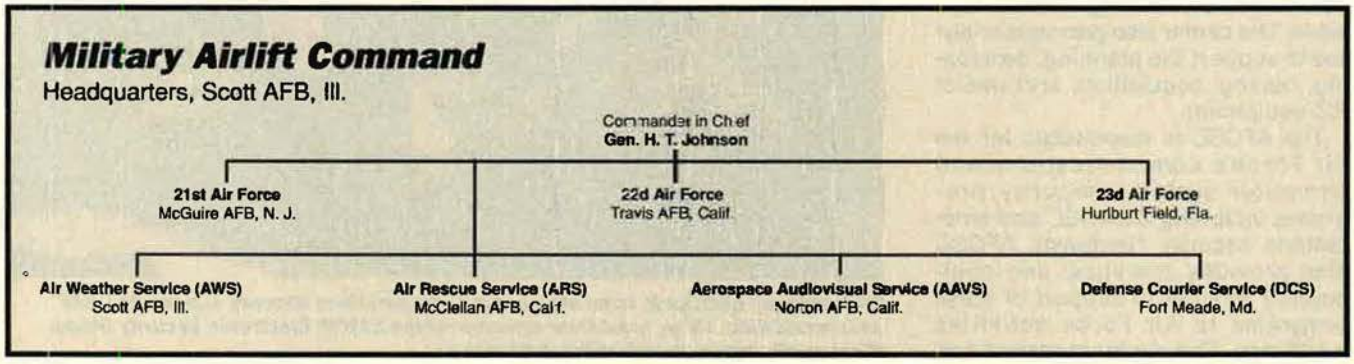
MAC operates thirteen bases in the US and controls facilities at Lajes Field in the Azores and at Rhein-Main AB, Germany. The command has assets exceeding $33 billion and an annual operating budget of $5.2 billion.

MAC is the Air Force component of the US Transportation Command. The MAC Commander in Chief, Gen. H. T. Johnson, also serves as USCINCTRANS.

MAC's Twenty-first and Twenty-second Air Forces are the combat-ready theater and strategic airlift arms of MAC. The command's Twenty-third Air Force provides a focal point for special operations and is the Air Force component of the US Special Operations Command.

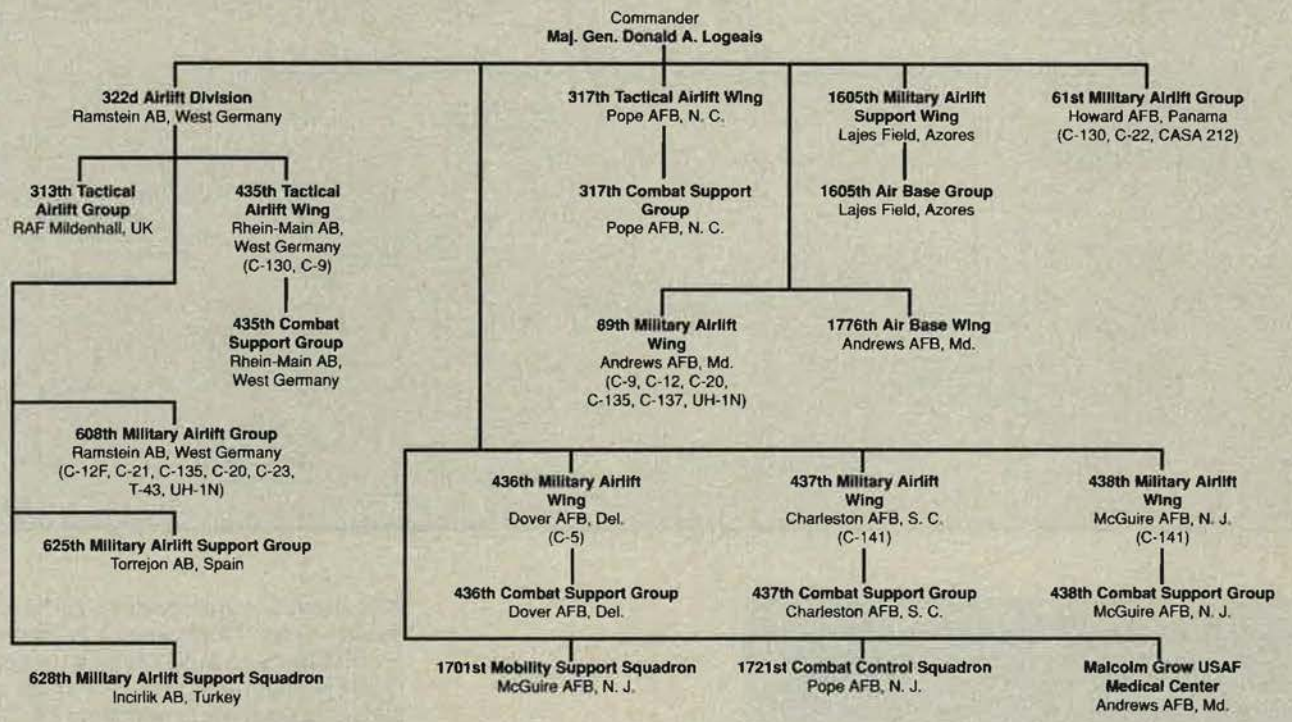
—Staff photo by Guy Aceto

MAC airlifts people and supplies in peace and war. Here, medical crew director Capt. Andy Jorgenson of the 375th Military Airlift Wing, 57th Medical Evacuation Squadron, Scott AFB, Ill., checks the patient load on a scheduled MAC C-9A medevac flight.



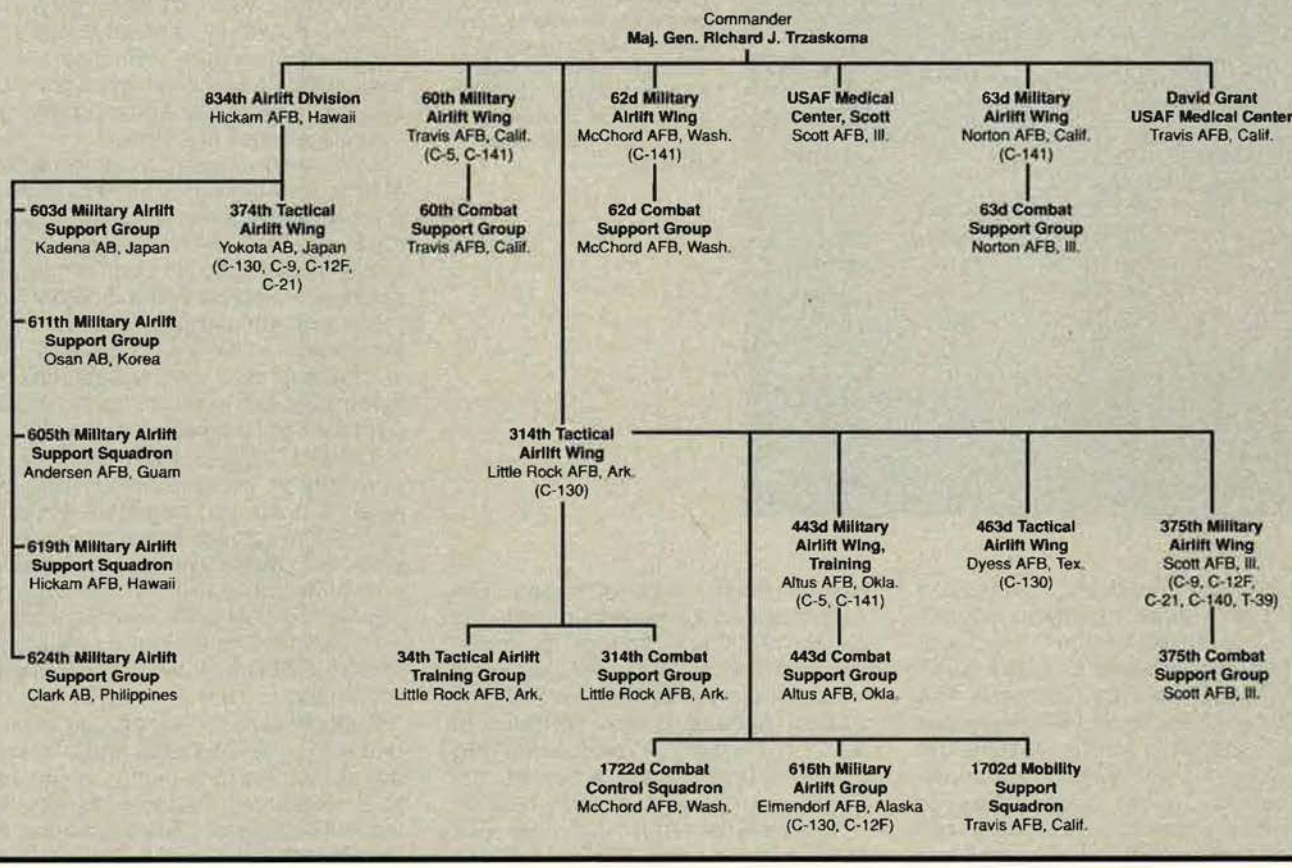
Twenty-first Air Force (MAC)

Headquarters, McGuire AFB, N. J.



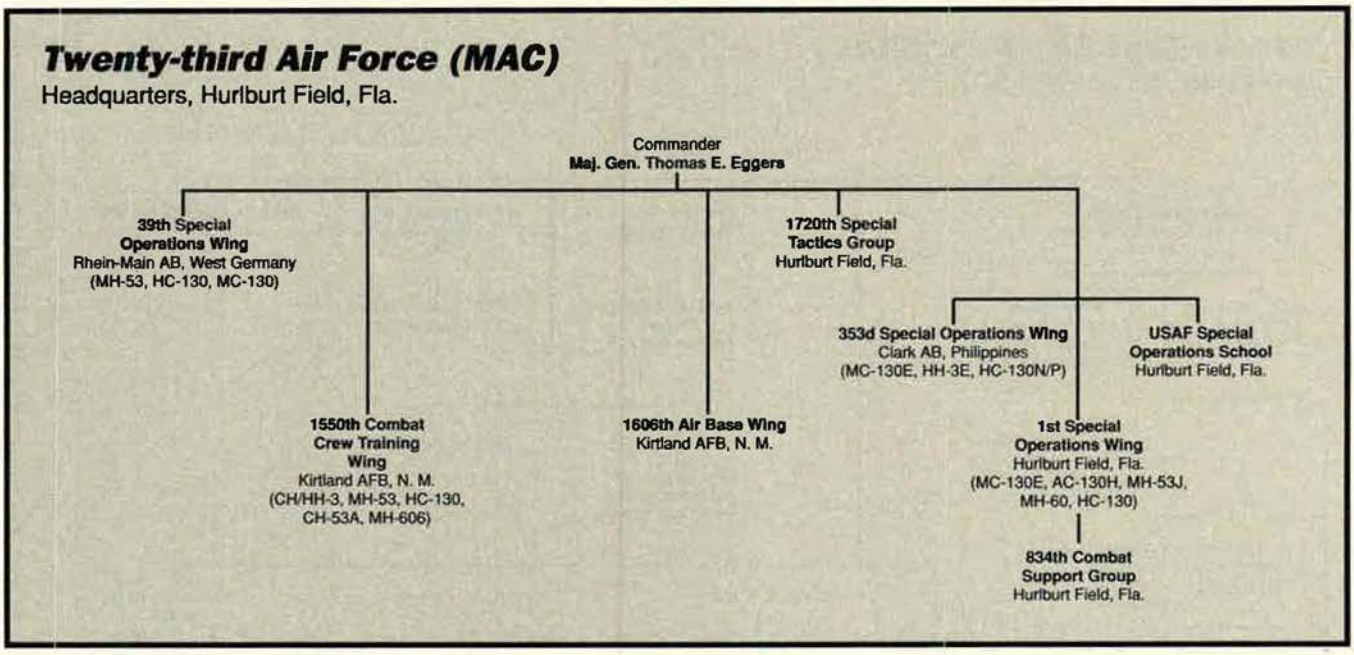
Twenty-second Air Force (MAC)

Headquarters, Travis AFB, Calif.

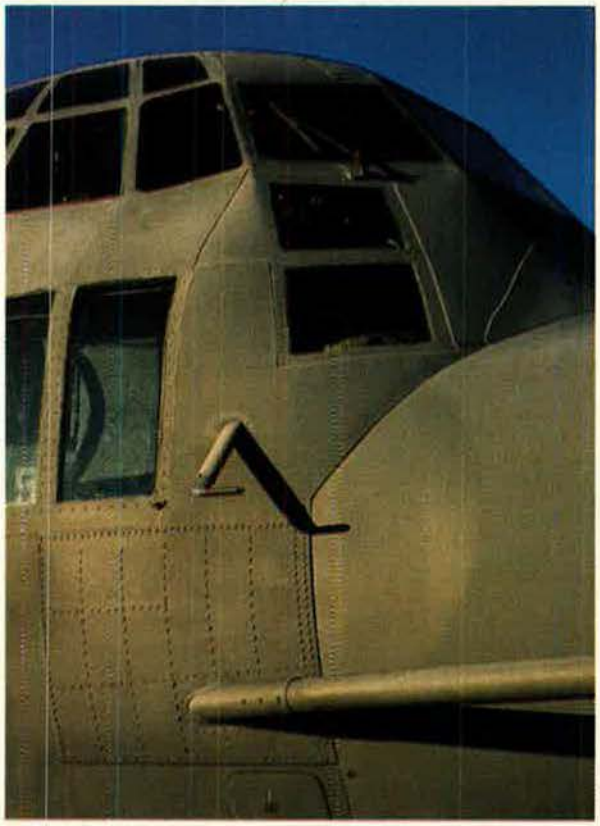


Twenty-third Air Force (MAC)

Headquarters, Hurlburt Field, Fla.



—Staff photo by Guy Aceto



MAC assets like this AC-130H of the Twenty-third Air Force, USAF's component of the US Special Operations Command, were called on to support Operation Just Cause in Panama. MAC also stepped up its daily airlift tempo to move troops and cargo into the area.

MAC also maintains specialized services to support day-to-day Air Force and Department of Defense operations. The newest of these is the Air Rescue Service, formerly the Aerospace Rescue and Recovery Service. Reactivated August 1, 1989, the ARS provides worldwide combat rescue forces. The Air Weather Service operates a weather observing and forecasting network to support Army and Air Force units worldwide. The Aerospace Audiovisual Service is the Air Force's single manager for combat, operational, and technical audiovisual documentation. The Defense Courier Service is also assigned to MAC, transporting and escorting time-sensitive, highly classified, national security material worldwide.

Aeromedical airlift is another vital MAC mission. The airevac mission was moved from Twenty-third to Twenty-second Air Force on February 1, 1990. In 1989, MAC's highly trained medical technicians, flight nurses, and aircrews moved more than 78,000 DoD patients on nearly 5,000 C-9, C-141, and C-130 missions.

In Fiscal 1990, MAC units are scheduled to participate in eighty-five exercises sponsored by the Joint Chiefs of Staff—more than any other command. Most of MAC's flying hours, however, are devoted to "channel missions," which provide regular service between important locations. About 930 active channels operate around the globe.

During contingencies or wartime, MAC's fleet would be expanded through activation of the Civil Reserve Air Fleet. The CRAF is a partnership between MAC and US commercial air carriers, providing approximately 500 passenger and cargo aircraft for military missions. On a daily basis, CRAF aircraft augment MAC capabilities by flying contract missions to move Department of Defense personnel.

The C-17, MAC's future airlifter, is currently in production at Douglas Aircraft Corp. in Long Beach, Calif. The C-17's capability to deliver outsize cargo directly to forward areas in both airland and airdrop roles will significantly increase the command's airlift flexibility. The Air Force expects to receive 210 C-17s, with a first flight scheduled in 1991.

Though the C-17 will play an important role in MAC's future, the present-day airlift mission is being carried out by professionals dedicated to upholding MAC's motto, "The Backbone of Deterrence." ■

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COL James L. Russell, Jr., Ret.

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COL Berdon M. Bell, Ret.

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"Michael Jordan has overcome the acceleration of gravity by the application of his muscle power in the vertical plane, thus producing a low altitude earth orbit."
Professor Douglas Kirkpatrick,
American Institute of Aeronautics and Astronautics
Air Jordan from Nike.

Pacific Air Forces

With headquarters at Hickam AFB, Hawaii, Pacific Air Forces (PACAF) is the principal air arm of US Pacific Command. PACAF's primary mission is to plan, conduct, and coordinate offensive and defensive air operations in an area extending from the west coast of the Americas to the east coast of Africa and from the Arctic to the Antarctic.

To maintain security in the vast Pacific region, PACAF has almost 300 fighter and attack aircraft, including air superiority F-15s, multirole F-4s, ground attack F-16s, OA-10s, and RF-4s. Aircraft from MAC, SAC, and TAC provide crucial support as well.

Gen. Merrill A. McPeak, Commander in Chief, Pacific Air Forces, commands nearly 40,000 Air Force military and civilians on duty in the Pacific. Along with their more than 35,000 family members, this force is distributed among ten major and many smaller installations, primarily in Hawaii, Japan, Guam, the Republic of Korea, and the Republic of the Philippines.

PACAF's military professionals stand ready to defend US interests and fulfill mutual defense agreements in an area containing thirty-nine countries and covering half the world's surface, posing a major challenge for PACAF war planners.

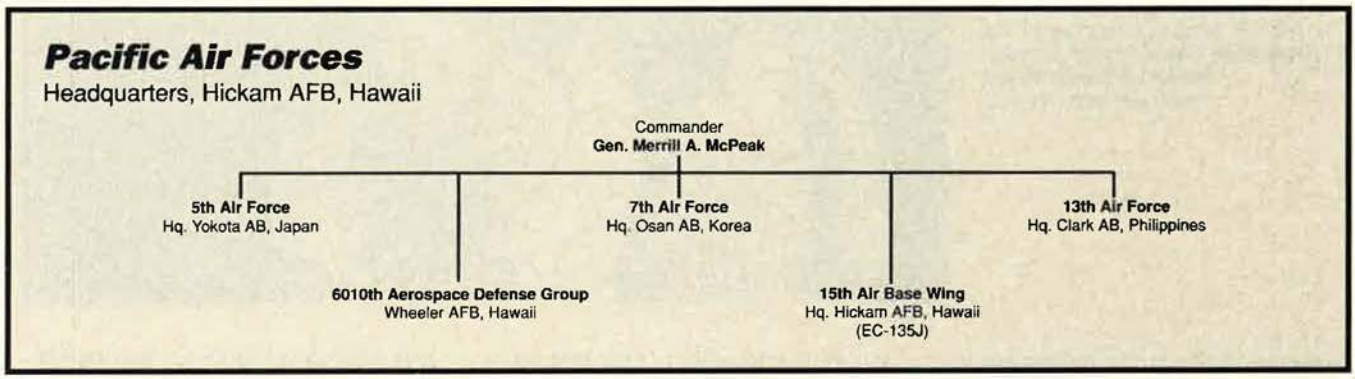
To help overcome long supply lines, command logisticians, working with Air Force Logistics Command, opened a forward wholesale supply activity at Kadena AB, Japan, in March 1989. Designated the Pacific Parts Store, the facility provides 40,000 square feet of storage space and brings essential spare parts some 7,000 miles closer to the people who need them in the western Pacific.

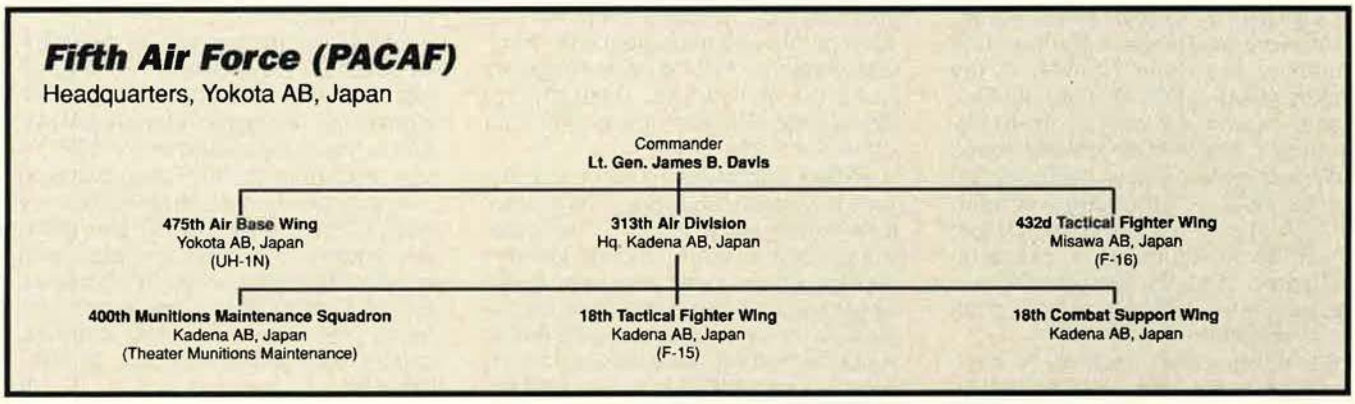
Organizational improvements and the introduction of newer weapon systems get the most out of PACAF's widely dispersed forces. The new C and D model F-16s, with improved engines and avionics, operate out of Kunsan and Osan ABs, Republic of Korea, and Misawa AB, Japan.

Intermediate-level aircraft maintenance has moved back to PACAF's tactical fighter wings. The Combat Oriented Supply Organization has expanded operations to support jet-engine and aerospace ground-equipment maintenance, improving PACAF's ability to generate combat sorties.

Even with the most sophisticated weapons, highly trained and motivated people, and improved logistics systems, PACAF's planners realize that their success ultimately depends on joint and combined operations. This realization is embodied in unprecedented levels of teamwork with sister services. Ninety-eight percent of all PACAF exercises are conducted jointly with Navy, Marine, or Army units.

More than sixty times last year, PACAF forces participated in dynamic and realistic field training and command post exercises. More than sixty percent of PACAF exercises are combined operations with allied or friendly countries. In PACEX '89, the largest series of joint/combined war games in the Pacific since World War II, PACAF forces exercised their theater-wide warfighting capability and demonstrated unquestionable US resolve in supporting mutual defense agreements with our allies. During last year's Team Spirit exercise in South Korea, more than 16,000 USAF personnel and more than 800 aircraft joined with other US and Republic of Korea forces to provide a visible dem-





Seventh Air Force (PACAF)

Headquarters, Osan AB, Korea

Commander
Lt. Gen. Thomas A. Baker

- **8th Tactical Fighter Wing** — Kunsan AB, Korea (F-16)
- **51st Tactical Fighter Wing** — Osan AB, Korea (F-16)
- **460th Tactical Reconnaissance Group** — Taegu AB, Korea (RF-4)
- **5th Tactical Air Control Group** — Suwon AB, Korea (OA-10)
- **6th Tactical Intelligence Group** — Osan AB, Korea

Thirteenth Air Force (PACAF)

Headquarters, Clark AB, Philippines

Commander
Maj. Gen. William A. Studer

- **3d Tactical Fighter Wing** — Clark AB, Philippines (F-4E/G)
- **6200th Tactical Fighter Training Group** — Clark AB, Philippines
- **633d Air Base Wing** — Andersen AFB, Guam

—USAF photo by Walt Weible

Pacific Air Command is the principal air arm of the US Pacific Command. PACAF's area of responsibility covers half the world's surface and includes thirty-nine countries. Here, A1C Furman L. C. Johnson (left) and SrA. John P. Tornow, members of the PACAF Elite Guard, stand guard at PACAF headquarters at Hickam AFB, Hawaii.

onstration of the US commitment to defend the region.

Cope North exercises in Japan, Cobra Gold in Thailand, Kangaroo in Australia, and Cope Thunder in the Philippines give PACAF and Allied aircrews intense air warfare training. During FY 1989, PACAF's pilots honed their warfighting skills flying 69,623 sorties. With a fighter/attack aircraft Class A mishap rate of only 2.03 per 100,000 flying hours, PACAF has demonstrated that its people are unequaled in maintaining combat readiness while minimizing risk.

Readiness also applies to contingency medical care. PACAF led the way with completion and testing at Osan AB of the Air Force's first full-size hospital hardened against nuclear fallout and biological and chemical weapons. A 750-bed contingency hospital at Kimhae, Republic of Korea, was also brought on line, another Air Force first.

PACAF continues to recognize the link between readiness, retention, and family well-being. The command's seven Family Support Centers strengthen the bond between the Air Force mission and its families. PACAF also boasts an aggressive program to renovate and upgrade existing family housing and MWR (morale, welfare, and recreation) facilities and to construct new housing and other quality-of-life facilities.

PACAF's concern for its people's welfare paid big dividends in terms of higher enlisted retention rates. About eighty-four percent of eligible PACAF first-termers reenlisted in FY 1989, a rate well above the Air Force average.

A combination of state-of-the-art equipment, highly trained and motivated men and women, and parts and supplies to keep aircraft flying makes PACAF a formidable force to help stabilize the region, to deter conflict, and, should deterrence fail, to fight and win. ■

Strategic Air Command

—Staff photos by Guy Aceto

In addition to controlling two elements of the US nuclear triad, SAC supports worldwide conventional power projection with its bombers (like the B-52 below) and tankers (like the KC-135 at left) and its reconnaissance and command and control systems.

STRATEGIC Air Command (SAC) is the US Air Force's largest command. SAC's awesome nuclear capability has proven strong enough to deter an attack on this nation or its allies for more than forty years.

In addition to controlling two elements of the US nuclear triad, SAC supports worldwide conventional power projection with its bombers and tankers. The command's total warfighting capability is enhanced by its reconnaissance, refueling, and command and control systems.

SAC's combat capability is derived from its weapons, its support systems, and its people. More than 119,000 officers, enlisted, and civilians, as well as the 15,648 SAC-gained Reservists and Guardsmen, solidly sustain the command.

SAC's striking power comes from a versatile force of bombers and missiles. More than 400 bombers—B-1Bs, B-52s, and FB-111s—are ready to fly, fight, and win. Peacekeeper and Minuteman intercontinental ballistic missiles (numbering 1,000) provide a hardened, responsive force that underwrites SAC's deterrent posture and promises swift retaliation to our nation's enemies.

More than 600 tankers are ready to take to the sky and extend the bombers' range. The KC-10s and KC-135s, including aircraft of the Air Force Reserve and the Air National Guard, serve American and many allied air forces.

SAC's reconnaissance aircraft provide specialized support for theater commanders. The U-2, TR-1, and RC-135 use the latest technology to gather immediate intelligence data. These reconnaissance aircraft proved themselves useful in peacetime as well when they rapidly responded to the need for aerial photo support of oil spills, forest fires, and even last October's California earthquake.

Quality command and control systems enhance a fighting force's effectiveness. The EC-135 and E-4B Command and Control System aircraft are survivable means of keeping our national leaders and warriors in touch throughout the spectrum of conflict.

As we enter the 1990s, advances in technology will come quickly. To keep up, SAC is upgrading its aircraft and missiles and is bringing new weapons as well as command and control systems on line.

The thirty-year-old B-52 stays viable with modifications to its offensive and defensive systems. It is the cruise missile platform, integrating these modern weapons with a proven workhorse.

The B-52G, with its worldwide range, heavy payload, and rapid response capabilities, is an important element of the theater CINC's conventional warfare assets. All B-52 crews

train to deliver nonnuclear weapons. In addition, B-52 aircraft are adapted to support the Navy in mine-laying, sea reconnaissance, and antiship operations with the Harpoon missile.

As a steadily maturing weapon system, the B-1B has proven itself the world's most capable penetrating

Strategic Air Command

Headquarters, Offutt AFB, Neb.

Commander in Chief
Gen. John T. Chain, Jr.

8th Air Force
Hq. Barksdale AFB, La.

7th Air Division
12th Air Division
42d Air Division

544th Strategic Intelligence Wing
Offutt AFB, Neb.

15th Air Force
Hq. March AFB, Calif.

1st Strategic Aerospace Division
3d Air Division
14th Air Division
40th Air Division
57th Air Division

—Staff photos by Guy Aceto

SAC's alert force relies on front-liners like 2d Lt. Kate McGraw (seated) and 1st Lt. Chris Harrington of the 490th Strategic Missile Squadron, Malmstrom AFB, Mont. Their charge is the Minuteman II ICBM. At far left is an inert version in Malmstrom's T-9 training silo.

bomber. B-1B crews use the aircraft's ability to fly low and fast. Its reduced radar cross section and electronic countermeasures make it extremely difficult to detect and intercept.

The bomber of the future, the B-2, is flying and expanding its operational envelope with each test. This aircraft will revolutionize the future of bombers and greatly enhance SAC's ability to secure peace worldwide.

Additional systems such as the Advanced Cruise Missile and an updated Short-Range Attack Missile will sustain bombers as a potent component of the nuclear triad. Conventional standoff weapons are also being developed to increase SAC's flexibility.

Peacekeeper missiles, currently based in underground silos, are slated for deployment in a rail-garrison system. This will give the nation a highly accurate ICBM capable of carrying ten warheads, providing mobility and great difficulty for an enemy to target.

SAC's new underground command center has been in operation for more than a year. It represents the latest in command and control technology, assuring SAC's Commander in Chief communication with his forces. Fully computerized, the new command center uses the Defense Satellite Communications System, Milstar, the Air Force Satellite Communications System, and the new electromagnetic-pulse-resistant Ground Wave Emergency Network to provide the best possible communications.

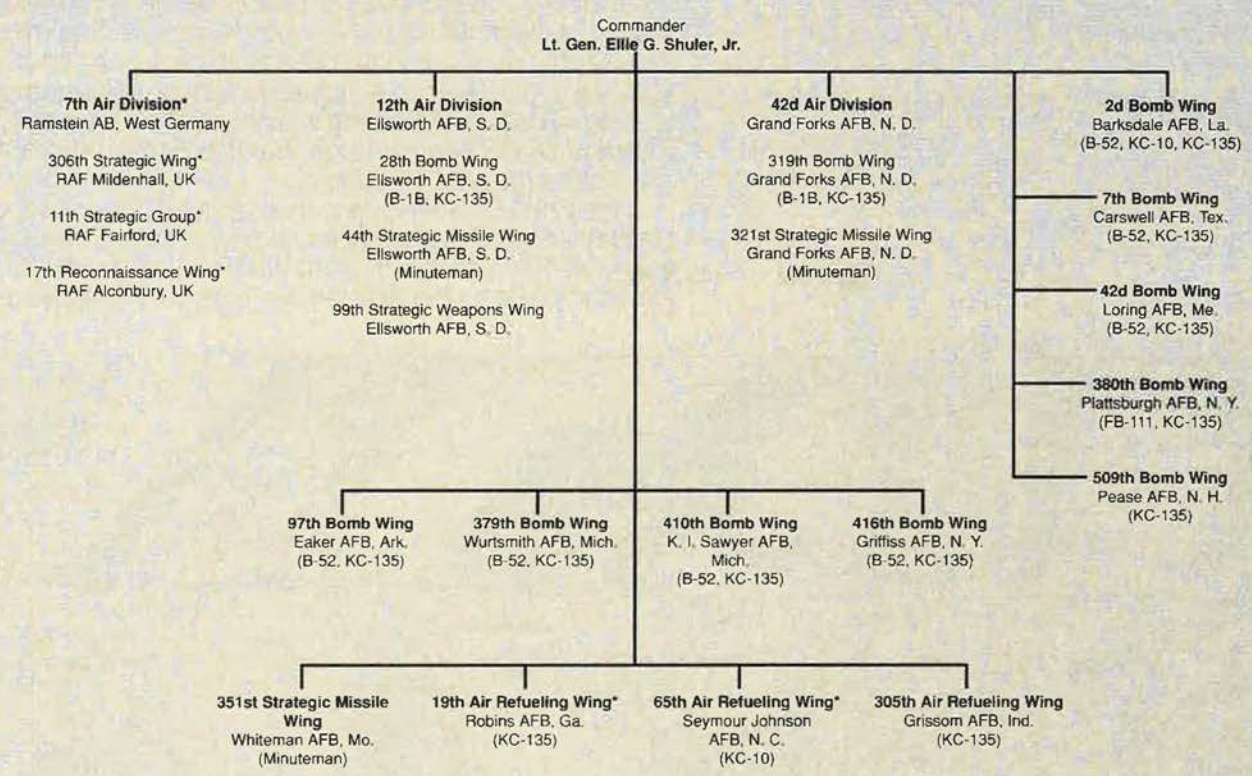
SAC's maintenance and operations people are a premier force ensuring world peace through deterrence of war. If called to war, they will be ready, because SAC people understand that peace is the product of the skill and professionalism of warriors.

The Strategic Warfare Center at Ellsworth AFB, S. D., is becoming a reality and will soon be the place where the best bomber crews in the world go to become even better. This "grad school" for bomber crews will stress high-quality aircrew training through improved tactics and evaluation.

SAC stresses the ability to deploy its forces anywhere in the world on short notice. The recently opened Warrior Training Center at Barksdale AFB, La., and increased deployments prepare SAC personnel for conditions they could face in wartime. ■

Eighth Air Force (SAC)

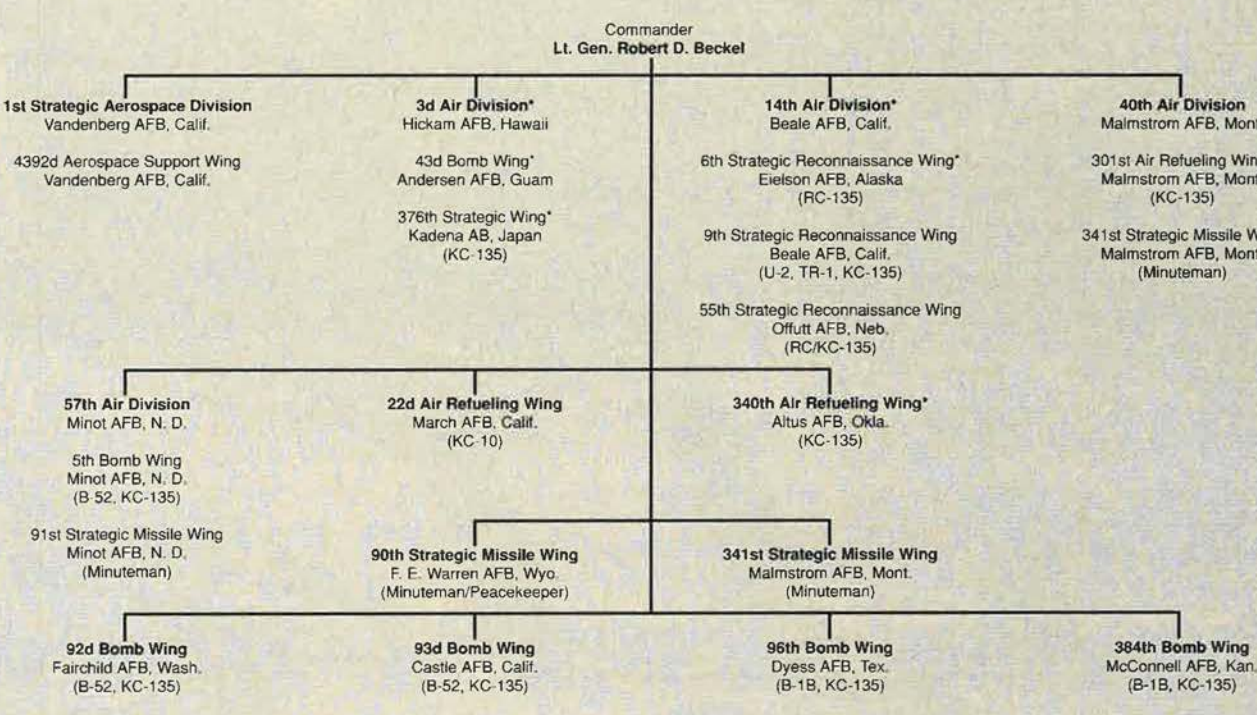
Headquarters, Barksdale AFB, La.



*Tenant Units

Fifteenth Air Force (SAC)

Headquarters, March AFB, Calif.



*Tenant Units

WILLIAM THE CONQUEROR AND AIR SUPERIORITY

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

That edge was the stirrup.

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

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

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

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

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

The laws of history have not changed. In our own time we find ourselves jockeying for the technological edge. The Warsaw Pact is expected to produce an air superiority fighter in the mid-1990s. This is where America's Advanced Tactical Fighter comes in. A culmination of the most far reaching technology in history, the ATF will effectively check a potential imbalance in air defense, and so preserve stability.

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

Lockheed
Giving shape to imagination.

Tactical Air Command

THE mission of Tactical Air Command (TAC) is to train, equip, and maintain combat-ready forces capable of rapid deployment and employment and to ensure that strategic air defense forces are ready to meet the challenges of peacetime air sovereignty and wartime air defense. TAC also works with the Army, Navy, and Marine Corps to develop joint doctrine, procedures, tactics, techniques, training, publications, and equipment for joint operations. TAC directly supports the DoD antidrug mission by providing fighter, surveillance, and command, control, and communications resources.

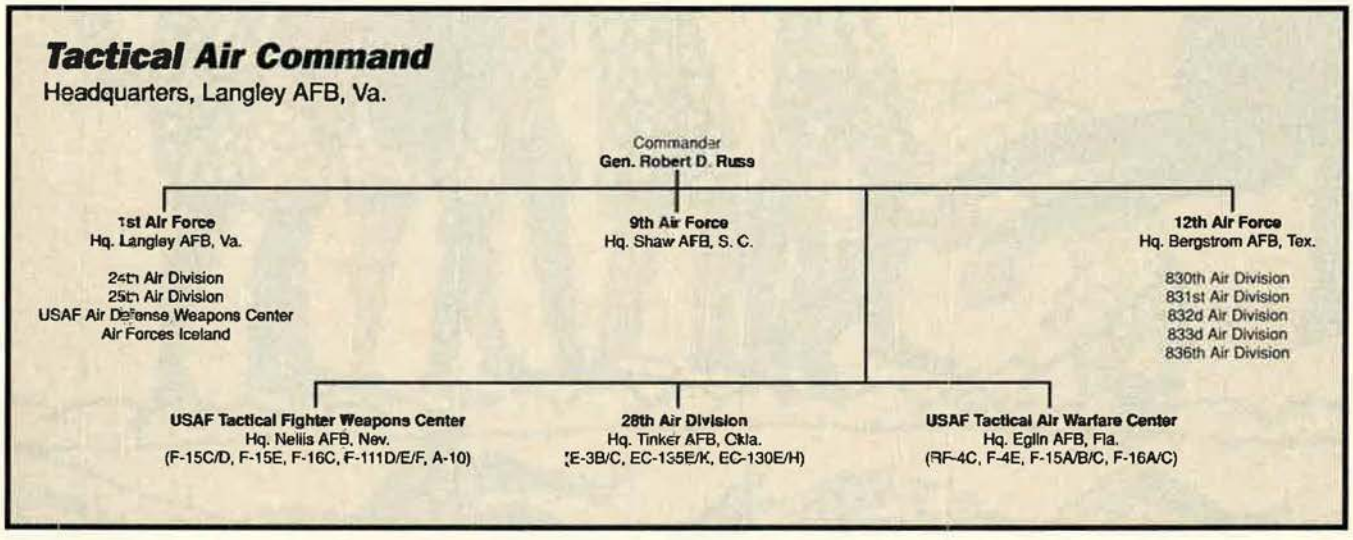
When mobilized, more than 73,500 members of the Air National Guard and Air Force Reserve, along with their 1,400 aircraft, are assigned to TAC. In total, TAC and these TAC-gained units consist of more than 4,000 aircraft (some forty-four percent of all USAF aircraft) and some 185,400 people (21,600 officers, 146,200 enlisted personnel, and 17,600 civilians).

TAC's forces are organized under three numbered air forces and three major direct reporting units (see chart). The TAC Commander is also the Commander in Chief, US Air Forces, Atlantic.

First Air Force, headquartered at Langley AFB, Va., performs a daily operational mission as the CONUS North American Aerospace Defense (NORAD) Region. The First Air Force

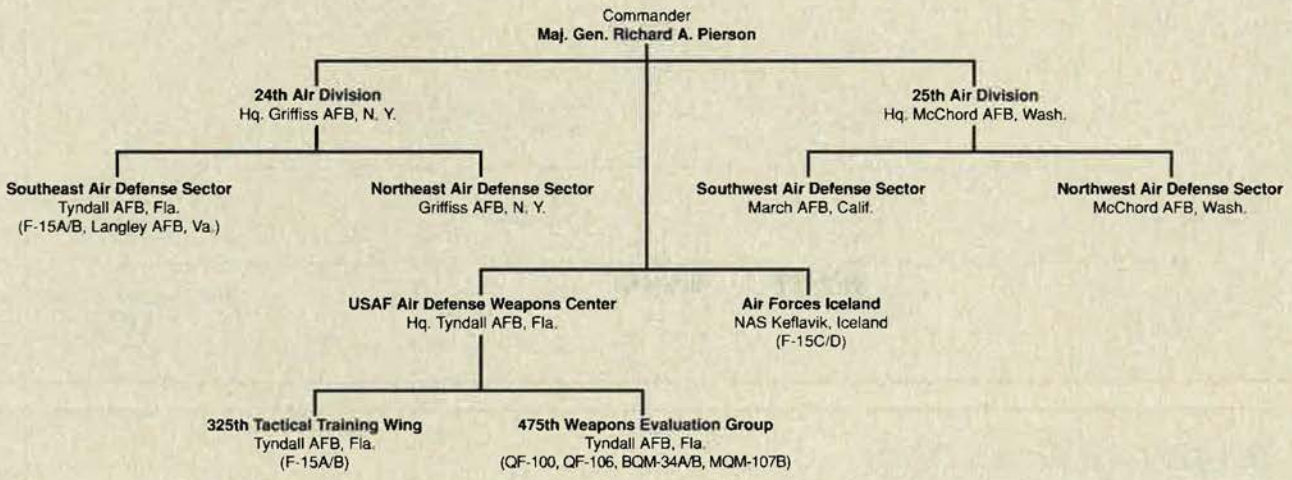
—Staff photo by Guy Aceto

Tactical Air Command's fleet of OA-10s like the one at left, belonging to the 602d Tactical Air Control Wing, Davis-Monthan AFB, Ariz., provides close air support as part of TAC's mission to train and maintain combat-ready forces and provide for strategic air defense.



First Air Force (TAC)

Headquarters, Langley AFB, Va.



Commander, as the region commander, reports directly to CINCNORAD for the air defense of the CONUS. First Air Force includes two air divisions, each with two air defense sectors responsible for the air defense of their respective quadrants of the CONUS using a total of fifty armed fighter aircraft on around-the-clock alert.

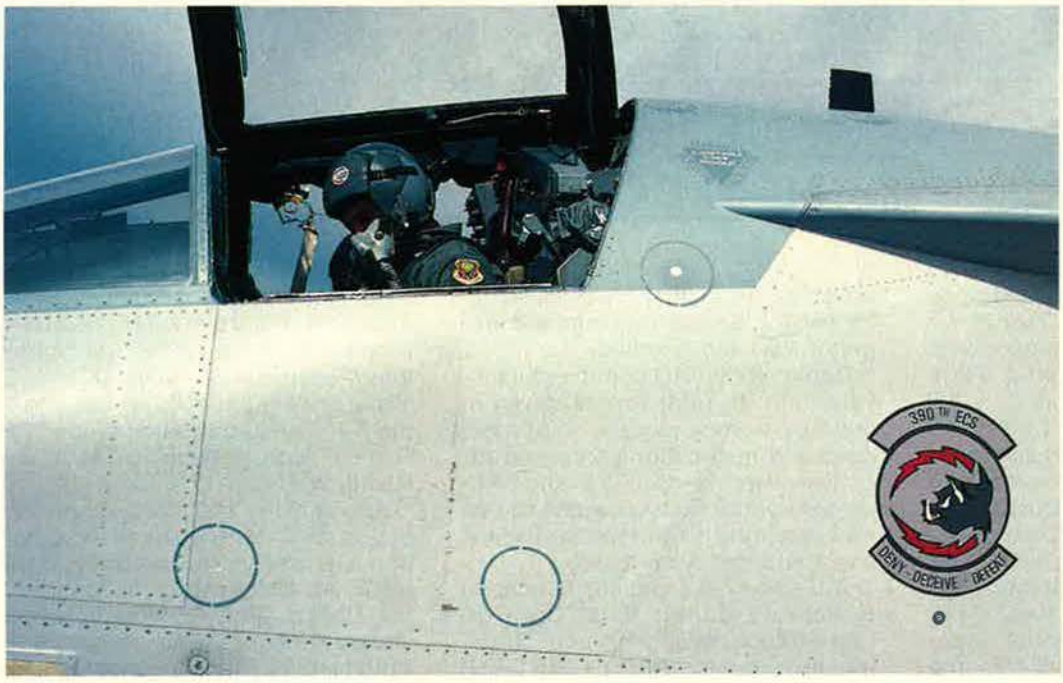
First Air Force plays a key role in the nation's war on drugs. In close coordination with the US Coast Guard and the US Customs Service, air defense units monitor and intercept illegal air traffic attempting to penetrate US airspace.

First Air Force also commands the USAF Air Defense Weapons Center at Tyndall AFB, Fla., which provides aircrew training and specialized training, tactics development, and tests of strategic air defense systems. Air Forces Iceland at NAS Keflavik, under the operational control of the Commander in Chief of US Atlantic Command, provides a combat force for the air defense of Iceland and air surveillance data in support of the NORAD mission.

Ninth Air Force at Shaw AFB, S. C., has ten wings performing tactical fighter operations, training, and tactical air control. Ninth Air Force comprises approximately 40,200 people and 750 aircraft—forty percent of TAC's active-duty forces.

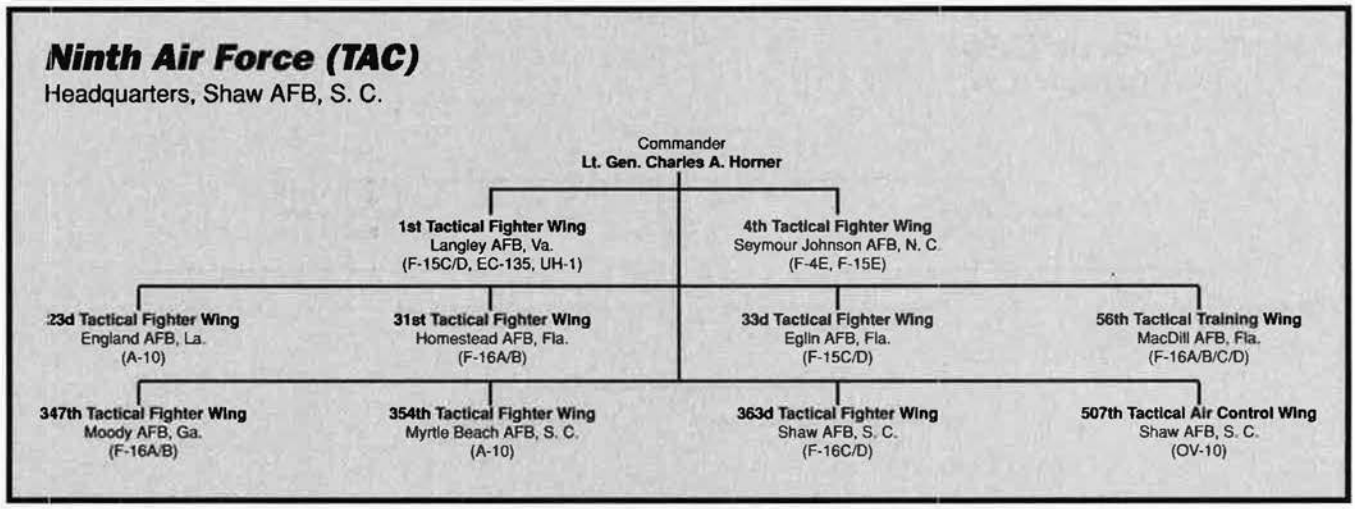
As part of a dual-role headquarters, Ninth Air Force becomes US Central Command Air Forces (USCENTAF), the air component of US Central Command. To prepare for this mission, USCENTAF active-duty and reserve forces train regularly with Army, Navy, and Marine Corps units in realistic joint training exercises.

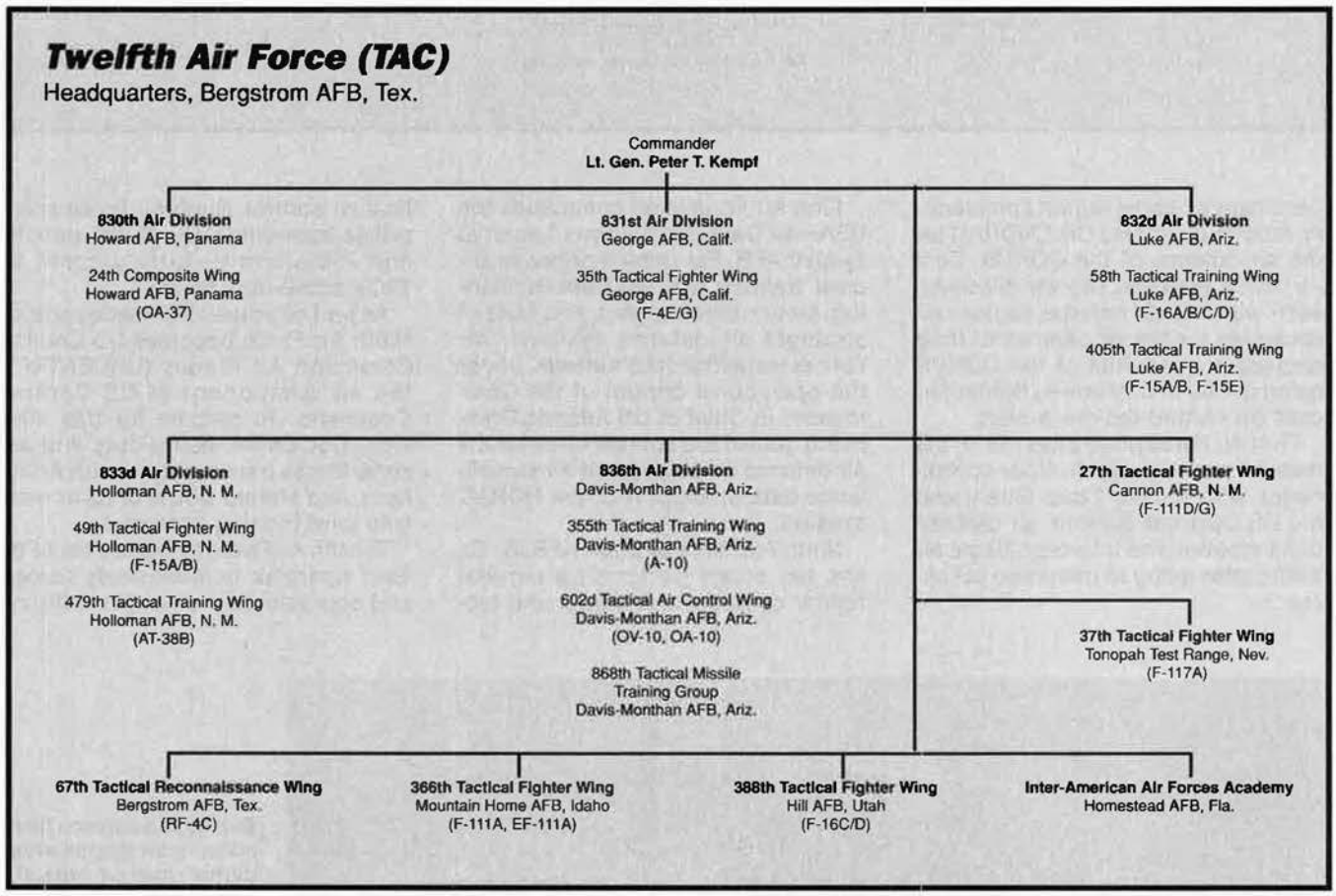
Twelfth Air Force at Bergstrom AFB, Tex., operates combat-ready forces and equipment for air superiority, in-



—Staff photo by Guy Aceto

Barrier surveillance jamming, radar degradation during close air support operations, and escort jamming for deep strike missions are among the missions of the EF-111As (left) of the 390th Electronic Combat Squadron, 366th Tactical Fighter Wing, Mountain Home AFB, Idaho.





terdiction, reconnaissance, and close air support. In addition, Twelfth Air Force is the Air Force component of the US Southern Command. More than 40,000 people and nearly 1,000 aircraft are assigned to Twelfth Air Force. The command operates five air divisions. Four of the air divisions and thirteen wings perform tactical fighter operations and training, reconnaissance, tactical air control, and a wide range of electronic combat tasks. The 830th Air Division at Howard AFB, Panama, is responsible for the air defense of the Panama Canal area and assisting Twelfth Air Force in developing security assistance plans and programs for Latin America.

During 1989, TAC continued its involvement in joint forces development by participating in joint exercises and host-nation-sponsored exercises. Twenty-nine TAC and TAC-gained fighter/reconnaissance squadrons deployed to European, Pacific, and southwest Asian bases.

TAC's combat capability continued to improve during 1989. The F-16 Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) training program began at Luke AFB, Ariz. The multirole F-15E beddown progressed at the 4th Tactical Fighter Wing, Seymour Johnson AFB, N. C. Of particular note was the unveiling of the F-117 and conversion of the 37th Tactical Fighter Wing to TAC's new stealth fighter.

Additionally, TAC hosted its biennial tactical air-to-ground competition, Gunsmoke, in October, and the USAF Air Demonstration Squadron, the Thunderbirds, flew seventy-nine shows throughout the US before an estimated 11.7 million spectators. ■

From the front line to the bottom line, the A-7F will be right on the money.

This upgraded veteran will far outperform its predecessor. At half *the cost of any comparably equipped new aircraft.*

When America's defense planners needed a combat-proven, cost-effective attack airplane, LTV Aircraft Products Group had the answer—the A-7F. If selected for production, the A-7F will be quicker, more powerful, and developed exclusively for the ground support role at a significant cost saving. And the A-7F will come with a 4,000-flight-hour warranty that covers it for approximately 20 years of flying.

The prototype A-7F is currently undergoing flight testing at Edwards AFB.

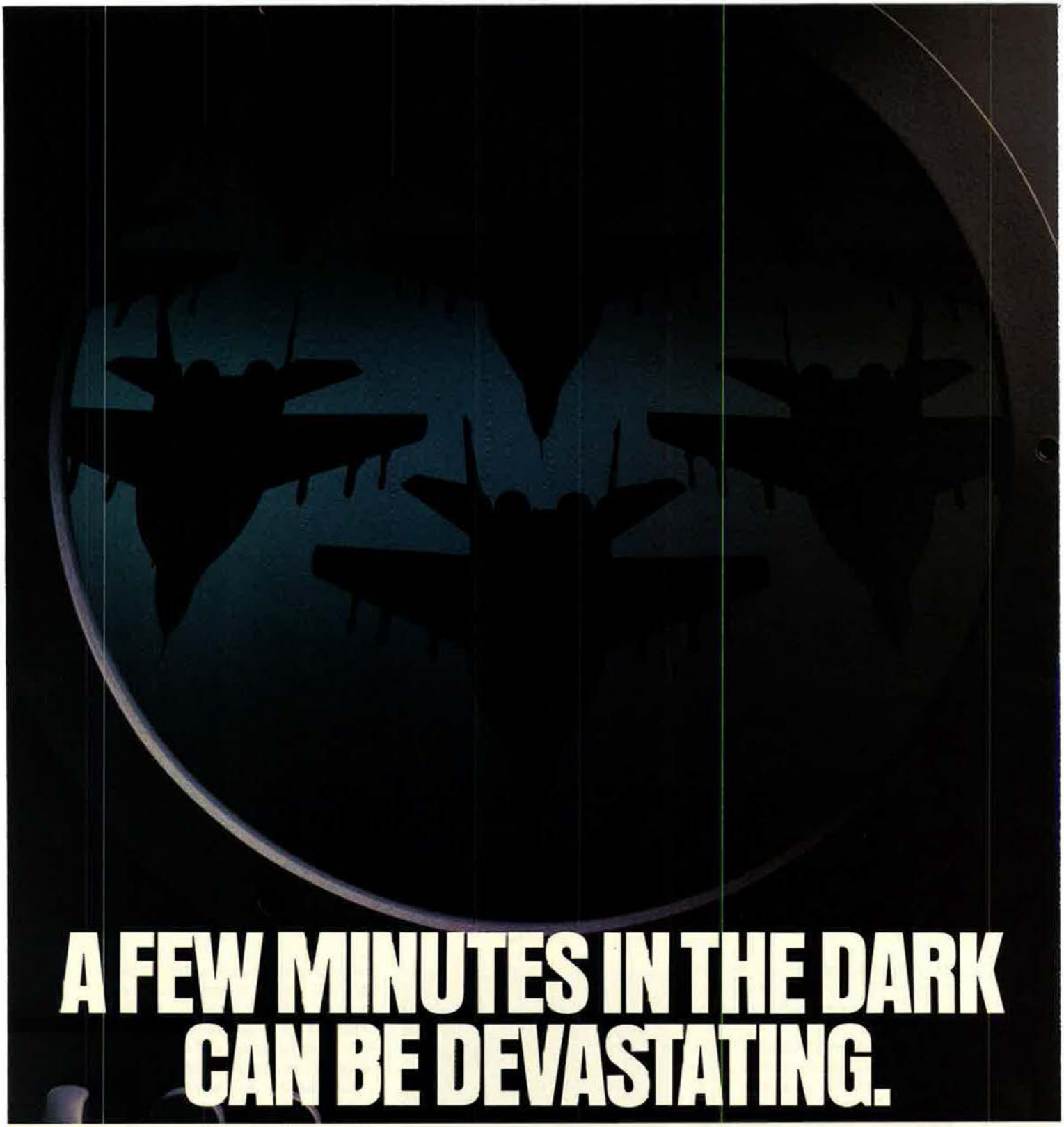
The A-7F will have 50 percent more available power, for increased maneuverability. Improved lift and angle-of-attack performance. And a fivefold increase in acceleration that translates into greatly enhanced survivability. Low-altitude or night strikes would be no problem for the A-7F when equipped with advanced navigation and targeting avionics.

Because the A-7 is an already-existing asset, LTV's modernization program can deliver a proven performer at *half* the cost of any comparably equipped new aircraft. And that's important in today's budget-conscious defense environment.

From the runway to the balance sheet, the A-7F will be a remarkable aircraft. It proves that America can hold the line—in more ways than one.

LTV Aircraft Products Group

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



A FEW MINUTES IN THE DARK CAN BE DEVASTATING.

The enemy's out there. Just waiting for a moment when you can't see them. Because when your power goes out, their's comes on. Protecting C3 capabilities means protecting your Mission Critical power supply, and nothing's better than a Powerware® UPS.

That's why the Air Force recently awarded Exide Electronics a significant requirements contract. Over the next five years, we'll install and maintain Powerware systems at crucial Air Force facilities around the world. All Powerware products in the contract are available to the Department of Defense.

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R.C. # FO4606-88-D-0067

United States Air Forces in Europe

EUROPE'S rapidly changing political and military environment is changing the shape of the US Air Forces in Europe.

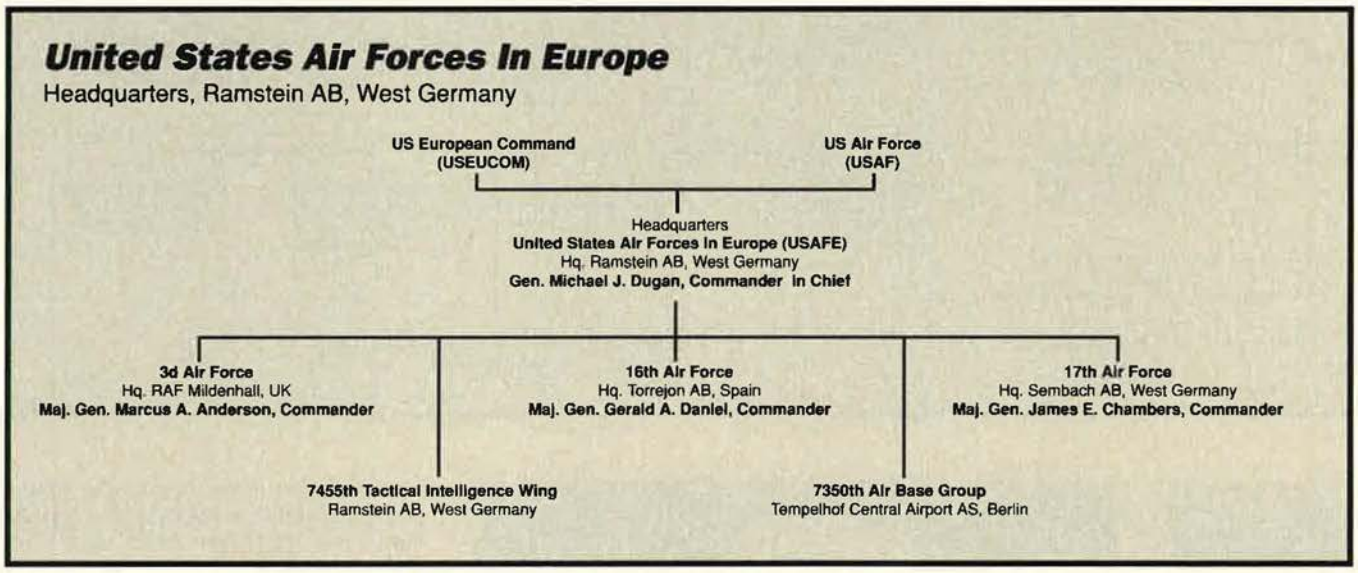
USAFE is the air component of the US European Command and a key element of the North Atlantic Treaty Organization. USAFE consists of Third Air Force in the UK, Sixteenth Air Force in the Southern/Mediterranean Region, and Seventeenth Air Force in Central Europe.

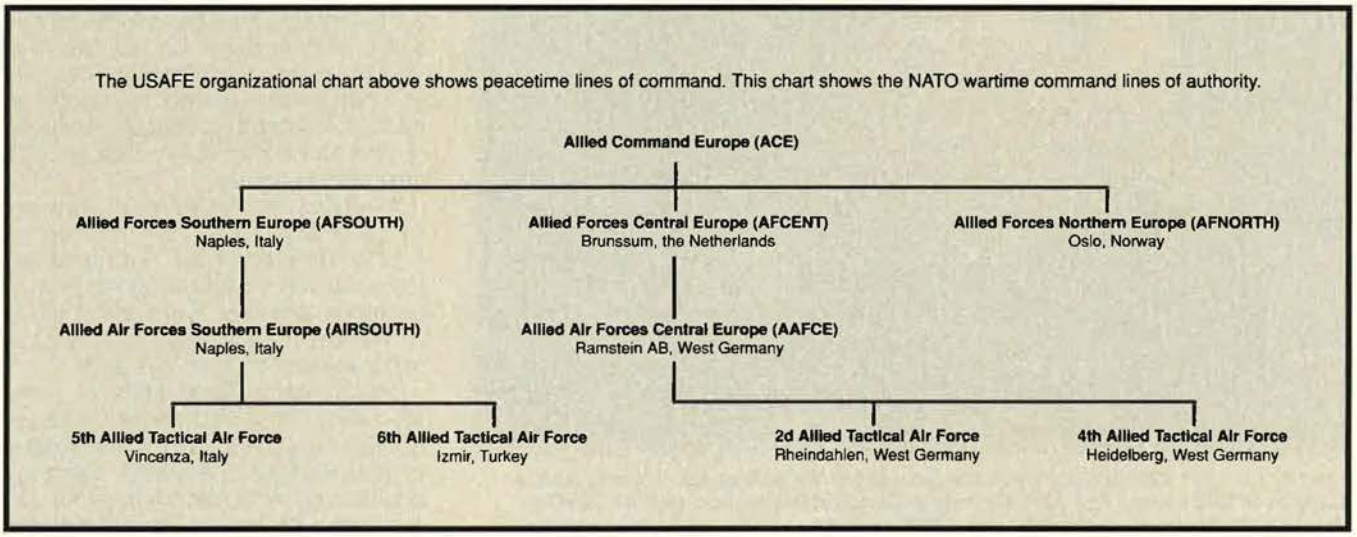
USAFE's Commander in Chief is also the Commander of Allied Air Forces, Central Europe. Air resources are provided by Belgium, Canada, West Germany, the Netherlands, the United Kingdom, and the United States. COMAAFCE controls some 2,000 tactical aircraft through the Second and Fourth Allied Tactical Air Forces. This force is augmented in wartime by tactical forces deploying from Stateside bases to approximately seventy collocated operating bases throughout NATO.

The combined effects of Conventional Forces in Europe negotiations and fiscal constraints may dictate significant force reductions.

USAFE is striving to reduce costs through improvements in efficiency and productivity. Under the Defense Management Review, USAFE has reduced manpower requirements through initiatives that reduce duplication of effort, redundant bureaucracy, or other inefficiencies. For example, USAFE expects to reduce the staff at its headquarters by more than fifteen percent over the next two years.

With a leaner force, USAFE must be postured to meet NATO host nation responsibilities. CINCUSAFE's num-





Third Air Force (USAFE)

Headquarters, RAF Mildenhall, United Kingdom

Commander
Maj. Gen. Marcus A. Anderson

- **10th Tactical Fighter Wing** — RAF Alconbury, UK (A-10, SAC TR-1)
- **20th Tactical Fighter Wing** — RAF Upper Heyford, UK (F-111, EF-111)
- **48th Tactical Fighter Wing** — RAF Lakenheath, UK (F-111F)
- **81st Tactical Fighter Wing** — RAF Bentwaters/Woodbridge, UK (A-10; F-16C/D; MAC Special Operations MC-130, MH-53, HC-130, HH-53)
- **501st Tactical Missile Wing** — RAF Greenham Common, UK (BGM-109G GLCM)
- **513th Airborne Command and Control Wing** — RAF Mildenhall, UK (USAFE EC-135; MAC rotational C-130; SAC rotational KC-135, SAC SR-71)
- **7020th Air Base Group** — RAF Fairford, UK (SAC rotational KC-135)
- **7274th Air Base Group** — RAF Chicksands, UK (Support; communications)
- **850th Munitions Maintenance Squadron (Theater)** — RAF Welford, UK (WRM storage)

Sixteenth Air Force (USAFE)

Headquarters, Torrejon AB, Spain

Commander
Maj. Gen. Gerald A. Daniel

- **Hq. TUSLOG** — Ankara AS, Turkey (Logistics management)
- **401st Tactical Fighter Wing** — Torrejon AB, Spain (F-16C/D)
- **406th Tactical Fighter Training Wing** — Zaragoza AB, Spain (Tactical range support; rotational USAFE aircraft)
- **487th Tactical Missile Wing** — Comiso AB, Italy (BGM-109G GLCM)
- **39th Tactical Group** — Incirlik AB, Turkey (Tactical range support; rotational USAFE aircraft)
- **40th Tactical Group** — Aviano AB, Italy (Rotational USAFE aircraft; logistical management)
- **7206th Air Base Group** — Hellenikon AB, Greece (Support; communications)
- **7275th Air Base Group** — San Vito Dei Normanni AB, Italy (Support; communications)
- **7276th Air Base Group** — Iraklion AB, Greece (Support; communications)
- **7217th Air Base Group** — Ankara AS, Turkey (Command and logistical management)
- **7241st Air Base Group** — Izmir AS, Turkey (NATO unit support)
- **40th Munitions Maintenance Squadron (Theater)** — Camp Darby, Italy (WRM storage)

—USAF photo by SrA. Kelvin Davis

A sentry from the 7206th Security Police Squadron, Hellenikon AB, Greece, stands guard over SAC assets. The 7206th Air Base Group at Hellenikon, part of USAFE's Sixteenth Air Force, supports SAC, MAC, ESC, and Army and Navy units in Greece.

ber one goal is to maintain a ready and sustainable force that can rapidly make the transition from peace to war.

Obtaining needed aircraft spare parts quickly and efficiently helps ensure a high mission-capable rate. The USAFE logistics community has developed and initiated a variety of computer-based processes that reduce man-hours and increase aircraft mission capability.

Avionics upgrades continue on F-111E/F and F-15C/D aircraft. For the F-111, upgrades have improved attack and terrain-following radar and weapons delivery. For the F-15C/D, upgrades have improved the avionics and weapons-delivery systems.

The logistics capabilities of more than sixty collocated operating bases (COBs) were evaluated for contingency and wartime operations. Each logistics discipline identified minimum requirements and developed criteria

to assess each COB in various phases of operations—prior to reinforcement, reinforcement, and sustainment.

USAFE also exercised the NATO cross-servicing program. This allows USAFE and NATO fighters to divert to NATO bases, receive all necessary servicing including armament, and quickly launch against new targets.

Under the Intermediate-range Nuclear Forces Treaty, two ground-launched cruise missile wings were deactivated in 1989. The remaining three active GLCM wings will deactivate by June 1991.

Another action affecting the command is the relocation of the 401st Tactical Fighter Wing from Torrejon AB, Spain, to Crotone, Italy. The Italian government volunteered to host the wing, which must move from Spain by May 1992. NATO infrastructure funds are financing base construction at Crotone.

The Central Region Wing Command and Control System should be operational this year. It will provide tactical wing battle staffs an automated, secure, near-real-time method of obtaining accurate resource information for command and control. System enhancements are being developed that include greater survivability, enlarged user base, and system interface capability.

To further improve readiness and survivability, the USAFE Security Police staff and 377th Security Police Group have jointly established a ground defense readiness evaluation program, "Creek Defender." It gives USAFE units with a ground defense mission an opportunity to train and evaluate the collective skills critical to defending USAFE assets.

—USAF photo by MSgt. Patrick Nugent

USAFE's Third Air Force, headquartered at RAF Mildenhall, United Kingdom, boasts among its assets the A-10 (top left), F-16 (top right), and F-15 (bottom). USAFE is the air component of US European Command and a key element of NATO.

Renovating and repairing USAFE's medical facilities was a high priority in 1989. More than $10 million was spent to upgrade the structural integrity of the command's medical facilities, expand them, and enhance their efficiency. This included completely renovating four clinics. More than $28 million in additional medical military construction projects were in progress in 1989.

All medical facilities have been electronically networked to allow instant transfer of patient information, improving access and timeliness of care. By year's end, all facilities will be automated.

As Europe changes in the 1990s, USAFE's challenge will be to tailor its forces to meet NATO's dynamic needs. ■

Seventeenth Air Force (USAFE)

Headquarters, Sembach AB, West Germany

Commander
Maj. Gen. James E. Chambers

65th Air Division
Lindsey AB, West Germany

52d Tactical Fighter Wing
Spangdahlem AB, West Germany
(F-4G, F-16C/D)

66th Electronic Combat Wing
Sembach AB, West Germany
(EF-111A stationed at RAF Upper Heyford, UK; EC-130H)

601st Tactical Control Wing
Sembach AB, West Germany
(Command, control, and communications)

26th Tactical Reconnaissance Wing
Zweibrücken AB, West Germany
(RF-4, C-23)

36th Tactical Fighter Wing
Bitburg AB, West Germany
(F-15C/D)

38th Tactical Fighter Wing
Wueschheim AB, West Germany
(BGM-109G GLCM)

50th Tactical Fighter Wing
Hahn AB, West Germany
(F-16C/D)

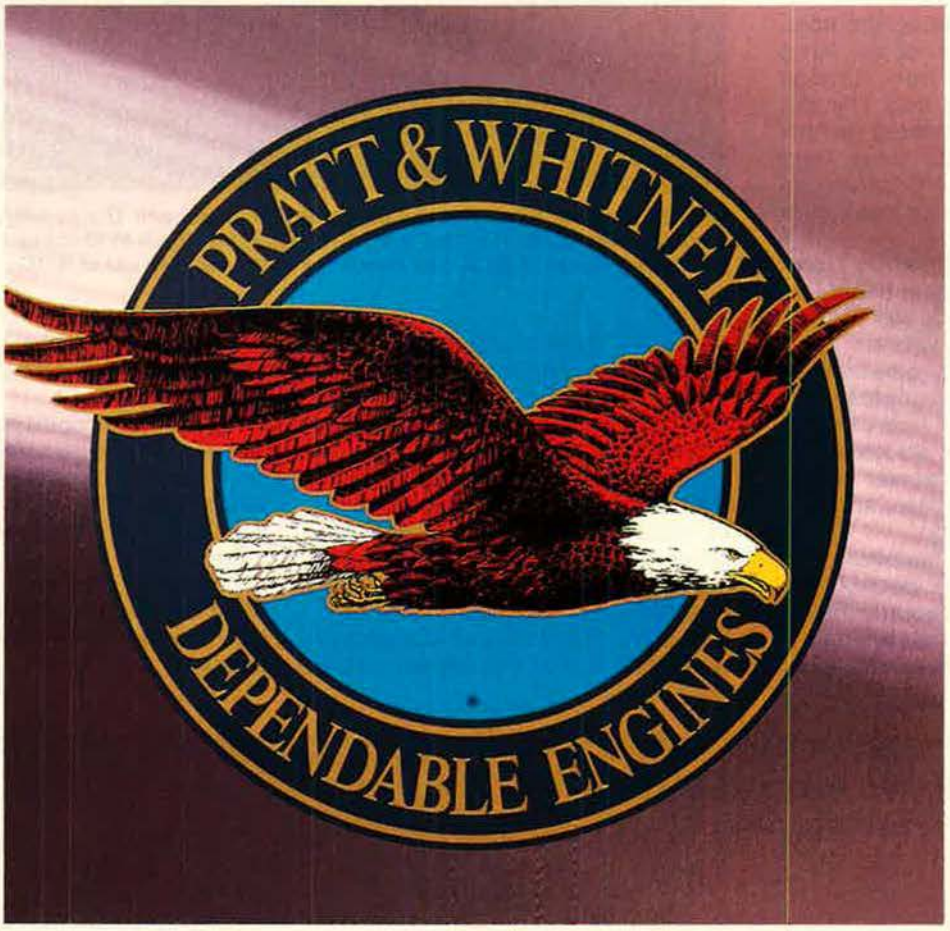
7100th Combat Support Wing
Lindsey AB, West Germany
(7100th CSW Regional Medical Center; collocated operating bases; munitions support squadrons; command, control, and communications)

32d Tactical Fighter Squadron
Soesterberg AB, The Netherlands
(F-15C/D)

316th Air Division
Ramstein AB, West Germany

86th Tactical Fighter Wing
Ramstein AB, West Germany
(F-16C/D)

377th Combat Support Wing
Ramstein AB, West Germany
(Support)



What exactly is a 'single-engine mentality'?
Here's the way we see it . . .

We make every engine as if it's the only one you've got.

And that's true for every single engine we make.

You told us what you need to keep America strong.
We read you loud and clear.

UNITED TECHNOLOGIES
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The 1990 USAF Almanac
Reports from the SOAs

Air Force Accounting and Finance Center

THE Air Force Accounting and Finance Center (AFAFC), located in Denver, Colo., is the home office for Air Force financial operations worldwide.

AFAFC pays all Air Force military members—active duty, retired, Air National Guard, Air Force Reserve, and annuitants—and accounts for all money appropriated to the Air Force, reporting to Congress and government financial managers on the use of these funds.

AFAFC pays more than 750,000 active, Guard, and Reserve personnel from combined appropriations totaling more than $21 billion. Retired Pay Operations pays more than $7.6 billion to 564,662 retirees and 44,573 annuitants under the Survivor Benefit Plan. AFAFC accounts for more than $127 billion, controls more than 60,000 reports, and processes more than 6,000,000 disbursement and collection vouchers annually. To handle this tremendous work load, the center employs 2,473 highly trained, dedicated military and civilian personnel.

In an effort to help the Army standardize its military pay system, the Directorate of Military Pay Operations established the Joint Service Software Program. The Army will essentially use the Air Force pay system to compute military pay and entitlements for its 1.5 million active-duty, Guard, and Reserve members. The system provides reduced operational costs and improved service.

Design continues on a centralized pay system for Air Force civilians and for those non-USAF civilians currently paid by the Air Force. The present system is complex and labor-intensive. Significant manpower savings will occur under the more efficient, centralized method. Worldwide implementation is scheduled for completion in September 1991.

The Base Level Accounting and Reporting System (BLARS) program will replace the current Air Force base-level accounting systems and provide an integrated financial management system. Phase I, the requirements-gathering process, was completed last November. Phase II will provide the Air Force with a standard, general, ledger-based, document-driven system with single-source entry of financial information.

As the executive agent for security assistance accounting, AFAFC is responsible for overall financial management of the total DoD Foreign Military Sales (FMS) program, consisting of about 17,500 active cases valued at nearly $156.4 billion. The center is developing the Security Assistance Central Accounting System (SACAS), which will be the central DoD system, to link each of the services. AFAFC is also developing the Case Management Control System (CMCS), which will better manage, control, and support the Air Force portion of the FMS program.

Air Force retirees enjoy customer service at 124 bases worldwide and toll-free telephone assistance from anywhere in the United States. The Directorate of Retired Pay is currently pursuing a voice response system to enhance the current toll-free telephone service.

AFAFC's worldwide financial network relies on its state-of-the-art Computer Operations Center (COC). A new COC, to be built adjacent to AFAFC, is in the planning stages and will provide spacious upgraded facilities that will allow the center's data automation role to grow. ■

Air Force Audit Agency

THE Air Force Audit Agency (AFAA), headquartered at Norton AFB, Calif., provides all levels of Air Force management with independent, objective, and constructive evaluations of managerial responsibilities (financial, operational, and support). Reports of audit indicate the effectiveness, efficiency, and economy of Air Force program management.

The Auditor General of the Air Force, John W. Boddie, reports directly to the Secretary of the Air Force. This enables AFAA to assess independently the activities and functions it audits.

The Auditor General, the Deputy Auditor General, and the staff directorates—Operations (AFAA/DO) and Resource Management (AFAA/RM)—are located at Norton AFB, Calif. The Auditor General maintains liaison with Hq. USAF and other governmental agencies in the Washington, D. C.,

area through an Associate Auditor General in the Pentagon (SAF/AGA).

AFAA's line operations were realigned as of July 1, 1988. Installation-level audit offices are now defined along major command lines rather than along geographic lines.

- *The Acquisition and Logistics Audit Directorate* (AFAA/QL), located at Wright-Patterson AFB, Ohio, directs the development and management of multisite audits relating to supply, maintenance, acquisitions/logistics, computer systems, transportation, and weapon systems. AFAA/QL is also responsible for the Systems Audit Region (AFAA/QLQ) at Andrews AFB, Md., and the Logistics Audit Region (AFAA/QLL) at Wright-Patterson.
- *The Financial and Support Audit Directorate* (AFAA/FS), located at Norton AFB, Calif., directs the development and management of audits relating to financial management; personnel; support services; command, control, communications, and computer systems; and morale, welfare, and recreation. Its finance and security assistance systems division is located at Lowry AFB, Colo. Its Training Audit Region (AFAA/FST) is headquartered at Randolph AFB, Tex.
- *The Field Activities Directorate* (AFAA/FD), located at Norton AFB, manages installation-level audit work at forty-eight area audit offices (AAOs). Supervision of forty-seven of the AAOs is exercised through five regions established along major command organizational lines. These regions are Tactical Audit Region, Langley AFB, Va. (twelve AAOs); Strategic Audit Region, Offutt AFB, Neb. (twelve AAOs); Airlift Audit Region, Scott AFB, Ill. (eight AAOs); European Audit Region, Ramstein AB, West Germany (nine AAOs); and Pacific Audit Region, Hickam AFB, Hawaii (six AAOs). The AAO at Air Force Space Command, Peterson AFB, Colo., reports directly to the Deputy Assistant Auditor General, Field Activities.

AFAA employs approximately 950 people and has a civilian/military ratio of three to one. Of the 817 auditors, ninety-seven percent have at least one college degree and forty percent have graduate degrees. Twenty-four percent of the auditors are also certified public accountants, certified internal auditors, and/or certified information system auditors. ■

Air Force Commissary Service

SAVINGS, top-quality service, and a wide selection of products remain the top priorities at the Air Force Commissary Service (AFCOMS).

AFCOMS continues to provide prices twenty-five percent lower than those offered at commercial grocery stores. The 1989 DoD Joint Services Triennial Commissary Pricing Survey shows an average savings of twenty-six percent after the commissary surcharge.

Special sales throughout the year left more money in the pockets of AFCOMS shoppers. A new sale for 1989 was February's "Doing Good Things for People" promotion, which generated more than $125,000 in vendor donations for morale, welfare, and recreation programs. Such innovations continue to place commissaries at the top of quality-of-life issues. Surveys of USAF personnel still rate commissaries as the second most valued benefit, after medical care.

A new concept called the "minicomm," which expands shopping by fifteen to twenty hours per week, is being tested in several locations. Mini-comms stay open for extended hours with minimum staffing. The net result: an extra service to patrons with a minimal increase in operating costs.

Four new commissaries opened in Fiscal 1989, built using surcharge funds at a cost of more than $37 million. The new stores are at Brooks AFB, Tex., Kirtland AFB, N. M., La Junta AFS, Colo., and Wilder AFS, Idaho. Eighty-one new facilities have been opened since 1976—the equivalent of one new commissary built every two months.

Seven bases will receive new commissaries during Fiscal 1990. Two have already opened—Lajes Field in the Azores and Bitburg AB in West Germany. Bolling AFB, D. C., Castle AFB, Calif., RAF Menwith Hill, UK, Camp Kinser, Japan, and Wurtsmith AFB, Mich., are also scheduled to open new stores.

Automation of all commissaries is almost complete. Scanning is operational in most stores. Inventory tracking through the Automated Commissary Operations System is helping commissary managers keep items in stock. The Commissary Automated Management Network is continuing to provide real-time communications among the headquarters, regions, and stores.

While the operation of more than 145 commissaries worldwide is

Basic trainees at Lackland AFB, Tex., line up for a meal. The Air Force Commissary Service's primary mission is to provide food for troops wherever and whenever they need it, whether on the battlefield or in the dining hall.

AFCOMS's most visible role, the command's primary mission is much different. AFCOMS is charged with getting food and supplies to troops in both war and peace. This means supplying dining halls and providing battlefield Meals, Ready-to-Eat, more commonly known as MREs, to Air Force members worldwide.

AFCOMS also operates Tactical Field Exchanges during exercises and in wartime. The TFEs, run under agreement with the Army/Air Force Exchange Service, provide basic personal care items to troops in the field.

The Strategic Planning Steering Group sets the command's strategic direction and oversees the implementation of plans that will carry AFCOMS into the 1990s. The "Year of the Customer" kicks off this decade. ■

Air Force Engineering and Services Center

THE Air Force Engineering and Services Center (AFESC), Tyndall AFB, Fla., is an extension of the Air Staff and a focal point for many of the Air Force's engineering and services responsibilities.

AFESC provides guidance and assistance to major commands, bases, and other federal agencies in the following areas of day-to-day operations: fire protection, readiness and contingency operations, facility energy issues, facility operations and maintenance, unaccompanied transient and permanent party housing, food service, and mortuary affairs.

The center also manages a number of long-range programs: a large research and development effort into environmental quality, fire suppression, aerospace facilities, and rapid runway repair; construction cost management of facilities; and the Air Force privatization program.

Finally, the center is the focal point for the information management systems used by all civil engineering and services activities.

In 1989, AFESC accomplished the following:

- Successfully completed action on Real Property Outleasing projects for visitors' quarters at Wright-Patterson AFB, Ohio, and Nellis AFB, Nev., and on military family housing units at Carswell AFB, Tex.
- Took advantage of the current natural gas "bubble," which has lowered utility prices, to increase USAF's annual utility savings to more than $20.1 million.
- Implemented the Heating, Ventilating, and Air Conditioning Training and Preacceptance Inspection Program with on-site training provided to twenty-two bases.
- Developed and fielded a computer-based model designed to teach rapid runway repair and enhance the resource-allocation skills of the crater crew chief.
- Developed a full-scale sodium sulfide/ferrous sulfate metals treatment process for Tinker AFB, Okla. This process, which has been patented and is now being licensed for commercial use, is expected to save the Air Force up to $655,000 per year in hazardous waste disposal costs incurred at electroplating shops.
- Provided an environmentally acceptable fire training pit that permits the use of fuel-fed training fires while avoiding the contamination of soil and groundwater by fuel and other wastes. This will save millions of dollars in cleanup costs to comply with the Installation Restoration Program.
- Completed full-scale development of folded fiberglass mat crater covers for the Rapid Runway Repair (RRR) Program and initiated central purchase of training mats.
- Conducted thirty-three weeks of base recovery after attack and force-beddown training at the Air Base Combat Support Training Complex, Detachment 2, AFESC, Eglin AFB, Fla. These fourteen courses provided the only integrated wartime training in the CONUS to 9,250 engineering, services, disaster preparedness, explosive ordnance disposal, and commissary personnel. The detachment also hosted Readiness Challenge, an annual worldwide engineering and services contingency skills competition designed to promote frequent, high-quality, home station readiness training. ■

Air Force Inspection and Safety Center

THE Air Force Inspection and Safety Center (AFISC), headquartered at Norton AFB, Calif., is responsible for USAF-wide management of readiness, resources, and safety. Maj. Gen. Alexander K. Davidson commands AFISC and is also the USAF Deputy Inspector General for Inspection and Safety.

The center comprises a command section and four directorates. The command section provides legal, computer, manpower, personnel, budget, supply, administrative, historical, graphics, and public affairs support.

Two Air Reserve Force advisors on the commander's staff represent the Air National Guard and the Air Force Reserve. The Flight Records Management Branch is the USAF custodian for active-duty, Air National Guard, and Reserve individual flight records dating from 1911.

- *The Directorate of Inspection* assists the Inspector General of the Air Force in inquiring into and reporting on the discipline, efficiency, and economy of the Air Force. Directorate personnel examine and analyze USAF operational readiness and mission capability, leadership, resource management, and systems management effectiveness. The directorate accomplishes its mission through a variety of inspections. The directorate also conducts the worldwide inspection school.
- *The Directorate of Aerospace Safety* is the Air Force manager for flight, ground, missile, explosives, space, and systems safety programs.

The directorate provides guidance and monitors the implementation and effectiveness of mishap prevention programs. This includes administering the investigation and reporting of mishaps to determine their cause and corrections. The directorate also designs, plans, and develops resources for professional safety education programs, including university-level safety courses, and publishes *Flying Safety* and *Road and Rec* magazines. The directorate also maintains the only "crash laboratory" for analyzing aircraft accidents.

• *The Directorate of Nuclear Surety* operates as Detachment 1, AFISC, at Kirtland AFB, N. M. The directorate's responsibilities include managerial oversight of the Air Force Nuclear Weapons Surety Program to make it a top priority that nuclear surety is incorporated during all phases of design, operation, maintenance, modifications, and logistical movement. The directorate also maintains nuclear surety responsibility for terrestrial nuclear reactor systems and the review procedures concerning space nuclear power systems and space or missile use of radioactive material. Directorate personnel originate all 122-series Air Force regulations and publish the *USAF Nuclear Surety Journal* for dissemination to nuclear-capable units.

—USAF photo by Manuel Ruiz

The Air Force Inspection and Safety Center is responsible for the readiness and safety of USAF resources. At the Directorate of Aerospace Safety's "crash laboratory," where aircraft accidents are analyzed, AFISC's Bruce Gandee (left) and Col. Bruce Wood (right) examine critical engine parts of a crashed B-1.

• *The Directorate of Medical Inspection* plans and conducts Air Force health-services management inspections (HSMIs), Air Reserve Components health-services readiness inspections (HSRIs), and special investigations to ensure effective management of health-care resources and the readiness of Air Force medical units. In addition to the 350 functional areas inspected in each medical facility, special emphasis items selected by the Air Force Surgeon General are given close attention. ■

Air Force Intelligence Agency

UNDER the command of Brig. Gen. Billy J. Bingham, the Air Force Intelligence Agency (AFIA) reports directly to the Assistant Chief of Staff for Intelligence (ACS/I). AFIA provides the Air Staff with analysis and assessments in the application of all-source intelligence in support of the Air Staff and combatant commands.

More than 2,300 active-duty, reserve, and civilian intelligence professionals are stationed worldwide to collect, process, disseminate, and apply reliable, accurate, and timely intelligence for Air Force commanders during peace, war, and contingency situations.

Headquartered at Fort Belvoir, Va., AFIA is composed of ten directorates functionally aligned under Deputy Commanders for Assessments and Resources and the Air Force Special Activities Center.

Located at the Pentagon, Col. Storm C. Rhode III, Deputy Commander for Assessments, is responsible for estimative, targeting, and warning intelligence. The directorates within the deputate are Research and Soviet Studies, Threat and Technology, Warning and Regional Assessments, and Targets.

AFIA acts as the ACS/I's executive agent in the national intelligence process by developing Air Force positions in National Intelligence Estimates (NIEs), Defense Intelligence Projections for Planning (DIPPs), Air Force Planning Guide (AFPG), and a host of other finished intelligence assessments used by plans and operations staffs.

AFIA directorates work closely with Air Force System Command's Foreign Technology Division in determining the threat to Air Force weapon systems posed by current and projected foreign weapon systems. These estimates ensure that USAF weapon systems will be effective.

AFIA elements conduct the Global Awareness Program, hosting presentations at Bolling AFB, D. C., and throughout the world. Also at Bolling is the Directorate of Targets, the Hq. USAF executive agent for classical targeting functions and for influencing weapons research, development, and acquisition.

From the Pentagon, AFIA provides daily intelligence highlights to more than eighty organizations, including all four services, the Defense Intelligence Agency, the State Department, and the White House. The Secretary of the Air Force and the Chief of Staff receive AFIA intelligence briefings on a regular basis and special briefings as necessary.

Col. John H. Birkner, Deputy Commander for Resources, with elements at Bolling AFB and Fort Belvoir, is responsible for AFIA's intelligence-related support functions, including the Directorates of Security and Com-

munications Management, Intelligence Data Management, Personnel, Intelligence Reserve Forces, Attaché Affairs, and Joint Services Support.

AFIA sets policy and manages the worldwide Air Force Special Security Office and Sensitive Compartmented Information programs. AFIA also plans, develops, and manages all Air Force intelligence data-handling systems.

AFIA also centrally manages 1,400 intelligence reservists to support peacetime, wartime, and contingency requirements of twenty-six MAJCOMs and agencies. AFIA organizations also manage participation in the Defense Attaché program, DoD Code of Conduct training programs, and central control of Air Force human intelligence activities. ■

Air Force Legal Services Center

THE Air Force Legal Services Center (AFLSC), headquartered in Washington, D. C., helps provide complete civil and military legal services to USAF and its members around the world.

AFLSC provides specialized legal services in military justice, claims for and against the Air Force, tort litigation, legal assistance, and labor, environmental, acquisition, and preventive law. It also handles all Air Force patent, copyright, and other intellectual property matters, provides judges and counsel for courts-martial, and reviews trial results.

The Air Force Judge Advocate General serves in a dual role as Commander of AFLSC.

The Air Force Court of Military Review, a Directorate in AFLSC, reviews all courts-martial that result in a punitive discharge or confinement of one year or more.

The Judiciary Directorate in AFLSC has five divisions.

- *The Military Justice Division* prepares regulations and policy on military justice. The division advises the Judge Advocate General on petitions for new trial and other applications for relief and reviews general court-martial records not reviewed by the Court of Military Review.
- *The Trial Judiciary Division* oversees seven judiciary circuits, five in CONUS and two overseas.
- *The Defense Services Division* represents USAF members before the Court of Military Review, the Court of Military Appeals, and the Supreme Court.
- *The Government Trial and Appellate Counsel Division* represents the US before the Court of Military Review and the Court of Military Appeals and assists the Solicitor General in appeals to the Supreme Court.
- *The Clemency, Corrections, and Officer Review Division* prepares officer dismissal cases for Secretarial action. It recommends clemency in appropriate cases to the Secretary or the Judge Advocate General.

The Judge Advocate General's Civil Law Directorate consists of eight divisions, six of which are included in the Legal Services Center.

- *The Preventive Law and Legal Assistance Office* provides personal legal assistance to USAF personnel assigned to the Pentagon and metropolitan Washington, D. C., manages the Air Force preventive law and legal assistance programs, and advises the Air Staff on federal and state income tax issues affecting military interests.
- *The Claims and Tort Litigation Division* adjudicates aviation, environmental, medical malpractice, and general tort claims and defends lawsuits arising from such claims.
- *The Environmental Law Division* represents USAF in environmental, occupational safety and health, and land-use litigation.
- *The General Litigation Division* represents USAF in administrative proceedings and all civil litigation brought against USAF and its officials involving personnel actions, the Freedom of Information Act, the Privacy Act, taxes, utilities, and constitutional and personal torts.
- *The Contract Law Division* represents USAF in Federal Court litigation involving Air Force contracts.
- *The Patents Division* investigates and makes administrative decisions on patent and copyright claims of infringement against USAF and prepares and submits patent applications for USAF. ■

Air Force Management Engineering Agency

THE primary mission of the Air Force Management Engineering Agency (AFMEA) is to develop and maintain Air Force manpower standards to improve manpower utilization and assure the implementation of technical and procedural guidance for the Air Force Management Engineering Program. AFMEA manages USAF productivity programs, develops manpower programming tools, and provides data systems support for the MAJCOM manpower community.

AFMEA works with units and headquarters to apply the most progressive industrial engineering techniques available. The resulting manpower standards specify, by grade and skill, the number of people necessary to perform each unit's mission. The MEP also enables AFMEA and commanders to assess wartime manpower needs and develop models to help commanders determine what manpower will be required for wartime operations.

AFMEA administers major USAF productivity programs, which include the Air Force Suggestion Program, Fast Payback Capital Investment (FASCAP) Program, and Commercial Activities (A-76) Program. In FY 1989, the Suggestion Program saved taxpayers $175 million. Also in FY 1989, AFMEA directed the distribution of $14.6 million to help bases finance productivity improvements and provided technical guidance to MAJCOMs for the A-76 program, which

MODERNIZING INFORMATION PROCESSING.

We're integrating a significantly more efficient management information system for Air Force Pentagon operations. This Headquarters Systems Replacement Program will convert an installed base of 23 computer systems into one system using different hardware and software without interrupting service. HSRP will streamline budgeting, resource tracking, force structuring and administrative tasks. And its enhanced software will consolidate common system functions, provide easier access to information, and increase responsiveness. For more information, contact Grumman Data Systems, 6862 Elm Street, McLean VA, 22101. Or call (703) 556-7400.

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ZEUS is already in operational service in Harrier aircraft declared to NATO by the UK. In trials Royal Air Force commentators reported that the aircraft has the "most effective internal countermeasures suite – currently well ahead of any Western fighter aircraft, and probably the best in the world".*

What does this mean for F16 pilots? Good news.

ZEUS matches the latest F16 installation using existing antennas and cabling. ZEUS gives the F16 a fully integrated internal countermeasures suite. It is already in production and includes intelligent multi-mode, range denial, deception and repeater jammers. ZEUS has already proved its powers on US ranges. For the F16, it is a fully developed option.

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*'AIR CLUES' Journal of the RAF, September 1989

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eliminated 994 work-years and saved taxpayers $19 million.

AFMEA also manages the Air Force's officer/enlisted grade distribution; operates and maintains the Logistics Composite Model (LCOM); develops Transient and Holding Accounts factors for special Air Force manpower accounts; and provides automated support for facets of the manpower management community that involve management engineering and productivity programs.

From its headquarters at Randolph AFB, Tex., AFMEA directs eleven subordinate units throughout the US and provides assistance and technical guidance to command management engineering teams (CMETs) at nearly every Air Force base in the world. These eleven units include eight functional management engineering teams (FMETs) and three specialized units. The FMETs are responsible for using industrial engineering work measurement techniques to develop efficient organizations and manpower standards in functional areas common throughout USAF.

The FMETs include the Comptroller Management Engineering Team at Lowry AFB, Colo. (AFCOMPMET); Engineering and Services Management Engineering Team at Tyndall AFB, Fla. (AFESMET); Intelligence Management Engineering Team at Fort Belvoir, Va. (AFINTELMET); Medical Management Engineering Team at Maxwell AFB, Ala. (AFMEDMET); Manpower and Personnel Management Engineering Team at Randolph AFB, Tex. (AFMPMET); Special Staff Management Engineering Team at Peterson AFB, Colo. (AFSSMET); Security Police Management Engineering Team at Kirtland AFB, N. M. (AFSPMET); and Logistics Management Engineering Team at Dover AFB, Del. (AFLOGMET).

The specialized units are OLA at the Pentagon; the Air Force Wartime Manpower and Personnel Readiness Team (AFWMPRT) at Fort Ritchie, Md.; and the Joint Health-care Management Engineering Team (JHMET) at San Antonio, Tex.

AFMEA has an authorized strength of sixty-six officers, 129 enlisted, and 120 civilians. ■

Air Force Military Personnel Center

NEARLY 600,000 active-duty Air Force men and women worldwide are affected by the procedures and policies formulated and implemented at Air Force Military Personnel Center (AFMPC), located at Randolph AFB, Tex. In addition, AFMPC provides services to approximately 620,000 retired Air Force members and spouses of deceased Air Force people.

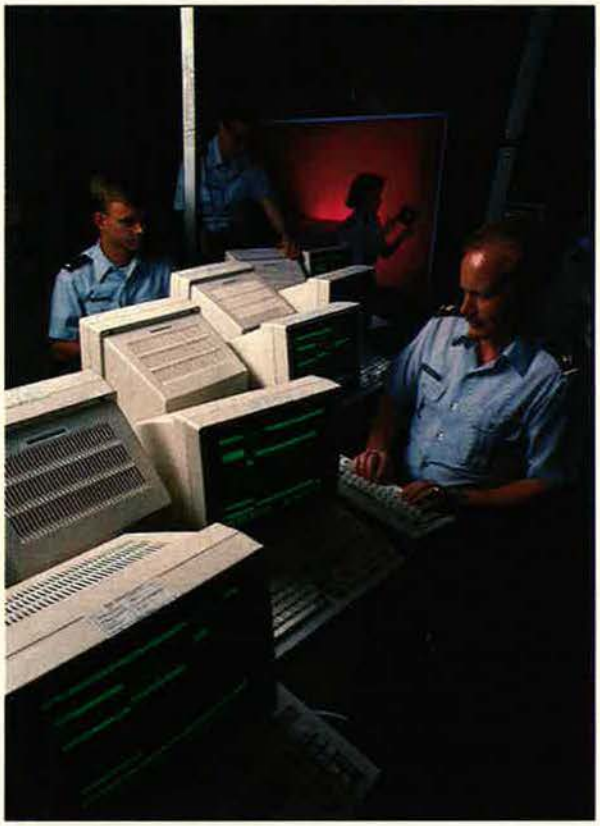
AFMPC puts personnel with the right skills in the right job at the right time to enable commanders to accomplish their missions. During contingency operations, AFMPC must respond quickly to meet wartime requirements. The Personnel Readiness Center coordinates personnel management activities during contingency operations.

AFMPC's military and civilian personnel balance the need to accommodate individual preferences and professional goals with the skill needs of commanders. Even before initial assignments are made, AFMPC works closely with the Air Force Recruiting Service and Air Training Command to acquire, classify, and train the numbers and types of personnel the Air Force needs.

AFMPC manages officer programs and conducts promotion boards. AFMPC also administers the Weighted Airman Promotion System (WAPS) and the Stripes for Exceptional Performers (STEP) program.

The Air Force Retention Division is responsible for officer and enlisted retention and reenlistment programs and policies, the Aviator Continuation Pay program, the Pilots' Electronic Bulletin Board, the Worldwide Personnel Issues and Retention Hotline, and the Career Airman Reenlistment Reservation System.

Military awards and decorations, quality force, line-of-duty determinations, USAF-level special trophies and recognition programs, dress and personal appearance programs, physical fitness programs, and Morale, Welfare, and Recreation activities are AFMPC's responsibilities as well. AFMPC also handles all separa-



—USAF photo by SMSgt. Bob Wickley

The Air Force Military Personnel Center's software engineers develop such computer software as PC-III, a system designed to provide units with instant access to personnel data. The system will be implemented at all bases during the next three years.

tions and retirements, administers survivor annuity programs, and is the focal point for retiree activities.

AFMPC develops, implements, and manages the officer and enlisted evaluation systems, directly affecting more than 650,000 active-duty, Guard, and Reserve officers and enlisted members. The Officer Evaluation System (OES) was implemented August 1, 1988. A revised enlisted evaluation system (EES) was phased in by grade beginning May 1, 1989.

AFMPC also provides operational guidance and long-range planning for 126 active-duty consolidated base personnel offices (CBPOs) worldwide. AFMPC is functional manager for more than 3,000 unit orderly rooms USAF-wide and is responsible for orderly room automation initiatives. One of those initiatives, Personnel Concepts III (PC-III), is designed to improve personnel support to commanders, staffs, and unit personnel. PC-III will be implemented at all bases during the next three years.

The Personnel Data System (PDS), developed and operated by AFMPC, supports active military and civilian, Reserve, and Guard through the personnel life cycle, from accession to retirement or separation.

One of AFMPC's most sensitive responsibilities is administering the Air Force Casualty Services Program. In addition to assisting families of active-duty and retired casualties, the center maintains contact with the families of 842 Air Force members unaccounted-for in the Southeast Asian conflict. ■

Air Force News Center

THE Air Force News Center (AFNEWS), headquartered at Kelly AFB, Tex., ensures that Air Force personnel everywhere are well informed. The center creates and furnishes public affairs products and services to Air Force people and their families worldwide through print, broadcast, film, and video media.

The center is commanded by Col. Paul F. Heye and reports directly to the Air Force Director of Public Affairs. AFNEWS has four mission elements: the Internal Information Directorate, the Army and Air Force Hometown News Service, the Air Force Broadcasting Service, and the Air Force Office of Youth Relations.

• *The Directorate of Internal Information* provides policy, products, and services to USAF people, their families, and to the general public through commanders and their public affairs representatives. Products include *Airman* Magazine, Air Force News Service, and the Air Force Policy Letter for Commanders.

This directorate oversees the base newspaper and base guide programs and originates the Air Force lithographs series. It also creates the Air Force Radio News releases and produces films and videos.

• *The Army and Air Force Hometown News Service* provides stories about newsworthy individuals to their hometown newspapers and other local media throughout the US. During 1989, more than 355,150 servicemen and -women were featured in 1.6 million releases to hometown newspapers.

The radio feature teams reached an additional 164 million listeners through 838 radio stations. The television feature teams conducted 768 interviews reaching 76.1 million households. Print-feature teams interviewed almost 2,000 servicemen and -women, whose stories were read by more than 36.8 million readers of civilian newspapers.

• *The Air Force Broadcasting Service* manages the Air Force functions of the Armed Forces Radio and Television Service, which is the world's largest radio-television network. AFBS operates 160 radio and television outlets in Alaska, Greenland, Europe, the Middle East, and the Pacific, reaching an audience of 250,000 military people and their families.

More than 600 airmen, soldiers, sailors, Marines, and civilian employees serve in the broadcast operation, bringing news, information, and entertainment to DoD people and their families around the world.

• *The Air Force Office of Youth Relations* is the liaison between USAF and thirty national youth organizations. It conducts special community relations activities to provide Air Force mission and career information to 35 million of the nation's youth.

AFNEWS provides its elements with administration, resources, communications, and computer support. The center also provides budget, manpower, and logistics support to the Chicago, Los Angeles, and New York City regional public affairs offices.

The same support is also given to the Air Force Orientation Group at Gentile AFS, Ohio. AFOG designs, builds, transports, and displays exhibits nationwide to inform Americans about the Air Force and its people, equipment, and national contributions.

AFNEWS operates with a staff of 822 military and 231 civilians. ■

Air Force Office of Medical Support

THE Air Force Office of Medical Support (AFOMS) has its headquarters at Brooks AFB, Tex. Its Commander serves on the staff of the Surgeon General, USAF, as the Director of Health-Care Support.

The Air Force Office of Medical Support assists the Air Force Surgeon General in developing programs, policies, and practices relating to Air Force health care in peace and war. The office is organized into the Directorate of Health-Care Support and Professional Affairs Activities.

The Directorate of Health-Care Support develops plans, programs, and management guidance through four divisions.

• *The Patient Administration Division* develops and implements plans to manage medical administrative functions for patient administration, ambulatory services, managed health care, and medical records.

• *The Health Facilities Division* serves as a consultant for medical design, construction, and maintenance.

• *The Medical Service Information Systems Division* monitors the development, acquisition, installation, and application of computer-based medical information handling and retrieval systems.

• *The Medical Logistics Division* develops plans and policies concerning medical materiel, supply and equipment, biomedical equipment maintenance repair, facility management, and service contracts.

Professional Affairs Activities consist of two programs and one committee, each assisting the Surgeon General in its particular area of expertise.

• *The Health Promotion Program* provides policy and guidance to major command and medical treatment facility program coordinators by disseminating health information.

• *The Family Advocacy Program* manages, monitors, and coordinates policy and guidance for the Air Force Exceptional Family Member Program (EFMP) and the Air Force Child and Spouse Abuse Program.

• *The USAF Radioisotope Committee* coordinates administrative and regulatory aspects of licensing, possession, use, storage, handling, and disposal of all radioactive material used by the Air Force.

AFOMS is directly involved on a daily basis with the Air Force Surgeon General, other Air Staff directorates, major commands, and other federal agencies in support of health-care operational policies and practices. ■

Air Force Office of Security Police

THE Air Force Office of Security Police (AFOSP) was activated September 1, 1979, at Kirtland AFB, N. M. Air Force Chief of Security Police Brig. Gen. Frank K. Martin is also the Assistant Inspector General for Security. He has a staff of eighty-seven at Kirtland and forty-five at the Air Force Security Clearance Office in Rosslyn, Va.

AFOSP sets Air Force policies for physical security, law enforcement, air base ground defense, information security, and small-arms training and maintenance. The agency plans and directs programs for 48,000 active-duty, reserve component, and civilian and contract security police and combat-arms training and maintenance personnel.

Programs also include prisoner correction and rehabilitation, acquisition and development of security police systems and equipment, personnel security, security education, and the classification and safeguarding of information in the interest of national security. The agency also manages DoD's Military Working Dog Program.

During 1989, the AFOSP staff accomplished the following:

• Expanded the capabilities of Contingency Security Elements (CSEs) through enhanced detection and weapon systems. CSEs are highly trained, thirteen-member, quick-reaction squads that can deploy worldwide to provide base security support.

• Assisted in and guided the development of the security aspects for the Weapons Storage and Security System (WS^3) and Kirtland Underground Munitions Storage Complex. The WS^3 employs underground vaults to protect munitions in hardened aircraft shelters overseas. Both initiatives will provide better protection and survivability of munitions and reduce security manpower requirements.

• Authorized the purchase of portable explosive detectors for anti-terrorism and other security programs to augment the use of military working dogs.

• Coordinated explosive-detector military working dog team support to the US Secret Service, State Department, and other federal agencies. Teams from major commands and

—Staff photo by Guy Aceto

Air base security and ground defense is an important part of the mission of the Air Force Office of Security Police. Here, a Security Policeman stands guard at K. I. Sawyer AFB, Mich.

sister services filled more than 600 requests to help ensure the safety of the President, the Vice President, their immediate families, the Secretary of State, and foreign dignitaries. AFOSP also plays a critical role in the use of military working dogs for drug interdiction.

• Tested and fielded an automated visitor-control system that decreases visitor processing time by eighty-five percent and enhances security at Air Force installations.

• Tested a new rifle training program at fourteen bases to evaluate its effectiveness in providing combat-oriented weapons skills to Air Force members.

• Produced a video, "Continuing Evaluation for Trustworthiness," to educate Air Force members on their responsibility to report behavioral changes that could affect an individual's continued eligibility for a security clearance.

• Conducted the ninth annual Air Force Security Police worldwide competition, Peacekeeper Challenge. Seventeen teams from the major commands, Air National Guard, Air Force Reserve, and Britain's Royal Air Force Regiment competed in combat-related events. ■

Air Force Office of Special Investigations

THE Air Force Office of Special Investigations (AFOSI) has been the Air Force's major investigative service since August 1, 1948. Headquartered at Bolling AFB, D. C., its Commander is Brig. Gen. Francis R. Dillon.

AFOSI provides investigative and counterintelligence information and services to commanders USAF-wide. AFOSI seeks to identify and stop espionage, subversion, terrorism, sabotage, and other criminal activities that may threaten Air Force resources. AFOSI commanders work closely with local wing and base commanders to direct efforts to those commanders' priorities.

Local AFOSI detachments have a full range of on-call specialists and state-of-the-art techniques to assist them. Electronics, computer, forensic, and behavioral-science specialists routinely deploy worldwide to protect USAF people and resources. AFOSI's polygraph examiners provide valuable investigative support.

AFOSI has about 2,500 personnel, of whom two-thirds are special agents. Eighty-five percent of the special agents are military, and fifteen percent are civilian. AFOSI recruits, selects, and trains its own special agents, who come from almost every Air Force specialty. Each year, about 240 AFOSI people attend the Special Investigators course at the USAF Special Investigations Academy, located at Bolling AFB, D. C. More than 440 individual mobilization augmentees also provide a wealth of civilian experience through AFOSI's Reserve Program.

Fighting economic crime at all levels is a major AFOSI priority, with special emphasis on programs designed to detect high-dollar procurement fraud. AFOSI's six-year-old "Seven PROs" program assigns special agents to each of the Air Force's Plant Representative Offices and has resulted in more than $113 million for the Air Force in recoveries, savings, and fines. AFOSI also works closely with AFLC in investigating economic crimes involving the purchase of spare parts.

Hostile intelligence-gathering and terrorist threats directed against Air Force people and resources continue unabated. Major counterintelligence activity by AFOSI in 1989 included the following:

• Conducting 249 counterintelligence investigations concerning intelligence threats to USAF personnel.

• Presenting 4,157 defensive counterespionage awareness briefings to more than 184,000 USAF members.

• Providing AFOSI counterintelligence support to USAF elements involved with systems security, technology transfer, and operations security.

• Conducting some 400 Protective Service Operations for key USAF, Department of Defense, and other US government officials and foreign dignitaries.

Investigating such major crimes as drug trafficking, murder, theft, rape, and assault consumes the largest portion (forty-one percent) of AFOSI man-hours.

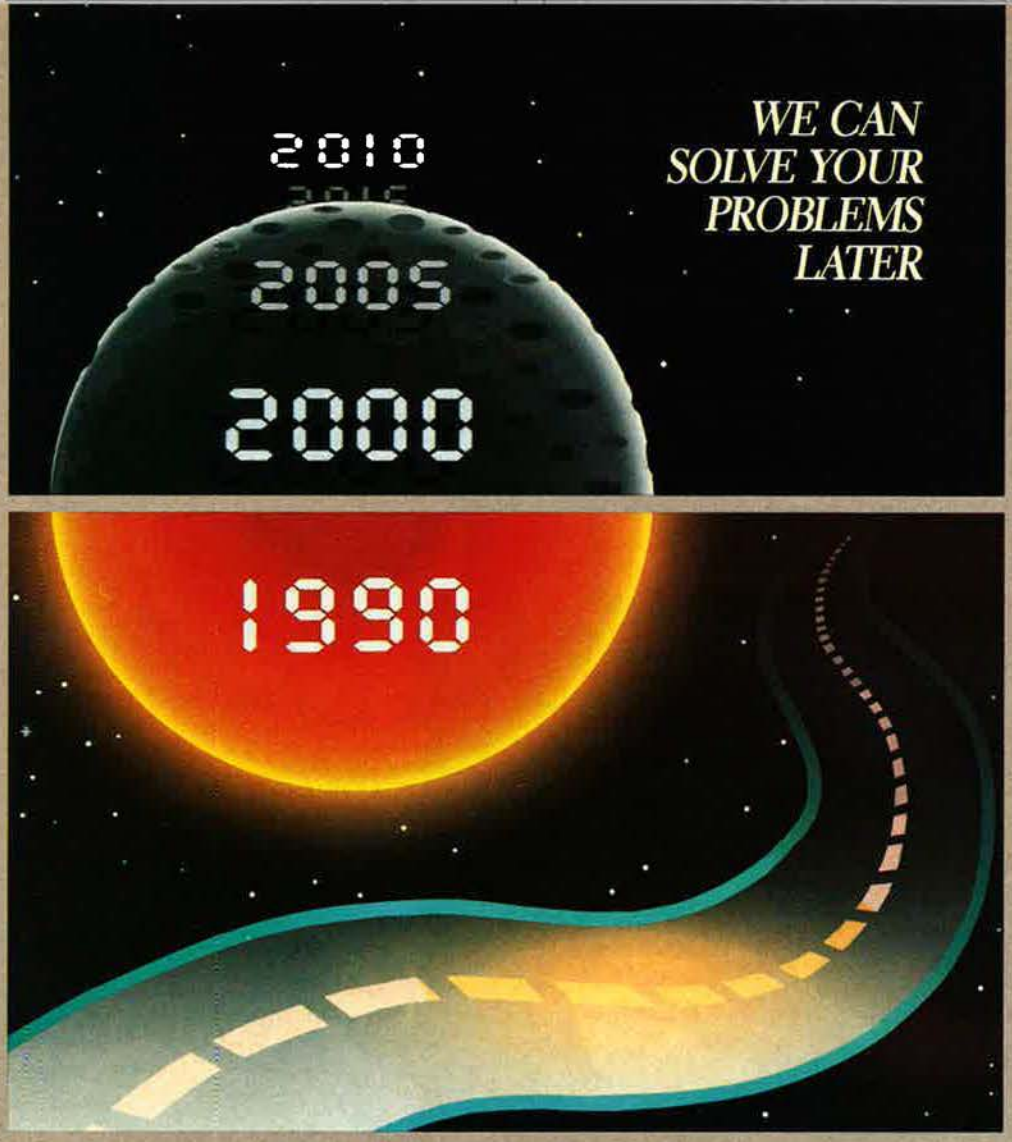
AFOSI's Narcotics and Contraband Smuggling Enforcement (NACSE) Program was developed to support DoD's role in the detection and monitoring of aerial and maritime narcotics smuggling into the US. NACSE focuses on drug smuggling as it involves DoD people and resources.

As a result of AFOSI criminal and fraud investigations, USAF recovered or saved nearly $62 million in assets in 1989 and assessed almost $197.2 million in fines. ■

Air Force Operational Test and Evaluation Center

THE Air Force Operational Test and Evaluation Center (AFOTEC) is the Air Force's independent test agency responsible for operational testing of new or modified weapon systems and components being developed for Air Force and multiservice use.

AFOTEC's Commander, Maj. Gen. Peter D. Robinson, reports directly to the Chief of Staff of the Air Force. The primary purpose of operational test and evaluation is to reduce risk in the acquisition process by determining how well systems perform when operated and maintained by USAF personnel in a realistic operational environment. The results from the center's tests are used at all levels of the Air Force and DoD to support program decisions that lead to the production and fielding of systems. The center's



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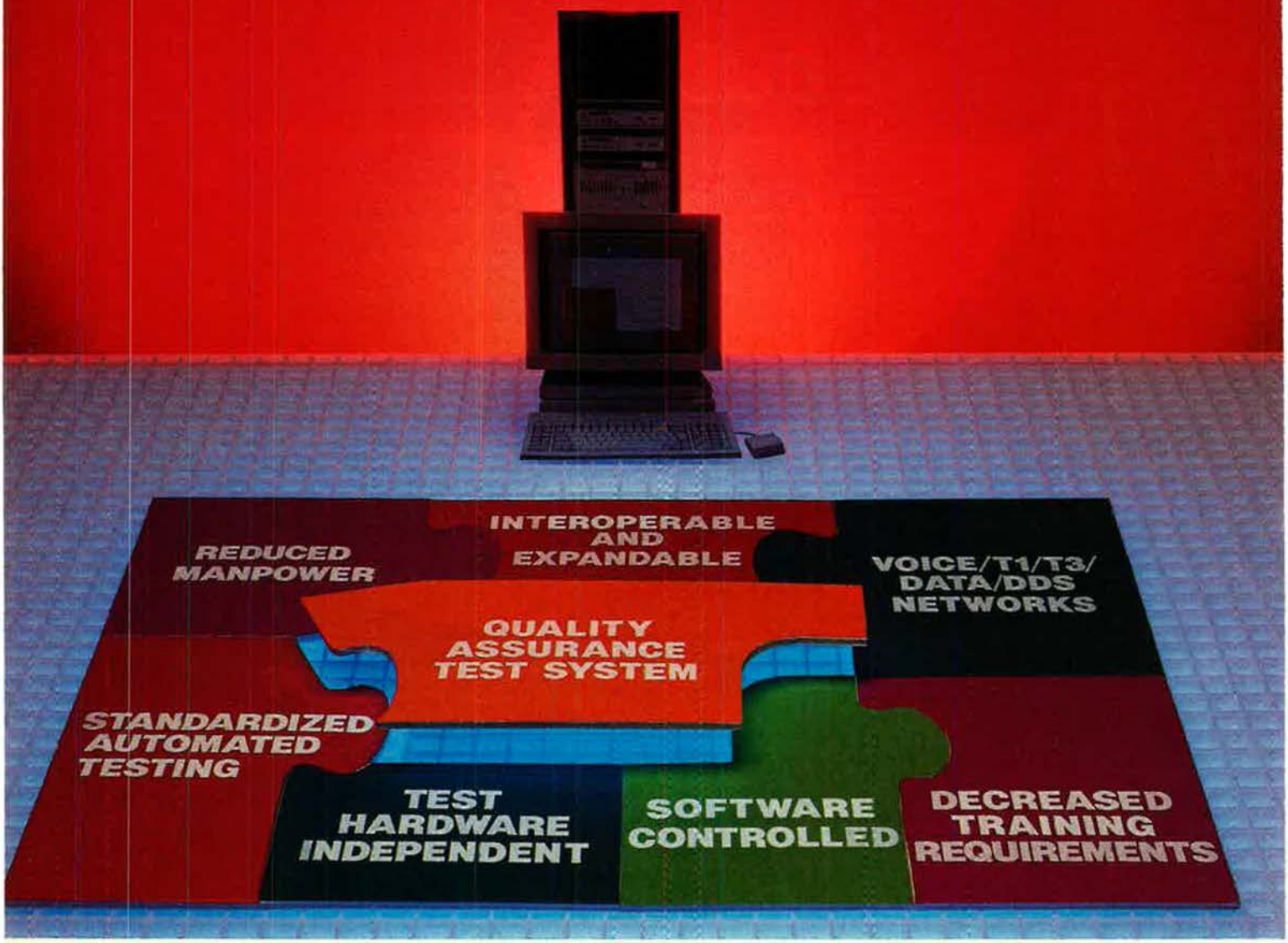

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The Air Force Operational Test and Evaluation Center performs operational tests of new or modified weapon systems being developed for USAF and the other services. Among recently tested systems is the AGM-130 rocket-powered glide bomb (above).

efforts focus on evaluating the operational effectiveness and suitability of the Air Force's future weapon systems and supporting equipment.

The center tests and evaluates equipment used over the entire spectrum of Air Force missions, including aircraft; strategic missiles; munitions; space systems; command, control, and communications systems; flight simulators; and intelligence systems. The center is currently conducting tests that involve the Over-the-Horizon Backscatter (OTH-B) radar program, the Advanced Medium-Range Air-to-Air Missile (AMRAAM), and the Consolidated Space Operations Center.

The center is also testing the High-Speed Antiradiation Missile (HARM), Short-Range Attack Missile (SRAM II), and simulator systems including the B-1B and F-15E weapon system trainers. The most recently completed tests include those on the Next-Generation Weather Radar program, the North Warning System, the Block 40 modifications to the F-16C, and the AGM-130.

The center has approximately 650 people assigned to its headquarters at Kirtland AFB, N. M., and at five detachments and two dozen test teams. The center has detachments at Eglin AFB, Fla., Nellis AFB, Nev., Edwards AFB, Calif., Peterson AFB, Colo., and Kapaun Administrative Annex, West Germany.

AFOTEC personnel form the management cadre for test programs, while the major commands supply the test teams with the majority of their evaluators. There are approximately 2,400 individuals under the center's operational control. The additional personnel provide current operational experience to ensure that the evaluation reflects the needs of the ultimate users of the system—operators, maintainers, and support and training specialists. By testing under operationally realistic conditions, the center ensures that the equipment will meet users' requirements and will be ready for operational use in accomplishing the Air Force mission. ■

Air Reserve Personnel Center

THE Air Reserve Personnel Center (ARPC) in Denver, Colo., provides personnel support for the mobilization and demobilization of more than 500,000 Air National Guard, Air Force Reserve, and retired members. ARPC's mission is to assist in the mobilization of the Air Reserve components, provide personnel support to individual members, and maintain their master personnel records.

ARPC has a staff of more than 750 military and civilian workers who provide support in assignments, promotions, discharges, retirements, career planning, school selections, orders, pay, airline tickets, veterans entitlements, Serviceman's Group Life Insurance, Defense Enrollment/Eligibility Report System, Reserve Component Survivor Benefit Plan, and a myriad of other personnel-assistance activities to reservists worldwide. ARPC is one of only two places in the world where Air Force officers are considered for promotion by central selection boards.

Accomplishments during 1989 included the graduation of the first class of the Excellence in Management Program for first-line supervisors. ARPC also helped to create a joint health and wellness center to treat minor civilian health problems and offer health-risk appraisals. ARPC received the Air Force Organizational Excellence Award.

As a result of extensive participation in Proud Eagle '90, ARPC employees are now in a better position to accomplish the center's mobilization mission than ever before. Another ARPC initiative during 1989 was a microfiche safety file, created to back up more than 300,000 master personnel records in case of a disaster at ARPC headquarters. Innovative programs scheduled for implementation in 1990 include a local area microcomputer network, conversion of microfiche records to optical disk, and education of the work force about Total Quality Management.

For the first time, ARPC tested the push-pull mobilization concept during the 1989 Individual Ready Reserve screening and recalled more than 3,200 IRR members with critical skills. ARPC assisted at four Air Training Command bases as members participated in mobilization processing, took skill-level tests, and received career-field update training.

ARPC's Consolidated Reserve Personnel Office is the largest base-level CBPO in the Air Force, serving nearly 14,000 individual mobilization augmentees (IMAs) and participating Individual Ready Reservists. Because IMAs train directly with the active-duty force, their CBPO functions are handled at ARPC.

The center also operates single-manager programs for nearly 1,800 medical, 1,060 legal, and 570 chaplain reserve personnel. ARPC also provides support to some 2,100 students working toward medical degrees under the Health Professions Scholarship Program and to nearly 270 chaplain candidates.

Since its inception in March 1954, ARPC has been called on to mobilize personnel of the Air Reserve components during three national emergencies—the Berlin crisis in 1961, the Cuban missile crisis in 1962, and the USS *Pueblo* incident in 1968. Today, continuing recall tests and exercises verify the effectiveness of ARPC mobilization procedures and ensure that the center can respond rapidly during any national emergency. ■

Air Force Reserve

An Air Force Reserve C-141 StarLifter from the 459th Military Airlift Wing, Andrews AFB, Md., flew relief supplies in January 1989 to Yerevan, Armenia, following an earthquake in Soviet Armenia. A Reserve C-5 Galaxy from the 433d MAW, Kelly AFB, Tex., flew the relief items to Turkey. The C-141 crew then flew the supplies to Armenia.

Air Force Reserve C-130 Hercules transports from the 913th Tactical Airlift Group, Willow Grove ARF, Pa., and the 928th TAG, O'Hare ARFF, Ill., flew relief missions after Northern California's massive earthquake in October. Assisted by ground crews from the 349th MAW (Associate), Travis AFB, Calif., they airlifted Navy Seabees and equipment to Treasure Island, Calif., to repair utilities and to NAS Alameda, Calif., to perform rapid runway repair.

Earlier, on the East Coast, Air Force Reserve weather reconnaissance WC-130s from the "Storm Trackers" of the 815th Weather Flight, Keesler AFB, Miss., were tracking Hurricane Hugo's course even before it hit the US.

After Hugo struck the Virgin Islands, reservists from the 302d Tactical Airlift Wing, Peterson AFB, Colo.; 403d TAW, Keesler AFB; 433d MAW, Kelly AFB.; 439th MAW, Westover AFB, Mass.; and 927th TAG, Selfridge ANGB, Mich., flew men, machines, and relief supplies to restore order and reduce suffering. Reserve crews from the 94th TAW, Dobbins AFB, Ga.; 919th Special Operations Group, Eglin Auxiliary Field 3, Fla.; 403d TAW; and 439th MAW flew supplies to Charleston, S. C., after it experienced its roughest storm this century.

The 301st ARRS (now ARS), Homestead AFB, Fla., reservists and those from squadrons at Selfridge ANGB, and at Portland IAP, Ore., rescued more than twenty-four stranded boat owners, pilots, mountain climbers, and hikers last year.

AFRES provided MAC with half of its combat-ready C-141 and C-5 aircrews, forty percent of its strategic airlift maintenance force, forty-seven percent of the aerial port force, nearly three-fourths of all MAC medical crews, half of all AC-130 Gunship crews, and almost a fourth of all Air Force C-130 tactical airlift crews.

Air Force Reserve aircrews played a vital part in relief operations after natural disasters struck on both coasts of the US and abroad last year. After the earthquake in northern California last fall, crews from the 315th Military Airlift Wing, a Reserve Associate unit (shown here), and its active-duty counterpart, the 437th MAW, delivered supplies to the area only weeks after their base at Charleston, S. C., was severely damaged by Hurricane Hugo.

AFRES continued to modernize its force with conversions of older to newer aircraft. At Homestead AFB, eighteen F-16A/B Fighting Falcons from the active-duty fighter squadron transferred to the Reserve's 482d TFW. At Youngstown MAP, Ohio, the 757th Tactical Airlift Squadron began converting six of its eight C-130Bs to C-130Hs.

AFRES's day-to-day support of USAF's mission averaged 134,000 hours in AFRES aircraft and almost 90,000 hours through the associate program in MAC- and SAC-owned aircraft.

Reservists from the 446th MAW, McChord AFB, Wash., posted the best US team showing and second place overall in MAC's Airlift Rodeo '89 at Pope AFB, N. C. Reservists from the 911th TAG, Pittsburgh IAP, Pa., took first in C-130 maintenance and post-flight inspection.

At Gunsmoke '89, the Air Force's worldwide gunnery meet, the 944th Tactical Fighter Group, Luke AFB, Ariz., finished second overall. An Air Force Reserve KC-135 crew from the 452d AREFW, March AFB, Calif., came in third at SAC's Proud Shield '89 bombing and navigation competition.

On the ground, Reserve security police nabbed second place in the grenade launching and third in the machine-gun event at Peacekeeper Challenge, the USAF-wide security police competition. ■

AIR FORCE RESERVE FLYING WINGS AND ASSIGNED UNITS

AIR FORCE	WING HQ.	GROUP	SQUADRON	TYPE AIRCRAFT	LOCATION	GAINING COMMAND
			71st SOS	HH-3E, CH-3E	Davis-Monthan AFB, Ariz.	MAC
		919th SOG	711th SOS	AC-130A	Eglin AFB, Fla. (Aux. 3)	MAC
		939th ARG	304th ARS	HC-130H/UH-1H, HH-3E/CH-3E	Portland IAP, Ore.	MAC
			301st ARS	HC-130H/N, HH-3E/CH-3E	Homestead AFB, Fla.	MAC
			305th ARS	HC-130H/N, HH-3E/CH-3E	Selfridge ANGB, Mich.	MAC
	349th MAW (Assoc)		301st MAS (Assoc)	C-5A/B	Travis AFB, Calif.	MAC
			312th MAS (Assoc)	C-5A/B	Travis AFB, Calif.	MAC
			708th MAS (Assoc)	C-141B	Travis AFB, Calif.	MAC
Fourth Air Force			710th MAS (Assoc)	C-141B	Travis AFB, Calif.	MAC
(Hq. McClellan	403d TAW		815th TAS	C-130E, WC-130E/H	Keesler AFB, Miss.	MAC
AFB, Calif.)		934th TAG	96th TAS	C-130E	Minneapolis-St. Paul IAP, Minn.*	MAC
Brig. Gen. James	433d MAW		68th MAS	C-5A	Kelly AFB, Tex.	MAC
E. Sherrard III	302d TAW		731st TAS	C-130B	Peterson AFB, Colo.	MAC
Commander		943d TAG	303d TAS	C-130B	March AFB, Calif.	MAC
	440th TAW		95th TAS	C-130H	General Mitchell IAP, Wis.*	MAC
		927th TAG	63d TAS	C-130E	Selfridge ANGB, Mich.	MAC
		928th TAG	64th TAS	C-130H	O'Hare ARFF, Ill.*	MAC
	445th MAW (Assoc)		728th MAS (Assoc)	C-141B	Norton AFB, Calif.	MAC
			729th MAS (Assoc)	C-141B	Norton AFB, Calif.	MAC
			730th MAS (Assoc)	C-141B	Norton AFB, Calif.	MAC
	446th MAW (Assoc)		97th MAS (Assoc)	C-141B	McChord AFB, Wash.	MAC
			313th MAS (Assoc)	C-141B	McChord AFB, Wash.	MAC
	301st TFW		457th TFS	F-4E	Carswell AFB, Tex.	TAC
		924th TFG	704th TFS	F-4E	Bergstrom AFB, Tex.	TAC
	419th TFW		466th TFS	F-16A/B	Hill AFB, Utah	TAC
		507th TFG	465th TFS	F-16A/B	Tinker AFB, Okla.	TAC
		944th TFG	302d TFS	F-16C/D	Luke AFB, Ariz.	TAC
	434th AREFW (H)		72d AREFS (H)	KC-135E	Grissom AFB, Ind.	SAC
Tenth Air Force		98th AREFG (H)	78th AREFS (H) (Assoc)	KC-10A	Barksdale AFB, La.	SAC
(Hq. Bergstrom AFB, Tex.)		916th AREFG (H)	77th AREFS (H) (Assoc)	KC-10A	Seymour Johnson AFB, N. C.	SAC
	442d TFW		303d TFS	A-10A	Richards-Gebaur AFB, Mo.*	TAC
Brig. Gen.		930th TFG	45th TFS	A-10A	Grissom AFB, Ind.	TAC
Robert A.	917th TFW		47th TFS	A-10A	Barksdale AFB, La.	TAC
McIntosh			46th TFTS	A-10A	Barksdale AFB, La.	TAC
Commander		926th TFG	706th TFS	A-10A	NAS New Orleans, La.	TAC
	452d AREFW (H)		336th AREFS (H)	KC-135E	March AFB, Calif.	SAC
			79th AREFS (H) (Assoc)	KC-10A	March AFB, Calif.	SAC
		940th AREFG (H)	314th AREFS (H)	KC-135E	Mather AFB, Calif.	SAC
	482d TFW		93d TFS	F-16A/B	Homestead AFB, Fla.	TAC
		906th TFG	89th TFS	F-16A/B	Wright-Patterson AFB, Ohio	TAC
		932d AAG (Assoc)	73d AAS (Assoc)	C-9A	Scott AFB, Ill.	MAC
	94th TAW		700th TAS	C-130H	Dobbins AFB, Ga.*	MAC
		908th TAG	357th TAS	C-130H	Maxwell AFB, Ala.	MAC
		910th TAG	757th TAS	C-130B	Youngstown MAP, Ohio*	MAC
	315th MAW (Assoc)		300th MAS (Assoc)	C-141B	Charleston AFB, S. C.	MAC
Fourteenth Air Force			701st MAS (Assoc)	C-141B	Charleston AFB, S. C.	MAC
			707th MAS (Assoc)	C-141B	Charleston AFB, S. C.	MAC
(Hq. Dobbins	439th MAW		337th MAS	C-5A	Westover AFB, Mass.*	MAC
AFB, Ga.)		911th TAG	758th TAS	C-130H	Greater Pittsburgh IAP, Pa.*	MAC
		914th TAG	328th TAS	C-130E	Niagara Falls IAP, N. Y.*	MAC
Brig. Gen. Dale	459th MAW		756th TAS	C-141B	Andrews AFB, Md.	MAC
R. Baumler		913th TAG	327th TAS	C-130E	Willow Grove ARFF, Pa.*	MAC
Commander		907th TAG	356th TAS	C-130E	Rickenbacker ANGB, Ohio	MAC
	512th MAW (Assoc)		326th MAS (Assoc)	C-5A	Dover AFB, Del.	MAC
			709th MAS (Assoc)	C-5A	Dover AFB, Del.	MAC
	514th MAW (Assoc)		335th MAS (Assoc)	C-141B	McGuire AFB, N. J.	MAC
			702d MAS (Assoc)	C-141B	McGuire AFB, N. J.	MAC
			732d MAS (Assoc)	C-141B	McGuire AFB, N. J.	MAC

AAG	**Aeromedical Airlift Group**	**ARG**	**Air Rescue Group**	**TAS**	**Tactical Airlift Squadron**
AAS	**Aeromedical Airlift Squadron**	**ARS**	**Air Rescue Squadron**	**TAW**	**Tactical Airlift Wing**
AREFG	**Air Refueling Group**	**MAS**	**Military Airlift Squadron**	**TFG**	**Tactical Fighter Group**
AREFS	**Air Refueling Squadron**	**MAW**	**Military Airlift Wing**	**TFS**	**Tactical Fighter Squadron**
AREFW	**Air Refueling Wing**	**SOG**	**Special Operations Group**	**TFTS**	**Tactical Fighter Training Squadron**
ARF	**Air Reserve Facility**	**SOS**	**Special Operations Squadron**	**TFW**	**Tactical Fighter Wing**
ARFF	**Air Reserve Forces Facility**	**TAG**	**Tactical Airlift Group**	*	**AFRES Base**

Air National Guard

With both a state and a federal mission, the Air National Guard (ANG) is unique among the Air Reserve components.

Air Guard units in a nonmobilized status are commanded by the governors of the fifty states, the Commonwealth of Puerto Rico, the Territories of Guam and the Virgin Islands, and the Commanding General of the District of Columbia. Each governor is represented in the state or territory chain of command by the adjutant general.

Units may be called to federal service by the President, Congress, or both, to enforce federal authority, to suppress insurrection, or in the national defense. During peacetime, ANG units are assigned to gaining USAF major commands, which provide advisory assistance and evaluate unit training, safety, and readiness programs.

Air Guard units from all mission areas participate annually in training deployments. Every day, somewhere in the world, ANG units are working alongside their active-duty counterparts. The Air Guard and Air Force Reserve (AFRES) share full-time responsibility for C-130 tactical airlift support throughout Central and South America. During Operation Just Cause, Guard aircraft and personnel on duty in Panama, plus State-side ANG C-141, C-5, and aerial port units, easily merged with active component forces in combat operations to protect American lives and restore Panama's democratic government.

Today the Air National Guard has 116,000 members and provides ninety-two percent of the fighter interceptor force, fifty-five percent of the tactical air support, fifty percent of the reconnaissance force, thirty-eight percent of the tactical airlift, thirty-three percent of the air rescue capability, twenty-four percent of the tactical fighters, nineteen percent of the air refueling capability, and six percent of the strategic airlift capability of the Total Air Force.

ANG F-15 and F-16 air defense units perform a twenty-four-hour alert mission along the coasts and borders of the US, with the Hawaiian F-15 unit responsible for the entire air defense of that state. Guard KC-135E tanker units also have crews and aircraft on round-the-clock alert in support of strategic defense requirements.

In 1990, several fighter units will convert to the F-16: the 127th Tactical Fighter Wing and the 191st Fighter Interceptor Group, Selfridge ANGB, Mich.; the 119th FIG, Fargo, N. D.; the 147th FIG, Ellington ANGB, Tex.; and the 148th FIG, Duluth, Minn. The 118th Tactical Airlift Wing, Nashville, Tenn., will be the eighth ANG unit to convert to the H model C-130. The Guard Air Rescue Groups, the 129th at NAS Moffett, Calif., and the 106th at Suffolk, N. Y., will convert from HH-3 to MH-60 Blackhawk helicopters. Also this year, the 210th Air Rescue Squadron will activate at Anchorage, Alaska, as part of the 176th Composite Group.

The first ANG unit to convert to the F-16 Fighting Falcon, South Carolina's 169th Tactical Fighter Group, was the Overall Top Team in the Air Force worldwide gunnery competition, Gunsmoke '89. Flying the oldest model F-16 in the meet, the 169th won over active-duty units from around the world, other Guard units, and Air Force Reserve participants.

Also in 1990, Air Guard people and equipment will continue to serve the nation in the air and on the ground as important components in America's counternarcotics program. ■

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Air National Guard units carry out both state and federal missions from air defense (at right, Montana ANG F-16s) to fire fighting (below, Wyoming ANG C-130s), working and training with their active-duty counterparts.

—Staff photo by Jeffrey P. Rhodes

THE AIR NATIONAL GUARD BY MAJOR COMMAND ASSIGNMENT

(As of January 1, 1990)

STRATEGIC AIR COMMAND

KC-135E Stratotanker

101st Air Refueling Wing	Bangor, Me.
126th Air Refueling Wing	Chicago, Ill.
141st Air Refueling Wing	Fairchild AFB, Wash.
171st Air Refueling Wing	Pittsburgh, Pa.
128th Air Refueling Group	Milwaukee, Wis.
134th Air Refueling Group	Knoxville, Tenn.
151st Air Refueling Group	Salt Lake City, Utah
157th Air Refueling Group	Pease AFB, N. H.
160th Air Refueling Group	Rickenbacker ANG Base, Ohio
161st Air Refueling Group	Phoenix, Ariz.
170th Air Refueling Group	McGuire AFB, N. J.
190th Air Refueling Group	Forbes Field, Kan.

TACTICAL AIR COMMAND

A-7D/K Corsair II

121st Tactical Fighter Wing	Rickenbacker ANG Base, Ohio
132d Tactical Fighter Wing	Des Moines, Iowa
140th Tactical Fighter Wing	Buckley ANG Base, Colo.
112th Tactical Fighter Group	Pittsburgh, Pa.
114th Tactical Fighter Group	Sioux Falls, S. D.
138th Tactical Fighter Group	Tulsa, Okla.
150th Tactical Fighter Group	Kirtland AFB, N. M.
156th Tactical Fighter Group	San Juan, Puerto Rico
162d Tactical Fighter Group[1]	Tucson, Ariz.
178th Tactical Fighter Group	Springfield, Ohio
180th Tactical Fighter Group	Toledo, Ohio
185th Tactical Fighter Group	Sioux City, Iowa
192d Tactical Fighter Group	Richmond, Va.

F-16A/B Fighting Falcon

113th Tactical Fighter Wing	Andrews AFB, Md.
127th Tactical Fighter Wing	Selfridge ANG Base, Mich.
174th Tactical Fighter Wing	Syracuse, N. Y.
149th Tactical Fighter Group	Kelly AFB, Tex.
169th Tactical Fighter Group	McEntire ANGB, S. C.
183d Tactical Fighter Group	Springfield, Ill.
184th Tactical Fighter Group[1]	McConnell AFB, Kan.
187th Tactical Fighter Group	Montgomery, Ala.
188th Tactical Fighter Group	Fort Smith, Ark.

A-10A Thunderbolt II

128th Tactical Fighter Wing	Truax ANG Base, Wis.
103d Tactical Fighter Group	Bradley ANG Base, Conn.
104th Tactical Fighter Group	Barnes ANG Base, Mass.
175th Tactical Fighter Group	Baltimore, Md.

F-4E Phantom

108th Tactical Fighter Wing	McGuire AFB, N. J.
122d Tactical Fighter Wing	Fort Wayne, Ind.
131st Tactical Fighter Wing	St. Louis, Mo.
163d Tactical Fighter Group	March AFB, Calif.
181st Tactical Fighter Group	Terre Haute, Ind.

RF-4C Phantom

117th Tactical Reconnaissance Wing	Birmingham, Ala.
124th Tactical Reconnaissance Group[2]	Boise, Idaho
152d Tactical Reconnaissance Group	Reno, Nev.
155th Tactical Reconnaissance Group	Lincoln, Neb.
186th Tactical Reconnaissance Group	Meridian, Miss.

OA-37B Dragonfly

110th Tactical Air Support Group	Battle Creek ANG Base, Mich.
182d Tactical Air Support Group	Peoria ANG Base, Ill.

OA-10A Thunderbolt II

111th Tactical Air Support Group	Willow Grove ARFF, Pa.

F-15A/B Eagle

116th Tactical Fighter Wing	Dobbins AFB, Ga.
159th Tactical Fighter Group	New Orleans, La.

AIR DEFENSE UNITS (TAC)

F-15A/B Eagle

102d Fighter Interceptor Wing	Otis ANG Base, Mass.
142d Fighter Interceptor Group	Portland, Ore.

F-16A/B Fighting Falcon

144th Fighter Interceptor Wing	Fresno, Calif.
107th Fighter Interceptor Group	Niagara Falls, N. Y.
119th Fighter Interceptor Group	Fargo, N. D.
120th Fighter Interceptor Group	Great Falls, Mont.
125th Fighter Interceptor Group	Jacksonville, Fla.
147th Fighter Interceptor Group	Ellington Field AGS, Tex.
148th Fighter Interceptor Group	Duluth, Minn.
158th Fighter Interceptor Group	Burlington, Vt.
177th Fighter Interceptor Group	Atlantic City, N. J.
191st Fighter Interceptor Group	Selfridge ANGB, Mich.

MILITARY AIRLIFT COMMAND

C-130 Hercules

118th Tactical Airlift Wing	Nashville, Tenn.
123d Tactical Airlift Wing	Louisville, Ky.
133d Tactical Airlift Wing	Minneapolis/St. Paul, Minn.
136th Tactical Airlift Wing	Dallas, Tex.
137th Tactical Airlift Wing	Oklahoma City, Okla.
146th Tactical Airlift Wing	Channel Island ANGB, Calif.
109th Tactical Airlift Group	Schenectady, N. Y.
130th Tactical Airlift Group	Charleston, W. Va.
135th Tactical Airlift Group	Baltimore, Md.
139th Tactical Airlift Group	St. Joseph, Mo.
143d Tactical Airlift Group	Quonset Point, R. I.
145th Tactical Airlift Group	Charlotte, N. C.
153d Tactical Airlift Group	Cheyenne, Wyo.
164th Tactical Airlift Group	Memphis, Tenn.
165th Tactical Airlift Group	Savannah Ga.
166th Tactical Airlift Group	Wilmington, Del.
167th Tactical Airlift Group	Martinsburg, W. Va.
176th Composite Group	Anchorage, Alaska
179th Tactical Airlift Group	Mansfield, Ohio
189th Tactical Airlift Group[3]	Little Rock, Ark.

HC-130 Hercules/MH-60G Blackhawk

106th Air Rescue Group	Suffolk, N. Y.
129th Air Rescue Group	NAS Moffett Field, Calif.

C-141B StarLifter

172d Military Aircraft Group	Jackson, Miss.

C-5A Galaxy

105th Military Airlift Group	Newburgh, N. Y.

EC-130E Hercules

193d Special Operations Group	Middletown, Pa.

PACIFIC AIR FORCES

F-15A/B Eagle

154th Composite Group	Hickam AFB, Hawaii

[1]Replacement Training Unit (RTU). The 162d TFG also serves as an RTU for the F-16 Fighting Falcon.
[2]Combat Crew Training Unit (CCTU).
[3]Aircrew CCTU.

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The 1990 USAF Almanac
Reports from the DRUs

Air Force Civilian Personnel Management Center

THE mission of the Air Force Civilian Personnel Management Center (AFCPMC) is to manage and operate Air Force civilian personnel data and information systems and career management, development, and placement programs. These programs and systems implement policies set forth by the Directorate of Civilian Personnel, Hq. USAF/DPC, and other authorities.

AFCPMC was established as a direct reporting unit of the Air Force Directorate of Civilian Personnel on January 1, 1986. Its forerunner, the Office of Civilian Personnel Operations, had been in existence at Randolph AFB, Tex., since July 1, 1976. The center is organized into two divisions: Career Management and Integrated Systems Management.

The Career Management Division helps identify civilian executive positions that need to be centrally managed for job referral and training. Its goal is to satisfy Air Force needs by providing a pool of career employees with strong skills in professional, technical, management, and administrative fields.

The Career Management Division also formulates and administers three recruitment programs to develop future civilian leaders in the Air Force. The Palace Acquire program is the occupational series used by the Air Force. The Palace Knight program recruits and trains scientists and engineers capable of assuming research and development leadership roles in the increasingly technical Air Force of the twenty-first century. The Copper Cap program recruits and trains individuals for contract management and oversight roles in the procurement process. The staff also conducts quality-of-work-life studies and performs research into performance appraisal and selection improvements. Additionally, the division acts as a liaison with the Air Staff in the development and administration of the Air Force civilian education and training budgets. It helps civilian personnel managers find the right school or course for employees' educational needs.

Eighteen career programs are now in effect, including Comptroller; Engineering and Services and Commissary; Historian; Public Affairs; Logistics; Manpower and Personnel, which includes Education, Technical Training, and Morale, Welfare, and Recreation; Contracting and Manufacturing; Information Systems; Safety, Security, and Special Investigations; Information Management; and Scientist and Engineer. Civilians involved in the programs can receive a combination of government, academic, and industry training. They have the opportunity to attend armed forces college programs and to participate in courses in executive development and may be selected for Education With Industry assignments.

The Integrated Systems Management Division is the Air Force's focal point for civilian personnel systems management. It oversees the civilian personnel systems management staff worldwide and keeps abreast of changing technology to plan and improve civilian personnel management support.

AFCPMC serves as a landmark organization for the Department of Defense and federal government commitment to effective and efficient personnel life-cycle management of the Air Force's valued civilian resources. ■

Air Force Cost Center

THE Air Force Cost Center (AFCSTC) is acknowledged as the "center of excellence" in cost and economic analysis. It was established to meet the requirements of public laws that mandate:

- Independent Cost Analyses (ICAs) on all major weapon system acquisition programs.
- Operations and support (O&S) cost reporting to Congress on all major weapon systems.

The center develops cost and planning factors that justify twenty-two percent of the Air Force budget. It leads the Air Force development, production, and O&S cost analysis program for all major Air Force acquisition programs. The center provides cost analysis expertise to the Air Force Cost Analysis Improvement

Group, Air Force System Acquisition Review Council, and Air Force Board Panels. The center also develops, validates, and distributes new cost analysis tools and methods for use USAF-wide.

The AFCSTC has three divisions: Acquisition, Operations and Support, and Resources Management.

• *The Acquisition Division* has become the principal lead in the Air Force's Independent Cost Analysis Program for major weapon systems and major automated information systems. Every major command and Air Force activity involved in these major systems receives guidance and support from the Acquisition Division. This division is deeply involved with the cost issues associated with the research, development, and production of new weapon systems. It is concerned with how to improve USAF's capability to estimate the costs of future weapon systems in an environment that is rapidly changing with the emergence of new and advanced technologies, coupled with an environment of significant fiscal constraints.

• *The Operations and Support Division* develops and publishes Air Force Cost and Planning Factors that affect more than $20 billion of the Air Force's annual budget. It is responsible for developing and updating the Systematic Approach to Better Long-Range Estimate (SABLE) model. This model is a critical analytical tool used by program managers to forecast the price impact of proposed force structure alternatives. In addition, the Operations and Support Division updates, maintains, and enhances O&S cost models for use by the Air Staff, major commands, and other USAF units. It also manages the Air Force portion of DoD's Visibility and Management of Operations and Support Costs (VAMOSC) project. The division's analysts perform cost studies to support the Air Force Board Structure. These studies include major weapon system acquisition or modification programs, force-mix studies, and base-realignment studies.

• *The Resources Management Division* is responsible for the computer and communications support of the AFCSTC and provides worldwide connectivity through the Cost Bulletin Board and Defense Data Network (DDN) host interface. DDN access is achieved through a local DDN host computer or through a local Terminal Access Controller (TAC). On-line cost consulting service is available through the Cost Bulletin Board or the AFCSTC's DDN host computer. ■

Air Force District of Washington

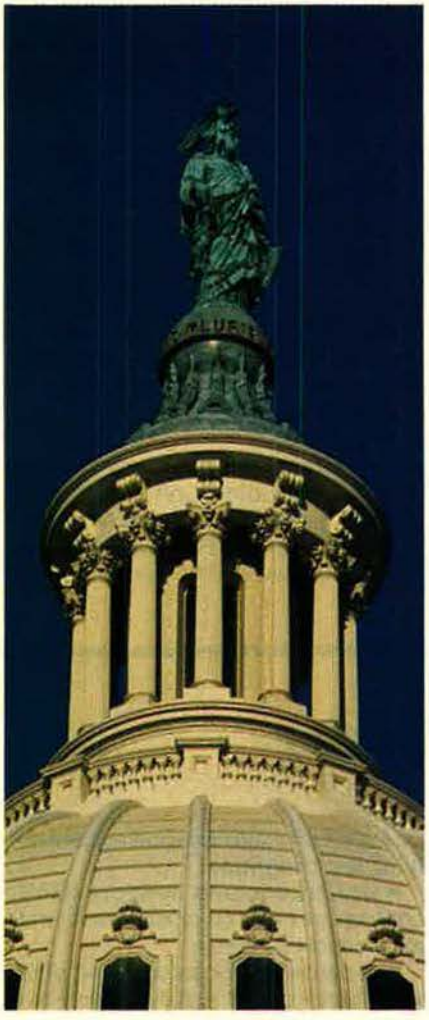
THE Air Force District of Washington (AFDW) is the single manager for support of Air Force activities in the National Capital Region, which includes Washington, D. C., and vicinity. Although its headquarters is located at historic Bolling AFB, D. C., AFDW covers a much broader area. Subordinate units, detachments, and operating locations are at the Pentagon, Andrews AFB, Md., and Fort Meade, Md.

Two major units form the majority of AFDW: the 1100th Air Base Group (ABG) and the 1100th National Capital Region Support Group (NCR SPTG).

The 1100th ABG is the host unit for Bolling AFB. It has the squadrons and support agencies usually found at the base level. These support functions serve numerous tenant units at Bolling, such as the Air Force Office of Scientific Research, Hq. Air Force Office of Special Investigations, and the Defense Intelligence Analysis Center. The Surgeon General, the Office of Air Force History, and the Chief of Chaplains are among Bolling's Air Staff tenants.

The 1100th NCR SPTG has many personnel activities, including command personnel, education office programs, and military personnel offices at Bolling, Fort Meade, and the Pentagon.

The 1100th NCR SPTG also contains the AFDW plans and operations branch. This includes a diverse group



—Staff photo by Guy Acelo

of responsibilities, such as engineering services, audiovisual production for the Air Staff, and management of more than 800 Pentagon parking spaces and 1,500,000 square feet of leased building space.

Contracting and financial services for all Air Force activities in the Washington area are provided by two 1100th NCR SPTG organizations—the 1100th Contracting Squadron and the AFDW Accounting and Finance Office. With more than 46,000 military and civilian customers, the latter constitutes the Air Force's largest base-level accounting and finance office.

The AFDW is responsible for Air Force ceremonial events in the nation's capital. Two of its most visible ambassadors are the US Air Force Honor Guard and the US Air Force Band, both based at Bolling.

The Honor Guard represents the Air Force at arrival and departure ceremonies for visiting dignitaries at the White House, the Pentagon, and Andrews AFB. It also participates in military funerals at Arlington National Cemetery and in memorial ceremonies at the Tomb of the Unknowns. The Honor Guard Drill Team, an elite component, performs around the country.

Some of the nation's best musicians make up the Air Force Band. Its varied components, including the Concert Band, String Orchestra,

Singing Sergeants, Airmen of Note jazz ensemble, Spectrum pop band, and Ceremonial Brass, provide music that is acclaimed around the world.

AFDW has a "Drug Free" program that has appeared at National Capital Region schools and has expanded to larger national performance arenas. This program emphasizes Air Force concern over drug abuse and features performances by the Honor Guard's drill team and by Spectrum. ■

USAF Historical Research Center

THE USAF Historical Research Center is the repository for Air Force historical documents. The center's collection, begun in Washington, D. C., during World War II, moved to Maxwell AFB, Ala., in 1949. It comprises more than 60,000,000 pages devoted to the history of the service and constitutes the largest and most valuable organized collection of documents on US military aviation in the world.

In 1979, the center became a direct reporting unit of the Air Force, receiving technical direction and guidance from the Chief, Office of Air Force History. It is collocated with the Air University Library and provides research facilities for professional military education students, faculty, and visiting scholars.

More than eighty-five percent of the center's pre-1955 holdings are declassified. Almost the entire collection is recorded on 16-mm microfilm, with copies deposited at the National Archives and Record Administration, Washington, D. C., and the Office of Air Force History, Bolling AFB, D. C.

Center holdings consist largely of periodic unit histories prepared by the major commands, numbered air forces, and other subordinate organizations. These histories provide comprehensive coverage of Air Force activities beginning in 1942, when the President authorized the program. Extensive primary source material is attached to the histories, greatly enhancing their value.

Special collections complement the unit histories. Among them are historical monographs, end-of-tour reports, joint and combined command documents, aircraft record cards, and materials from the US Army, British Air Ministry, and German Air Force. The center also houses the personal papers of key retired Air Force leaders and a substantial collection of their oral history interviews. About 6,000 acquisitions of documents and collections of all types are recorded annually.

In 1974, the center adopted automated data processing as a finding aid and began in 1980 to enter abstracts of its documents into a computer. The Inferential Retrieval Index System, or IRIS, became operational in 1983 when the center acquired an IBM 4341 computer. IRIS became accessible in 1987.

The center's main functions include the following:

- Reference. The center maintains documents and microfilm, assists visiting researchers, produces bibliographies, collects personal papers, reviews records for possible downrating or declassification, and provides other reference services to users.
- Research. Center personnel answer requests for historical information; write books and papers; prepare lineage and honors of Air Force units; maintain records of the Air Force seal and flag, records of unit and establishment emblems and flags, and records of Air Force organizations; verify aerial victory credits; and perform various other research and teaching services.
- Oral History. The center conducts oral history interviews and provides a training course for oral historians.
- Technical Services. The center processes, catalogs, abstracts, indexes, and microfilms documents for accessioning into the collection and entry into the IRIS database. ■

Air Force Technical Applications Center

THE Air Force Technical Applications Center (AFTAC) operates and maintains the US Atomic Energy Detection System (USAEDS). This worldwide system has operations in more than thirty-five countries. In operating USAEDS, AFTAC is responsible for detecting events in the atmosphere, underwater, underground, and in space; determining if such events are nuclear; and reporting the events to national command authorities through Hq. USAF.

Specific responsibilities assigned to AFTAC include implementing Safeguard (d) of the 1963 Limited Test-Ban Treaty and monitoring the Threshold Test-Ban Treaty of 1974 and the Peaceful Nuclear Explosions Treaty of 1976. AFTAC also supports the On-Site Inspection Agency in verifying compliance with the Intermediate-range Nuclear Forces (INF) Treaty.

AFTAC conducts an active research and development program to contribute to the nation's ability to monitor international test-ban agreements. Because of its capabilities, from time to time AFTAC is also tasked with unique missions in response to world events.

AFTAC was responsible for tracking debris from the Soviet reactor accident at Chernobyl in 1986. The center worked closely with the Environmental Protection Agency, the Federal Aviation Administration, and other executive agencies to document the radiological health hazard to Americans overseas and at home.

To accomplish its mission, AFTAC has approximately 1,400 men and women operating and maintaining a worldwide system of satellite, electromagnetic pulse, hydroacoustic, seismic, laboratory, sampling, and airborne operations facilities.

AFTAC headquarters at Patrick AFB, Fla., includes a complex of operations centers to monitor the USAEDS network and receive data twenty-four hours a day. These centers are primarily responsible for the detection and identification of nuclear events occurring anywhere in the world.

To manage the USAEDS, AFTAC

has three intermediate headquarters units that supervise and support the center's eleven detachments, six operating locations, and approximately seventy equipment locations.

The largest subordinate is the Technical Operations Division at McClellan AFB, Calif. This major complex contains the McClellan Central Laboratory (the central analysis facility of USAEDS) and a centralized logistics depot for the engineering, maintenance, and provisioning of the USAEDS network. In addition, an airborne operations directorate provides airborne special equipment operators for the USAEDS mission.

Hq. Pacific Technical Operations Area, located at Wheeler AFB, Hawaii, and Hq. European Technical Operations Area at Lindsey AB, West Germany, provide logistics and administrative support to subordinate activities in their geographic areas.

AFTAC's people possess a wide range of technical expertise, and many hold advanced degrees in chemistry, physics, nuclear engineering, and electrical engineering. Complementing an impressive scientific capability is an experienced and talented operational force of skilled, handpicked technicians. ■

United States Air Force Academy

THE mission of the US Air Force Academy is "to provide instruction and experience to all cadets so they graduate with knowledge and character essential to leadership and motivation to become career officers in the US Air Force." The Academy stands on an 18,000-acre site in the foothills of the Rocky Mountains near Colorado Springs, Colo.

Air Force Academy cadets take four years of academic studies leading to a bachelor of science degree. They also take professional military training to earn regular commissions in the US Air Force. When cadets enter the Academy, they agree to serve four years as cadets and, upon graduation, to serve five years or longer as active-duty Air Force officers, depending on their career fields. While they are at the Academy, the cadets are provided food, housing, and medical care. In addition, they receive a monthly salary to pay for uniforms, textbooks, and personal expenses.

In 1947, with the establishment of a separate Air Force, the issue of educating Air Force professionals became crucial. In 1949, the Secretary of Defense appointed a service academy board to study the need for another academy. Colorado Springs was selected to be its site.

Congress authorized creation of the Air Force Academy in 1954. The first class of 306 cadets entered temporary facilities at Lowry AFB, near Denver, in July 1955. The cadet wing moved into its permanent home in August 1958. Nine months later, 207 cadets graduated.

In 1964, President Lyndon B. Johnson signed legislation that increased the Academy's strength from 2,529 cadets to its present size of 4,417. Women first entered the Academy in 1976, graduating with the class of 1980.

The four-year program of instruction averages 167 semester hours and consists of military training, academics, athletics, and character development.

—Staff photo by Guy Aceto

The demonstration of leadership is a key part of a cadet's life at the Air Force Academy, whether in the classroom or on the athletic fields. The Academy's 4,400 cadets are encouraged to participate in sports as part of a well-rounded education. Here, quarterback Dee Dowis calls the next play at the Air Force–Navy game last fall.

Academics includes studies in the basic sciences, engineering, the humanities, and the social sciences. Within this framework, all cadets complete a core curriculum with a balance from these four areas. They also select additional courses in one or more available majors. Cadets may visit other Air Force or government installations to participate in various research projects. Cadets can compete with students from other universities for fellowships and scholarships.

The Cadet Honor Code is the centerpiece of moral and ethical development. Cadets pledge: "We will not lie, steal, or cheat, nor tolerate among us anyone who does." All cadets take a formal course in ethics and receive honor and ethics instruction. They are encouraged to participate in voluntary religious services and programs offered at the Academy.

Candidates for appointment to the Academy must be citizens of the United States, at least seventeen but not yet twenty-two years old on July 1 of the year of entry, unmarried with no legal dependents, and of good moral character. They must also pass qualifying medical examinations, the candidate fitness test, and college entrance examinations to qualify for appointment.

Full information, including preparation and admission procedures, can be obtained from the Director of Admissions, US Air Force Academy, Colo. 80840-5651. ■

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Guide to Major Air Force Installations Worldwide

Altus AFB, Okla. 73523-5000; within Altus city limits. Phone (405) 482-8100; AUTOVON 866-1110. MAC base. 443d Military Airlift Wing (Training); 340th Air Refueling Wing (SAC); 2002d Communications Sqdn. (AFCC); Field Training Det. 403; 71st Flying Training Wing, OLK ACE Det. (ATC), T-37 aircraft operations; Det. 4, 17th Weather Sqdn.; Det. 3, 1600th Management Engineering Sqdn.; Det. 4, 1365th Audiovisual Sqdn. Base activated Jan. 1943; inactivated May 1945; reactivated Jan. 1953. Area 3,582 acres, plus 818 leased. Altitude 1,376 ft. Military 3,404; civilians 816; approx. 200–300 TDY students (officer and enlisted) in training per month. Payroll $120.1 million. Housing: 143 officer; 657 NCO; 251 VAQ, 158 VOQ, 11 transient family units. 20-bed hospital.

Andersen AFB, Guam, APO San Francisco 96334-5000; 2 mi. N of Yigo. Phone: AUTOVON 322-1110. PACAF base. Host unit 633d Air Base Wing; 43d Bomb Wing (SAC), heavy bomber and tanker operations with B-52G and KC-135 aircraft; 27th Communications Sqdn. (AFCC); 605th Military Airlift Support Sqdn. (MAC). Base also supports Joint Typhoon Warning Center, Northwest Field, and Andersen South housing area. 43d BMW is SAC's only B-52 unit outside the CONUS. (B-52s at Andersen are scheduled to be deactivated in June 1990.) Mission is conventional bombing, sea surveillance, and antiship operations. Andersen serves as a vital refueling point for aircraft operating in the Pacific and is home for the Pacific Tanker Task Force. Base activated late 1944; named for Gen. James Foy Andersen, lost at sea between Kwajalein and Hawaii Feb. 26, 1946. General Andersen was the Chief of Staff, Headquarters Army Air Forces, Pacific Ocean Areas. Area: 20,504 acres. Altitude: 612 ft. Military 3,449; civilians 674. Payroll $81.2 million. Housing: 210 officer; 1,541 civilian. Clinic.

Andrews AFB, Md. 20331-5000; 11 mi. SE of Washington, D. C. Phone (301) 981-9111; AUTOVON 858-1110. MAC base. Hq. Air Force Systems Command (AFSC) provides aerospace systems, equipment, and initial spare parts for the Air Force's operational and support commands. 1776th Air Base Wing; 89th Military Airlift Wing; 113th Tactical Fighter Wing (ANG); 459th Military Airlift Wing (AFRES); 2045th Communications Gp. (AFCC); 1361st Audiovisual Sqdn.; Naval Air Facility; Marine Aircraft Gp. 41, Det. A. Base activated May 1943; named for Lt. Gen. Frank M. Andrews, military air pioneer and WW II commander of the European theater, killed in aircraft accident May 3, 1943, in Iceland. Area 4,982 acres (including easements). Altitude 281 ft. Military 10,112; civilians 4,624. Payroll $329.5 million. Housing: 387 officer; 1,695 NCO; 210 mobile home spaces; 482 transient (incl. 68 temporary living quarters for incoming personnel, 79 DV suites, 223 VOQ, 112 TAQ). 320-bed hospital.

Arnold AFB, Tenn. 37389; approx. 7 mi. SE of Manchester. Phone (615) 454-3000; AUTOVON 340-5011. AFSC base. Site of Arnold Engineering Development Center, free world's largest complex of wind tunnels, jet and rocket engine test cells, space simulation chambers, and hyperballistic ranges. AEDC supports the acquisition of new aerospace systems by conducting research, development, and evaluation testing for USAF, other services, and government agencies. Base dedicated June 1, 1950; named for Gen. H. H. "Hap" Arnold, wartime Chief of the AAF. Area 40,118 acres. Altitude 1,100 ft. Military 146; civilians 258; contractor employees 3,688. Payroll $166.8 million. Housing: 24 officer; 16 NCO; 45 transient. Medical aid station.

Aviano AB, Italy, APO New York 09292-5000; adjacent to Aviano, 50 mi N of Venice, Italy. Phone (commercial, from CONUS) 011-39-434-651141; AUTOVON 632-1110. USAFE base. 40th Tactical Gp. manages this USAFE main operating base in support of USAFE and NATO. Although no aircraft are permanently assigned, host unit would exercise command and control of a variety of deployed weapon systems in case of a war in Europe. It also provides administrative and logistical support to 48 off-base units at 31 locations throughout Italy. Aviano is the only USAF tactical air base in Italy. This and its strategic location give the base special importance to NATO's southern flank. Originally an Italian flying school, which opened in 1939; 40th Tactical Gp. began operation in Apr. 1966. Area 1,140 acres. Altitude 319 ft. Military 2,500; civilians 500. Payroll $74.6 million. No on-base or government-leased housing. 665 billeting spaces. Clinic.

Barksdale AFB, La. 71110-5000; in Bossier City. Phone (318) 456-2252; AUTOVON 781-1110. SAC base. Hq. 8th Air Force; 2d Bomb Wing, B-52G, KC-135, and KC-10 aircraft operations; 1st Electronic Combat Range Gp.; 46th Communications Gp. (AFCC); Det. 1, 307th Civil Engineering Sqdn. RED HORSE (AFRES); Det. 1, 14th Flying Training Wing (ATC), T-37 aircraft operations; Det. 5, 3904th Management Engineering Sqdn.; 26th Weather Sqdn. (MAC); Det. 3, 1401st Military Airlift Sqdn. (MAC), C-21 aircraft operations; 49th Test Sqdn.; 3097th Aviation Depot Sqdn. (AFLC); Det. 2, 4200th Test Sqdn.; Det. 1, 3903d School Sqdn. (SAC NCO Academy); 745th Air Force Band Sqdn.; 78th Air Refueling Sqdn. (AFRES), KC-10 aircraft operations; 917th Tactical Fighter Wing (AFRES), A-10 operations; Det. 1, 1360th Aerospace Audiovisual Sqdn. (MAC). Also home of the 8th Air Force Museum. The 917th TFW trains all ANG and AFRES pilots in the 46th Tactical Fighter Training Sqdn. Base activated Feb. 2, 1933; named for Lt. Eugene H. Barksdale, WW I airman killed Aug. 1926 in crash near Wright Field, Ohio. Area 22,000 acres (20,000 acres reserved for recreation). Altitude 166 ft. Military 7,000; civilians 1,207. Payroll $145.3 million. Housing: 205 officer; 828 NCO; 29 transient. 70-bed hospital.

Beale AFB, Calif. 95903-5000; 13 mi. E of Marysville. Phone (916) 634-3000; AUTOVON 368-1110. SAC base. 14th Air Div.; 9th Strategic Recon Wing; 7th Missile Warning Sqdn. (AFSPACECOM); 1883d Communications Sqdn. (AFCC). Aircraft include U-2/TR-1 reconnaissance aircraft, KC-135 Stratotankers, and T-38 Talon trainers. Originally US Army's Camp Beale. Became Air Force installation Apr. 1948; became AFB Nov. 1951. Named for Brig. Gen. E. F. Beale, Indian agent in California prior to Civil War. Area 22,944 acres. Altitude 113 ft. Military 4,142; civilians 500. Payroll $146.6 million. Housing: 211 officer; 1,501 NCO; 127 transient. 25-bed hospital.

Bergstrom AFB, Tex. 78743-5002; 7 mi. SE of downtown Austin. Phone (512) 479-4100; AUTOVON 685-1110. TAC base. 67th Tactical Reconnaissance Wing, RF-4C reconnaissance operations; Hq. 12th Air Force; Hq. 10th Air Force (AFRES); 924th Tactical Fighter Gp. (AFRES), F-4E fighter operations; TAC NCO Academy West; 602d Tactical Air Control Gp.; Det. 67, 4400th Management Engineering Sqdn.; Det. 12, Tactical Communications Div. Base activated Sept. 22, 1942; named for Capt. John A. E. Bergstrom, first Austin serviceman killed in WW II, who died Dec. 8, 1941, at Clark Field, Philippines. Area 3,999 acres. Altitude 541 ft. Military 4,951; civilians 1,728. Payroll $142.3 million. Housing: 76 officer; 644 enlisted; 190 transient (81 VOQ, 68 VAQ, 41 TLF). 30-bed hospital.

Bitburg AB, W. Germany, APO New York 09132-5000; 15 mi. N of Trier, W. Germany. Phone (commercial, from CONUS) 011-49-6561-61-1110; AUTOVON 453-1110. USAFE base. 36th TFW with three fighter squadrons flying F-15C/D Eagle aircraft. Base activated in 1952. Area 1,236 acres. Altitude 1,228 ft. Military 5,978; civilians 1,535. Payroll $112 million. Housing: 75 officer; 1,128 NCO; 62 transient. 40-bed hospital.

Bolling AFB, D. C. 20332-5000; 3 mi. S of US Capitol. Phone (202) 545-6700; AUTOVON 227-0101. Air Force District of Washington. 1100th Air Base Gp.; US Air Force Honor Guard; US Air Force Band; Air Force Office of Scientific Research (AFSC); Air Force Chief of Chaplains; Air Force Surgeon General; Air Force Office of History; Hq. Air Force Office of Special Investigations. Activated Oct. 1917; named for Col. Raynal C. Bolling, first high-ranking Air Service officer killed in WW I. Area 604 acres. Military 2,800; civilians 1,000. Payroll $112 million. Housing: 405 officer; 990 NCO; 257 transient. Clinic.

Brooks AFB, Tex. 78235; in SE San Antonio. Phone (512) 536-1110; AUTOVON 240-1110. AFSC base. Human Systems Div.; USAF School of Aerospace Medicine (AFSC); Air Force Occupational and Environmental Lab (AFSC); Air Force Drug Testing Lab (AFSC); Air Force Human Resources Lab (AFSC); 6570th Air Base Gp. Tenant units include 6575th School Sqdn. (Systems Acquisition School); Air Force Office of Medical Support; Hq. AFSC Det. 20, Directorate of Professional Development; 2199th Communications Sqdn. (AFCC); Det. 26, 6592d Management Engineering Sqdn.; 8906th Electronic Security Sqdn. (ESC). Base activated Dec. 8, 1917; named for Cadet Sidney J. Brooks, Jr., killed Nov. 13, 1917, on his commissioning flight. Area 1,310 acres. Altitude 600 ft. Military 1,483; civilians 1,343. Payroll $86 million. Housing: 70 officer; 100 NCO; 8 transient. Clinic.

Cannon AFB, N. M. 88103-5000; 7 mi. W of Clovis. Phone (505) 784-3311; AUTOVON 681-1110. TAC base. 27th Tactical Fighter Wing, F-111D fighter operations. Base activated Aug. 1942; named for Gen. John K. Cannon, WW II commander of all Allied air forces in the Mediterranean theater and former commander, Tactical Air Command. Area 25,663 acres. Altitude 4,295 ft. Military 3,650; civilians 782. Payroll $116 million. Housing: 149 officer; 862 enlisted; 81 transient (20 VAQ, 30 VOQ, 31 TLF). 40-bed hospital.

Carswell AFB, Tex. 76127-5000; 7 mi. WNW of downtown Fort Worth. Phone (817) 782-5000; AUTOVON 739-1110. SAC base. 7th Bomb Wing (SAC); 301st Tactical Fighter Wing (AFRES); 436th Strategic Training Sqdn. (SAC); 2048th Communications Sqdn. (AFCC); USAF Central Notice to Airman (NOTAM) Facility (AFSC); Det. 1, 1365th Audiovisual Sqdn. (MAC); Det. 7, USAF Global Weather Central (MAC); Det. 415, 3751st Field Training Sqdn. (MAC); aircraft include B-52s, KC-135s, and AFRES F-4s. T-37 Accelerated Copilot Enrichment Program. Base activated Aug. 1942; named Jan. 30, 1948, for Maj. Horace S. Carswell, Jr., native of Fort Worth, WW II B-24 pilot, and posthumous Medal of Honor recipient. Carswell is the only military facility to have its namesake interred on the premises. Area 3,274 acres. Altitude 650 ft. Military 5,125; civilians 1,236. Payroll $254.7 million. Housing: 107 officer; 700 NCO; 106 VOQ, 18 TLF, 80 VAQ. 140-bed regional hospital. Housing is unavailable due to massive renovations. The waiting list is indefinitely frozen.

Castle AFB, Calif. 95342-5000; 8 mi. NW of Merced. Phone (209) 726-2011; AUTOVON 347-1110. SAC base. 93d Bomb Wing. Conducts training of all SAC B-52 and KC-135 aircrews. Site of Castle Air Museum. Base activated Sept. 1941; named for Brig. Gen. Frederick W. Castle, WW II B-17 pilot and Medal of Honor recipient. Area 2,700 acres. Altitude 188 ft. Military 5,398; civilians 367. Payroll $124.8 million. Housing: 92 officer; 842

NCO; 432 transient (incl. 88 VAQ, 272 VOQ, 12 family quarters, 24 DVQ). 25-bed hospital.

Chanute AFB, Ill. 61868-5000; 14 mi. N of Champaign at Rantoul. Phone (217) 495-1110; AUTOVON 862-1110. ATC base. Chanute Technical Training Center provides training in missile and aircraft mechanics, aerospace ground equipment, life support, metallurgy and nondestructive inspection, weather forecasting, weather equipment, and fire protection and rescue. Display center and historical aircraft park constitute a base museum. Base activated May 1, 1917; named for Octave Chanute, aeronautical engineer and glider pioneer who died in 1910. Area 2,174 acres. Altitude 735 ft. Military 4,855; civilians 966. Payroll $119.6 million. Housing: 154 officer; 1,319 enlisted; 242 VOQ, 996 VAQ, 32 TLF. 35-bed hospital. Scheduled for closure in October 1993.

Charleston AFB, S. C. 29404-5000; located in North Charleston 10 mi. from downtown Charleston. Phone (803) 566-6000; AUTOVON 673-2100. MAC base. Joint-use airfield. 437th Military Airlift Wing; 315th MAW (AFRES Assoc.); 1968th Communications Sqdn.; Det. 1, 107th Fighter Interceptor Gp. (TAC); Det. 7, 1361st Audiovisual Sqdn. Base activated Dec. 1941; inactivated Feb. 1946; reactivated 1952. Area 6,314 acres (incl. an auxiliary airfield). Altitude 45 ft. Military 7,790 (incl. AFRES); civilians 1,362. Payroll $141.5 million. Housing: 127 officer; 850 NCO; 1,798 dormitory spaces; 75 trailer spaces; 535 transient (7 DV suites, 128 VOQ, 400 VAQ). Medical clinic.

Cheyenne Mountain AFB, Colo. 80914-5515; 6 mi. S of Colorado Springs. Phone (719) 554-7321; AUTOVON 692-7011. AFSPACECOM base. Host unit is 3d Space Support Wing (AFSPACECOM). Cheyenne Mountain Support Group, North American Aerospace Defense Command (NORAD) Command Center, and US Space Command operations center. Base activated 1966. Area 451 acres. Altitude 7,200 ft. More than 1,400 people representing US Army, Navy, and Air Force; Canadian Forces; and civilian technicians. No housing or transient quarters. Medical aid station.

Clark AB, Republic of the Philippines, APO San Francisco 96274-5000; 65 mi. N of Manila. Phone (commercial, from CONUS) 011-6345-35-33995; AUTOVON 393-3995. PACAF base. Hq. 13th Air Force; host unit 3d Tactical Fighter Wing, F-4E and F-4G fighter operations; 353d Special Operations Wing (MAC); 6200th Tactical Fighter Training Gp.; 624th Military Airlift Support Gp. (MAC); 13th Air Force Medical Center; 1961st Communications Gp. (AFCC); 6922d Electronic Security Sqdn. (ESC). Base activated as Fort Stotsenburg in 1903, renamed in 1919 for Maj. Harold M. Clark, an early aviator who was raised in the Philippines and was killed in a seaplane crash at Miraflores Locks, Panama Canal Zone. Area 9,285 acres. Altitude 478 ft. Military 8,200; US civilians 873; local nationals 4,685. Payroll $190 million. Housing: 537 officer; 1,922 NCO; 72 civilian houses and 51 unaccompanied/bachelor dormitories; 765 transient, 128 temporary lodging facility units. 145-bed medical center.

Columbus AFB, Miss. 39701-5000; 10 mi. NNW of Columbus. Phone (601) 434-7322; AUTOVON 742-1110. ATC base. 14th Flying Training Wing, undergraduate pilot training. Base activated 1941 for pilot training. Area 6,013 acres. Altitude 214 ft. Military 2,000; civilians 1,182. Payroll $60 million (FY 1989). Housing: 234 officer; 586 NCO; 77 transient. 7-bed hospital.

Comiso AB, Italy, APO New York 09694-5000; on the island of Sicily 3 mi. from Comiso. Phone (commercial, from CONUS) 011-39-932-731-111; AUTOVON 628-8110. USAFE base. 487th Tactical Missile Wing, which operates the BGM-109 ground-launched cruise missile. Part of Italy's Magliocco air base, activated in 1936; 487th TMW activated June 30, 1983. Area 379 acres. Altitude 714 ft. Military 1,500; civilians 402. Payroll $60 million. Housing: 900 base housing units; 31 TLF; 22 VAQ/VOQ rooms; 3 DV suites; 956 dormitory rooms. Clinic.

Davis-Monthan AFB, Ariz. 85707-5000; within the city limits of Tucson. Phone (602) 750-3900; AUTOVON 361-1110. TAC base. 836th Air Div.; 355th Tactical Training Wing, A-10 combat crew training; 602d Tactical Air Control Wing, OA-10, OV-10, and ground FAC tactical air control operations; 41st Electronic Combat Sqdn., EC-130H electronic operations; 868th Tactical Missile Training Gp., ground-launched cruise missile training operations (deactivates sometime in 1990); 71st Special Operations Sqdn. (AFRES), HH-3 and CH-3 Jolly Green Giant helicopter operations; and Det. 1, 120th Fighter Interceptor Gp. (MontANG), F-16 air defense operations. Also site of AFLC's Aerospace Maintenance and Regeneration Center, storage location for excess DoD aerospace vehicles. Base activated 1927; named for two local early aviators—1st Lt. Samuel H. Davis, killed Dec. 28, 1921, and 2d Lt. Oscar Monthan, killed Mar. 27, 1924. Area 11,000 acres. Altitude 2,620 ft. Military 5,393; civilians 1,444. Payroll $160.5 million. Housing: 133 officer; 1,102 enlisted; 608 transient (408 VAQ, 184 VOQ, 16 TLF). 65-bed hospital.

Dover AFB, Del. 19902-5000; 3 mi. SE of Dover. Phone (302) 678-7011; AUTOVON 455-1110. MAC base. 436th Military Airlift Wing; 512th MAW (AFRES Assoc.). Dover operates the largest aerial port facility on the East Coast. Base activated Dec. 1941; inactivated 1946; reactivated Feb. 1951. Area 3,734 acres. Altitude 28 ft. Military 6,675; civilians 2,277. Payroll $222 million. Housing: 110 officer; 1,446 enlisted; 763 transient (608 VAQ, 155 VOQ). 14 TLF. 30-bed hospital.

Dyess AFB, Tex. 79607-5000; WSW border of Abilene. Phone (915) 696-0212; AUTOVON 461-1110. SAC base. 96th Bomb Wing; 463d Tactical Airlift Wing; Det. 4, 1722d Combat Control Sqdn. (MAC); 1993d Communications Sqdn. (AFCC); Field Training Det. 417; 12th Flying Training Wing ACE Det. OLC; 436th Strategic Training Sqdn. (SAC); 49th Test Sqdn. (SAC); Air Force Operational Test and Evaluation Center Det. OLDT; B-1B, KC-135, C-130, T-38 operations. First base to activate an operational B-1B wing and conduct B-1 combat crew training for the Air Force. First B-1B arrived June 1985; wing met initial operational capability Oct. 1986. Base activated Apr. 1942; deactivated Dec. 1945; reactivated as Abilene AB Sept. 1955. In Mar. 1956, renamed for Lt. Col. William E. Dyess, WW II fighter pilot who escaped from a Japanese prison camp, killed in P-38 crash at Burbank, Calif., Dec. 1943. Area 6,405 acres. Altitude 1,789 ft. Military 5,400; civilians 436. Payroll $173 million. Housing: 120 officer; 873 NCO; 271 VAQ/VOQ, 40 TLF. 35-bed hospital.

Eaker AFB, Ark. 72315-5000; 4 mi. NW of Blytheville. Phone (501) 762-7000; AUTOVON 721-1110. SAC base. 97th Bomb Wing; aircraft include B-52s and KC-135s. Base activated June 1942; inactivated Feb. 1947; reactivated Aug. 1955. Known as Blytheville AFB until 1988, when name was changed to honor the late Gen. Ira C. Eaker, airpower pioneer and leader of 8th Air Force in World War II. Area 3,286 acres. Altitude 254 ft. Military 3,290; civilians 408. Payroll $69.9 million. Housing: 196 officer; 732 NCO; 69 transient. 20-bed hospital.

Edwards AFB, Calif. 93523; 20 mi. E of Rosamond. Phone (805) 277-1110; AUTOVON 527-1110. AFSC base. Site of Air Force Flight Test Center (AFFTC), which conducts developmental and follow-on testing and evaluation of manned and unmanned aircraft and related avionics flight-control and weapon systems. AFFTC also operates the USAF Test Pilot School, which trains test pilots, flight-test engineers, and flight-test navigators. Also site of USAF Astronautics Laboratory, US Army Aviation Engineering Flight Activity, the NASA Ames Dryden Flight Research Facility, and the Jet Propulsion Laboratory's test facility, and the primary landing site for space shuttle missions. Base activities began in Sept. 1933. Originally Muroc Army Air Field; renamed for Capt. Glen W. Edwards, killed June 5, 1948, in crash of a YB-49 "Flying Wing." Area 301,000 acres. Altitude 2,302 ft. Military 6,000 (including tenant units); government and contractor civilians 12,000. Payroll $528.9 million (incl. tenant units and contractors). Housing: 536 officer (incl. BOQ); 3,236 enlisted (incl. 1,466 dormitory spaces and 191 bachelor NCO quarters); 206 transient (64 VAQ, 91 VOQ, 51 TLF); 188 mobile home park spaces. 25-bed hospital.

Eglin AFB, Fla. 32542; 2 mi. SW of the twin cities of Niceville and Valparaiso; 7 mi. NE of Fort Walton Beach. Phone (904) 882-3931; AUTOVON 872-1110. AFSC base. Eglin is the free world's largest air force base in terms of land area, covering an area roughly two-thirds the size of Rhode Island. Air Force Munitions Systems Division (host); Air Force Armament Lab (AFSC); 33d Tactical Fighter Wing; Tactical Air Warfare Center; 1972d Communications Gp.; 919th Special Operations Gp. (AFRES); 20th Surveillance Sqdn.; 55th Special Operations Sqdn.; 728th Tactical Control Sqdn.; US Army Florida Ranger Camp; a US Navy Explosive Ordnance Disposal School; Air Force Armament Museum. Base activated 1935; named for Lt. Col. Frederick I. Eglin, WW I flyer killed in aircraft accident Jan. 1, 1937. Area 464,980 acres. Altitude 85 ft. Military 10,071; civilians 4,791; contractor 950 (excl. Hurlburt Field). Payroll $394 million (excl. Hurlburt Field). Housing: 332 officer; 2,014 enlisted; 227 trailer spaces (officer and enlisted); 88 transient. 145-bed USAF regional hospital. AFSC clinic at Hurlburt Field.

Eielson AFB, Alaska 99702-5000; 26 mi. SE of Fairbanks. Phone (907) 377-1178; AUTOVON (317) 377-1110. AAC base. 343d Tactical Fighter Wing (host); 343d Combat Support Gp.; 18th Tactical Fighter Sqdn. Major tenants include 6th Strategic Reconnaissance Wing (SAC); 1995th Communications Sqdn. (AFCC); Arctic Survival School (ATC); 168th AREFS (ANG). Base activated Oct. 1944; named for Carl Ben Eielson, Arctic aviation pioneer who died Nov. 1929. Area 23,500 acres (approx.). Altitude 534 ft. Military 3,299; civilians 940. Payroll $121 million. Housing: 164 officer; 1,296 NCO; 90 transient. Clinic.

Ellsworth AFB, S. D. 57706-5000; 11 mi. ENE of Rapid City. Phone (605) 385-1000; AUTOVON 675-1000. 12th Air Div. (host); 44th Strategic Missile Wing, Minuteman II operations; 28th Bombardment Wing, two B-1 squadrons, one each KC-135R, EC-135; 99th Strategic Weapons Wing trains all SAC bomber crews in combat situations; Det. 2, 37th Air Rescue Sqdn., Huey HH-1H; OLA, 64th Flying Training Wing (ATC); Det. 17, 26th Weather Sqdn.; 2148th Communications Sqdn. (AFCC). Home of the South Dakota Air and Space Museum. Base activated July 1942 as Rapid City Army Air Base; renamed June 13, 1953, for Brig. Gen. Richard E. Ellsworth, killed Mar. 18, 1953, in crash of RB-36 in Newfoundland. Area 4,906 acres. Altitude 3,200 ft. Military 7,000; civilians 750. Payroll $150.1 million. Housing: 268 officer; 1,228 NCO; 191 transient. A major housing project is under way to complete 200 units in downtown Rapid City by July 1990 and 828 units on Ellsworth by August 1992. 40-bed hospital.

Elmendorf AFB, Alaska 99506-5000; bordering Anchorage. Phone (907) 552-1110; AUTOVON (317) 552-1110. Hq. Alaskan Command; Hq. Alaskan Air Command; Hq. Alaskan NORAD Region; 21st Tactical Fighter Wing (host); 21st Combat Support Gp.; 11th Tactical Control Wing; 1931st Communications Wing; NORAD Region Operations Control Center; Rescue Coordination Center; 43d Tactical Fighter Sqdn.; 54th Tactical Fighter Sqdn.; 962d AWACS (TAC); 6981st Electronic Security Gp. (ESC); 616th Military Airlift Gp. (MAC); 17th Tactical Airlift Sqdn. (MAC); 71st Air Rescue Sqdn. (MAC); 11th Weather Sqdn. (MAC); plus varied US Army, Navy, and Marine activities. Base activated July 1940; named for Capt. Hugh Elmendorf, killed Jan. 13, 1933, at Wright Field, Ohio, while flight-testing a new pursuit plane. Area 13,130 acres. Altitude 118 ft. Military 6,300; civilians 2,000. Payroll $282 million. Housing: 230 officer; 1,300 NCO; transient incl. 52 family units (no pets), 90 VOQ, 300 VAQ. 95-bed hospital.

England AFB, La. 71311-5004; 5 mi. W of Alexandria. Phone (318) 448-2100; AUTOVON 683-1110. TAC base. 23d Tactical Fighter Wing, A-10 fighter operations. Base activated Oct. 1942; named for Lt. Col. John B. England, WW II P-51 pilot and ace credited with 17.5 victories, killed Nov. 17, 1954, in F-86 crash in France. Area 2,282 acres. Altitude 89 ft. Military 3,057; civilians 667. Payroll $76 million. Housing: 92 officer; 506 enlisted; 48 trailer park spaces; 62 transient (20 VAQ, 37 VOQ, 5 TLF). 15-bed hospital.

Fairchild AFB, Wash. 99011-5000; 12 mi. WSW of Spokane. Phone (509) 247-1212; AUTOVON 352-1212. SAC base. 92d Bomb Wing (SAC); 3636th Combat Crew Training Wing (ATC); 141st Air Refueling Wing (ANG); Det. 24, 37th Air Rescue Sqdn. (MAC); 5th Satellite Control Sqdn. (AFSPACECOM); 2039th Communications Sqdn. (AFCC). Base activated Jan. 1942; named for Gen. Muir S. Fairchild, USAF Vice Chief of Staff at his death in 1950. Area 4,223 acres. Altitude 2,462 ft. Military 4,368; civilians 1,194. Payroll $101.3 million for active-duty military and civilian. $19 million for ANG. Housing: 462 officer; 1,118 NCO; transient incl. 29 VOQ, 62 VAQ, and 8 temporary lodging facilities. 45-bed hospital.

Falcon AFB, Colo. 80912-5000; 10 mi. E of Colorado Springs. Phone (719) 550-4113; AUTOVON 560-1110. AFSPACECOM base. Host unit is 2d Space Wing. 1002d Space Support Gp.; 1879th Communications Gp. (AFCC); 73d Space Surveillance Gp.; Strategic Defense Initiative National Test Facility. Base activated Sept. 26, 1985. Area 2,590 acres. Altitude 6,267 ft. Military active-duty 1,900; civilians 300; contractors 2,000. No housing or transient quarters. Medical aid station.

Francis E. Warren AFB, Wyo. 82005-5000; adjacent to Cheyenne. Phone (307) 775-1110; AUTOVON 481-1110. SAC base. 90th Strategic Missile Wing; 90th Combat Support Gp.; 90th Security Police Gp.; 37th Air Rescue Sqdn. (MAC); SATAF (AFSC); Geodetic Survey Gp. (DoD). Base activated as Fort D. A. Russell July 4, 1867; under Army jurisdiction until 1947, when reassigned to USAF. Base renamed in 1930 for Francis Emory Warren, Wyoming senator and first state governor. Area 5,866 acres, plus 50 Peacekeeper and 150 Minuteman III missile sites distributed over 12,600 sq. mi. in Wyoming, Colorado, and Nebraska. F. E. Warren AFB will be the main operating base for the Peacekeeper rail-garrison system. Altitude 6,142 ft. Military 3,656; civilians 799. Payroll $100 million. Housing: 203 officer; 628 NCO; 36 transient. 25-bed hospital.

George AFB, Calif. 92394-5000; 6 mi. NW of Victorville. Phone (619) 269-1110; AUTOVON 353-1110. TAC base. 831st Air Div.; 35th Tactical Fighter Wing, home of TAC's Wild Weasel F-4G squadrons, F-4 transitional and upgrade training, and German Air Force training in F-4; Det. 1, 144th Fighter Interceptor Wing (TAC); 2067th Communications Sqdn. (AFCC). Base activated 1941; named for Brig. Gen. Harold H. George, WW I fighter ace killed Apr. 29, 1942, in aircraft accident in Australia. Area

5,348 acres. Altitude 2,875 ft. Military 5,114; civilians 425. Payroll $127.89 million. Housing: 145 officer; 1,496 enlisted; 173 transient (82 VAQ, 51 VOQ, 40 TLF). 25-bed hospital. Scheduled for closure in December 1992.

Goodfellow AFB, Tex. 76908-5000; 2 mi. SE of San Angelo. Phone (915) 654-3231; AUTOVON 477-3231. ATC base. Goodfellow Technical Training Center provides technical training for all Air Force people entering the intelligence career fields and also provides cryptologic training for members of the other military services, civilian intelligence agencies, and foreign military personnel. Major units include 3480th Technical Training Wing (ATC); 3480th Technical Training Gp. (ATC); 3480th Student Gp. (ATC); 3490th Technical Training Gp. (ATC); 3495th Technical Training Gp. (ATC); 8th Missile Warning Sqdn. (at nearby Eldorado AFS, the location of the Southwest Pave Paws radar site) (AFSPACECOM); Det. 6, USAF Occupational Measurement Center (USAFOMC); 2081st Communications Sqdn. (AFCC); NCO Professional Military Education Center (ESC); 3d Battalion, 112th Military Intelligence Brigade (US Army); Naval Technical Training Center Detachment; Marine Corps Administrative Detachment. Base activated Jan. 1941; named for Lt. John J. Goodfellow, Jr., WW I fighter pilot killed in combat Sept. 14, 1918. Area 1,127 acres. Altitude 1,877 ft. Military 3,745; civilians 810. Payroll $89.4 million. Housing: 35 officer; 264 NCO; 833 transient (740 VAQ, 65 VOQ, 28 TLF). Clinic.

Grand Forks AFB, N. D. 58205-5000; 16 mi. W of Grand Forks. Phone (701) 747-3000; AUTOVON 362-1110. SAC base. 42d Air Div.; 319th Bomb Wing (KC-135R and B-1B); 321st Strategic Missile Wing (Minuteman III); 2152d Communications Sqdn.; Det. 15, 26th Weather Sqdn. (MAC); 419th Field Training Det. (ATC); Det. 3, Air Rescue Sqdn. (MAC); 64th Flying Training Wing (ATC). Base activated 1956; named after the city of Grand Forks, whose citizens bought the property for the Air Force. Area 5,422 acres. Missile complex covers an additional 7,500 sq. mi. Altitude 911 ft. Military 5,352; civilians 556. Payroll $133 million. Housing: 476 officer; 1,795 NCO; 136 transient. 35-bed hospital.

Griffiss AFB, N. Y. 13441-5000; 1 mi. NE of Rome. Phone (315) 330-1110; AUTOVON 587-1110. SAC base. 416th Bomb Wing. Rome Air Development Center (AFSC); 485th Engineering Installation Gp. (AFCC); Hq. 24th Air Div. (TAC); Northeast Air Defense Sector (TAC); 10th Aviation Brigade (US Army). Base activated Feb. 1, 1942; named for Lt. Col. Townsend E. Griffiss, killed in aircraft accident Feb. 15, 1942 (the first US airman to lose his life in Europe during WW II while in the line of duty). Area 3,896 acres. Altitude 504 ft. Military 4,817; civilians 2,801. Payroll $238.4 million. Housing: 169 officer; 566 NCO; 50 trailers; 109 transient. 20-bed hospital.

Grissom AFB, Ind. 46971-5000; 7 mi. S of Peru. Phone (317) 688-5211; AUTOVON 928-1110. SAC base. 305th Air Refueling Wing; 930th Tactical Fighter Gp. (AFRES); 434th Air Refueling Wing (AFRES). Activated Jan. 1943 for Navy flight training; reactivated June 1954 as Bunker Hill AFB; renamed May 1968 for Lt. Col. Virgil I. "Gus" Grissom, killed Jan. 27, 1967, at Cape Kennedy, Fla., with other Astronauts Edward White and Roger Chaffee in Apollo capsule fire. Area 3,000 acres. Altitude 800 ft. Military 2,740; civilians 993. Payroll $56.3 million (SAC only). Housing: 144 officer; 972 NCO; 133 transient. Clinic, outpatient care only.

Gunter AFB, Ala. 36114; 4 mi. NE of Montgomery. Phone (205) 279-1110; AUTOVON 446-1110. AU base. Hq. Computer Systems Div. (AFCC); Air Force Logistics Management Center; USAF Extension Course Institute; USAF Senior NCO Academy. Base activated Aug. 27, 1940; named for William A. Gunter, longtime mayor of Montgomery and airpower advocate, died 1940. Area 368 acres. Altitude 220 ft. Military 1,619; civilians 968. Payroll included in Maxwell entry. Housing: 118 officer; 206 NCO; 363 transient (103 VOQ, 257 VAQ, 3 TLF).

Hahn AB, W. Germany, APO New York 09122-5000; 2 mi. from Sohren, approx. 70 mi. W of Frankfurt. Phone (commercial, from CONUS) 011-49-6543-51-1110; AUTOVON 450-1110. USAFE base. 50th Tactical Fighter Wing with three squadrons of F-16C/D aircraft. Base activated in 1951; USAF began operations in 1953. Area 1,920 acres. Altitude 1,560 ft. Military 5,493; civilians 952. Payroll $164.6 million. Housing: 672 apts.; 302 US Govt. leased housing. Billeting: 53 officer; 1,787 enlisted. 20-bed hospital.

Hanscom AFB, Mass. 01731; 17 mi. NW of Boston. Phone (617) 377-4441; AUTOVON 478-5980. AFSC base. Hq. Electronic Systems Div. (AFSC) manages development and acquisition of command control communications and intelligence (C³I) systems. Also site of Air Force Geophysics Lab, center for research and exploratory development in the terrestrial, atmospheric, and space environments. Base has no flying mission; transient USAF aircraft use runways of Laurence G. Hanscom Field, state-operated airfield adjoining the base. Base named for Laurence G. Hanscom, a pre-WW II advocate of private aviation, killed in a lightplane accident in 1941. Area 846 acres. Altitude 133 ft. Military 2,676; civilians 2,922. Payroll $176 million. Housing: 370 officer; 489 NCO; 30-unit TLF, 754 BOQ/VOQ. Clinic.

Hellenikon AB, Greece, APO New York 09223-5000; 10 mi. S of Athens. Phone (commercial, from CONUS) 011-301-989-5513; AUTOVON 662-1110. USAFE base. 7206th Air Base Gp. Provides operations and maintenance support, administrative control, and base operating support to USAFE and other US forces. Base began operation as a military mission in 1947 as Athinai Airport. Named after nearest town. Area 172 acres. Altitude 90 ft. Military 1,464; civilians 473. Payroll $56.7 million. No housing; 108 dormitory rooms and 264 consolidated billeting. Hospital.

Hickam AFB, Hawaii 96853-5000; 10 mi. W of Honolulu. Phone (808) 471-7110 (Oahu military operator); AUTOVON 471-7110. PACAF base. Hq. Pacific Air Forces. Host unit 15th Air Base Wing, supporting Air Force units and installations in Hawaii and throughout the Pacific; subordinate unit 9th Airborne Command and Control Sqdn., EC-135J flying operations. Major associate units include Hq. 3d Air Div. (SAC); 834th Airlift Div. (MAC); Hq. Pacific Communications Div. (AFCC); 1st Weather Wing (MAC); 154th Composite Gp. (ANG); 619th Military Airlift Support Sqdn. (MAC); Det. 1, 89th Military Airlift Wing (MAC). Base activated Sept. 1938; named for Lt. Col. Horace M. Hickam, air pioneer killed in crash Nov. 5, 1934, at Fort Crockett, Tex. Area 2,363 acres. Altitude sea level. Military 4,170; civilians 1,976. Payroll $249 million (includes Hickam and Wheeler AFBs and Bellows AFS). Housing: 535 officer; 1,920 enlisted. Clinic.

Hill AFB, Utah 84056-5990; 8 mi. S of Ogden. Phone (801) 777-7221; AUTOVON 458-1110. AFLC base. Hq. Ogden Air Logistics Center. Furnishes logistics support for Minuteman, Peacekeeper, and Small ICBM missiles; Maverick air-to-ground missiles; laser and electro-optical guided bombs; F-4 and F-16 systems manager; air munitions; aircraft landing gear, including wheels, brakes and struts, tires, and tubes; photographic and aerospace training equipment. Other units include 388th Tactical Fighter Wing (TAC); 419th Tactical Fighter Wing (AFRES); 729th Tactical Control Sqdn. (TAC); 6545th Test Gp. (AFSC), which oversees management of Utah Test and Training Range and RPV test programs. Hill AFB Heritage Museum. Base activated Nov. 1940; named for Maj. Ployer P. Hill, killed Oct. 30, 1935, test-flying the first B-17. Area 6,666 acres; manages 961,401 acres. Altitude 4,788 ft. Military 5,100; civilians 13,300. Payroll $587 million. Housing: 263 officer; 882 NCO; 45 transient. 35-bed hospital.

Holloman AFB, N. M. 88330-5000; 8 mi. SW of Alamogordo. Phone (505) 479-6511; AUTOVON 867-1110. TAC base. 833d Air Div.; 49th Tactical Fighter Wing, F-15 operations; 479th Tactical Training Wing, lead-in fighter training; 4449th Mobility Support Sqdn., Harvest Bare; 83d Tactical Control Sqdn.; 6585th Test Gp. (AFSC), test and evaluation of aircraft and missile systems. Twenty other tenant units located at Holloman, including 1877th Communications Sqdn., 4th Satellite Communications Sqdn. (AFSPACECOM), 1984th Communications Sqdn., Air Force Geophysical Laboratory detachment, and a US Army unit. Base activated 1942; named for Col. George Holloman, guided-missile pioneer, killed in B-17 crash on Formosa Mar. 19, 1946. Area 50,697 acres. Altitude 4,093 ft. Military 4,697; civilians 2,344. Payroll $208 million. Housing: 191 officer; 1,360 NCO; 457 transient (239 VAQ, 194 VOQ, 24 TLF). 30-bed hospital.

Homestead AFB, Fla. 33039-5000; 5 mi. NNE of Homestead. Phone (305) 257-8011; AUTOVON 791-0111. TAC base. 31st Tactical Fighter Wing, F-16 fighter operations; site of ATC sea-survival school; 726th Tactical Control Sqdn. (TAC); Naval Security Group Activity; 482d Tactical Fighter Wing (AFRES); 301st Air Rescue Sqdn. (AFRES); 125th Fighter Interceptor Gp. (TAC); Inter-American Air Forces Academy. Base activated Apr. 1955. Area 3,345 acres. Altitude 7 ft. Military 4,379; civilians 1,051. Payroll $111 million. Housing: 229 officer; 1,385 enlisted; 330 transient (116 VAQ, 195 VOQ, 19 TLF). 50-bed hospital.

Howard AFB, Panama, APO Miami 34001-5000. With headquarters at Howard, the 830th Air Div. represents the US Air Force in operations throughout Latin America. The 830th AD is a TAC unit reporting to 12th Air Force, Bergstrom AFB, Tex. Howard originally established in 1928 as a military post, known as Bruja Point Military Reservation; later named for Maj. Charles Harold Howard. Major units of the 830th Air Div. are the 24th Tactical Air Support Sqdn. and the 24th Composite Wing. Military 2,360; civilians 1,140. Payroll $56.4 million. Housing: 113 officer, 539 enlisted.

Hurlburt Field, Fla. 32544-5000; 5 mi. W of Fort Walton Beach. Phone (904) 881-6668; for information AUTOVON 872-1110 (Eglin AFB). Hurlburt Field is a MAC base, though located on the Eglin AFB (AFSC) reservation. Home of Hq. 23d Air Force, which is the focal point for all USAF special operations matters. The 23d Air Force serves a dual role as a numbered air force for MAC and as the Air Force Special Operations Command, a service component of the US Special Operations Command. The base host wing is the 1st Special Operations Wing (1st SOW). 1st SOW is equipped with MC-130E (Combat Talon I), AC-130H (Spectre Gunship), and MH-53J (Pave Low III) aircraft located at Hurlburt Field. Also part of the 1st SOW are the HC-130 and MH-60G (Pave Hawk) aircraft located at Eglin AFB. Tenant units include the USAF Special Operations School; 1720th Special Tactics Gp.; 1723d Combat Control Sqdn.; 6th Weather Sqdn.; 4441st Tactical Training Gp.; Det. 1, 3400th Technical Training Gp. (ATC); Joint Warfare Center; 2068th Communications Sqdn.; 327th Field Training Det.; Det. 14, 1600th Management Engineering Sqdn.; Special Missions Operational Test and Evaluation Center; 4442d Tactical Control Gp., which includes the US Air Force Air Ground Operations School and the 727th Tactical Control Sqdn.; 823d Civil Engineering RED HORSE Sqdn.; Det. 8, 1361st Audiovisual Sqdn. Base activated 1943; named for Lt. Donald W. Hurlburt, WW II pilot killed Oct. 1, 1943, in a crash on Eglin reservation. Altitude 38 ft. Military 5,200; civilians 740. Payroll $133 million. Housing: 36 officer; 344 NCO; 210 transient rooms with 258 beds. Medical clinic only at Hurlburt, but 155-bed hospital at Eglin Regional Hospital located 12 mi. away.

Incirlik AB, Turkey, APO New York 09289-5000; 10 mi. E of Adana. Phone (commercial, from CONUS) 011-90-71-221774 through 221780; AUTOVON 676-1110. USAFE base. Host unit 39th Tactical Gp. supports rotational weapons training deployments for USAFE fighter aircraft. Also home for 628th Military Airlift Support Sqdn., which provides a full aerial port operation. Base activated in May 1954; present unit began operations in Mar. 1966. Incirlik, in Turkish, means fig orchard. Area 3,400 acres. Altitude 240 ft. Military 2,200; civilians 1,500. Payroll $57.7 million. Housing: 957 units; 49 TLF; 284 VAQ; 216 VOQ; 408 dorm rooms. Regional hospital.

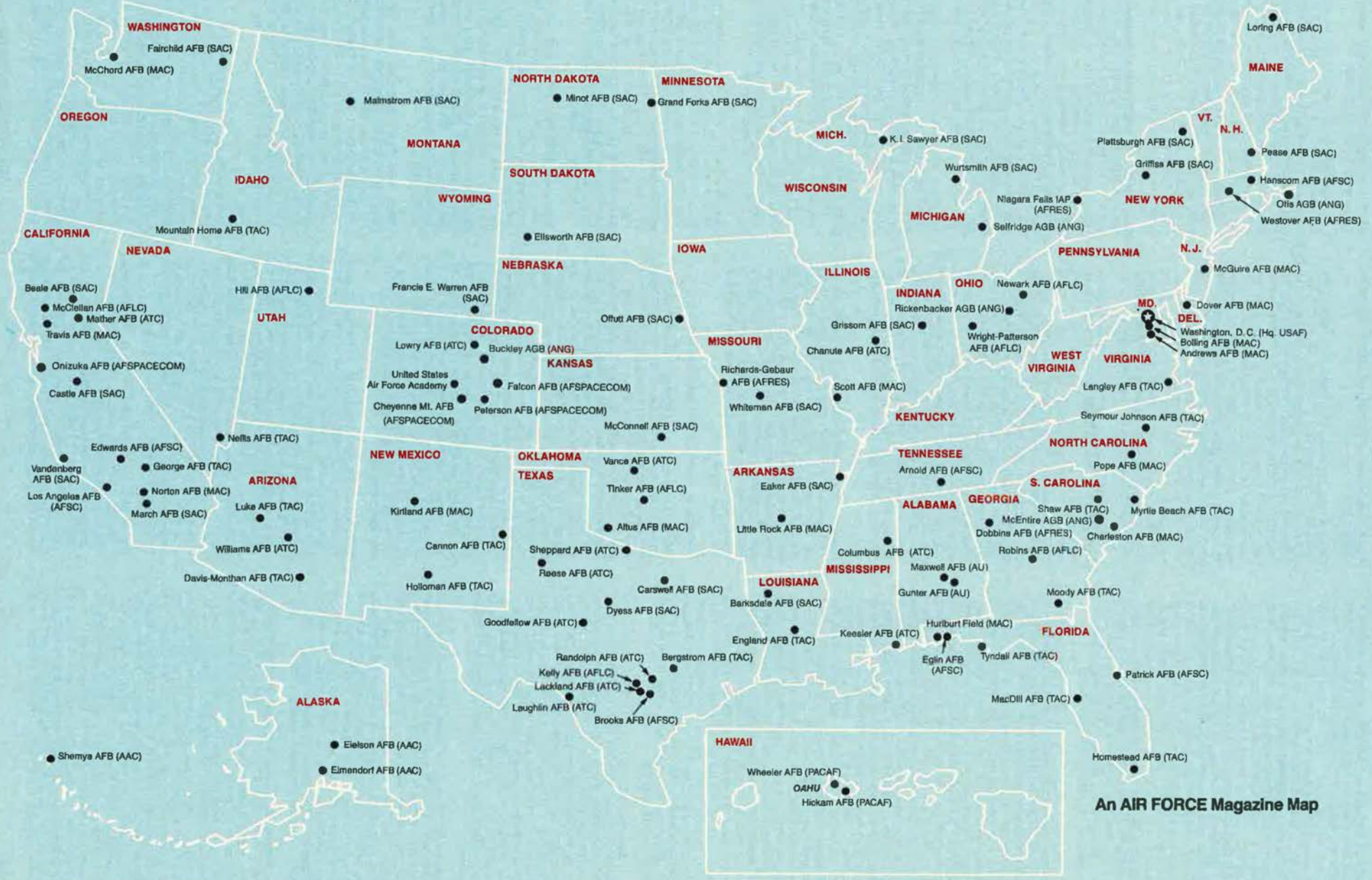
Iraklion AB, Crete, Greece, APO New York 09291-5000; 10 mi. E of Iraklion. Phone (commercial, from CONUS) 011-30-81761-196/197; AUTOVON 668-1110. USAFE base. Host unit is the 7276th Air Base Gp. (activated Aug. 1978). Major tenant units include the 6931st Electronic Security Sqdn. (activated Oct. 1954); and the 2115th Communications Sqdn. (activated Nov. 1986). Base named after Crete's capital city. Area 197 acres. Altitude 90 ft. Military 708; civilians 331. Payroll $20 million. Housing: 24 officer, 26 Senior NCO, 130 NCO, 37 billeting rooms, 362 dorm rooms. 2-bed hospital.

Kadena AB, Japan, APO San Francisco 96239-5000; 15 mi. N of Naha, Okinawa. Phone (commercial, from CONUS) 011-8109-893-6117-341-509; AUTOVON 630-1110. PACAF base. Hq. 313th Air Div., host organization; 18th Tactical Fighter Wing, F-15C/D operations; 18th Combat Support Wing; 400th Munitions Maintenance Sqdn. (Theater); 376th Strategic Wing (SAC), KC-135 and RC-135 operations; 1962d Communications Gp. (AFCC); 6990th Electronic Security Gp. (ESC); 961st Airborne Warning and Control Sqdn. (TAC), E-3 operations; 603d Military Airlift Support Gp. (MAC); 33d Air Rescue Sqdn. (MAC), HH-3 operations; 17th Special Operations Sqdn. (MAC), HC-130 operations; Western Pacific Rescue Coordination Center (MAC); 13th Military Airlift Sqdn. (MAC), C-12F operations. Base named for city of Kadena, Okinawa. Area 14,778 acres. Military 8,109; US civilians 2,221; local nationals 3,652. Payroll $350 million. Housing: 7,215 on-base units (officer/enlisted); 522 transient; 57 temporary. Clinic. US Naval Hospital at Camp Lester.

Keesler AFB, Miss. 39534-5000; located in Biloxi. Phone (601) 377-1110; AUTOVON 597-1110. ATC base. Hq. Keesler Technical Training Center (avionics, communications, electronics, radar systems, computer and command and control systems, personnel, and administrative courses); Keesler USAF Medical Center. Hosts MAC and AFRES weather reconnaissance units; AFRES tactical airlift unit; TAC airborne command and control sqdn.; AFCC engineering installation gp.; AFCC NCO Academy/Leadership School; USAF First Sergeant's Academy. Base activated June 12, 1941; named for 2d Lt. Samuel R. Keesler, Jr., WW I aerial observer, killed in action Oct. 9, 1918, near Verdun, France. Area 3,600 acres. Altitude 26 ft. Military 9,000; civilians 4,000. Payroll $230 million. Housing: 291 officer; 1,665 NCO; 51 trailer spaces; 76 transient (376 VOQ and 1,348 VAQ units or space availability; technical training students may occupy many units). 350-bed hospital.

Kelly AFB, Tex. 78245-5000; 5 mi. SW of San Antonio. Phone (512) 925-1110; AUTOVON 945-1110. AFLC base. Hq. San Antonio Air Logistics Center provides logistics management, procurement, and distribution support for such USAF aircraft as the C-5A and C-5B, C-17, C-9, F-5, OV-10, and T-38. As a specialized repair activity,

Major Active Air Force Installations in the U.S.



An AIR FORCE Magazine Map

SA-ALC modernizes and performs heavy depot maintenance on the entire USAF fleet of C-5s, a significant portion of Strategic Air Command's B-52s, and various engines, including the TF39, TF56, and F100. SA-ALC also manages more than half of the Air Force's engine inventory, all fuel lubricants used by the Air Force and NASA, the Air Force's fleet of boats and ships, and the Department of Defense Working Dog Program. Other major units include Hq. Electronic Security Command; Air Force Electronic Warfare Center; Air Force Cryptologic Support Center; Joint Electronic Warfare Center; Air Force News Center; Hq. Air Force Commissary Service; 433d Military Airlift Wing (AFRES); 149th Tactical Fighter Gp. (ANG); 1923d Communications Gp.; 1827th Electronics Installation Sqdn.; Defense Reutilization and Marketing Office; Air Force Audit Agency Office. Dating back to Nov. 21, 1916, Kelly AFB is the oldest continuously active air base in the US. Named for Lt. George E. M. Kelly, first Army pilot to lose his life in a military aircraft, killed May 10, 1911. Area 4,660 acres. Altitude 689 ft. Military 5,807; civilians 19,496. Payroll $721 million. Housing: 45 officer; 368 NCO. Clinic.

Kirtland AFB, N. M. 87117-5000; SE quadrant of Albuquerque. Phone (505) 844-0011; AUTOVON 244-0011. MAC base. 1606th Air Base Wing. Major agencies and units include Contract Management Div. (AFSC); Air Force Operational Test and Evaluation Center; Air Force Space Technology Center (AFSC); Air Force Weapons Laboratory (AFSC); Air Force Office of Security Police; 1550th Combat Crew Training Wing (MAC); 150th Tactical Fighter Gp. (New Mexico ANG); Field Command's Defense Nuclear Agency; Naval Weapons Evaluation Facility; Sandia National Laboratories; Lovelace Biomedical and Environmental Research Institute; Department of Energy's Albuquerque Operations Office; AFSC NCO Academy; 1960th Communications Sqdn. (AFCC); 3098th Aviation Depot Sqdn.; Det. 1, 1369th Audiovisual Sqdn.; Air Force Directorate of Nuclear Surety; Interservice Nuclear Weapons School. These agencies furnish contract management; nuclear and laser research, development, and testing; advanced helicopter training and search and rescue operations; pararescue training; and operational test and evaluation. Other major units include AFLC Nuclear Support Office; Albuquerque Seismological Laboratory; University of New Mexico Civil Engineering Research Facility. Base activated Jan. 1941; named for Col. Roy C. Kirtland, air pioneer and Commandant of Langley Field in the 1930s, who died May 2, 1941. Area 52,450 acres. Altitude 5,352 ft. Military 6,045; civilians 14,695. Payroll $945 million. Housing: 2,122 homes; BOQ/VOQ; officers 241 beds; enlisted 1,799 beds. Air Force/Veterans Administration joint medical center located outside base gates (inpatient); Air Force Clinic (outpatient).

K. I. Sawyer AFB, Mich. 49843-5000; 20 mi. S of Marquette. Phone (906) 346-6511; AUTOVON 472-1110. SAC base. 410th Bomb Wing; Navy Communications Unit, Marquette; 2001st Communications Sqdn. (AFCC); Det. 24, 26th Weather Sqdn. (AWS); Det. 2 (SATAF); 71st Flying Training Wing/OLA. Base activated 1959; named for Kenneth I. Sawyer, who proposed site for county airport, died 1944. Area 5,202 acres. Altitude 1,220 ft. Military 3,600; civilians 600. Payroll $88.1 million. Housing: 279 officer; 1,414 NCO; 199 trailer spaces; 26 BNCOQ; 18 BOQ; 103 transient (incl. 33 fully furnished TLFs, 36 VAQ, 28 VOQ, 3 DVQ, and 3 Senior NCO). 15-bed hospital.

Kunsan AB, Republic of Korea, APO San Francisco 96264-5000; 8 mi. SW of Kunsan City. Phone (commercial, from CONUS) 011-82-27-910-5194; AUTOVON 782-1110. PACAF base. Host unit 8th Tactical Fighter Wing, F-16C/D aircraft operations; 1982d Communications Sqdn. (AFCC). Parent unit for three geographically separated units, including Kwangju AB, approx. 60 mi. S of Kunsan. Base built by Japanese in 1938. Area 2,556 acres. Altitude 29 ft. Military 3,500; US civilians 33; local nationals 739. Payroll $72 million. Housing: 264 officer; 2,500 enlisted; all unaccompanied housing (dormitory/BOQ); 211 transient. 5-bed hospital.

Lackland AFB, Tex. 78236-5000; 8 mi. WSW of San Antonio. Phone (512) 671-1110; AUTOVON 473-1110. ATC base. Provides basic military training for active-duty, Air National Guard, and Air Force Reserve airmen; technical training for basic and advanced security police/law enforcement personnel; cryptographic maintenance operators and technicians; patrol dog-handler courses; training of instructors, recruiters, and social actions/drug abuse counselors; Officer Training School; Defense Language Institute English Language Center; Wilford Hall USAF Medical Center (Air Force's largest medical center, with 1,000 beds, conducts medical education and clinical research); ATC NCO Academy; military training instructor reserve squadron; 539th Air Force Band; Det. 40, Air Force Logistics Center. Base activated 1941; named for Brig. Gen. Frank D. Lackland, early commandant of Kelly Field flying school, died 1943. Area 6,783 acres, incl. 3,872 acres at Lackland Training Annex. Altitude 745 ft. Military 15,538; civilians 7,518. Payroll $352 million. Housing: 100 officer; 619 NCO; 1,346 transient.

Lajes Field, Azores, Portugal, APO New York 09406-5000; Terceira Island, 900 mi. W of Portugal. AUTOVON 723-1410. MAC base. 1605th Military Airlift Support Wing. Support base for aircraft crossing the Atlantic Ocean. Wing is host unit to US Forces Azores; Navy Forces Azores; Army Transportation Terminal Unit Azores; Naval Security Gp. Activity Azores; 1936th Communications Sqdn. (AFCC); Det. 3, Air Force European Broadcasting Sqdn. Base provides en route support for MAC, USAF, USN, USMC, third nation, and other authorized aircraft crossing the Atlantic and supporting US Navy antisubmarine warfare missions. US operations began at Lajes Field in 1946. Area 1,148 acres. Altitude 180 ft. Military 1,659; civilians 1,890. Payroll $53.01 million. Housing: 101 officer; 388 enlisted; 30 TLF; 144 VOQ; 670 VAQ; 6 DVQ; 2 senior NCO. 7-bed hospital.

Langley AFB, Va. 23665-5000; 3 mi. N of Hampton. Phone (804) 764-9990; AUTOVON 574-1110. TAC base. Hq. Tactical Air Command. 1st Tactical Fighter Wing, host unit, F-15 fighter operations; Hq. 1st Air Force (TAC); Hq. CONUS NORAD region; 2d Aircraft Delivery Gp. (TAC); 480th Reconnaissance Technical Gp.; 1913th Communications Gp. (AFCC); 1912th Computer Systems Gp. (AFCC); 564th Tactical Air Command Band (TAC); US Army TRADOC Flight Det.; 48th Fighter Interceptor Sqdn. (TAC); Low Intensity Conflict Center; 20 other tenant units. Base activated Dec. 30, 1916. Langley is the second oldest continuously active air base in the US; named for aviation pioneer and scientist Samuel Pierpont Langley, who died in 1906. NASA's Langley Research Center is located across base. Area 3,439 acres. Altitude 10 ft. Military 9,581; civilians 3,000. Payroll $308.6 million. Housing: 384 officer; 1,255 NCO; 298 transient (97 VAQ, 101 VOQ, 100 TLF). 75-bed hospital.

Laughlin AFB, Tex. 78843-5000; 6 mi. E of Del Rio. Phone (512) 298-3511; AUTOVON 732-1110. ATC base. 47th Flying Training Wing, undergraduate pilot training. Base activated Oct. 1942; named for 1st Lt. Jack T. Laughlin, Del Rio native, B-17 pilot killed over Java on Jan. 29, 1942. Area 4,008 acres. Altitude 1,080 ft. Military 2,330; civilians 975 (plus 155 contract civilians). Payroll $57.8 million. Housing: 268 officer; 335 NCO; 37 transient; 54 mobile home sites; 24 temporary family lodging facilities. 20-bed hospital.

Laurence G. Hanscom AFB *(see Hanscom AFB).*

Lindsey AB, W. Germany, APO New York 09634-5000; in Wiesbaden. Phone (commercial, from CONUS) 011-49-6121-82-0; AUTOVON 339-1110. USAFE base. Host unit is the 7100th Combat Support Wing, responsible for 17th Air Force's 25 collocated operating bases, five geographically separated munitions support squadrons, providing war- and peacetime health care through the 7100th Combat Support Wing Medical Center, and supporting approximately 80 associate units. Major associated units: Hq. 65th Air Div.; 1st Combat Communications Gp. (AFCC); 1836th Engineering Installation Group (AFCC); 691st Electronic Security Wing (ESC); Dist. 70, Office of Special Investigations, Department of Defense Dependent School, Germany Region. Established in 1897 as a German installation; Air Force gained control in 1947. Named for Medal of Honor recipient Darrell R. Lindsey, a WW II pilot killed during a bombing mission over France. Area 106 acres. Altitude 557 ft. Military 3,471; civilians 1,478. Payroll $119 million. Housing: No on-base housing (Wiesbaden Military Community housing is operated by the US Army); billeting (bachelor enlisted): 757 male and 168 female bed spaces. 200-bed medical center.

Little Rock AFB, Ark. 72099-5000; 17 mi. NE of Little Rock. Phone (501) 988-3131; AUTOVON 731-1110. MAC base. 314th Tactical Airlift Wing, only C-130 training base in DoD, training crew members from all branches of service and some foreign countries. Tenants include Hq. Joint Readiness Training Center, US Army Center (JRTC trains and evaluates light infantry units within the Army, using Fort Chaffee, Ark., as the training ground); several units of the Arkansas Air National Guard; 2151st Communications Sqdn.; 22d Air Force NCO Leadership School; 96th Mobile Aerial Port Sqdn.; 3548th USAF Recruiting Sqdn. Base activated 1955. Area 11,372 acres. Altitude 310 ft. Military 5,184; civilians 1,345. Payroll $157 million. Housing: 212 officer; 1,323 enlisted; 13 single-occupancy dormitories house 974 people; 360 transient (140 VAQ, 220 VOQ). 50-bed hospital.

Loring AFB, Me. 04751-5000; 4 mi. W of Limestone. Phone (207) 999-1110; AUTOVON 920-1110. SAC base. 42d Bomb Wing was activated here Feb. 25, 1953, as Limestone AFB; renamed for Maj. Charles Loring, Jr., F-80 pilot killed Nov. 22, 1952, in North Korea and posthumously awarded Medal of Honor. Area 11,165 acres. Altitude 756 ft. Military 3,593; civilians 498. Payroll $84.6 million. Housing: 303 officer; 1,481 NCO; 122 transient; 4 VIP. 20-bed hospital. The bomber mission converted to conventional as of Oct. 1, 1988.

Los Angeles AFB, Calif. 90009-2960; located in Southbay Los Angeles, city of El Segundo, 3 mi. S of Los Angeles IAP. Phone (213) 643-1000; AUTOVON 833-1110. AFSC base. Headquarters of AFSC's Space Systems Division, which manages the design, development, acquisition, and launch of DoD's space program. Support unit is 6592d Air Base Gp. 24 tenant units on base. Activated Apr. 1, 1964 as Los Angeles AFS. Area 96 acres at Los Angeles AFB and 96 acres at Fort MacArthur Annex and Crest/Heights housing areas. Altitude 95 ft. Military 2,235; civilians 2,582. Payroll $105.4 million. Housing at Fort MacArthur Annex: 574 townhouses; 56 enlisted quarters; 29 VOQ; 4 DVQ; 22 TLF. Clinic, commissary, child-care center, and Air Force Family Support Center.

Lowry AFB, Colo. 80230-5000; on border between Denver and Aurora. Phone (303) 370-1110; AUTOVON 926-1110. ATC base. Technical Training Center; Air Force Accounting and Finance Center; Air Reserve Personnel Center; 3320th Correction and Rehabilitation Sqdn. Lowry Technical Training Center conducts training in avionics, space operations, munitions, logistics, and audiovisual fields. Base activated Oct. 1, 1937; named for 1st Lt. Francis B. Lowry, killed in action Sept. 26, 1918, near Crepion, France, while on a photo mission. Area 1,863 acres. Altitude 5,400 ft. Military 5,950; civilians 4,500. Payroll $266 million. Housing: 95 officer; 772 NCO; 240 VOQ, 585 VAQ, 40 TLF. USAF clinic on base, with Fitzsimons Army Medical Center 15 minutes away.

Luke AFB, Ariz. 85309-5000; 20 mi. WNW of Phoenix. Phone (602) 856-7411; AUTOVON 853-1110. TAC base. 832d Air Div.; 405th Tactical Training Wing, F-15 operations; 58th Tactical Training Wing, F-16 operations; 944th Tactical Fighter Gp. (AFRES). Luke, the largest fighter training base in the free world, conducts training of USAF and foreign pilots in the F-15, F-15E, and F-16. Base activated 1941; named for 2d Lt. Frank Luke, Jr., observation-balloon-busting ace of WW I and first flyer to receive the Medal of Honor, killed in action Sept. 29, 1918, near Murvaux, France. Area 4,197 acres, plus 2,700,000-acre range at Gila Bend, Ariz. Altitude 1,090 ft. Military 6,500; civilians 1,351. Payroll $206 million. Housing: 95 officer; 779 enlisted; 305 transient (180 VOQ, 85 VAQ 40 TLF). 55-bed hospital.

MacDill AFB, Fla. 33608-5000; adjacent to Tampa city limits. Phone (813) 830-1110; AUTOVON 968-1110. TAC base. 56th Tactical Training Wing, F-16 operations; Hq. Special Operations Command; Hq. US Central Command; Joint Communication Support Element. 56th Tactical Training Wing conducts replacement training in the F-16. Base activated Apr. 15, 1941; named for Col. Leslie MacDill, killed in an aircraft accident Nov. 8, 1938, near Washington, D. C. Area 5,631 acres. Altitude 6 ft. Military 6,696; civilians 1,216. Payroll $253 million. Housing: 58 officer; 746 enlisted; 540 transient (114 VAQ, 316 VOQ, 110 TLF). 65-bed hospital.

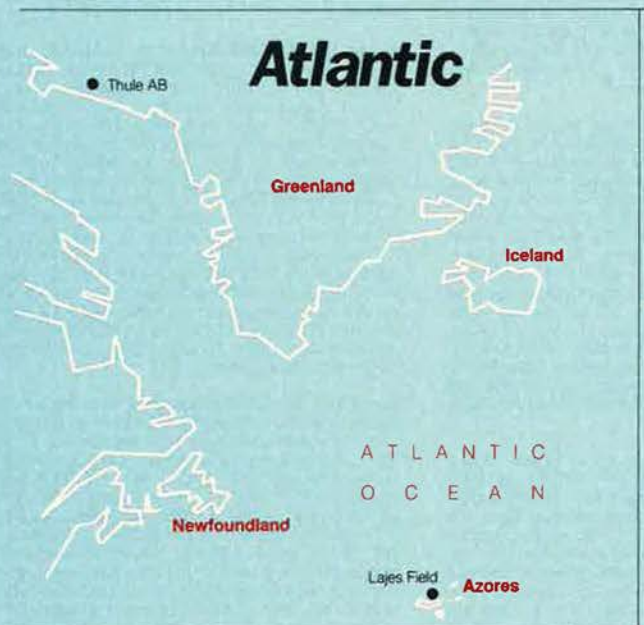
Malmstrom AFB, Mont. 59402-5000; 1.5 mi. E of Great Falls. Phone (406) 731-1110; AUTOVON 632-1110. SAC base. 40th Air Div.; 341st Strategic Missile Wing; 301st Air Refueling Wing. Base activated Dec. 15, 1942; named for Col. Einar A. Malmstrom, WW II fighter commander killed in air accident Aug. 24, 1954. Site of SAC's first Minuteman wing and newest flying unit. Area 3,573 acres, plus about 23,000 sq. mi. of missile complex. Altitude 3,525 ft. Military 4,252; civilians 553. Payroll $110 million. Housing: 258 officer; 1,148 NCO; 120 transient. Clinic.

March AFB, Calif. 92518-5000; 9 mi. SE of Riverside. Phone (714) 655-1110; AUTOVON 947-1110. SAC base. Hq. 15th Air Force; 22d Air Refueling Wing; Southwest Air Defense Sector (TAC); 22d Strategic Hospital; 452d Air Refueling Wing (AFRES); 943d Tactical Airlift Gp.; 163d Tactical Fighter Gp. (ANG); Customs Aviation Operations Center West. Base activated Mar. 1, 1918; named for 2d Lt. Peyton C. March, Jr., who died in Texas of crash injuries Feb. 18, 1918. Area 7,703 acres. Altitude 1,530 ft. Military 4,003; civilians 1,904. Payroll $244.6 million. Housing: 107 officer; 804 NCO; 215 transient. 105-bed hospital.

Mather AFB, Calif. 95655-5000; 12 mi. ESE of Sacramento. Phone (916) 364-1110; AUTOVON 828-1110. ATC base. DoD executive agent for Specialized Undergraduate Navigator Training (SUNT); USAF, Navy, and Marine Corps basic navigator training. Provides navigator training for 2d German Air Force and 90 other countries. Only navigator training base; also trains USAF electronic warfare officers. 323d Flying Training Wing (ATC); 940th Air Refueling Gp. (AFRES), KC-135E operations; 323d Air Base Gp. (ATC); 3506th Recruiting Gp. (ATC); 2034th Communications Sqdn. (AFCC); USAF Civil Air Patrol Pacific Liaison Region. Base activated 1918; named for 2d Lt. Carl S. Mather, killed in midair collision Jan. 30, 1918, in Texas. Area 5,800 acres. Altitude 96 ft. Military 5,388; civilians 1,976. Payroll $161.7 million. Housing:

Europe

USAF's Major Installations Overseas



Central America

452 officer; 820 NCO; 208 transient. 70-bed hospital. Scheduled for closure in October 1993.

Maxwell AFB, Ala. 36112-5000; 1 mi. WNW of Montgomery. Phone (205) 293-1110; AUTOVON 875-1110. AU base. 3800th Air Base Wing; Hq. Air University, professional military education center for USAF; Air War College; Air Command and Staff College; Center for Aerospace Doctrine, Research, and Education; Ira C. Eaker Center for Professional Development; Squadron Officer School; Air Force Historical Research Center; Hq. Air Force ROTC (ATC); Hq. Civil Air Patrol-USAF; Community College of the Air Force (ATC); 908th Tactical Airlift Gp. (AFRES). (The Senior NCO Academy and Extension Course Institute are at Gunter AFB.) Base activated 1918; named for 2d Lt. William C. Maxwell, killed in air accident Aug. 12, 1920, in the Philippines. Area 2,524 acres. Altitude 168 ft. Military 4,326; civilians 1,632. Payroll $237 million. Housing: 264 officer; 400 NCO; 1,123 transient (1,070 VOQ, 23 VAQ, 30 TLF). 60-bed hospital.

McChord AFB, Wash. 98438-5000; 8 mi. S of Tacoma. Phone (206) 984-1910; AUTOVON 976-1110. MAC base. 62d Military Airlift Wing; Hq. 25th Air Div. (TAC); 446th Military Airlift Wing (AFRES Assoc.). Base activated May 5, 1938; named for Col. William C. McChord, killed Aug. 18, 1937, while attempting a forced landing at Maidens, Va. Area 4,609 acres. Altitude 322 ft. Military 5,271; civilians 1,471. Payroll $157 million. Housing: 111 officer; 870 NCO; 284 transient. Dispensary.

McClellan AFB, Calif. 95652; 9 mi. NE of Sacramento. Phone (916) 643-2111; AUTOVON 633-1110. AFLC base. Hq. Sacramento Air Logistics Center provides logistics management, procurement, maintenance, and distribution support for F/FB/EF-111, A-10, A-7, and F-117A (Stealth fighter) weapon systems. It will also be support center for the Advanced Tactical Fighter. Other responsibilities include more than 200 electronic systems and programs and eight space systems. Also, technology centers for very-high-speed integrated circuits, fiber optics, and advanced composites. The center has unique capability for robotic nondestructive inspection using X-ray and neutron radiology on F-111-size aircraft. Other major units include Hq. Air Rescue Service (MAC); 2049th Communications Gp. and 1849th Electronics Installation Sqdn. (AFCC); Technical Operations Division, Air Force Technical Applications Center; 431st Test and Evaluation Sqdn. (TAC); Hq. 4th Air Force (AFRES); US Coast Guard Air Station, Sacramento (DOT). Named for Maj. Hezekiah McClellan, pioneer in Arctic aeronautical experiments, who was killed in crash May 25, 1936. Area 3,755 acres. Military 3,500; civilians 13,500. Payroll $545 million. Housing: 132 officer; 343 NCO; 21 transient. New USAF Medical Clinic.

McConnell AFB, Kan. 67221-5000; 5 mi. SE of Wichita. Phone (316) 652-6100; AUTOVON 743-1110. SAC base. 384th Bomb Wing; 184th Tactical Fighter Gp. (ANG). First B-1B arrived Jan. 1988. Base activated June 5, 1951; named for Capt. Fred J. McConnell, WW II B-24 pilot who died in crash of a private plane Oct. 25, 1945, and for his brother, 2d Lt. Thomas L. McConnell, also a WW II B-24 pilot, killed July 10, 1943, during attack on Bougainville in the Pacific. Area 3,066 acres. Altitude 1,371 ft. Military 3,259; civilians 415. Payroll $165 million. Housing: 96 officer; 493 NCO; 92 transient (26 VOQ, 41 VAQ, 25 TLF). 15-bed hospital.

McGuire AFB, N. J. 08641-5000; 18 mi. SE of Trenton. Phone (609) 724-1100; AUTOVON 440-0111. MAC base. 438th Military Airlift Wing; Hq. 21st Air Force; New Jersey ANG; New Jersey Civil Air Patrol; 170th Air Refueling Gp. (ANG); 108th Tactical Fighter Wing (ANG); 514th Military Airlift Wing (AFRES Assoc.); MAC NCO Academy East; Air Force Band of the East; and OLB, 1361st Audiovisual Sqdn. Base adjoins Army's Fort Dix; formerly Fort Dix Army Air Base. Activated as AFB 1949; named for Maj. Thomas B. McGuire, Jr., P-38 pilot, second leading US ace of WW II, recipient of Medal of Honor, killed in action Jan. 7, 1945, in the Philippines. Area 3,552 acres. Altitude 133 ft. Military 8,184 (incl. AFRES); civilians 5,684 (incl. AFRES). Payroll $226 million. Housing: 193 officer; 1,560 NCO; 863 transient (237 VOQ, 626 VAQ). Dispensary and 150-bed hospital at Fort Dix.

Minot AFB, N. D. 58705-5000; 13 mi. N of Minot. Phone (701) 723-1110; AUTOVON 453-1110. SAC base. 57th Air Div.; 91st Strategic Missile Wing, Minuteman III operations; 5th Bomb Wing, B-52H and KC-135 operations; 2150th Communications Sqdn. (AFCC); Det. 7, 37th Air Rescue Sqdn. (MAC), HH-1H operations; 64th Flying Training Wing OLB (ATC), T-38 operations; Det. 21, 9th Weather Sqdn. (AWS); AFOSI Det. 1312; Det. 35, 3904th Management Engineering Sqdn.; Det. 520, Air Force Audit Agency; 15th Air Force NCO Leadership School. Base activated Jan. 1957; named after the city of Minot, whose citizens donated $50,000 toward purchase of the land for the Air Force. Area 5,085 acres, plus additional 19,324 acres for missile sites. Altitude 1,668 ft. Military 5,285; civilians 580. Payroll $67 million. Housing: 480 officer; 1,981 enlisted; 163 private trailer spaces; 156 transient (incl. 32 VOQ, 84 VAQ, 40 TLF). 45-bed hospital.

Misawa AB, Japan, APO San Francisco 96519-5000; within Misawa city limits. Phone (commercial, from CONUS) 011-81-176-53-5181; AUTOVON 226-1110. PACAF base; joint service base. 432d Tactical Fighter Wing, host unit, F-16C/D operations; 6920th Electronic Security Gp. (ESC); 2114th Communications Sqdn. (AFCC); Naval Air Facility (USN); Naval Security Gp. Activity (USN); US Army field station; Company "E" US Marine Corps. Base occupied by US forces Sept. 1945. Area 3,873 acres. Altitude 119 ft. Military 5,125 (total US forces); US civilians 777; local nationals 813. Payroll $113 million. Housing: 325 officer; 1,859 NCO; 305 transient. 15-bed hospital.

Moody AFB, Ga. 31699-5000; 10 mi. NNE of Valdosta. Phone (912) 333-4211; AUTOVON 460-1110. TAC base. 347th Tactical Fighter Wing, F-16 fighter operations. Base activated June 1941; named for Maj. George P. Moody, killed May 5, 1941, while test-flying Beech AT-10. Area 6,050 acres. Altitude 233 ft. Military 3,493; civilians 664. Payroll $97 million. Housing: 36 officer; 268 enlisted; 68 transient (19 VAQ, 37 VOQ, 12 TLF). 25-bed hospital.

Mountain Home AFB, Idaho 83648-5000; 10 mi. SW of Mountain Home. Phone (208) 828-2111; AUTOVON 857-2111. TAC base. 366th Tactical Fighter Wing, F-111A fighter-bomber and EF-111A electronic countermeasures aircraft. 2036th Communications Sqdn. (AFCC); 513th Field Training Det. (ATC); Det. 5, 1st Electronic Combat Range Gp. (Wilder AS, ID); 777th Radar Sqdn. (OTH-B); Det. 2, USAF Fighter Weapons School; Det. 3, Tactical Air Warfare Center; AFOSI Det. 2007; Det. 454, Air Force Audit Agency; Det. 366, 4400th Management Engineering Sqdn.; Det. 18, 25th Weather Sqdn. Base activated Aug. 1943. Area 9,112 acres. Altitude 3,000 ft. Military 3,484; civilians 513. Payroll $87 million. Housing: 242 officer; 1,279 enlisted; 157 transient (80 VAQ, 61 VOQ, 16 TLF). 20-bed hospital.

Myrtle Beach AFB, S. C. 29579-5000; in south Myrtle Beach. Phone (803) 238-7211; AUTOVON 748-1110. TAC base. Shares runway with Myrtle Beach Jetport. 354th Tactical Fighter Wing, A-10 fighter operations; 2066th Communications Sqdn. (AFCC); 301st Field Training Det. (ATC); 1816th Reserve Advisor Sqdn.; Det. 3, 3d Weather Sqdn.; Det. 354, 4400th Management Engineering Sqdn. (ATC); Det. 2105 (AFOSI); 73d Tactical Control Sqdn. (TAC). Served as Army air base 1941–47; USAF base since 1956. Area 3,793 acres. Altitude 25 ft. Military 3,500; civilians 780. Payroll $85 million. Housing: 95 officer; 682 enlisted; 65 trailer lots; 133 transient (81 VAQ, 38 VOQ, 14 TLF). 20-bed hospital.

Nellis AFB, Nev. 89191-5000; 8 mi. NE of Las Vegas. Phone (702) 643-1800; AUTOVON 682-1800. TAC base. USAF Tactical Fighter Weapons Center, F-15, F-15E, F-16, F-111, A-10, AT-38; 57th Fighter Weapons Wing, F-16 Aggressor operations; USAF Air Demonstration Sqdn. (Thunderbirds); USAF Fighter Weapons School; 4440th Tactical Fighter Training Gp. (Red Flag); 4443d Tactical Training Gp. (Air Warrior); 554th Operations Support Wing; 554th Range Gp.; 820th Civil Engineering Sqdn. RED HORSE; 2069th Communications Gp. Base activated July 1941; named for 1st Lt. William H. Nellis, WW II P-47 fighter pilot, killed Dec. 27, 1944, in Europe. Area 11,274 acres, with ranges totaling 3,012,770 acres. Altitude 1,869 ft. Military 11,000; civilians 1,200. Payroll $443 million. Housing: 107 officer; 1,367 enlisted; 100 trailer spaces; 424 transient (153 VOQ, 211 VAQ, 60 TLF). 35-bed hospital.

Newark AFB, Ohio 43057; 1 mi. SW of Newark. Phone (614) 522-2171; AUTOVON 346-2171. AFLC base. Aerospace Guidance and Metrology Center repairs inertial guidance and navigation systems for most of the Air Force's missiles and aircraft as well as a variety of inertial systems for other branches of the armed forces. Also manages the Air Force's worldwide measurement and calibration program, providing the link between the National Bureau of Standards and the Air Force's 130 precision measurement equipment laboratories at bases around the world. Five tenant units. Activated as an Air Force station Nov. 7, 1962. Military 80; civilians 2,700. Payroll $92 million.

Norton AFB, Calif. 92409-5000; 59 mi. E of Los Angeles, within San Bernardino corporate limits. Phone (714) 382-1110; AUTOVON 876-1110. MAC base. 63d Military Airlift Wing; Hq. Air Force Inspection and Safety Center; Hq. Air Force Audit Agency; Hq. Aerospace Audiovisual Service (MAC); Ballistic Systems Division (AFSC); 445th Military Airlift Wing (AFRES Assoc.); MAC NCO Academy West; 22d Air Force NCO Leadership School. Base activated Mar. 2, 1942; named for Capt. Leland F. Norton, native of San Bernardino, WW II A-20 attack bomber pilot, killed in action May 27, 1944, near Amiens, France. Area 2,430 acres. Altitude 1,156 ft. Military 8,255 (incl. AFRES); civilians 2,899. Payroll $276 million. Housing: 380 transient (40 TLQ, 166 VAQ, 174 VOQ); 1,552 dormitories, 19 full hook-up trailer lots, 20 trailer sites. Clinic. Scheduled for closure in FY 1994.

Offutt AFB, Neb. 68113-5000; 8 mi. S of Omaha. Phone (402) 294-1110; AUTOVON 271-1110. SAC base. Hq. Strategic Air Command. 55th Strategic Reconnaissance Wing; 544th Strategic Intelligence Wing; Air Force Global Weather Central (MAC); 3d Weather Wing (MAC); Hq. Strategic Communications Div. (AFCC); 1st Aerospace Communications Wing (AFCC); 1000th Satellite Operations Gp. (AFSPACECOM); 6949th Electronic Security Sqdn. (ESC); Joint Strategic Target Planning Staff (JSTPS); National Emergency Airborne Command Post (NEACP); 702d Air Force Band. Base activated 1896 as Army's Fort Crook; landing field named in 1924 for 1st Lt. Jarvis J. Offutt, WW I pilot, who died Aug. 13, 1918, from injuries received at Valheureux, France. Area 1,914 acres (incl. housing area and off-base sites). Altitude 1,048 ft. Military 12,674; civilians 2,396 (incl. 576 contractors). Payroll $455 million. Housing: 513 officer; 2,133 NCO; 60 transient. 93-bed hospital.

Onizuka AFB, Calif. 94088-3430; 37 mi. S of San Francisco at Sunnyvale. Phone (408) 752-3110; AUTOVON 359-3110. AFSPACECOM base. Host unit is 2d Satellite Tracking Gp., 1004th Space Support Sqdn.; Consolidated Space Test Center (AFSC); 1999th Communications Sqdn. (AFCC). Base activated Dec. 2, 1959, as Sunnyvale AFS, renamed for Lt. Col. Ellison S. Onizuka, killed Jan. 28, 1986, in the space shuttle *Challenger* accident. Area 20 acres. Altitude 34 ft. Military 704, civilians 222, contractors 2,000. Housing: 20 officer, 80 NCO (located at NAS Moffett Field). No transient housing.

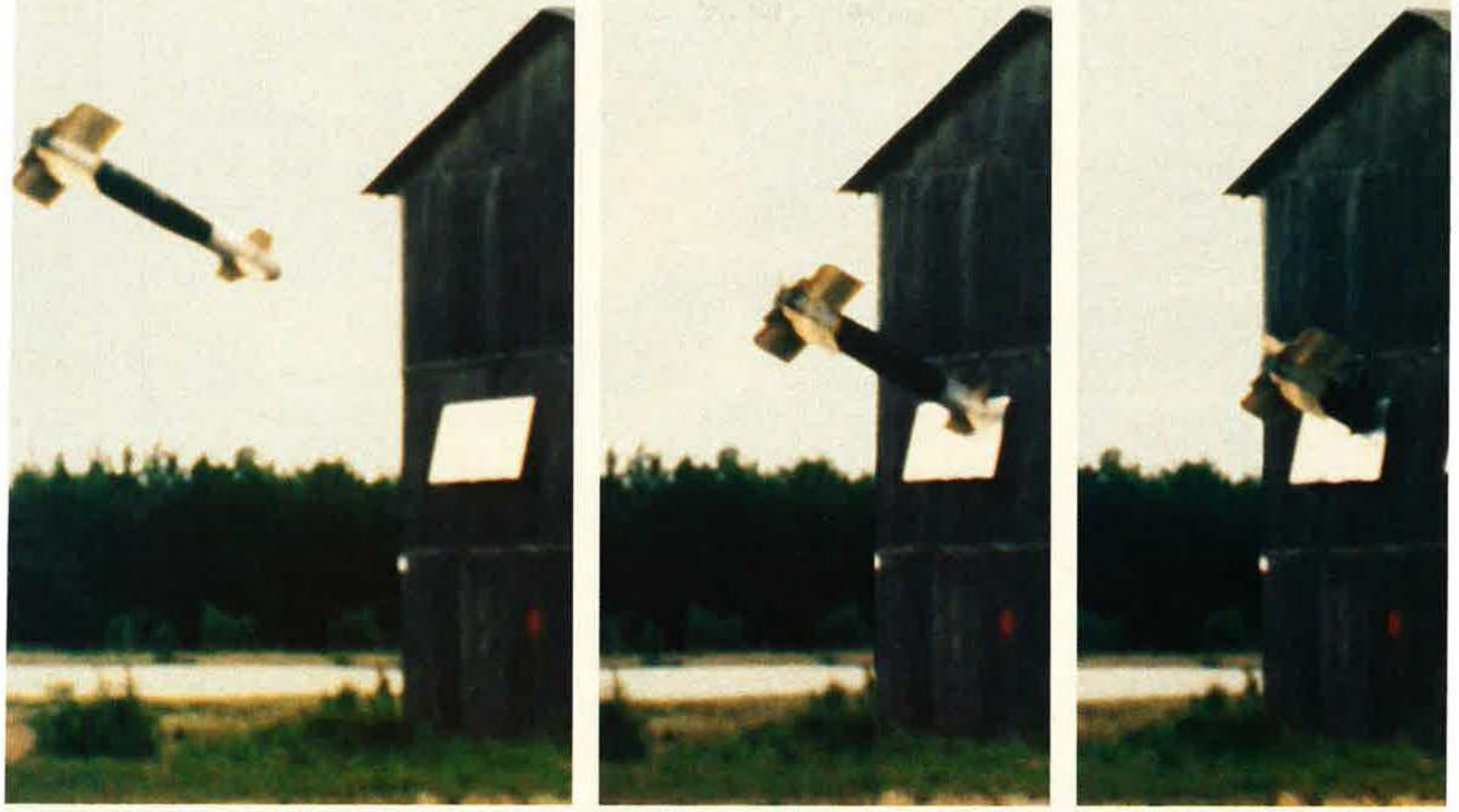
Osan AB, Korea, APO San Francisco 96570-5000; 38 mi. S of Seoul. Phone (commercial, from CONUS) 011-82-333-414-4044; AUTOVON 784-4110. PACAF base. Hq. 7th Air Force; Host unit 51st Tactical Fighter Wing, F-16C/D operations; 2146th Communications Gp. (AFCC); 6903d Electronic Security Gp. (ESC); 611th Military Airlift Support Gp. (MAC); 554th Civil Engineering RED HORSE Sqdn. (PACAF); 38th Air Rescue Sqdn. (MAC). Originally designated K-55; runway opened Dec. 1952. Renamed Osan AB in 1956 for nearby town that was the scene of first fighting between US and North Korean forces in July 1950. Area 1,674 acres. Altitude 38 ft. Military 7,754; US civilians 215; local nationals 1,610. Payroll $220 million. Housing: 153 officer; 59 enlisted. Transient 420, 16 temporary lodging facility units. 30-bed hospital.

Patrick AFB, Fla. 32925-6655; 2 mi. S of Cocoa Beach. Phone (407) 494-1110; AUTOVON 854-1110. AFSC base. Operated by the Eastern Space and Missile Center in support of DoD, NASA, and other agency missile and space programs. Major tenants are Defense Equal Opportunity Management Institute; Air Force Technical Applications Center; Det. 15, 41st Air Rescue Sqdn.; 2d Combat Communications Gp. (AFCC); 2179th Communications Gp. (AFCC); Det. 11, 2d Weather Sqdn. (MAC); Det. 5, 9th Strategic Reconnaissance Wing (SAC). Base activated 1940; serves as airhead for Cape Canaveral AFS. Cape Canaveral AFS has supported more than 3,000 launches since 1950. Named for Maj. Gen. Mason M. Patrick, Chief of AEF's Air Service in WW I and Chief of the Air Service/Air Corps, 1921–27. Area 2,341 acres. Altitude 9 ft. Military 3,722; civilians 1,758. Payroll $140.6 million (military, Civil Service). Housing: 157 officer; 1,419 NCO. 15-bed hospital.

Pease AFB, N. H. 03803-5000; 3 mi. W of Portsmouth. Phone (603) 430-0100; AUTOVON 852-1110. SAC base. 509th Bombardment Wing (FB-111 medium bomber and KC-135 tanker operations); 541st Air Force Band; 1916th Communications Sqdn. (AFCC); 3519th USAF Recruiting Sqdn. (ATC); 157th Air Refueling Gp. (ANG). Base activated 1956; named for Capt. Harl Pease, Jr., WW II B-17 pilot and Medal of Honor recipient, killed Aug. 7, 1942, during attack on Rabaul, New Britain Island. First base to close as a result of the 1988 Base Realignment and Closure Commission, scheduled for closure in September 1990. 509th BMW will transfer to Whiteman AFB, Mo., on October 1, 1990. Area 4,254 acres. Altitude 101 ft. Military 3,607; civilians 654. Payroll $97.1 million. Housing: 196 officer; 1,015 NCO (plus 50 trailer spaces); 124 transient (incl. 41 VOQ, 55 VAQ, 28 TLF). 70-bed hospital.

Peterson AFB, Colo. 80914-5000; at eastern edge of Colorado Springs. Phone (719) 554-7321; AUTOVON 692-7011. AFSPACECOM base. Hq. Air Force Space Command. Host unit is 3d Space Support Wing (AFSPACECOM). Provides support to Hq. North American Aerospace Defense Command; Hq. US Space Command; Hq. Army Space Command; 1st Space Wing; 302d Tactical Airlift Wing (AFRES); and 2d Space Wing located 10 mi. E at Falcon AFB. Base activated 1942; named for 1st Lt. Edward J. Peterson, who was killed Aug. 8, 1942, in aircraft crash at the base. Area 1,155 acres. Altitude 6,200 ft. Military active-duty 5,696; re-

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



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serves 1,374; civilians 2,381. Payroll $218 million. Housing: 107 officer; 384 NCO; 217 transient (75 VOQ, 102 VAQ, 40 TLF). 50 trailer spaces. Clinic.

Plattsburgh AFB, N. Y. 12903-5000; adjacent to Plattsburgh. Phone (518) 565-5000; AUTOVON 689-5000. SAC base. 380th Bomb Wing, medium bomber and tanker operations with FB-111 and KC-135. 530th Combat Crew Training Sqdn., trains all FB-111 combat crews for SAC. 8th Air Force NCO Leadership School; FOLE, 71st Flying Training Wing (ATC); 2042d Communications Sqdn. (AFCC); 210th Field Training Det. Second oldest active military installation in the US, established 1814; AFB since 1955. Area 4,879 acres. Altitude 235 ft. Military 3,966; civilians 496. Payroll $115 million. Housing: 222 officer; 1,421 NCO. 20-bed hospital.

Pope AFB, N. C. 28308-5000; 12 mi. NNW of Fayetteville. Phone (919) 394-0001; AUTOVON 486-1110. MAC base. 317th Tactical Airlift Wing; USAF Airlift Center; 1st Aeromedical Evacuation Sqdn.; 1943d Communications Sqdn. (AFCC); 1721st Combat Control Sqdn.; 53d Mobile Aerial Port Sqdn. (AFRES); Det. 3, MACOS (Combat Control School); 215th Field Training Detachment (ATC); Tactical Air Control Party (TAC); OLC, 1361st Audiovisual Service and 1724th Special Tactics Sqdn. (23d Air Force). Base adjoins Army's Fort Bragg and provides intratheater airlift support for airborne forces and other personnel, equipment, and supplies. Base activated 1919; named after 1st Lt. Harley H. Pope, WW I flyer, killed Jan. 7, 1917, when his JN-4 "Jenny" crashed into the Cape Fear River near Fayetteville. Area 1,750 acres. Altitude 218 ft. Military 4,492; civilians 662. Payroll $184 million. Housing: 89 officer; 370 NCO; 218 transient. Clinic.

RAF Alconbury, United Kingdom, APO New York 09238-5000; 3 mi. NW of Huntingdon; 60 mi. N of London. Phone (commercial, from CONUS) 011-44-480-82300; AUTOVON 223-3000. Royal Air Force base. 10th Tactical Fighter Wing (USAFE) provides air-to-ground support for US and Allied forces in Europe. Major associate units include 17th Reconnaissance Wing (SAC); 2166th Communications Sqdn. (AFCC); 6952d Electronic Communications Sqdn. (AFCC); 819th RED HORSE Civil Engineering Sqdn. (RAF Wethersfield); Det. 36, 28th Weather Sqdn. (MAC); Det. 6, 7200th Management Engineering Sqdn., 7119th Air Base Flight (RAF Wethersfield); Det. 4, 7000th Contracting Sqdn. (RAF Upwood). Initially activated in 1938; first used by US forces in September 1942. Area 2,954 acres. Altitude 160 ft. Military 3,800; civilians 1,250. Payroll $122 million. Housing: 103 officer, 738 enlisted; 300 leased units (enlisted only); 2,485 dorm spaces. Clinic.

RAF Bentwaters/RAF Woodbridge, United Kingdom, APO New York 09755-5000; 90 mi. NE of London. Phone (commercial, from CONUS) 011-44-394-433000; AUTOVON 225-1110. Royal Air Force base. 81st Tactical Fighter Wing (USAFE) operates the twin bases (which are four miles apart), four A-10 attack squadrons (two at each base), and one squadron of F-16Cs flown by the 527th Aggressor Sqdn. The wing also supports three forward operating location detachments in W. Germany. Associate units include three squadrons of the 39th Special Operations Wing-Woodbridge (MAC) and the 2164th Communications Sqdn. (AFCC). Bases opened by RAF in 1944 and 1943, respectively, and reactivated by the US in 1951 and 1952. Bases named after local landmark and nearby town, respectively. Area 1,990 acres. Altitude 86 ft. Military 4,297; civilians 970. Payroll $115 million. Housing: 156 officer; 1,026 enlisted; 1,411 dorm spaces; 180 transient quarters. Clinic.

RAF Chicksands, United Kingdom, APO New York 09193-5000; 9 mi. S of Bedford; 45 mi. N of London. Phone (commercial, from CONUS) 011-44-462-812571; AUTOVON 234-1110. Royal Air Force base. 7274th Air Base Gp. (USAFE) provides logistics, administrative, and air base management. Mission units provide rapid radio relay; secure communications; and command, control, and communications countermeasures support to US and Allied forces. The base supports three major mission units: the 693d Electronic Security Wing (ESC); 6950th Electronic Security Gp. (ESC); and the Department of Defense Joint Operations Center Chicksands (DoD). Base activated in 1939; US presence began in November 1950. Base named after the sandy soil on which it sits. Area 411 acres. Military 1,272; civilians 408. Payroll $33.7 million. Housing: 45 officer; 368 enlisted; 26 UNCO; 75 billeting rooms; four dorms with 603 bed spaces. Clinic.

RAF Fairford, United Kingdom, APO New York 09125-5000; 20 mi. N of Swindon. Phone (commercial, from CONUS) 011-44-285-714000; AUTOVON 247-1110. Royal Air Force base. 7020th Air Base Gp. (USAFE) provides operation and maintenance for the 11th Strategic Gp. (SAC) and other associate units; part of the European Tanker Task Force, flying KC-135 Stratotankers. Activated by the RAF in Jan. 1944 and reactivated by the US in Feb. 1979. Named after the town of Fairford. Area 1,170 acres. Altitude 286 ft. Military 1,200; civilians 450. Payroll $27.3 million. Housing: 88 officer; 474 enlisted; 205 dorm rooms; 60 VOQ; 27 VAQ; 24 TLF; 23 UNCO. Clinic.

RAF Greenham Common, United Kingdom, APO New York 09150-5000; 2 mi. S of Newbury and 47 mi. SW of London. Phone (commercial, from CONUS) 011-44-635-512000; AUTOVON 266-1110. Royal Air Force base. 501st Tactical Missile Wing (USAFE) maintains and operates BGM-109G ground-launched cruise missile; also the 850th Munitions Maintenance Sqdn. (USAFE). Base activated by RAF in 1941. Current US presence began in 1967. Named after the tract of common land on which it is situated. Area 1,005 acres. Altitude 398 ft. Military 1,547; civilians 466. Payroll $44.2 million. Housing: 664 units; 31 VAQ; 21 VOQ; 1 TLF. Clinic.

RAF Lakenheath, United Kingdom, APO New York 09179-5000; 70 mi. NE of London; 25 mi. from Cambridge. Phone (commercial, from CONUS) 011-44-638-52-3000; AUTOVON 226-1110. Royal Air Force base. 48th Tactical Fighter Wing (USAFE) flies the F-111 and trains for and conducts tactical air operations in support of NATO. Base activated in 1941; 48th TFW began operations in Jan. 1960. Named after nearby village. Area 2,226 acres. Altitude 32 ft. Military 4,490; civilians 1,603. Payroll $137.1 million. Housing: 651 units; 1,065 US Govt. leased housing; 295 billeting spaces. Regional medical center.

RAF Mildenhall, United Kingdom, APO New York 09127-5000; 30 mi. NE of Cambridge. Phone (commercial, from CONUS) 011-44-638-51-1110; AUTOVON 238-1110. Royal Air Force base. Hq. 3d Air Force (USAFE). 513th Airborne Command and Control Wing (USAFE) supports four major USAFE functions. Associate units include 306th Strategic Wing (SAC) (rotational), 313th Tactical Airlift Gp. (MAC) (rotational), Silk Purse Control Gp. (USEUCOM), and 2147th Communications Wing (AFCC). Base activated in 1934; US presence began in July 1950. Named after the village of Mildenhall. Area 1,144 acres. Altitude 33 ft. Military 2,793; civilians 976. Payroll $73.2 million. Housing: 95 officer; 510 enlisted; 1,115 US Govt. leased housing; 1,485 transient (40 TLF; 238 VOQ; 467 VAQ; 740 BAQ). Medical annex.

RAF Upper Heyford, United Kingdom, APO New York 09194-5000; 13 mi. N of Oxford. Phone (commercial, from CONUS) 011-44-869-232331; AUTOVON 263-1110. Royal Air Force base. 20th Tactical Fighter Wing (USAFE) provides long-range, all-weather tactical fighter and electronic combat sorties for NATO. Associate units include 2130th Communications Gp., 317th Contingency Hospital, 7520th Air Base Sqdn., and 2119th Communications Sqdn. Activated during WW I; 20th TFW began operations here in Dec. 1969. Named after local town. Area 1,221 acres. Altitude 412 ft. Military 5,089; civilians 1,939. Payroll $153 million. Housing: 203 officer; 624 enlisted; 350 enlisted US Govt. leased housing; 53 TLF; 8 BOQ; 42 VOQ; 104 senior enlisted and 1,970 junior NCO/airman BEQ; 30 VEQ. Hospital.

Ramstein AB, W. Germany, APO New York 09094-5000; adjacent to Ramstein; 10 mi. W of Kaiserslautern. Phone (commercial, from CONUS) 011-49-6371-47-113; AUTOVON 480-1110. USAFE base. Hq. USAFE; Hq. Allied Air Forces Central Europe (NATO). 316th Air Div. is host unit for the Kaiserslautern Military Community and is composed of two major wings: the 377th Combat Support Wing and the 86th Tactical Fighter Wing, which flies the F-16C/D. Major associates include Hq. European Electronic Security Div. (ESC), Hq. 7th Air Div. (SAC), Hq. 322d Airlift Div. (MAC), 2d Weather Wing (MAC), 7455th Tactical Intelligence Wing (USAFE), 608th Military Airlift Gp. (MAC), 1856th Communications Gp. (AFCC), and the 1964th Communications Gp. (AFCC). Base activated and US presence began in 1953. Area 5,292 acres. Altitude 782 ft. Military 7,867; civilians 6,531. Payroll $539.9 million. Housing: 5,891 units; 569 US Govt. leased units; 5,116 billeting units. Clinic.

Randolph AFB, Tex. 78150-5000; 17 mi. ENE of San Antonio. Phone (512) 652-1110; AUTOVON 487-1110. ATC base. Hq. Air Training Command; 12th Flying Training Wing, T-37 and T-38 pilot instructor training; Air Force Military Personnel Center; Hq. Air Force Management Engineering Agency; USAF Occupational Measurement Center; Civilian Personnel Management Center; Hq. Joint Military Medical Command; Hq. USAF Recruiting Service. Base activated June 1930; named for Capt. William M. Randolph, killed Feb. 17, 1928, when his AT-4 crashed on takeoff at Gorman, Tex. Area 3,223 acres. Altitude 761 ft. Military 5,781; civilians 5,418. Payroll $302 million. Housing: 241 officer; 718 NCO; 412 transient. Clinic.

Reese AFB, Tex. 79489-5000; adjacent to Lubbock. Phone (806) 885-4511; AUTOVON 838-1110. ATC base. 64th Flying Training Wing, undergraduate pilot training. Base activated 1942; named for 1st Lt. Augustus F. Reese, Jr., P-38 fighter pilot killed during a train-strafing mission at Cagliari, Sardinia, May 14, 1943. Area 2,467 acres. Altitude 3,338 ft. Military 1,290; civilians 447. Payroll $73.3 million. Housing: 109 officer; 289 NCO (188 under renovation); 63 transient (8 suites, 25 TLF, 14 VOQ, 16 VAQ). 15-bed hospital.

Rhein-Main AB, W. Germany, APO New York 09097-5000; 5 mi. S of Frankfurt. Phone (commercial, from CONUS) 011-49-69-699-1110; AUTOVON (314) 330-1110. MAC base. 435th Tactical Airlift Wing is host at Rhein-Main, the only MAC base in Europe. The 37th Tactical Airlift Sqdn. flies C-130E aircraft in support of DoD and European theater airlift requirements. The 2d Aeromedical and Evacuation Sqdn. and the 55th Aeromedical Airlift Sqdn. provide inter- and intratheater aeromedical airlift. Other major units include the 39th Special Operations Wing, the On-Site Inspection Agency Field Office Europe, and the Army's 21st Replacement Battalion. Base activated July 1936; US Forces began operations Mar. 1945. Named after the confluence of the Rhein and Main rivers west of Frankfurt. Area 923 acres. Altitude 365 ft. Military 5,744; civilians 1,549. Payroll $95.3 million. Housing (on-base, government-owned): 152 officer; 492 enlisted; (off-base, government-owned): 12 officer; 145 enlisted; (off-base, government-leased): 301 units; 266 rooms/564 beds at base hotel; 173 rooms/278 beds VAQ. USAF clinic.

Robins AFB, Ga. 31098; 15 mi. SSE of Macon at Warner Robins. Phone (912) 926-1110; AUTOVON 468-1110. AFLC base. Hq. Warner Robins Air Logistics Center provides worldwide logistics management for the F-15 air superiority fighter, C-130 and C-141 cargo aircraft, as well as helicopters, air-to-air missiles, air-to-ground missiles, a ground-to-air missile, and remotely piloted vehicles. Other management responsibilities include the Low-Altitude Navigation and Targeting Infrared for Night system, the Joint Tactical Information Distribution System, the Navstar Global Positioning System, E-3 Airborne Warning and Control System avionics, all Air Force airborne electronic warfare equipment, airborne communications equipment, airborne bomb and gun directing systems, fire fighting equipment, general-purpose vehicles, general-purpose computers, and measuring and hand tools. Other major units include Hq. Air Force Reserve (AFRES); 2853d Air Base Gp.; 19th Air Refueling Wing (SAC); 5th Combat Communications Gp. (AFCC); 3503d US Air Force Recruiting Gp.; 1926th Communications Sqdn. (AFCC); 9th Missile Warning Sqdn. (AFSPACECOM). Base activated Mar. 1942; named for Brig. Gen. Augustine Warner Robins, an early Chief of the Materiel Division of the Air Corps, who died June 16, 1940. Area 8,800 acres. Altitude 294 ft. Military approx. 4,000; civilians approx. 15,000. Payroll $607.7 million. Housing: 249 officer; 1,147 NCO; 40 TLF; 145 VOQ; 111 VAQ; 100 trailer spaces. 20-bed hospital.

San Vito Dei Normanni AB, Italy, APO New York 09240-5000; 7 mi. NW of Brindisi; 200 mi. ESE of Naples. Phone (commercial, from CONUS) 011-39-831-42-3519; AUTOVON 622-1110. USAFE base. 7275th Air Base Gp. provides logistics, administrative, and air base management support to other associate and tenant units such as the 6917th Electronic Security Gp; 2113th Communications Sqdn; Det. 8, 4th Weather Wing; OLA, Det. 7, Air Force European Broadcasting Sqdn.; OLA, Det. 6, 7000th Contracting Sqdn.; Baker-Nunn Spacetrack; and Naval Security Group Activity, San Vito. Base activated and US presence began Nov. 1960. Named for nearby village. Area 318 acres. Altitude 15 ft. Military 1,843; civilians 405. Payroll $41.6 million. Housing: 28 officer; 202 enlisted; (150 units to be completed by Oct. 1990); 447 dorm spaces for E-1 to E-6; 6 Senior NCO; 10 VOQ; 27 VAQ; 30 TLF rooms. Clinic.

Sawyer AFB *(see K. I. Sawyer AFB).*

Scott AFB, Ill. 62225-5000; 6 mi. ENE of Belleville. Phone (618) 256-1110; AUTOVON 576-1110. MAC base. 375th Military Airlift Wing; Hq. Military Airlift Command; Hq. Air Force Communications Command; Hq. US Transportation Command; Hq. Air Weather Service; Defense Commercial Communications Office; Environmental Technical Applications Center; USAF Medical Center, Scott; 7th Weather Wing; 932d Aeromedical Airlift Gp. (AFRES Assoc.); Airlift Communications Div.; 375th Combat Support Gp. Base activated June 14, 1917; named for Cpl. Frank S. Scott, the first enlisted man to die in an aircraft accident, killed Sept. 28, 1912, while "hitching" a ride in one of the Wright Type B Flyers at College Park, Md. Area 3,000 acres. Altitude 453 ft. Military 6,500; civilians 4,000. Payroll $388.3 million. Housing: 309 officer; 1,396 NCO; plus 193 spaces for privately owned trailers; 300 transient. 325-bed hospital; 100-bed aeromedical staging facility.

Sembach AB, W. Germany, APO New York 09130-5000; 9 mi. NE of Kaiserslautern. Phone (commercial, from CONUS) 011-49-6302-67-113; AUTOVON 496-1110. USAFE base. Hq. 17th Air Force (USAFE). Host unit is the 66th Electronic Combat Wing with a mission of employing electronic combat weapon systems in the European theater of operations flying the EC-130H Compass Call

aircraft. Major associate units include the 601st Tactical Control Wing; 2005th Communications Wing; 2134th Communications Sqdn.; 31st Weather Sqdn.; and 6914th Electronic Security Sqdn. Sembach is also a forward operating location for Det. 1, 81st Tactical Fighter Wing, RAF Bentwaters, which flies the A-10 Thunderbolt II. Base activated 1930; US presence began July 1953. Named after a nearby farming community. Area 843 acres. Altitude 1,037 ft. Military 3,200; civilians 564. Payroll $76.1 million. Housing: 92 officer; 414 enlisted; 1,021 billeting spaces. Clinic.

Seymour Johnson AFB, N. C. 27531-5000; within city limits of Goldsboro. Phone (919) 736-5400; AUTOVON 488-1110. TAC base. 4th Tactical Fighter Wing, F-4E and F-15E fighter operations; 68th Air Refueling Wing (SAC); 916th Air Refueling Gp. (AFRES); 2012th Communications Sqdn. (AFCC); OLAD, 191st Fighter Interceptor Gp. (MichANG). Base activated June 12, 1942; named for Navy Lt. Seymour A. Johnson, Goldsboro native, killed Mar. 5, 1941, in an aircraft accident in Maryland. Area 3,320 acres. Altitude 109 ft. Military 4,500; civilians 950. Payroll $112.9 million. Housing: 154 officer; 1,543 enlisted; 147 transient (76 VAQ, 44 VOQ, 27 TLF). 20-bed hospital.

Shaw AFB, S. C. 29152-5000; 10 mi. WNW of Sumter. Phone (803) 668-8110; AUTOVON 965-1110. TAC base. 363d Tactical Fighter Wing, F-16 fighter operations; Hq. 9th Air Force (TAC); 507th Tactical Air Control Wing, OV-10 aircraft; manages ground tactical air control systems. Base activated Aug. 30, 1941; named for 2d Lt. Ervin D. Shaw, one of the first Americans to see air action in WW I, killed in France on July 9, 1918, when his Bristol fighter was shot down during a reconnaissance mission. Area 3,363 acres; supports another 8,078 acres. Altitude 244 ft. Military 6,125; civilians 1,666. Payroll $176 million. Housing: 170 officer; 1,534 enlisted; 251 transient (124 VAQ, 87 VOQ; 40 TLF). 40-bed hospital.

Shemya AFB, Alaska (APO Seattle 98736-5000); located at western tip of the Aleutian Islands chain, midway between Anchorage, Alaska, and Tokyo, Japan. Phone (907) 392-3000; AUTOVON (317) 392-3000. AAC base. 5073d Air Base Gp. (AAC), host unit; 16th Surveillance Sqdn. (AFSPACECOM); Det. 1, 6th Strategic Reconnaissance Wing (SAC). Base activated 1943. Shemya was used as a bomber base in WW II. The International Date Line has been bent around Shemya so that the local date is the same as elsewhere in the US. Island area about 11.25 sq. mi. Altitude 270 ft. Military 578; civilian contract employees 125. Payroll $2.7 million. Housing: 70 transient. Dispensary.

Sheppard AFB, Tex. 76311-5000; 4 mi. N of Wichita Falls. Phone (817) 851-2511; AUTOVON 736-1001. ATC base. Sheppard Technical Training Center includes the 3700th Technical Training Wing, which conducts courses in aircraft maintenance, civil engineering, communication, comptroller, transportation, and instructor training; 3790th Field Training Wing, which provides training in biomedical sciences, dentistry, health service administration, medical readiness, medicine, nursing, and the Physician Assistant Training Program; 3785th Field Training Wing, which provides training on specific weapon systems and on-the-job training advisory service at 75 field training detachments, 19 operating locations, and one field training flight worldwide; 80th Flying Training Wing (ATC), which conducts T-37 and T-38 undergraduate pilot training and instructor pilot training for 12 nations in the Euro-NATO Joint Jet Pilot Training Program; 2054th Communications Sqdn. (AFCC); and the 3750th Air Base Gp. Base activated June 14, 1941; named for US Sen. Morris E. Sheppard of Texas, who died April 9, 1941. Area 5,500 acres. Altitude 1,015 ft. Military 5,491; civilians 1,121. Payroll $175 million (not including allies' UPT). Housing: 200 officer; 1,085 NCO; 398 VOQ, 2,006 VAQ, 50 TLF. 135-bed regional hospital.

Soesterberg AB, The Netherlands, APO New York 09292-5000; 3 mi. from Zeist; 26 mi. from Amsterdam. Phone (commercial, from CONUS) 011-31-3463-58199; AUTOVON 363-8199. Royal Netherlands air base. 32d Tactical Fighter Gp. (USAFE) prepares for and conducts all-weather operations in intercept, identification, and air superiority roles in support of NATO using the F-15. Base activated 1913; US presence began 1954. Area 515 acres. Altitude 66 ft. Military 1,595; civilians 1,788. Payroll $63.6 million. Housing: 40 officer; 290 US Govt. leased housing; 225 dorm spaces; 31 VAQ; 6 VOQ. Clinic.

Spangdahlem AB, W. Germany, APO New York 09126-5000; 8 mi. E of Bitburg; 20 mi. NE of Trier. Phone (commercial, from CONUS) 011-49-6565-61-1110; AUTOVON 452-1110. USAFE base. 52d Tactical Fighter Wing is the only Wild Weasel base in USAFE. Base activated and US presence began in 1953. Named after the local town. Area 1,282 acres. Altitude 1,196 ft. Military 4,800; civilians 900. Payroll $106 million. Housing: 43 officer; 615 enlisted; 500 US Govt. leased units; 1,110 billeting spaces. Clinic.

Thule AB, Greenland, APO New York 09023-5000; NW coast of Greenland; 700 mi. N of Arctic Circle; approx. 900 mi. S of North Pole. Phone (commercial, from CONUS) 011-299-50124; AUTOVON 834-1211 for Cheyenne Mountain AFB, then ask for Thule operator. AFSPACECOM base. 1012th Air Base Gp.; 12th Missile Warning Sqdn.; Det. 3, 2d Satellite Tracking Gp. Base activated in 1952. Area 2,600 acres. Altitude sea level. Military 180; civilians 180 American contractors and approx. 1,000 Danish contractors. Housing: no family housing; no quarters or facilities for visitors. Permanent party dormitories for military and civilian personnel. Transient quarters available only for TDY personnel.

Tinker AFB, Okla. 73145-5990; 8 mi. SE of Oklahoma City. Phone (405) 732-7321; AUTOVON 884-1110. AFLC base. Hq. Oklahoma City Air Logistics Center furnishes logistics support for bombers, jet engines, instruments, and electronics. Other major units include Engineering Installation Div. (AFCC); 3d Combat Communications Gp. (AFCC); 28th Air Div. (TAC); 507th Tactical Fighter Gp. (AFRES). Base activated Mar. 1941; named for Maj. Gen. Clarence L. Tinker, whose LB-30 (an early model B-24) went down at sea southwest of Midway Island on June 7, 1942. Area 5,001 acres. Altitude 1,291 ft. Military 7,231; civilians 17,779. Payroll $677 million (FY 1989). Housing: 108 officer; 622 NCO. 35-bed hospital.

Torrejon AB, Spain, APO New York 09283-5000; 14 mi. NE of Madrid. Phone (commercial, from CONUS) 011-341-665-7777; AUTOVON 723-1110. USAFE base. Hq. 16th Air Force (USAFE). 401st Tactical Fighter Wing (USAFE) mission is to fly, maintain, and mobilize F-16C/D combat-ready aircraft in support of the NATO Southern Region and contingency taskings by Southern Air Command and USAFE; supports joint and combined forces through strike attack and air-superiority missions; combines one main operating base, one collocated operating base, and eight communications sites; responsible for the support and protection of 65 associate units, including Hq. 16th Air Force. Major associates include 625th Military Airlift Support Gp. (MAC); 1969th Communications Wing (AFCC); 2186th Communications Sqdn. (AFCC); Air Force Office of Special Investigations, District 68. Base activated and US forces began operation in June 1957. Named for the village of Torrejon de Ardoz. Area 3,206 acres. Altitude 2,000 ft. Military 3,745; civilians 1,555. Payroll $133.7 million. Housing: 67 units; 858 US Govt. leased units; 254 VOQ/VAQ rooms; 147 TLF; 616 dorm rooms. 35-bed hospital.

Travis AFB, Calif. 94535-5000; 50 mi. NE of San Francisco at Fairfield. Phone (707) 424-5000; AUTOVON 837-1110. MAC base. Hq. 22d Air Force; 60th Military Airlift Wing; 349th Military Airlift Wing (AFRES Assoc.); David Grant Medical Center; 1901st Communications Gp. (AFCC); 504th Air Force Band of the Golden Gate. Primary mission of the 60th MAW is strategic airlift. Base activated May 17, 1943; named for Brig. Gen. Robert F. Travis, killed Aug. 5, 1950, in a B-29 accident. Area 7,580 acres. Altitude 62 ft. Military 13,082; civilians 3,832. Payroll $274.5 million. Housing: 258 officer; 1,907 enlisted; 3,546 enlisted dormitory spaces; 704 transient (100 TLF; 165 VOQ; 439 VAQ). 298-bed hospital (acute care), 75 aeromedical staging flight beds and 52 dental treatment rooms.

Tyndall AFB, Fla. 32403-5000; 12 mi. E of Panama City. Phone (904) 283-1113; AUTOVON 523-1113. TAC base. USAF Air Defense Weapons Center; primary units are the 325th Tactical Training Wing, F-15 operations; 475th Weapons Evaluation Gp.; and 325th Combat Support Gp. Provides training of F-15 aircraft pilots, weapons controllers, centralized training for all F-15 maintenance personnel, and special training to enhance air-to-air combat skills. Single-point management for all continental USAF subscale and full-scale drone aerial target operations. TAC units include Southeast Air Defense Sector, home of Southeast Sector Operations Control Center, 4702d Computer Services Sqdn.; TAC NCO Academy East. Tenant units include Air Force Engineering and Services Center; 3625th Technical Training Sqdn. (ATC); and 2021st Communications Sqdn. (AFCC). Base activated Dec. 7, 1941; named for 1st Lt. Frank B. Tyndall, WW I fighter pilot killed July 15, 1930, in crash of P-1 near Mooresville, N. C. Area 29,115 acres. Altitude 18 ft. Military 4,623; civilians 1,685. Payroll $140 million. Housing: 149 officer; 921 enlisted; 1,007 transient (739 VAQ; 228 VOQ; 40 TLF). 30-bed hospital.

US Air Force Academy, Colo. 80840-5000; N of Colorado Springs. Phone (719) 472-1818; AUTOVON 259-3110. Direct Reporting Unit. Established Apr. 1, 1954. First class entered Lowry AFB, Colo., July 1955. Moved to permanent location Aug. 1958. Tenant units include 1876th Communications Gp.; Frank J. Seiler Research Lab (AFSC); DoD Medical Exam Review Board. Aircraft flown: T-41; Cessna 150 (cadet flying team); UV-18 (Det. 1, Peterson AFB); ASK-21 (glider); SG-233 (sailplane); TG7A (motor glider). Area 18,000 acres. Altitude 7,280 ft. Military 2,837; cadets 4,351; civilians 2,180. Payroll $240 million. Housing: 445 officer; 772 enlisted; 78 transient; 26 temporary family quarters. 65-bed hospital.

Vance AFB, Okla. 73705-5000; 3 mi. SSW of Enid. Phone (405) 237-2121; AUTOVON 962-7110. ATC base. 71st Flying Training Wing, undergraduate pilot training. Base activated Nov. 1941; named for Lt. Col. Leon R. Vance, Jr., Enid native, 1939 West Point graduate, and Medal of Honor recipient, killed July 26, 1944, when air-evac plane returning him to the US went down in the Atlantic near Iceland. Area 4,000 acres. Altitude 1,007 ft. Military 1,327; civilians 1,380 (1,200 contract employees). Payroll $86.1 million. Housing: 132 officer; 98 enlisted; 34 transient, 10 TLF. Clinic.

Vandenberg AFB, Calif. 93437-5000; 8 mi. NNW of Lompoc. Phone (805) 866-1611; AUTOVON 276-1110. SAC base. 1st Strategic Aerospace Div. (SAC), the host command, conducts all SAC missile combat crew training and ICBM follow-on operational testing and evaluation. Through the 4392d Aerospace Support Wing, 1st STRAD furnishes facilities and essential services to more than 50 DoD and non-DoD government organizations and 60 aerospace contractors on base. The major tenant unit, the Western Space and Missile Center (AFSC), provides launch and launch support of research and development ballistic missile tests and polar-orbiting space launches for DoD, USAF, and NASA. WSMC's Western Test Range supports ballistic and space test operations as well as East Coast space shuttle flights and other aeronautical tests employing the same sensors and data-gathering equipment. Originally Army's Camp Cooke. Activated Oct. 1941. Base was taken over by USAF June 7, 1957; renamed for Gen. Hoyt S. Vandenberg, USAF's second Chief of Staff. Area 98,400 acres. Altitude 400 ft. Military 3,586; civilians 1,408; civilian contractors 4,569. Payroll $119 million (military and civilians); $181.3 million (contractors). Housing: 511 officer; 1,567 NCO; 172 mobile trailer spaces; 400 transient. 45-bed hospital.

Warren AFB *(see Francis E. Warren AFB).*

Wheeler AFB, Hawaii 96854-5000; near center of the island of Oahu, adjacent to the Army's Schofield Barracks. Phone (808) 471-7110 (Oahu military operator); AUTOVON 471-7110. PACAF base. Host unit 15th Air Base Sqdn. Associate units include 6010th Aerospace Defense Gp. (Hawaii Regional Operations Control Center); US Army aviation units from Schofield Barracks. Base activated Feb. 1922; named for Maj. Sheldon H. Wheeler, commanding officer of Luke Field, Hawaii, in 1919, who was killed there July 13, 1921, when his biplane crashed during an aerial exhibition. Area 1,369 acres. Altitude 845 ft. Military 770; civilians 106. Payroll included in entry for Hickam AFB. Housing: 102 officer; 390 enlisted. Dispensary run by 15th Medical Gp.

Whiteman AFB, Mo. 65305-5000; 2 mi. S of Knob Noster. Phone (816) 687-1110; AUTOVON 975-3727. SAC base. 351st Strategic Missile Wing. Whiteman AFB is responsible for 150 Minuteman II ICBMs and is scheduled to receive the first B-2 bombers when they become operational in the 1990s. Base activated 1942; named for 2d Lt. George A. Whiteman, nearby Sedalia resident, who was the first pilot to die in combat during the attack on Pearl Harbor. Area 3,706 acres, plus missile complex of about 10,000 sq. mi. Altitude 869 ft. Military 3,025; civilians 500. Payroll $133.7 million. Housing: 129 officer; 849 enlisted; 74 transient (incl. 12 3-bdrm. guest houses, 40 VAQ, 18 VOQ, 4 DVQ). 30-bed hospital.

Williams AFB, Ariz. 85240-5000; 10 mi. E of Chandler. Phone (602) 988-2611; AUTOVON 474-1001. ATC base. 82d Flying Training Wing, largest undergraduate pilot training base; 1922d Communications Sqdn. (AFCC); home of AFSC Human Resources Lab/Flying Training Div., doing extensive research on flight simulators. Base activated July 1941; named for 1st Lt. Charles L. Williams, killed in bomber crash near Fort DeRussy, Hawaii, July 6, 1927. Area 4,761 acres. Altitude 1,385 ft. Military 3,000; civilians 1,277. Payroll $189.5 million. Housing: 272 officer; 428 NCO; 40 transient. 15-bed hospital.

Wright-Patterson AFB, Ohio 45433; 10 mi. ENE of Dayton. Phone (513) 257-1110; AUTOVON 787-1110. AFLC base. Hq. Air Force Logistics Command; Hq. Aeronautical Systems Div. (AFSC); Air Force Institute of Technology; USAF Medical Center, Wright-Patterson; US Air Force Museum; Air Force Acquisition Logistics Center; Logistics Operations Center; Logistics Management Systems Center; AFLC International Logistics Center; 2750th Air Base Wing (AFLC); 906th Tactical Fighter Gp. (AFRES); more than 90 other DoD activities and government agencies. Originally separate, Wright Field and Patterson Field were merged and redesignated Wright-Patterson AFB on Jan. 13, 1948. Named for aviation pioneers Orville and Wilbur Wright and for 1st Lt. Frank S. Patterson, killed June 19, 1918, in the crash of a DH-4. The Wright brothers did much of their early flying on Huffman Prairie, now in Area C of present base. Area 8,145 acres. Altitude 824 ft. Military 11,000; civilians 18,000; contracted service and contractor employees

6,000. Payroll $899 million. Housing: 732 officer; 1,629 NCO. 301-bed hospital.

Wueschheim AB, W. Germany, APO New York 09122-5000; 97 mi. NE of Frankfurt. Phone (commercial, from CONUS) 011-49-676241-113; AUTOVON 451-1110. USAFE base. 38th Tactical Missile Wing (USAFE) mission is to train personnel and to maintain and operate the BGM-109 ground-launched cruise missile. The wing will inactivate in late 1990 in accordance with the INF Treaty. Base activated in 1954; 38th TMW activated April 1, 1985. Named after nearby town. Area 121 acres. Altitude 1,465 ft. Military 862; civilians 17. Payroll $26.2 million. Support facilities provided by Hahn AB, Germany, 12 mi. away.

Wurtsmith AFB, Mich. 48753-5000; 3 mi. NW of Oscoda. Phone (517) 739-2011; AUTOVON 623-1110. SAC base. 379th Bomb Wing. Base activated 1924 as Camp Skeel, gunnery camp for Selfridge Field; became Oscoda Army Air Field during WW II; renamed in 1953 for Maj. Gen. Paul B. Wurtsmith, killed Sept. 13, 1946, in a B-25 crash. Base assigned to SAC Apr. 1, 1960. Area 5,221 acres. Altitude 634 ft. Military 3,239; civilians 613. Payroll $85.9 million. Housing: 224 officer; 1,118 NCO; 7 TLF units; 20 UOQ; 20 VOQ; 34 VAQ. 20-bed hospital.

Yokota AB, Japan, APO San Francisco 96328-5000; approx. 28 mi. W of Tokyo. Phone (commercial, from CONUS) 011-81-0425-2511, Ext. 7020; AUTOVON 225-7020. PACAF base. Hq. US Forces, Japan; Hq. 5th Air Force; host unit 475th Air Base Wing, UH-1N operations; 374th Tactical Airlift Wing, C-130 and C-21 operations, primary aerial port in Japan; 1956th Communications Gp. and 4th Combat Communications Gp. (AFCC). Base opened as Tama Army Air Field by Japanese in 1940. Area 1,750 acres. Altitude 457 ft. Military 4,580; US civilians 901; local nationals 1,674. Payroll $179.9 million. Housing: 600 officer; 1,565 enlisted; 324 transient; 26 temporary lodging facility units. 30-bed hospital.

Zaragoza AB, Spain, APO New York 09286-5000; 12 mi. SW of Zaragoza. Phone (commercial, from CONUS) 011-34-76-32-67-11; AUTOVON 724-1110. USAFE base. 406th Tactical Fighter Training Wing provides air-to-ground and air-to-air training for USAFE's Central Region fighter bases. Current US presence began in Feb. 1970. Area 2,982 acres. Altitude 863 ft. Military 850, plus 260 TDY personnel per month; civilians 1,370. Payroll $39.8 million. Housing: 30 officer; 126 enlisted; 174 VOQ; 357 VAQ; 10 TLF. Clinic.

Zweibrücken AB, W. Germany, APO New York 09860-5000; 20 mi. S of Ramstein AB. Phone (commercial, from CONUS) 011-49-6332-47-1110; AUTOVON 498-1110. USAFE base. 26th Tactical Reconnaissance Wing has four primary and very diverse missions: all-weather tactical reconnaissance in central Europe, wartime medical support, support of the European distribution system performed by the 10th Military Airlift Sqdn. (MAC), and support for the 601st Tactical Control Sqdn. Base activated 1953; US presence began 1969. "Zweibrücken" translates into "two bridges," which were the essential monuments of the city. Area 694 acres. Altitude 1,133 ft. Military 3,499; civilians 768. Payroll $110.3 million. Housing: 32 officer; 315 enlisted; 40 VOQ; 118 VAQ; 23 TLQ. Clinic. ■

Guide to USAF's Minor Installations

In addition to the places listed in this "Guide to Major Air Force Installations Worldwide," USAF has a number of minor installations. These Air Force stations (AFS) and air stations (AS) perform various missions, including air defense and missile warning. Here is a listing of such installations with state (or APO), ZIP code, and major command. When an installation can be reached by a general-purpose AUTOVON number, that number (AV) is also listed. In some cases, the designation air base (AB) is used because of political sensitivities.

Ankara AS, APO New York 09254-5000 (USAFE)	AV 672-1110
Avon Park AFS, Fla. 33825 (TAC)	AV 968-1110
Cape Canaveral AFS, Fla. 32925-5000 (AFSC)	AV 467-1110
Cape Cod AFS, Mass. 02532-1419 (AFSPACECOM)	AV 557-2202
Cavalier AFS, N. D. 58220-5000 (AFSPACECOM)	AV 330-3292
Clear AFS, APO Seattle 99704-5000 (AFSPACECOM)	AV 317-585-6416
Decimomannu AB, APO New York 09161-5000 (USAFE)	AV 621-9267
Duke Field AFS, Fla. 32542-6005 (MAC)	AV 872-1110
Eldorado AFS, Tex. 76936-5000 (AFSPACECOM)	AV 477-4220
Galena Airport, APO Seattle 98723 (AAC)	AV 317-446-3311
Gila Bend Air Force Auxiliary Field, Ariz. 85337-5000 (TAC)	AV 853-5220
Hessisch-Oldendorf AS, APO New York 09669-5000 (USAFE)	AV 331-1110
High Wycombe AS, APO New York 09241-5000 (USAFE)	AV 232-1110
Indian Springs Air Force Auxiliary Field, Nev. 89018-5000 (TAC)	AV 682-6201
Izmir AS, APO New York 09224-5000 (USAFE)	AV 675-1110
King Salmon Airport, APO Seattle 98713 (AAC)	AV 317-721-3301
Kwangju AB, APO San Francisco 96264-5000 (PACAF)	AV 786-1110
New Boston AFS, N. H. 03031-5000 (AFSPACECOM)	AV 881-1550
Pirinclik AS, APO New York 09294-5000 (USAFE)	AV 679-1110
Pruem AS, APO New York 09692-5000 (USAFE)	AV 453-1110
RAF Croughton, APO New York 09378-5000 (USAFE)	AV 236-1110
RAF Wethersfield, APO New York 09120-5000 (USAFE)	AV 224-1110
Sondrestrom AB, APO New York 09121-5000 (AFSPACECOM)	AV 834-1211; ask for Sondrestrom AB.
Suwon AB, APO San Francisco 96461-5000 (PACAF)	AV 784-4110
Taegu AB, APO San Francisco 96213-5000 (PACAF)	AV 766-1110
Tempelhof Central Airport AS, APO New York 09611-5155 (USAFE)	AV 332-5300
Woomera AS, APO San Francisco 96287-5000 (AFSPACECOM)	AV 730-1350

Guide to ANG and AFRES Bases

NOTE: This section of the Guide consolidates major Air National Guard (ANG) and Air Force Reserve (AFRES) bases into a single listing. Most ANG locations are listed alphabetically, according to the city in which or near which they are located. AFRES units are listed by the names of their bases and are designated as AFRES facilities. There are, in addition, some ANG and AFRES units that are located on active-duty bases. These may be found in the main "Guide to Major Air Force Installations Worldwide" elsewhere in this issue.

Anchorage, Alaska (Kulis ANG Base at Anchorage International Airport) 99502. Phone (907) 243-1145; AUTOVON (317) 626-1444. 176th Tactical Airlift Gp. (ANG); 144th Tactical Airlift Sqdn. (ANG). Base named for Lt. Albert Kulis, killed in training flight in 1954. Area 129 acres. Altitude 124 ft. Military 853, full-time personnel 249. Payroll $19.6 million. 6-bed hospital.

Atlanta, Ga. (McCollum Airport, Kennesaw, Ga.) 30144; 27 mi. N of Atlanta, 10 mi. from Dobbins AFB. Phone (404) 422-2500; AUTOVON 925-2474. 129th Tactical Control Sqdn. and 118th Tactical Control Sqdn. (ANG). Area 13 acres. Altitude 1,060 ft. Military 353, full-time personnel 47. Payroll through Dobbins AFB.

Atlantic City International Airport, N. J. (400 Langley Rd., Pleasantville) 08232-9500; 10 mi. W of Atlantic City. Phone (609) 645-6000; AUTOVON 445-6000. 177th Fighter Interceptor Gp. (ANG). Area 286 acres. Altitude 76 ft. Military 1,039, full-time support 378. Payroll $12.9 million.

Baltimore, Md. (Glenn L. Martin State Airport) 21220-2899; 8 mi. E of Baltimore. Phone (301) 687-6270; AUTOVON 235-9210. 175th Tactical Fighter Gp. (ANG); 135th Tactical Airlift Gp. (ANG). Area 175 acres. Altitude 24 ft. Military 1,864, full-time personnel 469. Payroll $18.3 million. Clinic.

Bangor ANG Base, Me. 04401-3099; 4 mi. NW of Bangor. Phone (207) 947-0571; AUTOVON 476-6210. 101st Air Refueling Wg. (ANG); 776th Radar Sqdn. (TAC). Area 300 acres. Altitude 192 ft. Military 1,072, full-time personnel 365, Title 5 civilians 25. Payroll $15.0 million. Small BX-Foodland.

Battle Creek, Mich. 49015-1291; adjacent to W. K. Kellogg Airport. Phone (616) 963-1596; AUTOVON 580-3210. 110th Tactical Air Support Gp. (ANG). Area 315 acres. Altitude 941 ft. Military 895, full-time personnel 243. Payroll $9.8 million.

Birmingham Municipal Airport, Ala. 35217. Phone (205) 841-9200; AUTOVON 694-2260. 117th Tactical Recon Wg. (ANG). Area 86 acres. Altitude 650 ft. Military 948, full-time personnel 337. Payroll $16.8 million.

Boise Air Terminal, Idaho (Gowen Field) 83707; 6 mi. S of Boise. Phone (208) 389-5011; AUTOVON 941-5011. 124th Tactical Recon Gp. (ANG). Also host to ARNG (Army field training site) and Marine Corps Reserve. Airport named for Lt. Paul R. Gowen, killed in B-10 crash in Panama July 11, 1938. Area 1,994 acres. Altitude 2,858 ft. Military 1,401, full-time personnel 476. Payroll $14.7 million. Limited transient facilities available during Army Guard camps.

Bradley ANG Base, Conn. 06026-5000; 15 mi. N of Hartford at East Granby, adjacent to Bradley International Airport. Phone (203) 623-8291; AUTOVON 636-8310. 103d Tactical Fighter Gp. (ANG); Army National Guard aviation battalion. Base named for Lt. Eugene M. Bradley, killed in P-40 crash Aug. 1941. Area 161 acres. Altitude 173 ft. Military 988, full-time personnel 292. Payroll $12.8 million.

Buckley ANG Base, Colo. 80011; 8 mi. E of Denver. Phone (303) 366-5363; AUTOVON 877-9011. 140th Tactical Fighter Wg. (ANG); 154th Tactical Control Gp.; Hq. Colorado ANG; 227th Air Traffic Control Flt. (ANG); and 240th Civil Engineering Flt. (ANG). Also host to Navy Reserve, Marine Corps Reserve, ARNG, and Air Force units. Base activated Apr. 1, 1942, as a gunnery training facility. ANG assumed control from US Navy in 1959. Base named for Lt. John H. Buckley, National Guardsman, killed in the Argonne, France, Sept. 27, 1918. Area 3,309 acres. Altitude 5,663 ft. Military 1,419, full-time personnel 336, Title 5 civilians 215. Payroll $24.4 million. Dispensary.

Burlington, Vt. (Burlington International Airport) 05401; 3 mi. E of Burlington. Phone (802) 658-0770; AUTOVON 689-4310. 158th Fighter Interceptor Gp. (ANG). Area 241 acres. Altitude 371 ft. Military 1,027, full-time personnel 396. Payroll $12.7 million.

Channel Island ANG Base, Calif. (Point Mugu) 93041-4001. Phone (805) 986-8000; AUTOVON 873-4000. 146th Tactical Airlift Wg. (ANG). Area 86 acres. Altitude 12 ft. Military 1,498, full-time personnel 372. Payroll $19.3 million.

Charleston, W. Va. (Yeager Airport) 25311-5000; 4 mi. NE of Charleston. Phone (304) 357-5100; AUTOVON

366-9210. 130th Tactical Airlift Gp. (ANG). Airport named for Brig. Gen. Charles "Chuck" Yeager, first man to break the sound barrier. Area 236 acres. Altitude 981 ft. Military 917, full-time personnel 245. Payroll $10.7 million. Dispensary, clinic.

Charlotte, N. C. (Charlotte/Douglas International Airport) 28208. Phone (704) 399-6363; AUTOVON 583-9210. 145th Tactical Airlift Gp. (ANG). Area 69 acres. Altitude 749 ft. Military 1,292, full-time personnel 321. Payroll $14.9 million. Clinic.

Cheyenne, Wyo. (Cheyenne Municipal Airport) 82001. Phone (307) 772-6201; AUTOVON 943-6201. 153d Tactical Airlift Gp. (ANG). Area 67 acres. Altitude 6,156 ft. Military 1,017 full-time personnel 260. Payroll $11.2 million.

Dallas Naval Air Station, Tex. (Hensley Field) 75211. Phone (214) 266-6111; AUTOVON 874-6111. 136th Tactical Airlift Wg. (ANG). Area 49 acres. Altitude 495 ft. Military 942, full-time personnel 252. Payroll $12.1 million.

Des Moines Municipal Airport, Iowa 50321; in city of Des Moines. Phone (515) 285-7182; AUTOVON 939-8210. 132d Tactical Fighter Wg. (ANG). Area 113 acres. Altitude 957 ft. Military 1,103 full-time personnel 339. Payroll $13.3 million.

Dobbins AFB, Ga. 30069-5000; 2 mi. S of Marietta, 16 mi. NW of Atlanta. Phone (404) 421-5000; AUTOVON 925-1110. AFRES base. Hq. 14th Air Force (AFRES); 94th Tactical Airlift Wg. (AFRES); 116th Tactical Fighter Wg. (ANG); 151st Military Intelligence Battalion (ARNG); 145th and 412th Medical Detachments (USAR). Base activated 1943; named for Capt. Charles Dobbins, WW II pilot killed in action near Sicily. Area 1,656 acres (ANG 55 acres). Altitude 1,068 ft. AFRES: active duty 33, full-time personnel 158, civilians 844, Reservists 1,744. Payroll $53.2 million. ANG: military 1,209, full-time personnel 383. Payroll $17.4 million. USAR: active duty 3; reservists 69. Housing: 5 NCO; VOQ, VAQ. Dispensary. NAS Atlanta, Lockheed Aeronautical Systems Company-Ga./Air Force Plant 6 adjoin Dobbins AFB and use airfield facilities.

Duluth International Airport, Minn. 55811-5000; 5 mi. NW of Duluth. Phone (218) 727-6886; AUTOVON 825-7210. 148th Fighter Interceptor Gp. (ANG). Area 409 acres. Altitude 1,429 ft. Military 1,072, full-time personnel 378 (+ 25 civilians). Payroll $15.3 million.

Ellington ANG Base, Tex. 77034-5586; adjacent to Ellington Field, a City of Houston Airport 17 mi. SE of downtown Houston. Phone (713) 929-2221; AUTOVON 954-2110. 147th Fighter Interceptor Gp. (ANG). Other tenants include NASA Flight Operations, US Coast Guard, Army National Guard, FAA. Base named for Lt. Eric L. Ellington, a pilot killed Nov. 1913. Area 213 acres. Altitude 40 ft. Military 1,040, full-time personnel 394. Payroll $17.6 million.

Fargo, N. D. (Hector Field) 58105-5536. Phone (701) 237-6030; AUTOVON 362-8110. 119th Fighter Interceptor Gp. (ANG). Area 133 acres. Altitude 900 ft. Military 1,219, full-time personnel 396. Payroll $16.2 million.

Forbes Field, Kan. 66619-5000; 2 mi. S of Topeka. Phone (913) 862-1234; AUTOVON 720-1234. 190th Air Refueling Gp. (ANG). Area 200 acres. Altitude 1,079 ft. Military 978, full-time personnel 329 (+ 43 civilians). Payroll $12.9 million.

Fort Smith Municipal Airport, Ark. 72906. Phone (501) 646-1601; AUTOVON 962-8210. 188th Tactical Fighter Gp. (ANG). Area 98 acres. Altitude 468 ft. Military 1,060, full-time personnel 298. Payroll $11.5 million.

Fort Wayne, Ind. (Fort Wayne Municipal Airport) 46809-5000; 5 mi. SSW of Fort Wayne. Phone (219) 478-3210; AUTOVON 786-1210. 122d Tactical Fighter Wg. (ANG). Area 138 acres. Altitude 800 ft. Military 1,306, full-time personnel 361. Payroll $14.8 million.

Fresno Air Terminal, Calif. 93727-2199; 5 mi. NE of Fresno. Phone (209) 454-5155; AUTOVON 949-9210. 144th Fighter Interceptor Wg. (ANG). Area 127 acres. Altitude 332 ft. Military 1,027, full-time personnel 410. Payroll $15.8 million.

General Mitchell International Airport, Wis. 53207-6299; 3 mi. S of Milwaukee. AFRES base. Altitude 722 ft. ANG and AFRES have separate phones and facilities. ANG phone (414) 747-4410; AUTOVON 580-8410. 128th Air Refueling Gp. (ANG). ANG area 110 acres. Military 1,133, full-time personnel 300. Payroll $13.3 million. AFRES phone (414) 481-6400; AUTOVON 786-9110. 440th Tactical Airlift Wg. (AFRES). AFRES area 101 acres. Full-time personnel and civilians 364, Reservists 1,234. Payroll $11.3 million.

Greater Peoria Airport, Ill. 61607-1498; 7 mi. SW of Peoria. Phone (309) 633-3000; AUTOVON 724-9210. 182d Tactical Air Support Gp. (ANG). Area 137 acres. Altitude 624 ft. Military 1,011, full-time personnel 253. Payroll $10.1 million. Dispensary.

Greater Pittsburgh International Airport, Pa. 15231-0459; 15 mi. NW of Pittsburgh. Altitude 1,203 ft. AFRES base. ANG and AFRES have separate phones and facilities. 171st Air Refueling Wg. (ANG); phone (412) 269-8402, AUTOVON 277-8402. 112th Tactical Fighter Gp. (ANG); phone (412) 269-8441, AUTOVON 277-8441. ANG area 94 acres. Military 1,847, full-time personnel 411. Payroll $19.8 million. AFRES phone (412) 269-8000; AUTOVON 277-8000. 911th Tactical Airlift Gp. (host unit). AFRES area 165 acres. Military 15, full-time personnel 135, civilians 200, Reservists 1,059. Payroll $12.5 million. Other units include 2185th Communications Installation Gp. (AFCC). Base activated 1943. Housing: 50 VOQ, 230 enlisted qtrs.

Great Falls International Airport, Mont. 59401-5000; 5 mi. SW of Great Falls. Phone (406) 727-4650; AUTOVON 279-2301. 120th Fighter Interceptor Gp. (ANG). Area 139 acres. Altitude 3,674 ft. Military 1,042, full-time personnel 404. Payroll $17.9 million. Dispensary.

Gulfport-Biloxi Regional Airport, Miss. 39501; within city limits of Gulfport. Phone (601) 868-6200; AUTOVON 363-8200. Training site; also host to 255th Tactical Control Sqdn. (ANG); the Army National Guard Transportation Repair Shop; and 173d Civil Engineering Flt. An air-to-ground gunnery range is located 70 mi. due N of site. Area 212 acres. Altitude 28 ft. ANG military 516, full-time personnel 46. Payroll $4.2 million. 2-bed dispensary.

Harrisburg International Airport, Middletown, Pa. 17057; 10 mi. E of Harrisburg. Phone (717) 948-2201; AUTOVON 454-9201. 193d Special Operations Gp. (ANG). ANG area 66 acres. Altitude 310 ft. Military 1,110, full-time personnel 312. Payroll $19.1 million.

Jackson, Miss. (Allen C. Thompson Field) 39208-0810; 7 mi. E of Jackson. Phone (601) 939-3633; AUTOVON 731-9310. 172d Military Airlift Gp. (ANG). ANG area 84 acres. Altitude 346 ft. Military 1,212, full-time personnel 309. Payroll $15.5 million. 6-bed dispensary.

Jacksonville International Airport, Fla. 32229; 15 mi. NW of Jacksonville. Phone (904) 757-1360; AUTOVON 460-7210. 125th Fighter Interceptor Gp. (ANG). Area 332 acres. Altitude 26 ft. Military 1,024, full-time personnel 402. Payroll $15.9 million. 5-bed dispensary.

Kingsley Field, Ore. 97603-0400; 5 mi. SE of Klamath Falls. Phone (503) 883-6350; AUTOVON 830-6350. 114th Tactical Fighter Training Sqdn. (ANG); 142d OLAD (ANG). Field named for 2d Lt. David R. Kingsley of Oregon, WW II Medal of Honor winner, killed June 23, 1944, over Ploesti, Romania. Area 402 acres. Altitude 4,000 ft. Military 390, full-time personnel 370, Title 5 civilians 16. Payroll $38.4 million. Clinic.

Knoxville, Tenn. (McGhee Tyson Airport) 37901; 10 mi. SW of Knoxville. Phone (615) 970-3077; AUTOVON 588-8210. Host unit is 134th Air Refueling Gp. (ANG). Tenants include 228th Combat Communications Sqdn. and ANG's I. G. Brown Professional Military Education Center. Area 271 acres. Altitude 980 ft. Military 1,166, full-time personnel 345. Payroll $15.1 million. Dispensary.

Lincoln Municipal Airport, Neb. 68524-1897; 1 mi. NW of Lincoln. Phone (402) 473-1326; AUTOVON 720-1210. 155th Tactical Recon Gp. (ANG). Also hosts Army National Guard unit. Area 175 acres. Altitude 1,207 ft. Military 1,117, full-time personnel 334. Payroll $12.5 million. Tactical clinic.

Louisville, Ky. (Standiford Field) 40213. Phone (502) 364-9400; AUTOVON 989-4400. 123d Tactical Airlift Wg. (ANG); 223d Communications Sqdn. (ANG). Area 65 acres. Altitude 497 ft. Military 1,111, full-time personnel 317. Payroll $13.9 million.

Mansfield Lahm Airport, Ohio 44901-5000; 3 mi. N of Mansfield. Phone (419) 522-9355; AUTOVON 696-6210. 179th Tactical Airlift Gp. (ANG). Airport named for nearby city and aviation pioneer Brig. Gen. Frank P. Lahm. Area 210 acres. Altitude 1,296 ft. Military 932, full-time personnel 256. Payroll $10.1 million. Clinic. Limited dependent ID card service. Coast Guard exchange.

Martinsburg, W. Va. (Shepherd Field) 25401; 4 mi. S of Martinsburg. Phone (304) 267-5100; AUTOVON 242-9210. 167th Tactical Airlift Gp. (ANG). Area 349 acres. Altitude 556 ft. Military 1,231, full-time personnel 286. Payroll $13.0 million. Dispensary.

McEntire ANG Base, S. C. 29044; 12 mi. E of Columbia. Phone (803) 776-5121; AUTOVON 583-8201. 169th Tactical Fighter Gp. (ANG). Also host to 240th Combat Communications Sqdn. (ANG) and Army Guard aviation unit. Base named for ANG Brig. Gen. B. B. McEntire, Jr., killed in an F-104 accident in 1961. Area 2,473 acres. Altitude 250 ft. Military 1,401, full-time personnel 370. Payroll $13.9 million. Dispensary.

Memphis International Airport, Tenn. 38181-0026; within Memphis city limits. Phone (901) 369-4111; AUTOVON 966-8210. 164th Tactical Airlift Gp. (ANG). ANG occupies 85 acres. Altitude 332 ft. Military 940, full-time personnel 258. Payroll $10.6 million. Clinic.

Meridian, Miss. (Key Field) 39302-1825; located at municipal airport near Highways 20 and 59. Phone (601) 693-5031; AUTOVON 694-9210. 186th Tactical Recon Gp. (ANG); host to 238th Combat Communications Sqdn. (ANG). Area 64 acres. Altitude 297 ft. Military 1,257, full-time personnel 363. Payroll $14.3 million. Dispensary.

Minneapolis-St. Paul International Airport, Minn. 55450-5000; in Minneapolis, near confluence of the Mississippi and Minnesota Rivers. AFRES base. Altitude 840 ft. ANG and AFRES have separate phones and facilities. ANG phone (612) 725-5011; AUTOVON 825-5681. 133d Tactical Airlift Wg. (ANG). ANG area 128 acres. Military 1,362, full-time personnel 270. Payroll $15.2 million. AFRES phone (612) 725-5011; AUTOVON 825-5110. 934th Tactical Airlift Gp. (AFRES) flies C-130 aircraft. AFRES area 300 acres. Reservists 1,130, full-time personnel 130, civilians 190. Payroll $17 million. Other units include 210th Engineering and Installation Sqdn. (ANG); 237th Air Traffic Control Flt. (ANG); Navy Readiness Comd., Region 16; OLG, 2185th Comm. Gp. (AFRES); Naval Air Reserve Center; Marine Wg. Support Gp. 47, Det. A; USAF-CAP/NCLR and CAP MNLO; Rothe Development Inc. (AFRES); Det. 3, 1974th Teleprocessing Gp. (USAF).

Moffett Naval Air Station, Calif. 94035; 2 mi. N of Mountain View. ANG phone (415) 966-4700; AUTOVON 462-4700. 129th Air Rescue Gp. (ANG). Area 13 acres. Altitude 34 ft. Military 762, full-time personnel 244. Payroll $14.0 million.

Montgomery, Ala. (Dannelly Field) 36196; 7 mi. SW of Montgomery. Phone (205) 284-7210; AUTOVON 742-9210. 187th Tactical Fighter Gp. (ANG). Base hosts 232d Combat Communications Sqdn. Field named for Ens. Clarence Dannelly, Navy pilot killed at Pensacola, Fla., during WW II. Area 51 acres. Altitude 221 ft. Military 1,065, full-time personnel 343. Payroll $15.0 million. Dispensary.

Nashville Metropolitan Airport, Tenn. 37217-0267; 6 mi. SE of Nashville. Phone (615) 361-4600; AUTOVON 446-6210. 118th Tactical Airlift Wg. (ANG). Area 85 acres. Altitude 597 ft. Military 1,407, full-time personnel 377. Payroll $18.2 million.

New Orleans Naval Air Station, La. (Alvin Callender Field) 70143-5000; 15 mi. S of New Orleans. Altitude 3 ft. ANG and AFRES have separate phones and facilities. ANG phone (504) 393-3392; AUTOVON 363-3399. 159th Tactical Fighter Gp. (ANG). ANG military 1,193, full-time personnel 421. Payroll $16.5 million. AFRES phone (504) 393-3293; AUTOVON 363-3293. 926th Tactical Fighter Gp. (AFRES). Military 820, full-time personnel 177. Payroll $10 million. NAS New Orleans was the first joint Air Reserve Training Facility. Field named for Alvin A. Callender, who served with the British Royal Flying Corps during WW I and who was shot down over France in 1918. Area 3,245 acres (ANG 19 acres). Dispensary.

Niagara Falls International Airport, N. Y. 14304-5000; 6 mi. E of Niagara Falls. Phone (716) 236-2000; AUTOVON 489-3011. AFRES base. 914th Tactical Airlift Gp. (AFRES); 107th Fighter Interceptor Gp. (ANG). Base activated Jan. 1952. Area 979 acres (ANG 104 acres). Altitude 590 ft. AFRES: civilians 255, Reservists 1,200. Payroll $18.7 million. ANG: military 1,055, full-time personnel 375. Payroll $14.5 million.

O'Hare Air Reserve Forces Facility, Ill. 60666; 22 mi. NW of Chicago's Loop. Phone (312) 694-6000; AUTOVON 930-1110. AFRES base. 928th Tactical Airlift Gp. (AFRES); 126th Air Refueling Wg. (ANG); Defense Contract Administration Services Region, Chicago. Base activated Apr. 1946; named for Lt. Cmdr. Edward H. "Butch" O'Hare, USN, Medal of Honor recipient, killed Nov. 26, 1943, during battle for Gilbert Islands. Area 391 acres (ANG 36 acres). Altitude 643 ft. Reservists 1,440, full-time personnel and civilians (all units) 1,350, Illinois ANG 1,426, full-time personnel 330. Payroll for total facility $64 million ($15.0 million for ANG). Limited base exchange, no on-base billeting facilities.

Ontario International Airport, Ontario, Calif. 91761. Phone (714) 984-2705; AUTOVON 898-1895. 148th Combat Communications Sqdn. (ANG); 210th Weather Flt. (ANG). Area 39 acres. Altitude 900 ft. Military 166, full-time personnel 25. Payroll $1.1 million.

Otis ANG Base, Mass. 02542-5001; 7 mi. NNE of Falmouth. Phone (508) 968-1000; AUTOVON 557-4003.

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102d Fighter Interceptor Wg. (ANG); 567th USAF Band (ANG); 101st and 202d Weather Flts. (ANG). Adjacent installations and organizations include Cape Cod AFS (6th Missile Warning Sqdn., 2165th Communications Sqdn.); US Coast Guard Air Station Cape Cod; Camp Edwards Army National Guard Training Site; 26th Aviation Brigade (ARNG); 1st Battalion, 25th Marines (Reserve); Massachusetts National Cemetery (VA). Base named for 1st Lt. Frank J. Otis, ANG flight surgeon and pilot killed in 1937 crash. Area 3,849 acres. Altitude 132 ft. ANG military 1,169, ANG full-time personnel 407 (+ 282 Title 5 Civil Service). Payroll $25.9 million.

Phelps Collins ANG Base, Alpena, Mich. 49707; 7 mi. W of Alpena. Phone (517) 354-6291; AUTOVON 741-3500. Training site detachment. Facilities used by ANG and AFRES units for annual field training and by ARNG and Marine Reserve for special training. Base named for Capt. W. H. Phelps Collins, American Flying Corps, killed in France Mar. 1918. Area 2,708 acres. Altitude 689 ft. Military 74, civilian full-time support 67. Payroll $2.2 million. Housing: 1,500 personnel. 14-bed hospital. Dispensary.

Phoenix, Ariz. (Sky Harbor International Airport) 85034. Phone (602) 244-9841; AUTOVON 853-9211. 161st Air Refueling Gp. (ANG). Area 51 acres. Altitude 1,230 ft. Military 1,016, full-time personnel 302. Payroll $14.8 million.

Portland International Airport, Portland, Ore. 97218-2797. Phone (503) 288-5611; AUTOVON 891-1701. 142d Fighter Interceptor Gp. (ANG); 244th Combat Communications Sqdn. (ANG); 272d Combat Communications Sqdn. (ANG); 116th Tactical Control Sqdn. (ANG); Det. 5, 2036th Communications Sqdn. (AFCC); 12th Special Forces Gp. (USAR); Oregon Wg., CAP. Also host to 939th Aerospace Rescue and Recovery Gp. (AFRES) and 83d Aerial Port Sqdn. (AFRES). Area 232 acres. Altitude 26 ft. Military 1,419, full-time personnel 474 (+ 58 civilians). Payroll $23.5 million.

Providence, R. I. (Quonset Point State Airport) 02852; 20 mi. S of Providence. Phone (401) 885-3960; AUTOVON 476-3210. 143d Tactical Airlift Gp. (ANG). Area 60 acres. Altitude 9 ft. Military 990, full-time personnel 259. Payroll $13.9 million.

Puerto Rico International Airport, Puerto Rico (Muniz ANG Base) 00914; E of San Juan. Phone (809) 728-5450; AUTOVON 860-9210. 156th Tactical Fighter Gp. (ANG). Base named for Lt. Col. José A. Muniz, killed in an aircraft accident July 4, 1960. Area 86 acres. Military 948, full-time personnel 278. Payroll $15.0 million.

Reno-Cannon International Airport, Nev. (May ANG Base) 89502; 5 mi. SE of Reno at 1776 ANG Way. Phone (702) 788-4500; AUTOVON 830-4500. 152d Tactical Recon Gp. (ANG). Base named for Maj. Gen. James A. May, state Adjutant General. Area 64 acres. Altitude 4,411 ft. Military 1,095, full-time personnel 324. Payroll $12.8 million. Dispensary.

Richards-Gebaur AFB, Mo. 64030-5000; 17 mi. S of Kansas City. Phone (816) 348-2000; AUTOVON 463-1110. 442d Tactical Fighter Wg. (AFRES); Navy and Army Reserve units. Base activated Mar. 1944; named for 1st Lt. John F. Richards and Lt. Col. Arthur W. Gebaur, Jr. Richards was killed Sept. 26, 1918, in France, while on an artillery spotting mission; Gebaur, an F-84 pilot, was killed Aug. 29, 1952, over North Korea during his 99th mission. Area 620 acres; another 120 acres occupied by non-USAF military units and federal agencies. Joint-use airport facility with Kansas City, Mo. Altitude 1,090 ft. AFRES and active-duty USAF military 1,471, full-time personnel 362. Payroll $21.3 million. On-base, Marine Corps-operated, all-service housing: 27 officer, 214 enlisted. Consolidated open mess and 156 transient quarters available.

Richmond, Va. (Byrd International Airport) 23150; 4 mi. SE of downtown Richmond. Phone (804) 222-6884; AUTOVON 274-8210. 192d Tactical Fighter Gp. (ANG). Airport named for Adm. Richard E. Byrd, famous Arctic and Antarctic explorer. Area 143 acres. Altitude 167 ft. Military 1,063, full-time personnel 318. Payroll $13.0 million.

Rickenbacker ANG Base, Ohio 43217; 13 mi. SSW of Columbus. Phone (614) 492-8211; AUTOVON 950-1110. Base transferred from SAC to ANG Apr. 1, 1980. 121st Tactical Fighter Wg. (ANG); 907th Tactical Airlift Gp. (AFRES); 160th Air Refueling Gp. (ANG); 2032d Communications Sqdn. (AFCC); Naval Air Reserve and Naval Construction (USNR). Base activated 1942. Formerly Lockbourne AFB; renamed May 7, 1974, in honor of Capt. Edward V. Rickenbacker, top US WW I ace and Medal of Honor recipient, who died July 23, 1973. Area 2,017 acres. Altitude 744 ft. ANG military 1,875, full-time personnel 474, Title 5 civilians 299. Payroll $30.9 million.

Roslyn ANG Station, Roslyn, N. Y. 11576-2399; 27 mi. E of New York City. Phone (516) 299-5201; AUTOVON 456-5201. 274th Combat Communications Sqdn. (ANG); 213th Engineering Installation Sqdn. (ANG). Also hosts two Army National Guard units. Area 50 acres. Altitude 320 ft. Military 403, full-time personnel 42. Payroll through Stewart IAP, N. Y.

Salt Lake City International Airport, Utah 84116; 3 mi. W of Salt Lake City. Phone (801) 521-7070; AUTOVON 790-9210. 151st Air Refueling Gp. (ANG); 169th Electronic Security Sqdn. (ANG). Also hosts ANG's 130th Engineering Installation Sqdn. and 106th and 109th Tactical Control Flts. Area 132 acres. Altitude 4,220 ft. Military 1,544, full-time personnel 374 (+ 41 civilians). Payroll $18.9 million. Dispensary.

Savannah International Airport, Ga. 31402; 4 mi. NW of Savannah. Phone (912) 964-1941; AUTOVON 860-8210. 165th Tactical Airlift Gp. (ANG). Also field training site. Area 232 acres. Altitude 50 ft. Military 1,150, full-time personnel 383. Payroll $16.1 million. Housing: 156 officer, 736 enlisted. 3-bed dispensary.

Schenectady County Airport, Scotia, N. Y. 12302-9752; 2 mi. N of Schenectady. Phone (518) 381-7300; AUTOVON 974-9221. 109th Tactical Airlift Gp. (ANG). Area 106 acres. Altitude 378 ft. Military 1,086, full-time personnel 248. Payroll $11.1 million. Dispensary.

Selfridge ANG Base, Mich. 48045; 3 mi. NE of Mount Clemens. Phone (313) 466-4011; AUTOVON 273-0111. 127th Tactical Fighter Wg. (ANG); 191st Fighter Interceptor Gp. (ANG); 927th Tactical Airlift Gp. (AFRES). Also hosts Air Force, Navy Reserve, Marine Air Reserve, Army Reserve, Army units, and US Coast Guard Air Station for Detroit. Base activated July 1917; transferred to Michigan ANG July 1971. Named for 1st Lt. Thomas E. Selfridge, first Army officer to fly an airplane and first fatality of powered flight, killed Sept. 17, 1908, at Fort Myer, Va., when plane piloted by Orville Wright crashed. Area 3,064 acres. Altitude 583 ft. ANG military 2,078, ANG full-time personnel 594 (+ 524 civilians). Payroll $41.7 million. Dispensary.

Sioux City Municipal Airport, Iowa 51110; 7 mi. S of Sioux City. Phone (712) 255-3511; AUTOVON 939-6210. 185th Tactical Fighter Gp. (ANG). Area 98 acres. Altitude 1,098 ft. Military 922, full-time personnel 291. Payroll $12.6 million. Dispensary.

Sioux Falls, S. D. (Joe Foss Field) 57104; N side of Sioux Falls. Phone (605) 336-0670; AUTOVON 939-7210. 114th Tactical Fighter Gp. (ANG). Field named for Brig. Gen. Joseph J. Foss, WW II ace, former governor of South Dakota, former AFA National President, and founder of the South Dakota ANG. Area 163 acres. Altitude 1,428 ft. Military 940, full-time personnel 286. Payroll $11.4 million.

Springfield, Ill. (Capital Airport) 63707-5000; 2 mi. NW of Springfield. Phone (217) 753-8850; AUTOVON 892-8210. 183d Tactical Fighter Gp. (ANG). Area 91 acres. Altitude 592 ft. Military 1,084, full-time personnel 307. Payroll $13.9 million. Dispensary.

Springfield-Beckley Municipal Airport, Ohio 45501-1780; 5 mi. S of Springfield. Phone (513) 323-8653; AUTOVON 346-2311. 178th Tactical Fighter Gp. (ANG); 251st Combat Communications Gp. (ANG); 269th Combat Communications Sqdn. (ANG). Area 114 acres. Altitude 1,052 ft. Military 1,191, full-time personnel 311. Payroll $14.8 million. 6-bed dispensary.

Stewart ANG Base, N. Y. (Stewart International Airport) 12550-0031; 4 mi. W of Newburgh, 15 mi. N of USMA (West Point). Phone (914) 563-2000; AUTOVON 247-2000. Hq. New York ANG; 105th Military Airlift Gp. (ANG); USMA subpost airport. Stewart AFB until 1969; acquired by state of New York in 1970. ANG area 264 acres. Altitude 491 ft. ANG military 1,787, full-time personnel 625. Payroll $14.9 million. Dispensary. Most military services available through West Point or subpost.

St. Joseph, Mo. (Rosecrans Memorial Airport) 64503; 4 mi. W of St. Joseph. Phone (816) 271-1300; AUTOVON 720-9210. 139th Tactical Airlift Gp. (ANG). Area 302 acres. Altitude 724 ft. Military 915, full-time personnel 258. Payroll $11.1 million.

St. Louis International Airport, Mo. (Lambert Field) 63145. Phone (314) 263-6356; AUTOVON 693-6356. 131st Tactical Fighter Wg. (ANG). Area 49 acres. Altitude 589 ft. Military 1,530, full-time personnel 371. Payroll $21.2 million.

Suffolk County Airport, Westhampton Beach, N. Y. 11978-1294; within corporate limits of Westhampton Beach. Phone (516) 288-4200; AUTOVON 456-7210. 106th Air Rescue Gp. (ANG). Area 70 acres. Altitude 67 ft. Military 804, full-time personnel 243. Payroll $14.4 million.

Syracuse, N. Y. (Hancock Field) 13211-7099; 5 mi. NE of Syracuse. Phone (315) 470-6100; AUTOVON 587-9100. 174th Tactical Fighter Wg. (ANG). Base operations for Hancock ANG Base. 152d Tactical Control Gp.; 108th and 113th Tactical Control Sqdns. (ANG). Area 376 acres. Altitude 421 ft. Military 1,392, full-time personnel 272. Payroll $15.7 million. Dispensary.

Terre Haute, Ind. (Hulman Regional Airport) 47803-5000; 5 mi. E of Terre Haute. Phone (812) 877-5210; AUTOVON 724-1210. 181st Tactical Fighter Gp. (ANG). Area 279 acres. Altitude 585 ft. Military 1,169, full-time personnel 317. Payroll $13.6 million. 5-bed dispensary.

Toledo Express Airport, Swanton, Ohio 43558; 14 mi. W of Toledo. Phone (419) 866-2078; AUTOVON 580-2078. 180th Tactical Fighter Gp. (ANG). Area 79 acres. Altitude 684 ft. Military 1,009, full-time personnel 287. Payroll $13.5 million. 4-bed clinic.

Truax Field, Madison, Wis. (Dane County Regional Airport) 53704-2591; 2 mi. N of Madison. Phone (608) 241-6200; AUTOVON 273-8210. 128th Tactical Fighter Wg. (ANG). Activated June 1942 as AAF base; taken over by Wisc. ANG in Apr. 1968. Field named for Lt. T. L. Truax, killed in a P-40 training accident in 1941. Area 155 acres. Altitude 862 ft. Military 1,006, full-time personnel 300. Payroll $11.9 million. Housing: 7 transient. Dispensary.

Tucson International Airport, Ariz. 85734; within Tucson city limits. Phone (602) 573-2210; AUTOVON 853-4210. 162d Tactical Fighter Gp. (ANG). Area 86 acres. Altitude 2,650 ft. Military 1,587, full-time personnel 832. Payroll $25.4 million.

Tulsa International Airport, Okla. 74115. Phone (918) 832-5208; AUTOVON 956-5297. 138th Tactical Fighter Gp. (ANG); 219th Electronic Installation Sqdn. Area 82 acres. Altitude 676 ft. Military 1,123, full-time personnel 290. Payroll $12.5 million.

Volk Field ANG Base, Wis. 54618-5001; 90 mi. NW of Madison. Phone (608) 427-1210; AUTOVON 798-3210. ANG field training site featuring air-to-air and air-to-ground gunnery ranges and providing training for ANG flying units. Base and field named for Lt. Jerome A. Volk, first Wisconsin ANG pilot killed in the Korean War. Area 2,273 acres. Altitude 910 ft. Military 61. Payroll $2.1 million. 6-bed dispensary.

Westfield, Mass. (Barnes Municipal Airport) 01085; 3 mi. N of Westfield. Phone (413) 568-9151; AUTOVON 636-1210/11. 104th Tactical Fighter Gp. (ANG). Area 133 acres. Altitude 270 ft. Military 1,026, full-time personnel 294. Payroll $13.2 million.

Westover AFB, Mass. 01022-5000; 5 mi. NE of Chicopee. Phone (413) 557-1110; AUTOVON 589-1110. AFRES base. 439th Military Airlift Wg. (AFRES). Also home of Army, Navy, and Marine Corps Reserve and Massachusetts Army National Guard. Base dedicated Apr. 6, 1940; named for Maj. Gen. Oscar Westover, Chief of the Air Corps, killed Sept. 21, 1938, in crash near Burbank, Calif. Area 2,386 acres. Altitude 244 ft. Reservists 2,632, full-time personnel (AFRES and tenant units) 211, civilians 744. Payroll $35.9 million. Housing: 360 VAQ rooms (656 beds), 44 VOQ (168 beds).

Willow Grove Air Reserve Forces Facility, Pa. 19090; 14 mi. N of Philadelphia. Altitude 356 feet. ANG and AFRES have separate phones and facilities. ANG phone (215) 443-1500; AUTOVON 991-1500. 111th Tactical Air Support Gp. (ANG). ANG area 39 acres. Military 1,191, full-time personnel 282. Payroll $10.4 million. AFRES phone (215) 443-1062; AUTOVON 991-1062. 913th Tactical Airlift Gp. (AFRES). AFRES area 162 acres. Reservists 856, full-time personnel 147, civilians 122. Payroll $9.3 million. Other units include Army, Navy, and Marine Corps Reserve. Defense Contract Administration Services Region, Philadelphia; 92d Aerial Port Sqdn. (MAC) off-base tenant. Base activated Aug. 1958. Navy transient quarters available but limited.

Will Rogers World Airport, 5624 Air Guard Dr., Oklahoma City, Okla. 73169-5000; 7 mi. SW of Oklahoma City. Phone (405) 686-5210; AUTOVON 956-8210. 137th Tactical Airlift Wg. (ANG). Area 71 acres. Altitude 1,290 ft. Military 1,213, full-time personnel 253. Payroll $13.2 million.

Wilmington, Del. (Greater Wilmington Airport) 19720; 5 mi. S of Wilmington. Phone (302) 322-3361; AUTOVON 455-3000. 166th Tactical Airlift Gp. (ANG); Army National Guard aviation company. Area 57 acres. Altitude 80 ft. Military 1,066, full-time personnel 242. Payroll $10.5 million. 2-bed dispensary.

Youngstown Municipal Airport, Ohio 44473-5000; 16 mi. N of Youngstown. Phone (216) 392-1000; AUTOVON 346-1000. AFRES base. 910th Tactical Airlift Gp. (AFRES); 757th Tactical Airlift Sqdn. (AFRES). Other units include OLC, 2046th Communications Gp.; Defense Contract Administration Services. Base activated 1952. Area 230 acres. Altitude 1,196 ft. Reservists 1,005, full-time personnel 143, civilians 233. Payroll $17 million. ■

COUNTDOWN TO FIRST FLIGHT

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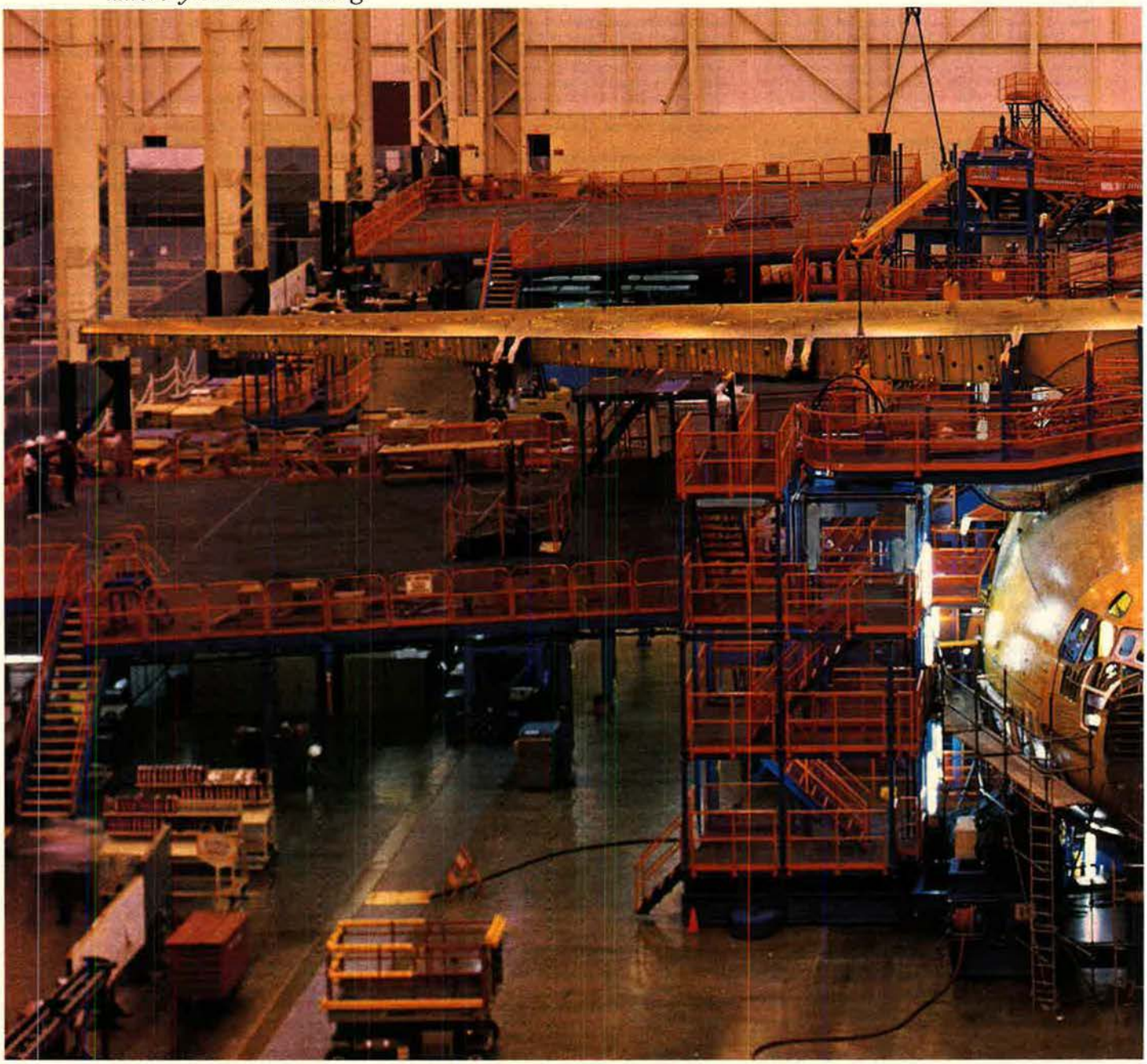

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Joining the largest supercritical wing in the free world to the main fuselage of the C-17 is more than a major engineering and production feat. It also marks a major milestone in the completion of this remarkable aircraft.

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Wing joined to main fuselage March 1, 1990.

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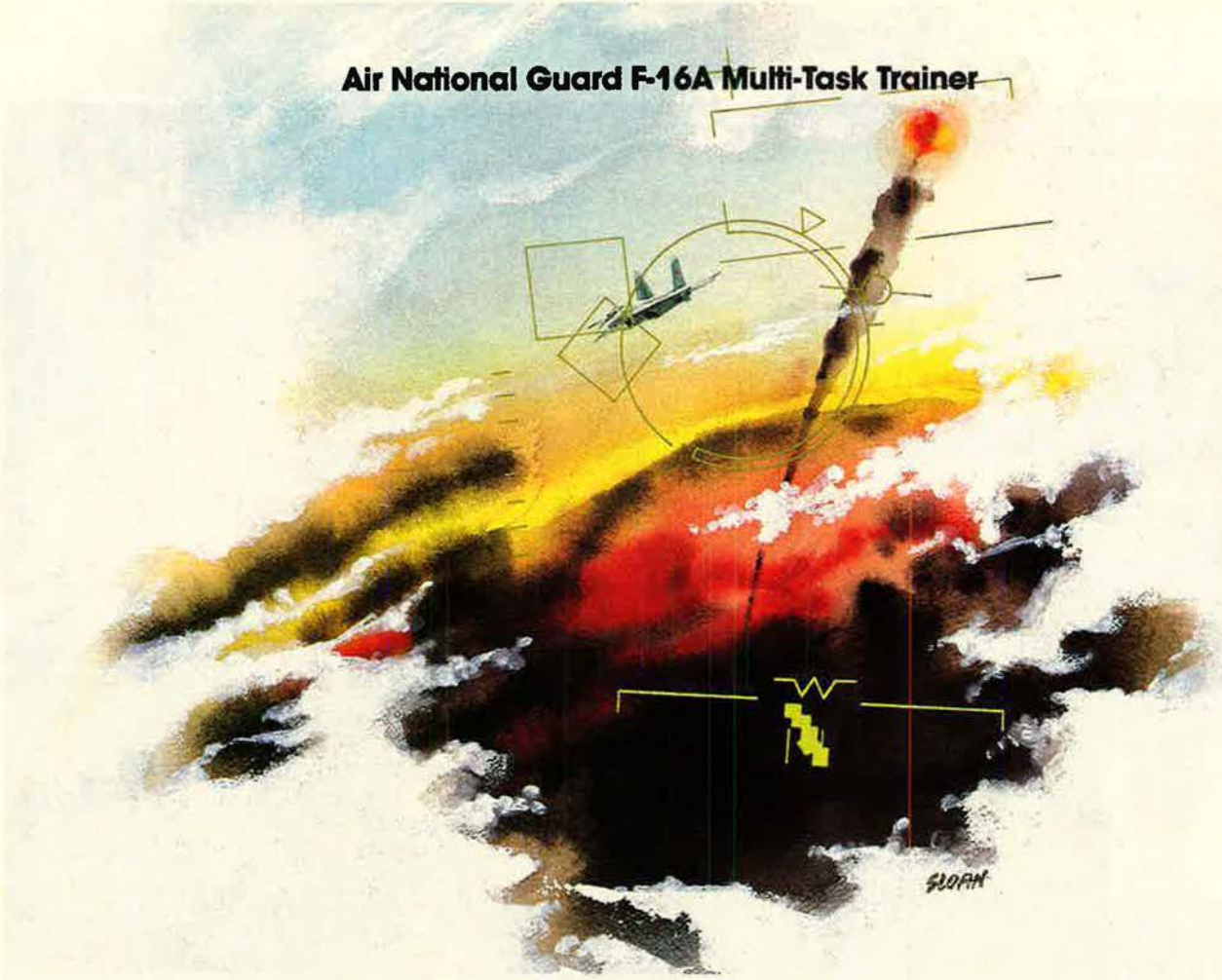
Air National Guard F-16A Multi-Task Trainer



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The 1990 USAF Almanac

Gallery of USAF Weapons

By Susan H. H. Young **Edited by John W. R. Taylor**

Bombers

B-1B

The B-1B is smaller than the B-52, which it partners in SAC's strategic bomber force, but carries a considerably greater weapons load because of improved engine performance and advanced aerodynamic technology. Ninety of the 97 currently available B-1Bs are assigned to a dual-role nuclear/theater mission, each with three weapons bays providing the flexibility to carry long- and short-range nuclear air-to-surface missiles, nuclear and conventional gravity bombs, mines, other weapons, or additional fuel, as required. They are expected to remain capable of penetrating sophisticated enemy defenses through much of this decade, and of operating within less heavily defended areas into the next century. The Air Force has no plans to convert them into cruise missile carriers in the foreseeable future, but a movable bulkhead in the forward weapons bay allows for the carriage of a wide range of different-size weapons, including ALCMs if required. Meanwhile a B-1B has been modified to permit airborne development of the AGM-131 SRAM II missile prior to its first launch later this year. IOC for B-1B SRAM II capability is scheduled for 1993.

The B-1B has a blended wing/body configuration with variable-geometry wings. The unswept wing setting would permit rapid takeoff from a base threatened by imminent attack or operation from shorter runways and less sophisticated airfields. The fully swept position is used in supersonic flight and for the primary role of high-subsonic, low-level penetration. The bomber's offensive avionics include a modern forward-looking and terrain-following radar, an extremely accurate inertial navigation system, new computer-driven avionics, strategic Doppler radar, and a radar altimeter. The efficiency of these systems was demonstrated last November when an operational B-1B flew the type's first low-level night sortie over terrain that varied greatly in altitude, using the fully automatic terrain-following equipment.

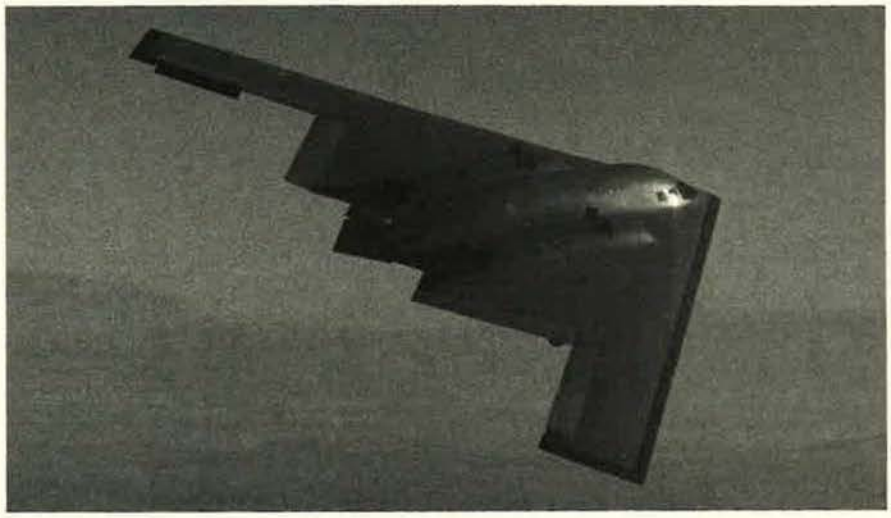
The defensive avionics package is built around the ALQ-161 ECM system, with a wide frequency coverage and tail warning function, supplemented by such expendables as chaff and flares. Development of the full potential of this system has proved difficult, and it is planned to develop a separate radar warning receiver for the B-1B while efforts to improve the existing avionics suite continue. Radar-absorption materials are used to reduce the aircraft's radar signature, which is only one percent that of a B-52. A program to attach Kevlar, a tough synthetic fiber, to vulnerable areas of the bomber will prevent repetition of an accident that occurred in 1987 when an aircraft was lost through birdstrike.

Dyess AFB, Tex., received the first operational B-1B in June 1985 and achieved IOC in September 1986. Deliveries were completed in April 1988. Dyess now has 27 B-1Bs; Ellsworth AFB, S. D., has 34; Grand Forks AFB, N. D., and McConnell AFB, Kan., each have 17 aircraft.

In 1987, a series of international speed and distance with payload records was set by the B-1B. On July 4, a 2,000-km closed circuit was covered at a speed of 669.96 mph with a payload of 30,000 kg (66,140 lb). On September 17, a similar payload was carried around a 5,000-km circuit at 655.05 mph.

Contractors: Rockwell International, North American Aircraft; Eaton Corporation, AIL Division; Boeing Military Airplanes; and General Electric.

Rockwell B-1B



Northrop B-2A

Power Plant: four General Electric F101-GE-102 turbofans; each 30,780 lb thrust.

Accommodation: four: pilot, copilot, and two systems operators (offensive and defensive).

Dimensions: span spread 136 ft 8½ in, fully swept 78 ft 2½ in, length 147 ft, height 34 ft.

Weights: empty, equipped 192,000 lb, gross 477,000 lb.

Performance: max speed at low level high subsonic (supersonic at altitude); range intercontinental.

Armament: three internal weapons bays capable of accommodating in a nuclear role 24 AGM-69 SRAMs, 12 B28 or 24 B61 or B83 free-fall nuclear bombs; in a nonnuclear role up to 84 Mk 82 (500 lb) bombs or Mk 36 (500 lb) mines. Provisions exist for the internal carriage of eight cruise missiles on a Common Strategic Rotary Launcher (CSRL) and external carriage of up to 12 cruise missiles on six underfuselage stores stations.

B-2A

Official confidence in the B-2 Advanced Technology Bomber program was reaffirmed by inclusion of funding in the 1990 defense authorization bill for procurement of a further two B-2A Stealth bombers, with $4.3 billion for the overall B-2 program. The FY 1991 budget proposals include the larger sum of $5.5 billion for continued R&D and the procurement of five production aircraft. Since the first flight of a B-2A, from Air Force Plant 42 in Palmdale, Calif., to Edwards AFB, Calif., on July 17 last year, the program has gone well, including the first aerial refuelings, and officials have stated that "there is no reason to believe we cannot proceed as planned."

The B-2A is being developed as a highly survivable strategic bomber to supplement, and ultimately replace, the B-1B in its penetration role. It utilizes sophisticated technologies, notably low-observable stealth techniques, to minimize the possibility of detection. Its ability to cruise at high or low altitude, at relatively high subsonic speed, would, according to SAC, make it "difficult to track and shoot down individually," although "the presence of a significant force of B-2s would be detected because the aircraft is not invisible to radar."

Of flying-wing configuration, the B-2A has no vertical tail surfaces. The smoothly blended "fuselage" section accommodates a two-person flight crew, with room for a third person, and with two large weapons bays side by side to the rear. These contain rotary launchers capable of carrying a total weapons load of between 40,000 and 75,000 lb; but about 25,000 lb of nuclear weapons would be normal under the nation's Single Integrated Operational Plan (SIOP). Mounted in pairs within the wing structure are four nonafterburning turbofans, with scalloped overwing intake ducts and shielded overwing trailing-edge nozzles. The aircraft has a quadruple-redundant fly-by-wire digital flight control system, actuating movable surfaces at the wing trailing-edges which combine aileron, elevator, and flap functions. A landing

Boeing B-52G Stratofortress

gear track of 40 ft enables the B-2 to use any runway which will handle a Boeing 727 airliner. In flight, the bomber is reported to be near neutrally stable. It is claimed to have almost 50 percent better fuel efficiency than the B-1B and to require less than half the latter's air refueling support to accomplish SIOP missions. A typical unrefueled range of 6,218 miles is estimated for a hi-lo-hi mission carrying eight SRAMs and eight B61 nuclear free-fall bombs.

Flight testing of the B-2 is expected to continue for four years, with the key radar-signature tests due for completion in 1993. USAF has a stated requirement for 132 aircraft, of which 120 would be nuclear-capable. If all goes according to plan, the first operational B-2As will be delivered to Whiteman AFB, Mo., and will achieve IOC in the mid-1990s.

Prime Contractor: Northrop Corporation, with Boeing, LTV, and General Electric as key members of the development team.

Power Plant: four General Electric F118-GE-100 turbofans; each estimated at 19,000 lb thrust.

Accommodation: basic crew of two, with provision for third person.

Dimensions (approx): span 173 ft, length 69 ft, height 17 ft.

Weights (approx): empty 100,000–110,000 lb, gross 240,000–376,000 lb.

Performance: unrefueled range 4,250 to 7,500 miles.

Armament: in a nuclear role: up to 20 B61 nuclear bombs; or 16 AGM-69A SRAMs, AGM-131A SRAM IIs, or B83 nuclear bombs, or a combination thereof. In a conventional role: 80 500 lb bombs, or various other conventional weapons including sea mines. There are no plans to carry the AGM-129A ACM on the B-2A.

B-52G/H Stratofortress

After more than three decades of service, the B-52 remains a substantial element in the SAC inventory and a vital contributor to the US strategy of worldwide deterrence. The 232 B-52s currently operational are capable of delivering a wide range of weapons. Apart from their nuclear mission, they are deployed in important conventional roles, including show of force, maritime interdiction, precision strikes, and defense suppression. Other collateral missions in recent years have included sea surveillance flights, aerial minelaying and antisurface warfare operations in cooperation with the US Navy, and support for NATO allies.

Two versions are still in service: the **B-52G,** which introduced a redesigned wing containing integral fuel tanks, fixed underwing external tanks, a tail fin of reduced height and broader chord, and a remotely controlled tailgun turret that allowed the gunner to be repositioned with the rest of the crew; deliveries began in February 1959, and 193 were built; and the **B-52H,** which switched to TF33 turbofans, providing increased unrefueled range, and which has improved defensive armament, including a 20-mm Vulcan multibarrel tailgun. 102 were built, with deliveries beginning in May 1961.

During the early 1970s, all B-52Gs and Hs were modified to carry AGM-69A Short-Range Attack Missiles (SRAMs). Additionally, all Gs and Hs were equipped with an AN/ASQ-151 electro-optical viewing system (EVS), using forward-looking infrared (FLIR) and low-light-level TV sensors to improve their low-level flight capability, and were updated with Phase VI avionics. These include

General Dynamics FB-111A (J. Gaffney)

ALQ-122 SNOE (smart noise operation equipment) and AN/ALQ-155 (V) advanced ECM; an AFSATCOM kit permitting worldwide communications via satellite; a Dalmo Victor ALR-46 digital radar warning receiver; Westinghouse ALQ-153 pulse-Doppler tail warning radar; and an improved ITT Avionics ALQ-117 Pave Mint or ALQ-172 ECM jamming system. The G/Hs have also been fitted with a digital-based solid-state offensive avionics system (OAS) that includes inertial guidance, Tercom (terrain comparison) guidance, and microprocessors to upgrade their navigation and weapons delivery systems.

As development and deployment of the B-1B were followed by the B-2A program, the primary role of the B-52 was changed to ALCM (AGM-86) carrier. A typical profile envisaged multiple ALCM launches at high altitude, often followed by B-52 low-level descent to attack additional targets using gravity weapons or SRAMs. USAF completed deployment of AGM-86s on 98 on-line B-52Gs, each with 12 external cruise missiles, in December 1984, and will complete similar deployment on 96 B-52Hs during FY 1990. Full-scale production of the Common Strategic Rotary Launcher (CSRL), which will permit internal carriage of eight additional AGM-86s in the B-52H, is under way. This will allow a total ALCM offensive weapon load of 20 cruise missiles. Full operational capability for this system at all SAC bases is scheduled for late summer 1993. Eventually, B-52Hs will be equipped with the AGM-129A Advanced Cruise Missile (ACM). Captive-carry tests of eight ACMs mounted on a B-52H's underwing pylons began early last year. Initial operational capability is anticipated for 1992, at SAC's 410th Bomb Wing, K. I. Sawyer AFB, Mich.

All B-52 crews train to drop conventional weapons, and the ALCM-modified B-52Gs are being assigned increasingly to support conventional operations by employing airpower over great distances at short notice on behalf of theater CINCs. In 1988, B-52Gs achieved IOC fitted with an Integrated Conventional Stores Management System (ICSMS). This enables aircraft normally configured for the carriage of nuclear weapons to carry conventional weapons, by rearranging data stored in the weapon systems computer, using a preprogrammed removable software cassette. The 28 non-ALCM-modified B-52Gs equipping two SAC squadrons are assigned to the primary conventional role of supporting naval antisurface warfare operations through Harpoon missile employment. One full squadron is based at Loring AFB, Me., for Atlantic operations. *(Data for B-52G except where noted.)*

Contractor: Boeing Military Airplanes.

Power Plant: eight Pratt & Whitney J57-P-43WB turbojets; each 13,750 lb thrust.

Accommodation: two pilots, side by side, plus navigator, radar navigator, electronic warfare officer, and fire control system operator (gunner).

Dimensions: span 185 ft 0 in, length 160 ft 10.9 in, height 40 ft 8 in.

Weight: G/H models gross more than 488,000 lb.

Performance (approx): max level speed at high altitude 595 mph, service ceiling 55,000 ft, range more than 7,500 miles.

Armament: G model has four 0.50-caliber guns in tail turret; H model has 20-mm gun. G/H models carry eight SRAMs and nuclear free-fall bombs internally and 12 AGM-86B ALCMs instead of SRAMs externally. Provision for eight more ALCMs instead of SRAMs internally on H model. Alternatively, G models can carry conventional weapons including, on some aircraft, eight to 12 Harpoons in underwing clusters.

FB-111A

The FB-111A is soon to begin a new career with TAC, in modified form, as the F-111G dual-role combat aircraft. It was designed originally as a two-seat, medium-range, supersonic strategic bomber version of the variable-geometry F-111, capable of high-precision, low-altitude weapons delivery in all weather, day or night, to replace early versions of the B-52 and supersonic B-58A Hustlers. The first of 76 production aircraft flew in July 1968, and the initial delivery was made in October 1969 to the 340th Bomb Group; 61 aircraft remain.

Current upgrading includes installation of improved terrain-following radar, and it is planned to replace the existing analog flight control system with a digital system by 1994. Operational units equipped with FB-111As in early 1990 were the 380th and 509th Bomb Wings, but the latter is to lose its aircraft by the time its home at Pease AFB, N. H., is closed. Its FB-111As will be converted to F-111G standard *(see F-111 entry in Fighters section)* and will be transferred to Cannon AFB, N. M., for use by TAC.

Contractor: General Dynamics Corporation.

Power Plant: two Pratt & Whitney TF30-P-7 turbofans; each 20,350 lb thrust with afterburning.

Accommodation: two, side by side.

Dimensions: span spread 70 ft 0 in, fully swept 33 ft 11 in, length 73 ft 6 in, height 17 ft 1.4 in.

Weight (approx): gross 100,000 lb.

Performance: max speed at 36,000 ft Mach 2.5, service ceiling more than 60,000 ft, range 4,100 miles with external fuel.

Armament: up to four AGM-69A SRAM air-to-surface missiles on external pylons, plus two in the weapons bay, or six nuclear bombs, or combinations of these weapons; provision for up to 31,500 lb of conventional bombs.

Fighters

F-4/D/E/G Phantom II

Although the F-4 continues to be replaced by the F-15 and F-16 in active USAF units, many hundreds are still operational. Designed in the mid-1950s, the F-4 has moved to a predominantly air-to-ground role, although it retains residual air-to-air capability. Continuous updating has maintained the effectiveness of the F-4, and under a 1986 contract the navigation and weapons delivery systems on some USAF and ANG F-4s are being modified. The original version supplied to USAF, the F-4C, was a two-seat, twin-engine, all-weather, tactical fighter with J79-GE-15 turbojets, dual controls, an inertial navigation system, and boom flight refueling. This version is no longer in the USAF inventory. The **F-4D** introduced major systems changes, including new weapon ranging and release computers to increase accuracy in air-to-air and air-to-surface weapon delivery. F-4Ds equip Air Force Reserve and Air National Guard units, although they are being gradually replaced with newer aircraft. All AFRES F-4s will have been repainted gray-on-gray by this year, to make them less visible at high altitudes. The **F-4E** was developed as a multirole fighter capable of performing counterair, close-support, and interdiction missions. A 20-mm Vulcan multibarrel gun is fitted, together with an improved fire-control system and an additional fuselage fuel tank. Leading-edge slats, to improve maneuverability, were retrofitted to all USAF F-4Es. In addition, from early 1973, some were fitted with Northrop's target-identification system electro-optical (TISEO) as an aid to positive long-range visual identification of airborne or ground targets. System improvements include the Pave Tack system, which provides a day/night adverse weather capability to acquire, track, and designate ground targets for laser, infrared, and electro-optically guided

weapons; the Pave Spike day tracking/laser ordnance designator pod, for use with "smart" weapons; and a digital intercept computer that includes launch computations for USAF AIM-9 and AIM-7 missiles. All ANG F-4Ds and Es are being modified to carry AIM-9L/M Sidewinder missiles; the F-4E version will also be equipped with improved AGM-65D Maverick TV-guided missiles and a new area-denial submunition, the CBU-87/89. A new one-piece bird-resistant windscreen, to counter the problem of birdstrikes during low-level missions, has been successfully tested. The **F-4G "Advanced Wild Weasel"** is a modified F-4E with its gun replaced by AN/APR-38 electronic warfare equipment. Working in "hunter-killer" teams of two aircraft, such as F-4G/F-4E or F-4G/F-16C, the F-4G "hunter" will detect, identify, and locate enemy radars and then direct against them weapons for their destruction or suppression. A performance upgrade program (PUP) upgraded the system's on-board computers, installation of which was completed in October 1989. Primary armament includes Shrike (AGM-45) and HARM (AGM-88). *(Data for F-4E.)*

Contractor: McDonnell Aircraft Company. Division of McDonnell Douglas Corporation.

Power Plant: two General Electric J79-GE-17A turbojets; each 17,900 lb thrust with afterburning.

Accommodation: pilot and weapon systems operator in tandem.

Dimensions: span 38 ft 7½ in, length 63 ft 0 in, height 16 ft 5½ in.

Weights: empty 30,328 lb, gross 61,795 lb.

Performance: max speed at 40,000 ft Mach 2.0 class, range with typical tactical load 700 miles.

Armament: one 20-mm M61A1 multibarrel gun; provision for up to four AIM-7E Sparrow, AGM-45A Shrike, AGM-88A HARM, or AIM-9 Sidewinder missiles on four underfuselage and four underwing mountings, or up to 16,000 lb external stores.

F-15 Eagle

The F-15 is USAF's primary air-superiority fighter. The original single-seat **F-15A** and two-seat **F-15B** were followed in June 1979 by the **F-15C** and **F-15D**, respectively, with 2,000 lb of additional internal fuel and provision for carrying conformal fuel tanks (CFTs). Delivery of 409 C models and 61 Ds for USAF was completed last November. Basic F-15 equipment includes a Hughes Aircraft APG-63 or APG-70 lightweight X-band pulse-Doppler radar for long-range detection and tracking of small high-speed objects down to treetop level. Under ongoing contracts initiated in February 1983, the F-15 is undergoing a Multistage Improvement Program (MSIP). Improvements include a Programmable Armament Control Set (PACS), improved central computer, MIL-STD 1760 incorporation, an expanded tactical electronic warfare system (TEWS) providing improvements to the ALR-56C radar warning receiver and ALQ-135 countermeasures set, and provision for AIM-120A AMRAAM air-to-air missiles, augmenting the existing AIM-7 and AIM-9 air-to-air capability. Delivery of MSIP-equipped F-15s began in June 1985. An overload warning system, permitting safe maneuver to 9*g* throughout most of the flight envelope at flight design gross weights, was delivered in later F-15C/Ds and is being retrofitted to earlier aircraft.

The **F-15E** is USAF's two-seat, dual-role, totally integrated fighter for all-weather air-to-air and deep interdiction missions. The demonstrator was a modified two-seat F-15B with the rear cockpit upgraded to include four multipurpose CRT displays for radar, weapon selection, and monitoring of enemy tracking systems. Production F-15Es also have front cockpit modifications, including redesigned controls, a wide-field-of-view head-up display, and three CRT multipurpose displays. The F-15E is capable of carrying up to 24,500 lb of ordnance. The digital, triple-redundant Lear Siegler flight control system permits coupled automatic terrain following, and navigational accuracy is improved by a Honeywell ring-laser gyro INS. For low-altitude, high-speed penetration and precision attack on tactical targets at night and in adverse weather, the F-15E has a high-resolution Hughes APG-70 radar and carries LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) pods, with wide-field forward-looking infrared (FLIR).

To accommodate the new avionics, internal fuel capacity was reduced slightly, but the F-15E is fitted with CFTs, adapted to carry ordnance tangentially to reduce drag. In addition to its primary load of guided and unguided bombs and other air-to-ground weapons, the F-15E retains its air-superiority performance and weapons. Armament options include AIM-7F and M Sparrow, AIM-9J, L, M, and P Sidewinder, and AIM-120A AMRAAM, as well as AGM-65 Maverick, GBU-12/-24 laser-guided bombs, and GBU-15 glide bombs. A new engine bay was developed by McDonnell Douglas to allow installation of either General Electric F110 or Pratt & Whitney F100 engines, and Pratt & Whitney's improved F100-PW-220 engines. Tests have also been carried out on an F-15 with one of its standard engines replaced by an improved performance F100-PW-229. Further improvements include foam-filled fuel tanks for greater survivability, higher-rated generators, and an improved environmental control system. The first of three prototypes was flown in December 1986. The 4th TFW at Seymour Johnson AFB, N. C., was scheduled to become the first operational F-15E wing by the end of last year, with a complement of 24 aircraft. Procurement of 200 F-15E Eagles is planned, with 80 already procured and a further 36 planned for FY 1990. IOC is scheduled for this year.

McDonnell Douglas F-4E Phantom II

McDonnell Douglas F-15A Eagle

F-15E

Planned procurement of all models of the F-15 totals 1,074 aircraft for USAF, plus the original twenty R&D models, by the mid-1990s. Units equipped with F-15 Eagles include TAC's 57th FWW, 325th and 405th TTWs, 1st, 4th, 33d, and 49th TFWs, the 48th FIS at Langley AFB, Va., and the 57th FIS at NAS Keflavik, Iceland; USAFE's 32d TFS and 36th TFW; PACAF's 18th TFW; and AAC's 21st TFW.

Equipment of ANG units with F-15A/B aircraft began in 1985 with the 159th TFG, followed by the 116th TFW in 1986, the 154th Composite Group in 1987, the 102d FIW in 1988, and the 142d FIG in 1989.

In response to a USAF request made in 1983, McDonnell Douglas is developing and flight-testing an advanced technology version of the F-15, with short takeoff and landing (STOL) and new maneuvering capabilities, designated **F-15 S/MTD** (STOL/Maneuvering Technology Demonstrator). Flight trials began in September 1988, initially to explore basic handling with active canards installed forward of the wings. Rectangular vectoring nozzles were fitted subsequently to the S/MTD's F100-PW-220 engines, and the aircraft made its first flight thus equipped last May, at the beginning of a 100-flight, 13-month flight-test program during which the nozzles' usefulness in vectoring engine thrust during takeoff and in-flight manuevers, and for thrust reversal to shorten the landing run, is being evaluated. It is reported that the thrust can be changed from full reverse to full forward in half a second. The aircraft is expected to be capable of takeoff with full internal fuel and a 6,000-lb external payload from a 1,500 ft runway; landing run with payload expended is expected to be under 1,250 ft on a wet runway. Flying control, engine, steering, and braking functions are integrated with existing F-15 controls through a digital fly-by-wire system, to take optimum advantage of the aircraft's added capability while reducing the pilot's work load. Radar, infrared, and inertial navigation systems generate data to locate the runway and furnish guidance cues.

A further modification of the F-15 has been proposed by the manufacturers to fulfill USAF's requirement for a Follow-on Wild Weasel (FWW) defense suppression aircraft to replace the current F-4G. *(Data for F-15C, except where stated.)*

Contractor: McDonnell Aircraft Company, Division of McDonnell Douglas Corporation.

Power Plant: two Pratt & Whitney F100-PW-100 turbofans; each approx 23,830 lb thrust. Improved F100-PW-220 will equip new F-15s.

Accommodation: pilot only in F-15A/C; two seats in F-15B/D/E.

Dimensions: span 42 ft 9¾ in, length 63 ft 9 in, height 18 ft 5½ in.

Weights: empty 27,300 lb, gross 68,000 lb in F-15A/B/C/D; gross 81,000 lb in F-15E.

Performance: max speed Mach 2.5, service ceiling 60,000 ft, ferry range, with external fuel tanks, more than 2,878 miles; with CFTs, 3,570 miles.

Armament: one internally mounted M61A1 20-mm six-barrel cannon; four AIM-9L/M Sidewinder and four AIM-7F/M Sparrow air-to-air missiles, or eight AMRAAMs, carried externally. Provision for carrying up to 24,500 lb of ordnance on weapon stations on F-15E.

F-16 Fighting Falcon

The F-16 was developed to replace F-4s in the active force and to modernize the air reserve forces. Advanced technologies incorporated from the start in the single-seat **F-16A** and two-seat **F-16B** versions made them two of the most maneuverable fighters ever built. The advances include decreased structural weight through the use of composites, decreased drag resulting from reduced static stability margin, fly-by-wire flight controls with side stick controller, high *g* tolerance/high visibility cockpit with a 30-degree reclined seat and single-piece bubble canopy, blended wing-body aerodynamics with forebody strakes, and automatically variable wing leading-edge flaps. The F-16 is powered by a single afterburning turbofan. Equipment includes a multimode radar with a clutter-free look-down capability, advanced radar warning receiver, a head-up display, internal chaff and flare dispensers, and a 500-round 20-mm internal gun. The aircraft also has provisions for ECM.

The F-16 entered operational service with TAC's 388th TFW at Hill AFB, Utah, in January 1979. Production of the F-16A and B for USAF ended in 1985. However, USAF and NATO users are collaborating in an operational capabilities upgrade. The OCU program improves the radar, fire control computer, stores management computer,

General Dynamics F-16C Fighting Falcon

and avionics software, giving F-16A/Bs the ability to utilize next-generation air-to-air and air-to-surface weapons.

A forward-looking plan for the aircraft, known as the Multinational Staged Improvement Program (MSIP), was implemented by USAF in February 1980 to assure the aircraft's capability to accept systems under development, thereby minimizing retrofit costs. As a first stage, all F-16s delivered since November 1981 have had built-in structural and wiring provisions and systems architecture that expand the single-seater's multirole flexibility. MSIP II was applicable to the improved **F-16C** (single-seat) and **F-16D** (two-seat) versions, of which deliveries to USAF began in July 1984. These aircraft have a Westinghouse APG-68 multimode radar with increased range and advanced ECCM; and advanced cockpit displays including a wide-angle head-up display. Weapons improvements include HARM/Shrike antiradiation missiles and multitarget AMRAAM compatibility. Also introduced were systems improvements that include installation of a LANTIRN nav/attack system, GPS, EEGS, digital flight controls, automatic terrain following, advanced IFF, increased T-O weight and maneuvering limits, an 8,000-hour airframe, and 9*g* capability. Follow-on systems include ALE-47 improved defensive countermeasures, ALR-56M advanced radar warning receiver, full HARM/Shrike capability, and increased performance engines, to be supplied principally by General Electric (F110-GE-129 IPE engines) with Pratt & Whitney as secondary supplier (F100-PW-229 IPE engines). The proposed cancellation of the Airborne Self-Protection Jammer (ASPJ), originally planned for installation in the F-16, has led USAF to consider alternatives, including a possible F-16/Tacit Rainbow combination. The first launch of an AGM-88 HARM from an F-16C took place in September 1988. Currently, F-16C/Ds are assigned to defense suppression missions in conjunction with F-4G Wild Weasels based at Spangdahlem AB, West Germany. Others serve as "aggressor" trainers with the 527th and 26th Aggressor Squadrons, based respectively at RAF Bentwaters, UK, and Osan and Kunsan ABs, Korea, but these units are being disbanded.

A sophisticated research variant of the F-16, known as the **AFTI/F-16,** is being modified but will continue in use at Edwards AFB, Calif., to test and evaluate advanced fighter technologies, including flight control systems, pilot/vehicle interface, an automated maneuvering attack system, an advanced weapon interface, and close air support technologies. An upgrade of the AFTI/F-16's radar and other sensors is planned, to improve the aircraft's all-terrain capability.

Up to 270 of the original F-16A/Bs are being modified to **F-16 ADF** (Air Defense Fighter) standard under a contract awarded in October 1986, to replace aging F-106s and F-4s in eleven ANG continental air defense squadrons. The APG-66 radar of these aircraft is being upgraded with an AMRAAM data link, provisions for AIM-7 Sparrows, improved ECCM, and improved capability against cruise missiles. New equipment includes HF radio, an IFF interrogator, an ID light, a crash-survivable flight data recorder, and provisions for GPS. Armament includes the M61 gun and up to six missiles, including combinations of Sparrows, AMRAAMs, and Sidewinders. The F-16 ADF entered service in 1989, with the last modified aircraft due in 1992.

Another 130 of the original F-16A/Bs are being considered for an **F-16 MLU** (midlife upgrade) in a codevelopment and coproduction program with the European Participating Governments (EPG) of the F-16 Multinational Fighter Program (MNFP). A modified F-16 MLU will enhance the capability of the F-16A/Bs, while achieving maximum avionics commonality with the latest model F-16C/Ds.

Derivative F-16s (referred to as **A-16s**) are under consideration as close air support/battlefield air interdiction (CAS/BAI) aircraft. The F-16 is also a candidate in USAF's Follow-on Wild Weasel (FWW) program.

USAF plans a total buy of 2,609 F-16s through 1994, with 1,731 scheduled for delivery by the end of FY 1990.

F-16s are standard equipment with 35 TAC, USAFE, and PACAF units, and are progressively replacing older aircraft in the AFRES and ANG. F-16As also equip USAF's Thunderbirds. Well over a thousand more F-16s have been delivered to, or ordered for, the air forces of Bahrain, Belgium, Denmark, Egypt, Greece, Indonesia, Israel, the Netherlands, Norway, Pakistan, Singapore, South Korea, Thailand, Turkey, Venezuela, and the US Navy. Japan is to produce, in conjunction with the US government, a variant of the F-16 called FSX. *(Data for F-16C:)*

Contractor: General Dynamics Corporation.

Power Plant: one augmented turbofan. General Electric F110-GE-100 (27,600 lb thrust) and Pratt & Whitney F100-PW-220 (23,450 lb thrust) are alternative standard engines.

Accommodation: pilot only.

Dimensions: span over missiles 32 ft 9¾ in, length overall 49 ft 4 in, height 16 ft 8½ in.

Weights: empty (F100-PW-220) 18,335 lb, (F110-GE-100) 19,100 lb; gross 42,300 lb.

Performance: max speed Mach 2 class, service ceiling more than 50,000 ft, ferry range more than 2,000 miles.

Armament: one M61A1 20-mm multibarrel cannon, with 500 rounds, mounted in fuselage; wingtip-mounted infrared missiles; seven other external stores stations for fuel tanks and air-to-air and air-to-surface munitions.

ATF (YF-22A and YF-23A)

Continuation of the Advanced Tactical Fighter (ATF) program was confirmed with the provision of $911 million ($200 million less than requested) in the FY 1990 defense authorization bill, with a further $1.0 billion proposed in the FY 1991 budget.

The aim of the program is to produce the next-generation air-superiority fighter as a follow-on to the F-15, to counter the threat projected for the mid-1990s and beyond. ATF is being designed to penetrate high-threat enemy airspace and support AirLand Battle forces with a first-look, first-kill capability against multiple targets. It will combine a highly maneuverable airframe at both sub- and supersonic speeds with low-observable stealth technologies, sustained supersonic cruise capability without the use of afterburners, and advanced, significantly integrated avionics and weapon systems, permitting simultaneous engagement of multiple targets. To this end, VHSIC common signal processors are being developed to communicate with and tie together such avionics elements as radar, infrared search and track, and collections of major offensive and defensive functions. Projected armament includes such existing and planned weapons as AIM-9 Sidewinder and AMRAAM air-to-air missiles, as well as an internal gun. A target weight of 50,000 lb has been set. Program emphasis from the outset has been on achieving a proper balance of reliability/supportability, affordability, survivability, and performance.

In 1986, the program was restructured to incorporate the development of prototype vehicles, implement Packard Commission recommendations, emphasize "fly before buy" competition, and reduce technical/cost risk for full-scale development (FSD). In October of the same year, USAF awarded contracts to the Lockheed and Northrop Corporations to enter the 50-month demonstration/validation phase of the program, now extended by six months. First flight of the prototype Northrop **YF-23A** was anticipated before midyear at Edwards AFB, Calif., with the Lockheed **YF-22A** flying later. FSD is expected around September 1991. USAF has a stated requirement for 750 ATFs, with IOC by the mid-1990s. Lockheed has teamed with Boeing and General Dynamics, Northrop with McDonnell Douglas. Simultaneous demonstration and validation of ground-based avionics prototypes and development of ground-test General Electric YF120 and Pratt & Whitney YF119 prototype engines are also under way. The latter will fly first in the Northrop YF-23 and the former in the Lockheed YF-22, but both aircraft will be required to fly with GE and P&W engines.

General Dynamics F-111F

F-111

Maintaining USAF's around-the-clock long-range, interdiction mission, four versions of this pioneer variable-geometry tactical aircraft were built. Deliveries of production **F-111As** to the first operational wing began in October 1967, and 141 were built. This version served with distinction in southeast Asia in 1972–73 and currently equips the 366th TFW. The A was superseded in production by the **F-111E,** with modified air intakes that improved engine performance above Mach 2.2. Ninety-four were built, and most of these serve with the 20th TFW, based at RAF Upper Heyford in the UK, in support of NATO. The replacement of their analog bombing and navigation systems with digital equipment began last year, with completion expected in 1993. This will enable F-111A/E aircraft to handle modern guided munitions and advanced sensors as well as future systems, such as the Global Positioning System (GPS). The **F-111D** was designed with advanced avionics, offering improvements in navigation and air-to-air weapon delivery. Ninety-six were built and equip the 27th TFW at Cannon AFB, N. M. The **F-111F,** of which 106 were built, has uprated turbofans. Equipping the 48th TFW at RAF Lakenheath, this version can carry in its weapons bay the Pave Tack system, which provides a day/night capability to acquire, track, and designate ground targets for laser, infrared, and electro-optically guided weapons. The F-111F is capable of employing the GBU-15, as well as TV and IR precision guided weapons. Under the recently initiated Pacer Strike program, F-111D/F aircraft are undergoing an avionics modernization, involving the removal of outdated subsystems and the installation of a ring-laser gyroscopic Standard Inertial Navigation Unit, a GPS receiver, and new cockpit displays. The program also includes new computer software, integration and test of prototype D and F models, and production of modification kits for the remaining 161 aircraft to be reworked.

Production of the F-111 was completed in 1976. Its EW capabilities are being updated with the ALQ-131/184 ECM pod system, and future improvements will include AIM-9L/M self-defense capability. Also, following the signing of the INF Treaty in 1988, a program was initiated to modify SAC FB-111As to **F-111G** standard for dual-role service with TAC. The bomber version's AGM-69A SRAM missile compatibility is retained, but a conventional weapon-release system is added. Future armament could include AGM-131A SRAM II missiles. Other modifications include Have Quick UHF radio and a new ECM system. The first F-111Gs were completed early last year. Transfer from SAC to TAC is beginning this year. The last conversion from FB-111A to F-111G is scheduled for completion in 1994.

In addition to its nuclear and conventional bombing capability, the F-111 can carry up to twelve French Durandal parachute-retarded, rocket-boosted, runway attack bombs for low-altitude high-speed delivery, and Gator, USAF's first air-delivered mine system.

The **EF-111A** is an ECM conversion of the F-111A *(see p. 148).* The **FB-111A** strategic bomber version is described more fully on p. 142. The Royal Australian Air Force acquired 24 F-111Cs for strike duties, four of which were subsequently modified for tactical reconnaissance.

Contractor: General Dynamics Corporation.

Power Plant: F-111A/E: two Pratt & Whitney TF30-P-103 turbofans; each 18,500 lb thrust with afterburning. F-111D: two TF30-P-109 turbofans; each 19,600 lb thrust with afterburning. F-111F: two TF30-P-111 turbofans; each approx 25,100 lb thrust with afterburning.

Accommodation: crew of two side by side in escape module.

Dimensions: span spread 63 ft 0 in, fully swept 31 ft 11.4 in, length 73 ft 6 in, height 17 ft 1.4 in.

Weights (F-111F): empty 47,481 lb, gross 100,000 lb.

Performance (F-111F): max speed at S/L Mach 1.2, max speed at altitude Mach 2.5, service ceiling more than 49,000 ft, range with max internal fuel more than 2,925 miles.

Armament: up to four nuclear bombs on four pivoting wing pylons, and two in internal weapon bay. Wing pylons carry total external load of up to 25,000 lb of bombs, rockets, missiles, or fuel tanks.

F-117A

First announced in November 1988, the F-117A is the world's first operational aircraft designed to exploit low-observable technology. While much about the airplane is still classified, details are starting to emerge. With a design and a designation totally unexpected by commentators, the F-117A is a single-seat, twin-engine aircraft operated by the recently redesignated 37th TFW from Tonopah Test Range Airfield, Nev. It was flown for the first time in June 1981 and achieved IOC in 1983, according to the Pentagon. Fifty-nine have been ordered, all but two of which had been delivered by February of this year.

Initially, the F-117As were restricted mainly to night flying, to maintain secrecy; three were lost in much-publicized accidents. Public acknowledgment of their existence has permitted the aircraft to operate in daylight and has facilitated their integration into operational planning and exercises. Six F-117As were assigned to Operation Just Cause, the Panama invasion, of which one pair dropped two laser-guided 2,000 lb bombs very precisely, within 500 feet of buildings, at the start of the operation, to disorient rather than kill hostile troops. They were flown directly from Tonopah to Panama and back with the aid of air refueling (reportedly four or five hookups).

The F-117A's designers, in the famous Lockheed "Skunk Works" at Burbank, Calif., relied on the concept of faceting to give the aircraft its minimal radar signature. The skin panels of the arrowhead-shaped airframe (leading-edge sweep of about 67.5 degrees) are divided into many small, perfectly flat surfaces, which reflect at a variety of angles all signals from probing hostile ground or airborne radars. Much of the aircraft's external surface is made of radar-absorbent composite materials. The engine air intakes and exhaust nozzles are above the wings and rear fuselage, respectively, to shield them from infrared seekers below.

It is known that F-117As can be carried on board C-5 Galaxy transports, with their wings folded or removed. The power plant comprises two General Electric F404

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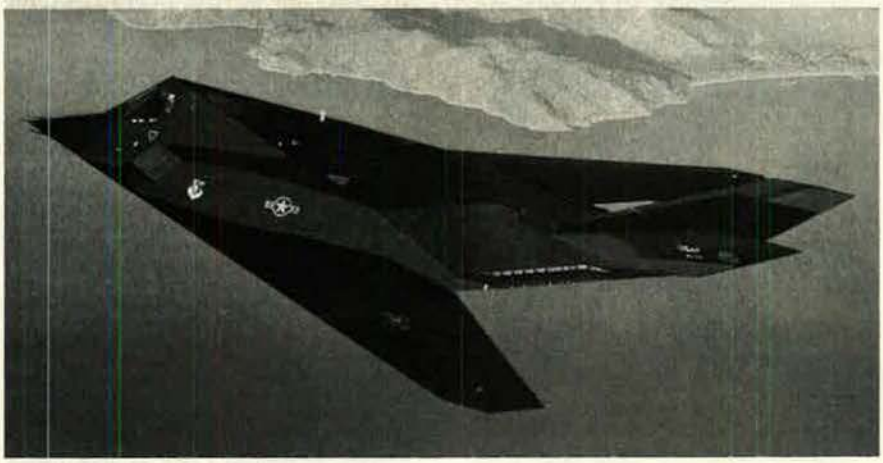

Lockheed F-117A

nonafterburning turbofans, giving the aircraft a low noise signature and high subsonic performance. Quadruple redundant fly-by-wire flight controls and a state-of-the-art digital avionics suite are key features of the aircraft. Navigation is believed to be by high-precision INS and GPS, with FLIR and a steerable laser designator to ensure attack precision. The primary role and mission of the F-117A continue to be classified.

Contractor: Lockheed Aeronautical Systems Company, Burbank, Calif.

Power Plant: two General Electric F404-GE-F1D2 nonafterburning turbojets; 11,000 lb thrust.

Accommodation: pilot only.

Dimensions: span 43 ft 4 in, length 65 ft 11 in, height 12 ft 5 in.

Weight: max gross 52,500 lb.

Performance: high subsonic speeds; little other detail available.

Armament: full internal carriage of what is described as a wide variety of tactical weapons, including some especially designed for the aircraft; provisions (type unknown) for self-defense.

Attack and Observation Aircraft

A-7D/K Corsair II and YA-7F

Operated by ANG units in ten states and Puerto Rico, the **A-7D Corsair II** is a single-seat subsonic close air support and interdiction aircraft, of which 459 were delivered between 1968 and 1976. Thirty-one **A-7K** combat-capable two-seat training models were delivered from April 1981. The A-7Ds have demonstrated outstanding target kill capability, initially in southeast Asia. This is achieved with the aid of a continuous-solution navigation and weapon-delivery system, including all-weather radar bomb delivery, and is undergoing continuous update. Pave Penny laser target-identification pods were installed on 383 A-7Ds. LTV is modifying 75 A-7Ds and eight A-7Ks for low-altitude night attack (LANA) capability, with a wide-angle head-up display, forward-looking infrared (FLIR), and automatic terrain-following (ATF) systems to provide round-the-clock effectiveness. The first LANA-equipped A-7 was delivered in July 1987 to the 150th TFG. LTV has also tested augmented wing flaps and spoilers to enhance flight-control characteristics. A single-piece windscreen that offers increased visibility and greater protection against birdstrike is currently being tested by the 162d TFG.

Under a contract awarded in May 1987, LTV is upgrading two LANA-equipped A-7Ds to the supersonic A-7F configuration, under the official designation **YF-7F**. The aim is to provide the Air Force with a close air support/battlefield air interdiction (CAS/BAI) aircraft to support the Army's AirLand battle concept into, and beyond, the next decade. Modifications include a lengthened fuselage to accommodate a new afterburning Pratt & Whitney F100-PW-220 or General Electric F110-GE-100 engine and additional fuel; an airframe-mounted accessory drive unit for self-contained ground operations; wing strakes, an extended vertical tail, automatic maneuvering flaps, trailing-edge flap augmentors, and lift dump spoilers to enhance maneuverability; upgraded avionics; and provision for AGM-65 Maverick and AIM-9 Sidewinder missile operation. The first modified aircraft flew for the first time on November 29 last year, with an F100 engine. A ten-month developmental test and evaluation flight-test program is being conducted at Edwards AFB, Calif., after which a decision will be taken whether to modify the 337 ANG A-7D/Ks to A-7F standard. *(Date for A-7D.)*

Contractor: LTV Corporation (formerly Vought Corporation).

Power Plant: one Allison TF41-A-1 nonafterburning turbofan; 14,500 lb thrust.

Accommodation: pilot only.

Dimensions: span 38 ft 9 in, length 46 ft 1½ in, height 16 ft 0¾ in.

Weights: empty 19,781 lb, gross 42,000 lb.

Performance: max speed at S/L 698 mph, ferry range with external tanks 2,871 miles.

Armament: one M61A1 20-mm multibarrel gun; up to 15,000 lb of air-to-air or air-to-surface missiles, bombs, Gator mines, rockets, or gun pods on six underwing and two fuselage attachments.

A-10A/OA-10A Thunderbolt II

Designed specifically for the close air support (CAS) mission, the **A-10A** offers a combination of large military load, long loiter, and wide combat radius. In a typical antiarmor, close air support mission, the A-10, affectionately nicknamed "Warthog," could fly 150 miles and remain on station for an hour. It can carry up to 16,000 lb of mixed ordnance with partial fuel or 12,086 lb with full internal fuel. The 30-mm GAU-8/A gun can fire 2,100 or 4,200 rds/min and provides a cost-effective weapon with which to defeat the whole array of ground targets encountered in the CAS role, including tanks. The A-10 achieves its survivability through a combination of high maneuverability and design features that make it a "hard" aircraft. Equipment includes an inertial navigation system, head-up display, Pave Penny laser target identification pod, ECM, target penetration aids, self-protection systems, and associated equipment for Maverick missiles and air-to-air missiles.

LTV A-7D Corsair II (J. Rhodes)

Republic OA-10A Thunderbolt II

Delivery of 713 A-10s was completed in March 1984. The first operational squadron was activated at Myrtle Beach AFB, S. C., in June 1977, and achieved operational capability in October. The first IR Maverick-equipped A-10 squadron became fully operational at RAF Bentwaters, UK, in February 1986. Introduction of the AIM-9 missile system for self-defense has begun, by configuring the aircraft to accommodate dual rail adapters with associated launchers.

Units equipped with A-10s include USAFE's 10th and 81st TFWs, based respectively at RAF Alconbury and RAF Bentwaters/Woodbridge in the UK, and TAC's 23d and 354th TFWs and the 355th TTW. The 57th FWW, at Nellis AFB, Nev., also has some A-10s. AAC's 18th TFS at Eielson AFB, Alaska, and PACAF's 25th TFS at Suwon AB, Korea, are also A-10 equipped.

A-10s were the first first-line aircraft to be assigned to the ANG; they equip the 128th and 174th TFWs and the 103d, 104th, and 175th TFGs. A-10s also equip the 442d and 917th TFWs and the 926th and 930th TFGs of AFRES.

In October 1987, the first of 24 operational and two backup **OA-10s** entered the inventory of the 23d Tactical Air Support Squadron for use in the Forward Air Control (FAC) mission. These aircraft are A-10s that have been redesignated and are intended to be used also for combat escort, search and rescue, and visual reconnaissance. The 30-mm GAU-8/A gun is retained, but underwing stores are restricted normally to canisters of white phosphorus rockets for target marking.

Contractor: Fairchild Republic Company, Division of Fairchild Industries.

Power Plant: two General Electric TF34-GE-100 turbofans; each 9,065 lb thrust.

Accommodation: pilot only.

Dimensions: span 57 ft 6 in, length 53 ft 4 in, height 14 ft 8 in.

Weights: empty 24,959 lb, max gross 50,000 lb.

Performance: combat speed at S/L, clean, 439 mph; range with 9,500 lb of weapons and 1.7 hr loiter, 20 min reserve, 288 miles.

Armament: one 30-mm GAU-8/A gun; eight underwing hard points and three under fuselage for up to 16,000 lb of ordnance, including various types of free-fall or guided bombs, combined effects munition (CEM) dispensers, gun pods, six AGM-65 Maverick missiles, or four AIM-9 Sidewinder missiles, and jammer pods. Chaff and flares carried internally to counter radar-directed or infrared-directed threats. The centerline pylon and the two flanking fuselage pylons cannot be occupied simultaneously.

AC-130A/H/U Spectre

Two versions of the AC-130 gunship are currently in USAF service. **AC-130As** are operated by the Air Force Reserve's 711th SOS at Elgin AFB, Fla.; **AC-130Hs** continue in active service with MAC's 23d Air Force, 1st Special Operations Wing, 16th SOS. AC-130As are equipped with two 40-mm cannon, two 20-mm Vulcan cannon, and two 7.62-mm Miniguns. AC-130Hs are similar, except that one 40-mm cannon is replaced with a 105-mm howitzer and the 7.62-mm Miniguns are deleted. Both models are equipped with sensors and target-acquisition systems, including forward-looking infrared and low-light-level TV. AC-130Hs are equipped for in-flight refueling. Under an improvement program announced in the spring of 1987, AC-130Hs will be fitted with new fire-control computers, navigation equipment, and sensors by FY 1992.

In July 1987, Rockwell was awarded a contract to cover research and development of a new **AC-130U** side-firing gunship to replace the aging and increasingly unsupportable AC-130A version. A total of twelve AC-130Us will be procured to replace ten AC-130As, using new C-130H airframes supplied by Lockheed, with the aim of producing aircraft capable of combining intense firepower with the latest methods of target location and increased loiter capability. AC-130Us will have a highly accurate suite of 105-mm, 40-mm, and 25-mm guns that can be slaved to FLIR, all-light-level television, and Hughes AN/APG-180 fire-control radar, permitting night and/or adverse weather operations. ECM will enhance survivability in a low-to-medium-threat environment. Apart from their primary precision fire support mission, the air-refuelable AC-130Us will be capable of performing other special operations roles, including escort, surveillance, and reconnaissance/interdiction. Each will carry a crew of only thirteen, as one of the gunners of the AC-130A will no longer be required. Rollout of the first AC-130U is expected this summer. The test program will extend into 1992, when the first of the new gunships will be delivered to the 16th SOS. *(Data basically as for C-130.)*

OA-37B Dragonfly

A-37B Dragonfly ground-support aircraft withdrawn from operational service with AFRES have been adapted for forward air control duty as OA-37Bs, replacing O-2As in ANG's 110th, 111th, and 182d Tactical Air Support Groups. Some OA-37Bs are based with TAC's 24th Composite Wing at Howard AFB, Panama.

Contractor: Cessna Aircraft Company.
Power Plant: two General Electric J85-GE-17A turbojets; each 2,850 lb thrust.
Accommodation: two, side by side.
Dimensions: span over tip-tanks 35 ft 10½ in, length excluding fuel probe 28 ft 3¼ in, height 8 ft 10½ in.
Weights: empty 6,211 lb, gross 14,000 lb.
Performance: max level speed at 16,000 ft 507 mph, service ceiling 41,765 ft, range with max payload, including 4,100 lb ordnance, 460 miles.
Armament: one GAU-2B/A 7.62-mm Minigun installed in forward fuselage, four pylons under each wing able to carry various combinations of rockets and bombs.

OV-10A Bronco

First flown in August 1967, the twin-turboprop OV-10A was acquired by USAF for use in the forward air control role and for limited quick-response ground support pending the arrival of tactical fighters. USAF took delivery of 157, and OV-10As still equip TAC, PACAF, and AAC units for use in low-intensity conflicts. Over today's highly dangerous battlefields, they would be used mainly for communications relay and airborne command post missions.

Contractor: Rockwell International Corporation, Aircraft Operations.
Power Plant: two Garrett T76-G-416/417 turboprops; each 715 hp.
Accommodation: two, in tandem.
Dimensions: span 40 ft 0 in, length 41 ft 7 in, height 15 ft 2 in.
Weights: empty 6,893 lb, overload gross weight 14,444 lb.
Performance: max speed at S/L, without weapons, 281 mph; service ceiling 24,000 ft; combat radius with max weapon load, no loiter, 228 miles.
Armament: four fixed forward-firing M60C 7.62-mm machine guns; four external weapon attachment points under short sponsons, for up to 2,400 lb of rockets, bombs, etc.; fifth point, capacity 1,200 lb, under center fuselage. Provision for carrying one Sidewinder missile on each wing and, by use of a wing pylon kit, various stores, including rocket and flare pods and free-fall ordnance. Max weapon load 3,600 lb.

Reconnaissance and Special-Duty Aircraft

U-2R and TR-1A/B

The last of 37 U-2R and TR-1 high-altitude reconnaissance aircraft was delivered to USAF last October, marking completion of a contract awarded in 1979 as a follow-on to earlier U-2 production. The total was made up of seven single-seat **U-2Rs,** one two-seat **U-2R(T),** 25 single-seat **TR-1As,** two two-seat **TR-1Bs,** and two basically similar ER-2s delivered to NASA for earth resources research.

Production of the original U-2 had begun in the late 1950s; 55 are belived to have been built, in various forms but with similar dimensions. They were followed by the U-2R, a version with much increased span and length, 12 of which were manufactured in the late 1960s. The U-2R is now the only operational version of the U-2, following retirement of the last U-2C in 1989. All U-2s have been essentially powered gliders, with high aspect ratio wings and lightweight structure, designed to perform strategic reconnaissance for long periods at very high altitudes. "Superpods" can be fitted to the wings, containing specialized equipment appropriate to individual mission demands. This versatility has enabled Air Force U-2s to perform also important nonmilitary missions, including flights for the Department of Agriculture land management and crop estimate programs; photographic work in connection with flood, hurricane, and tornado damage; data gathering for a geothermal energy program; and search missions for missing boats and aircraft.

Structurally identical to the U-2R, the TR-1A is a single-seat tactical reconnaissance aircraft designed for high-altitude standoff surveillance missions. It was first flown in 1981, and pilot training at Beale AFB, Calif., began later that year. Currently, TR-1As and TR-1B trainers are based at Beale AFB and at RAF Alconbury in the UK. Those operating in Europe remain under the jurisdiction of SAC, which has responsibility for all U-2s and TR-1s. Each TR-1A is equipped with electronic sensors to provide continuously available, day and night, all-weather surveillance of the battle area or potential battle area in direct support of US and allied ground and air forces during peace, crisis, and war situations. The sensors include an advanced synthetic aperture radar system in side-looking airborne radar (SLAR) form and modern ECM.

A proposal to reengine more than 40 U-2R/TR-1 aircraft with the General Electric F118 turbofan is under consideration. The F118, developed for the B-2 bomber, would have the dual benefits of enhancing all-round performance of the aircraft while providing much improved supportability over the current engine which is used in no other USAF operational aircraft.

Contractor: Lockheed Corporation.
Power Plant: one Pratt & Whitney J75-P-13B turbojet; 17,000 lb thrust.
Dimensions: span 103 ft 0 in, length 63 ft 0 in, height 16 ft 0 in.
Weight: gross 40,000 lb.
Performance: max cruising speed at over 70,000 ft more than 430 mph, ceiling 90,000 ft, range more than 3,000 miles.
Armament: none.

RF-4C

This unarmed, multisensor version of the F-4C Phantom II was developed to replace the day-only RF-101 for day/night, all-weather reconnaissance operations. The first production RF-4C flew in May 1964, and 505 were built before manufacture ended in December 1973. They are operated by four TAC, USAFE, and PACAF tactical reconnaissance squadrons and by five squadrons of the ANG. The RF-4 was the first tactical aircraft equipped with a forward-looking radar capable of simultaneous terrain-following and low-altitude navigation. The basic aircraft is configured with conventional optical cameras for day operations and infrared (IR) sensors for night. Both the radar and the camera systems are housed in a modified nose, which increases the length of the aircraft by 33 inches compared with the fighter version. Twenty-four RF-4Cs were fitted with a tactical electronic reconnaissance (TEREC) sensor for locating electronic emitters. Other equipment includes the ARN-101 digital avionics system for improved navigation accuracy and greater reconnaissance capability; and data link transmission of TEREC intelligence in near real time to enhance timeliness of information to tactical decision-makers. An advanced radar warning receiver is currently being developed for the RF-4C, but proposals to replace the aircraft's cameras with electro-optical sensors, under the joint-service Advanced Tactical Air Reconnaissance System (ATARS) program, were abandoned due to the limited long-term survivability of the aircraft. *(Data similar to those for F-4.)*

Lockheed AC-130H Spectre

Cessna OA-37B Dragonfly

Rockwell OV-10A Bronco

Lockheed TR-1A

EC-130

Several variants of the basic C-130 have been produced for specialized missions, including the **EC-130E ABCCC,** used as an airborne battlefield command and control center by the 7th Airborne Command and Control Squadron at Keesler AFB, Miss., a geographically separated unit of the 28th Air Division, Tinker AFB, Okla.; the **EC-130E "Volant Solo II"** psychological operations (PSYOP) broadcasting version flown by the 193d Special Operations Group, ANG, from Middletown, Pa.; and the **EC-130H "Compass Call"** communications jammer operated by the 41st Electronic Combat Squadron at Davis-Monthan AFB, Ariz., also a geographically separated unit of the 28th Air Division, and the 66th Electronic Combat Wing at Sembach AB, West Germany. Altogether, 16 EC-130Hs are in service. An upgrade program was due to have started in FY 1988. *(Data basically as for C-130.)*

EC-135, etc.

Several aircraft in the KC-135 Stratotanker series were modified for specialized missions during production or at a later date. Thirty-nine are modified for strategic airborne command and control missions. Five KC-135A tankers were converted for Airborne Command Post use by SAC in 1960. Additional aircraft were modified in 1962, and 17 new production KC-135B turbofan aircraft entered the system in 1965. Currently, **EC-135A/C/G/H/J/L/P** aircraft are assigned to SAC, TAC, PACAF, and USAFE. They are fitted with extensive communications equipment to support strategic command and control missions of their respective CINCs. At least one SAC EC-135C is airborne at all times, accommodating a flight crew of four, a general officer, and a staff of 18. EC-135Cs can be refueled by SAC tankers. Thirteen are in service and have been adapted to provide control of Minuteman ICBMs. TAC provides overseas deployment control of tactical fighters with the **EC-135K.** Planned modifications to the EC-135 aircraft in FY 1989 included continuation of the ultrahigh-frequency line-of-sight system replacement, the initial Milstar transition satellite com-

munications terminals, and the Peacekeeper upgrades to Airborne Launch Control Aircraft. Future enhancements include full Milstar capability and improved low- and very-low-frequency radios and antennas.

Three **EC-135N Advanced Range Instrumentation Aircraft (ARIA)** are operated by ASD's 4950th Test Wing as telemetry and voice relay stations to supplement land and sea receiver stations for DoD and NASA space and missile programs. The aircraft's distinctive bulbous nose houses the world's largest airborne steerable antenna.

Versions of the C-135 Stratolifter series used for reconnaissance include turbofan **RC-135Vs** and **RC-135Ws,** equipped for electronic reconnaissance with SAC, and **RC-135Ss, RC-135Us,** and **RC-135Xs** for specific reconnaissance tasks. **WC-135Bs,** converted C-135Bs operated by MAC, provide atmospheric sampling capability. Under the Milstar program, an **NKC-135** will collect data to assist airworthiness certification of the radome installation on the SAC EC-135s.

To minimize the cost of retrofitting special-purpose -135s with more efficient turbofan engines, USAF installed in some aircraft refurbished Pratt & Whitney JT3D-3Bs taken from Boeing 707-100B aircraft purchased as surplus from commercial air carriers. *(Data basically as for C-135.)*

EF-111A Raven

The EF-111A Raven is a conversion of the basic General Dynamics F-111A airframe fitted with mainly off-the-shelf components that enable it to accomplish important defense suppression missions in worldwide support of US tactical strike forces. Its ALQ-99E primary jammer is a modification of the Navy ALQ-99 and is carried internally. This system's frequency coverage, reliability, and effective use of available jamming power enables the EF-111A to suppress extremely dense electronic defenses. Other equipment includes self-protection systems from the F/FB-111 (ALQ-137, ALR-62). The cockpit is revised, and a new vertical stabilizer houses the ALQ-99E receivers. An upgrade program for the EF-111A is currently being developed, with improvements to the ALQ-99E being undertaken to enable the system to counter advanced electronic defenses for the 1990s and beyond. Other improvements under the avionics modernization program (AMP) include upgrading the terrain-following radar, installation of GPS equipment, and a new inertial navigation system.

Forty-two EF-111As were produced for missions that include barrier standoff jamming, degradation of acquisition radars during close-in jamming operations, and direct support jamming for deep strike missions. Flight testing began in March 1977, and the first "production" EF-111s were delivered in late 1981 to the 366th TFW at Mountain Home AFB, Idaho, where they achieved initial operational capability with the 390th Electronic Combat Squadron in December 1983. These aircraft have one of the highest utilization rates in the Air Force. Second operational location is at RAF Upper Heyford in the UK, from February 1984, with the 42d ECS. Aircraft from this unit took part in the attack on Libyan targets in April 1986.

Contractor: Grumman Aerospace Corporation.
Power Plant: two Pratt & Whitney TF30-P-109 turbofans; each 19,600 lb thrust with afterburning.
Accommodation: crew of two, side by side in escape module.
Dimensions: span spread 63 ft 0 in, fully swept 31 ft 11.4 in length 76 ft 0 in, height 20 ft 0 in.
Weights: empty 55,275 lb, gross 88,948 lb.
Performance: max combat speed 1,377 mph, service ceiling with afterburning at combat weight 45,000 ft, combat radius with reserves 230–929 miles, according to mission.
Armament: none.

E-3B/C Sentry (AWACS)

AWACS is a mobile, flexible, survivable, and jam-resistant surveillance and command, control, and communications (C^3) system capable of all-weather, long-range, high- or low-level surveillance of all air vehicles, manned or unmanned, above all kinds of terrain. A modified Boeing 707-320B (AWACS) carries an extensive complement of mission avionics, including computer, radar, IFF, communications, display, and navigation systems. The capability of AWACS is provided by its Westinghouse Electric Corporation look-down radar, which makes possible all-altitude surveillance over land or water, thus correcting a serious deficiency in earlier surveillance systems.

The E-3 serves a dual role within USAF: as a command and control center to support quick reaction deployment and tactical operations by TAC units, and as a survivable early warning command and control center for identification, surveillance, and tracking of airborne enemy forces and for the command and control of NORAD forces over the continental USA.

Deliveries of the basic production version, designated **E-3A Sentry,** began in March 1977, when the first aircraft was handed over to TAC's 552d Airborne Warning and Control Wing at Tinker AFB, Okla. Twenty-four were built.

RF-4C

Lockheed EC-130H Compass Call

Grumman EF-111A

Boeing E-3 Sentry

Twenty-two of them, plus two prototypes, have been upgraded to **E-3B** configuration. Improvements include much-enhanced computer capabilities, antijam communications, an austere maritime surveillance capability, additional radio communications, and five additional display consoles. The first E-3B was redelivered to the 552d AWACW in July 1984.

A **US/NATO Standard E-3A** configuration was introduced starting with the 25th production USAF Sentry, delivered in December 1981. In this version, the data-processing capability is improved and a maritime detection capability included. Nine were built for USAF, and one of the original E-3As was upgraded to this standard. NATO operates a further 18, purchased as part of a cooperative program to upgrade the command and control of NATO's air defense forces. Saudi Arabia has five E-3s; Britain's Royal Air Force and the French Air Force have also selected the E-3 for future service.

Ten US Standard E-3A aircraft were upgraded to **E-3Cs,** with additional command and control capability, in 1984–88.

A $425 million Multistage Improvement Program (MSIP) for the E-3 was proposed by ESD, to be phased over five years. Eventually, all USAF and NATO E-3s will be equipped with the Joint Tactical Information Distribution System (JTIDS) for antijam digital communications. As a first step, Boeing was awarded a contract in May 1987 for E-3 improvements that include full-scale development and integration into US and NATO aircraft of an ESM system that will detect signals emitted by both hostile and friendly targets. Additional enhancements to US E-3s will include upgrading of JTIDS to TADIL-J (tactical digital information link-J) capability, computer upgrade, and ability to employ the GPS. Full-scale development contracts for a major radar upgrade under the Radar System Improvement Program (RSIP) were awarded in September 1989. IOC for these improvements is scheduled for FY 1995, with contract completion by FY 1998.

E-3s assumed a US continental air defense role in January 1979, when NORAD personnel began augmenting TAC E-3 flight crews on all operational NORAD missions by 28th Air Division's 552d AWACW from Tinker AFB. Units of the 28th Air Division include the 960th, 961st, and 962d AWAC Squadrons based, respectively, at NAS Keflavik, Iceland, Kadena AB, Japan, and Elmendorf AFB, Alaska. Deployments have been made to the Pacific, the Middle East, southwest Asia, the Mediterranean area, and Europe. AWACS aircraft are also used in support of the US drug enforcement program.

Contractor: Boeing Aerospace and Electronics.
Power Plant: four Pratt & Whitney TF33-PW-100/100A turbofans; each 21,000 lb thrust.
Accommodation: basic operational crew of 20, including 16 AWACS mission specialists.
Dimensions: span 145 ft 9 in, length 152 ft 11 in, height 41 ft 9 in.
Weight: gross 335,000 lb.
Performance: max speed 530 mph, service ceiling above 29,000 ft, endurance six hr on station 1,000 miles from base.

E-4B

SAC is the Air Force single-resource manager for the E-4 airborne command post aircraft, the main operating base for which is Offutt AFB, Neb. Three E-4As were built initially to support the National Emergency Airborne Command Post (NEACP). Each had a modified Boeing 747 airframe and provided an interim capability by utilizing existing EC-135 command, control, and communication (C^3) equipment. Four fully developed E-4B Airborne Command Post aircraft (three of them converted from E-4A) now support the NEACP mission. They are hardened against the effects of nuclear explosions, including electromagnetic pulse, equipped for in-flight refueling, contain a 1,200kVA electrical system designed to support advanced electronics, and have a wide variety of communications equipment. This includes a more powerful LF/VLF system, improved satellite communications system, and communications processing equipment. These systems have antijam features and will support operations in a nuclear environment over extended ranges. The E-4B system is capable of tying into commercial telephone and radio networks and could, potentially, be used for radio broadcasts to the general population. Additional improvements, to include a data-processing capability and more survivable C^3, including initial Milstar modification, were planned for FY 1989. The first E-4B entered service with SAC in January 1980, and the first operational mission was flown in March of that year.

Contractor: Boeing Aerospace.
Power Plant: four General Electric CF6-50E2 turbofans; each 52,500 lb thrust.
Dimensions: span 195 ft 8 in, length 231 ft 4 in, height 63 ft 5 in.
Weight: gross 800,000 lb.
Performance: unrefueled endurance in excess of 12 hours.

E-8A Joint STARS

In September 1985, Grumman received a $657 million contract for full-scale development of the USAF/US Army Joint Surveillance and Target Attack Radar System (Joint STARS). Two 707-320 airframes were modified by Boeing as vehicles for the airborne equipment. Grumman is responsible for subsystems installation, integration, and flight-testing of the equipment, which will include a Norden multimode side-looking radar antenna, some 25 ft long, faired into the belly of each aircraft. The radar will operate in synthetic aperture radar (SAR) mode to detect and locate stationary objects, such as parked tanks, and will alternate between SAR and a Doppler-type mode to locate and track slow-moving targets. The Joint STARS system will then direct attack on the targets, via the Joint Tactical Information Distribution System (JTIDS).

The first modified airframe was delivered to Grumman in August 1987, with the second delivered in November 1988. First flight of a Joint STARS aircraft took place in April 1988. The second aircraft flew last August and will be the primary test version following the installation and test of additional equipment. The system will be temporarily deployed in Europe in FYs 1990 and 1991 to demonstrate its capabilities in the NATO environment. After this, a decision will be made on whether or not to proceed to production of operational aircraft and ground stations. However, USAF is faced with the task of selecting another aircraft platform to carry the system, as Boeing is expected to end 707 production before Joint STARS is ready to go into procurement. The Air Force has decided to purchase and modify used 707s as the airframe for future E-8As, rather than modify and qualify another type of aircraft. The selected aircraft would be expected to carry a crew of around 19 US Army and USAF specialists.

Contractor: Grumman Corporation.

E-9A

Under this designation, two highly modified Boeing

Canada (de Havilland) DHC Dash 8M aircraft are operated by the Air Force Air Defense Weapons Center at Tyndall AFB, Fla., as airborne platform telemetry relay aircraft. Each is equipped with a sensor suite developed by the Sierra Research Division of LTV, including an AN/APS-128D sea surveillance radar in a ventral radome and a five-beam, electronically steerable 75-square-foot phased-array telemetry antenna, in a starboard side fuselage fairing. This is capable of automatically detecting, tracking, and relaying data simultaneously from five distinct sources traveling at speeds up to Mach 5 or more. It will be used for low-altitude, over-the-horizon telemetry data-gathering during missile tests and for sea surveillance in order to keep boats out of the Gulf Test Range during tests.

Contractor: de Havilland Division of Boeing Canada.
Power Plant: two Pratt & Whitney Canada PW120A turboprops; each 1,800 shp. (No military designation on these engines.)
Accommodation: three: pilot, copilot, and systems operator.
Dimensions: span 85 ft 0 in, length 73 ft 0 in, height 24 ft 7 in.
Weight: gross 33,000 lb fully fueled.
Performance: max speed at 25,000 ft 245 mph, max operational altitude 25,000 ft, loiter time 5 hr.

EC-18B/D

The **EC-18B Advanced Range Instrumentation Aircraft (ARIA)** is a modified former American Airlines Boeing 707-320 series transport, of which four have replaced some of the EC-135N ARIAs operated by ASD's 4950th Test Wing. In common with the EC-135 ARIAs, the 707s are converted to house the world's largest airborne steerable antenna in a bulbous nose, with a probe antenna on each wingtip, and a completely new cockpit configuration. Range, cabin space, and fuel efficiency are all increased to provide greater support for the expanding ARIA mission, including DoD and NASA space and missile programs. The aircraft can accommodate a crew of 16–24. Following conversion, the first EC-18B was flown for the first time in February 1985 and entered operational service in January 1986. All four were expected to be fully operational by 1988. A sonobuoy missile impact location system (SMILS) of the kind fitted on some USN P-3s is currently under development for the EC-18B.

A $42.6 million contract was awarded to Electrospace Systems Inc. to modify two Boeing 707s for use as dedicated Cruise Missile Mission Control Aircraft (CMMCA). Designated **EC-18D,** they will, after the completion of flight tests in early 1991, be flown by the 4750th TW at Wright-Patterson AFB, Ohio, in support of USN and SAC missile testing. They will also be capable of monitoring and controlling unmanned aerial vehicles.

Contractor: Boeing Military Airplanes.

WC-130E/H

Modified C-130 Hercules transports, designated **WC-130E** and **H,** are equipped for weather reconnaissance duties, including penetration of tropical storms to obtain data for forecasting of storm movements. They are assigned to the Air Rescue Service (ARS) of MAC and the 403d TAW of AFRES. *(Data similar to those for C-130.)*

X-29A Forward Swept Wing Demonstrator

Flight testing of the unique X-29A Forward Swept Wing (FSW) multitechnology demonstrator has been under way at NASA's Dryden Flight Research Center at Edwards AFB, Calif., since December 1984. A reexamination of the FSW principle was made both practical and feasible by the introduction of advanced lightweight composite materials that eliminate many of the problems encountered with conventional metal construction. Day-to-day management of the program was handed over to NASA following acceptance of the aircraft by USAF's Aeronautical Systems Division in March 1985. USAF manages flight test support.

The two X-29 demonstrators were built by Grumman. A standard Northrop F-5A forward fuselage and nose landing gear and many off-the-shelf components, such as F-16 main landing gear and control surface actuators, were utilized on each aircraft to reduce costs. Integrated with a triplex fly-by-wire flight-control system, the X-29's forward-swept wings, made of strong, lightweight graphite composites, and its stubby canards, which act as its main control surfaces, combine to enhance lift and reduce drag. In flight, the wings' trailing edges change shape continuously to match flight conditions. The canards, flaperons, and strake flaps at the tail work together to enhance maneuverability.

The early phase of the flight program, following the installation of an improved backup flight-control system in the fall of 1985, was aimed at testing stability and control loads, flutter, and wing divergence up to 40,000 ft and at speeds up to Mach 1.5. The first supersonic flight took place in December 1985, when preliminary data showed Mach 1.03 airspeed at an altitude of 40,000 ft. This phase ended in December 1986 after 104 flights. Before commencement of the second phase, a calibrated engine with two thrust measuring systems for performance

Boeing E-4B (NEACP)

Grumman E-8A

De Havilland E-9A

Boeing EC-18B

data, a NASA noseboom calibrated for air data measurements, and upgraded instrumentation were installed. In June 1988, this first X-29 made its 200th flight, a record for a single X-series aircraft. Performance and asymmetric load testing were completed after a total of 242 flights during which a maximum speed of Mach 1.52 at 51,000 ft had been recorded. The aircraft was grounded to provide spares for the second demonstrator.

Work on design modification and installation of flight test instrumentation and an antispin parachute on the second X-29 began in the summer of 1987. It was delivered in October 1988 and was flown for the first time in May of last year. This aircraft is being used to explore the low-speed, high-angle-of-attack side of the envelope.

Contractor: Grumman Corporation.
Power Plant: one General Electric F404-GE-400 turbofan; 16,000 lb thrust class.
Accommodation: pilot only.
Dimensions: span 27 ft 2½ in, length overall 53 ft 11¼ in, height 14 ft 3½ in.

Lockheed C-5B Galaxy

Weights: empty 13,800 lb, gross 17,800 lb.
Performance: max level speed approx Mach 1.6.

NASP/X-30A

The **National Aerospace Plane (NASP)** research program, initiated jointly by DoD and NASA, is intended to develop a family of hypersonic single-stage-to-orbit aircraft/spacecraft able to take off from and land on conventional runways. Such vehicles could place payloads in orbit at costs far below those of current expendable launch vehicles or the space shuttle. They could also point the way to future military transatmospheric vehicles (TAVs) able to leave and return to orbital flight on reconnaissance or attack missions. USAF has overall responsibility for the NASP research program; NASA is responsible for the overall technology maturation and commercial applications.

The current technology development phase of the program began in April 1986, when DoD and NASA announced the award of contracts for propulsion and airframe development. In the following year, two of the airframe contractors were eliminated, leaving General Dynamics, McDonnell Douglas, and Rockwell International to proceed into a three-year preliminary design phase on the airframe, with Rocketdyne and Pratt & Whitney continuing their propulsion work. By late 1989, it had been decided to stretch the NASP program to cut costs in the short term and reduce technical risks in the long term. In January 1990, the five prime contractors engaged in the program announced plans to form a national contractor team to pool resources and develop the vehicle jointly.

A subscale experimental aircraft designated **X-30A,** similar in size to a McDonnell Douglas MD-80 series airliner, is intended to be used in the third phase of the program, to develop and demonstrate Aerospace Plane technologies throughout the flight envelope for hypersonic cruise and acceleration to low-Earth orbit. No timetable for this part of the program has been decided.

Transports and Tankers

C-5A/B Galaxy

This long-range, air-refuelable, heavy logistics transport flew for the first time in June 1968. Delivery of 81 basic **C-5As** began in December 1969 and was completed by May 1973. Each aircraft is capable of airlifting loads up to 291,000 lb, such as two M60 tanks or three CH-47 Chinook helicopters, over transoceanic ranges. Under a major modification program initiated in 1978, Lockheed produced component kits to extend the service life of the C-5A's wings by 30,000 flight hours, without load restrictions. These kits replaced only the five main load-carrying wing boxes, to which other existing components were transferred. The use of 7175-T73511 aluminum alloy provided greater strength and resistance to corrosion. Installation of production kits began in 1982, and modification of all 77 aircraft in the inventory was complete by July 1987. In December 1984, the 433d MAW at Kelly AFB, Tex., became the first AFRES unit to be equipped with "AFRES-owned" C-5As, and the 439th MAW at Westover AFB, Mass., began replacing its C-130s with C-5s in 1987. ANG's 105th MAG at Newburgh, N. Y., received its first C-5As in July 1985. Two C-5As have been modified to carry outsize space cargo by extending the cargo bay and modifying the aft doors.

To meet an urgent need for additional heavy airlift capacity, USAF has acquired 50 **C-5Bs,** generally similar to the C-5A, but embodying all the improvements that have been introduced since completion of C-5A production. These include the strengthened wings, General Electric TF39-GE-1C turbofans, and updated avionics, including Bendix color weather radar and Delco triple INS. The original MADAR (MAlfunction Detection Analysis and Recording) instrument units are replaced by the more advanced MADAR II. The first C-5B flew for the first time in 1985 and was delivered to Altus AFB, Okla., in January 1986. Deliveries were completed in April 1989. The two operational C-5B units (each with 23 aircraft) are the 60th MAW at Travis AFB, Calif., and the 436th MAW at Dover AFB, Del. One hundred and twenty-seven C-5s are now within the purview of the US Transportation Command (USTRANSCOM), which was activated in October 1987. *(Data for C-5B.)*

Contractor: LASC Georgia Division of Lockheed Corporation.
Power Plant: four General Electric TF39-GE-1C turbofans; each 43,000 lb thrust.
Accommodation: crew of five, rest area for 15 (relief crew, etc.); 75 troops and 36 standard 463L pallets or assorted vehicles, or additional 270 troops.
Dimensions: span 222 ft 8½ in, length 247 ft 10 in, height 65 ft 1½ in.
Weights: empty 374,000 lb, max payload 261,000 lb, gross (for 2*g*) 837,000 lb.

AFFORDABLE PERFORMANCE

Latest technology 1,150 shp, flat rated to 950 shp, Pratt & Whitney PT6A-62 engine is fitted with electronic temperature and torque limiter.

THE PILATUS PC-9

– THE TRAINER DESIGNED FOR THE PRIMARY AIRCRAFT TRAINING SYSTEM (PATS) REQUIREMENT.

AVAILABILITY:

In service today as the choice of air forces around the world for the primary training role, the PC-9 offers "off-the-shelf" capability to train military jet pilots which no competitor can match for its combination of high performance and low cost!

PERFORMANCE:

The PC-9 offers climb rates and cruise performance exceeding those of many turbojet trainers. The throttle quadrant, containing a single power lever, controls the jet-like power response of the engine while agile and responsive handling and predictable stall and spin characteristics quickly build student confidence.

TECHNOLOGY:

Power is by the DoD-proven Pratt and Whitney PT6A engine with electronic engine control to take care of power management. Cockpit avionics dictated by the customer can include the latest in electronic flight instrumentation.

AFFORDABILITY:

A third generation turboprop, the PC-9 is the latest descendant of the Pilatus thoroughbred trainer line, drawing on fifty years of experience. Its low maintenance costs, high reliability and outstanding performance guarantee increased training levels for fewer dollars.

PC9 – "THE AFFORDABLE PERFORMER"

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Performance: max speed at 25,000 ft 571 mph, service ceiling (at 615,000 lb) 35,750 ft, range with max payload 3,434 miles, range with max fuel 6,469 miles.

C-9A/C Nightingale

Derived from the DC-9 Series 30 commercial airliner, the **C-9A** is an aeromedical airlift transport, in service since August 1968. Modifications include a special-care compartment with separate atmospheric and ventilation controls. Delivery of 21 to MAC's 375th Aeromedical Airlift Wing (to be redesignated 375th Military Airlift Wing this spring) was completed by February 1973; this unit is now augmented by the 73d AAS (Assoc) of AFRES, collocated at Scott AFB, Ill. The Nightingale also performs overseas theater aeromedical evacuation missions in Europe and the Pacific. Three specially configured **C-9Cs** were delivered to the 89th Military Airlift Wing at Andrews AFB, Md., in 1975 for Presidential and other US governmental duties. *(Data for C-9A.)*

Contractor: Douglas Aircraft Company, Division of McDonnell Douglas Corporation.

Power Plant: two Pratt & Whitney JT8D-9 turbofans; each 14,500 lb thrust.

Accommodation: crew of three; 40 litter patients or 40 ambulatory patients, or a combination of both, plus five medical staff.

Dimensions: span 93 ft 3 in, length 119 ft 3 in, height 27 ft 6 in.

Weight: gross 108,000 lb.

Performance: max cruising speed at 25,000 ft 565 mph, ceiling 35,000 ft, range more than 2,000 miles.

C-12 Huron

Thirty military versions of the Beechcraft Super King Air 200 were delivered to USAF under the designation **C-12A.** Their role is to support attaché and military assistance advisory missions throughout the world. MAC uses two C-12As to train aircrews and to supplement support airlift. C-12As refitted with PT6A-42 engines are redesignated **C-12E.** Six **C-12D** versions, with cargo door, high flotation landing gear, and provision for tip tanks, were delivered to USAF.

MAC uses 40 passenger/cargo-capable Super King Air B200Cs **(C-12Fs)** at eleven bases throughout CONUS, PACAF, and USAFE for the time-sensitive movement of people and cargo. The C-12Fs, along with the C-21A aircraft, replaced the CT-39 fleet. The ANG has six **C-12Js** (military versions of the 19-passenger Beechcraft 1900C) ordered in FY 1985, the first of which was delivered in September 1987. These serve as mission support aircraft, replacing the Convair C-131. *(Data for C-12A.)*

Contractor: Beech Aircraft Corporation.

Power Plant: two Pratt & Whitney Canada PT6A-38 turboprops; each 750 shp. (C-12F: 850 shp PT6A-42s.)

Accommodation: crew of two; up to eight passengers or 4,764 lb of cargo. Convertible to aeromedical evacuation configuration.

Dimensions: span 54 ft 6 in, length 43 ft 9 in, height 15 ft 0 in.

Weight: gross 12,500 lb.

Performance: max speed at 14,000 ft 301 mph, service ceiling 31,000 ft, range at max cruising speed 1,824 miles.

C-17A

Developed to meet US force projection requirements, the C-17A is a heavy-lift, air-refuelable cargo transport that will provide intertheater and theater airlift of all classes of military cargo, including outsize. It will be able to operate routinely into small, austere airfields (3,000 ft × 90 ft) previously restricted to C-130s and provide the first capability to airland or airdrop/extract outsize cargo in the tactical environment. The C-17 will not only enhance US airlift capability across the board but will also provide much-needed force structure modernization. The C-17 will be based at active-duty locations as well as at Air Force Reserve and Air National Guard bases.

McDonnell Douglas was announced as the selected prime contractor in August 1981 and received a low-level research and development contract the following July. This was intended to cover C-17 technologies that would also benefit other airlift programs while preserving the option to proceed to full-scale development (FSD) work on the C-17. FSD was approved in February 1985. Initial procurement funding was authorized in the FY 1987 budget, together with continued R&D. The first two production aircraft were funded in FY 1988; the FY 1989 budget approved $941.1 million for continued R&D as well as procurement of four more production aircraft; a further four were funded in FY 1990; and six have been requested in the FY 1991 budget, as well as funding for continued RDT&E. A plant at Macon, Ga., is producing major subassemblies. Subcontractors for the C-17 program include Beech Aircraft Corporation (composite winglets); Delco Electronics Corporation (mission computer and electronic display system); Grumman Aircraft Systems (ailerons, rudder, and elevators); GEC Avionics (advanced HUD); LTV Aircraft Products (vertical and horizontal stabilizers, engine nacelles); Honeywell Inc. (support equipment and air data computers); and General Electric (electronic flight-control system).

Current plans envisage first flight in FY 1991, with IOC for 12 aircraft in FY 1993. Delivery of the planned buy of 210 C-17s would be completed by the year 2001. The 437th MAW at Charleston AFB, S. C., has been designated as the first C-17 unit.

Prime Contractor: Douglas Aircraft Company, Division of McDonnell Douglas Corporation.

Power Plant: four Pratt & Whitney F117-PW-100 turbofans; each 41,700 lb thrust.

Accommodation: normal flight crew of two, plus loadmaster. Provisions for the full range of military airlift missions.

Dimensions: span 165 ft 0 in, length 174 ft 0 in, height 55 ft 1 in.

Weights: max payload (2.25*g*) 172,200 lb, gross 580,000 lb.

Performance (estimated): normal cruising speed at height 518 mph (Mach 0.77), range with 167,000 lb payload 2,400 miles.

McDonnell Douglas C-9A Nightingale

Gulfstream C-20

Learjet C-21A

C-20A/B Gulfstream III

USAF acquired eleven off-the-shelf Gulfstream III transports, each with accommodation for five crew and 14 passengers, for VIP duties, to replace aging, fuel-inefficient C-140Bs. Three **C-20As** and one **C-20B,** delivered to the 89th Military Airlift Wing in FY 1983 and FY 1984 under a lease/purchase agreement, were subsequently purchased. Another seven C-20Bs, with advanced mission communications equipment and revised interior, were ordered in January 1986. As these were delivered to Andrews AFB, Md., the original three C-20As were transferred to Ramstein AB, West Germany, in support of 58th MAS's special airlift mission in Europe. The C-20s provide the Special Airlift Mission (SAM) fleet with intercontinental range and ability to operate from short runways.

Contractor: Gulfstream Aerospace Corporation.

Power Plant: two Rolls-Royce F113-RR-100 turbofans; each 11,400 lb thrust.

Accommodation: crew of five; 14–18 passengers.

Dimensions: span 77 ft 10 in, length 83 ft 1 in, height 24 ft 4½ in.

Weight: gross 69,700 lb.

Performance: max cruising speed 561 mph, service ceiling 45,000 ft, range 4,050 miles.

C-21A

Eighty-three C-21As are operated by active-duty and ANG units from twelve US bases and three overseas locations. These aircraft, together with the C-12Fs, replaced the CT/T-39 fleet and are used to provide operational support airlift for time-sensitive movement of people and cargo throughout the United States and the Pacific and European theaters, including aeromedical missions if required. The first C-21A was delivered to USAF in 1984; in 1987, ANG acquired four C-21s to replace its T-39s based at Andrews AFB, Md. All C-21A aircraft are currently undergoing modification with digital electronic engine controls.

Contractor: Learjet Corporation.

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

Accommodation: crew of two and up to eight passengers, or 3,153 lb cargo. Convertible to aeromedical evacuation configuration.

Dimensions: span 39 ft 6 in, length 48 ft 8 in, height 12 ft 3 in.

Weight: gross 18,500 lb.

Performance: cruising speed Mach 0.81, service ceiling 45,000 ft, range with maximum passenger load 2,420 miles, with maximum cargo load 1,653 miles.

C-22B

Under the designation C-22B, four Boeing 727 commercial transports have been purchased and are being modified for use by ANG on operational support airlift missions. Two aircraft will be further modified to accommodate an additional 1,100 gallons of fuel and landing gear rated for 170,000 lb gross landing weight.

C-23A Sherpa

Eighteen Sherpa light transports were delivered to USAF between November 1984 and December 1985. They are operated by MAC and controlled by CINCUSAFE, primarily to ferry aircraft spares and complete engines to bases throughout Europe.

First flown in December 1982, the Sherpa is an all-freight version of the Shorts 330 regional airliner, with a 6 ft 6 in square cabin section over an unimpeded hold length of 29 ft. Through loading is provided via a large forward freight door, a full-width hydraulically operated rear ramp door, and removable roller conveyors. The USAF aircraft are used in the European Distribution System (EDS) aircraft program, centered on Zweibrücken AB, West Germany, with main warehousing facilities at RAF Kemble in the UK and Torrejon AB in Spain. In peacetime, the Sherpas service at least 20 USAF bases in a system analogous with the civil air freight operation carried out by Federal Express in the US. They have reduced transit time on delivery of parts from as long as a week to only one to four days.

Contractor: Short Brothers PLC.

Power Plant: two Pratt & Whitney Canada PT6A-45R turboprops; each 1,198 shp.

Accommodation: crew of three; up to 7,000 lb of freight, including four LD3 containers, and engines the size of the F100 series.

Dimensions: span 74 ft 8 in, length 58 ft 0 ½ in, height 16 ft 3 in.

Weight: gross 22,900 lb.

Performance: max cruising speed at 10,000 ft 218 mph, range 789 miles with 2,800 lb payload.

VC-25A

USAF has assigned the military designation VC-25A to the two specially equipped Presidential aircraft, based on Boeing 747-200B airframes, that will replace the current primary and backup "Air Force One" transports (C-137Cs). The new aircraft will have a Bendix Aerospace EFIS-10 electronic flight instrument system and state-of-the-art onboard communications equipment. A pair of self-contained air-stairs will be located on the left side and a built-in baggage loader on the right side, which, together with a second auxiliary power unit, will allow the aircraft to be practically self-sufficient and reduce the need for ground-support equipment. Despite its long

range, the aircraft will be air-refuelable. Delivery to USAF on September 30, 1990, will be later than scheduled, due to the complexity of the modification requirements.
Contractor: Boeing Military Airplanes.
Power Plant: four General Electric CF6-80C2B1 turbofans; each 56,750 lb thrust.
Accommodation: crew of 23; up to 70 passengers.
Dimensions: span 195 ft 8 in, length 231 ft 10 in, height 63 ft 5 in.
Weight: long-range mission T-O weight 803,700 lb.
Performance: high speed cruise Mach 0.88–0.91, normal cruising speed Mach 0.84, unrefueled range in excess of 6,910 miles.

Fairchild C-26A

Lockheed C-130H Hercules

C-26A

USAF is acquiring 13 Fairchild Metro III commuter transport aircraft to replace ANG C-131s, under the designation C-26A. The first aircraft was delivered in March last year and was assigned to the 147th FIG at Ellington ANGB, Tex. The C-26As serve in the ANGOSTA (Air National Guard Operational Support Transport Aircraft) role. They have a quick-change interior, enabling passenger seats to be replaced by a medevac or cargo-carrying configuration.
Contractor: Fairchild Aircraft Corporation.
Power Plant: two Garrett TPE331-11U-612G turboprops, each 1,100 shp.
Accommodation: crew of two; 19–20 passengers.
Dimensions: span 57 ft 0 in, length 59 ft 4¼ in, height 16 ft 8 in.
Weights: empty 9,410 lb, gross 16,000 lb.
Performance: max cruising speed 320 mph, service ceiling 26,700 ft, range with 19 passengers, 1,224 miles.

C-29A

Six British Aerospace 125-800 business-jet type aircraft, equipped with a state-of-the-art LTV-Sierra flight inspection system, were scheduled for delivery to MAC between December 1989 and May of this year. The aircraft are off-the-shelf models, the only modifications being the addition of some military avionics, an upgraded electrical system, UHF radios, and an oxygen system. The MAC flight inspection mission provides worldwice, all-weather, certified instrument approaches, traffic control and landing system equipment, and air-ground communications evaluation during contingency or wartime operations. The six C-29As are intended to replace the aging C-140s and T-39As that have accomplished the mission until now.
Contractor: British Aerospace PLC.
Power Plant: two Garrett TFE731-5R-1H turbofans, each 4,300 lb thrust.
Accommodation: crew of two on flight deck.
Dimensions: span 51 ft 4½ in, length 51 ft 2 in, height 17 ft 7 in.
Weight: gross 27,400 lb.
Performance: max level speed and max cruising speed at 29,000 ft 525 mph, service ceiling 43,000 ft, range with max payload 3,305 miles.

CT-39A/B Sabreliner

Acquired in the late 1950s and early 1960s, the CT-39 Sabreliner became increasingly less cost-effective and has been replaced in MAC by the C-12F and C-21A. The few CT-39A/B basic utility and training aircraft still in the inventory are in service with AFSC, and with MAC facility checking squadrons, which use two Sabreliners, together with three C-140As, to evaluate communications and navigation aids at Air Force bases, although these two aircraft types are currently being replaced by new C-29A aircraft. In addition, ATC has acquired CT-39As in support of the Air Force Instrument Flight Center.
Contractor: Sabreliner Division of Rockwell International Corporation.

Lockheed MC-130H Combat Talon II

HC-130H

Power Plant: two Pratt & Whitney J60-P-3 turbojets; each 3,000 lb thrust.
Accommodation: crew of two; four to seven passengers.
Dimensions: span 44 ft 5 in, length 43 ft 9 in, height 16 ft 0 in.
Weights: empty 9,300 lb, gross 17,760 lb.
Performance: max speed at 36,000 ft 595 mph, service ceiling 39,000 ft, range 1,950 miles.

C-130 Hercules

Almost four decades after TAC issued its original design specification, the remarkable C-130 Hercules continues in production, while basic and specialized versions continue to perform a diversity of roles worldwide, including airlift support, DEW Line and Arctic ice cap resupply, aeromedical missions, aerial spray missions, and fire-fighting duties for the US Forest Service. The initial production model was the **C-130A,** first flown in April 1955, with 3,750 ehp Allison T56-A-11 or -9 turboprops; 219 were ordered, and deliveries began in December 1956. Two **DC-130As** (originally GC-130As) were built as drone launchers/directors for ARDC (now AFSC), carrying up to four drones on underwing pylons. All special equipment was removable, permitting the aircraft to be used as freighters, assault transports, or ambulances, as required. The **C-130B** introduced 4,050 ehp Allison T56-A-7 turboprops; the first of 134 entered USAF service in April 1959. C-130Bs are used in aerial fire-fighting missions by ANG and AFRES units. Six C-130Bs were modified in 1961 for airsnatch recovery of classified USAF satellites by the 6593d Test Squadron at Hickam AFB, Hawaii. Twelve **C-130Ds** were modified C-130As for use in the Arctic, with wheel-ski landing gear, increased fuel capacity, and provision for JATO. The **C-130E** is an extended-range development of the C-130B, with large underwing fuel tanks; 389 were ordered for MAC and TAC, with deliveries beginning in April 1962. A wing modification has been undertaken to correct fatigue and corrosion on USAF's current force of 492 C-130B/Es, extending the life of the aircraft well into the next century. Ongoing modifications include a self-contained navigation system (SCNS) to enhance navigation capabilities, especially in the low-level environment. SCNS incorporates an integrated communications navigation management system that features the USAF standard laser-gyro inertial navigational unit and the 1553B databus. Installation was scheduled to begin last year on 477 aircraft. Other modifications include enhanced station-keeping equipment (ESKE), 50kHz VOR/ILS receivers, secure voice capability, and replacement radar for the adverse weather aerial delivery system (AWADS). Eleven are scheduled for an extensive modification to enhance their Special Operations Low Level (SOLL) capability. Another major modification installs a state-of-the-art autopilot that incorporates a ground proximity warning system (GPWS). Specifically modified aircraft are used by the 356th TAS, AFRES, based at Rickenbacker ANGB, Ohio, for aerial spraying, typically to suppress mosquito epidemics. Fourteen C-130Es were modified to **MC-130E (Combat Talon I)** standard and equipped for use in low-level deep-penetration tactical missions by the 1st, 7th, and 8th Special Operations Squadrons based in the Philippines, West Germany, and Florida, respectively. The MC-130E is being supplemented by the improved, night/adverse weather, low-level **MC-130H (Combat Talon II).** Twenty-four are to be acquired, equipped with an in-flight refueling receptacle, explosive-suppressive fuel tanks, a modified cargo ramp area for the high-speed, low-level aerial delivery system, Emerson Electric AN/APQ-170 precision terrain-following/terrain-avoidance radar, dual radar altimeters, dual inertial navigation systems, and provision for a GPS receiver. The defensive avionics suite is much improved over that of the MC-130E and will eventually be retrofitted on the earlier aircraft. The test program is due to end in June, and deliveries to the 1st SOW's 8th SOS, based at Hurlburt Field, Fla., will begin later that month. Generally similar to the E, the basic **C-130H** has uprated T56-A-15 turboprops, a redesigned outer wing, updated avionics, and other, minor improvements; delivery began in April 1975. Well over 300 C-130Hs and derivatives have been ordered for the US services. Four **LC-130Hs,** modified with wheel-ski gear, have been acquired by the ANG. Other variants include **HC-130H/N/P** for MAC's 23d Air Force and MAC-gained units of the ANG and Reserve, and the **AC-130A/H/U** and **WC-130E/H,** all described separately. Four HC-130Hs were modified as **JC-130H** with added equipment for aerial recovery of reentering space capsules, and one was modified as **DC-130H** for drone control duties. ANG C-130s acquired a new role in 1987 when about nine aircraft were assigned to ANG fighter wings and groups to provide support for jet fighter units on deployments. *(Data for C-130H.)*
Contractor: LASC Georgia Division of Lockheed Corporation.
Power Plant: four Allison T56-A-15 turboprops; each 4,508 ehp.
Accommodation: crew of five; up to 92 troops, 64 paratroops, 74 litter patients, or up to five 463L standard freight pallets, etc.
Dimensions: span 132 ft 7 in, length 97 ft 9 in, height 38 ft 3 in.
Weights: operating empty 76,469 lb, max payload 50,000 lb, gross 175,000 lb.
Performance: max cruising speed at 20,000 ft 374 mph, service ceiling (at 130,000 lb) 33,000 ft, range with max payload 2,356 miles.

HC-130H/N/P

All active-duty HC-130 tanker aircraft are now dedicated to special operations missions. Eight primary aircraft are assigned to the 9th SOS, Eglin AFB, Fla. All eight are modified with communications, navigation, and countermeasures systems and night vision goggle compatible lighting. Six further primary aircraft are assigned to the 33d SOS, Kadena AB, Japan, and the 67th SOS, RAF Woodbridge, UK. Others are assigned to the 1550th Combat Crew Training Wing at Kirtland AFB, N. M. The aircraft's primary mission is to conduct single-ship or formation in-flight refueling of special operations helicopters in a no- to low-threat environment. These missions involve night low-level flights using minimum lighting, minimum communications, and deceptive course changes. All 31 HC-130s in the active Air Force inventory, including primary, backup, and training aircraft, are to be modified to a special operations configuration. In addition, 14 HC-130s are assigned to AFRES and ANG, dedicated to rescue and recovery operations. *(Data similar to those for C-130.)*

C-131 Samaritan

The very last thirty-year-old-plus Convair C-131 twin-engine transports are used by ANG for support airlift. However, the type has been almost entirely replaced by C-130 Hercules aircraft.

KC-135 Stratotanker

As single manager of all USAF KC-135 tanker aircraft, SAC supports its own refueling requirements as well as aerial refueling requirements of other Air Force commands, the US Navy and Marines, and other nations. In particular, the KC-135 is an integral part of the Single Integrated Operational Plan (SIOP), providing mission-critical fuel to the strategic bomber force. Although similar in size and appearance to commercial 707 aircraft, the KC-135 was designed to military specifications, incorporates different structural details and materials, and was designed to operate at high gross weights. The KC-135 fuel tankage is located in the "wet wings" and in fuel tanks below the floor in the fuselage. First flight of the **KC-135A** was in August 1956, and by 1966 a total of 732 had been built. At present, 634 remain in operational service, though many have been modified to later standards in three programs initiated to enhance the KC-135's capability and extend its operational utility well into the next century. First, the selection of 22,000 lb thrust General Electric/SNECMA F108-CF-100 (CFM56) fuel-efficient engines for retrofit of the KC-135 fleet was announced in 1980. Reengined aircraft are designated **KC-135R** and have a gross weight of 322,500 lb. They embody modifications to 25 major systems/subsystems and not only carry more fuel farther but also have reduced maintenance costs, are able to operate from shorter runways, and are less pollution-prone. The first KC-135R flight was in August 1982, and first deliveries to SAC were in July 1984; the 179th reengined aircraft was delivered in December 1989. Second, the JT3D reengining program upgrades the 148 KC-135As serving in 13 ANG and three AFRES units to **KC-135E** standard, with JT3D turbofans removed from surplus commercial 707s. One hundred and thirty-four KC-135Es have been delivered; the remaining 14 are being modified. Finally, the Life Extension Structural Modification has provided for the renewal of the lower wing skin, enabling the fleet of KC-135s to remain fully operational past the year 2020. Development of new and improved aerial refueling systems is also under way. The first camouflaged KC-135 made its debut in 1987. *(Data for KC-135R.)*

Contractor: Boeing Military Airplanes.
Power Plant: four CFM International F108-CF-100 turbofans; each 22,224 lb thrust.
Accommodation: crew of four or five; up to 80 passengers.
Dimensions: span 130 ft 10 in, length 136 ft 3 in, height 38 ft 4 in.
Weights: empty 119,231 lb, gross 322,500 lb.
Performance: max speed at 30,000 ft 610 mph, service ceiling 50,000 ft, range with 120,000 lb of transfer fuel 2,128 miles, ferry mission 11,192 miles.

C-135A/B Stratolifter

Thirteen C-135 transports and variants, without the KC-135's refueling equipment, remain operational with MAC. They were ordered originally to serve as interim jet passenger/cargo transports, pending delivery of C-141s. Three converted KC-135s were followed by 45 production Stratolifters in two versions: the **C-135A** with J57-P-59W turbojets and **C-135B** with Pratt & Whitney TF33-P-5 turbofans. Eleven Bs were retrofitted with revised interior for VIP transportation; others became **WC-135Bs** and **RC-135E/Ms.** Additionally, two C-135s belonging to ASD's 4950th Test Wing were permanently modified as Laser Communications Airborne Test-beds for the Have Lace program. *(Data similar to those for KC-135, except where indicated.)*

Dimension: length 134 ft 6 in.
Weights (C-135B): operating weight empty 102,300 lb, gross 275,500 lb.
Accommodation (C-135B): 60 passengers.
Performance (C-135B): max speed 600 mph, range with 54,000 lb payload 4,625 miles.

VC-137B/C Stratoliner

Six specially modified Boeing 707 transports are operated by MAC's 89th Military Airlift Wing from Andrews AFB, Md., for VIP duties. Best known is "Air Force One," a **VC-137C** for use by the President. It is basically a 707-320B with a special VIP interior. Two other VC-137Cs are also operated, together with three smaller 707-120s, originally designated VC-137As but later modified to **VC-137B** standard by the installation of turbofan engines. Both "Air Force One" and its backup are soon to be replaced by modified Boeing 747-200Bs (VC-25As).

Contractor: The Boeing Company.
Power Plant: four Pratt & Whitney JT3D-3 turbofans; each 18,000 lb thrust.
Dimensions: VC-137B span 130 ft 10 in, length 144 ft 6 in, height 42 ft 0 in; VC-137C span 145 ft 9 in, length 152 ft 11 in, height 42 ft 5 in.
Weights: VC-137B gross 258,000 lb; VC-137C gross 322,000 lb.
Performance (VC-137C): max speed 627 mph, service ceiling 42,000 ft, range 5,150 miles.

C-140A JetStar

Soon to be replaced by C-29As, just three C-140A JetStars remain in service, used by MAC to evaluate landing systems, navigational aids, and radar approach and control equipment.

Contractor: Lockheed-Georgia Company.
Power Plant: four Pratt & Whitney J60-P-5A turbojets; each 3,000 lb thrust.
Accommodation: crew of five.
Dimensions: span 54 ft 11 in, length 60 ft 5 in, height 20 ft 5 in.
Weight: gross 40,920 lb.
Performance: max cruising speed at 20,000 ft 550 mph, ceiling above 45,000 ft, range with reserves 2,280 miles.

C-141A/B StarLifter

The **C-141A** began operations with MAC in April 1965. Two hundred and eighty-five were built, some of which were structurally modified to accommodate the 82,207 lb Minuteman ICBM. During operational use it became clear that the cargo compartment was often fully loaded without the aircraft's maximum payload capability being utilized. In order to realize the C-141's full potential, USAF funded modification of the entire force of 270 (now 266) aircraft to **C-141B** standard, except for four AFSC aircraft used for test purposes. The fuselage was lengthened by 23 ft 4 in, and an in-flight refueling capability was added. The first production C-141B was delivered to USAF in December 1979, and the final modified StarLifter was received in June 1982, ahead of schedule and below projected cost. The modification significantly increased MAC's airlift capability, giving USAF the equivalent of 90 additional C-141A aircraft. Under the Pacer Center program, initiated in 1987, a center wing structural modification is under way, aimed at extending the C-141's flying life by 15,000 hours; modification of the entire fleet is envisaged. Other C-141 modification plans include 50kHz VOR/ILS receivers, secure voice capability on UHF and HF radios, permanently mounted SATCOM antennas, and a digital display fuel-indicating system. A program to install a state-of-the-art autopilot and all-weather landing system with enhanced flight display instrumentation is a major modification to enhance maintenance supportability. In addition, thirteen 437th MAW C-141Bs are scheduled for modifications to increase their Special Operations Low Level (SOLL) capability and survivability. C-141s from this unit flew disaster-relief equipment to NAS Moffett Field, Calif., after the earthquake in northern California last October.

Since 1986, AFRES and the ANG have begun receiving C-141s transferred from the active force; a total of 80 aircraft is scheduled for transfer by 1997. These C-141s are used frequently for humanitarian missions, transporting vital supplies to areas that, in recent years, have been devastated by natural disaster, such as the Caribbean Basin and Soviet Armenia. Meanwhile, 234 C-141Bs have moved under the purview of the US Transportation Command (USTRANSCOM). *(Data for C-141B.)*

Contractor: Lockheed-Georgia Company.
Power Plant: four Pratt & Whitney TF33-P-7 turbofans; each 21,000 lb thrust.
Accommodation: crew of five; cargo on 13 standard 463L pallets. Alternative freight or vehicle payloads, 200 fully equipped troops, 155 paratroops, or 103 litter patients plus attendants.
Dimensions: span 159 ft 11 in, length 168 ft 3½ in, height 39 ft 3 in.
Weights: operating 149,000 lb, max payload 89,000 lb, gross 343,000 lb.
Performance: max cruising speed 566 mph, range with max payload 2,293 miles without air refueling.

Boeing KC-135E Stratotanker

Boeing VC-137 Stratoliner

Lockheed C-141B StarLifter

McDonnell Douglas KC-10A Extender

KC-10A Extender

The KC-10 was conceived to meet USAF requirements for an Advanced Tanker/Cargo Aircraft (ATCA). It is based on the commercial DC-10 Series 30CF, modified to include fuselage fuel cells, a boom operator's station with aerial refueling boom and integral hose reel/drogue unit, a receiver refueling receptacle, and military avionics. In its primary role of enhancing worldwide air mobility, the KC-10A combines the tasks of tanker and cargo aircraft in a single unit. With this capability, the Extender supports fighter deployments, strategic airlift, strategic reconnaissance, and conventional operations. Since it has both types of tanker refueling equipment installed, the KC-10A can service USAF, USN, USMC, and allied aircraft on the same mission.

For deployment, the KC-10A's refueling capabilities and long range will, in many situations, dispense with the need for forward bases while leaving vital fuel supplies in the theater of operations untouched. Aircraft maintenance is performed under the contractor logistics support concept, where flight line maintenance is provided by USAF while intermediate and depot level maintenance is supported by a contractor. In addition, extensive commonality with the commercial DC-10 allows USAF to capitalize on a worldwide network of spares and maintenance facilities.

The KC-10A made its maiden flight in July 1980, and the first service usage by SAC took place in March 1981. USAF units equipped with KC-10As include the 6th and 9th AREFS at March AFB, Calif., the 2d and 32d AREFS at Barksdale AFB, La., and the 344th and 911th AREFS at Seymour Johnson AFB, N. C. AFRES also crews the aircraft under the Associate Reserve concept. Associate units include the 79th AREFS at March AFB, the 78th AREFS at Barksdale AFB, and the 77th AREFS at Seymour Johnson AFB.

Fifty-nine KC-10As are in the USAF inventory. The final production aircraft was used to test wing-mounted air refueling pods designed to supplement the standard fuselage hose reel/drogue unit and refueling boom. Currently, 20 aircraft are scheduled for modification to accept the wing-mounted pods. An additional modification, to utilize an on-board loader, will allow pallet handling without prepositioning wide-body cargo loading equipment. Installation should be complete by 1992.

Contractor: Douglas Aircraft Company, Division of McDonnell Douglas Corporation.
Power Plant: three General Electric CF6-50C2 turbofans; each 52,500 lb thrust.
Accommodation: crew of four; additional seating possible for up to 75 persons; max 27 pallets; max cargo payload 169,409 lb.
Dimensions: span 165 ft 3½ in, length 181 ft 7 in, height 58 ft 1 in.
Weight: gross 590,000 lb.
Performance: cruising speed Mach 0.825, service ceiling 42,000 ft, range with max cargo 4,370 miles.

Trainers

T-37B Tweet

USAF's first purpose-built jet trainer, the T-37 is Air Training Command's standard two-seat primary trainer. The original T-37A was superseded in November 1959 by the T-37B; all A models were converted subsequently to B standard. Following cancellation of the T-46A, which had been planned as a replacement for these aircraft, a contract was awarded last August to Sabreliner Corporation for the T-37B Service Life Extension Program (SLEP). The contractor will design, test, and produce kits to modify or replace critical structural components for the entire fleet, extending the capability of the T-37 into the next century. A prototype kit was scheduled for delivery early in 1990, with production kits to be delivered during 1991–93. Well over 1,000 T-37s were built, and more than 600 remain in USAF's inventory; all are being repainted in a distinctive dark blue and white to help formation training and to ease maintenance.

Contractor: Cessna Aircraft Company.
Power Plant: two Continental J69-T-25 turbojets; each 1,025 lb thrust.
Accommodation: two, side by side.
Dimensions: span 33 ft 9.3 in, length 29 ft 3 in, height 9 ft 2.3 in.
Weight: empty 3,870 lb, gross 6,600 lb.
Performance: max speed at 25,000 ft 426 mph, service ceiling 35,100 ft, range at 360 mph with standard tankage 870 miles.

T-38A and AT-38B Talon

Almost identical in structure to the F-5A export tactical fighter, the **T-38A** lightweight twin-jet advanced trainer is capable of flying well above supersonic speed in level flight. First flown in April 1959, it was in continuous production from 1956 to 1972 and entered operational service in March 1961. Of 1,187 T-38s built, more than 1,100 were delivered to USAF, and some 800 remain in service throughout the Air Force. Most are used by ATC for high-performance pilot training; others fly with SAC and with the 479th Tactical Training Wing at Holloman AFB, N. M., where a slightly different version designated **AT-38B,** with a gunsight and practice bomb dispensers, is used for Lead-in Fighter Training (LIFT).

An ongoing program called Pacer Classic, the T-38 SLEP, is integrating ten modifications, including major structural renewal, into one program. As a result, the service life of the T-38s should extend to the year 2010. Additionally, the introduction of the Tanker/Transport Training System (TTTS) *(see below)* will significantly relieve the T-38's training work load.

Contractor: Northrop Corporation.
Power Plant: two General Electric J85-GE-5 turbojets; each 2,680 lb thrust dry, 3,850 lb thrust with afterburning.
Accommodation: student and instructor, in tandem.
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 level speed at 36,000 ft more than Mach 1.23 (812 mph), ceiling above 55,000 ft, range, with reserves, 1,093 miles.

T-41A/C Mescalero

The **T-41A** trainer is a standard Cessna Model 172 light aircraft acquired by USAF for use in a preliminary flight screening program for USAF pilot candidates. An initial order for 170 aircraft in 1964 was supplemented by a further 34 in 1967. More powerful **T-41Cs,** based on the Cessna Model R172E, are used for cadet flight training at the USAF Academy. Around 100 T-41s remain in USAF service. *(Data for T-41A.)*

Contractor: Cessna Aircraft Company.
Power Plant: one Continental O-300-C piston engine; 145 hp. (210 hp Continental O-360-D in T-41C).
Accommodation: crew of two, side by side.
Dimensions: span 35 ft 10 in, length 26 ft 11 in, height 8 ft 9½ in.
Weights: empty 1,285 lb, gross 2,300 lb.
Performance: max speed at S/L 139 mph, service ceiling 13,100 ft, range 720 miles.

T-43A

Derived from the commercial Boeing Model 737-200, the T-43A navigation trainer made its first flight in April 1973. It was developed as a replacement for the piston-engined T-29 and was equipped with the same on-board avionics as the most advanced USAF operational aircraft of that time, including celestial, radar, and inertial navigation systems, LORAN, and other radio systems. Deliveries of the 18 aircraft ordered for ATC were completed in July 1974. Fourteen remain in the ATC inventory; the other four are assigned to the ANG. The aircraft are being repainted in an all-white paint scheme.

Contractor: Boeing Aerospace Company.
Power Plant: two Pratt & Whitney JT8D-9 turbofans; each 14,500 lb thrust.

Cessna T-37B Tweet

Northrop T-38A Talon

Accommodation: crew of two, 12 students, five advanced students, and three instructors.
Dimensions: span 93 ft 0 in, length 100 ft 0 in, height 37 ft 0 in.
Weight: gross 115,500 lb.
Performance: econ cruising speed at 35,000 ft Mach 0.7, operational range 2,995 miles.

UV-18B Twin Otter

The UV-18B is a military version of the DHC-6 Twin Otter STOL utility transport. Two were procured in FY 1977 for use as parachute jump training aircraft at the Air Force Academy.

Contractor: The de Havilland Aircraft of Canada Ltd.
Power Plant: two Pratt & Whitney Canada PT6A-27 turboprops; each 620 ehp.
Accommodation: crew of two and up to 20 passengers.
Dimensions: span 65 ft 0 in, length 51 ft 9 in, height 19 ft 6 in.
Weight: gross 12,500 lb.
Performance: max cruising speed 210 mph, service ceiling 26,700 ft, range with 2,500 lb payload 806 miles.

Beech T-1A Jayhawk

T-1A Jayhawk Tanker/Transport Training System (TTTS)

On February 21 of this year, USAF announced that it had chosen the team of McDonnell Douglas, Beech Aircraft Corporation, and Quintron to provide the Tanker/Transport Training System that will be used for specialized undergraduate pilot training. As team leader, McDonnell Douglas is responsible for system integration; Quintron will provide flight simulators, Beech the aircraft. Designated Beechjet 400T, these will be similar to the Beechjet 400A corporate transport. The flight deck will be configured for a student in the left seat, an instructor in the right seat, and another student to the rear. Structural enhancements will provide for a large number of landings per flight hour, increased birdstrike resistance, and an additional fuselage fuel tank. The T-1A will also have single-point pressure fueling and fewer cabin windows. A Rockwell Collins avionics package will include a five-tube EFIS, turbulence detection radar, digital autopilot, tactical air navigation with air-to-air capability, and a central diagnostics and maintenance system.

The FY 1991 budget requests include $144.4 million for FY 1990 and $193.1 million for FY 1991, to procure 14 and 28 TTT systems respectively. Beech plans to deliver the first 400T next year, followed by 28 in 1992 and completion of the currently planned 211-aircraft program by 1997. Training is scheduled to begin in September 1992. Pilots trained on the TTTS will then move on to transports such as the C-5 and C-17, and tankers such as the KC-10 and KC-135.

Contractor: Beech Aircraft Corporation.
Power Plant: two Pratt & Whitney JT15D-5 turbofans; each 2,900 lb thrust.
Accommodation: two, side by side.
Dimensions (400A): span 43 ft 6 in, length 48 ft 5 in, height 13 ft 9 in.
Weight (400A): gross 16,100 lb.
Performance (400A): max speed at 29,000 ft 531 mph, ceiling 45,000 ft, range 2,222 miles.

Helicopters

HH-1H Iroquois

Basically a military version of the Bell Model 205, the HH-1H is a general-purpose helicopter first ordered by USAF in 1970 and used for missile site support duties.

Contractor: Bell Helicopter Textron Inc.
Power Plant: one Textron Lycoming T53-L-13B turboshaft; 1,400 shp.
Accommodation: two pilots and 12 passengers; or two crew and 2,400 lb of cargo.
Dimensions: rotor diameter 48 ft 4 in, length of fuselage 42 ft 0 in, height 13 ft 0 in.
Weight: gross 9,500 lb.
Performance: max speed 120 mph, service ceiling at mission gross weight 13,450 ft, range with max fuel 347 miles.

UH-1N Iroquois

The UH-1N is a twin-engine version of the UH-1 utility helicopter. Seventy-nine were ordered for USAF, most of which remain in the inventory for missile site support duties and administrative airlift.

Contractor: Bell Helicopter Textron Inc.
Power Plant: Pratt & Whitney Canada T400-CP-400 Turbo "Twin-Pac," consisting of two PT6 turboshafts coupled to a combining gearbox with a single output shaft; flat-rated to 1,290 shp.
Accommodation: pilot and 14 passengers or cargo; or external load of 4,000 lb.
Dimensions: rotor diameter (with tracking tips) 48 ft 2¼ in, length of fuselage 42 ft 4¾ in, height 14 ft 10¼ in.
Weight: gross and mission weight 11,200 lb.
Performance: max cruising speed at S/L 115 mph, service ceiling 13,000 ft, max range, no reserves, 261 miles.
Armament (optional): two General Electric 7.62-mm Miniguns or two 40-mm grenade launchers; two seven-tube 2.75-in rocket launchers.

CH-3E

This twin-engine amphibious transport helicopter, based on the US Navy's SH-3A Sea King, incorporates important design changes that permit speedier cargo handling and ease of maintenance, with built-in equipment for the removal and replacement of all major components in remote areas. The initial version was the CH-3C. Introduction of uprated engines led to the designation CH-3E in February 1966, applicable to 42 new production aircraft and 41 reengined CH-3Cs, of which 50 were adapted subsequently as HH-3Es (see below). CH-3 missions include Special Operations duties, natural disaster relief, and evacuation.

Contractor: Sikorsky Aircraft, Division of United Technologies Corporation.
Power Plant: two General Electric T58-GE-5 turboshafts; each 1,500 shp.
Accommodation: crew of two or three; 25 fully equipped troops, 15 litters, or 5,000 lb of cargo.
Dimensions: rotor diameter 62 ft 0 in, length of fuselage 57 ft 3 in, height 18 ft 1 in.
Weights: empty 13,255 lb, gross 22,050 lb.
Performance: max speed at S/L 162 mph, service ceiling 11,100 ft, max range, with 10% reserve, 465 miles.
Armament: General Electric 7.62-mm machine gun.

HH-3E Jolly Green Giant

Modified version of the CH-3E for USAF's Air Rescue Service, originally to facilitate penetration deep into North Vietnam on rescue missions. Additional equipment includes self-sealing fuel tanks, armor, defensive armament, a rescue hoist, and a retractable in-flight refueling probe. HH-3s are now assigned primarily to rescue units of the Reserve and ANG. *(Data basically similar to those for CH-3E above.)*

HH-53B Super Jolly

This twin-turbine heavy-lift helicopter was ordered in September 1966 for USAF's Aerospace Rescue and Recovery Service (now Air Rescue Service) to supplement the HH-3E. The HH-53B carries the same general equipment as the HH-3E, including the in-flight refueling probe and armament, but is faster and larger. It first flew in March 1967; delivery began in June of the same year.

After extensive use for rescue operations in southeast Asia, HH-53Bs continue in first-line service, but are being converted to MH-53J Pave Low III "Enhanced" standard *(see below)*.

Contractor: Sikorsky Aircraft, Division of United Technologies Corporation.

Power Plant: two General Electric T64-GE-7A turboshafts; each 4,325 shp.

Accommodation: crew of five; basic accommodation for 38 combat-equipped troops or 24 litters and four attendants.

Dimensions: rotor diameter 72 ft 3 in, length of fuselage (without refueling probe) 67 ft 2 in, height 24 ft 11 in.

Weights: empty 23,125 lb, gross 42,000 lb.

Performance: max speed at S/L 186 mph, service ceiling 18,400 ft, max range, with 10% reserve, 540 miles.

HH-53C and CH-53C

The **HH-53C,** an improved version of the HH-53B, was first delivered to USAF in August 1968. With a maximum speed of 196 mph, it can transport 38 passengers or 18,500 lb of freight and has an external cargo hook of 20,000 lb capacity. Other data basically as for HH-53B above. A total of 72 HH-53B/Cs was built. Eight generally similar **CH-53Cs** are used to provide battlefield mobility for the Air Force mobile Tactical Air Control System. All 31 remaining HH/CH-53s are being converted to MH-53J Pave Low III "Enhanced" standard *(see below)*.

MH-53H/J Pave Low

Under USAF's Pave Low III program, nine HH-53Cs were modified for night and adverse weather operations and redesignated **MH-53H;** two lost in accidents in 1984 were subsequently replaced. Equipment includes a stabilized FLIR installation mounted below the refueling boom, an inertial navigation system, a new Doppler navigation system, and the computer-projected map display and radar from the A-7D, with the radar installed in an offset "thimble" fairing on the nose. The first of the MH-53Hs was delivered to Hurlburt Field, Fla., in 1979, and the last in 1980, for special operations duties.

In a program initiated in 1986 to upgrade the Special Operations Forces, Sikorsky is undertaking a major modification of the 31 remaining HH/CH-53B/C helicopters. Designated **MH-53J,** these **Pave Low III "Enhanced"** aircraft are equipped with an integrated digital avionics suite that includes terrain-following and terrain-avoidance radar, GPS terminals, secure communications, an advanced ECM system, titanium armor plating, and mounts for .50-caliber machine guns and/or 7.62-mm Miniguns. The first was delivered in the summer of 1987; deliveries were due for completion by the end of last year. It is planned to bring the eight remaining MH-53Hs to J standard.

MH-60G Pave Hawk

As an interim remedy for a shortfall in its rescue helicopter inventory, USAF acquired 20 UH-60A Black Hawks in standard US Army configuration, including a rescue hoist, deicing system, and winterization and air transportability kits. Beginning in 1982–83, these were delivered to the 55th Aerospace Rescue and Recovery Squadron at Eglin AFB, Fla. Sikorsky Support Services of Troy, Ala., has since been contracted to modify these helicopters to MH-60G Pave Hawk standard, by installing an aerial refueling probe, auxiliary fuel tank, and fuel management panel. All will be upgraded further to have Doppler/INS, an electronic map display, Tacan, a lightweight weather/ground-mapping radar, secure HF and Satcom, .50-caliber machine guns, and FLIR. Ten of the MH-60G helicopters have been designated for special operations, while the remainder will go to combat rescue units of the active, reserve, and ANG forces. The MH-60Gs will be suitable for precision low-level missions in day/night VMC, including marginal weather.

Contractor: Sikorsky Aircraft, Division of United Technologies Corporation.

Power Plant: two General Electric T700-GE-700 turboshafts; each 1,560 shp.

Accommodation: crew of two or three; 11–14 troops, up to six litters, or internal or external cargo.

Dimensions: rotor diameter 53 ft 8 in, length of fuselage 50 ft 0¾ in, height 16 ft 10 in.

Weights: empty 10,624 lb, gross 16,260–20,250 lb.

Performance: max speed 192 mph, service ceiling 19,000 ft, max range, with reserves, 373 miles (internal fuel), 500 miles (auxiliary tank).

V-22A Osprey

Despite approved funding in the FY 1990 budget of $255 million for continued R&D, the future of this advanced design is still uncertain, as the Secretary of Defense has announced his decision to terminate the V-22 Osprey program at the end of its R&D phase and not to proceed to production.

Following on from the US government's Joint Services Advanced Vertical Lift Aircraft (formerly JVX) proposal, a contract was awarded in May 1986 to Boeing Helicopters and Bell Helicopter Textron as prime contractors in a seven-year full-scale development (FSD) program for the V-22 Osprey. The USN and USAF are currently participating in the program, with the former as executive service. This tilt-rotor, multimission aircraft, based on Bell's XV-15, is designed to have the maneuverability and lift capability of a helicopter and the speed of a fixed-wing aircraft. Boeing has overall responsibility for the aircraft's tail unit, overwing fairings, and fuselage, while Bell provides the wing, nacelles, transmissions, and rotor hub assemblies. Under subcontracts, Grumman is responsible for design and manufacture of the V-22's tail unit, General Electric the digital fly-by-wire flight-control system, LMSC-Georgia the wing control surfaces and fixed trailing-edge, and Menasco of Canada and Dowty of Canada, respectively, the nose and main landing gear. Allison supplies the aircraft's two 6,000 shp T406-AD-400 turboshaft engines.

USAF has a stated requirement for 55 long-range versions of the aircraft for special operations, to carry 12 troops or up to 2,880 lb of internal cargo over a 600-mile mission radius at 288 mph, with capability to hover OGE (out of ground effect) at 4,000 ft at 95 degrees Fahrenheit.

First flight of the V-22 Osprey was made in March 1989 and all six full-scale development aircraft are scheduled to be flying by the end of this year. On September 14 last year, the Osprey achieved full conversion from helicopter mode to airplane mode while in flight. The aircraft has also demonstrated a speed of 288 mph EAS (equivalent airspeed) at a height of 8,300 ft, the first stage of stall tests, 2*g* maneuvers, and single-engine flight. *(Data for V-22 prototypes.)*

Dimensions: rotor diameter (each) 38 ft 0 in, fuselage length 57 ft 4 in, height over tail fins 17 ft 7¾ in.

Weights: normal mission weight: VTO 47,500 lb, STO 55,000 lb.

Performance: max cruising speed in helicopter mode 115 mph, in airplane mode 345 mph, service ceiling 26,000 ft, range VTO 1,382 miles, STO 2,073 miles.

Sikorsky MH-53H Pave Low III

Sikorsky MH-60G Pave Hawk

Strategic and Tactical Nuclear Missiles

LGM-30F/G Minuteman

With more than two decades of operational service, Minuteman remains a key element of the US strategic deterrent posture. It is a three-stage, solid-propellant ICBM, housed in underground silos for which an upgrade program was completed in 1980 to provide increased launch facility protection. Minuteman silos and launch-control centers are currently undergoing a depot-level maintenance refurbishment, known as Rivet Mile, to correct existing, and retard future, age-related deterioration of facilities. The current versions are:

LGM-30F Minuteman II: Similar in configuration to the original Minuteman I, Minuteman II has increased range and targeting coverage; also increased accuracy and payload capacity. Operational since 1965, it is based at Malmstrom AFB, Mont.; Ellsworth AFB, S. D.; and Whiteman AFB, Mo. In the late summer of 1986, Minuteman IIs at Malmstrom and Whiteman AFBs were equipped with a command data buffer capability to permit remote targeting, as in Minuteman III.

LGM-30G Minuteman III: Third-stage motor with fluid-injection thrust vector control gives longer range and, allied to MIRV capability, enables this version to place warheads on three targets with a high degree of accuracy. First test launch was made in 1968, and Minuteman III is operational at Minot AFB, N. D.; F. E. Warren AFB, Wyo.; Grand Forks AFB, N. D.; and Malmstrom AFB, Mont. A command data buffer system permits rapid missile retargeting. Deployment of the larger yield Mk 12A RV was completed in 1983.

Of the original force of 450 Minuteman IIs and 550 Minuteman IIIs, 50 have been displaced by Peacekeeper missiles. However, enhancements and modifications under way will maintain the viability of the force well beyond the year 2000. On the missile itself, the second-stage motors on both versions are being washed out and repoured; the third-stage motors on Minuteman III are being remanufactured. In addition, improvements to the Minuteman II's missile guidance set are continuing under the Accuracy Reliability Supportability Improvement Program; and Minuteman III's guidance has been upgraded to improve its accuracy by 30 percent. The Rapid Execution and Combat Targeting (REACT) Program will ensure long-term supportability of the aging electronics components, and will modify the launch control center, enabling real-time status information on the weapons and communications nets to correct operability problems,

Minuteman III

Peacekeeper

improve responsiveness to launch directives, and provide rapid retargeting capability.
Assembly and Checkout: Boeing Aerospace.
Power Plant: first stage: Thiokol M-55 solid-propellant motor, 210,000 lb thrust; second stage: Aerojet-General SR19-AJ-1 solid-propellant motor, 60,300 lb thrust; third stage: LGM-30F: Hercules, Inc., solid-propellant motor; LGM-30G: Thiokol SR73-AJ-1 solid-propellant motor: 17,000 lb thrust (LGM-30F), 34,400 lb thrust (LGM-30G).
Guidance: Autonetics Division of Rockwell International inertial guidance system.
Dimensions: length LGM-30F 55 ft 10 in; LGM-30G 59 ft 10 in, diameter of first stage 5 ft 6 in.
Weights: launch weight (approx) LGM-30F 73,000 lb, LGM-30G 78,000 lb.
Performance: speed at burnout more than 15,000 mph, highest point of trajectory approx 700 miles, range with max operational load LGM-30F more than 6,000 miles; LGM-30G more than 7,000 miles.

LGM-118A Peacekeeper

In response to the improved hardness of Soviet strategic forces, deployment of 50 Peacekeeper ICBMs in existing Minuteman III silos near F. E. Warren AFB, Wyo., began in June 1986. Initial operational capability for the first ten Peacekeepers was achieved in December of that year; full operational capability with 50 missiles followed in December 1988. A total of 102 Peacekeepers was funded during FYs 1984–90, with 12 more requested in FY 1991. However, the FY 1990 budget approved a statutory cap on deployment of only 50 of these missiles. They are to be redeployed in a rail-garrison mode for greater survivability. Two of the Peacekeepers will be carried by each of 25 trains, which will be manned and on alert in hardened shelters at seven bases. These were named last November as Barksdale AFB, La., Dyess AFB, Tex., F. E. Warren AFB, Wyo., Fairchild AFB, Wash., Grand Forks AFB, N. D., Little Rock AFB, Ark., and Wurtsmith AFB, Mich. The trains will be turned over to SAC in 1992–94. When directed to disperse by the National Command Authorities, they will have access to more than 120,000 miles of the nation's commercial rail system.

Peacekeeper is a four-stage ICBM that carries up to ten independently targetable reentry vehicles. It has many advantages over other missile systems currently in the US inventory. In particular, it is more accurate, carries more warheads, and has greater range and target flexibility than the Minuteman missiles. Its greater resistance to nuclear effects and its more capable guidance system provide Peacekeeper with a much improved ability to destroy very hard targets. The prompt retaliation made possible by these factors would provide a decisive deterrent to any hostile first strike.
Basing: Boeing Aerospace and Electronics.
Assembly and Test: Martin Marietta, Denver Aerospace.
Power Plant: first three stages solid-propellant, fourth stage storable liquid; by Thiokol, Aerojet, Hercules, and Rocketdyne, respectively.
Guidance: inertial; integration by Rockwell, IMU by Northrop.
Warheads: 10 Avco Mk 21 reentry vehicles.
Dimensions: length 71 ft, diameter 7 ft 8 in.
Weight: approx 195,000 lb.

MGM-134A Small ICBM (SICBM)

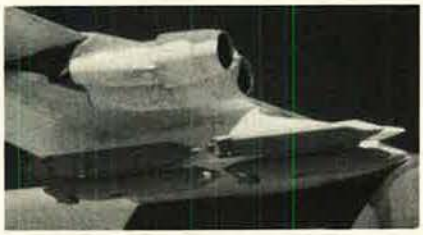
Full-scale development of this single-warhead ICBM, unofficially called "Midgetman," is continuing. Deployment on road-mobile, radiation-hardened truck launchers would enhance survivability, and, despite its relatively small size, the SICBM is expected to have sufficient accuracy to ensure a high probability of damage to hard targets. IOC is planned for 1997, but the future of the SICBM is dependent on the outcome of US-Soviet strategic arms reduction talks. The first cold launch of an SICBM from an above-ground silo at Vandenberg AFB, Calif., on May 11, 1989, was unsuccessful.
Contractors: Martin Marietta, General Electric (reentry vehicle) and Boeing Aerospace and Electronics (launch vehicle).
Power Plant: solid-propellant three-stage rocket motors.
Guidance: Northrop modified Advanced Inertial Reference Spheres system.
Warhead: single Mk 21 RV; yield 500 kilotons.
Dimensions: length 46 ft, body diameter 3 ft 10 in.
Weight: 37,000 lb.
Performance: range 6,835 miles.

AGM-69A SRAM

This defense suppression and primary attack missile was deployed initially with the B-52Gs of SAC's 42d Bombardment Wing (Heavy) at Loring AFB, Me., in 1972. USAF contracts covering the production of 1,500 AGM-69As were authorized, and deliveries to equip 17 B-52 wings and two FB-111 wings at 18 SAC bases were completed in July 1975.

Armed with a nuclear warhead, the supersonic air-to-surface SRAM was designed to attack and neutralize enemy terminal defenses, such as surface-to-air missile

AGM-86B ALCM



AGM-129A (ACM)

AGM-69A SRAM

sites. An inertial guidance system makes the missile impossible to jam. SAC B-1Bs can carry 24 AGM-69As internally; B-52G/Hs can carry eight AGM-69As on a rotary dispenser in the aft bomb bay, together with up to four nuclear bombs; and FB-111As can carry four AGM-69As on swiveling underwing pylons and two internally. When carried externally, a tailcone, 22.2 in long, is added to reduce drag.
Contractor: Boeing Aerospace Company.
Power Plant: Lockheed Propulsion Company LPC-415 restartable solid-propellant two-pulse rocket engine.
Guidance: General Precision/Kearfott inertial system, permitting attack at high or low altitude and dogleg courses.
Warhead: nuclear, of similar yield to that of single Minuteman III warhead.
Dimensions: length 14 ft 0 in, body diameter 1 ft 5½ in.
Weight: launch weight approx 2,230 lb.
Performance: speed up to Mach 2.5, range 100 miles at high altitude, 35 miles at low altitude.

AGM-86B ALCM

The AGM-86B air-launched cruise missile is a small, unmanned, winged air vehicle capable of sustained subsonic flight following launch from a carrier aircraft. It has a turbofan engine and a nuclear warhead and is programmed for precision attack on surface targets. When launched in large numbers, each of the missiles would have to be countered, making defense against them both costly and complicated. Additionally, by diluting defenses, the ability of manned aircraft to penetrate to major targets is improved. Small radar signature and low-level flight capability enhance the missile's effectiveness. Delivery of the last of 1,715 production models was accomplished in October 1986. USAF completed deployment of AGM-86s on 98 (now 97) on-line B-52Gs in 1984, with 12 missiles fitted externally to each aircraft. B-52Hs are undergoing a similar conversion, which was scheduled for completion in FY 1990. Ultimately, each B-52H is intended to be modified further to have a bomb-bay common strategic rotary launcher (CSRL) for eight more ALCMs, eight SRAMs, or a mix of both. ALCM-equipped units are at Griffiss AFB, N. Y., Wurtsmith AFB, Mich., Fairchild AFB, Wash., Eaker AFB, Ark., Carswell AFB, Tex., Barksdale AFB, La., and Minot AFB, N. D. Should the decision be made to place ALCMs on the B-1B, provisions exist for the carriage of 12 cruise missiles on underfuselage stores stations, and eight carried internally on a CSRL.
Contractor: Boeing Aerospace Company.
Power Plant: Williams International Corporation/Teledyne CAE F107-WR-100 turbofan; 600 lb thrust.
Guidance: inertial plus Tercom, by Litton.
Warhead: W80-1 nuclear.
Dimensions: length 20 ft 9 in, body diameter 2 ft 0½ in, wing span 12 ft.
Weight: 3,200 lb.
Performance (approx): speed 500 mph, range more than 1,500 miles.

AGM-129A (ACM)

Convair Division of General Dynamics was selected in April 1983 to develop and manufacture an air-launched advanced cruise missile (ACM) to arm the B-52H and B-1B. In addition, McDonnell Douglas was awarded a contract in November 1987 for technology transfer leading to second-source capability for this advanced system. The ACM will have improved range, accuracy, survivability, and targeting flexibility compared with the AGM-86B, notably through embodiment of low-observability technology. It is in production and is expected to enter service in 1992.
Contractors: General Dynamics (Convair)/McDonnell Douglas Missile Systems.
Power Plant: Williams International F112 turbofan.
Guidance: inertial midcourse guidance; laser radar terminal homing.
Warhead: nuclear; 200 kilotons yield.
Dimensions: length 19 ft 8 in.
Weight: 2,750 lb.
Performance: range 1,865 miles.

AGM-131A SRAM II/AGM-131B SRAM-T

Full-scale development (FSD) has been under way since 1987 of this nuclear-capable air-to-surface missile intended to augment, and eventually to replace, the aging AGM-69A. **SRAM II** will arm B-1Bs and B-2s and will be capable of penetrating advanced defense systems from standoff ranges to strike hardened, heavily defended targets and mobile targets. It will use existing propulsion, guidance, and airframe technology to make possible significant performance improvements without unacceptable program risk. Major program activities include development of a new Hercules rocket motor to provide higher missile velocities and increased range; development by Litton of a guidance system that will ensure greater accuracy, even with extended range; and incorporation of a new digitally controlled warhead with modern safety features. Like the AGM-69A, SRAM II will be supersonic.

First live launch of the AGM-131A is expected later this year, and low-rate initial production is scheduled to begin in June 1991, during which time second-source subcontractors will be qualified. Planned procurement is for 1,633 missiles, with IOC in the late spring of 1993.

A variant of the SRAM II for the tactical air forces, the **SRAM-T,** or **AGM-131B,** is just entering development. This version will have a slightly different warhead as well as minor differences in computer memory cards and connectors, but will have ninety-five percent commonality with the A model. If full SRAM-T development is approved, the missile should be in service in 1995. (*Data for AGM-131A.*)
Contractor: Boeing Aerospace and Electronics.
Power Plant: Hercules solid rocket motor.
Warhead: Department of Energy W89 nuclear warhead.
Dimensions: length 14 ft 0 in, diameter 1 ft 3.6 in.
Weight: 1,920 lb.

BGM-109G Gryphon GLCM

The GLCM is a small, mobile, ground-to-ground cruise missile that was developed to modernize NATO's Intermediate-range Nuclear Forces (INF). Its characteristics include a small radar cross section, very low altitude flight profile, and all-weather capabilities; it is designed to complicate the enemy's targeting and defenses, thereby helping the survivability of other allied systems.

A total of 464 missiles was planned for deployment by 1988, and the first GLCM-operational base was at RAF Greenham Common, UK (1983), followed by Comiso AB, Sicily, and Florennes AB, Belgium (both 1984), Wueschheim AB, West Germany (1986), and RAF Molesworth, UK (1987). However, this program was halted at 19 flights—a flight comprising four transporter-erector launchers, each carrying four missiles, and two launch control centers—with the signing of the INF Treaty. The first GLCMs were removed from Europe in September 1988, and all GLCM missiles and erector launchers will be eliminated by May 31, 1991, as required by the INF Treaty.
Contractors: General Dynamics (Convair)/McDonnell Douglas Astronautics.
Power Plant: Williams International Corporation/Teledyne CAE F107-WR-400 turbofan; 600 lb thrust. Atlantic Research Corporation solid-propellant booster.
Guidance: Inertial plus Tercom, by Litton.
Warhead: W84 nuclear.
Dimensions: length 20 ft 6 in, diameter 1 ft 8½ in, wing span 8 ft 7 in.
Weight: with booster, 3,250 lb.
Performance: max speed high subsonic, range 1,500 miles.

Airborne Tactical and Defense Missiles

AIM-7 Sparrow

Sparrow is a radar-guided air-to-air missile with all-weather, all-altitude, and all-aspect capability. Approximately 34,000 AIM-7C, D, and E versions were produced. The **AIM-7E** was the original design primarily for use by the F-4 Phantom. The **AIM-7E-2** and **E-3** are improved versions that provide better maneuverability and "dogfight" capability. A later version is the advanced solid-state **AIM-7F**, with larger motor, Doppler guidance, improved ECM, and better capability over both medium and "dogfight" ranges; this version currently equips USAF and USN F-4, F-14, F-15, and F/A-18 aircraft, and will equip the F-16 (ADF). Approximately 5,400 AIM-7Fs were produced. A monopulse version of Sparrow designated **AIM-7M**, aimed at reducing cost and improving performance in the ECM and look-down clutter regions, entered production in FY 1980 and began operational service during FY 1983. (*Data for AIM-7F.*)

Contractors: Raytheon Company/General Dynamics Pomona Division.
Power Plant: Hercules Mk 58 Mod 0 boost-sustain rocket motor.
Guidance: Raytheon semiactive Doppler radar homing system.
Warhead: high-explosive, blast fragmentation, weighing 86 lb.
Dimensions: length 11 ft 10 in, body diameter 8 in, wing span 3 ft 4 in.
Weight: launch weight 504 lb.
Performance (estimated): max speed more than Mach 3.5; range AIM-7E 14 miles, AIM-7F more than 25 miles.

AIM-9 Sidewinder

The AIM-9 Sidewinder is a close-range air-to-air missile using infrared guidance. Versions currently in the USAF inventory are:

AIM-9P: improved version of the AIM-9J, produced by Ford Aerospace by conversion of existing AIM-9Es and -9Js. Increased target-acquisition envelope, solid-state electronics, and increased lethality due to seeker improvements.

AIM-9P-3: improved version of AIM-9P, with increased lethality due to fuze improvements and a new rocket motor, providing reduced smoke and increased range.

AIM-9P-4: improved version of AIM-9P-3 developed by Ford Aerospace. A new guidance control unit provides an increased target acquisition envelope. The AIM-9P-4 is for foreign military sales.

AIM-9L: third-generation Sidewinder for USAF and USN, with all-aspect intercept capability. Improvements include new motor, double-delta nose fins for improved inner boundary performance and maneuverability, AM-FM conical scan for increased seeker sensitivity and improved tracking stability, annular blast fragmentation warhead and active optical fuze for increased lethality, and low susceptibility to countermeasures. This version arms USAF F-15 and F-16 aircraft and features in USAF plans to provide self-defense capability for its A-7s, A-10s, F-4s, and F-111s.

AIM-9M: improved version of AIM-9L, with increased IRCCM capability, improved background discrimination, and reduced-smoke rocket motor. Full production began in FY 1981 with an order for approximately 1,850 missiles. A total of 1,716 AIM-9Ms was requested in FY 1988/89, with a final USAF procurement planned for FY 1990.

AIM-9R: development of AIM-9M with improved control and guidance section for greater target acquisition range and better resistance to ECM. FSD started in 1986, and captive-carry flights began in 1988. This version is expected to be in service in the early years of this decade, with many AIM-9Ms being converted to AIM-9R standard during 1992–94. (*Data for AIM-9M.*)

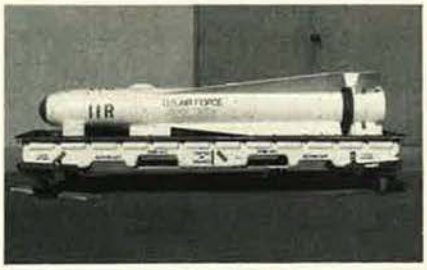
Contractor: Raytheon Company/Ford Aerospace and Communications Corporation.
Power Plant: Thiokol Hercules Mk 36 Mod 11 solid-propellant rocket motor.
Guidance: solid-state infrared homing guidance.
Warhead: high-explosive, weighing 20.8 lb.
Dimensions: length 9 ft 5 in, body diameter 5 in, fin span 2 ft 1 in.
Weight: launch weight 191 lb.
Performance: max speed above Mach 2; range more than 10 miles.

AIM-120A (AMRAAM)

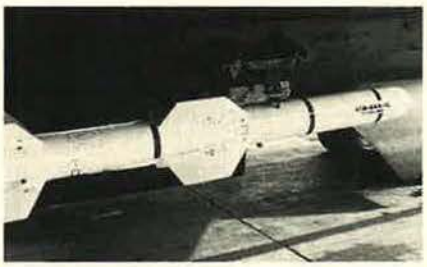
Intended as a replacement for the AIM-7 Sparrow, the advanced medium-range air-to-air missile (AMRAAM) is currently described as the "number one tactical priority." It will provide an all-weather, all-environment capability for USAF's F-15 and F-16 and the Navy's F-14 and F/A-18 fighters. Development has been under way since December 1981.

Designated AIM-120A, AMRAAM has inertial midcourse guidance and active radar terminal homing that provide launch-and-maneuver capability. There are significant improvements in operational effectiveness over the AIM-7 Sparrow, including increased average velocity, reduced miss distance, improved fuzing, increased warhead lethality, multiple target engagement capability, improved clutter rejection in low-altitude environments, improved ECCM capability, increased maximum launch range, reduced-smoke motor, and improved maintenance and handling.

AIM-9 Sidewinder (top) and AIM-7 Sparrow



AGM-65D Maverick



AGM-84A Harpoon

A leader/follower program has been under way (Hughes/Raytheon), with the preproduction effort (producibility and qualification) in FY 1986 and low-rate initial production in FY 1987 (180 missiles). Hughes and Raytheon have already been awarded Lots 1 and 2 and will compete for subsequent lots. The first production AIM-120A was delivered by Hughes in 1988, and IOC is anticipated this year. Last fall, the 33d TFW at Eglin AFB, Fla., was due to become the first operational unit to receive AMRAAM missiles. A preplanned product improvement (P^3I) program will seek to develop AMRAAM improvements, including rapid reprogramming, adjustable countermeasures, advanced counter-countermeasures, and options for smart ordnance packages and dual-mode fuzing.

Contractors: Hughes Aircraft Company/Raytheon Company.
Guidance: inertial midcourse, with active radar terminal homing.
Dimensions: length 12 ft, body diameter 7 in, span of tail control fins 2 ft 1 in.
Weight: 340 lb.
Performance: cruising speed approx Mach 4, range approx 31 miles.

AGM-45A Shrike

Twelve versions of this supersonic air-to-surface missile were produced for USAF and USN, differing primarily in the frequency coverage of the front end detachable seeker sections. Designed to home automatically on enemy radar installations, the AGM-45 entered operational service in Vietnam during 1965. Thereafter, it played an important part in the US air offensive, becoming a standard penetration aid on US tactical aircraft. More than 13,000 were delivered to USAF between 1965 and 1978, and Shrikes continue to equip "Wild Weasel" F-4Gs and defense suppression F-4Es and F-16Cs. Upgrading under the Shrike gravity bias modification program will result in improved capabilities at low altitude.

Contractor: Naval Weapons Center.
Power Plant: Rocketdyne Mk 39 Mod 7 or Aerojet Mk 53 solid-propellant rocket motor.
Guidance: passive homing head by Texas Instruments.
Warhead: high-explosive fragmentation, weighing 145 lb.
Dimensions: length 10 ft 0 in, body diameter 8 in, span 3 ft 0 in.
Weight: launch weight 400 lb.
Performance (estimated): range more than 3 miles.

AGM-65 Maverick

The basic **AGM-65A** Maverick is a launch-and-leave TV-guided air-to-surface missile that enables the pilot of the launch aircraft to seek other targets or leave the target area once it has been launched. Production was initiated in 1971, following successful test launches over distances ranging from a few thousand feet to many miles, and from high altitudes down to treetop level. Maverick missiles were first employed by USAF in Vietnam and are now carried by the A-7D, A-10, F-4D/E/G, F-111F, F-16, and, soon, the F-15E, singly or in three-round underwing clusters, for use against pinpoint targets, such as tanks and columns of vehicles. Orders totaled 19,000, including AGM-65Bs.

AGM-65B has a "scene magnification" TV seeker that enables the pilot to identify and lock on to smaller or more distant targets.

To overcome limitations of the TV Maverick, which can be used only in daylight clear-weather conditions, two further versions have been developed:

AGM-65D: with imaging infrared seeker (IIR) as well as a new lower-smoke motor. AFOTEC and TAC conducted operational flight testing with 25 live launches from A-7, A-10, F-4E, F-4G, and F-16 aircraft at Nellis AFB, Nev., in September 1986, resulting in 24 direct hits on a variety of vehicles. IIR Maverick became operational on A-10s at RAF Bentwaters, UK, in February 1986. A total of 17,302 has been ordered for USAF through FY 1989. Raytheon is second-source supplier.

AGM-65G: uses the IIR seeker with an alternate 298 lb blast fragmentation warhead for use against hardened targets. Software has been modified to include options for targeting ships and large land targets as well as mobile armor. This version also has a digital autopilot and a pneumatic, rather than hydraulic, actuation system. First successful launch took place in November 1987, and this version is now in production. USAF plans to acquire 7,400 AGM-65Gs through FY 1994. (*Data for AGM-65A.*)

Contractor: Hughes Missile Systems Group/Raytheon Company.
Power Plant: Thiokol TX-481 solid-propellant rocket motor.
Guidance: self-homing electro-optical guidance system.
Warhead: high-explosive, shaped charge.
Dimensions: length 8 ft 2 in, body diameter 1 ft 0 in, wing span 2 ft 4½ in.
Weight: launch weight (AGM-65A) 462 lb, (AGM-65G) 662 lb.
Performance: range of 0.6 to 14 miles.

AGM-84A Harpoon

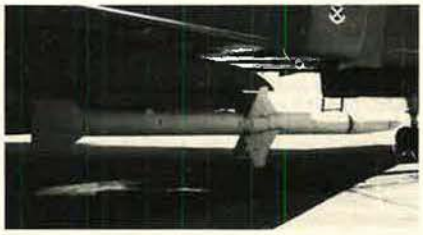
USAF initiated a cocperative memorandum of understanding with the USN to equip two 15-aircraft B-52G squadrons with the Harpoon all-weather antiship missile in support of maritime antisurface warfare operations. Compatibility testing began in the spring of 1983, and full operational capability was achieved that October. Modified aircraft are located at Loring AFB, Me., for Atlantic operations and at Barksdale AFB, La. Each B-52G can carry eight to 12 missiles.

Contractor: McDonnell Douglas Missile Systems Company.
Power Plant: Teledyne CAE J402-CA-400 turbojet; 660 lb thrust.
Guidance: sea-skimming cruise monitored by radar altimeter, active radar terminal homing.
Warhead: penetration high-explosive blast type, weighing 488 lb.
Dimensions: length 12 ft 7½ in, body diameter 1 ft 1½ in, wing span 3 ft.

Weight: 1,145 lb.
Performance: speed high subsonic, range more than 57 miles.

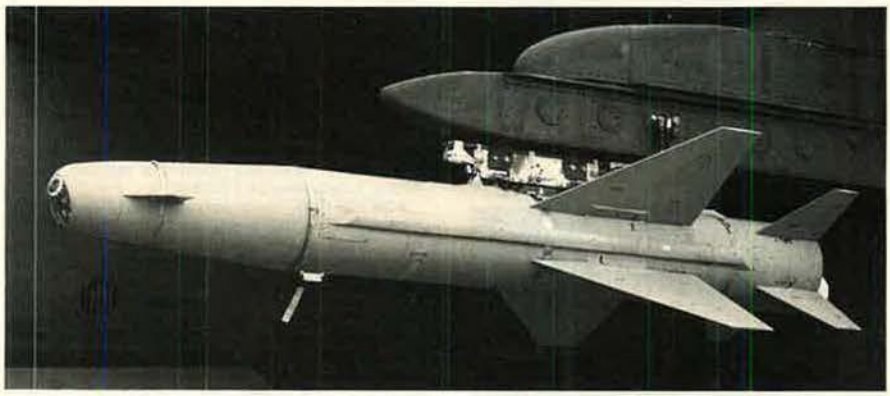
AGM-88A/B/C HARM

The lethality of USAF's F-4G "Wild Weasel" is greatly enhanced by the availability of **AGM-88A HARM** (High-speed Antiradiation Missile), which achieved IOC in September 1984. The emphasis on high speed reflects experience gained in Vietnam, where Soviet-built surface-to-air-missile radar systems sometimes detected the approach of first-generation Shrikes and ceased operation before the missiles could lock on to them. HARM can cover a wide range of frequency spectra through the use of programmable digital processors in both the aircraft's avionics equipment and the missile. An integration program is ongoing to equip F-16s in the defense suppression role with HARM. The missile is also suitable for adaptation to the EF-111A, B-52, and F-15. Current production version is the **AGM-88B,** with tungsten alloy cubes in the warhead rather than steel. Testing of a software upgrade, due for completion last year, is aimed at improving performance against new radars. EEPROMs (Erasable Electronically Programmable Read Only Memory) are being retrofitted on USAFE, PACAF, and TAC HARMs, permitting changes to missile memory in the field. Development of a lower-cost seeker (LCS), jointly funded by USN and USAF, is in hand for a new **AGM-88C** version, as is a Block IV upgrade to make the missile more effective against hardened targets. By the end of 1988 a total of 3,063 HARMs had been delivered. USAF plans to acquire 9,273 by the time production ends in 1994. (*Data for AGM-88A.*)
Contractor: Texas Instruments, Inc.
Power Plant: Thiokol smokeless dual-thrust solid-propellant rocket motor. Hercules second source.
Guidance: passive homing guidance system, using seeker head that homes on enemy radar emissions.
Warhead: high-explosive.
Dimensions: length 13 ft 8½ in, body diameter 10 in, wing span 3 ft 8½ in.
Weight: 807 lb.
Performance: cruising speed supersonic, altitude limits S/L to 40,000 ft, range more than 10 miles.



AGM-88A HARM

AGM-136A Tacit Rainbow



AGM-142A Have Nap

AGM-136A Tacit Rainbow

Designed to complement the AGM-88 HARM, the AGM-136A Tacit Rainbow is a low-cost, programmable, loitering, antiradiation weapon system that can be air-launched to seek out autonomously and destroy enemy radars. The missile features a single-piece, spring-loaded wing that is stored under the fuselage before launch, and rotates and locks into place on release. The horizontal stabilizers and a dorsal tail fin deploy after launch. Carrier aircraft will be the B-52G. FSD was scheduled for completion during FY 1990, with subsequent production to be centered in a new plant at Perry, Ga. A contract awarded to Northrop last October covered production tooling and special test equipment for the missile, as well as the FY 1990 purchase of 90 missiles for follow-on flight test. Major supporting contractors include Boeing Military Airplanes, Delco, Kearfott, Texas Instruments, and Williams International. Second-source contractors are Raytheon, McDonnell Douglas, and E-Systems.
Prime Contractor: Northrop Ventura.
Power Plant: Williams International turbofan.
Guidance: passive radar homing.
Warhead: high-explosive blast fragmentation, weight 40 lb.
Dimensions: length 8 ft 4 in, body diameter 2 ft 3 in, wing span 5 ft 1½ in.
Weight: 430 lb.
Performance: range more than 50 miles.

GBU-15 and AGM-130A

The **GBU-15** is an air-launched cruciform-wing glide bomb fitted with a guidance system designed to give it pinpoint accuracy from low or medium altitudes over short standoff ranges. Development began in 1974, based on experience gained in Vietnam with the earlier Pave Strike GBU-8 HOBO modular weapon program. The GBU-15 is intended for tactical use to suppress enemy defenses and to destroy heavily defended targets. The target-detecting device is carried on the front of the warhead; the control module, with autopilot and data link module, attaches to the rear.

The weapon offers two modes of attack. In direct attack, the weapon is locked on to the target before launch and flies a near line-of-sight profile to impact. In the indirect mode, the seeker can be locked on to the target after launch, or the operator can fly the weapon manually to impact, using guidance updates provided through the data link. This profile uses a midcourse glide phase and extends standoff range. The GBU-15 is deployed with F-4E and F-111 aircraft and has been test launched from the F-15E and F-16D. The **GBU-15(V)1/B** TV-guided variant qualified for operational service in 1983, and production is now complete; the **GBU-15(V)2/B** imaging infrared (IIR) version entered service in 1987.

Production of the **AGM-130** rocket-powered version of the GBU-15 was postponed under the amended FY 1988–89 budget requests. However, testing has continued through completion of the originally contracted program, providing very useful technology demonstration. The program is now back on track, and USAF plans to begin procurement of this weapon in FY 1992. (*Data for GBU-15.*)
Contractor: Rockwell International Corporation.
Guidance: TV or imaging infrared seeker.
Warhead: Mk 84 bomb (2,000 lb unitary).
Dimensions: length 12 ft 10½ in, body diameter 1 ft 6 in, wing span 4 ft 11 in.
Weight: 2,450 lb.
Performance: cruising speed subsonic.

AGM-142A Have Nap

Under the Have Nap program, USAF has acquired twelve Israeli-built Popeye medium-range, TV-guided standoff missiles. Value of the sixteen-month contract, awarded in June 1988 to Rafael of Haifa, Israel, is $39 million plus options.

Purpose of Have Nap is to provide long-range bombers with a conventional precision strike capability, in support of worldwide theater commanders. Primary carrier aircraft will be the conventionally dedicated B-52G if the decision is taken to put Have Nap into production. For that phase of the program Rafael would be teamed with Martin Marietta.
Contractor: Rafael Armament Development Authority.
Power Plant: solid-propellant rocket motor.
Guidance: inertial, with TV homing.
Warhead: high-explosive, weighing 1,975 lb.
Dimensions: length 18 ft 8½ in, body diameter 1 ft 8½ in, wing span 5 ft 1 in.
Weight: 3,300 lb.
Performance: range 50 miles.

Rapier

Rapier is unusual in that US land-based antiaircraft missiles are normally operated by the Army. Under a decision confirmed by an initial contract for 32 fire units in February 1981, British-built Rapier missile systems are deployed at seven USAF bases in the UK to protect Air Force installations. The last unit became operational in July 1986. Manned by RAF Regiment personnel, the USAF version of Rapier is intended primarily for defense against fast (Mach 1+) maneuvering, low-flying targets by day and night. The four-round fire unit, Blindfire radar, and a trailer of reload missiles are towed by Land Rovers loaded with support equipment.

Under a similar agreement, the government of Turkey agreed to locate Rapiers procured by DoD to defend two US air bases in that country.
Contractor: British Aerospace PLC, Dynamics Division.
Power Plant: IMI two-stage solid-propellant rocket motor.
Guidance: Racal-Decca surveillance radar and command to line-of-sight guidance. Optional Marconi DN181 Blindfire radar of optical target tracking, according to conditions.
Warhead: semi armor-piercing, with impact fuze.
Dimensions: length 7 ft 4 in, body diameter 5 in, wing span 1 ft 3 in.
Weight: approx 94 lb.
Performance: max speed more than Mach 2, range 4 miles.

Launch Vehicles

Atlas E/II

In operation since 1957, Atlas and Atlas/Centaur vehicles have achieved a 90th percentile success rate in around 500 launches of military and commercial satellites, as well as manned spacecraft. There are two current versions:

Atlas E: a modified ICBM, used to launch various USAF, Navy, and NOAA satellites; by mid-1989, eight remained available for launch at Vandenberg AFB, Calif., with launches planned at the rate of two a year until they are expended.

Atlas II: In May 1988, USAF selected General Dynamics to build an upgraded Atlas/Centaur vehicle, known as Atlas II, to meet its continuing medium launch vehicle (MLV II) requirement. The familiar "stage-and-a-half" configuration of the original ICBM is retained for the basic Atlas. Changes include lower-cost advanced avionics, an improved flight computer, booster engines with greater thrust, and longer propellant tanks. The engine and tank changes will be made to both the Atlas and Centaur stages. Eleven Atlas II vehicles have been procured, with the first flight scheduled for 1991. Primary payload will be the Defense Satellite Communciations System (DSCS). (*Data for Atlas II.*)
Prime Contractor: General Dynamics Corporation, Convair Division.
Power Plant: uprated Rocketdyne MA-5 propulsion system in Atlas stage, comprising central sustainer motor and two boosters; total thrust 414,000 lb.
Dimensions (Atlas stage): length 81 ft 7 in, max body diameter 10 ft 0 in.
Launch Weight: 412,000 lb.
Performance: capable of putting 11,200 lb into a low-Earth orbit and 6,100 lb into a geosynchronous transfer orbit.

Centaur

Centaur was the first US high-energy upper stage and the first to utilize liquid hydrogen as a propellant. Its multiburn and extended coast capability were first used operationally during the 1977 Mariner Jupiter/Saturn missions. The **D-1A** version used with the Atlas demonstrated widely ranging applications and capabilities. The nose section of Atlas was modified to a constant 10 ft diameter to accommodate the Centaur, which, in turn, provided most of the electronic command and control

systems for the launch vehicle. A 10 ft diameter fairing protected payloads for Centaur D-1A. The version of Centaur to be used on the new Atlas II will have modifications to its tanks and engines. The modified **Centaur G-prime** upper stage will be used with the Titan IV, creating the greatest weight-to-altitude capability of any US launch vehicle, by placing a 10,200 lb payload into geosynchronous orbit. (*Data for Centaur D-1A and G-prime.*)

Prime Contractor: General Dynamics Corporation, Convair Division.

Power Plant: two Pratt & Whitney RL 10A-3 liquid oxygen/liquid hydrogen rocket engines; each 16,500 lb thrust.

Guidance: inertial guidance system.

Dimensions (Centaur D-1A only): length 30 ft 0 in, diameter 10 ft 0 in.

Launch Weight (D-1A, approx): 35,000 lb; (G-prime-mod, approx): 53,000 lb.

Scout

Scout was designed to enable NASA and DoD to conduct space, orbital, and reentry research at comparatively low cost, using off-the-shelf major components where available. The basic current version, with an improved fourth stage, was launched successfully for the first time in August 1965. In addition to increasing the payload, this version can be maneuvered in yaw and can send a 100 lb payload more than 16,000 miles into space. Using the Algol IIIA first-stage motor, Scouts can put 377 lb payloads into a 310-mile polar orbit and have been used to launch many unmanned spacecraft, including satellites, for DoD, NASA, and international groups.

Prime Contractor: LTV Missiles & Electronics Group (a unit of LTV Corporation).

Power Plant: first stage: CSD Algol IIIA, 109,000 lb thrust; second stage: Thiokol Castor IIA solid-propellant motor, 64,000 lb thrust; third stage: Thiokol Antares IIIA solid-propellant motor, 18,700 lb thrust; fourth stage: Thiokol Altair IIIA solid-propellant motor, 5,800 lb thrust.

Guidance: simplified Honeywell gyro guidance system.

Dimensions: height overall 75 ft 5 in, max body diameter 3 ft 9 in.

Launch Weight: 47,619 lb.

Titan II

USAF has contracted Martin Marietta to refurbish and reactivate fourteen Titan II ICBMs for use as space-launch vehicles to supplement the remaining Atlas Es. Able to place payloads of more than 4,200 lb into polar orbit, the Titan IIs are suitable for launch-on-demand missions. The first launch of a Titan II space vehicle took place in September 1988, followed by a second a year later. The Titan II will support a variety of DoD users, including DMSP, NROSS, and the space test program. Launches are expected to continue into 1995 and will include launch of the SDI Midcourse Space Experiment, to collect target detection and tracking data, in 1992.

Prime Contractor: Martin Marietta Space Launch Systems.

Power Plant: first and second stages: Aerojet liquid hypergolic propellants: first stage 430,000 lb thrust; second stage 100,000 lb thrust. Strap-on solid rocket motors can be added to the first stage to increase payload capability.

Guidance: Delco inertial guidance system.

Dimensions: first and second stages height 110 ft 0 in; diameter 10 ft 0 in; payload fairing heights 20, 25, and 30 ft; diameter 10 ft 0 in.

Launch Weight: 408,000 lb.

Performance: more than 4,200 lb to low-Earth polar orbit. Max payload with strap-on boosters 7,500 lb.

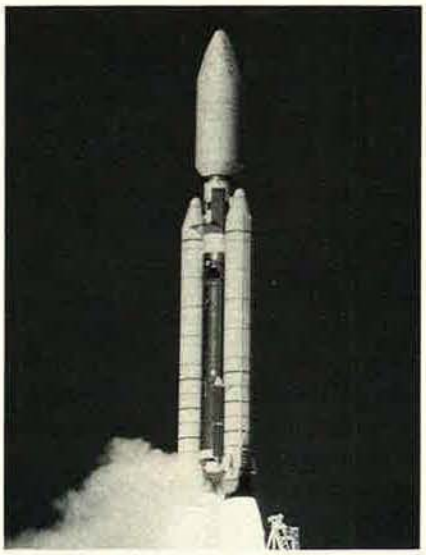
Titan IV

The final Titan 34D, last of the Titan III series, was used last September to launch a classified military payload from Cape Canaveral. Of the 141 liftoffs accomplished by the Titan III space-launch vehicles, 135 were successful, with more than 200 spacecraft launched.

In February 1985, the **Titan IV** was selected to augment the space shuttle and to allow greater flexibility in launching critical military payloads. It is a growth version of the Titan 34D, with stretched first and second stages, seven-segment solid boosters, a 16.7 ft diameter payload fairing, and a modified Centaur G-prime upper stage, enabling it to place a 10,000 lb payload into geosynchronous orbit, 32,000 lb into low polar orbit, or 39,000 lb into low equatorial orbit. With an alternative Inertial Upper Stage (IUS), it can place 5,300 lb into geosynchronous orbit; it may also be flown with no upper stage. The addition of upgraded solid rocket motors in 1991 will enhance performance by approximately 25 percent. USAF's original requirement of 23 Titan IVs had increased to firm orders for 41 vehicles by mid-1989, with options on additional Titan IVs through 1995. Titan IV is launched from Cape Canaveral, and from Vandenberg AFB, Calif.; first launch took place in June of last year from Cape Canaveral.

Prime Contractor: Martin Marietta Space Launch Systems.

***Space shuttle* Discovery**



Titan IV

Power Plant: first and second stages: Aerojet liquid hypergolic propellants; first stage 551,200 lb thrust; second stage 106,150 lb thrust; initially two United Technologies solid rocket boosters, each 1,394,000 lb thrust, later two Hercules solid rocket boosters, each 1,700,000 lb thrust.

Dimensions: first and second stages: height 119 ft 2½ in, diameter 10 ft.

Launch Weight: approx 1,900,000 lb.

Space Transportation System

Since orbital missions by the Space Transportation System (STS) were resumed with the successful flight of the space shuttle *Discovery* in September 1988, further scientific and military flights have been made routinely by all three currently available vehicles. Shuttle crews launched two important scientific probes (Magellan and Galileo) in 1989. The schedule this year calls for the launch of the Hubble Space Telescope (HST) by the STS-31 crew this spring. The HST, ten years in the making, will help probe the origins of the universe.

Developed for use by both DoD and NASA, the STS was the first reusable space vehicle. It consists of an orbiter, similar in configuration to a delta-wing airplane but powered by liquid-propellant rocket motors; a large jettisonable tank carrying the fuel for these motors, which is attached to the orbiter at liftoff; and two solid-propellant rocket boosters, mounted on each side of the fuel tank for liftoff. In April 1989, a contract was awarded to a Lockheed/Aerojet team to develop and produce an advanced solid rocket motor (ASRM) for the shuttle, to replace those now in use. The ASRMs will permit a payload increase of 12,000 lb, so attaining the shuttle goal of 65,000 lb into orbit.

The shuttle is launched vertically, with all engines firing in both the orbiter and the boosters. At an altitude of approximately 28 miles, the booster stages separate and descend by parachute into the ocean for recovery and eventual reuse. The orbiter then continues under its own power, jettisoning the external fuel tank just before attaining orbit. The orbiter is provided with a series of smaller rocket engines for maneuvering and attitude control, and these ensure insertion of the vehicle into the final desired orbit. Its main tasks are to place satellites into orbit, retrieve satellites from orbit, and repair and service satellites in orbit. On completion of a mission the orbiter flies back into the atmosphere and, once through the reentry phase, lands like an airplane, but without power.

Four operational orbiters named *Columbia, Challenger, Discovery,* and *Atlantis* were built originally. Following the loss of *Challenger*, a new orbiter, *Endeavour,* is under construction and scheduled for delivery in the spring of 1991. Operational missions by the STS began in November 1982 and have involved a number of classified military flights. However, following the loss of *Challenger*, military payloads will be carried on fewer than one-third of the shuttle flights now scheduled over the next few years. Shuttle facilities at the Vandenberg AFB, Calif., launch and landing site have been placed in mothball status.

Prime Contractors: Rockwell International (orbiter), Martin Marietta (propellant tank), Thiokol (boosters), Lockheed Space Operations (shuttle processing).

Power Plant: three Rocketdyne main engines, each 375,000 lb thrust at liftoff. Two Thiokol solid-propellant rocket boosters, each 2,700,000 lb thrust at liftoff.

Guidance: automatic and manual control.

Dimensions (orbiter): length 122 ft, wing span 78 ft 0.7 in, height 56 ft 7 in.

Launch Weights: shuttle complete approx 4,500,000 lb, orbiter (empty) 165,000 lb, external tank (full) 1,655,600 lb, boosters (2) each 1,292,000 lb.

Inertial Upper Stage (IUS)

Used for the first time in October 1982, the IUS is intended to serve as an upper stage for the Titan IV and the space shuttle. Consisting of an aft skirt, an aft-stage solid rocket motor, an interstage, a forward-stage solid rocket motor, and an equipment support structure, it has the capability of boosting 5,300 lb into geosynchronous orbit when used on Titan IV.

Prime Contractor: Boeing Aerospace.

Power Plant: aft-stage solid rocket motor 21,400 lb thrust, forward-stage solid rocket motor 18,500 lb thrust.

Guidance: inertial, plus star tracker.

Dimensions: length 17 ft, diameter 9 ft 2¼ in.

Launch Weight: 32,500 lb.

PAM-D II

The original PAM (Payload Assist Module) was developed as a commercial venture in 1976 to improve the load-carrying capability of the Delta and Atlas launch vehicles and for use on the space shuttle. An improved motor in PAM-D II enables it to boost a 4,200 lb satellite into geosynchronous orbit. It was selected by USAF to put 28 Navstar GPS satellites into 10,900 nautical mile, twelve-hour orbits from the shuttle, under a multiyear purchase agreement to procure 28 of the upper stages in 1985–90. It is still hoped to launch 22 of the satellites by October 1991, but 12 of them will now be put into orbit by Delta II MLVs and only ten by shuttle. A spring-loaded mechanism will eject each spinning PAM-D II and satellite from the shuttle cargo bay. The spinning motion will stabilize the package from initial deployment to positioning in orbit.

Contractor: McDonnell Douglas Space Systems Company.

Delta II

In January 1987, McDonnell Douglas was selected by USAF to build 20 of a modified version of its Delta rocket to launch the Navstar Global Positioning System (GPS) satellites. The Delta II is slightly larger than the earlier Delta in order to satisfy USAF's medium-payload requirement. The first launch took place in February of last year, and by October, four operational GPS satellites had been successfully launched. All 20 rockets are to be launched by 1991, the contract containing harsh financial penalties should any fail.

Delta II is a three-stage booster surrounded by nine solid-propellant, graphite epoxy motors (GEMs). The GEMs are currently under development; therefore, the first nine flights are employing a modified version of the Delta's Castor IV engine, the Castor IVA. Delta II will differ from the earlier version in having a twelve-foot stretch in the first stage tanks and, from flight No. 10, an increased expansion ratio on the first-stage engine.

Additional Delta IIs are planned for procurement for GPS replenishment after the required constellation is achieved.

Prime Contractor: McDonnell Douglas Space Systems Company.

Power Plant: first stage: Rocketdyne RS-27A liquid propellant engine, 237,000 lb thrust; second stage: Aerojet IT1P liquid propellant engine, 9,400 lb thrust; third stage: Morton Thiokol SGS II derivative, 15,400 lb thrust; strap-on GEM solid rocket motors, 143,235 lb thrust.

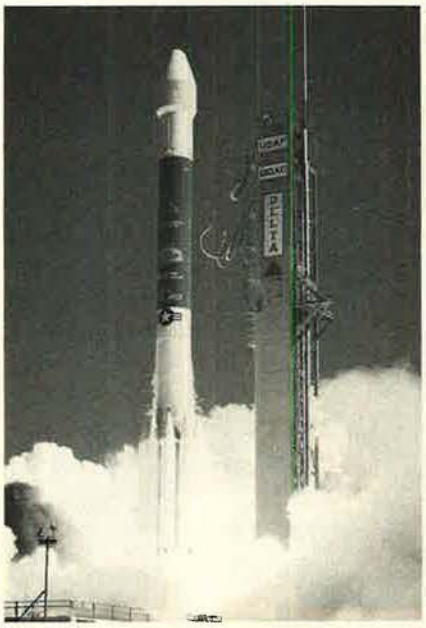
Dimensions: length 130 ft, diameter 8 ft; bulbous payload fairing, max diameter, 9 ft 6 in.

Liftoff Weight: 509,000 lb.

Performance: 11,110 lb to 100 nm.

Advanced Launch System (ALS)

On August 16, 1988, USAF awarded contracts to Boeing Aerospace, General Dynamics Space Systems Division, and the team of Martin Marietta and McDonnell Douglas Space Systems for system design and technology demonstrations through preliminary design review of a heavy-lift Advanced Launch System (ALS). The contracts are for a minimum of 24 months, after which time a decision will be made on whether to proceed to FSD; a winning contractor would be selected the following year, with initial ALS test flights in 1998 and IOC in 2000. Development of the ALS is aimed at significantly reducing launch costs for civil and defense users while assuring access to space for the late 1990s and beyond. The new system must be able to place payloads weighing up to 160,000 lb into low-Earth orbit at considerably reduced cost per pound of payload. FY 1989 funding was provided by SDI, with Air Force funding beginning in FY 1990. However, USAF funding for the project has been reduced by about a third in the FY 1991 budget proposals. NASA is a major participant in this effort.



Delta II

Remotely Piloted Vehicles (RPVs)

MQM-107B/D Streaker

A longer, reengined version of the earlier MQM-107A, originally ordered for the US Army in 1975, the **MQM-107B** is a recoverable, variable-speed target drone. Improvements tested and proven on the A version are incorporated on the B version. An initial order for ten each for USAF and the US Army was supplemented in April 1983 with major production orders for both services. Deliveries of a total of 70 for USAF were made in 1984–86, and it is planned to continue procurement of the MQM-107B as USAF's standard subscale target drone. Also in use with USAF, the **MQM-107D** is similar to the B version but is powered by a Teledyne CAE 373-8 engine (960 lb thrust). MQM-107B/Ds assigned to Tyndall AFB, Fla., and MQM-107Ds at Wallace AS in the Philippines are used to test and evaluate air-to-air missiles. (*Data for MQM-107B.*)

Contractor: Beech Aircraft Corporation.

Power Plant: one Microturbo TRI 60-2 Model 074 turbojet; 831 lb thrust.

Guidance and Control: analog or digital, for both ground control and preprogrammed flight. High-*g* autopilot provisions.

Dimensions: length 18 ft 1 in, body diameter 1 ft 3 in, span 9 ft 10 in.

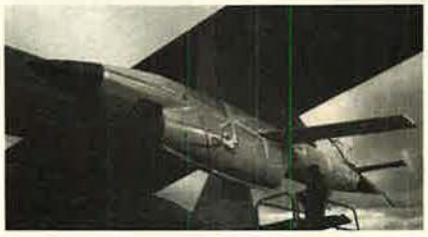
Weight: launch weight (incl booster) 1,090 lb.

Performance: operating speed 230–594 mph, operating height 50–40,000 ft, endurance 2 hr 18 min.

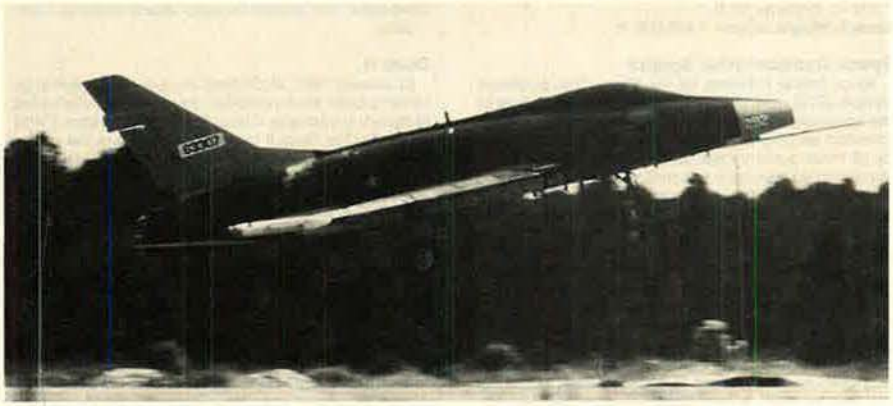
BQM-34 Firebee

Since initial development of the **BQM-34A** in the late 1950s, more than 6,000 of these jet target vehicles have been delivered to support weapon system and target research, development, test, evaluation, quality assurance, training, and annual service practices by all three of the US services and foreign governments. The BQM-34s deployed at Wallace AS in the Philippines and Tyndall AFB, Fla., are used in the testing and evaluation of air-to-air missiles.

The BQM-34A was to have been replaced by the MQM-107D. However, in September 1987, USAF placed an order for 50 new Firebee drones. These are equipped with an uprated General Electric J85-17C engine, which provides a thrust to weight ratio of 1:1, enabling this version to offer higher climb rates and 6*g* maneuvering capability. A new microprocessor flight control system (MFCS) provides a prelaunch and in-flight self-test capability. Starting last year, the new targets are being used for weapon system evaluation at Tyndall AFB. (*Data for BQM-34A.*)



Ryan BQM-34M Firebee



QF-100

Contractor: Teledyne Ryan Aeronautical.

Power Plant: one Teledyne CAE J69-T-29 turbojet; 1,700 lb thrust; later models have one General Electric J85-GE-7 turbojet; 2,450 lb thrust.

Guidance and Control: remote control methods include choice of radar, radio, active seeker, and automatic navigator developed by Teledyne Ryan; Vega DTCS (drone tracking and control system); microwave command and guidance system also available.

Dimensions: length 22 ft 10.8 in, body diameter 3 ft 1.2 in, span 12 ft 10.8 in.

Weight: launch weight 2,500 lb.

Performance: max level at 6,500 ft 690 mph, operating height range 20 ft to more than 60,000 ft, max range 796 miles.

BQM-34M/L Firebee

Eighteen Firebee drones have been reactivated for tests of the Over-the-Horizon Backscatter (OTH-B) and North Warning Radar systems. The first was successfully tested in September 1987. The drones, which had been stored at the Warner Robins (Ga.) Air Logistics Center for ten years, are being used by the 6514th Test Squadron at Hill AFB, Utah.

Contractor: Teledyne Ryan Aeronautical.

Power Plant: one J69-T-41A turbojet; 1,920 lb thrust.

Guidance and Control: preprogrammed digital computer, with Doppler guidance system.

Dimensions: length 30 ft, body diameter 3 ft 1.2 in, wing span 14 ft 6 in.

Weight: max launch weight 3,113 lb.

QF-100

A full-scale aerial target (FSAT) program is ongoing that converts retired F-100 fighter-bombers to QF-100 RPV configuration. This program provides FSATs for air-to-air and ground-to-air missile evaluation at Eglin Gulf Test Range in Florida and White Sands Missile Range in New Mexico.

Contractor: initial deliveries (from 1981) Sperry Corporation; follow-on (from 1984) FSI.

Power Plant: one Pratt & Whitney J57-P-21A turbojet; 16,950 lb thrust.

Guidance and Control: dual Vega command guidance and telemetry systems.

Dimensions: length 54 ft 3 in, height 16 ft 2⅔ in, wing span 38 ft 9⅓ in.

Weight: mission operational weight 31,000 lb.

Performance: max speed at altitude Mach 1.3, operating height range 200–50,000 ft, nominal range 138 miles.

QF-106

The QF-106 is due to replace the QF-100 as USAF's FSAT. Advantages of the QF-106 over the QF-100 include higher supersonic speeds while under remote control and increased maneuverability.

Contractor: Honeywell, Inc.

Power Plant: one Pratt & Whitney J75-P-17 turbojet; 24,500 lb thrust with afterburning.

Guidance and Control: automatic flight-control system with digital backup.

Dimensions: length 70 ft 8 in, height 20 ft 3 in, wing span 38 ft 5 in.

Weight: mission operational weight 40,500 lb.

Performance: max speed Mach 2, service ceiling 50–55,000 ft, range (approx) 400 miles.

Unmanned Air Reconnaissance System

Unmanned Air Reconnaissance System

The Unmanned Air Reconnaissance System (UARS), developed under a USAF/USN agreement, will provide a real-time/near-real-time unmanned reconnaissance complement to current and projected manned reconnaissance platforms. The UARS consists of the medium-range unmanned aerial vehicle (UAV-MR), being built by Teledyne Ryan Aeronautical, and the Advanced Tactical Air Reconnaissance System (ATARS) sensor payload, being developed by Control Data Corporation. The UAV-MR, designated the Model 350, is capable of being air- or ground-launched and will carry interchangeable mission payloads up to 350 nm at high subsonic speeds. The vehicle first flew in October 1988. The ATARS payload will consist of interchangeable electro-optical and IR sensors, recorder, and data link. The first production system is scheduled for delivery in FY 1994.

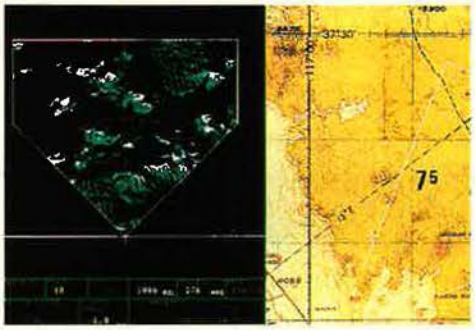
Contractors: Teledyne Ryan Aeronautical/Control Data Corporation.

Power Plant: one Teledyne CAE 382-10 turbofan.

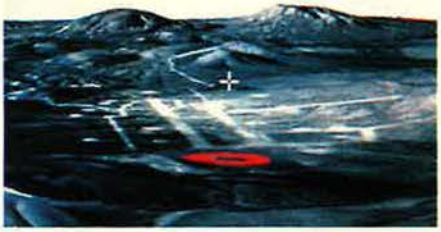
Dimensions: length 18 ft 0 in, span 10 ft 6 in. ■

USAF's MSS II: Right On Target

Now in production.



The USAF/ Fairchild Mission Support System II is the first breakthrough in mission planning in 45 years. With over 230 in production and 150 already delivered, the MSS II enables aircrews to plan complex missions in minutes instead of hours. More importantly, it helps maximize target accuracy and pilot survivability.



We're not just blowing smoke.

At Gunsmoke 89, the MSS II helped one team walk away with the most points in Gunsmoke history for the navigation/ attack competition profile. With the MSS II, pilots could "rehearse" missions on the system by watching computer-generated visual previews. The team also relied on the MSS II to determine the best routes for getting in and getting out.

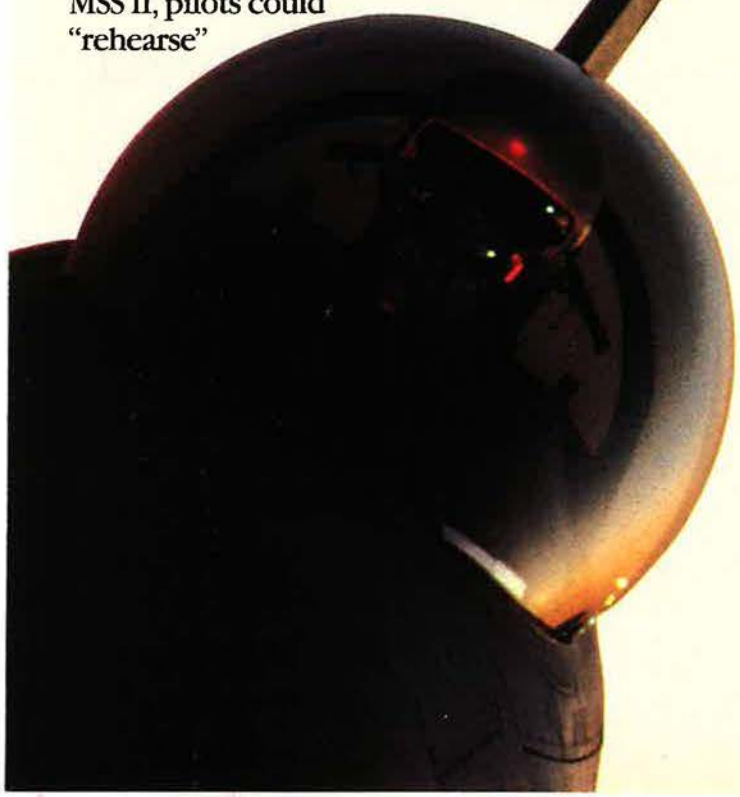
And we haven't been standing still.

Fairchild has made further enhancements to create the new MSS II+. The MSS II+ has all of the MSS II's capabilities, *plus* it provides a lightning-fast, high-resolution perspective view; three-dimensional preview generated in real-time; *plus* faster radar predictions (<10 sec.); real-time enemy air defense updates; *plus* faster route optimization (<5 sec.). The MSS II+ also provides a high-speed color printer for generating color combat mission folders, *plus* a monochrome text image printer for navigation forms, perspective views, and radar predictions.

Don't delay.

No one else can provide a better system today that will also meet your needs tomorrow. For more information, contact Don Ryan, V.P. Business Development, at (301) 428-6477.

The MSS II+



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This thirty-two-bit processing powerhouse may be standard on military aircraft and space vehicles of the next century.

The Airborne Supercomputer

By John Rhea

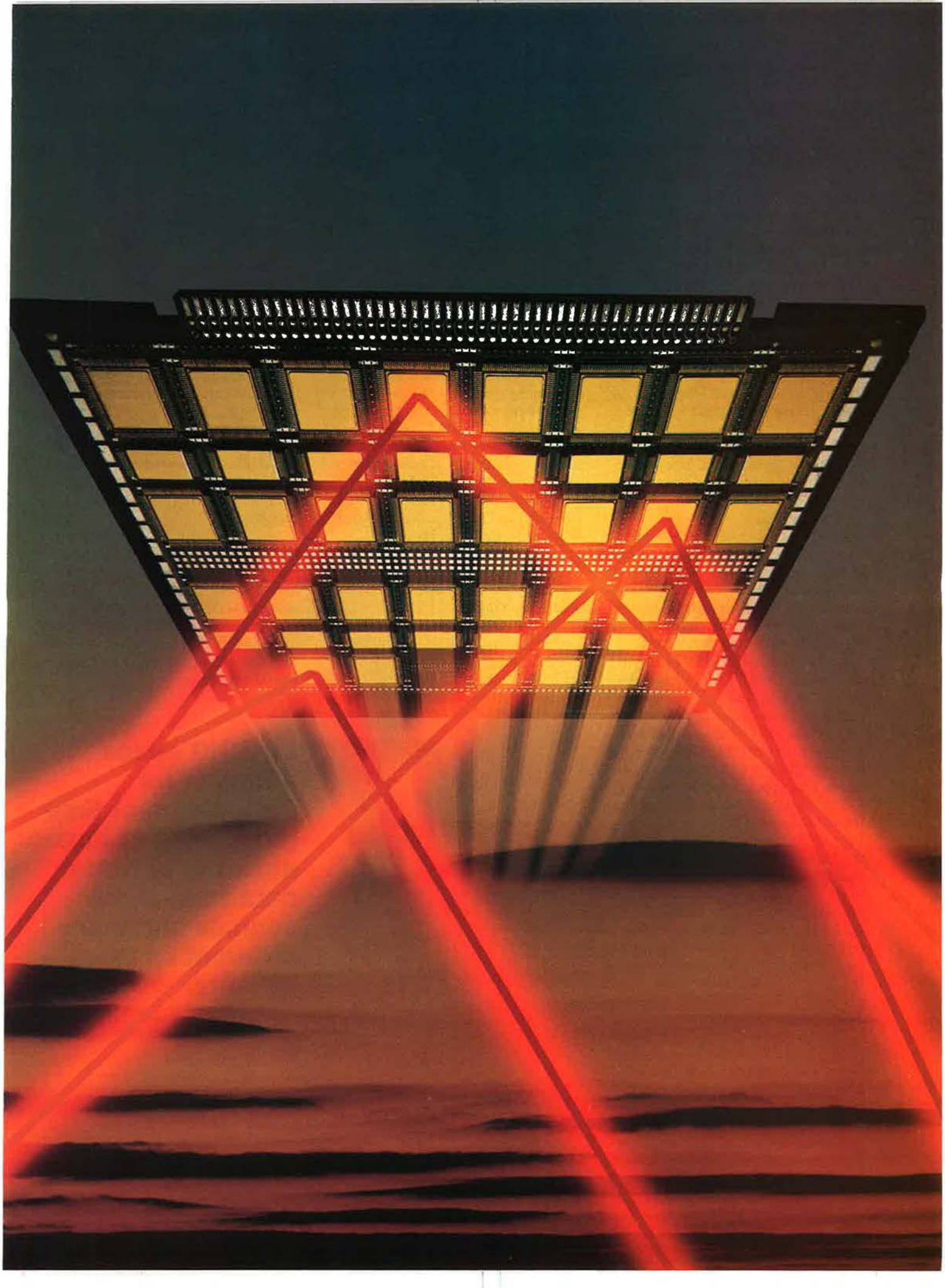
In a historic reversal of the usual flow of technology from aircraft to spacecraft, computers derived from RH-32 developmental models could be applied to future tactical aircraft.

AN extraordinary new class of airborne supercomputer, one probably destined to become the standard for US military aircraft and space vehicles in the next century, is now taking shape at Air Force research facilities.

USAF technologists working on the high-priority project are accelerating the pace of development on a broad front.

Known as the RH-32 program, this research effort at USAF's Rome Air Development Center (RADC) at Griffiss AFB, N. Y., aims first to develop computers capable of performing the critical battle management function for any future antiballistic missile system that emerges from the Strategic Defense Initiative (SDI).

However, in a historic reversal of the usual flow of technology from aircraft to spacecraft, the airborne computers to be derived from the RH-32 developmental models are being eyed for applications to future tactical aircraft. These applications could include retrofits of the awesome supercomputers into the Advanced Tactical Fighter (ATF), now being developed for initial opera-



tions in the late 1990s, and use in a future USAF multirole combat aircraft now being considered by the advanced planning staff at Air Force Systems Command's Aeronautical Systems Division.

The computers are based on a system architecture known as multi-interlock pipe stages, developed by the Defense Advanced Research Projects Agency (DARPA). They are aimed specifically at the post-ATF generation of air vehicles.

Even so, the first use of the new technology will come in upgrades to existing aircraft through use of component technology already available. For example, USAF is upgrading E-3 Airborne Warning and Control Systems aircraft with a new advanced modular processor made by Control Data Corp. About the size of a videocassette, it will contain five computers, each able to operate at one million instructions per second (MIPS).

The Navy has under way a parallel effort to examine the use of the DARPA architecture for its Next Generation Computer (NGC). The service, in fact, already uses the technology on ships. It may also retrofit its surveillance aircraft.

In the name of the RH-32 computer project, "RH" stands for radiation hardening, and "32" is the number of bits per computer "word" in this avionics system architecture. Both are important requirements for any future generation of airborne and spaceborne computers.

The radiation-hardening part of the development effort is relatively simple. Any avionics equipment intended to operate in the background radiation environment of space must be either shielded or built out of radiation-resistant materials, or both. The requirement to continue operating after nuclear weapons have been detonated nearby makes the need a fundamental one.

The Sixteen-Bit "Word"

The thirty-two-bit part of the effort is more complicated. Most of today's computers—from personal computers used in conducting day-to-day business to the airborne processors planned for ATF—use what is known as sixteen-bit architecture. In computer parlance, a "bit" is either a zero or a one. Standard computers, therefore, process information as a series of sixteen-bit-long "words" composed of ones and zeros.

The choice of this architecture represented a compromise between the desire for more powerful processing capability and the need to keep hardware costs within bounds.

It was known from the beginning that increasing word length would increase the amount of data that could be processed per unit of time and would improve the accuracy of the results. It also was known that use of the longer word would provide exponentially greater access to the logic units to the computer's memory. The standard sixteen-bit architecture enables the computer's central processors to address directly 65,536 "bytes" of memory. For a thirty-two-bit computer, the number of direct access paths is four billion bytes. Thus, a thirty-two-bit computer is not twice as powerful as the sixteen-bit version, but 65,536 times as powerful.

With recent advances in microcircuits and computer design techniques, the cost per computation also is declining.

Executives within the Strategic Defense Initiative Organization have the most pressing need for this increased computing power. In its effort to create a functioning strategic defense system, SDIO needs a means for effective, real-time processing of huge amounts of threat data from many sources and many different types of sensors. In the long term, however, the needs of the tactical forces are seen as equally great. The United States at present ranks as the world leader in stealth technology, but it is likely that other countries will acquire this capability. The need to process images of targets with low radar cross sections, experts say, will strain current airborne computers to the limit.

The logical solution to this problem is introduction of thirty-two-bit processors, which provide greater accuracy and better detection capabilities. They are particularly suited for intense computation problems in which more than sixteen bits of precision are needed to solve the problem.

Within the defense community this class of problems encompasses signals intelligence, such as radar and sonar signal processing, and imagery intelligence, including satellite imaging, synthetic aperture radar, and image enhancement of threat data from forward-looking infrared sensors.

The SDIO needs a means for effective, real-time processing of huge amounts of threat data from many sources and many different types of sensors.

The advantage of thirty-two-bit processors is that they have sufficient word length to handle the powerful algorithms known as "fast Fourier transforms," used for filtering and other signal processing techniques. This is particularly important for the Navy, whose acoustic signal processing requirements for antisubmarine warfare have been compounded by the introduction of such new, "quieter" Soviet submarines as the Akula- and Mike-class boats.

Terrestrial Uses

The Air Force and the other services are already using ground-based thirty-two-bit computers for specialized applications. In the B-1B bomber program, for example, avionics subcontractor Boeing is employing thirty-two-bit array processors as main processing elements for digital radar landmass simulators for real-time simulation. The simulation systems use terrain and cultural databases to reconstruct high-resolution images of landmasses and provide cockpit displays for pilot mission training. Similar computers are planned for the Air Force's Over-the-Horizon Backscatter (OTH-B) radar system to handle complex signal processing.

Other scientific applications of thirty-two-bit computing—and even sixty-four-bit architectures for the top-of-the-line supercomputers—are well established, and this technology is coming into commercial use as well.

One example is X-ray computer tomography (a technique similar to CAT scans) used at General Electric's aircraft engine plants. Others include seismic data processing, molecular modeling, and nondestructive testing. The computers also will be useful in inspection of composite structures, advanced electronics, complex castings, petroleum core samples, automotive components, munitions, and tactical missiles.

However, the RADC's RH-32 program differs from all those that have come before, and in a highly significant way. Nobody has ever tried to package this kind of vast computing power into radiation-hardened, lightweight modules for aerospace applications.

That was the purpose of the first phase of the program that was launched two years ago to solicit industry ideas for a computer capable of performing at least twenty MIPS in a standard electronics module measuring 5.8 by 6.7 by 0.6 inches. Such a device would be compatible with USAF's proposed Pave Pace architecture for future aircraft avionics *[see "The Next Generation of Avionics," January 1990 issue, p. 68].*

The program moved into its second phase—the design and fabrication of prototype modules—last January with the award of parallel, $8 million contracts to Honeywell's Space Systems Group of Clearwater, Fla. (backed by Westinghouse Electric Corp. of Baltimore as a subcontractor), and TRW Inc. of Redondo Beach, Calif. Each contractor is required to deliver, by October 1991, ten advanced development modules with about five chips in each. There must be two versions, one for spacecraft and one for aircraft, plus about fifty additional unpackaged chips for testing.

This phase is further subdivided into two efforts, to be conducted in serial fashion. First, each company must define the architecture and run a complete simulation on it before actually fabricating any chips. Then the competitors move on to detailed design, layout, fabrication, assembly, and testing of the devices. Each firm can decide how the functions are to be partitioned among the devices within the modules.

Playing It Safe

Two facts point up the conservative nature of the current technical approach. First, the chips will be made of silicon rather than the inherently faster and more radiation-resistant gallium arsenide (GaAs). Second, functional density won't even be up to the level of the Very-High-Speed Integrated Circuit (VHSIC) chips developed over the past ten years under sponsorship of DARPA.

Each standard electronics module will contain the equivalent of about 1.5 million transistors distributed among five chips (the TRW design) or seven chips (Honeywell's approach). The modules are partitioned into separate chips for the central processor, floating point arithmetical operations, memory management, and systems control functions.

The chips will be fabricated with the so-called complementary metal oxide semiconductor process, in use for more than twenty years by the semiconductor industry. That results in a size of about 1.25 microns per equivalent transistor. VHSIC devices are already below half a micron (a human hair is about a hundred microns in diameter).

Silicon was chosen over GaAs material, say industrial experts, because the silicon-working process results in higher yields—*i.e.*, more usable chips per wafer of material. Also, GaAs does not meet all the radiation-hardness requirements in space and is not needed to achieve the required twenty MIPS speed.

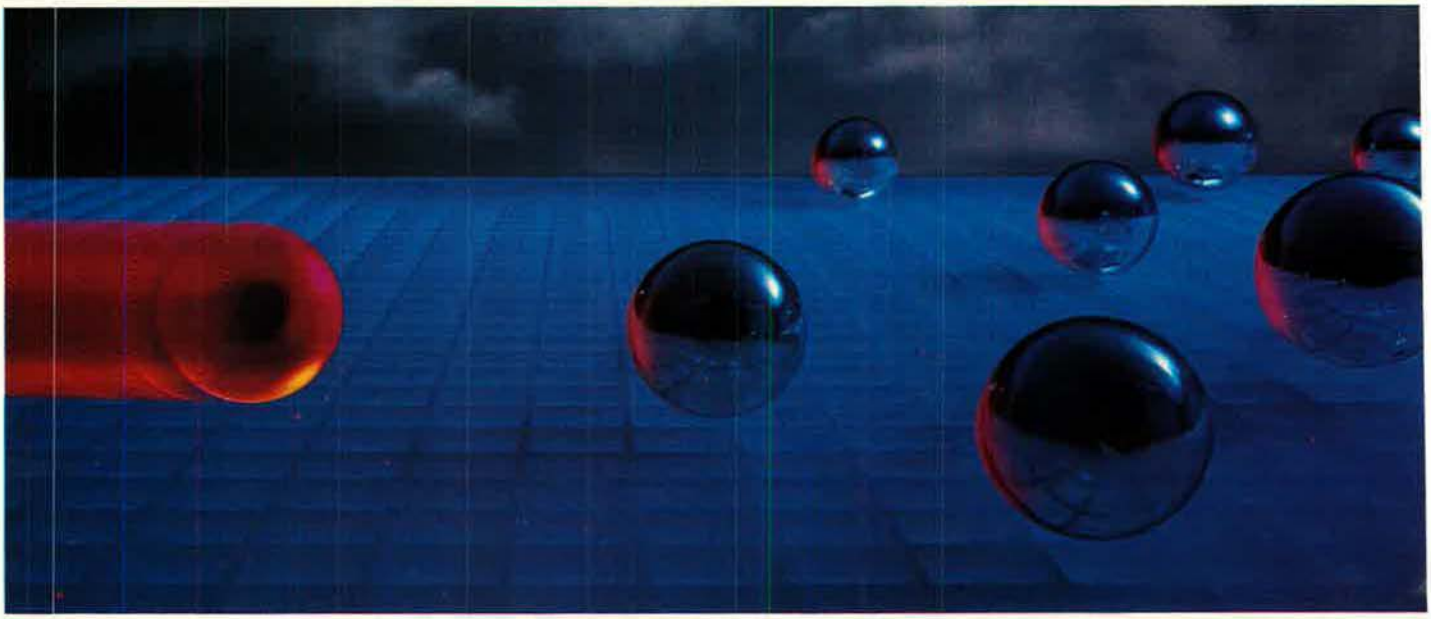
However, the use of an open system architecture like Pave Pace should permit later substitution of GaAs for silicon. That would achieve higher functional densities without making it necessary to redesign the whole computer. It should also push up the processing speed well beyond twenty MIPS. Well it might; Pave Pace developers anticipate that future aerospace vehicles will have computational requirements measured in billions of operations per second.

Another requirement for the RH-32 program is that the prototype hardware must run on the Ada software language, which the Department of Defense has mandated for all major weapons of the future. The two contractors add that they will apply a new technique known as reduced instruction set computing (RISC) to reduce the overall software requirements by doing more things in hardware, *i.e.*, in the chips themselves.

Though the specifications for the computer system don't spell out a requirement to use fiber-optic data buses, these are the only communications media that are likely to match the speed of the processors. They are also inherently radiation-resistant. The current generation of military fiber-optic data buses has an effective data rate of at least fifty megabits per second, and much more powerful data buses are likely to be available by the time RH-32 computers are ready for operational use.

When you're playing for all the marbles . . .

Go with your best shot.



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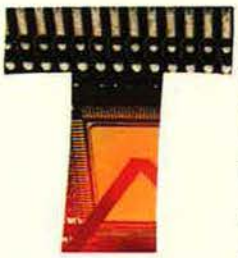


The airborne computer industry is gambling that the RH-32 and its equivalents will be the only game in town in the next few decades.

Under the Pave Pace system architecture, the RH-32 processors would have to be arranged into fault-tolerant networks of supercomputers that could continue to operate even if some of the modules were damaged. The original specifications also call for low power needs, light weight, and high mean time between failures. Each contractor is free to come up with its own approaches to these requirements.

A Rare Joint Effort

At present, the SDIO provides principal funding for the supercomputer development program. Actual management, however, is exercised by a rare type of joint team from RADC and the Avionics Laboratory at the Wright Research Development Center, Wright-Patterson AFB, Ohio.

Primary applications are listed as the SDIO's Space Surveillance and Tracking System, Space-Based Interceptor System, and upgrades to the Boost Surveillance and Tracking System. Even so, the ATF is a prominent entry on the application list, as is the National Aeronautics and Space Administration's prospective space station. The latter is expected to have computing requirements comparable to those found in a military strategic defense system.

This short list by no means covers all the possible applications of the new computer. Under a 1987 agreement signed by the three military departments, a Joint Integrated Avionics Working Group (JIAWG) is supposed to make available to all services any avionics technology created by any one of them.

One problem is that the Air Force and Navy have not agreed on the instruction set architecture (ISA) for their thirty-two-bit computers. Two ISA standards developed by California firms, one known as R3000 from Intel Computer Systems and the other called i960 from Intel Corp., were approved by the JIAWG in July 1989. The two RH-32 contractors will use R3000 (as well as Control Data for AWACS), while the Navy favors i960 for ATA. Both of these ISAs employ RISC techniques.

Other possibilities include incorporation of thirty-two-bit computers in new types of unmanned autonomous vehicles currently in early stages of definition. Some believe this group is potentially the largest volume user of all. Eventually, as prices decline along the traditional experience curve, this technology could filter down to commercial aircraft and spacecraft.

In fact, that's what the airborne computer industry is betting on. It is gambling that the RH-32 and its equivalents will be the only game in town in the next few decades. Just as today's sixteen-bit airborne computers—the USAF 1750 and the Navy AN/AYK-14—became the standards for the current generation of air vehicles, thirty-two-bit processors are seen as likely to dominate future generations.

The Race for the Future

The stakes are high. To stay in the game, other companies are going to have to invest independent research and development funds to keep pace with the winners, Honeywell and TRW. Those two companies beat out computer industry leaders IBM and Unisys for government contracts in Phase 2 of RH-32 development. Even so, federal procurement regulations require that the competition be reopened to all comers if USAF proceeds to a third phase, full-scale engineering development.

There are further opportunities. If the program reaches production, the Air Force (and any other participating service) will need at least two sources of supply. The logical approach would be to create a leader-follower arrangement, as the Navy currently has with Control Data and Unisys on the AYK-14. The usual result is that, because of annual competitive bidding, one company gets about sixty percent of the total business and the other gets forty percent.

The RH-32 itself, being the product of a basic research effort, may never see operational use. What seems clear, however, is that the technologies that emerge from this major R&D program will set the standards for airborne computers well into the next century. ■

John Rhea is a free-lance writer who specializes in military technology issues and is a frequent contributor to Air Force *Magazine. His most recent article, "Why Is the Pentagon Watching High-Definition TV?", appeared in the April 1990 issue.*

These electromagnetic guns fire projectiles at speeds never witnessed before.

—Photos by Ron Lentz

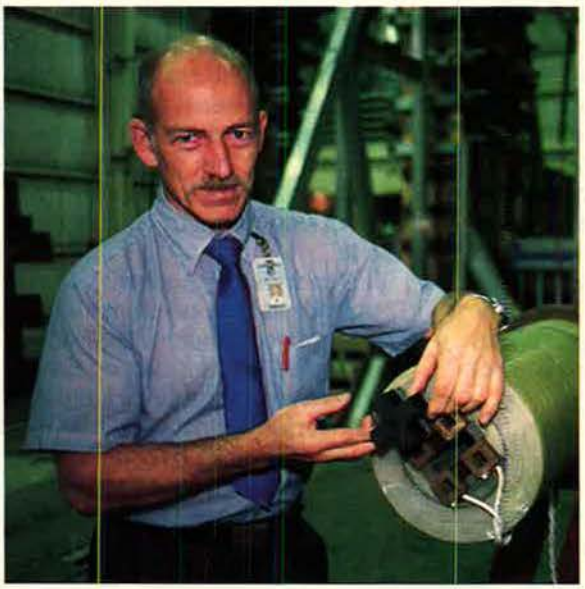
Fastest Shot in the World

By Terry L. Metzgar

THE AIM-9 Sidewinder missile streaks toward its target at 1.2 kilometers per second (kps). That's significantly faster than a speeding bullet. (Muzzle velocity of an M16 rifle round—one of your faster speeding bullets—is .99 kps.) As raw speed goes, though, even the Sidewinder is slow. The High Endoatmospheric Defense Interceptor (HEDI) missile moves at 2.43 kps. As the search for even greater velocity continues, HEDI is being outpaced as well.

USAF Systems Command's Armament Laboratory (AL) and the Strategic Defense Initiative Organization (SDIO) are vigorously developing pulsed power electromagnetic launchers (EMLs). Such devices, now in the earliest stages of development, offer significant advantages over traditional, chemical-based propulsion systems.

When fired at sea-level air densities, projectiles from EMLs generate raw velocity and acceleration far greater than anything ever witnessed or, until recently, even imagined. Several small-mass EMLs have generated projectile speeds greater than eight kps.



"Bullets" fired from electromagnetic launchers pull 50,000 Gs, taking a mere four milliseconds to reach a velocity of four kps. At left, Billy Lucas, Chief of Launcher System Development at Okaloosa Island Facility, Eglin AFB, Fla., displays a 75-mm EML polycarbonate practice round. Power for EML shots comes from Okaloosa's Battery Power System (right), 14,000 car batteries that produce 2,000,000 amps of current.

From the perspective of the weapons-maker, however, sheer velocity alone isn't enough; acceleration is also critical. The space shuttle, for example, is very fast but accelerates slowly, taking seven minutes to reach the speed of six kilometers per second. Missiles shot from EMLs, however, normally take less than five milliseconds (five one-thousandths of a second) to attain such velocities.

This property of achieving peak velocity almost instantaneously has obvious value in a variety of

USAF's kinetic-kill systems—for example, in hypervelocity air-intercept missiles. The less time an aircraft has to evade an incoming projectile, the better the chance of a successful intercept. When one compares the acceleration profile of today's air-intercept missile with that of a four-kps EML projectile, the contrast is striking:

- From launch to target at five kilometers, the standard missile takes seven seconds, the EML missile only 1.5 seconds.
- From launch to target at ten kilometers, the standard missile takes thirteen seconds, the EML missile only three seconds.
- From launch to target at twenty kilometers, the standard missile takes twenty-two seconds, the EML missile only eight seconds.

Fundamental Asymmetry

There is a fundamental asymmetry in the starting speeds of these two different types of projectiles. The standard chemical-based missile of today accelerates with a force of fifty Gs until it reaches terminal velocity of 1.15 kps, where it remains until burnout. The EML projectile, by contrast, pulls a wrenching 50,000 Gs to reach peak velocity of four kps in four one-thousandths of a second. Atmospheric attenuation slows the projectile throughout flight.

EMLs achieve this remarkable performance by harnessing electromagnetic propulsion. Unlike missiles or guns that use chemical propellants, EMLs push projectiles with the invisible force of an electromagnetic pulse. This gives EMLs several advantages in terms of velocity.

With conventional chemical propellants, a projectile's speed is always limited to the speed at which a gas expands. Stuff in all the powder you want, but the bullet can't exceed the velocity of the expanding gas itself. It follows that if faster projectiles are required, a different propulsion system must be used. Because an electromagnetic pulse travels at nearly the velocity of light, it surpasses the limits of gas expansion and has the potential to launch projectiles faster than is possible with chemical propellants.

This thought isn't lost on Air Force scientists at AL, located at Eglin AFB, Fla. Their goal is straightforward: By the end of 1992, prepare a power system and hardware that can launch a five-kilogram mass at four kps or, alternatively, launch a seven-kilogram mass at 3.4 kps. Either objective works out to the creation of forty megajoules of energy. (A megajoule is power equivalent to 737,000 foot-pounds of work per second.) Although the mission is clear, accomplishing it will be anything but easy.

Already the technological infrastructure for the project has had to expand dramatically. AL now operates a new center known as the Eglin Okaloosa Island Facility. Four years ago, notes Albert F. Young, Chief of the EML Technology Branch at Okaloosa Island, "we had nothing but an old capacitor bank that someone had hauled out here in an old pickup truck." Now the facility houses the world's largest and most powerful battery power system. One barn-sized shed contains 14,000 car batteries interconnected to produce 2,000,000 amperes of current. Plans call for expanding the system to a capacity of 5,000,000 amps.

The Okaloosa Island Facility faces out over the Gulf of Mexico amid some of the most desolate "beachfront property" this side of Rogers Dry Lake Bed. In fact, the Electromagnetic Facility has the same "sand dune and tin shack" ambience of the old Muroc Field (now Edwards AFB), immortalized in Tom Wolfe's book *The Right Stuff.* The buildings are simple and stark, designed for function rather than aesthetics.

Bending Steel Beams

Even at 2,000,000 amps, the battery power system generates such a potent magnetic field that it bends the building's steel beams. In order to avoid further damage, technicians reinforced the structure for future EML test shots. This "beam bending" phenomenon is just one indication of the challenge facing EML development. The act of "dumping" 2,000,000 amps all at once places extraordinary demands on materials, switches, inductors, and all components that make up an EML.

Other problems that must be addressed include high-energy management, data acquisition, diagnostics, development of rapid fire technology, and power upgrades. Mr. Young's scientists are laboring not only to demonstrate the technology but also to build an extensive database by conducting consistent, repeated test firings. "If we're going to build a better launcher," explains Mr. Young, "then we need to know what's going on inside the bore [of the launcher]. We're making a concerted effort to develop diagnostics to improve instrumentation and data acquisition."

Perhaps the toughest challenge will be development of an adequate projectile. At standard EML velocities, atmospheric friction will simply vaporize conventional projectiles within a few milliseconds of launch. Developing one that can withstand such friction is an immense task. Then there is the problem of developing sensors to fit on the projectile. Severe acceleration, inherent with any EM launch, gives the problem of sensors new meaning; 50,000 Gs would turn today's conventional sensors into the electromagnetic equivalent of a toad under a steamroller. Ways must be found to fortify these delicate devices to withstand such enormous pressures.

The US Army's Strategic Defense Command in Huntsville, Ala., is attempting to do just that. It is developing a smart endoatmospheric missile, known as the D2 Projectile, that is specifically tailored for the severe environment of launch from an EML. On-board sensors and other mechanisms are designed to survive axial accelerations of 100,000 Gs and magnetic field forces of eleven teslas (the tesla is a standard unit of magnetic flux density). Using both command guidance and an on-board, near-infrared-band seeker, the D2 will have the capability of making fifteen-G maneuvers. Full-size projectiles will be ready in 1995.

Voracious Appetite for Energy

Also creating problems for AL scientists is the matter of energy storage. Because EMLs have a voracious appetite for energy, power-source selection is a critical issue. Choices run the gamut from capacitors to homopolar generators to compulsators to old-fashioned car

batteries. Batteries appear to be the least expensive alternative. This, however, could change. The Defense Nuclear Agency (DNA) is now funding advanced capacitor research under Project Mile Run. Thus far, technologists have succeeded in shrinking the size of capacitor cans to energy density effective for mobile applications.

Then, of course, there is the matter of rapid fire technology. While several different EML facilities have managed to demonstrate hypervelocity shots of projectiles, they've done it in a "single shot" way, rebuilding the launcher after each shot. Researchers at Okaloosa have built a fifteen-millimeter, square-bore launcher that is, arguably, the state of the art. Its best performance has been thirty shots before reconstruction, which is remarkable in light of the harsh thermal environment within an EML. "Our rapid fire program is unique," says Mr. Young. "It drives us into the study of rapid switching and thermal management."

At Okaloosa Island, the rapid fire device is just one of sixteen EMLs that range in size from fifteen millimeters to seventy-five millimeters. A 90-mm launcher will arrive soon. The 75- and 90-mm launchers are in adjacent bays pointing toward an open-air trap door overlooking the Gulf test range. Any exo/endoatmospheric shots would pass through this portal.

Despite the difficulties, scientists are optimistic that they will succeed. "We feel confident we can make a forty-megajoule shot," says Mr. Young. "Funding is a bigger problem to us than the technology. We feel that we've already addressed the technology issues that apply to forty megajoules. . . . Our next goal of 100 megajoules entails higher risk."

In the general press, EMLs are often called "railguns." EM researchers avoid the term because of its antiarmor connotation. They feel that describing a five-kps EML as a railgun is like calling the B-2 bomber an airplane. It's accurate up to a point, but it doesn't tell the whole story. If you can launch a five-kilogram package at four kps with near-instantaneous acceleration, then a number of interesting things become possible.

Terminal ICBM defense. In the view of Mr. Young and others, the ability to launch heavy masses at such extraordinary velocities makes it feasible to intercept incoming warheads at standoff ranges, using only kinetic destruction weapons. In the past, available kinetic weapons were too slow to be able to reach a warhead much before the speeding reentry vehicle reached its target.

Air-to-air weaponry. It is not only EM intercept missiles that are possible. Pulsed-power electromagnetic weapons are a natural adjunct to a variety of airborne systems. Scientists say that electricity generated by main engines, already used to power flight controls, could be used in pulsed-power weapons. For example, an AWACS-type surveillance plane, equipped with electromagnetic weapons, could defend itself out to a distance of some 200 miles.

Electromagnetic armor. Electromagnetic armor, also known as EMA, is a direct spin-off from DNA's EML capacitor development program. The armor uses an outer ground plate to form a magnetic field and then deflects incoming projectiles. The technique is highly classified. There are indications that EMA application increases survivability by a factor of ten. EMA development today is focused on warship and armored-vehicle applications, but it could have aerospace applications.

Lethality testing. Billy Lucas, Chief of EML's Launcher Systems Division, believes one near-term application could involve testing concepts such as SDIO's "Brilliant Pebbles" missile defense system. "Without sufficient space to accelerate a rocket up to speed, lethality testing of Brilliant Pebbles is very difficult," he explains. "EMLs can provide that same velocity in a confined space. We can do lethality testing for all kinetic interceptors."

Aerodynamic Modeling. EMLs offer a free-flight, hypersonic modeling capability without undesirable wind tunnel side effects.

If EML potential were limited to glorified wind-tunnel testing, there would be little point in pushing the technology. There are, however, more impressive incentives. EMLs also have an inherent antisatellite potential. Political sensitivities have prevented open public discussion of this capability, but there is no doubt that it exists.

Space-Launch Potential

Then there is the EML's space-launch potential. The same hypervelocity capability that makes EMLs ideal for the mission of terminal defense could in time develop into an earth-to-space launch capability. Existing EMLs generate projectile speeds of four to eight kps, which is more than sufficient to loft packages beyond Earth's atmosphere. That fact has convinced many in the electromagnetic development community that pulsed-power technology could provide a dramatic breakthrough in the way the US places small payloads into space.

"I think it is very feasible to use EMLs to put things into space or low-Earth orbit," says Mr. Young. "I don't mean people, I mean resupply containers or small reconnaissance satellites—anything you want to put up there real quick. A rocket carries so much fuel for such a tiny warhead. All we need to do is propel the warhead."

In fact, several existing EMLs have enough punch to execute a quick and dirty "sounding rocket" demonstration right now. There is nothing about the launcher itself that would prevent the AL technicians from elevating the tube and blasting a package to an altitude of around 400 kilometers. Only range safety and political considerations prevent such a demonstration. Of those US facilities with adequate EMLs, only the Okaloosa Island Facility has an open-air test range suitable for this first historic exoatmospheric demonstration.

If and when that happens, it will be an event of considerable significance. The shot might well turn out to be a "pulse heard round the world" and establish Okaloosa Island in the tradition of Kitty Hawk and Muroc Field. ■

Terry L. Metzgar is a free-lance writer specializing in communications and defense technologies. This is his first article for AIR FORCE *Magazine.*

This quarter-century has seen more technological change than all the previous centuries combined.

—Photo by Paul Kennedy

The Top Ten From the Last Twenty-five

By Robert S. Dudney, Executive Editor

VIEWED in retrospect, it was a dark age. Doctors cut patients open to find what ailed them. Giant storms appeared suddenly, striking without warning. Crude machines performed rudimentary calculations. The moon was a deep mystery.

Yes, the world was pretty primitive back in 1964.

Or so it seems only a quarter century later. Today, machines can look inside the human body without ever touching it, yielding detailed pictures of its inner workings. Other machines spot violent weather even before it develops, tracking its course and predicting its behavior. Strong, lightweight glass threads, ceramics, and thermoplastics have become basic building materials. Cheap, powerful desktop computers are common. The moon long ago came within human reach.

Even by twentieth-century standards, the technological gains of the recent past are awesome. Robert M. White, President of the National Academy of Engineering, says the world between 1964 and 1989 "witnessed more advancement in technology and, consequently, greater changes in the lives of people than [in] any previous twenty-five-year period in recorded history."

The Academy, a federal advisory group established in 1964, recently took the measure of this unique era, identifying what it believes are the ten most important engineering accomplishments. In no particular order of importance, the top ten are as follows:

The moon landing. The July 1969 feat of landing men on the moon and returning them safely to Earth puts the Apollo campaign in a class with the Manhattan Project and construction of the Egyptian pyramids and the Panama Canal. It is seen to be "one of the outstanding engineering achievements of all time." At Apollo's peak, 400,000 persons were working on the project at three space centers and 20,000 contractor sites. The US project remains "the model for operating a massive, well-run engineering program." Managers created a monitoring system to ensure that millions of hardware pieces came


250ml
200ml
150
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The Washington Post
FINAL
MONDAY, JULY 21, 1969
The Weather
The Eagle Has Landed'
Two Men Walk on the Moon
'One Small Step For Man ... Giant Leap for Mankind'

together at the right time and place, in the right configuration, and for the right price. On the technical side, the Apollo program succeeded in making millions of pieces of equipment work together.

Application satellites. The Early Bird communications satellite went aloft in 1965; the first weather satellite began operations in 1966. From that humble beginning, a huge system of space-based equipment has grown. Today, highly sophisticated satellite systems ring the earth, spotting storms far out at sea, relaying communications and images between continents, exploring uncharted parts of the planet from space, and helping ships and airplanes navigate anywhere on the globe. These satellites, in their various applications, are the workhorses of today's modern, global system of instantaneous communication and information-gathering.

The microprocessor. The first "computer on a chip," no bigger than a fingernail, was introduced in 1971. Since then, as integrated circuits have shrunk to microscopic size, the microprocessor has become the driving force behind the personal computer revolution. The personal computer—small, cheap, easy to use, and powerful—has done for computer power what the printing press did for written knowledge: made it available to the common man and woman.

Computer-aided design and manufacturing. The use of computers to design new products and to manufacture them to very precise specifications brought a sea change in industrial technique, one as profound as the introduction of power machinery in the 1700s and mass production in this century. The modern CAD/CAM systems first began to appear in 1970. Their origins, however, stretch back to two Air Force programs begun in 1949; in the quest for an effective air defense system, USAF technologists linked computers to radars, whose data were displayed on video screens. The same method is used today to analyze and manipulate product design data and to sharpen the tolerances of machines used in the manufacturing process.

The CAT scan machine. The Computerized Axial Tomography scanner has all but eliminated the need for exploratory surgery in the diagnosis of human maladies. The breakthrough was to combine computer imaging and other diagnostic techniques, such as X rays, ultrasound imaging, and magnetic resonance imaging, to produce detailed "portraits" of the inside of the human body. The first CAT scanners went into operation in 1971 in Britain, a year later in the US. Since then, doctors maintain, more progress has been made in diagnostics than in all previous medical history. The machine has saved countless lives by making possible early discovery of tumors, infections, and blood clots.

Advanced composite materials. In the early 1960s, the US Air Force set out to produce new materials that would have higher strength-to-weight and stiffness-to-weight ratios than aluminum used in their current aircraft. Production of advanced composites are a direct result of this effort. Composites, which are formed from a matrix of one material reinforced by the fibers of another, are lighter, stronger, and more heat-resistant than most metals. They are now beginning to find widespread use in aircraft, spacecraft, and civilian products. For the future, ceramic composites for jet engines hold high promise.

The jumbo jet. Now the workhorse of the world aviation industry, the wide-body aircraft had its origins in the Air Force development of the C-5A Galaxy transport in the mid-1960s. The C-5 introduced not only numerous aeronautic advances but also the high-bypass engine configuration, now standard in commercial jumbo jets. The configuration helped the C-5 engines develop almost twice the thrust per pound of engine weight available from earlier, conventional turbojet engines and used twenty-five percent less fuel. By reducing the per-passenger cost of operation for civil airlines, the jumbo jet has helped cut fares and thereby introduce the masses to long-distance travel.

Lasers. Once considered the exclusive province of the military, the "glamorous blowtorch" now has become a standard feature of the civilian economy. Lasers can drill holes in hard ceramics, cut through composite materials, even vaporize diamonds and steel. Finely tuned laser waves are used to play music in compact disk players, to read price tags, to carry telephone calls over thousands of miles, and to test air quality. Doctors use the laser as a surgical knife, cutting through some tissue while leaving other areas unaffected; lasers can vaporize brain tumors, perform delicate inner ear surgery, remove cysts, and pulverize kidney stones.

Fiber-optic communication. Finely spun transparent glass thread, thinner than a human hair, marks a dramatic advance in signal-carrying capacity for the world's communications systems. Fiber-optic filament carries so much data that four fibers in a transatlantic telephone cable, two running in each direction, can handle up to 40,000 calls simultaneously. Fiber-optic material is far cheaper than copper cable and more reliable. Infrared laser light carried over optical telephone cables has a frequency of about 100 million megahertz, which is 100 million times higher than a typical AM radio signal and 100 billion times higher than an electric telephone signal.

Genetically engineered products. These new products, made by implanting foreign genes in certain living organisms, promise to revolutionize world medicine and agriculture. Since 1982, for example, scientists have used genetically engineered forms of bacteria to produce cheap, abundant quantities of insulin for the commercial market. It is identical to natural insulin, with the exception that it does not produce allergic reactions. Also being marketed is genetically engineered Human Growth Hormone, which enhances physical development in children. The technology promises to find many other outlets, ranging from pest-resistant seeds to stronger farm animals, from hardier types of grain to cheaper medicines.

Mr. White observes that these ten technological advances have had a "striking" effect on the daily lives of everyone. Even so, he expects the pace of technological innovation to continue to accelerate. "We've built CAT scans and other wonderful machines that peer into the unopened human body," he says, "but can we develop devices and techniques that perform a total chemical analysis of the body without breaking the skin? We've used microprocessors to make soda machines talk, but can we use them to make computers really think before they speak? And yes, we have been to the moon, but what about going to Mars?" ■

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An AIA survey of aerospace technical manpower confirms—unfortunately—the findings of the AEF/AFA study.

Another View of the Flunkout

By Amy D. Griswold, Editorial Assistant

"IF WE are to remain a prosperous nation," says Don Fuqua, President of the Aerospace Industries Association (AIA), "we must do a better job of educating Americans in the fundamentals of science and technology. And we must begin . . . now."

Education is now one of the "top ten issues of importance" to the aerospace industry, according to Mr. Fuqua. An AIA survey, *Aerospace Education 2000*, showed why the aerospace industry has particular reason to be concerned about the current crisis in education.

Its findings coincide with those of *America's Next Crisis: The Shortfall in Technical Manpower,* a study released last fall by AFA's Aerospace Education Foundation.

From AIA's perspective, the jobs of tomorrow will require more workers who are skilled, not just in the basics, but also in such higher-level areas as computers, statistics, analytical problem-solving, design, and communications, as industries try to remain competitive in the world market by computerizing their production lines and giving more decision-making responsibility to the workers.

These jobs will require higher levels of skills at a time when the pool of workers is shrinking and workers who have the necessary skills are rare. Computer literacy is becoming a fundamental requirement at all employment levels, and the jobs available will require workers who can scientifically analyze a situation and react to it. Workers will need knowledge of statistics and other high-level skills that require a thorough grounding in the basics before they can be taught, says Mr. Fuqua.

Three Major Problems

The Aerospace Industries Association survey identified three major, interrelated problems:

- *US students do not measure up when compared with foreign students,* especially in the critical areas of math and science.

Part of the problem is our expectations—we demand less of our educational system and our students than other nations do. For example, the average Soviet high school student studies six years of biology, five years of physics, and four years of chemistry. Japanese and West German schools have similar requirements. Contrast that with the average American high school student, who studies a total of just two and a half years of science.

Math and science are the foundation on which technical skills are based. Companies responding to the AIA survey cited eighty-five specific areas of skill shortage that reflect the aerospace industry's reliance on computers and its emphasis on improving the manufacturing process.

- *Fewer young people are opting for science or technology-related careers.*

There is a lack of interest on the part of college-age Americans in science and technology as career fields. This is especially unfortunate because, as we head into the twenty-first century, industry faces a shortage of workers in these areas.

Related to this are changing demographics. In the years to come, women and minorities will make up an ever-larger proportion of the work force. This could be bad news for high-technology-based industries, because neither of these groups has a history of pursuing technology-related careers in large numbers, although this is due more to social stereotyping than to any

innate lack of ability. While women account for fifty percent of all professional workers, they account for only twenty-eight percent of scientists and just four percent of engineers. These groups could represent a new source of skilled labor to meet the industry's needs, but first they must be taught the skills.

• *Many of those who do enter the aerospace work force are ill-prepared for technical jobs* and require remedial educational programs before they can become productive.

Twenty-two companies report spending an aggregate of $235 million a year on in-house education programs. Half of the twenty-six respondents provide remedial education to teach their workers basic skills, including math, reading, computer skills, and use of basic tools, in programs that cost anywhere from $1,000 to $1.7 million per year.

If these companies' grim expectations are fulfilled, US industries will soon be faced with the additional handicap of being forced to devote scarce funds to reeducating their workers, while foreign competitors will be able to devote all of their resources to doing business.

Reduced Competitiveness

For the aerospace industry, the net result of these three factors will be vast shortages of skilled workers at all levels, and many of those who are hired will be incompetent. The implications for the future are sobering: Sixty-seven percent of the companies who participated in the AIA survey report current shortages of scientists and engineers. Eighty-five percent of the respondents expect to face such shortages in the future. The figures for other types of workers are similar.

The effects of labor shortages and incompetence will be lowered productivity and increased costs. The AEF study cites the example of a worker who mismeasured sheet steel, costing his company $700 in one morning. The lack of skills will cost industry dearly in the global marketplace as well, because workers who do not understand the basic principles of the technology cannot make the innovations that keep an industry on the cutting edge.

This problem, although it will be felt in all industries, is especially acute in the US aerospace industry, whose dominance in the world market depends on its ability to react quickly to new situations and discoveries. Aerospace companies need workers with a higher level of skills than do industries that do not put such a high premium on flexibility.

The implications for our national defense are ominous. With fewer skilled workers available, DoD and the armed services will be in heavier competition with the aerospace industry for qualified workers. In this scenario, industry will always win, because it can afford to offer higher salaries and better benefits. Defense requirements for technically skilled workers will go unmet.

The implications for our national defense are ominous. With fewer skilled workers available, DoD and the armed services will be in heavier competition with the aerospace industry for qualified workers.

Already the erosion of our technical labor base means that American industry probably is not capable of mounting a production surge like the one that sustained us in World War II. We simply do not have enough workers who can do the job. The skills gap has implications far beyond business needs. The military unpreparedness of the US that results from the shortage of skilled workers "implies a steady slide from first place in the world standings," according to the AEF study.

How to Reverse the Trend

Although the picture it paints is gloomy, AIA is not simply sitting back and allowing these predictions to come true. As Mr. Fuqua emphasized, the companies that make up the aerospace industry are already spending money and attention on education, and this report urges them to continue and to expand their involvement. In 1988–89, twenty-four AIA members contributed $28.7 million to education, which amounted to 38.4 percent of their total contributions.

The ways in which companies contribute to education are varied. Besides remedial education, the survey respondents reported providing on-site, job-related training to upgrade employees' skills to meet the needs of changing technologies, reimbursing employees' education expenses, funding scholarships for colleges, and providing money and equipment to schools at all levels.

AIA makes three specific recommendations toward solving this crisis:

• The Administration should create a cabinet-level task force to develop a national policy for science, mathematics, and technology education.

• The National Science Foundation should spearhead a reform of science curricula at all grade levels to foster improved student competence.

• The federal, state, and local governments should develop requirements and incentives for producing more and better science and technology teachers.

The final recommendation is the most important and the most difficult to carry out. It emphasizes that this is a national problem that affects everyone and that everyone must get involved in its solution. "As a nation, we must strengthen the industry-school-government partnership in order to better educate and train our citizens for a highly competitive world," Mr. Fuqua concludes. "We will be shortchanging all Americans unless we succeed." ■

It's doubtful that anyone else ever saved so many military airmen from death or injury.

Duckworth's Legacy

By C. V. Glines

MANY Air Force personnel have been honored over the years for saving lives, but there is one man who may be responsible for saving more people from injury or death than any other. He never saw combat, did not fly fighters, bombers, or helicopters, and was never in the air rescue business. However, his system of instrument training during World War II saved countless pilots and crews and earned him an honorable place in Air Force history. His name: Col. Joseph B. Duckworth.

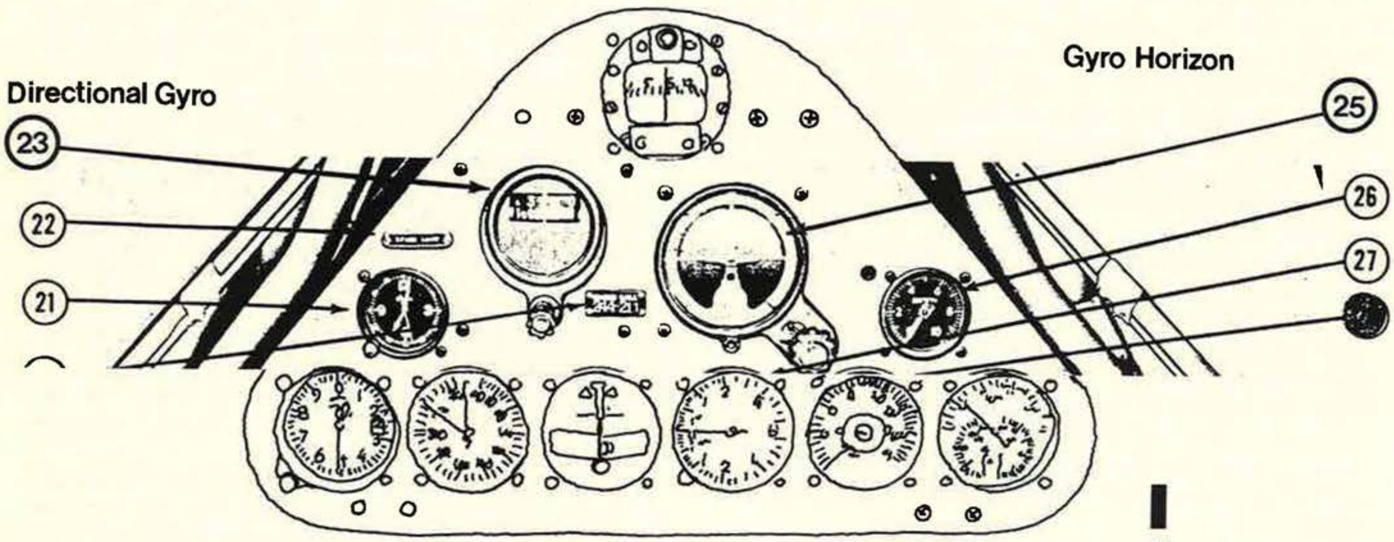
To understand his unusual contribution to the war effort, picture pilot training before Pearl Harbor. We took primary training in PT-17s or PT-19s, basic training in BT-9s and -14s, and advanced training mostly in AT-6s. We learned all the flying fundamentals, then moved on to bombers, fighters, transports, or observation aircraft after graduation. However, one element was sadly lacking in our training: Few of us were really capable of flying solely on instruments, although we had been given a few hours of "needle, ball, and airspeed" instruction in the basic and advanced phases. Many brand-new lieutenants were killed soon after they won their silver wings because they ventured into bad weather and couldn't handle it.

My first exposure to instrument flying amounted to three or four desultory hours of dual instruction during basic flying training at Randolph Field, Tex., in the fall of 1941. I completed the instrument portion of the flight check in the North American BT-14 by demonstrating my ability to make a few steep turns under the hood and managing to recover from the instructor-induced "unusual positions" without making either of us sick.

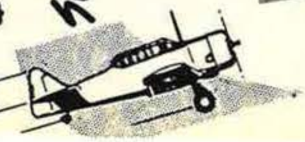
"Any questions, Glines?" the check pilot inquired

—Illustration by Guy Aceto

START



"I'll give them the other half if they survive six months."



after he had relieved his boredom by demonstrating his aerobatic prowess.

I had only one. "Sir, what are these two instruments that we're supposed to keep caged all the time?" One looked like a compass, and the other had a small airplane on it.

"Don't mess with those things, Glines! Keep those gyros caged. They're for airline pilots."

I didn't realize it then, but neither the check pilot nor my instructor really knew how to use those two gyroscopic instruments—the directional gyro and the artificial horizon.

Today, this admonition seems ludicrous, but it shows how woefully ignorant we were about flying the gauges in those days. When I received my wings in Class 42-A at Foster Field, Tex., a month after Pearl Harbor, my Form 5 flight record showed only five hours of dual instruction on instruments in the air and eight hours in a Link trainer. Hundreds of pilots were lost at home and abroad during the early World War II years because of their lack of instrument proficiency. The weather in all theaters of operation turned out to be a far more dangerous enemy than the enemy.

Col. Joe Duckworth deserves eternal credit not only for realizing the need to improve instrument training but also for doing something about it. The lanky Georgian had enlisted in the Air Corps as a Flying Cadet in 1927 and received his wings and reserve commission at Kelly Field the following year. After graduation, he flew for Ford Motor Co. and the Curtiss-Wright Flying Service before joining Eastern Air Lines in 1930. While flying the line, he obtained a law degree from the University of Miami.

In late 1940, Duckworth returned to active duty as a major with 12,000 hours of flying time and a healthy respect for instrument proficiency. After the war began, he was promoted to lieutenant colonel and assigned to the twin-engine flying school at Columbus, Miss., as director of training.

Years later, in an interview with George Ogles of *Airman* Magazine, Colonel Duckworth recalled the difficulties he faced. "The first shock I received was the almost total ignorance of instrument flying throughout the Air Corps. Cadets were being given flight training as if there were no instruments and then directed to fly an aircraft across the Atlantic at night. Losses in combat were less than those sustained from ignorance of instrument flying alone."

The instruction of cadets was so unsatisfactory, Duckworth told *Airman,* that he wanted to cut their prized silver wings in half and "tell the cadet graduates that the other half would be given them if they survived six months."

The gap in instrument training had already been identified by combat pilots as a major danger. The need for improvement was best summarized by an Eighth Air Force B-17 pilot in England who, according to *Airman,* wrote to a friend taking flying training at a Texas base: "For God's sake, get all the instrument flying you can. It's the difference between life and death over here."

When he reported to Columbus, Colonel Duckworth's first job was to reduce the students' high accident rate. He did so by establishing what may have been the first Air Force standardization board to evaluate flight instructors and standardize their teaching methods. Night flying accidents were immediately reduced by forty percent; the overall accident rate also declined quickly.

It was instrument instruction that demanded the most attention. Between wars, most Army Air Corps pilots flew "contact," taking off only when they could navigate by visual contact with the ground. During the Depression years, planes were too costly and scarce to risk flying at night or in marginal weather. Only a few Air Corps pilots were considered even halfway skillful at flying on instruments, although much experimentation with "blind" flying instruments *[see "Flying Blind," September 1989 issue, p. 138]* and radio navigation was conducted by Lts. Albert F. Hegenberger, Ira Eaker, and other Air Corps pilots in the early 1930s. The burgeoning airlines, meanwhile, took advantage of the advances the Air Corps was making. They forged ahead in their pilot training programs and improved the instruments and navigation and radio equipment in their aircraft in order to "make schedule" in any weather.

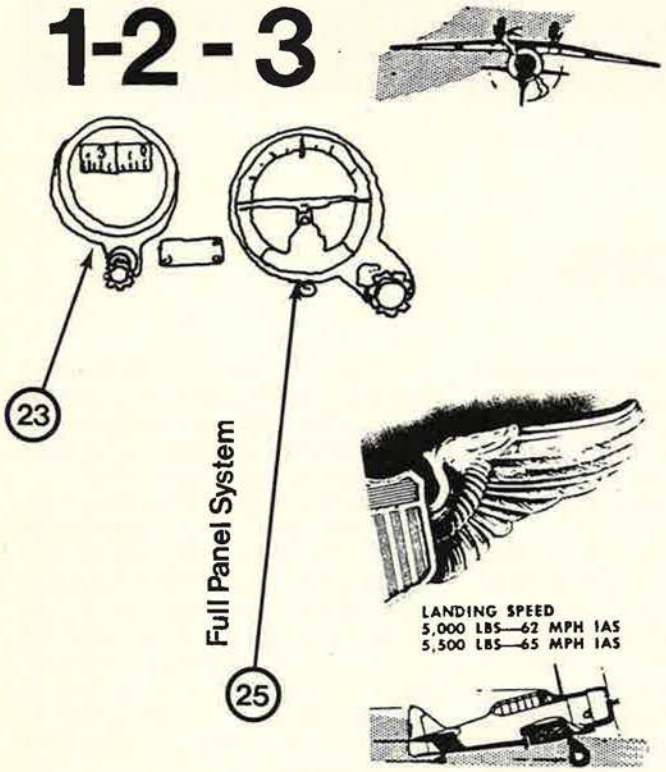
The system used initially in Air Corps pilot training schools was the "1–2–3," or "needle, ball, and airspeed," system. Students were taught to rely on three instruments—the turn indicator (needle), the bank or slip-skid indicator (ball), and the airspeed indicator. Clocks, when they worked, were used to time turns to predetermined headings on the magnetic compass. Basic and advanced trainers had directional gyros and flight indicators (artificial horizons) installed, but students were instructed to keep them caged to prevent damage.

Duckworth developed what he called the "full panel," or "attitude," system, whereby the two gyro instruments were used in conjunction with the three basic instruments plus the magnetic compass, the rate of climb indicator, and the clock. He devised the "A" pattern, "B" pattern, and ascending and descending vertical "S" pattern, all of which required timed turns, climbs, and descents to predetermined headings and altitudes. Students were required to make takeoffs under the hood, a feat that amazed everyone when first demonstrated. He composed a course syllabus and trained an experimental group of pilots who began teaching the new method to the school's instructors.

"The response exceeded Colonel Duckworth's fondest hopes," noted *Airman*'s report. "Every pilot who studied the full-panel system immediately became its enthusiastic booster. Word soon filtered through the AAF that 'The Duck' really had something."

Duckworth wanted to be sure his system was worthwhile. He asked the Training Command to select from other advanced flying schools eight cadets who had scored highest during their instrument training using the "partial panel," or 1–2–3, system. Selected from the Duckworth program were the eight graduates who had shown the *least* proficiency using the full-panel system. The sixteen cadets were then given check rides by impartial instructors who had not been involved in the project. The *worst* Duckworth system graduate scored higher than the *best* graduate of the 1–2–3 system.

As Colonel Duckworth later recounted the story, word about the success of the full-panel system was quickly relayed to Lt. Gen. Barton K. Yount, Commander of the Training Command. He contacted Gen.



Henry H. "Hap" Arnold, who flew to Columbus in late 1942 and was briefed by Duckworth. In January 1943, Colonel Duckworth and his volunteer assistants—Capts. George C. Cooke and Christian B. Walk and Lts. Arlyn S. Powell and Roy W. Ferguson—were ordered to Randolph Field on temporary duty.

"Working night and day, we trained, tested, and wrote," Duckworth recalled. Within sixty days, the Army Air Forces published its first manual on instrument flying as a Technical Order. Colonel Duckworth and his dedicated volunteers had officially introduced precision instrument flying into USAAF's flying training curriculum.

Meanwhile, a field at Bryan, Tex., intended originally to be an advanced single-engine flying school, had a sudden mission change. It became a school for instrument instructors. Colonel Duckworth, the originator of the "attitude system" of instrument flying, became its commander. The instructors who had helped write the instrument manual and volunteers who had trained with them at Randolph enrolled their first class at Bryan in March 1943, flying North American AT-6s. Most of the students for the ensuing two years were instructors assigned to basic and advanced flying schools in the Training Command. They were ordered to Bryan for thirty days of TDY. Upon graduation, they returned to their bases and started local instrument instructor schools in order to spread the word about the full-panel system as rapidly as possible.

The flying part of the course at Bryan was divided into thirds—one third was with a Bryan instructor, another devoted to instructing and acting as safety pilot for a fellow student, and the final third under the hood, flying the radio range and making practice approaches. Automatic direction-finder equipment was installed and P-40 external fuel tanks were added to give the "Sixes" improved navigational capability and extended range. Ground school consisted of navigation refresher classes, instrument flying problems, and learning instrument procedures by "flying" the Link trainer.

Colonel Duckworth was one of those World War II commanders who was the right man for the job at the right time. Well-liked by instructors, students, and enlisted personnel, he visited the flight line every day to chat with students and line personnel. He wore no rank on his flying suit and would sit casually with students waiting for their flights. At first, they were usually unaware of the identity of this slim, gray-haired, fatherly man who asked what they thought of the course and how it could be improved.

Colonel Duckworth flew the AT-6 daily, especially when the weather was below minimums for student flying. While the students watched, he would fire up his AT-6, take off, disappear into the overcast, fly a pattern and return—solo.

In addition to founding the school for flying instructors, Colonel Duckworth established an instrument trainer instructor course for Link trainer instructors. The enrollees came from USAAF bases throughout the country and returned to their bases as department heads. When Duckworth found that many ground school and Link instructors had never been in an airplane or had never heard a radio range in flight, he had a Beech AT-11 modified with six stations for the trainees. Each station had its own instrument panel and headset so that during flight the sounds of a radio range could be heard as the pilot maneuvered on the low-frequency radio range and practiced instrument approaches.

The result of the training at Bryan and the spread of that training throughout the USAAF was a greatly reduced weather-related accident rate worldwide. There are thousands of pilots living today who completed the Duckworth-inspired instrument course to earn their wings during World War II. Many probably don't realize how fortunate they were to have been taught the full-panel, or attitude, system from the beginning.

Colonel Duckworth left the Air Force briefly in 1945 to become Director of the Safety Bureau of the Civil Aeronautics Board. In late 1946, he returned to active duty with a regular Air Force commission. He retired in 1953 from Hickam AFB, Hawaii, where he was the base commander.

In 1963, on the twentieth anniversary of Bryan's opening, a reunion of former instructors was held, during which a tribute from the Air Force's Chief of Staff summarized Duckworth's accomplishment: "Few men have done more to promote safety of flying. . . . Your contributions have been of inestimable value to the United States Air Force."

Col. Joseph Duckworth, the "father of modern-day Air Force instrument flying," died several years ago. All who took his training course at Bryan and subsequently survived some unforgettable encounters with bad weather owe much, possibly our very lives, to this man. ■

C. V. Glines is a regular contributor to this magazine. A retired Air Force colonel, he is a free-lance writer, a magazine editor, and the author of a number of books. His most recent article for AIR FORCE *Magazine was "Eighty Years at College Park" in the January 1990 issue.*

Valor

By **John L. Frisbee,** Contributing Editor

Hero of the Philippines

Ed Dyess triumphed over stupendous odds in the skies and jungles of the Philippines.

It is close to a tradition that this country enters its foreign wars unprepared. World War II, though long on the horizon, was no exception. The epitome of that lamentable situation was the condition of American defense forces in the Philippine Islands on December 8, 1941. US strategists were convinced that war with Japan was inevitable and would begin with an attack on the Philippines. Some small and belated effort had been made to reinforce the 19,000 Army, Navy, and USAAF forces in the Islands. However, the entire fighter defense of the Philippines rested on the 24th Pursuit Group, commanded by Maj. Orrin L. Grover. On the eve of December 8 (December 7 at Pearl Harbor), the 24th had only seventy-two P-40s, some of them early B models, and eighteen obsolete P-35s in commission to meet an invasion force that included an estimated 450 Japanese aircraft, many flown by veterans of ten years' fighting in China.

The full extent of our unpreparedness, including nearly every item needed for air warfare, is laid out in detail in Walter Edmunds's classic book *They Fought With What They Had,* recently reprinted by Zenger Publishers. That account was commissioned by Gen. H. H. "Hap" Arnold at the end of the war.

The 24th PG's 21st Pursuit Squadron was commanded by 1st Lt. William Edwin Dyess, a twenty-five-year-old Texan who had completed flying training in October 1937. His squadron landed in the Philippines eighteen days before the attack. Ed Dyess concentrated on the combat training of his newly commissioned second lieutenant pilots. He soon was recognized as the 24th PG's outstanding squadron commander. (Other squadron leaders were Lts. Boyd "Buzz" Wagner, first USAAF ace of the war, and Sam Marrett; and Benny Putnam, Henry Thorne, and Joseph A. Moore, all three of whom eventually retired as general officers.) According to the 24th's incomplete records, Dyess shot down five enemy planes, none of which has been officially credited to him.

That is only the beginning of the record of Ed Dyess as combat pilot, infantry commander, prisoner of war, and guerrilla fighter in the Philippines, for whom the Air Force Base at Abilene, Tex., is named today.

Combat losses and enemy strafing and bombing rapidly reduced the strength of the 24th Pursuit Group and the 19th Bombardment Group, many of whose B-17s were caught on the ground during the initial bombing of Clark Field. By December 10, the pursuit force had been cut down to twenty-two P-40s and eight P-35s. After that, the pursuits were used mainly for reconnaissance. Two weeks later, only twelve P-40s and six P-35s were operational. The 24th was ordered to move its remaining resources to the rugged Bataan Peninsula, which forms the western rim of Manila Bay. There Dyess trained and led his squadron as a provisional regiment of the 71st Infantry Division. When the Japanese landed at Agloloma Bay, his men helped hold off the invaders for nearly two weeks, subsisting largely on food from the jungle. Medical supplies were scarce or nonexistent. Dysentery, malaria, and other tropical diseases were rampant. In a mopping-up action, Dyess landed twenty volunteers behind enemy lines and annihilated the remnants of the invading force.

A senior officer reported that some of the 24th Pursuit Group squadrons on Bataan were disorganized and demoralized. The exception was the 21st Squadron under Ed Dyess's strong leadership. He continued to fly combat missions whenever one of the 24th's pooled P-40s was available. On March 3, Dyess hung a 500-pound bomb with a jerry-rigged bomb release on a P-40 and, with three other pilots, bombed and strafed Japanese shipping in Subic Bay. Three times that day he braved the heavy flak, destroying or damaging several small vessels, warehouses, and supply dumps. One P-40 was shot down, the others so badly damaged they had to crash-land at their jungle strips.

As the end of resistance drew near, pilots, who were badly needed to reconstruct a force in Australia, were evacuated in anything that would fly. Dyess was ordered to go on the last plane out. He refused to leave the 200 survivors of his squadron, giving his place to Philippine Col. Carlos Romulo, who years later served as President of the United Nations General Assembly.

On April 3, Ed Dyess, who had been promoted to major, was taken prisoner. Six days later the sick, starving, and hopelessly outnumbered defenders of Bataan surrendered, and there began one of the most disgraceful chapters in the history of modern warfare—the Bataan Death March. Dyess, one of the survivors of that nightmare, later wrote an official report of the Bataan fighting, the Death March, and his escape from his captors nearly a year later. "Had the Americans and Filipinos known the fate that was in store for them," he wrote, "though beaten, hungry, and tired from months of hardships in the last hectic days of combat, never would they have surrendered."

Dyess took little personal credit for his part in the events recounted here. Most of that comes from a fragmentary history of the 24th Pursuit Group, written after the fall of Bataan, and from other sources.

As an omen of what was to come after the surrender, the American and Philippine prisoners were searched and all personal possessions taken from them. An AAF captain in Dyess's group was found to have some Japanese money. He was immediately beheaded by a Japanese officer. The men were informed that they were enemies of Japan, not subject to international agreements on the treatment of POWs.

The Death March followed a zigzag course across the island of Luzon, under the blazing tropical sun and along roads choked with dust from Japa-

Dyess AFB is named for Texan Lt. Col. Edwin Dyess, combat pilot, infantry commander, prisoner of war, and guerrilla fighter in the Philippines in World War II.

nese convoys. Dyess tried to keep his men together, since any too weak to walk were shot or beaten to death by their guards. The men were given no food for three days, and then only a mess kit of rice—all they were to have for six tortured days. At the end of the first day, the prisoners were allowed to drink from a filthy carabao (water buffalo) wallow. Any thirst-crazed man who made a break for one of the artesian wells along the road was shot. Several times, Japanese truck and tank drivers ran over stragglers.

On one day, Dyess's group marched continuously for twenty-one hours. When they were allowed to rest, some 2,000 men were jammed into pens designed for a tenth that number, where many died or went out of their minds from exhaustion and thirst. Those who survived finally arrived at Camp O'Donnell, where Dyess was held for two months in indescribable filth and crowding with no medical attention and little food. He estimated that 2,200 Americans and 27,000 Filipinos died at O'Donnell from malnutrition, disease, and calculated brutality.

In June, the American POWs were moved to Cabanatuan Concentration Camp. There Ed Dyess witnessed one of the worst atrocities of his months as a POW. Two lieutenant colonels and a Navy lieutenant were caught attempting to escape. The men were stripped naked, tied to posts at the camp gate, and left in the blazing sun for three days without food or water. Passing Filipinos were forced to beat the men with boards until the three were barely recognizable as human beings. On the third day, the officers were cut down and dragged into the camp, where one lieutenant colonel was beheaded and the other two men were shot.

On October 26, Dyess and more than 900 other Americans, all in poor physical condition but judged by the Japanese to be fit for heavy labor, were crowded in the hold of a small, dirty ship for an eleven-day voyage to Davao Penal Colony on Mindanao, the southernmost of the large islands. Living conditions were somewhat better there, but most of the Americans contracted scurvy, though an abundance of citrus fruit was allowed to rot on the ground. Medical supplies sent by the American Red Cross were confiscated by the Japanese, as had been the case in the earlier camps. Even very sick men were forced to do heavy labor in the rice paddies and on construction. Many did not survive.

Dyess's job at Davao was to drive a bullcart that hauled building supplies to jungle construction projects. He joined a group of nine other Americans and two Filipinos in a daring plan of escape. For several months they gathered scraps of food and other objects that would help them survive in the jungle. The supplies and equipment were hidden under the load on Dyess's cart and passed to Marine Capt. Austin Shafer and USAAF Lt. Sam Grashio, who would steal away from their work details and hide the loot in the jungle.

The escape was made from work details on April 3, 1943. The twelve men rendezvoused at a predetermined point, evaded Japanese troops who were in hot pursuit, and four days later joined a guerrilla unit. After a month of travel through largely unexplored territory, members of the group contacted Lt. Col. Wendell Fertig, who commanded all guerrilla units on the island. Major Dyess was made G-3 of the 110th Guerrilla Division, operating in northern and central Mindanao. Having gained detailed knowledge of guerrilla activities and particularly of the landing strips being built in anticipation of an American return to the Philippines, Colonel Fertig arranged for the US Navy in Australia to rescue Dyess and some other Americans. They were picked up on July 23, 1943, ending Ed Dyess's year as a POW and four months as a guerrilla fighter.

After debriefing, Dyess was sent home, promoted to lieutenant colonel, and hospitalized while regaining his health. He was anxious to get back to the action. That was not to be. On December 22, 1943, he was killed at Burbank, Calif., while attempting to land a disabled P-38 Lightning in a vacant lot, rather than leaving it to crash in an urban area.

In recognition of his combat achievements in the Philippines, his leadership while a POW, and his guerrilla service, Edwin Dyess was twice awarded the Distinguished Service Cross, the first of only fourteen airmen to earn that distinction in World War II. Though his distinguished career ended tragically, his final sacrificial act symbolized the character of that selfless and heroic man. ■

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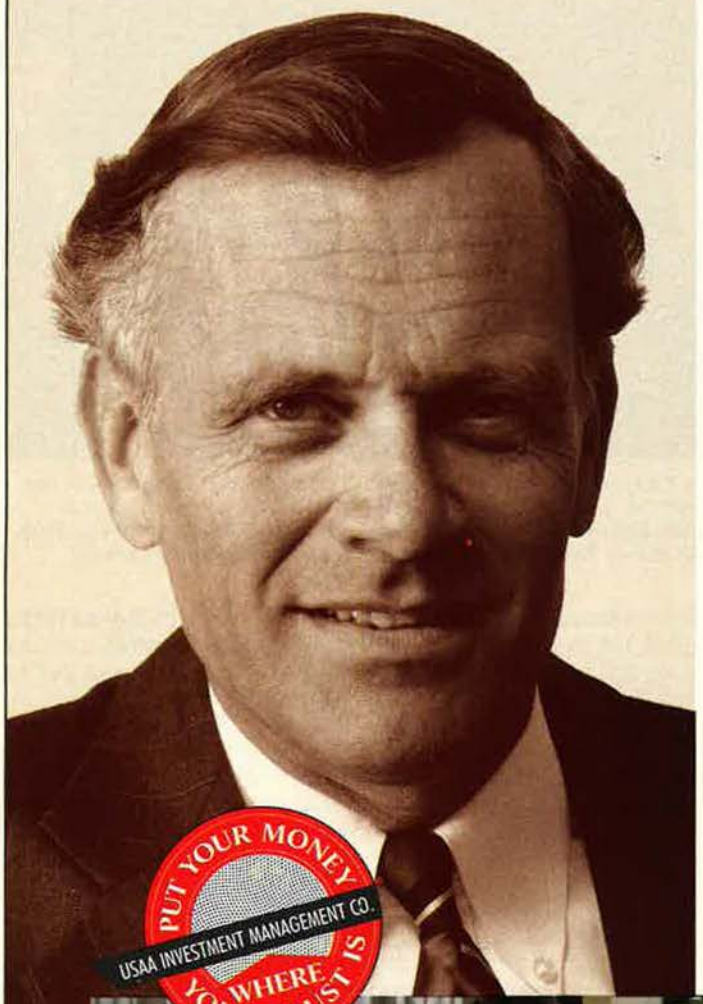

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USAA

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

Museum Support

When the Museum of Aviation at Warner Robins Air Logistics Center (ALC) at Robins AFB, Ga., opened in November 1984, it was the start of a beautiful friendship with the local AFA chapter. The Museum's Director, Peggy Young, says that the **Carl Vinson Memorial (Ga.) Chapter** is one of the museum's most enthusiastic supporters. To date, the Chapter has donated nearly $100,000 to the museum. Chapter member Dr. Dan Callahan says that two of its most successful fund-raising efforts are golf tournaments and an annual auction.

On March 24, **Georgia State AFA** sponsored a Young Astronauts Day. The Carl Vinson Memorial Chapter played host at the museum to hundreds of aspiring astronauts from all over the state. Chapter Treasurer Victoria Hunnicutt said that the activities included workshops on astronomy, meteorites, and rocket building. The group also had the opportunity to examine the museum's displayed aircraft, which include a U-2 reconnaissance aircraft, B-29 bomber, F-80 fighter, and C-124 transport. Maj. Gen. Richard F. Gillis, Commander of Warner Robins ALC, closed the program with a few remarks.

Chapter News

AFA National President Jack C. Price traveled to Sacramento to award a special National Citation in conjunction with the **Sacramento (Calif.) Chapter** to the team at the Air Logistics Center at McClellan AFB. The civilians and active-duty USAF at the ALC successfully managed the logistics components of the F-117 Stealth fighter from its highly classified development to its operational status, contributing significantly to its maturation and readiness. Mr. Price presented the citation to Maj. Gen. Trevor Hammond, Commander of Sacramento ALC, and praised the "exceptional efforts of the innovative, motivated, and highly effective" personnel, who continue to provide cost-effective support to the program.

In North Carolina, members of the **Tarheel (N. C.) Chapter** were able to share in the lessons learned during Operation Just Cause, the successful action against Panamanian dictator Manuel Noriega last December. Col. Daniel E. "Stump" Sowada, Commander of the 317th Tactical Airlift Wing at Pope AFB, N. C., who participated in that operation, told Chapter members that the keys to its success were performing realistic training, planning effectively, and following the plan. He bestowed special praise on the people of his command, saying that the Panamanian operation showed that they were "the best."

The Central Florida Chapter honored all eight living Chief Master Sergeants of the Air Force, collectively, as a Barry Goldwater Fellow of the AEF. From left: former CMSAFs Sam Parrish, James McCoy, Robert Gaylor, Thomas Barnes, and Paul Airey and current CMSAF James Binnicker. Not shown: Chiefs Harlow and Andrews.

Also in the Tarheel State, the **Scott Berkeley (N. C.) Chapter** celebrated the addition of sixteen Community Partners with a luncheon at the Seymour Johnson AFB Officers Club. Chapter President Ed Kelly welcomed the new partners, who brought the Chapter's total to seventy-eight. Mr. Kelly noted that the relationship between the base and the surrounding community has always been a good one. Col. Dennis Carpenter, Vice Commander of the 68th Air Refueling Wing, gave a slide presentation detailing the history of Seymour Johnson AFB for the new Community Partners, who then received a tour of the base.

Lt. Gen. Clifford H. "Ted" Rees, Vice Commander in Chief of USAFE, addressed a meeting of the **Dallas (Tex.) Chapter.** His talk concentrated on the ramifications of recent changes in eastern Europe and the Soviet Union. He calculated that the Soviets had merely reduced their numerical advantage from three-to-one to 2.5-to-one and warned that it would be a misconception to believe that "the big bear no longer has any claws." He pledged that USAFE would continue modernization and maintained that, although the force would be smaller, "NATO will continue to exist regardless of what happens to the Warsaw treaty." Representatives from local aerospace companies, including Texas Instruments, Inc., E-Systems, Inc., LTV Corp., and Rockwell International, were on hand to hear the General's talk.

It took a while, but AFA's CAP Cadet of the Year, Capt. David A. Snell, finally received his award. The captain was unable to attend the AFA National Convention in September, so **Arizona State AFA** officials arranged to get the award to him. State President William A. Lafferty presented the plaque at a meeting held at the Arizona campus of Embry-Riddle Aeronautical University to consider a proposed chapter in Prescott. Besides Captain Snell's family and friends, State Vice

Coming Events

May 4–5, **Tennessee State Convention,** Knoxville, Tenn.; **New York State Convention,** Rome N. Y.; May 18–19, **Maryland State Convention,** Andrews AFB, Md.; May 18–20, **New Jersey State Convention,** Cape May, N. J.; May 26, **USAFA Outstanding Squadron Dinner,** USAF Academy, Colorado Springs, Colo.; June 1–3, **Alabama State Convention,** Huntsville, Ala.; June 2, **Connecticut State Convention,** West Haven, Conn.; June 2, **Massachusetts State Convention,** Worcester, Mass.; June 8–9, **Alaska State Convention,** Fairbanks, Alaska; June 16, **Oregon State Convention,** Portland, Ore.; June 22–23, **Arkansas State Convention,** Hot Springs, Ark.; July 6–7, **Ohio State Convention,** Dayton, Ohio; July 6–8, **Arizona State Convention,** Litchfield Park, Ariz.; July 13–15, **Pennsylvania State Convention,** Philadelphia, Pa.; July 13–15, **Texas State Convention,** Fort Worth, Tex.; July 13–15, **Virginia State Convention,** Hampton, Va.; July 26–28, **California State Convention,** Los Angeles, Calif.; July 27–29, **Florida State Convention,** Tampa, Fla.; July 27–29, **New Mexico State Convention,** Alamogordo, N. M.; August 4, **Indiana State Convention,** Indianapolis, Ind.; August 10–11, **North Dakota State Convention,** Fargo, N. D.; August 17–18, **Wisconsin State Convention,** Milwaukee, Wis.; August 18, **Mid-America Ball,** St. Louis, Mo.; August 18–19, **Illinois State Convention,** St. Louis, Mo.; August 24–25, **Utah State Convention,** Hill AFB, Utah; August 25, **Minnesota State Convention,** Minneapolis, Minn.; September 7–8, **Colorado State Convention,** Colorado Springs, Colo.; September 17–20, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C.; October 13, **North Central Regional Workshop,** Bloomington, Minn.; November 17–18, **Southeast Regional Workshop,** Shaw AFB, Sumter, S. C.

Presidents Ray Chuvala, Florence Henninger, and Cal Callicott; Tucson Chapter President Steve Bartalsky; and ROTC Assistant Professor Capt. Dean Metzger attended the meeting.

The fiftieth state got the word on bombers from a man who should know about them. SAC Commander in Chief Gen. John T. Chain, Jr., addressed a meeting of the **Hawaii Chapter** in Honolulu. The General spoke of the absolute requirement for a new penetrating bomber. The B-2 is a system that "we cannot afford not to have," said the General.

The F-117 Stealth fighter team from Sacramento Air Logistics Center, McClellan AFB, Calif., received national AFA citations from President Jack Price. From left: Directorate Commander Col. Kelly McGuire, Mr. Price, Colleen Henning, MSgt. Lloyd Ostrander, John Rosso, Barbara Jones, and Jerry Potter.

Celebrating the newly chartered Eastern Iowa Chapter at a gala charter dinner are, from left, National Vice President (Midwest Region) Raymond W. Peterman, Chapter President Louis Rapier, Mr. Price, Chapter Secretary Stephanie Burkemper, and Chapter Vice President Brig. Gen. R. Dean Airy, USAF (Ret.).

Youth Will Be Served

Under the leadership of Lillian McQuaig, the **Citrus Belt (Fla.) Chapter** is lending strong support to the Young Astronauts Program. Chapter President Leslie Pawson has encouraged local businesses to get behind the program. Citrus Belt AFA is doing its part, sponsoring three chapters of the program in Lake County. It also cosponsors a fourth with the Clermont Kiwanis Club.

Young and old alike were introduced to the world of ejection seats at a meeting of the **Metro Philadelphia (Pa.) Chapter**. The youngest attendee, Jimmy Smalley, was selected to don the G-suit, helmet, and gloves and was strapped into F-4E Martin-Baker ejection seat that a team from the New Jersey Air National Guard had brought to the meeting. Maj. Mark Jones and Capt. Al Moore explained how the survival equipment operated, while egress specialist SSgt. Robert Lawler detailed the purpose and operation of the seat. Also at the meeting was the Chapter's oldest member, Henry Coffin III, a World War I balloonist. Chapter President Raymond Hammond, a New Jersey Air National Guardsman, was instrumental in arranging for the demonstration team to be at the meeting.

In order to give elementary school students a better appreciation of aerospace history, **Ohio State AFA** is sponsoring twenty eighth-graders from the Newark, Ohio, area in a Youth Aerospace Leadership Program. The program consists of tours and classroom instruction with an

emphasis on written reports about aerospace history and pioneers. Ohio State President Cecil Hopper has high hopes for the program and is encouraged by the youngsters' enthusiastic participation. Kevin Kittle, Chairman of Special Projects for Ohio AFA, oversees the program, which is intended to make the AFA theme, "Youth of Today—Leaders of Tomorrow," a reality.

Have AFA News?

Contributions to "AFA/AEF Report" should be sent to Dave Noerr, AFA National Headquarters, 1501 Lee Highway, Arlington, VA 22209-1198. ■

Bulletin Board

If you need information on an individual, unit, or aircraft, or if you want to collect, donate, or trade USAF-related items, write to "Bulletin Board," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA. 22209-1198. Letters should be brief and typewritten. We cannot acknowledge receipt of letters to "Bulletin Board." We reserve the right to condense letters as necessary. Unsigned letters are not acceptable. Photographs cannot be used or returned.—THE EDITORS

Seeking photos, documents, and memorabilia of the **7th Bomb Squadron,** 34th Bomb Group, recently reactivated as the 7th Flying Training Squadron at Vance, AFB, Okla. **Contact:** Lt. Col. Craig L. Haines, Commander 7th FTS, Vance AFB, OK 73705.

For a book on the activities of the **6th Bomb Group,** which was stationed at Rio Hato airfield in Panama, author seeks the whereabouts of officers who were stationed there in February 1942. **Contact:** James Rusbridger, Jasmine Cottage, Tremorebridge, Lanivet, Bodmin, Cornwall PL30 5JT, England.

Seeking whereabouts of permanent base personnel who served at **Det. 116, Cigli AB,** Turkey, between January 1, 1962, and June 1, 1965. **Contact:** Lt. Col. Edward A. Zink, Jr., USAFR (Ret.), 108 Cornwell Hill, Marshfield, MA 02050.

Seeking information on the whereabouts of **David C. Bole,** who was stationed at Davis-Monthan AFB, Tucson, Ariz., from 1941 until approximately 1945. **Contact:** John R. Ellis, 511 E. Waylon Jennings Blvd., Littlefield, TX 79339.

For an **encyclopedia of World War I,** author seeks contributions and reminiscences of the air war. **Contact:** Anne Cipriano Venzon, Ph.D., 14509 Triple Crown Pl., Darnestown, MD 20878.

Seeking former members of the **409th Bomb Group (L)** who are not already members of the 409th Bomb Group Association. **Contact:** Thomas R. Sammons, 216 S. Jones Blvd., Las Vegas, NV 89107.

I have a photo of an **RB-36/703 from the 348th Reconnaissance Squadron,** 99th Strategic Reconnaissance Wing, Fairchild AFB, Wash., taken in 1953 or 1954. Seeking anyone from the crew of twenty-three who wants a copy. **Contact:** Everett Procter, P. O. Box 884, Warrenton, OR 97146.

Seeking the whereabouts of **Capt. Judyth Scolney,** who was with 2167th Comm. Squadron, Korat AB, Thailand, in 1969. **Contact:** Maj. Bud Martin, USAF (Ret.), Box 1593, Arvada, CO 80001-1593.

Seeking members of **Class 42-E (Douglas, Ga.),** who went on to become pilots, navigators, or bombardiers. **Contact:** Lt. Col. James Craig, USAF (Ret.), 32 Birchwood Dr., Rye, NH 03870.

Seeking members of the **26th Service Group** who supported the 366th Fighter Group of the 9th Air Force in Europe during World War II and are interested in attending the dedication of the 366th Fighter Group Association's memorial tree at the Air Force Museum in Dayton, Ohio, on September 28, 1990. **Contact:** J. F. Peterson, P. O. Box 392, Harrodsburg, KY 40330.

Seeking information on the history and development of **ejection seats** and systems. **Contact:** Glen Turner, Leading Aircraftsman, Armament Engineering Squadron, RNZAF Base Ohakea, New Zealand.

Seeking contact with anyone who knew **Virgil F. Summers,** who trained at Pyote, Tex., in 1943 and was in the 149th Bomb Squadron, 100th Bomb Group, in Europe. Also seeking his friend, **TSgt. Forrest Vosler. Contact:** Robert Lynn Maurer, 334 E. 308, Willowick, OH 44095.

Seeking contact with crew members of the **307th Bomb Group. Contact:** Thomas Flanigan, 1831 Alessandro Trail, Vista, CA 92084-4214.

Seeking contact with those who knew **SSgt. Donald Burkhart,** who was at RAF Brize Norton, England, in 1954. **Contact:** S. Ellis, 2 Sunbury Lane, Battersea, London SW11 3NP, England.

Beginning collector seeks **photos, posters, stickers, patches, and badges,** as well as contact with other collectors. **Contact:** Alper T. Kenaroglu, P. K. 110, 44099 Malatya, Turkey.

Seeking contact with **MSgt. James R. Morris,** USAF (Ret.), who was the 1st Sergeant with the 85th Bomb Squadron, Sculthorpe, England, during the mid- to late 1950s. **Contact:** Mr. Richard C. McCormick, 307 S. Meridian St., Greenwood, IN 46143-1604.

Seeking the whereabouts of the following members of Capt. Charles P. Irwin's crew on "Dodgin' Don" of the 706th Bomb Squadron, 446th Bomb Group, 8th Air Force, in England in 1944: **Lt. James L. Bell, TSgt. Andrew F. Krempusch, SSgt. George C. Harris, and SSgt. Virgil J. Huff. Contact:** Marvin H. Speidel, 708 Dianne Ct., Rahway, NJ 07065.

Seeking details of the color scheme and **markings of a B-17E** that was at the 449th Student Squadron, Army Air Forces Combat Crew

School, Hendricks Field, Fla., between April 1942 and April 1943. I am building a model of this aircraft from scratch. **Contact:** Mike Krusniak, 5426 Calder Way #417, Indianapolis, IN 46226.

Seeking back issues of ***Interceptor* Magazine** from 1959 to 1979. Please send a list of available issues and cost. **Contact:** Elmer W. Ross, P. O. Box 807, Everett, WA 98206.

Patch collector seeks contact with fellow collectors from all over the world. Especially interested in AW&CS and Radar Squadron patches. Send trade list. **Contact:** TSgt. Andreas Hunold (GAF), Postfach 1205, D-5133 Gangelt, West Germany.

Author seeks stories of **unexplained phenomena,** inexplicable events, apparitions, out-of-time experiences, "ghosts," or any other related incidents. Include hard data such as dates, places, and aircraft involved. **Contact:** Martin Caidin, 13416 University Station, Gainesville, FL 32604.

Seeking personnel who were with the **337th Bomb Squadron,** 98th Bomb Wing, at Altus AFB, Okla., and later at Dyess AFB, Tex. Also seeking personnel of the **10th Bomb Squadron,** 341st Bomb Wing, at Dyess AFB between 1955 and 1959. **Contact:** George Grieb, 2109 Marin, Carrollton, TX 75006.

Seeking information on the whereabouts of **1st Lt. William E. (Billy) Rose,** who was a navigator en route from Clark Field to Okinawa to join the 823d Bomb Squadron, 38th Bomb Group, in 1945, when he was injured in a crackup on takeoff. **Contact:** W. O. Donald, Jr., 1091 Sea Cliff Dr. S., Daphne, AL 36526.

Collector seeks **patches** from all the Fighter-Interceptor Groups and Squadrons and the ADWC that have flown the **F-106A/B Delta Dart.** Also seeking photographs showing the development and deployment of the F-106, as well as the location of each F-106 aircraft on display, its tail number, and date of arrival. **Contact:** David F. Lahrman, 5753 Farmfield Dr., Mason, OH 45040.

Seeking information, pictures, and artifacts for book on **flight helmets and pilot's gear.** Dated pictures of pilots wearing flight gear and information from life-support personnel would be greatly appreciated. **Contact:** Richard Daniell, Quarters 4411E, USAF Academy, CO 80840.

Seeking information on the whereabouts of **William Merrill Metty,** who was a member of Cadet Class 44-J of the W. and B. Flying School in Chickasha, Okla., in May 1944. **Contact:** Anne Catherine Davidson, 2700 Old Farm Rd., Edmond, OK 73013.

Seeking information on the whereabouts of **SSgt. Arden J. Maule,** who was a flight engineer on a B-52 named "Section Eight" on Ascension Island in 1944. His last known address was in El Paso, Tex. **Contact:** Patrick H. McCarthy, RR 2, Box 110, Oswego, NY 13126.

Seeking information and photos of an **FB-111A, serial number 68-0243,** that crashed in early 1989. **Contact:** Jim Murray, 7203A Rte. 89, Bath, NY 14810.

Seeking information on **Cessna UC-94 (C-165 Airmaster) aircraft,** especially technical manuals and photos and documents that refer to markings, insignia, and modifications. **Contact:** Chris Whiting, 3811-23d, Lubbock, TX 79410.

Seeking information on **Capt. Malcolm A. Smith,** who was a P-47 pilot and flight commander with the 368th Tactical Fighter Group and was killed May 21, 1944, on a ground attack mission near Vibrayue, France. **Contact:** Col. William D. Brady, USAF (Ret.), 5502 Paseo de Pablo, Torrance, CA 90505.

Unit Reunions

Air Force Security Police Ass'n
The Air Force Security Policy Association will hold a reunion August 9–11, 1990, at the Hyatt Fair Lakes Hotel in Fairfax, Va. **Contact:** Col. Jerry Bullock, USAF (Ret.), 28 Willow Circle, San Marcos, TX 78666. Phone: (512) 396-5444.

B-25 Anniversary
A fiftieth anniversary reunion is planned for 1990 for B-25 "Mitchell" personnel. **Contact:** Joe Biggs, P. O. Box 8893, Albuquerque, NM 87198. Phone: (505) 255-9890.

Burtonwood Association
The Burtonwood Association will hold a reunion October 25–28, 1990, in San Antonio, Tex. **Contact:** Bill McManus, 318 Whitecliff, San Antonio, TX 78227. Phone: (512) 674-9439.

CBI Hump Pilots
China-Burma-India Hump Pilots and support personnel will hold a reunion September 12–16, 1990, at the Cavalier Hotel at Virginia Beach, Va. **Contact:** Jan Thies, P. O. Box 458, Poplar Bluff, MO 63901. Phone: (314) 785-2420 or FAX (314) 785-2444.

Coconut Heads
Veterans of World War II who served on Christmas Island (now part of Kiribati) in the central Pacific will hold a reunion September 13–16, 1990, in Cooperstown, N. Y. **Contact:** Ernest Garrels, 402 Linn St., Benson, IL 61516. Phone: (309) 394-2273.

Deming Army Airfield
Personnel who served at Deming Army Airfield will hold a reunion September 7–9, 1990, in Deming, N. M. **Contact:** Reunion Committee, 402 S. Tin, Deming, NM 88030. Please include self-addressed, stamped envelope for details.

P-38 National Ass'n
The P-38 National Association will hold a reunion May 18–21, 1990, at the Sheraton Universal Hotel, Universal City, Los Angeles, Calif. **Contact:** P-38 National Association, P. O. Box 1816, Burbank, CA 91507.

Roswell/Walker Veterans Ass'n
Personnel who were stationed at Roswell Army Airfield or Walker AFB, N. M., will hold a reunion September 28–30, 1990, at the Roswell Inn in Roswell, N. M. **Contact:** RAAF/WAFB Veterans Association, P. O. Box 8092 (Linda Vista Station), Roswell, NM 88201.

Suffolk County AFB
Personnel who served at Suffolk County AFB, N. Y., will hold a reunion September 7–9, 1990, in Colorado Springs, Colo. **Contact:** Don Isgrig, 300 Sunglow, Alamogordo, NM 88310. Phone: (505) 437-6435.

BAD 2 Ass'n
Members who served with Base Air Depot 2 at

Unit Reunions

Warton, England, during World War II will hold a reunion in New Orleans, La., October 25–27, 1990. **Contact:** Tom Miller, 5549 S. Afton Pkwy., Baton Rouge, LA 70806.

2d Combat Cargo Squadron
The 2d Combat Cargo Squadron will hold a reunion October 9–10, 1990, at the Riverside Hotel-Casino in Laughlin, Nev. **Contact:** Lt. Col. Joe Couture, 159 E. Amber, San Antonio, TX. 78221. Phone: (512) 927-6621.

2d Emergency Rescue Squadron
Members of the 2d Emergency Rescue Squadron, 13th Air Force (World War II), will hold a reunion October 4–6, 1990, at the Marriott Hotel in Dayton, Ohio. **Contact:** Bill Allman, 650 Tampico Ct., Berea, OH 44017. Phone: (216) 234-6651.

3d Hospital Group
Members of the 3d Hospital Group and the 7510th USAF Hospital (Wimpole Park, England) will hold a reunion in October 1990, in Las Vegas, Nev. **Contact:** Rowland D. Garver, 182 E. Fifth St., Peru, IN 46970. Phone: (317) 473-7184.

4th Ferrying Group
Members of the 4th Ferrying Group, ATC, who served during World War II will hold a reunion May 17–19, 1990, at the Ramada Inn in Memphis, Tenn. **Contact:** W. Jordan, Wildwood Rd., #161-H, Zebulon, GA 30295. Phone: (404) 567-8112.

9th Photo Recon Squadron
Members of the 9th Photo Reconnaissance Squadron (World War II) will hold a reunion September 19–22, 1990, at the Sheraton Inn in Colorado Springs, Colo. **Contact:** William H. Greenhalgh, 654 Haggerty Rd., Wetumpka, AL 36092. Phone: (205) 567-6566.

20th Air Force
Members of the 20th Air Force who served on Guam during World War II will hold a reunion September 7–9, 1990, in Dayton, Ohio. **Contact:** R. Penrod, 408 E. Colorado Ave., Casey, IL 62420. Phone: (217) 932-4286.

20th Troop Carrier Squadron
Members of the 20th Troop Carrier Squadron will hold a reunion September 25–27, 1990, at the Holiday Inn Dayton South in Dayton, Ohio. **Contacts:** Starr K. Thompson, 1216 Calle Arroyo, Thousand Oaks, CA 91360. Phone: (805) 498-2420. Ed Milam, 273 Belvedere Dr., Macon, GA 31204. Phone: (912) 477-9300.

22d TAS Squadron
Members of the 22d TAS Squadron stationed at Wheeler AFB, Hawaii, between 1970 and 1976 will hold a reunion July 3–5, 1990, at the Wheeler AFB Officers Club in Oahu, Hawaii. **Contact:** John MacLennan, 19 Ridge St., Pawtucket, RI 02860. Phone: (401) 726-2528.

23d Bomb Squadron
The 23d Bomb Squadron will hold a reunion September 27–29, 1990, at the Crossway Inn in Cocoa Beach, Fla. **Contact:** Lee Benbrooks, 39685 Ramshorn Dr., Murrieta, CA 92362. Phone: (714) 677-3853.

30th Mobile Rclm/Repair Squadron
Members of the 30th Mobile Reclamation and Repair Squadron who served during World War II in the 9th Air Force will hold a reunion September 21–22, 1990, in Lima and Alger, Ohio. **Contact:** Glenn W. Carder, 415 E. Smith, McAlester, OK 74501. Phone: (918) 423-4648.

32d Troop Carrier Squadron
The 32d Troop Carrier Squadron will hold a reunion October 5–7, 1990, at the Marriott Hotel at La Guardia Airport, N. Y. **Contacts:** Harvey Cohen, 125 Woodhill Lane, Manhasset, NY 11030. Fred Wagner, Box 212, Chester, NJ 07930. Phone: (201) 879-5296.

38th Bomb Group
Members of the 38th Bomb Group will hold a reunion September 12–16, 1990, in Dayton, Ohio. **Contact:** Allen Barbour, 20706 Haynes St., Canoga Park, CA 91306. Phone: (818) 346-0150.

39th Fighter Squadron
Members of the 39th Fighter Squadron, 35th Fighter Group, 5th Air Force (World War II), who also served in Vietnam or Korea will hold a reunion October 15–18, 1990, at the Tropicana Hotel in Las Vegas, Nev. **Contact:** CMSgt. Nelson C. Thompson, USAF (Ret.), 9170 E. 8th St., Tucson, AZ 85710. Phone: (602) 885-9782.

Class 41-C
Members of Class 41-C (Barksdale, Brooks, Kelly, and Maxwell Fields) will hold a reunion September 13–15, 1990, in Colorado Springs, Colo. **Contact:** Col. Harold C. Gibson, USAF (Ret.), 4304 Ridgelane Dr., Colorado Springs, CO 80918. Phone: (719) 598-0176.

Class 41-G
Members of Class 41-G will hold a reunion September 5–9, 1990, in Kalispell, Mont., and also on September 26–30, 1990, in Orlando, Fla. **Contact:** Hal Ebbeler, P. O. Box 5208, Albuquerque, NM 87185. Phone: (505) 296-9417.

Class 54-M
Members of Class 54-M will hold a reunion September 17–19, 1990, in Reno, Nev. **Contact:** Leonard Ashburn, 4523 W. 16th St., P. O. Box 22608, Indianapolis, IN 46222-0608. Phone: (307) 248-9880.

Class 55-C
Members of Class 55-C (Lackland AFB, Tex.) will hold a reunion September 8–9, 1990, in Las Vegas, Nev. **Contact:** Col. Juri V. Nou, USAF (Ret.), 3363 Vema Dr., Las Vegas, NV 89121-5137. Phone: (702) 458-9376.

67th Field Hospital
The 67th Field Hospital will hold a reunion September 1990 in Las Vegas, Nev. **Contact:** William O. Doeppe, 624 Brandy Creek Dr., Mechanicsville, VA 23111. Phone: (804) 746-7144.

75th Fighter Squadron
Members of the 75th Fighter Squadron, 23d Fighter Group, 14th Air Force (World War II), will hold a reunion September 7–10, 1990, in New Orleans, La. **Contact:** Myron D. Levy, 11933 Claychester Dr., Des Peres, MO 63131.

89th Troop Carrier Group
The 89th Troop Carrier Group, which included the 24th, 25th, 26th, 30th, and 31st Troop Carrier Squadrons (World War II), will hold a reunion September 19–22, 1990, at the Ramada Inn in downtown Indianapolis, Ind. **Contact:** Wayne Handy, 9889 Shelbyville Rd., Indianapolis, IN 46259.

93d Troop Carrier Squadron
Members of the 93d Troop Carrier Squadron, 439th Troop Carrier Group (World War II), will hold a reunion September 20–23, 1990, at the Hilton Hotel in Oshkosh, Wis. **Contact:** Tom Morris, 456 St. George's Ct., Satellite Beach, FL 32937. Phone: (407) 773-6960.

98th Bomb Group/Wing
Members of the 98th Bomb Group "Pyramidiers" are planning to hold a reunion October 17–20, 1990, in Norfolk, Va. **Contact:** Sam Wareham, 639 Mulder Dr., Lincoln, NE 68510.

246th Signal Operations Company
The 246th Signal Operations Company (World War II) will hold a reunion August 3–4, 1990 in Johnson City, Tenn. **Contact:** Johnnie Huggins, Jr., 30031 S. W. 169th Ave., Homestead, FL 33030. Phone: (305) 247-0150.

308th Bomb Wing
Members of SAC's 308th Bomb Wing who served in Savannah, Ga., between 1952 and 1959 will hold a reunion June 14–17, 1990, in Colorado Springs, Colo. **Contact:** Roland Sabourin, 7717 Palmyra Dr., Fair Oaks, CA 95628. Phone: (916) 966-8990.

319th Bomb Group/Wing
Veterans of the 319th Bomb Group and Wing will hold a reunion September 6–9, 1990, at the Valley Forge Holiday Inn in Valley Forge, Pa. **Contact:** Joseph P. Madrano, 8308 Springtown, Converse, TX 78109. Phone: (512) 659-4237.

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.

345th Bomb Group
The 345th Bomb Group will hold a reunion October 15–18, 1990, at the Riviera Hotel in Las Vegas, Nev. **Contact:** Brenna Weimann, 23 E. College Ave., Westerville, OH 43081. Phone: (614) 891-4800.

351st Bomb Group
The 351st Bomb Group, stationed in Polebrook, England, during World War II will hold a reunion June 13–16, 1990, in Kansas City, Mo. **Contact:** Ben Schohan, 398 Catawba Ave., Westerville, OH 43081. Phone: (614) 882-8410.

355th Fighter Group
The 355th Fighter Group, 8th Air Force (World War II), will hold a reunion September 27–30, 1990, in Williamsburg, Va. **Contact:** Robert E. Kuhnert, 4230 Shroyer Rd., Dayton, OH 45429. Phone: (513) 294-2986.

364th Fighter Group
Members of the 364th Fighter Group, 8th Air Force (Honington, England), will hold a reunion September 19–22, 1990, in St. Louis, Mo. **Contact:** Dan Leftwich, 6630 Caldero Ct., Dayton, OH 45415. Phone: (513) 890-3641.

375th Troop Carrier Group
Members of the 375th Troop Carrier Group, which included the 55th, 56th, 57th, and 58th Troop Carrier Squadrons, will hold a reunion September 26–30, 1990, at the Holiday Inn in Valley Forge, Pa. **Contact:** Lt. Col. Eugene A. Diemand, 625 S. Wheaton Ave., Wheaton, IL 60187. Phone: (708) 668-9575.

376th Heavy Bomb Group
The 376th Heavy Bomb Group, 9th, 12th, and 15th Air Forces (World War II), will hold a reunion September 20–24, 1990, at the Clarion Hotel in St. Louis, Mo. **Contact:** Dick Schoenthal, 366 Shoreline Pl., Decatur, IL 62521. Phone: (217) 422-9244.

438th Troop Carrier Group
Members of the 438th Troop Carrier Group, which included the 87th, 88th, 89th, and 90th Troop Carrier Squadrons and Headquarters Squadron, will hold a reunion September 21–23, 1990, at the Ramada Beach Resort Hotel in Fort Walton Beach, Fla. **Contact:** Bob Gates, 254 Yacht Club Dr., Fort Walton Beach, FL 32548. Phone: (904) 244-5143 (office) or (904) 243-7465 (home).

451st Bomb Group
Members of the 451st Bomb Group and the 60th Service Squadron, 15th Air Force, who served in Italy during World War II are planning to hold a reunion September 6–9, 1990, in Omaha, Neb. **Contact:** Robert Karstensen, 1032 S. State St., Marengo, IL 60152. Phone: (815) 568-7766.

456th Bomb Group
Members of the 456th Bomb Group (World War II) who served in Italy will hold a reunion July 4–8, 1990, in Newton, Mass. **Contact:** James F. Watkins, 11415 Minor Dr., Kansas City, MO 64114-5436. Phone: (816) 942-5594.

509th Bomb Wing
Members of the 509th Bomb Wing will hold a reunion October 17–21, 1990, at the TraveLodge on the River in San Antonio, Tex. **Contact:** Jus Rose, P. O. Box 790663, San Antonio, TX 78279. Phone: (512) 492-2770.

1600th QM Car Company
The 1600th QM Car Company of the 20th Air Force, stationed in Guam during World War II, will hold a reunion October 23–25, 1990, at the Imperial Palace Casino Hotel in Las Vegas, Nev. **Contact:** Hobart Grayson, 1125 Seamas Ave., Sacramento, CA 95822. Phone: (916) 441-1789.

6147th Tactical Control Group
The 6147th Tactical Control Group "Mosquitos," 5th Air Force (Korean War), will hold a reunion September 20–23, 1990, at the Best Western Landmark Resort Hotel in Myrtle Beach, S. C. **Contact:** John N. Webster, 610 1st Ave., North Surfside Beach, SC 29577. Phone: (803) 238-0560.

3d Air Force Staging Wing
For the purpose of organizing a reunion, I would like to hear from personnel assigned to the 3d Air Force Staging Wing, stationed at Hunter Field, Ga., between January 1943 and October 1945. **Contact:** Marc E. Graves, 3170 Kersdale Rd., Cleveland, OH 44124-5352. Phone: (216) 831-2595 (office), (216) 831-8824 (home), or FAX (216) 831-1699.

22d Tow Target Squadron
For the purpose of organizing a reunion, I would like to hear from members of the 22d Tow Target Squadron who served at Dalhart and Pyote, Tex., during World War II. **Contact:** Dr. Ken Pierce, 2381 Keech Rd., Branchport, NY 14418. Phone: (315) 536-0205.

Class 42-K
I would like to hear from members of Class 42-K (Luke AFB, Ariz.) who are interested in holding a reunion. **Contact:** Lt. Col. Melvin Smith, USAF (Ret.), P. O. Box 2913, Santa Rosa, CA 95405.

71st/341st AREFS/4060th AREFW
For the purpose of organizing a reunion, I would like to hear from members of the 71st and 341st Air Refueling Squadrons, 4060th Air Refueling Wing (KC-97), who were stationed at Dow AFB, Me., between 1954 and 1964. **Contact:** Lt. Col. James R. Everett, USAF (Ret.), 1615 Woodcrest Lane, Carrollton, TX 75006. Phone: (214) 242-1932.

397th/374th Bomb Squadrons
For the purpose of organizing a reunion, I would like to hear from members of the 397th and 374th Bomb Squadrons, 6th Air Force, who served on the Galapagos Islands or were stationed at Rio Hata AB, Panama, during World War II. **Contact:** Lt. Col. Howard E. Day, USAF (Ret.), Rte. 1, Box 221, Tennessee Colony, TX 75861. Phone: (214) 928-2278.

Bob Stevens'

"There I was..."

WE'VE ALL HEARD, "PRIDE GOETH BEFORE..." ETC. HOW ABOUT; "A MAN'S PRIDE SHALL BRING HIM LOW: BUT HONOUR SHALL UPHOLD THE HUMBLE IN SPIRIT"?

PROVERBS XXIX, 11

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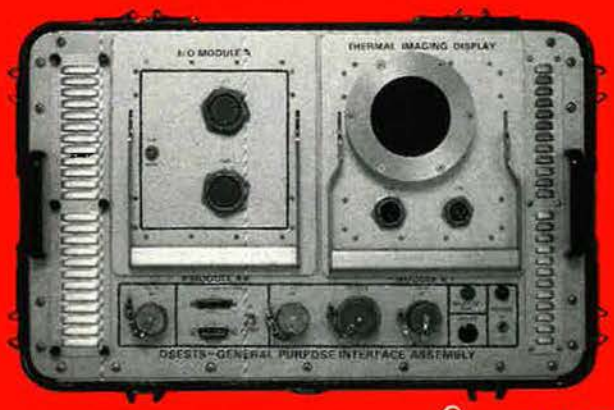

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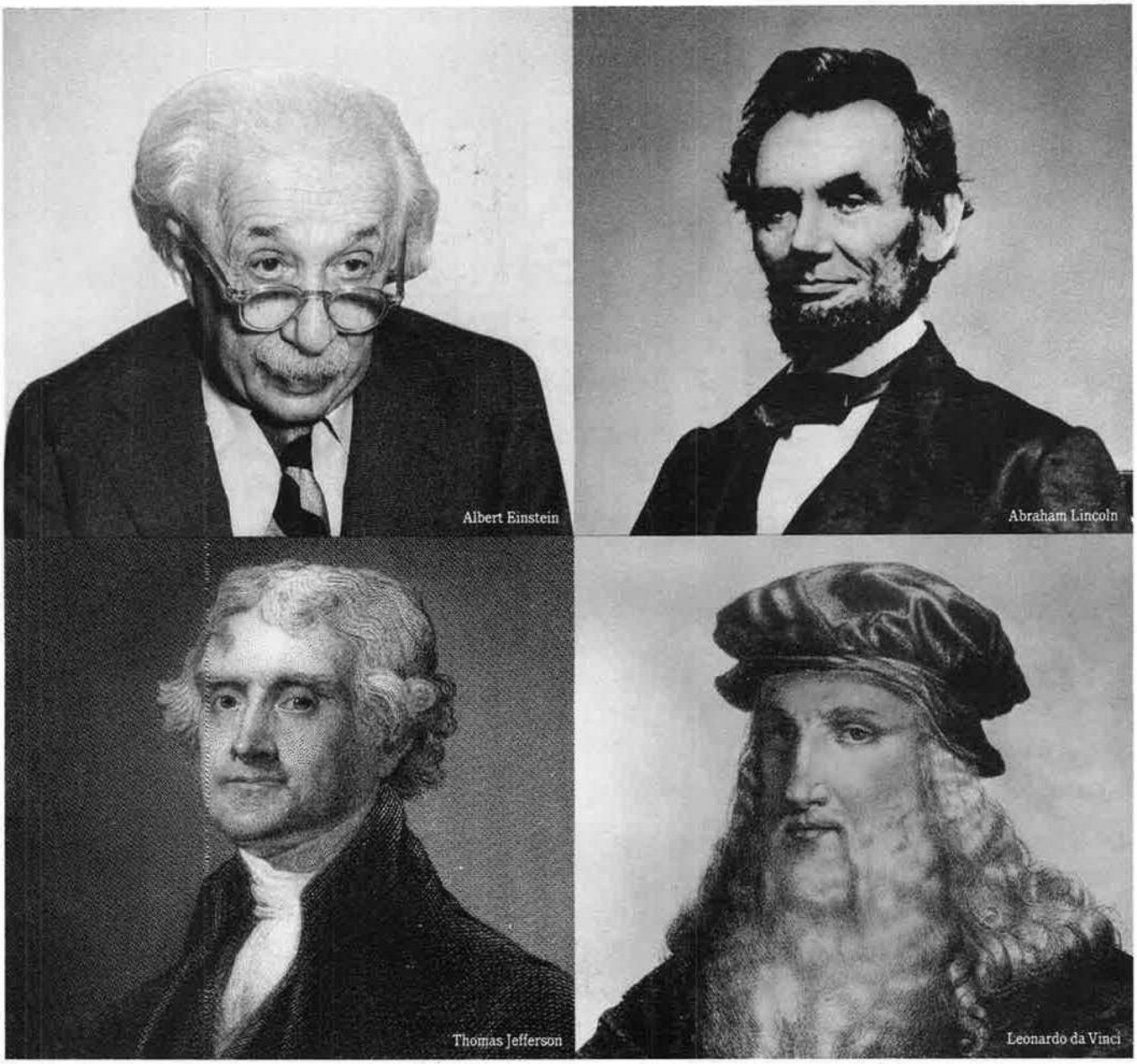

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