DECEMBER 1990/$2

AIR FORCE MAGAZINE

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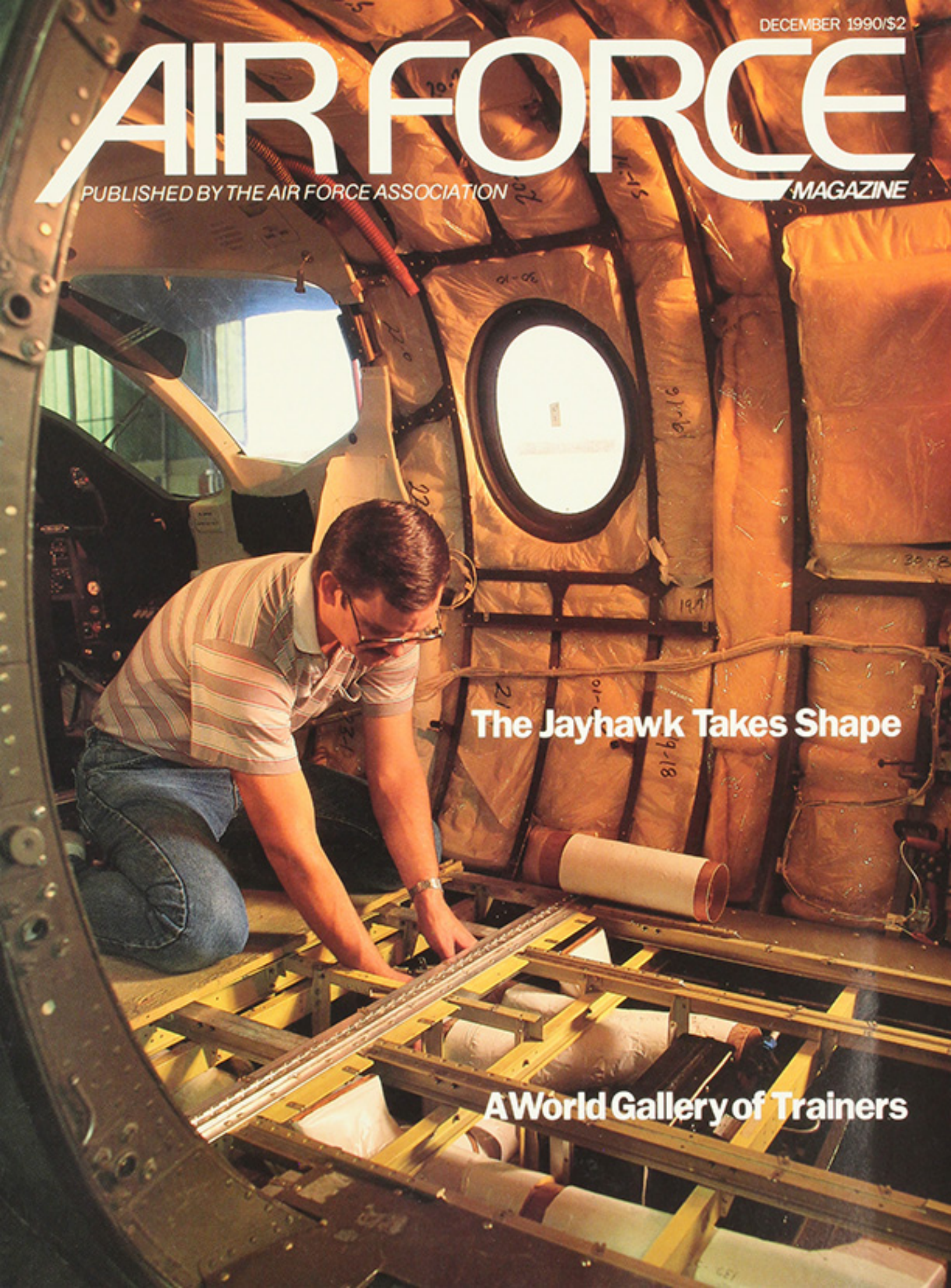

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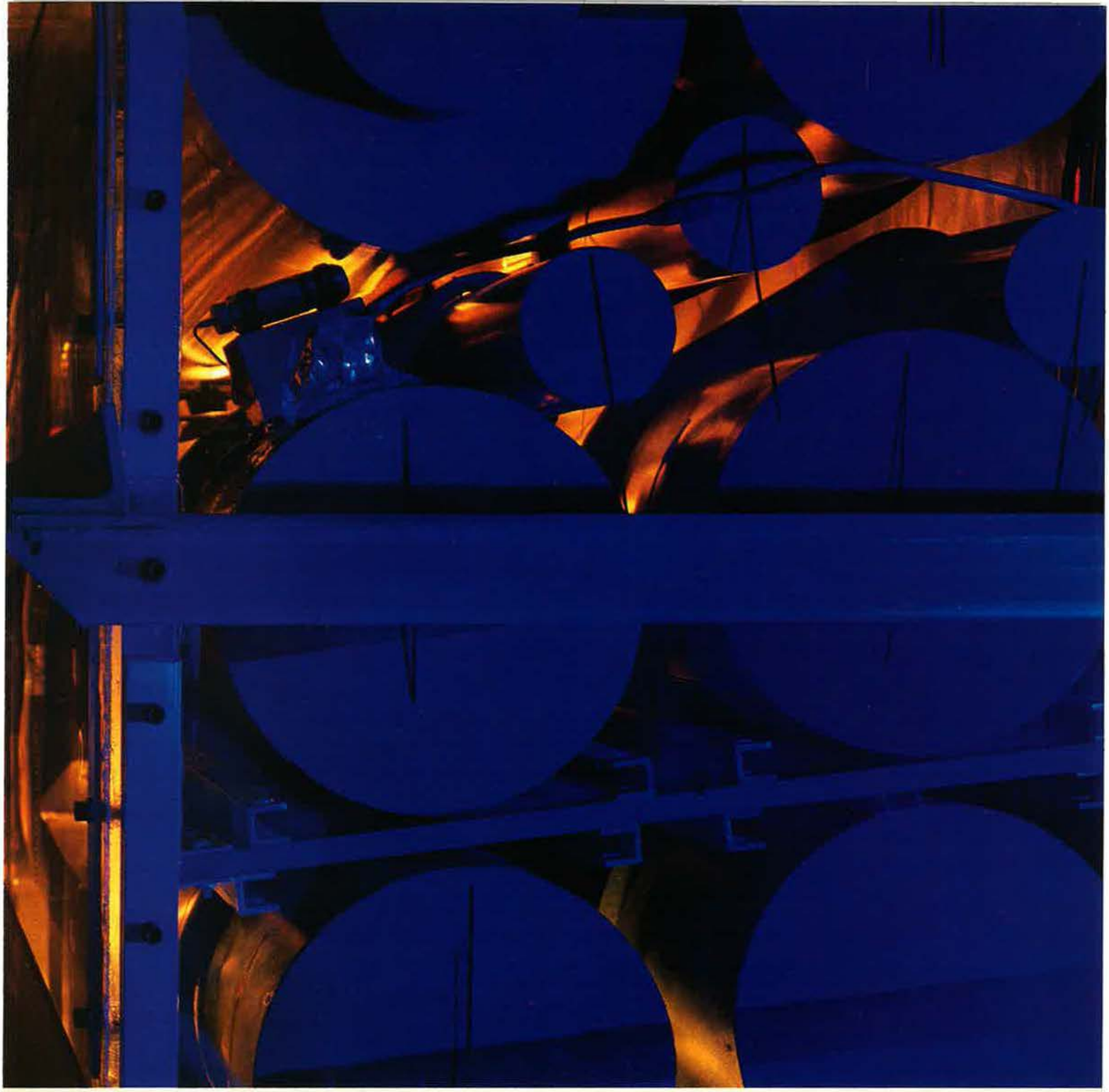

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December 1990, Vol. 73, No. 12

AIR FORCE MAGAZINE

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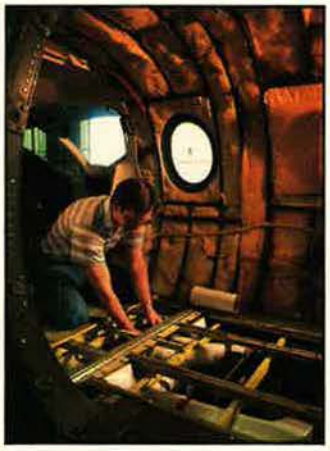
Building to Train for the Future

Departments



About the cover: Workers on the Beechjet assembly line in Wichita, Kan., will soon be turning out T-1A Jayhawks, the Air Force's newest trainer. Cover photo courtesy of Beech Aircraft.

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Editorial

By John T. Correll, Editor in Chief

Thirty Minutes Away

SOVIET Leader Mikhail Gorbachev got a boost to his spirits October 15 when he was announced as the winner of the 1990 Nobel Peace Prize. Then, all too soon, it was back to the discouraging grind of domestic troubles. His economy is near collapse. The annual inflation rate may hit eighty percent. In state stores, 996 of the 1,000 goods officially monitored are not regularly available.

Ironically, the changes in foreign and defense policy that impressed the Nobel Prize Committee were thrust on Mr. Gorbachev by the same domestic imperatives that now consume him and that may ultimately lead to his downfall.

Seventy years of Communist bungling had left the Soviet state a paradigm of inefficiency. Industrial quality existed only in pockets, and much of that was devoted to weapons production. The armed forces claimed up to twenty-five percent of a tottering GNP. In his reform program, Mr. Gorbachev cut military expenditures and diverted resources to domestic priorities.

He earned his Nobel Prize. Regardless of his motives, the world benefited greatly from his military retrenchment. At the same time, we must recognize that his primary objective is stopping the Soviet Union's slide toward oblivion. His aspirations beyond that are unclear. Whatever course he or his successors pursue, they will have massive military power at their disposal.

For Soviet armed forces, "less" is a relative term. They began reducing from a level of 214 divisions and 5,000,000 military personnel. They are now down to 190 divisions. Troop strength might fall as low as 3,000,000. That is reduction on an epic scale, but when (and if) it is done, Soviet armed forces will remain the largest in the world.

The same applies to war materiel. Soviet tank production is down by half, from 3,400 a year to 1,700. Thus diminished, the output still is approximately double NATO's annual tank production.

By US reckoning, the Soviets cut their military spending by about five percent in 1989, but Secretary of Defense Dick Cheney maintains that the new total is "higher than when Mr. Gorbachev came to power" and "at a level that will permit considerable Soviet force modernization."

Modernization is particularly intense in the strategic forces, which have also been protected from reductions. The ICBM force is in the midst of a complete upgrade. Quality improvements are evident in all of the Soviet combat arms. Tactical forces, for example, are responding to the reductions by junking older equipment and outfitting their slimmed-down units with better weapons.

For the Soviet armed forces, "less" is a relative term.

They are already testing improved variants of their MiG-29 "Fulcrum" and Su-27 "Flanker." Two entirely new aircraft, the Counter-Air Fighter (CAF) to succeed the MiG-29 and the Air Superiority Fighter (ASF) to follow the Su-27, might show up by the end of this decade.

In 1987, the Soviet Union announced a new defensive doctrine. Like most Soviet cogmas, it tended toward ambiguity, but it made a break, at least nominally, with the concept of the large-scale offensive, which had dominated Soviet military thinking for forty years.

While the change is encouraging in a general sort of way, the Soviets themselves are not sure of what it means exactly. *Soviet Military Power 1990,* published in September by the Pentagon, points out that the "concept of a defensive doctrine seems to apply only to conventional forces, not to strategic forces" and that the Soviets are proceeding to build a force that, even with the limitations of a strategic arms treaty, will hold a first-strike capability against US missile silos and forces not on alert.

Furthermore, the defensive doctrine embraces a "strategic counteroffensive," the capabilities and training for which are similar to those required for offensive attack.

At the moment, the Soviet Union looks tame. Our attention is drawn to the reductions rather than to the forces that remain. Furthermore, Mr. Gorbachev has been a model of cordiality and conciliation in his conduct of foreign affairs.

We cannot assume these conditions to be permanent. The Soviet Union is not sure of its own borders, much less of its eventual objectives and relationships with other nations. It may not happen this year or next, but the time will probably come when the Soviets feel that their interests are threatened.

At that point, military power will be an awesome instrument of Soviet foreign policy. Mr. Gorbachev may still be in charge, but that is not an automatic assurance of peaceful behavior. He does not shrink from assertiveness when he believes the situation calls for it.

The inescapable factor in any speculation is the effective continuation of Soviet military power. As Gen. Colin Powell, Chairman of the Joint Chiefs of Staff, said in a speech October 15, "now and in the future, the Soviet Union will remain a military superpower," one that "I never forget has the capability to destroy the United States in thirty minutes." ■

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Watch for the Pampa trainer as it makes a U.S. flight demonstration tour this year.

LTV Aircraft Products Group FMA

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

Letters

Bring on the Sequester

Having taken a major interest in the FY 1991 federal budget debacle, which was precipitated by the legislative and executive branches over many years, I very much enjoyed October's "Capitol Hill" column, "The Gramm-Rudman Snapshot," by Brian Green on p. 21. I've watched C-SPAN and the major news networks, read newspapers, and discussed the issue with friends; however, nothing compared with the article. It was brief, easy to understand, full of statistics, and an absolutely excellent overview of the federal budget fiasco.

Unfortunately, it irritates me terribly that our federal government attempts to circumvent the provisions of the Gramm-Rudman-Hollings Act. Congress has spent five months wasting time discussing, but not resolving, the issue, and suddenly the floodgates are about to open and drown the country. The bureaucrats have gone about their merry way, thinking they are going to solve a complex problem in the first few weeks of October, when the deficit, which totals $3 trillion, has fermented for years.

Ironically, the politicians, including President Bush, scream "foul," thinking that the public doesn't want to make sacrifices—cutting expenditures that affect the public's interests. In fact, the public is saying, "Cut expenditures (across the board) to meet the Act's provisions and ensure that everybody makes a sacrifice, rather than cutting *some* expenditures and again raising taxes." Sequestration is the only answer to slow down the runaway train. . . .

It is time to end the "free ride" by the politicians who voted themselves a pay raise after the taxpayers said no. I say support the national effort to "Vote the Hypocritical Rascals Out," begun by Jack Gargan of Tampa, Fla., even though eighty-three of 435 US Representatives and four of thirty-one US Senators seeking reelection are running unopposed by major party candidates.

Lt. Col. Gary L. Gilchrist,
USAF (Ret.)
Rome, N. Y.

Global Reach in the 1950s

Your cover story and related articles in the October 1990 issue leave the impression that the global mobility of tactical airpower is a very recent invention. General T. R. Milton states *[see "Viewpoint: The New Front Line," p. 96]*, "In those days [the 1950s], mobility was generally limited to an exchange of airplanes on the alert pad. Today, our fighter force can crisscross the oceans. . . ." I can tell you from personal experience that we began doing that on a regular basis in the 1950s.

After TAC demonstrated the feasibility of large-scale deployments of fighter aircraft with the use of air refueling, they began forming Composite Air Strike Force (CASF) squadrons late in 1957. In addition to the aircraft, aircrews, and maintenance personnel, the makeup of these units included a "flyaway kit" of the support equipment and parts required to operate at a forward base. Four of the eight F-100 squadrons based at Cannon AFB, N. M., at that time were designated as CASF units.

In the summer of 1958 when the Chinese threatened to invade Taiwan, the 477th and 388th Squadrons were deployed to George AFB, Calif., their jumping-off point to the Pacific theater. In August the 388th deployed to Chiai, Taiwan, and a few days later the 477th followed and set up operations at Kadena AB, Okinawa. The air route then included one refueling to Hawaii for an overnight crew rest stop, followed by a nonstop flight of nine or ten hours to destination. Three refuelings using KB-50J tankers were required for that leg. . . .

On this same Taiwan defense operation TAC deployed other squadrons to the theater that included B-57 and F-101A aircraft, and a contingent of partially disassembled F-104As was shipped by air in C-124s. This show of force seemed to work, and four months later all of these units returned to home base in time for Christmas.

The next spring, when Khrushchev rattled his rockets and threatened NATO's continued access to Berlin, several TAC squadrons deployed on short notice to European bases. Every two weeks thereafter a new squadron from Cannon rotated to Hahn AB, West Germany, and replaced the one on station, thus exercising all four of the assigned CASF units in that particular emergency.

My point is that TAC has had true global mobility for a couple of generations of fighter pilots. Most of us 1950s and 1960s jocks are envious of the absolutely marvelous aircraft that our modern day brethren fly, not to mention the qualitative advantage they enjoy over most enemies, but it is very doubtful that they can get the job done any better than we did.

Lt. Col. Edwin V. Wells,
USAF (Ret.)
Brentwood, Tenn.

• *"Back to the Future" by James W. Canan, October 1990 issue, p. 32, dealt extensively with the CASF concept of the 1950s and should dispel the "impression" that global mobility is a "very recent invention."*—THE EDITORS

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

Easing Transition

I read Maj. Walt Dunlavey's letter in the October 1990 issue *[see "Transition Woes," p. 8]* with a great deal of interest. His assessment of problems in attaining meaningful employment after retirement is on the money. I retired in 1986 and accepted a position with a defense contractor. There was virtually no transition required because I could still "be a GI," without all of the negative aspects of military

service. Now that my contract has expired, I must seek a position away from the military-industrial complex and am finding that my background may not be sufficiently diversified for some firms. Was I surprised? That would be a mild description of my reaction.

I am in complete agreement with Major Dunlavey. A large percentage of potential employers still believe that military management is based on the "Do it or I'll kill you" ethic. Education, coupled with proper preparation for the civilian environment, will make transition to it much easier.

The major and I probably never thought we'd have any difficulty finding worthwhile employment after retirement when we were running radar in Neu Ulm, West Germany, a decade or so ago.

MSgt. Arthur R. Olson,
USAF (Ret.)
Tucson, Ariz.

Navy F-16Ns

In reading your July 1990 "Gallery of US Navy, Marine Corps, and Army Aircraft," *[by Kenneth Munson, Paul Jackson, and Bill Gunston, p. 90],* I noticed you failed to recognize the US Navy/General Dynamics F-16N program. These aircraft, powered by F110-GE-100 engines, serve in four Navy squadrons: six with NAS Miramar VF-126 "Bandits," six with NAS Oceana VF-43 "Challengers," six with Key West VF-45 "Blackbirds," and eight with Naval Fighter Weapons School, "Top Gun," at NAS Miramar.

John Schmidt
Las Vegas, Nev.

Replacing General Dugan

I suppose those in other professions reach a point at which they can be confident of the respect of their profession and their public upon retirement. It is not so for career military officers.

Gen. Michael Dugan's career navigated safely through several hundred combat missions and many high-profile general officer assignments but ended in public humiliation. *[See "McPeak to Replace Dugan," November 1990 "Aerospace World," p. 20.]*

Secretary of Defense Cheney's rationale for the firing doesn't hold up. Saddam Hussein is already fully alert to the air threat mounting against him. There was no "security" breach that raised the threat to our forces.

No mention of chastisement has been forthcoming for the commanding generals of theater forces who, subsequent to General Dugan's candor, gave explicit details of the ground strategy for the campaign.

President Truman's firing of General MacArthur followed a long, messy contest for policy control. General Dugan made a single *faux pas.* It hardly called for the draconian step of humiliation and dismissal.

This is Secretary Cheney's second exercise in public humiliation of a Chief of Staff. No other Secretary in history found that necessary to run the Department. Perhaps those other Secretaries accorded some respect to officers whose careers had much physical danger and achievement.

The larger lesson is that Air Force generals have few, if any, friends in Washington these days. Lynching outsiders bears no political cost to a Secretary of Defense.

The damage to General Dugan's reputation and his ability to serve the nation publicly or privately is regrettable. Even more to be regretted is that the Air Staff is seriously weakened at

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Letters

a time when all its power of persuasion is needed to overcome public and congressional reluctance to fund what Air Staff thinkers believe is needed for national security.

Lt. Col. Robert C. Brenzel, Sr., USAF (Ret.)
Louisville, Ky.

Turf Battles

When the life expectancy of aircrews in combat is measured in seconds, congressional politics in procurement is greatly disturbing. These people are more concerned about in whose district the manufacture takes place than about the ability of the item to perform. They are looking at money going to their district, and as a result, at their own job tenure. To put this personal interest ahead of the national needs is deplorable.

What is even worse is when military politicians do the same thing, deciding on the basis of their preferences what should be procured. Two classic examples are the B-58, a magnificent bomber for its time whose service life was severely curtailed because of military politics, and Kelly Johnson's tremendous design, the Lancer, a follow-on fighter to the F-104. The F-104 was far and away the most capable of the "Century Series" fighters. The Lancer, had it been accepted and produced, in the hands of a competent pilot would give the F-15 and F-16 a real run for their money, even with their electronic wizardry.

It is bad enough when congressional politicians mess around in procurement for reasons no more urgent than their own reelection. It is far worse when military politicians do so over turf battles. We shoot ourselves in the foot in these situations. Those struggling over turf should be cautioned not to play that silly game, which jeopardizes the lives of future aircrews.

Lt. Col. Wallace H. Little, USAF (Ret.)
Fort Walton Beach, Fla.

Patch It Through

I enjoyed the article "Patches" in the October 1990 issue *[by Jeffrey P. Rhodes, p. 66].*

One of the funniest patch incidents in my USAF career occurred at Bien Hoa AB, South Vietnam, in the 1960s. The grizzled old TAC vets (F-100s, F-105s, F-4s) viewed the introduction of the A-37 "Dragonfly" with some amusement; skeptical—as only fighter pilots can be—of the thinly disguised T-37 of ATC fame. The A-37 guys didn't help their cause when they appeared in the officers' club wearing huge green patches—on the back of the flight suits—that stated in large letters: "I'm a Combat Dragon!"

It only took a few days for a hasty R&R trip to Thailand, and suddenly an entire F-100 squadron entered the club one evening, sporting twelve-inch patches on their backs that were exact replicas of the A-37 abomination. Exact, that is, except for the lettering, which read: "I am *Not* [underlined in red] a Combat Dragon!" After a few days of grumbling, the wing issued an edict retiring all Combat Dragon patches.

Jack Doub
Anchorage, Alaska

I enjoyed reading "Patches" very much. However, I feel I must point out some errors found on p. 67.

First of all, the MH-60G Pave Hawks are not part of 20th Special Operations Squadron. They are in fact in the 55th SOS, formerly the 55th ARRS. Also conspicuously absent from your photo is the other half of the former 55th ARRS, the 9th Special Operations Squadron, who fly the HC-130P/N Combat Shadow.

Although we've only been in "the family" for about a year and a half or so, we are members of the 1st SOW.

Capt. Derek H. Abel, USAF
Eglin AFB, Fla.

There is an error in the article "Patches." At this time, the 94th Tactical Fighter Squadron has not deployed to Saudi Arabia in support of Operation Desert Shield. The 71st and 27th Tactical Fighter Squadrons are the F-15 units presently deployed from the 1st Tactical Fighter Wing.

Capt. Marianne T. Williams, USAF
Langley AFB, Va.

More Nicknames

I enjoyed Jeffrey Rhodes's "What They *Really* Called Them" *[see September 1990 issue, p. 68],* and a few additions came to mind. Some of these were not as common as others, but they were occasionally used over the years. Ones not mentioned of which I've heard or read include C-47 ("Douglas Racer"), F-89 ("Anteater," "Hoover," "Gravel Gobbler"), B-57 ("Bongo"), F-104 ("Silver Sliver"), F7U ("Double-Engine Ensign-Eater"), F8U/F-8 ("U-Bird"), AD-5Q/EA-1 ("Left-Handed Spad," "Queer Spad"), and Panavia Tornado ("Mighty Fin").

Lt. Col. Barry A. Miller, USAF
Lindsey AB, Germany

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Washington Watch

By Robert S. Dudney, Executive Editor

The Electronics Industry Is Sinking

If present trends continue, world leadership in electronics production, trade, and technology will pass from the United States to other nations. Japan is not the only challenge.

"A strong, technologically superior industrial base is a key element of national security. The future of the US electronics sector, as one of the key high-technology sectors, is particularly important to the United States, since the country's military advantage is based on technological superiority, not quantity of weapons."

Few would disagree with that statement, contained in the preamble to a massive new Commerce Department assessment of this nation's electronics base. The $200 billion industry, employing some two million workers, has always been a highly innovative source of high technologies that, one way or another, have found their way into US aircraft, missiles, avionics, communications, and other defense systems.

Now, however, it is becoming increasingly clear that this industry has fallen into serious trouble—and faces even greater difficulties in the near future. In the view of the Commerce Department study and others prepared in recent months, the US electronics sector is now losing its competitive edge in the world market and may soon be eclipsed by Japan and even in some ways by such upstarts as South Korea and Singapore.

The Commerce Department's 221-page assessment, "The Competitive Status of the US Electronics Sector," was two years in the making and might be the most comprehensive look Washington has ever produced. It comes to a sobering conclusion: "If current relative growth rates continue, the Japanese will be the world's No. 1 electronics producer and trader by the early 1990s."

As a result of that event, the report makes plain, worldwide technological leadership in electronics also would pass from the United States.

Not "Terminal"—Yet

The industry, the report notes, is not "a terminal case, at this point." The upshot of the Commerce Department's bleak recitation of facts, however, is that it might become one in the not-so-distant future, unless the United States acts to stave off "a serious challenge from foreign competitors."

The report focuses on the firms that produce business equipment, computers, semiconductors, precision instruments such as automatic test equipment, semiconductor manufacturing tools and materials, software, and telecommunications equipment. This review leaves little doubt that the industry now is in extreme trouble. Danger signs, large and small, abound:

• *Anemic growth.* Of the world's nine leading electronics-producing nations (counting the European Community as one nation), the United States still ranks first in sheer volume of goods produced. However, in the rate of growth, a far more significant indicator, the United States comes in dead last.

The US industry is growing at an average rate of only one percent per year, compared to eight percent for Japan and six percent for the EC.

At today's growth rates, warns the report, Japanese electronics production, currently twenty-six percent of the world total, will surpass that of the United States, currently thirty-eight percent, no later than 1994.

• *Lagging exports.* The United States, though it is twice as populous as Japan and has a larger electronics industry, has fallen behind the Asian nation's $42 billion in total annual electronics exports. The US, with $39 billion in shipments, ranks second, which is still respectable, but it comes in an embarrassing seventh in the all-important rate of export growth. Japan outstrips the US by a three-to-one margin in this area.

• *Market weakness.* The domestic US market for high-technology electronic products is slowing down, relative to other nations, showing a consumption growth rate that is, again, dead last among the top nine electronics-making centers.

The United States today accounts for forty percent of the world's electronics consumption—still the most of any nation, in gross terms, but down considerably from recent years. Japan, which buys twenty-six percent of total world output, and the EC nations, which consume twenty percent, are catching up to the US, underlining the future importance of foreign markets.

This shift, notes the study, has big negative implications for American electronics producers, who tend to have much better success selling in the domestic market than in those overseas.

• *Employment stagnation.* With two million workers, the US electronics industry labor force is still the world's largest, but the high rates of growth seen in the past (600,000 jobs were added in the 1980s) appear to be over. Since 1982, the number of US production workers has stayed constant, the result of increased automation and the migration of jobs to offshore facilities.

Employment in Japan, South Korea, and most other producer countries is growing far more rapidly than in the US, a fact that also portends a major drain of the best scientists and technicians.

• *Lagging innovation.* Many signs today are that this nation's vaunted basic technology base has begun to lose its edge.

For example, patents awarded by the United States generally correspond to the most advanced technologies in the world, and as such provide good indicators of the strength of US firms relative to the foreign competition. What now worries analysts is that the American share of US electronics patents has dropped from eighty percent of all those awarded in the mid-1970s to only fifty-five percent today.

Shockingly, three giant Japanese companies—Canon, Hitachi, and Toshiba—occupy the top three places on the most recent list of US electronics patent winners. Another Japanese firm, Mitsubishi, ranks ninth. Of US firms, only GE, IBM, Westinghouse, and RCA are in the top ten. The two other top ten slots are occupied by European firms.

In the 1980s, Japanese companies more than doubled their number of US patents, and those patents have been licensed far more frequently than those of US competitors.

Greatest Worry

The Commerce report cites this specific problem, the apparent ebbing of US industrial innovation relative to that of foreign competitors, as perhaps the most worrisome of all the problems it surveyed.

"This downward trend in the US share of patents," says the report, "is reflected in the declining capabilities of US firms relative to the Japanese in the research and development phases of bringing key electronics technologies to market."

For example, though the US traditionally has led in the field, Japan has now become the dominant world supplier of high-quality semiconductor materials, such as ceramics and quartz glass, and such products as silicon wafers.

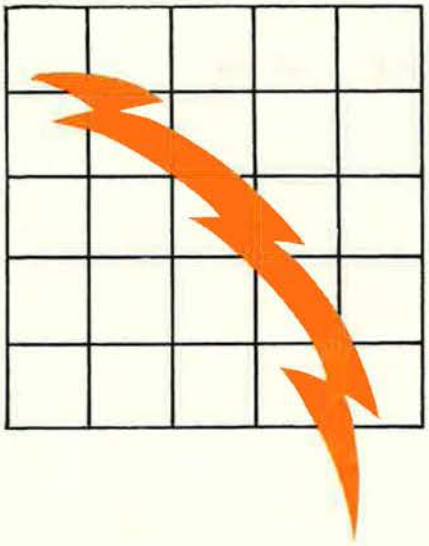
The US industry's sagging relative R&D position shows up vividly in the statistics on worldwide market shares for finished electronic products, where there has been "dramatic erosion" in the US position. At the component level, Japanese firms lead in most memory technologies, optoelectronics, and indeed everything else except custom logic chips and microprocessors, where the US has an edge. When it comes to completed, multicomponent systems, the US has seen its lead in computers eroded.

The industry-wide figures are striking. Since 1984, US industry's market share of semiconductor sales fell from fifty-four to forty-one percent, computers and related equipment from seventy-eight to sixty-nine percent, electronic instruments from fifty-two to forty-six percent, photocopiers from forty to thirty-six percent, and consumer electronics from nineteen to twelve percent.

Only in software production did the US position improve, and there only marginally.

The ultimate result of these shifts becomes only too clear in the report's itemization of growth trends in the world's top 100 computer companies.

From 1983 to 1988 (the last year for which data are available), US companies in the top 100 grew at a composite rate of 10.8 percent. European firms, by contrast, expanded at a 17.5 percent rate, sixty percent faster. The massive Japanese corporations posted growth rates of 27.9 percent—an astonishing 160 percent faster than their US competitors.



Nowhere is the general US decline more evident than in the industrial sector that produces semiconductor materials and equipment (SM&E), the tools and raw materials with which today's revolutionary computer chips are made.

Semiconductors—tiny chips containing perhaps millions of electronic circuits—form the heart of today's computers, defense equipment, telecommunications, medical equipment, and mass market electronics. Basic components of the chip-making industry are wafer fabrication equipment, assembly and packaging equipment, highly automated test equipment, processing and packaging equipment, and raw materials such as pure silicon and gases.

The Foundation

Worldwide demand is growing. In 1989, the SM&E industry produced worldwide revenues of $19 billion, up from $15.2 billion in just one year. Estimates for 1990 and 1991 are that every $5 of semiconductor production creates $1 worth of demand for this type of manufacturing equipment. More importantly, however, this industry provides the manufacturing foundation for the $50 billion global semiconductor industry, which in turn feeds key technologies into the $750 billion global electronics market.

The National Advisory Committee on Semiconductors, a fourteen-member panel set up by Congress, recently took the measure of this key industry in a major study. It sees the emergence of a potentially fatal problem for the entire US electronics industry.

"The SM&E industry in this nation is headed for trouble," says the thirty-one-page report, "Preserving the Vital Base," in a warning that many experts would call a major understatement. "This tools-and-materials sector of the US semiconductor industry has declined dramatically over the past decade and shows every sign of continuing its decline."

The share of the worldwide market held by US equipment producers, sixty-nine percent in 1983, has dropped to fifty-one percent and is expected to plummet to thirty-two percent in 1993. The big winner, once again, is Japan, whose companies in 1983 had only twenty-five percent of the market but in 1993 are expected to control fifty-six percent.

In these trends, the committee sees a great danger. With Japan now producing the highest-quality, most efficient chip-making equipment, Japan's own semiconductor firms are likely to gain first access to top-of-the-line equipment and in so doing gain a major edge in quality, efficiency, and market share.

"The stakes in the future of the SM&E industry are enormous," warns the panel. "The entire US semiconductor industry is at risk."

The panel proposes a national effort to revitalize the domestic SM&E industry. Over the next three years, it claims, American industry will need to make R&D investments of $1.2 billion over and above what it is already spending, if it hopes to regain parity with Japan. Outside experts say that, however critical the task, chances for such a rebound taking place are slim.

In this vein, the Commerce Department's report issues a series of bleak predictions about the likely futures of key parts of the US electronics base:

- *Computers.* Japan, already superior to the US in many product segments, threatens to pull away in all. In addition, the study says, South Korea and Taiwan are now "very competitive" in microcomputers and peripherals. EC nations, it adds, may play a "significant" future role in several areas, particularly in the wave of the future, parallel processors.
- *Telecommunications.* Japan, France, Germany, Sweden, and Canada, the major US competitors, "are seriously challenging the US lead in networking equipment," reports the study. In particular, Japan and Europe

are mounting a significant challenge in fiber optics, satellite, and cellular telephone technologies.

• *Semiconductors.* Japanese firms have blitzed the US in production of most types of leading-edge memory devices. Japan now is vying with the United States for the lead in all industry segments and, in particular, microprocessors and the so-called application-specific integrated circuits, or ASICs, which are single-purpose chips.

US companies traditionally have been the strongest force in microprocessors, which have been critical in development of the personal computer. Now starting to make inroads in the world market are a number of foreign-made microprocessors, notably the "transputer" from Inmos of Britain and the "V" series from Nippon Electric Co. of Japan.

• *Electronic instruments.* The United States still holds a lead here. Even so, Japan boasts one of the world's three major manufacturers (the other two are American), and another Japanese firm is starting to come on strong, says the report. This is one area in which developing countries such as South Korea and India are making little headway, principally because the product does not lend itself to mass production.

• *Medical electronics.* The US industry is under assault from European manufacturers. Siemens of Germany has moved aggressively into the US market and is a major market force in pacemakers, lithotripters (used for fragmenting kidney stones), hearing aids, and all kinds of diagnostic imaging equipment. However, Japan has just begun to challenge US and European firms in this field. The report predicts that, in the long run, the Asian giant "will probably be the leading contender" for the world's top spot.

• *Software.* Though Japan has not to date gone all out in production of software, it may emerge as a leading competitor in the next several years. Japan's high-profile, government-industry SIGMA (Software Industrialized Generation and Maintenance Aids) project aims to develop the best software techniques. Seeking the best software-writing talent, Japanese firms already are linking up with US and European firms in a big way. Warns the report: "If the Japanese achieve this goal, they will have neutralized one of the few remaining competitive advantages that the United States currently has in electronics."

What lies at the root of the decline? The Commerce Department report cites a number of well-known international problems, including foreign government targeting and protectionism, joint R&D projects, and dumping.

International Pirates

The report also calls attention to the growing problem of "intellectual piracy." For example, US revenue losses from global software piracy—the unauthorized copying and redistribution of software products—is at least $4 billion a year. Big offenders are Brazil, Mexico, Italy, Saudi Arabia, India, China, Thailand, South Korea, and Taiwan.

Another international problem, says the study, is the increasing reliance of US producers on components made overseas, particularly in Japan. For instance, there no longer exist any major US-owned merchant suppliers of silicon wafers, the basic building block of semiconductors and thus of all downstream electronics products. The entire wafer-making subindustry, the report warns, is "now under the control of Japanese and European companies."

With personal computer systems, Far East manufacturers have a strong position in key components such as memory chips and in key subsystems such as floppy and optical drives and video displays.

"The Japanese," notes the report, "are steadily becoming the principal suppliers of the upstream products in these systems, while US companies are becoming systems integrators." The danger in this is that "the systems integrators count on being able to buy the latest component and subsystem technologies, often from the . . . manufacturers who may be their competitors at the system level." This, the study implies, is dangerous.

In the view of the study, the problems stem not only from predations from overseas but also from actions within the United States. The report criticizes the US electronics industry, claiming that most companies take a "less than strategic view" of the competition. Many firms also are small and undercapitalized and lack good manufacturing techniques.

US industry also faces peculiar national problems not faced by companies elsewhere in the world. The largest of these is the high cost and diminishing availability of capital. The report claims that, in the 1980s, the cost of capital was more than twice as high in the US as in Japan and thirty percent higher than in Germany. The report cites the estimates of two Stanford University economists that the US suffers from a three-to-one cost-of-capital disadvantage against Japan.

Educational attainment of the US work force is another current and increasing problem. The National Science Foundation estimates that, by 2000, the United States will be turning out 400,000 fewer scientists and engineers than the country needs.

Well-Worn Solutions

The study proposes a series of remedies that have often been cited in the past by the Reagan and Bush Administrations. These include tax credits for R&D, antitrust exemptions for joint manufacturing consortiums, relaxed export-control regulations, and cuts in the capital gains tax. It issues no ringing call for massive federal financial and legislative intervention.

Surprisingly, however, the report criticizes the recent record of the US government. The report maintains that, "in contrast to foreign governments, the US government has not had a coordinated set of policies directed to this sector. In general, the US has followed an *ad hoc* approach, the effect of which has been to place the US electronics sector at a competitive disadvantage vis-à-vis some of its foreign competitors."

The study notes that, within government and industry, there are two ideologically opposed camps. Camp One believes that significant problems exist, that they are caused principally by unfair foreign trading practices, and that the industry is in danger of disappearing. This group calls for much greater government intervention and protectionism.

Camp Two believes that, while US leadership has slipped, such erosion is normal in a world economy. Its members condemn unfair trading practices but believe that the US electronics base, like other US industries, suffers principally from low product quality and mismanagement and that markets, not the political system, should decide which companies survive.

These no-intervention partisans believe that this is the best course, the Commerce report says, "even if, in the extreme, it may mean that the US electronics sector is 'hollowed out' and becomes a mere distributor of foreign products." The study acknowledges that this is indeed a possibility. ■

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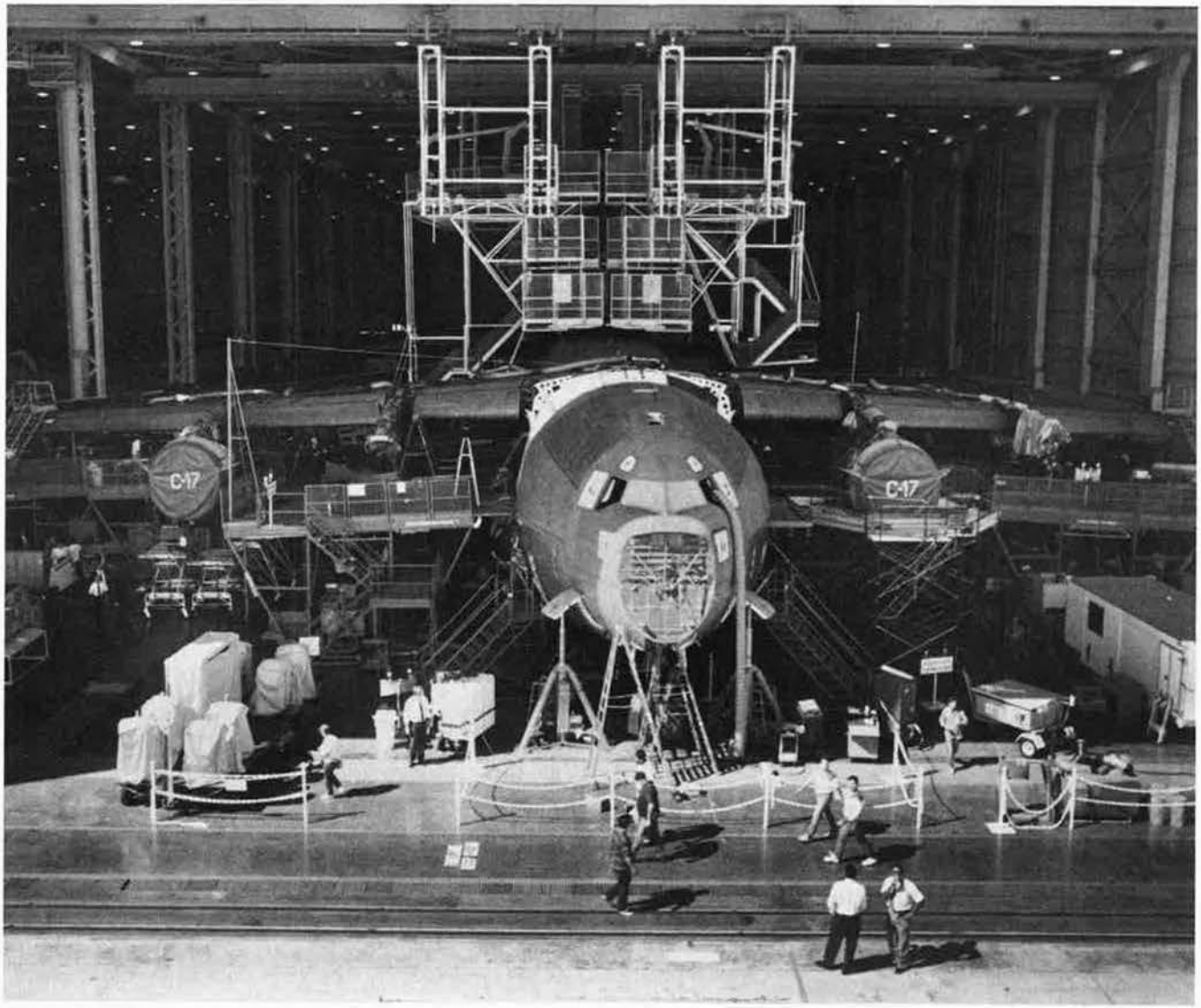

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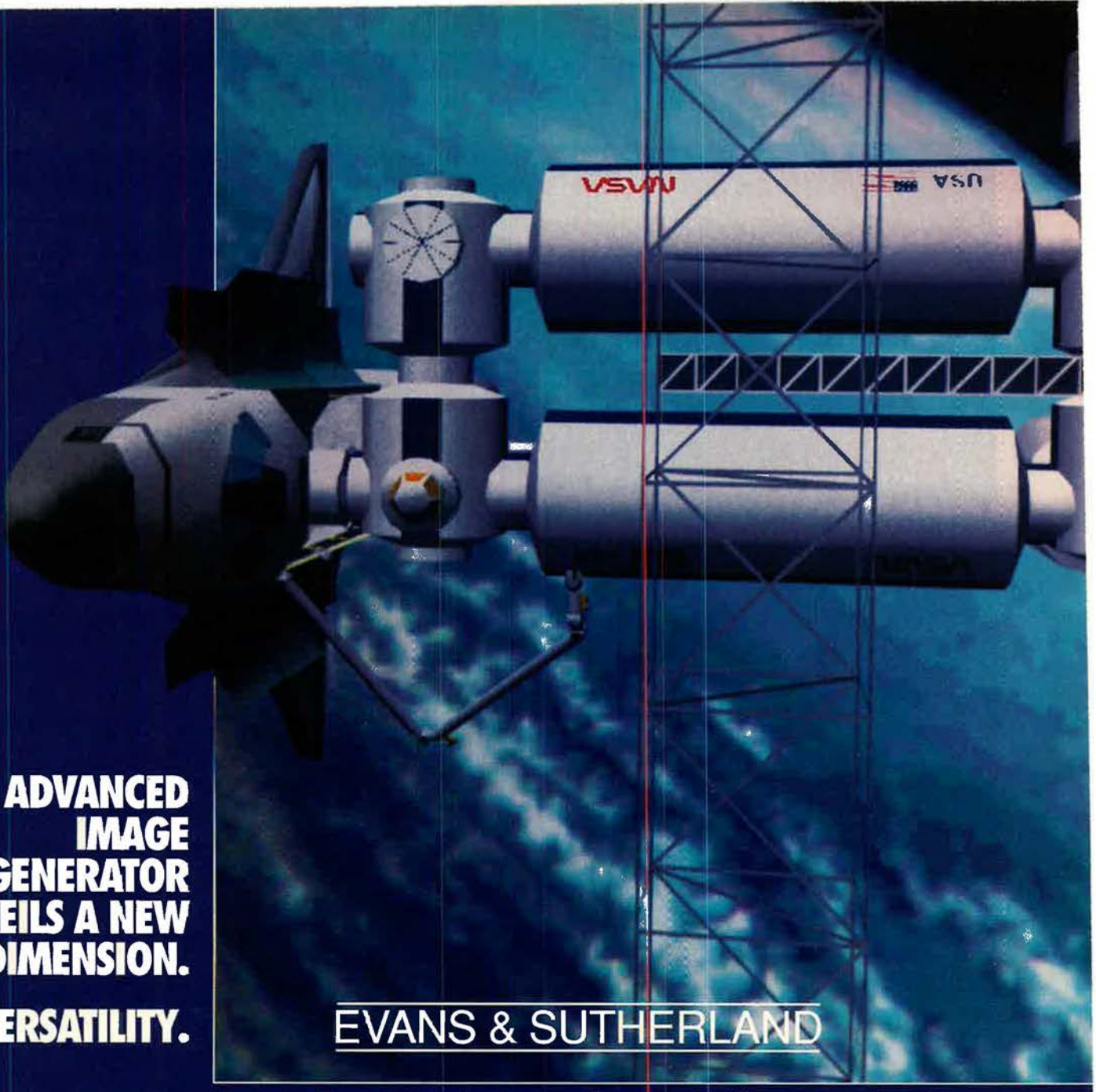

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The Chart Page

Edited by Colleen A. Nash, Associate Editor

Before and After Gorbachev

Equipment	Pre-Gorbachev yearly average (1982–84)	Gorbachev yearly average (1986–88)	Gorbachev (1989)
Tanks	2,800	3,400	1,700
Other armored fighting vehicles	5,400	4,600	5,700
Towed field artillery	1,300	1,000	800
Self-propelled field artillery	900	900	750
Multiple rocket launchers	600	480	300
Self-propelled antiaircraft artillery	200	100	250
Submarines	9	9	9
Major surface warships	9	9	12
Minor surface combatants	57	55	54
Bombers	40	47	40
Fighters/fighter-bombers	950	700	625
ASW fixed-wing aircraft	5	5	5
AWACS aircraft	2	5	5
Military helicopters	580	450	400
ICBMs	116	116	140
SLBMs	115	100	100
SRBMs	580	700	700
Long-range SLCMs	35	200	200
Short-range SLCMs	980	1,100	1,100
SAMs (excludes man-portable)	15,000	16,000	14,000

In 1986–88, production of Soviet tanks, bombers, AWACS planes, SAMs, cruise missiles, and short-range ballistic missiles actually increased. However, the output of conventional ground force equipment as well as fighter aircraft and helicopters generally declined. Gorbachev announced in January 1989 that output would be reduced, and Soviet 1989 production of military materiel generally fell from 1988. Major surface warships here include carriers, frigates, corvettes, and paramilitary ships. R&D accounts for twenty-four percent of Soviet defense spending (compared to 13.4 percent for the US) and procurement of weapons and military equipment accounts for another forty-three percent (compared to 27.5 percent for the US).

Soviet leaders seek to address the growing shortages in the civilian economy by redirecting into production of civilian goods the resources and capacities released as a result of weapon production cuts. According to Soviet statements, some 400 defense plants and 100 civilian plants that produce military products are engaged in or are planning for industrial conversion. Conversion, however, has been slower and less extensive than promised by Soviet officials.

Source: US Department of Defense, *Soviet Military Power 1990,* September 1990.

By Brian Green, Congressional Editor

The B-2 Is Still Hanging

Congress finally settled on an eight percent cut for defense but did not resolve the battle over the B-2, which will be refought next year.

The House and Senate finally agreed on Fiscal 1991 authorization and appropriations bills to fund Pentagon operations, investment, and personnel. Congress approved, for President Bush's signature, $288.3 billion in budget authority and $297.0 billion in outlays. Congress reduced the President's budget request by $18.6 billion in budget authority and $6.3 billion in outlays.

The compromise struck by the two chambers left unresolved the fate of the B-2 Stealth bomber, the key defense issue before Congress this year. The bottom line on the B-2 appears to be that the battle over production in 1991 of new aircraft will have to be refought in a new Congress potentially less supportive of the program.

The compromise defense bills also slow the pace of the Air Force AIM-120A advanced medium-range air-to-air missile (AMRAAM) program, mobile ICBM programs, and other key Air Force programs. The status of the high-priority Advanced Tactical Fighter (ATF), however, remains uncertain.

With respect to the B-2, the defense bills provide $2.35 billion in new, 1991 procurement money for the new bomber and $1.75 billion for continued research and development. The House had provided $1.8 billion in R&D funds, but eliminated all procurement money and called for terminating the program at the fifteen aircraft already authorized. For its part, the Senate authorized two new aircraft and a total of $4.6 billion in funding.

The final authorization bill, worked out by House and Senate negotiators, dropped the House termination language but did not specifically authorize any new B-2s. Compounding the confusion is Congress's provision in last year's defense budget for money to buy long lead time items to build the sixteenth, seventeenth, and eighteenth B-2s.

Because the defense bills left the B-2 issue ambiguous, opponents in the House and supporters in the Senate both claimed victory. Rep. Les Aspin, the Wisconsin Democrat who chairs the House Armed Services Committee, argued that the task of completing the first fifteen aircraft would swallow up all of the 1991 procurement money, and thus the 1991 funding did not represent approval of new planes. Representative Aspin did concede, however, that the B-2 program "is fully going." Rep. Ron Dellums, a California Democrat on Aspin's committee and one of the sponsors of the bill to terminate the B-2, said flatly, "There is no procurement for any new planes." In the event the Air Force tries to go beyond fifteen planes, Representative Dellums said, he would seek an injunction.

Georgia Democrat Sam Nunn, chairman of the Senate Armed Services Committee, and John Warner (R-Va.), the panel's ranking minority member, claimed that the lack of specificity in the bill gave the Air Force wide latitude in structuring the B-2 program. "What we would say," observed Senator Nunn, "is that [the Air Force] can build one bomber, they can build two bombers, they can build three bombers, and we'd be delighted if they built more." Senator Warner maintains that "we were able to persuade the House to go forward' with the B-2 program.

The authorization conference report reflects this fundamental disagreement. It provides no definitive guidance to the Air Force on further B-2 procurement. The report repeats House and Senate interpretations of the bill and states that the House "expects' the Secretary of Defense to report on how FY 1991 B-2 funding will be spent.

Failure to resolve the B-2 conflict this year leaves the Air Force in a potentially awkward position. No matter which path it takes—production or no production—it seems likely to offend one of the congressional chambers.

Congressional action on the ATF program provides another potential flash point. The authorization bill defers full-scale development of the ATF beyond Fiscal 1991. The authorization conferees "agreed on the need to check the Defense Department's rush to full-scale development" of the new air-superiority fighter. The appropriations bill, however, provides $200 million for full-scale development, accepting the conclusion of the House report that deferral "raises program costs, delays the schedule, and jeopardizes some of the contractor subvendors." In debate on the bills. Sen. William Cohen (R-Me.) of the Armed Services Committee warned the Air Force not to use the appropriations go-ahead to move the ATF into full-scale development. Moreover, the authorization bill contains $100 million (unrequested by the Air Force) to protect "an option to proceed with [an] upgraded F-15 as [an] alternative to [the] ATF." Conflicts between the appropriations and authorization bills are often resolved through discussions between the relevant committees and the Pentagon.

Other actions, though less contentious, slow a number of major Air Force programs. The authorization bill keeps AMRAAM in low-level production, approving only $463 million for 450 USAF missiles. Authorization conferees expressed concern about AMRAAM's "performance, reliability, and producibility." The final appropriations bill, however, provides $535 million for 600 of the air-to-air missiles.

Both bills adopt this year's House approach to ICBM modernization, providing $680 million for both the rail-garrison Peacekeeper and the Small ICBM programs. The bills also eliminate procurement funding for the mobile Peacekeeper's rail-garrison basing system; provide $540 million for procurement of two C-17 airlifters and $2.9 billion for SDI; direct the Air Force to restructure the Milstar communications satellite program to emphasize use for tactical rather than strategic purposes; and authorize a 4.1 percent military pay raise. The authorization bill also creates a new base closure commission and provides benefits for involuntarily separated officers and enlisted members. ■

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Aerospace World

By Jeffrey P. Rhodes, Aeronautics Editor

★ The teams competing in the Air Force's Advanced Tactical Fighter program are now both off and running. The second entry, the Lockheed/Boeing/General Dynamics YF-22A, was flown for the first time on September 29. Meanwhile, the first Northrop/McDonnell Douglas YF-23A continues its flight envelope expansion program at the Air Force Flight Test Center at Edwards AFB, Calif.

The first flight of the YF-22 had to be cut short because of ground telemetry problems. Lockheed test pilot Dave Ferguson sat at the end of the runway at Palmdale, Calif. (where the YF-22A was built), with his two General Electric YF120-GE-100 engines running, while repairs to the monitoring system were made.

The delay lasted forty-five minutes, and consequently, the YF-22 only had enough fuel to make the short hop to Edwards, rather than its planned hour-long flight. Mr. Ferguson kept the landing gear extended during the eighteen-minute flight. The plane reached a speed of 288 mph and an altitude of 12,500 feet.

Air Force Maj. Ron "Taco" Johnston gets a wet welcome from the all–Air Force ground crew after becoming the first military pilot of the Northrop/McDonnell Douglas YF-23. His sortie, the sixth in the number one YF-23's flight-test program, lasted nearly two hours and was made from the Air Force Flight Test Center at Edwards AFB, Calif.

Meanwhile, the first Lockheed/Boeing/General Dynamics YF-22 gets blocked in at Edwards after company pilot Dave Ferguson made the type's first flight September 29. Flight-testing of both prototypes will conclude at the end of this month, and final proposals are due at Aeronautical Systems Division by January 2.

As of October 26, the plane had been flown eleven times. A number of glitches plagued the aircraft (gear retraction problems, loss of some flight-control indicators, and a hydraulic leak) during its early flights. Mr. Ferguson brought the YF-22 to supercruise on the plane's ninth flight (October 25), as it reached a speed of Mach 1.23 without afterburner while flying at 40,000 feet.

The first YF-23, powered by two Pratt & Whitney YF119-PW-100 engines, had been flown thirteen times as of October 25. The plane has accumulated nearly twenty-one hours of air time. Maj. Ron Johnston became the first Air Force pilot to take the plane aloft. He served as the pilot on the YF-23's sixth flight.

Major Johnston's flight lasted nearly two hours, and he performed a series of engine tests and an aerial refueling from a KC-135. During the flight, Major Johnston ignited the plane's afterburners for the first time

and conducted a number of in-flight engine restarts at various altitudes. After landing, he was deluged with water thrown by the all–Air Force ground crew.

Both teams were scheduled to have their number two aircraft flying by the end of October. The second YF-22 will be powered by Pratt & Whitney engines, while the second YF-23 will use the General Electric powerplants.

★ NASA shook off the hex that had hung over the space shuttle program all summer with the nearly flawless STS-41 mission in early October. The thirty-sixth shuttle mission marked the eleventh trip into space for *Discovery,* which set the orbiter fleet record for successful missions.

The missions planned for *Atlantis* and *Columbia,* which had been plagued by hydrogen leaks all summer, were put on hold to allow *Discovery,* with its time-sensitive payload, the Ulysses unmanned solar probe, to be launched. Missing this "window" would have delayed the probe's launch until next November because of planetary alignment.

The crew of Navy Capt. Richard Richards (commander), Marine Lt. Col. Robert Cabana (pilot), and Coast Guard Cmdr. Bruce Melnick, Navy Capt. William Shepherd, and Air Force Maj. Thomas Akers (mission specialists) lifted off at 7:47 a.m. October 6, after a twelve-minute delay. Colonel Cabana, Major Akers, and Commander Melnick (the first Coast Guard astronaut) were all making their first space mission.

The $750 million, nuclear-powered Ulysses probe, a joint effort by the European Space Agency and NASA, was released from *Discovery*'s payload bay six hours after liftoff. Using both an Inertial Upper Stage and a Payload Assist Module, the 807-pound probe reached an escape velocity of 34,130 mph.

Ulysses will take a roundabout 1.86 billion mile route to the sun—via Jupiter to alter its trajectory—and will arrive in solar orbit in 1994. It will spend a year studying the solar polar regions and the space above the poles from a safe orbit that varies between 120,000,000 miles and 500,000,000 miles away.

Among the experiments the crew conducted was setting a carefully controlled fire to study the spread of flames in space. A piece of ashless filter paper one inch wide and four and one-half inches long was ignited and allowed to burn for seventy seconds in a sealed aluminum container filled with oxygen and nitrogen.

The crew touched down at 6:57 a.m. PDT on Runway 22 at Edwards AFB, Calif., on October 10. The 15,000-foot-long concrete runway was used to retest the new carbon-carbon brakes. These brakes could allow crews on future missions to land orbiters on the shuttle runway at the Kennedy Space Center, as was done on several earlier flights. Returning directly to Florida would reduce costs and turnaround time.

★ The Bell-Boeing V-22 Osprey tiltrotor program, one that Secretary of Defense Richard Cheney would like to see canceled because he sees it as unaffordable, received some good news in early fall. Two major studies, including one mandated by Congress, both concluded that the Osprey was better suited and more affordable than any proposed alternative.

Things are a little more straight and level for the Bell-Boeing V-22 Osprey program than they were for this number one V-22 prototype during a recent test. Two important studies concluded that the Osprey was better than any proposed alternative, and the program fared well in the budget battles. The tests are also going well.

Congress directed the Institute for Defense Analyses, a not-for-profit federal contract research center, to provide an independent cost and operations effectiveness analysis of all reasonable V-22 alternatives. The study was to address all aspects of operations, particularly drug interdiction and Special Operations, that could be performed by the V-22 or its alternative.

IDA used two twenty-year life cycle cost estimates (one for the V-22 and one for the Pentagon's proposed alternative of UH-60 and CH-53E helicopters) and looked at eight different missions (four for the Marines and two Navy, one Air Force, and one drug interdiction) as the basis of the study.

The study found "the V-22's speed, range, and survivability advantages . . . to be more effective—sometimes significantly more and sometimes only slightly more—than all of the proposed alternatives in each of the four Marine missions examined." The V-22 was also "more cost-effective than helicopter alternatives for the Navy combat search-and-rescue, Air Force Special Operations, and . . . drug interdiction missions."

The other study was performed by technicians at the Lawrence Livermore National Laboratory in California, using its Janus computer simulation. This simulation carries a given situation to its logical conclusion. A simulated battle in Lebanon's Bekaa Valley was played out over four hours using a force of V-22s and CH-53Es in one test run and a force of UH-60s and CH-53Es in the other.

The computer found that the V-22/CH-53 force delivered two to three times more combat power; ground force mass achieved with the V-22/CH-53 fleet was greater, leading to an earlier dissipation of the enemy force; V-22 attrition was an order of magnitude lower; and the combined V-22/CH-53 force conserved the CH-53s, as they only had to be used for heavy-lift missions.

In other V-22 news, the flight-test program has shown relatively few problems and is going well, although it is slightly behind schedule.

The initial flight envelope expansion has been completed, with the plane withstanding maneuvers up to 2.3 Gs and reaching an altitude of

15,000 feet. One of the four aircraft now in the test program reached the type's design speed (345 knots) on August 21. All significant problems encountered (primarily excess vibration) have been corrected. The flight-control system was fully tested in forty fewer hours than originally expected, and the V-22 completed its first formal government evaluation with high marks.

Tests of the V-22's wing fold/stowage system have gone well, and two of the prototypes are scheduled to go to sea this month for compatibility tests with Navy ships. Those tests may be delayed, however, because of Operation Desert Shield commitments.

The configuration of production V-22s will be set and full flight envelope expansion is scheduled to have been completed by next December, when the full-rate production decision is to be made under the current program schedule.

In the aftermath of congressional budget deliberations, it appears that the V-22 is one of the big winners. The conference committee approved the House version of V-22 spending, with

Five medics from the Ehrling Bergquist Strategic Hospital at Offutt AFB, Neb., recently qualified for the Army's Expert Field Medical Badge. Medics are tested in emergency field medical techniques, radio communications, CPR, and combat survival skills. Fewer than 100 Air Force medics have earned the EFMB since the program began in 1966. Here, Air Force TSgt. James M. Carsten (left) bandages a "gunshot wound" with the aid of Army Pfc. Burk L. Charles.

the program to receive $200 million in carryover FY 1990 production money, $238 million in new research and development money, and $165 million in FY 1991 advance procurement money. An option to set up the production line and start pilot production was also allowed for, but has not yet been acted upon.

In a separate action, approximately $8 million was authorized to begin development of the Air Force's Special Operations Forces variant. If the Secretary of Defense does not submit a request for V-22 funding in the FY 1992 budget, Congress will have to decide if the more than $1 billion needed for initial production should be restored.

★ **HONORS—Edwin I. Colodny,** chairman and president of USAir Group, Inc., will receive the 1990 **Wright Brothers Trophy** in Washington ceremonies later this month. Mr. Colodny is being cited for his accomplishments in fostering air service to small and medium-size communities and for his thirty-three-year career as an airline innovator and leader. The Wright Brothers Trophy is presented annually by the National Aeronautic Association to an American citizen who, as a civilian, has rendered significant public service of enduring value to aviation in the US. The trophy was first awarded in 1948.

Northrop chief test pilot **Bruce Hinds** and Air Force **Col. Richard Couch** received the 1990 **Iven C. Kincheloe Award** in ceremonies earlier this fall. The two were honored for their work in making the first flights of the Northrop B-2A Stealth bomber and validating the theoretical data accumulated before the flight. The Kincheloe Award is presented annually by the Society of Experimental Test Pilots in recognition of outstanding professional accomplishment in the conduct of flight testing the previous year.

★ **PURCHASES**—Air Force Systems Command's Ballistic Missile Organization recently awarded two contracts for the MGM-134A **Small Intercontinental Ballistic Missile** program. **Rockwell's Autonetics Strategic Systems Division** received a $30.6 million contract on October 3 for continued full-scale development of the missile's guidance and control system. **Aerojet** received a $203 million contract in mid-October to restart FSD work on the missile's second-stage solid rocket motor. Work on the second-stage motor was stopped two years ago because of funding cuts.

The **three contractors teamed for the National Aerospace Plane airframe** effort each received a face-value increase to their cost-plus development contracts on October 4. **General Dynamics** and **McDonnell Douglas** each received $5.8 million from Air Force Systems Command's Aeronautical Systems Division (ASD), while **Rockwell** was awarded an additional $7.6 million. In other NASP news, the complete contractor team (which also includes Rocketdyne and Pratt & Whitney) has decided that the X-30A NASP technology demonstrator will be a lifting body design with small wings and twin stabilizers that will be powered by three to five scramjets. NASA and Air Force officials recently approved Palmdale, Calif., as the permanent site of the NASP National Contractor Office. If the X-30 program proceeds to actual aircraft fabrication, the vehicle will likely be built in that area.

The two teams working on the Navy's very-long-range advanced air-to-air missile **(AAAM)** received Naval Air Systems Command contracts on

October 5 for the next phase of the missile's demonstration/validation effort. The contracts call for **General Dynamics/Westinghouse** ($11.6 million) and **Hughes/Raytheon** ($12.6 million) to design the baseline AAAM system and to conduct studies, simulations, free-flight tests of prototype control vehicles, tests of guidance subsystems, and captive-carry tests of the missiles. The contracts also call for comparative tests of the complete prototype guidance systems. Work is to be completed by late 1992. The AAAM will replace the AIM-54 Phoenix missile.

Contel Federal Systems received a $36.5 million Strategic Air Command contract on October 16 to **operate and maintain the Ground Wave Emergency Network.** Under the one-year contract, the company will provide logistic support to test, maintain, and operate the fifty-six-node system that provides US strategic forces with long-range communications that can continue to function even in the presence of electromagnetic pulse. The contract includes four one-year options.

McDonnell Douglas received an $836.4 million ASD contract on September 20 for the FY 1990 buy of **F-15E aircraft.** The contract calls for thirty-six of the two-seat, dual-role fighters, and work is expected to be completed in May 1992. This buy brings the total number of F-15Es delivered or on order to 116.

Trans World Airlines received an Air Force contract of undisclosed value on September 23 to **train all VC-25A pilots.** The Air Force One pilots will complete TWA's 747 training course at the company's facility at New York's John F. Kennedy International Airport. The course includes flight crew training, a sixty-nine-hour ground school course, and sixteen hours in the simulator. The contract has a two-year option.

UNC Support Services received a $1.3 million Air Force contract on September 18 to provide basic and advanced **T-37 and T-38 simulator training** at Reese AFB, Tex. The one-year contract includes four one-year options. The company also received a subcontract from Loral to provide instructors and mission-rehearsal specialists for the Special Operations Forces Aircrew Training System. The value of the SOF ATS subcontract could total $65 million over fifteen years.

★ **DELIVERIES—Rocketdyne** delivered the **third spare space shuttle main engine** to the Kennedy Space Center in Florida in late September. This now gives NASA a full set of spare engines for the three-orbiter shuttle fleet, allowing much greater scheduling flexibility. The first of four main engines (three operational and one spare) designated for use on *Endeavour,* the replacement orbiter, recently completed the second of three tests at NASA's Stennis Space Center in Mississippi and was scheduled to be delivered to the space agency by late fall.

ASD transferred program management of the Pratt & Whitney **F100-PW-220 fighter engine** to Air Force Logistics Command's **San Antonio Air Logistics Center** on September 28. An upgrade of P&W's F100-PW-100/200 engine, the -220 engine was first ordered in 1985 and was competed against the General Electric F110-GE-100 engine to power the yearly buys of F-15s and F-16s. Final deliveries of the nearly 800 -220 engines ordered by the Air Force are expected next year.

Rockwell's Defense Electronics Division delivered the **first Peacekeeper rail-garrison launch-control system functional test car** to the Air Force at the company's facility in San Bernardino, Calif., on October 4. The

December Anniversaries

- *December 11, 1915:* The first foreign students to enter a US flying training program—four Portuguese Army officers—report to the Signal Corps Aviation School at San Diego, Calif.
- *December 17, 1925:* Airpower pioneer Billy Mitchell is found guilty of violating the 96th Article of War ("conduct of a nature to bring discredit on the military service") and is sentenced to a five-year suspension of rank, pay, and command. Already demoted from brigadier general, Colonel Mitchell decides instead to resign from the Army.
- *December 27, 1925:* Industrialist and philanthropist Daniel Guggenheim creates the $2.5 million Daniel Guggenheim Fund for the Promotion of Aeronautics to speed the development of aviation in the US.
- *December 17, 1935:* Carl Cover, Fred Stineman, and Frank Collbohm make the first flight of the Douglas Sleeper Transport, the progenitor of the legendary DC-3 airliner and its military cousin, the C-47, at Santa Monica, Calif. By production's end in 1947, 10,654 "Gooney Birds" had been built. Many are still flying around the world today.
- *December 30, 1945:* Republic reveals the existence of the XF-12 Rainbow, a four-engined "flying photo laboratory" that carries a crew of five and has a top speed of 425 mph. An order for six production aircraft is later canceled.
- *December 14, 1960:* Lt. Col. T. R. Grissom and Capt. J. P. Bosley set a world unrefueled closed-course distance record in a Boeing B-52G, flying from Edwards AFB, Calif., over Texas, Washington, D. C., Newfoundland, Alaska, and Montana before returning to Edwards. The 10,078.84-mile trip takes nineteen hours and forty-four minutes.
- *December 16, 1960:* Technicians at the Semi-Automatic Ground Environment (SAGE) station at Gunter AFS, Ala., control the launching of two Boeing CIM-10B Bomarc missiles from Eglin AFB, Fla., and direct the missiles to intercept a QB-47 flying at 500 mph at 30,000 feet over the Gulf of Mexico.
- *December 20, 1960:* After forty-eight years and more than 12,000 aircraft, the Glenn L. Martin Co. delivers its last aircraft, a Navy P5M-2 Marlin seaplane. The company later enters the missile and spacecraft business.
- *December 4, 1965:* The Gemini 7 crew, Air Force Lt. Col. Frank Borman and Navy Lt. Cmdr. Jim Lovell, is launched atop a Titan II booster from the Kennedy Space Center to start a record-breaking fourteen-day mission.
- *December 15, 1965:* After a delay of two months, the Gemini 6A crew, Navy Capt. Wally Schirra and Air Force Maj. Thomas Stafford, is launched atop a Titan II booster in order to perform the most daring maneuver yet attempted in space—rendezvous with another space vehicle. An Agena target vehicle had exploded in October, and the decision was made to use Gemini 7 as a target instead. The maneuver is completed, and the two spacecraft hold position six inches from each other for nearly five hours. The Gemini 6A crew separates and returns to Earth after only one day in space.
- *December 6, 1985:* The eighteenth and final Shorts C-23A Sherpa is accepted by the Air Force one day prior to delivery to the 10th Military Airlift Squadron at Zweibrücken AB, West Germany. The aircraft is to be used to deliver engines and spares as part of the European Delivery System.
- *December 16, 1985:* After twenty years of operation, the Pioneer 6 satellite becomes the longest-running spacecraft in history. When launched in 1965, the solar-orbiting satellite had a life expectancy of six months.

car is an engineering model of the launch-control car that will carry the equipment and personnel necessary to launch LGM-118A Peacekeeper intercontinental ballistic missiles from the rail-garrison trains. Each of the twenty-five operational trains will carry two ICBMs. The test car will now undergo command and control checkout and functional interface testing at Vandenberg AFB, Calif., and mobility testing at the Association of American Railroads Transportation Test Center in Pueblo, Colo.

The **first Pratt & Whitney F117-PW-100 turbofan engine was installed on the McDonnell Douglas C-17** airlifter on October 18. The remaining three engines were scheduled to have been installed by early November. The F117, a militarized version of the commercial PW2000 series engines that power close to 500 in-service Boeing 757s, develops 41,700 pounds of thrust. The engine was first shipped in early October to LTV in Dallas, Tex., where it was fitted with its nacelle. The entire assembly was then shipped to Long Beach, Calif., where the C-17 is being built.

ASD delivered an example of the Boeing YCEM-138 **Seek Spinner loitering antiradiation missile to the Air Force Museum,** located across Wright Field, on September 11. Seek Spinner, the Air Force name for the Brave 200 unmanned aerial vehicle (a small, 450-pound monoplane drone powered by a snowmobile engine) carried a forty-pound warhead and had a range of nearly 400 miles. The Seek Spinner program lasted for six years (1983–89), but fell victim to budget cuts and the Air Force's decision to develop the AGM-136A Tacit Rainbow missile instead.

★ **MILESTONES**—The **second Northrop B-2A Stealth bomber was flown for the first time** on October 19. Company pilot Leroy Schroeder and Air Force Lt. Col. John Small took off from Air Force Plant 42 in Palmdale, Calif., and landed two hours and thirty-six minutes later at Edwards AFB. The flight included flight-control and landing gear tests, but was cut short because of high winds at Edwards and because a cockpit warning light came on. This B-2 is instrumented for dynamic loads testing. After a long layup, the first B-2 began its low-observability test program on October 23. Company chief test pilot Bruce Hinds and Air Force Col. Tom LeBeau flew the five hour and nineteen minute mission, the number one aircraft's seventeenth flight.

The **Rockwell/MBB X-31A Enhanced Fighter Maneuverability aircraft was flown for the first time** on October 11. Company test pilot Ken Dyson took off from the company's facility at Air Force Plant 42 and flew the aircraft for thirty-eight minutes. The X-31A reached a speed of 340 mph and an altitude of 10,000 feet before landing back at Palmdale. The flight had been delayed several months because of minor flight-control system software problems. The X-31 is the first international X series aircraft, and it is designed to explore controlled flight at high angles of attack. The aircraft's thrust-vectoring paddles were not used on this first flight but will be installed for later sorties. Flight envelope expansion will take place at Palmdale, and then the two X-31s will be transferred to the Naval Air Test Center at NAS Patuxent River, Md. The test program will run through 1992. *[For more on the X-31, see "High Alpha," by F. Clifton Berry, Jr., August 1990 issue, p. 54.]*

The Rockwell/MBB X-31A Enhanced Fighter Maneuverability aircraft comes in for a landing at Air Force Plant 42 in Palmdale, Calif., after its first flight October 11. Rockwell test pilot Ken Dyson was at the controls for the thirty-eight minute flight. The chase aircraft is a privately owned, civil registered Northrop T-38.

The first three **Shorts C-23A Sherpa intratheather airlifters were flown from Zweibrücken AB, West Germany,** to the US on October 2 **as part of the elimination of the European Distribution System.** The EDS, which ferried aircraft engines and spare parts between European bases, is being phased out because the Defense Management Review II panel decided it was no longer needed and because a number of European bases, including Zweibrücken, are to be closed *[see "News Notes"]*. The eighteen C-23As, which entered the inventory in 1985, are being transferred to Air Force Systems Command (which will use the planes at Edwards AFB, Calif.), the Army, and the US Forest Service. The last C-23 was scheduled to arrive in the US by mid-November. The 10th Military Airlift Squadron, the unit that flew the Sherpas, is to be deactivated next year.

The **Navy decommissioned its last diesel-powered submarine,** USS *Blueback* (SS-581), in ceremonies at Point Loma, Calif., on October 1. The sub, the first to be built by Ingalls Shipbuilding in Pascagoula, Miss., was commissioned in 1959, and it made the first underwater voyage from Japan to San Diego. The trip took twenty-three days. The *Blueback,* which had a part in the movie "The Hunt for Red October," will be put in storage at Bremerton, Wash. The Navy's submarine force is now completely nuclear-powered.

★ **NEWS NOTES—Martin Marietta** announced on October 8 that it **had acquired the rights to** complete development, testing, integration, and production of the Advanced Tactical Air Reconnaissance System **(ATARS)** from Control Data Corp., the program's prime contractor. Control Data was awarded a $118.6 million contract for ATARS work in 1988. ATARS will use an electro-optical sensor suite to replace camera and film systems in US tactical reconnaissance aircraft. The system is scheduled for its first flight, aboard an RF-4 at Eglin AFB,

Fla., late this year. ATARS will be tested aboard F-16s (in a pod) and Navy F/A-18s (on a pallet) next year.

The **ninth operational NS-7B Navstar Global Positioning System satellite was successfully launched** from Launch Complex 17 at Cape Canaveral AFS, Fla., on October 1. The Rockwell-built satellite was launched aboard a McDonnell Douglas SB-3A Delta II booster. It was the first launch conducted by the 1st Space Launch Squadron, newly activated as part of the transfer of space-launch responsibilities from Air Force Systems Command to Air Force Space Command, which became effective earlier that day.

Three pilots of the North American XB-70 Mach 3 research aircraft fill the Valkyrie's cockpit access door at the Air Force Museum at Wright-Patterson AFB, Ohio, on September 21, the twenty-sixth anniversary of the type's first flight. Retired Col. Joe Cotton (top) and company pilot Al White (right) crewed the first flight, and retired Lt. Col. Fitz Fulton (left) took part in the plane's last flight in 1969.

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There were two separate incidents involving Rockwell B-1B bombers in the early fall. On September 19, a B-1B assigned to the 28th Bomb Wing at Ellsworth AFB, S. D., struck three birds while on a low-level training mission over Montana. Both windscreens were cracked so badly that the crew had to be talked down through landing via radio by ground crews. There were no injuries. On October 4, a B-1 crew from the 384th Bomb Wing at McConnell AFB, Kan., made an emergency landing at Pueblo Memorial Airport, Colo., after literally losing an engine. The crew heard a loud noise and landed when instruments showed a loss of power on the number one engine. After landing, the crew saw that the General Electric F101-GE-102 engine and its nacelle were missing. The engine was recovered nearly intact near Pueblo the next day. Results of the preliminary investigation point to the engine's first-stage fan blades as the cause of the incident.

Air Force Logistics Command announced on September 6 that **Ogden Air Logistics Center and Oklahoma City ALC will be the two depots for the Advanced Tactical Aircraft.** The ATA is the Air Force version of the Navy's A-12A Avenger deep-strike aircraft, and it will replace the F-111. Ogden ALC at Hill AFB, Utah, will serve as program manager and be the source of repair for the plane's airframe, while Oklahoma City ALC at Tinker AFB, Okla., will manage logistics support for the General Electric F404 derivative engines that will power the A-12, which is built by the team of General Dynamics and McDonnell Douglas.

In September, Secretary of Defense Richard Cheney announced that **the US will end or draw down its operations at 150 sites overseas** over the next few years and will also **reduce the number of US forces in Europe by 40,000** in FY 1991. The US military will end operations at ninety-four sites in Germany, eleven in Spain, nine in South Korea, three each in Greece, Italy, the United Kingdom, and Australia, and one in Japan. Operations will be reduced at fourteen sites in Germany, three in South Korea, two in Spain, and one each in Italy, Japan, Canada, and Bermuda. Pending an agreement on the Conventional Forces in Europe discussions taking place in Vienna, the US Army will withdraw 30,000 troops from Europe during FY 1991, while the Air Force presence will be reduced by 10,000 people.

—Photo by Paul Jackson

Twelve Royal Air Force Panavia Tornado GR. Mk. 1 strike aircraft were deployed from Brüggen, West Germany, to Bahrain in late August as part of Operation Desert Shield. Established as 14 (Composite) Squadron, the Tornadoes received a hastily applied coat of "sandy pink" camouflage color wash (as shown here) so they will blend in with their new surroundings.

The Air Force announced on September 28 that **Space Launch Complex-6** at Vandenberg AFB, Calif., is the choice for a **west coast launch site for Martin Marietta Titan IV boosters.** Modifying SLC-6 for Titan IVs was seen as the better alternative to building a new launch complex. SLC-6 (nicknamed "Slick Six") was originally built in the 1960s for the Air Force's Manned Orbiting Laboratory project and was modified (at a cost of $3 billion) to launch space shuttles in the 1980s. No shuttles were ever launched from there, and the site was placed in "caretaker" status after the *Challenger* accident. The first SLC-6 Titan IV launch is scheduled for FY 1996.

From the "Try It, You Might Like It" file: One fallout of German unification is that the new government finds itself with both NATO and Warsaw Pact weapons. In most cases the Warsaw Pact equipment will be discarded, but Defense Minister Gerhard Stoltenberg said on October 11 that the **Luftwaffe will try out the sixty Soviet-built MiG-29 fighters** it inherited. If the MiGs are kept, that decision could influence Germany's future participation in the four-nation Eurofighter consortium.

★ **DIED—Douglas Campbell,** the first US-trained pilot to gain a victory in World War I and later the first US-trained ace, of heart failure at his home near Greenwich, Conn., on October 16. He was ninety-four. On April 14, 1918, Lieutenant Campbell and Lt. Alan Winslow were scrambled to intercept two German aircraft over Gengoult, France. The duo, flying Nieuport 28 C.1s, downed both aircraft in a ten-minute engagement. *[For complete details of this engagement, see "The First Victory," by Theodore Hamady, April 1988 issue, p. 68.]* Both were later awarded the French Croix de Guerre with Palm and the Distinguished Service Cross from the US. Lt. Campbell ended the war with 5.5 victories. After the war, he began working with the W. R. Grace company and later became general manager of Pan American Grace Airways. He retired in 1963.

Retired Air Force **Gen. Earle E. "Pat" Partridge,** the first commander of North American Air (later Aerospace) Defense Command, of unreported causes at his home in Palm Beach, Fla., on September 7. He was ninety. An infantryman in World War I, he graduated from West Point in 1924 and joined the Air Service. He served as a test pilot and set up two advanced single-engine flying schools in the south before serving as deputy commander of Fifteenth and Eighth Air Forces. He was the last wartime commander of Eighth Air Force and was Fifth Air Force commander when the Korean War broke out. He was the second commander of Air Research and Development Command, which became Air Force Systems Command before serving at NORAD. He retired in 1959 after forty years of service.

Retired Air Force **Brig. Gen. William H. L. Mullins,** decorated combat pilot and former deputy director of Air Force legislative liaison, in the crash of a vintage P-51 in Chatham, Mass., on September 29. He was fifty-five. A 1957 graduate of West Point, he flew 146 combat missions in Vietnam and received the Bronze Star, five Distinguished Flying Crosses, and thirteen Air Medals. A longtime AFA supporter, he became a vice president of General Dynamics after he retired from the Air Force in 1979. ■

Senior Staff Changes

PROMOTION: To be **General:** George L. **Butler.**

CHANGES: L/G (Gen. selectee) George L. Butler, from Dir., Strategic Plans and Policy, J-5, Joint Staff, Washington, D. C., to CINC, Hq. SAC; Dir., Joint Strategic Target Planning Staff; and Cmdr., STRACOS, Offutt AFB, Neb., replacing retiring Gen. John T. Chain, Jr. . . . **M/G Harold N. Campbell,** from Ass't DCS/L&E, Hq. USAF, Washington, D. C., to DCS/P&P, Hq. AFLC, Wright-Patterson AFB, Ohio, replacing B/G (M/G selectee) Ronald C. Spivey . . . **M/G Fred R. Nelson,** from DCS/Air, AFNORTH, ACE (NATO), Oslo, Norway, to Cmdr., Lowry TTC, ATC, Lowry AFB, Colo., replacing M/G Dale C. Tabor . . . **B/G (M/G selectee) Ronald C. Spivey,** from DCS/P&P, Hq. AFLC, Wright-Patterson AFB, Ohio, to DCS/Air, AFNORTH, ACE (NATO), Oslo, Norway, replacing M/G Fred R. Nelson . . . **M/G Dale C. Tabor,** from Cmdr., Lowry TTC, ATC, Lowry AFB, Colo., to Cmdr., Sheppard TTC, ATC, Sheppard AFB, Tex., replacing M/G (L/G selectee) Michael A. Nelson.

SENIOR EXECUTIVE SERVICE (SES) CHANGES: John M. Gilligan, from Dir., Studies & Analysis, Hq. AFCC, Scott AFB, Ill., to Dir., Technology & Architecture, Hq. USAF, Washington, D. C. . . . **S. W. Hall,** from Dir., Air Force Communication-Computer Sys. Integration Office, AFCC, Scott AFB, Ill., to Dir., Studies & Analysis, Hq. AFCC, Scott AFB, Ill., replacing John M. Gilligan . . . **Myron H. Nordquist,** to Dep. Gen. Counsel, OSAF, Washington, D. C., replacing Roy G. Wuchitech. ■

"Enhanced flight screening" helps decide who'll fly fighters, who'll fly heavies, and who won't fly at all.

Matching the Pilots to Their Tracks

By James W. Canan, Senior Editor

THE Air Force is preparing to take a harder, longer look at young officers who apply for pilot training. It needs to learn a great deal more about them than it has in the past, with emphasis on their natural flair for flying, before signing them up.

Closer scrutiny of flight training applicants is in keeping with the shrinking of the Air Force. As it grows smaller, the Air Force can afford to be more selective about recruits of all persuasions, but this is not the reason for putting would-be pilots under the magnifying glass.

That reason has to do with changes in the way the student pilots are to be trained. It is rooted in Air Training Command's coming switch to dual-track specialized undergraduate pilot training (SUPT) from the single-track, generalized UPT that has been in effect since 1959.

On entering SUPT, each student pilot will be assigned to one of two training tracks—the fighter/bomber track or the transport/tanker track. Putting an even finer point on it, ATC will peg each candidate as more likely to wind up flying one type of aircraft than any other.

"The students will know from the outset which category of aircraft they're going to fly," explains Lt. Gen. Joseph Ashy, commander of Air Training Command. "We'll tell them, before they ever start primary training, whether they're going to fly tankers, bombers, transports, or fighters, and we'll explain why. We expect they'll accept it up front. Then everyone can settle down and focus on the training."

Making such matchups even before flight school begins will mark a drastic departure from present practice. As it is, student pilots are considered "universally assignable" all through the primary and advanced phases of their generalized training. Although many develop a good idea of their destinies as they go along, all must wait until graduation to get the official word on which types of planes they will be assigned to fly.

This approach to making assignments has worked well on the whole but has been far from perfect. It has seemed too unscientific and inexact for the liking of some graduates who have been disaffected by their assignments.

Rigorous screening should enable the Air Force to earmark new student pilots for bombers, tankers, transports, or fighters, such as this F-15, early on.

Not Enough Seats

Most of the many undergraduate pilots who hope to fly fighters never make it. The numbers are stacked against them. There are simply not enough fighter seats to go around. Well over half of flight-school graduates wind up in heavies—bombers, tankers, and transports. Of those, relatively few are assigned to bombers, which have evolved into high-performance aircraft and are now identified more closely with

fighters than with tankers and transports in terms of flying techniques and training purposes.

Through the years, ATC has tried several different pilot-assignment schemes in a continuing effort to improve the system. Among criteria, class standings and flying skills have been constants but have fluctuated in importance when weighed against one another. ATC has resorted to lotteries at times in deciding who goes where.

As things stand, wing commanders at UPT bases have final say. Each is given a block of assignments, based on the numbers of pilot slots to be filled in the operational commands, which he parcels out among his graduates according to his personal knowledge of their individual capabilities.

All such methods have been open to criticism and have caused heartburn in UPT graduating classes on assignment nights.

Brig. Gen. Michael McGinty, ATC's deputy chief of staff for plans and requirements, puts the matter into perspective. "The [UPT] system that has been in effect for the past thirty years has produced thousands of great pilots for the Air Force. But there has always been some frustration and discontent among the graduates about how their assignments came out, no matter which scheme we tried. Switching to SUPT gives us the opportunity to address that problem and solve it."

Pilot assignments will not be pulled out of a hat. Having analyzed the future market for pilots in operational commands, ATC has a clear idea of what to expect in terms of long-range supply and demand. It anticipates that forty percent of its new students will be projected as transport pilots, twenty-seven percent as fighter pilots, twenty-five percent as tanker pilots, and eight percent as bomber pilots.

Sorting out the students in such a fashion right from the start means that ATC will have to do more than decide whether they seem generally fit for flight, as it now does. It will be compelled to determine what manner of flying seems to suit each best.

To accomplish this, ATC has come up with its "pilot selection and classification system." PSACS will have several elements, the final and decisive one to be the enhanced flight screening program. In EFS, as it is called, the airmanship aptitudes of flight training applicants will come to the fore.

ATC plans to phase in EFS for the first class of students to enter SUPT, now scheduled to begin in the spring of 1992 at Reese AFB, Tex. The importance of EFS to specialized training can hardly be overstated. Asserts General McGinty, "The key to the success of SUPT will be how well we select and classify the students. The most important part of that process may well be the enhanced flight screening program."

The New Wrinkle

There is nothing new about flight screening as such. Pilot applicants have always been taken aloft so that they—and their ATC monitors—can check out whether they are comfortable in flight and physically coordinated at the controls. What is new about flight screening in connection with the advent of SUPT is that ATC will demand much more of it—and of the candidates who are put through it.

The T-41 aircraft long used for generalized UPT flight screening cannot fulfill those demands.

"For the enhanced flight screening program we want an airplane that's aerobatic certified and that can do a lot of things the T-41 can't do," General Ashy explains. The EFS airplane, he says, "should be able to do, on a small scale, most of the things a fighter can do."

He includes among such capabilities aerobatics, overhead and box patterns, and "unusual-attitude recoveries," all of which are too much for, or would sorely stress, the T-41.

Why such emphasis on fancy flying for fledglings so early in the game? To spot—and to help them spot—where their natural talents and preferences lie. Among other things, EFS should provide insights as to which candidates will be most at ease in high-performance aircraft and should show the would-be fighter pilots whether or not they truly take to fighter-type flying.

ATC officials are quick to disclaim undue emphasis on identifying fighter pilots in the rough. They stress that it is no less important to discern bomber, tanker, and transport pilots in the making.

"We're going to expand the envelope of the [flight screening] airplane so that the candidates can experience the whole spectrum," General Ashy explains. "We'll find out a lot about them, and they'll find out a lot about themselves."

He has the results of a recent real-life test to substantiate that claim. From July through November, ATC put four classes of fifteen pilot candidates each through an EFS trial program at its Hondo, Tex., airstrip,

—Photo by J. Gaffney

The enhanced flight screening process awaiting candidates for specialized undergraduate pilot training (SUPT) will require an airplane more aerobatically adept than the T-41 (shown here), which is used in conjunction with generalized UPT.

adjacent to Lackland AFB. Instructor pilots were blue-suiters from the Air Force Academy and ATC. Students, all of them new or relatively new officers, came from the Academy, ROTC, and Air Force Officer Training School at Lackland.

"The purpose," says General McGinty, "was to cement in our minds exactly what the enhanced flight screening program should look like and to learn what we'll need from the EFS airplanes and what EFS can show us about the individuals involved."

The washout rate was low; for example, two in the first class and three in the second. Two fell into the "self-induced elimination" category, deciding that piloting wasn't for them after all. One had a problem with airsickness, which might not have been discovered—unfortunately for the candidate and for ATC once his training began in earnest—in the blander flight screening program now in effect for UPT.

—Staff photo by Guy Aceto

This 1550th Combat Crew Training Wing HC-130 at Kirtland AFB, N. M., exemplifies transport aircraft that require special flying skills. Undergraduate pilot training prepares students to move on to advanced training that develops such skills.

Airsickness "Opportunities"

There was plenty of opportunity to get airsick in the 21.5 hours of EFS "advanced syllabus" flying at Hondo. It put the pilot aspirants through the gamut of standard maneuvers including stall recoveries. They found themselves upside down much of the time.

"The instructors reported that the students flew the advanced syllabus very well, without much trouble at all," General McGinty says. "They also said they learned a whole lot more about individual flying skills by putting them through the more comprehensive flight screening program."

Once EFS goes into effect, ATC will scrap its long-standing policy of allowing applicants with private pilot licenses to give flight screening a pass. That policy was predicated on the assumption that licensed pilots have nothing to prove in advance of formal flight training. With EFS, that assumption is no longer valid.

For the EFS trial program at Hondo, ATC used seven SIAI-Marchetti SF.260 aircraft. The SF.260 is only one of several entrants in the competition for an eventual production contract. The Air Force plans to buy 125 off-the-shelf aircraft—sixty-nine for Hondo, fifty-six for the Air Force Academy.

Eight companies entered light planes in "suitability demonstrations" last summer at the Air Force Academy. From mid-July to mid-August, each plane was put through two and a half days of EFS-type flying under the scrutiny of officials from ATC and the Academy, both of which will conduct EFS, and from Air Force Systems Command (AFSC), the buyer-to-be.

"We wanted to see how all those little airplanes would perform—and check out the maintenance and logistics actions—in the hottest time of summer at that altitude," General Ashy explains. "It helped us nail down our operational requirements."

Those requirements are being hammered out by ATC and AFSC. ATC has settled on such physical characteristics as low wing, stick control, and side-by-side seating. The simpler the systems on the airplane, such as those for fuel management and power control, the better, ATC officials say.

Affordability is a prime concern. Holding down costs may hex nice-to-have, but not quite mandatory features, such as air-conditioned cockpits.

The Air Force is scheduled to pick a winner next November in the EFS aircraft competition, which may yet attract additional entries, and to begin taking deliveries the following May.

Officials at ATC headquarters (Randolph AFB, Tex.) emphasize that flight screening is by no means the only element of the pilot selection and classification system in store for ATC.

For each flight training applicant, PSACS will start out much the same as the present selection does, with a physical exam, a study of academic and service records, and a half-hour interview of each candidate to determine his or her motivation for becoming a pilot.

After that, sophistication sets in.

Applicants will take two four-hour tests, the first called the Air Force Officer Qualifying Test, which has been around for many years; the other, wholly on computer, is the "basic attributes test." Its purpose is to measure basic eye-hand coordination, "complex coordination" involving multiple mental and physical reactions, and other attributes related to real-life stick-and-rudder demands on mind and body.

Key Information

"It's kind of a physical test on a computer," General McGinty explains. He continues, "We feed the information from the two tests into a computer model developed for PSACS by the [Air Force] Human Resources Laboratory at Brooks [AFB, Tex.].

"Out of that model we get two important pieces of information:

—USAF photo by TSgt. David McLeod

ATC's T-37 primary trainer for student pilots is destined to be replaced by a new plane, the Joint Primary Aircraft Training System. ATC plans to begin buying JPATS planes in early 1994 and to put them into SUPT service in 1997.

whether each individual looks like a successful pilot candidate, and which track—bomber/fighter or tanker/transport—the individual should enter."

Candidates then present themselves to review boards of veteran pilots who have already perused their PSACS profiles. The boards vote them up or down. Those who pass proceed into the flight screening phase of PSACS, where they will do more than fly.

In protracted "pathfinder interviews" with experienced pilots, the flight-school applicants will begin finding out what it takes to be in command of tankers, transports, fighters, and bombers as weapon systems, not just as flying machines. They will also be given the opportunity to express in writing, in the form of "preference statements," which of those machines they would rather fly.

ATC trusts that classifying pilot candidates and tailoring their training to fit with certain airplanes will lower attrition rates and result in well-satisfied, highly motivated graduates. But ATC does not want to give the impression that those graduates will be fully qualified right away to fly fighters, bombers, tankers, or transports in the operational Air Force.

Declares General Ashy, "Air Training Command does the initial training only. We're not trying to make airlift pilots or any other kind. We're trying to make pilots who will leave here and go, for example, to tanker combat crew training and become better equipped to make the transition into an assigned [tanker] weapon system.

"Our training will be more specialized, but it shouldn't be confused with the follow-on training the [SUPT] graduates will get in a B-1 or an F-16 or a KC-10 or a C-141. They'll get their wings after graduating from ATC; then they'll go out, and the major commands will give them advanced flying training."

The way General Ashy expresses it, ATC's objective is clear and straightforward: "to graduate a better, more motivated pilot at less attrition and cost."

Day of the Jayhawk

Plans for new trainer aircraft seem to be falling into place. ATC has begun buying the T-1A Jayhawk, a modified twin-engine business jet, as its Tanker/Transport Training System (TTTS) aircraft for SUPT (see p. 34). ATC officials see no major problems, at the moment, with plans for two other new aircraft as well.

One of those planes, dubbed the Joint Primary Aircraft Training System (JPATS), is projected as the successor to the Air Force T-37 and Navy T-34C primary trainers. Companies are crowding into the JPATS competition, which is expected to result in an Air Force buy of 495 planes through Fiscal Year 2003. The word in the aircraft industry is that there could be more than fifteen competitors before all is said and done. ATC officials predict about ten.

ATC hopes to award the first contract for JPATS planes in February 1994 and to put them into SUPT service in December 1997.

The other new aircraft on ATC's horizon is the BFTS—Bomber/Fighter Training System—to replace the T-38. ATC hopes to begin buying BFTS high-performance aircraft in the year 2003 and to begin flying them in 2005.

Meanwhile, things are looking up for the trainers that have served ATC long and well. The life spans of the T-37 and the T-38 have been extended by means of structural modifications. Moreover, the new T-1A trainers, once in operation, will ease the burden on the T-38. The tanker/transport training to be assumed by the T-1A accounts for roughly half of the T-38 fleet's present work load.

General Ashy is well aware of how long the T-38 has been around. He was the first UPT student to fly a sortie in one.

"That was in the early spring of 1963, and the airplane was wonderful," the ATC Commander recalls. "It still is. However, it's becoming a bit outmoded in comparison with the modern equipment we have today in the operational Air Force—like the totally digital 'glass cockpits' with multifunctional TV displays that you get in a B-1 or an F-15E."

How true to life does ATC expect its future T-38 replacement aircraft to be? Does ATC aspire to a BFTS plane that will approximate the ATF in performance and technology?

"No," General Ashy emphatically replies. "It will not approximate the ATF. Compared to the T-38, it will be an airplane with a little better performance, lower operating costs, and an upgraded cockpit to bring us into the modern era. It will enable us to teach basic flying skills that will be the springboard for the students to transfer easily into the ATF, better prepared to handle the rigors of modern operational flying." ■

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The T-1A trainer represents the biggest single buy of business jets in history.

Meet the Jayhawk

By Jeffrey P. Rhodes, Aeronautics Editor

"THE T-1A Training System is a real step forward for Air Training Command. This is truly breaking new ground."

So asserts Joe Grubiak, deputy program manager of the T-1A TS at McDonnell Douglas Training Systems. MDTS, teamed with Beech Aircraft and Quintron, leads the contractor team that will develop and produce the T-1A TS for the Air Force.

The new pilot training system is highly unusual. It's not just that the 211-aircraft program is the largest single buy of business jets in history. The six-year, $1.3 billion T-1A Training System will be the first major Air Force procurement to include computer-based ground instruction, simulators, and contractor logistics support in one integrated package.

The real significance of the T-1A TS is the resurgence of specialized undergraduate pilot training (SUPT), a concept the Air Force is now reviving after thirty years of single-track flying training.

SUPT is a dual-track method of training pilot candidates. After learning basic flying skills, students

—Photos courtesy of Beech Aircraft

The first Air Force T-1A Jayhawk is taking shape (above) in Beech Aircraft's Experimental Hangar in Wichita, Kan. It will be completed next fall. The demonstrator aircraft (right) in the TTTS competition is now being used to collect data for Quintron, which is building the T-1A simulator.

separate into two groups. One produces pilots who later fly tankers and transport planes. In the other, candidates train to become fighter and bomber pilots. (Bomber pilots are included in this track because the B-1B and the B-2 handle in many ways like fighters, despite their size.) The T-1A TS will be used to train that sixty percent of each class that will fly airlifters or tankers.

The T-1A TS program, originally known by the generic name "Tanker/Transport Training System" (TTTS), sets in motion the three-phase joint Air Force/Navy Trainer Master Plan. Plans call for procurement of an off-the-shelf Joint Primary Aircraft Training System—Phase Two of the Trainer Master Plan—to replace Air Force T-37Bs and Navy T-34Cs, with selection coming in 1994. The Bomber/Fighter Training System, Phase Three, will be a new-design aircraft, along with simulators and academic training. The BFTS aircraft will begin to replace the Northrop T-38A, the Air Force's supersonic advanced trainer, around 2003; the Talons will be some forty years old.

Activation of the T-1A TS will greatly reduce the utilization rate of T-38s. Bomber and fighter students will still fly T-38s, but elimination of their use by tanker and transport students will extend the service life of the Talon fleet into the next century.

No Time to Waste

The competition among the three contractor teams bidding for the TTTS contract (the other two being General Dynamics/Cessna/Link and FlightSafety International/Learjet) consisted primarily of written proposals, though each team did have to submit for evaluation an aircraft representative of the plane in its TTTS bid.

"We wanted to enter the competition for TTTS, and we were looking for a partner that had a strong background in training," says Don Wells, the T-1A aircraft program vice president at Beech. "McDonnell Douglas saw us as a strong candidate because of our Beechjet. We teamed up by mutual agreement."

Quintron, the final partner, was added through open competition. "McDonnell Douglas was looking for a simulator house that would best complement their team," says Simeon Cotton, vice president for marketing at Quintron. "Even though they have their own simulator group, we won a spot on the team."

At the core of the TTTS specification was its call for use of a commercially available, Federal Aviation Administration–certified, twin-turbofan business jet. This type of aircraft exposes students to the rigors of flying a larger plane and helps them learn the skills of flight deck management, important considerations for those slated to fly heavy military craft. It also allows two students to train simultaneously. Use of an off-the-shelf jet saved the Air Force the cost of designing a new aircraft and allows the service to get the program in the field quickly.

Last February 21, Air Force Systems Command's Aeronautical Systems Division awarded the McDonnell Douglas/Beech/Quintron team three contracts totaling $8.9 million for initial T-1A TS work and procurement of the first T-1A, later officially nicknamed "Jayhawk."

The Air Force, moving quickly on the program, exercised a $95 million contract option for fourteen additional Jayhawks (the first production lot) in March. An additional $36 million was included for training system work.

"We have to make decisions and move on," says Malio Leone, T-1A TS program manager at MDTS. "Everything is compressed and is happening much quicker. This is a very fast-track program. Fortunately, we don't have any technological breakthroughs to make."

The plan dictates that in March 1992, twenty-five months after contract award, the team must deliver the assets required for the 64th Flying Training Wing at Reese AFB, Tex., to begin instructor pilot training. Student training begins there six months later.

"There is a substantial penalty clause in the contract that will come into effect if we are late," notes Mr. Cotton. "We are working at max effort now."

The use of a commercially available, twin-turbofan business jet saved the Air Force the cost of developing a new aircraft. The TTTS demonstrator aircraft, above, is painted in the Jayhawk livery, and except for the extra window in the door and the thrust reversers, this is how a T-1A will look.

In the Classroom

Work of the T-1A TS team is integrated by McDonnell Douglas Training Systems. Additionally, MDTS is responsible for developing and implementing ground-based academic training and computer support for the program.

Since McDonnell Douglas first entered the training field in the early 1980s, its efforts have expanded rapidly, and the company now handles aircrew or maintenance training for fourteen US military aircraft, including the KC-10, the C-17, and five fighters or tactical support platforms for the Air Force, plus the first totally integrated US training system, the Navy's T45TS.

As a result of corporate restruc-

turing to bring military training under one organization, T-1A TS management moved to the company's headquarters in St. Louis, Mo., from Long Beach, Calif., earlier this year. MDTS will close its Bedford, Tex., operations next summer, consolidate work, and transfer employees to its facilities in St. Louis and Aurora, Colo.

In Aurora, work is progressing on the design and development of the academic courseware, which includes computer-based instruction, for the T-1A TS. The system will allow students to undertake self-instruction and advance at their own pace. There will be three courses of classroom instruction—one to train the first cadre of instructors, one to train future instructors (the Pilot Instructor Training program run by the 12th Flying Training Wing at Randolph AFB, Tex.), and one for SUPT students.

"Computer-based training is a wonderful advancement," says Fred Chana, program development director at MDTS, "but we have found that not *everything* has to be done on a computer. Some things can be done on paper, and some need stand-up instruction. After careful analysis of our customer's requirements, we'll use the most cost-effective mix."

MDTS will hire the T-1A TS ground instructors, who also will operate the simulators. Most will be former military personnel with training or operational flying backgrounds.

The Jayhawk and the T-1A simulator will make use of Collins's Pro Line 4 avionics package. The all-glass cockpit features side-by-side electronic primary flight display and multifunction display for student and instructor. It has an advanced map display capability and can show all navaids, airports, and the active flight plan, as well as checklists, progress pages, and crew notes.

Computer systems will also be put to use in other areas of the T-1A TS program. A training management system will aid in scheduling lessons, allocating resources, and tracking student grades at the five SUPT bases: Reese, Vance AFB, Okla., Laughlin AFB, Tex., Williams AFB, Ariz., and Columbus AFB, Miss.

Training is not a static process, and a new courseware support system will permit Air Force personnel to make changes in computer software. A training media support system will allow changes to be made in the simulator. Finally, a training system support center is to be established at ATC headquarters at Randolph AFB, to enable command officials to monitor the operation of the courseware and simulator and plan for future changes.

The T-1A simulator will make use of the Evans & Sutherland ESIG-500 image generator, with four infinity optics displays and a textured day/dusk/night capability. The ESIG-500 is also used on the Air Force's F-16 simulators and produces high-fidelity visual scenes like this F-16 about to refuel from a KC-10.

Close to the Real Thing

MDTS will also provide flight deck mockup trainers. They will be complete, though nonworking, models of the flight deck of the T-1A aircraft. These will allow students to become familiar with the location of the various instruments and practice checklist procedures before getting in the simulator or the aircraft.

The student pilot's first "real" exposure to the Jayhawk will come from one of eleven simulators Quintron is building for the T-1A TS. Two of these full-scale, fully operational, high-fidelity replicas of the interior of the T-1A flight deck will be assigned to each SUPT training base. The final simulator goes to Randolph.

The newest simulators must fit into the space now occupied by the T-38 simulators; it would be imprac-

tical to add space to the simulator bays at the bases. Part of Quintron's job will be to remove half of the T-38 simulators at each base.

The T-1A simulator will be compact—eighteen feet long, eight and one-half feet wide, and nine feet tall. Two standard-size equipment racks (nineteen inches wide), located in the left rear corner of the cabin, serve as the "brain" of the simulator. Beech is now collecting aircraft data that Quintron will use as the database for the simulator.

A Harris Night Hawk 1200 series computer runs the simulator, one of the first cockpit trainers to operate on Ada, the common computer language adopted by the Defense Department. One requirement is that the T-1A simulator computer must have 100 percent spare computational capacity so changes can be made to it without buying additional equipment.

Changes promise to be easy, thanks to computational system architecture that is built on common module technology. The simulator will use modules known as "VME," for Vera Modula Europa, the European consortium that first established the uniform-size module. Upgrades to the simulator will be as easy as opening the rack and sliding in new modules.

"The government didn't require us to do this," recalls Mr. Cotton, one of the five entrepreneurs who started the Chantilly, Va.-based company in 1984. "We decided to be modular and cut down on nonrecurrent design expense. There must be a zillion companies making the modules, so we are not tied to one company's printed circuit board." That, in turn, will reduce costs.

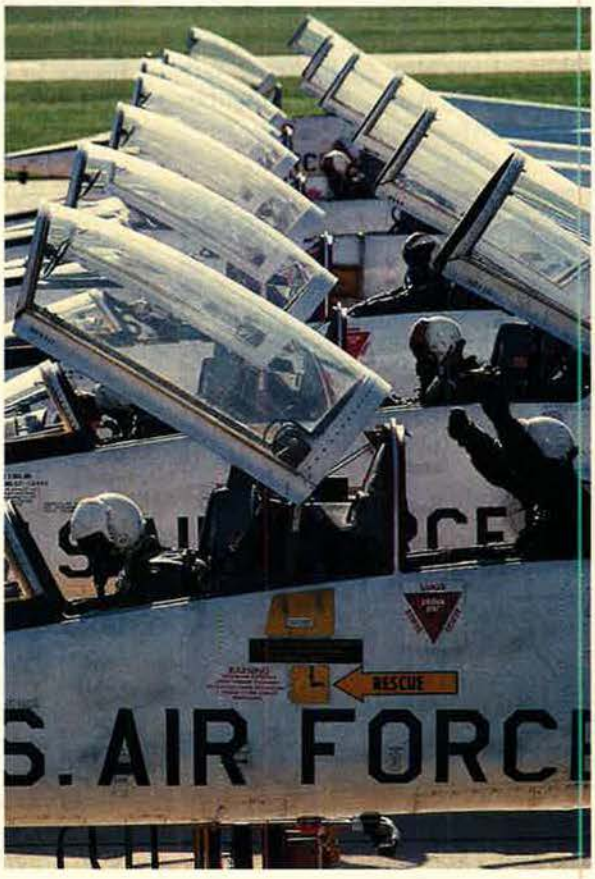
The instructor's station—monitor, keyboard, and printer—is situated behind the left student seat. The instructor's seat is behind and between the two student seats and can swivel to face the work station or the students. Thus, the instructor has the ability to look over the shoulder of either of the two students to make sure they are developing good habits and, at the same time, to monitor the simulation.

The major simulator subcontractor to Quintron, Evans & Sutherland, provides the visual system. The T-1A simulator will use the ESIG-500, the same textured, day/dusk/night system that is used to provide the out-of-the-window visuals for F-16 operational flight trainers. The ESIG-500 will present eighty-five-degree horizontal and thirty-four-degree vertical fields of view to pilot and copilot.

The simulators will not have full-motion capability. "The Air Force has kind of soured on six-post [degrees of freedom] motion systems for small to medium-size aircraft," notes Mr. Cotton. "What they did want [in the T-1A simulator] was vibration for the pilot's seat and higher-frequency cues, which would alert the pilot to stalls, the onset of buffet, and landing conditions."

The simulator will also use the Collins Pro Line 4 five-tube, color electronic flight instrumentation system (EFIS) that will go into the actual airplane. Because most tankers and transports use round-dial technology in their cockpits, using an EFIS may seem extravagant. However, the Air Force wants to modernize all cockpits eventually with nonmechanical displays, so early exposure to these types of instruments will help students. Installing them now reduces cost.

Another key advantage to an EFIS: The amount of information displayed on the instruments can be changed. "When a student starts flying the T-1, for instance, a basic compass rose can be displayed," says Mr. Wells. "Later on, when he has gained more experience with the airplane, a weather radar can be displayed over the compass. The EFIS displays are also much more reliable than standard gauges."



The T-1A TS contract is the first step in the Air Force/Navy Joint Trainer Master Plan. Using the T-1As to train tanker and transport pilots will greatly reduce the work load on T-38s such as these, allowing the Talon to soldier on past the turn of the century, when it will be replaced by an all-new Bomber/Fighter Training System aircraft.

—USAF photo by Candy Tate

Meet the Jayhawk

The cockpit instrumentation is one of several changes that will differentiate the military T-1A Jayhawk from the civilian Beechjet 400A nine-passenger business jet. While these changes are substantive, they are not major revisions.

The Jayhawk will have just three seats, two for students and one for an instructor. However, it will have rails to accommodate four extra passenger seats. This will give the aircraft flexibility for use as a personnel transport. Spare seats (each base will get several sets) will be bought later under a separate contract.

Aft of the seats, a small galley of commercial design will be installed on the port side. A built-in storage

locker for maps, charts, and other paperwork goes on the starboard side. In the rear of the cabin, a folding partition will provide lavatory privacy and will hide the avionics cabinet, located on the right side. Low-heat-release interior panels will be installed for safety.

The avionics have to be located in a rack inside the aircraft because space was needed to install an air-conditioner in the Jayhawk's nose. The air-conditioner will need external power on the ground, but is a vital piece of equipment for both crew comfort and smooth functioning of the avionics equipment, which could break down in the hot climates found at the SUPT bases.

On each side of the fuselage, the Jayhawk will have three fewer windows than the Beechjet, mainly because windows allow the sun to heat the avionics. To simplify maintenance, the window will be removed from the port side cabin entrance door and from the emergency door on the starboard side. The T-1A's emergency door will be forward of its location on the Beechjet to allow straight-through egress.

The Jayhawk's windscreen, forward bulkhead, wing leading edges, stabilator, and fin will be strengthened to better withstand birdstrikes. The wing carry-through structure and attach points for the plane's Pratt & Whitney JT15D-5B engines are also being beefed up to help the airplane withstand the stresses of low-level flight, one of ten flight profiles in the 119-hour-long course that tanker/transport students will fly.

The Jayhawk will have a single-point refueling system, requiring the reengineering of the Beechjet's fuel system. TTTS requirements stated that the aircraft has to be "turned" for a new flight within thirty minutes. With the new system and pressure fueling, the T-1A can be fueled in roughly twelve minutes.

Modifications have increased the military airplane's weight by approximately 300 pounds over that of its civilian cousin, bringing the empty weight of a Jayhawk to 5,200 pounds. This meant the T-1A needed stronger brakes than the Beechjet's. "We have developed new brakes that essentially double the energy absorption properties over the brakes on the civil version," says Claude Foltz, Jayhawk systems engineering manager. The T-1A won't have thrust-reversers, mainly to avoid maintenance on a complex part.

—Photo courtesy of Beech Aircraft

The first Jayhawks are being built in Beech's experimental hangar. Once production starts in earnest, the T-1As will come down the assembly line side by side with their civilian cousins, as shown here. Beech is doubling the size of its Beechjet assembly facility to handle Jayhawk production.

Several other changes will make maintenance of the T-1A easier than that of the Beechjet. For example, the windshield on the civilian version must be installed from the inside of the aircraft, a complex process requiring up to forty hours of work and removal of the instrument panel. On the T-1A, replacement can be made from the outside in about thirty minutes.

A Former Diamond

An interesting story lies behind the choice of the Beechjet as the Air Force's newest trainer. The aircraft was designed by Mitsubishi Heavy Industries, the Japanese industrial giant, in the early 1980s. Beech, which had in recent years invested $350 million in its futuristic, all-composite, top-of-the-turboprop-line Starship, could not afford to start a new corporate jet program but was looking to fill out its product line.

So, in 1985, Beech acquired US and non-Japanese world marketing rights to the Mitsubishi Diamond aircraft, renaming it the Beechjet. Later, Beech exercised a contract option and brought manufacture of the airplane to its facilities in Wichita and Salina, Kan. The Beechjet is now completely US-made.

Sales of the Beechjet were steady. However, deliveries slowed because of the manufacturing transfer from Japan to the US. In fact, the company had delivered only sixty-five by the time of the announcement of the TTTS award. Two weeks later, with instant credibility because of the Air Force buy, Beech had thirty-two additional firm orders for new Beechjets.

To accommodate construction of 211 Jayhawks and the large number of Beechjets now on order, production facilities are to be expanded. Plant IV, one of the production buildings inside Beech's square-mile facility in Wichita, will grow by 120,000 square feet, more than doubling its size.

Production of Jayhawks is scheduled to ramp up to forty-eight aircraft in 1994. The last of the T-1As will be delivered in 1997. Beech Aerospace Services, Inc., a wholly owned subsidiary based in Madison, Miss., will provide on-site technical representatives for engine, airframe, and avionics maintenance at bases where Jayhawks are stationed. BASI will also provide parts, equipment, and work on some ground-support equipment.

"All of the parts are in place, and the companies are working together," concludes Mr. Foltz. "The challenge now is to deliver what we've promised and to do it on time and on budget." ■

The new gear includes an improved chemical protection suit and a personal air-conditioning vest.

Cooler Wear for Desert Warriors

By Colleen A. Nash, Associate Editor

WHEN the threat of chemical warfare in the Persian Gulf emerged last summer, Air Force Systems Command pushed ahead with development of new personal protective equipment for troops operating in oppressive desert heat.

The result: new, one-piece aircrew and ground crew chemical-defense suits that are cooler, lighter, and perhaps far more effective than the bulky, multilayered outfits in use until now. In addition, the effort produced the Multiman Intermittent Cooling System (MICS), based on an individual air-vest undergarment that provides cooling relief in the hottest temperatures. Each air vest costs $168. The Air Force originally planned to start production of the new suits in 1992 but sped up production by two years.

Gen. Ronald W. Yates, commander of AFSC, said the new equipment will help airmen "effectively deal with the threat of chemical warfare" in extreme heat. At a special briefing for the press held during AFA's National Convention last September in Washington, D. C., the Commander outlined the development and accelerated procurement of the new chemical gear, and system experts provided details.

"The danger of a chemical attack," said General Yates, "is clearly one of the most serious threats our forces face." Iraqi leader Saddam Hussein had repeatedly threatened to use chemical weapons against the multinational forces in Saudi Arabia, which would force US troops to wear protective gear. The older, cumbersome chemical defense equipment previously in use reduced the effectiveness of military personnel by fifty percent, by some accounts.

In the Saudi Arabian desert, where temperatures have gone as high as 120 degrees Fahrenheit, chemical defense gear does more than hamper readiness. Once outfitted in the notoriously hot suits in use up to now, "your body temperature will start rising in a New York minute," reported Dr. Robert J. Reyes of AFSC's Human Systems Division, Brooks AFB, Tex.

An Airtight Envelope

The body "normally removes this heat by sweating," explained Dr. Reyes, but it can't do so "when

Capt. Dave Little models the Air Force's new, cooler, lighter, ground crew chemical defense ensemble. More than forty news media representatives attended the AFSC briefing held during AFA's National Convention last September in Washington, D. C.

—Photo by Paul Kennedy

wrapped in what amounts to an almost airtight envelope." This thermal buildup can lead to heat stroke, which is frequently fatal. "If you've ever worn your heaviest clothes in west Texas in the summer, you can get an idea of what this is all about."

Bob May, director of AFSC's Human Protection Systems Division, Wright-Patterson AFB, Ohio, gave a description of the new aircrew and ground crew chemical defense ensembles that replace the "hot, bulky, and very heavy" ones worn by USAF personnel in the earliest weeks of Operation Desert Shield. Reporters got a close look during the briefing as models displayed the old and new garb.

Mr. May emphasized that the new one-piece ground crew ensemble not only weighs less than the older two-piece version but also is fifty to sixty percent cooler. The new tan jumpsuit is made of fire-resistant Nomex and is impregnated with microscopic spheres of charcoal that filter out chemical agents. All new ground crew suits will be specially treated with a liquid to repel chemical agents.

The new ensemble for aircrews is similar to the new one for ground crews, but it is olive drab and will not be treated with repellent. It weighs less than the current three-piece aircrew outfit and is twenty to thirty percent cooler, said Mr. May.

The one-piece aircrew suit boasts one other feature: It can be laundered up to ten times before the washing starts to affect its capabilities. If the charcoal layer of an older aircraft suit is laundered, its chemical filtering powers vanish.

Mr. May emphasized that the improved ground crew and aircrew suits are just as resistant to chemical agents and fire as the older ensembles are. In addition, AFSC has improved a key component of the full chemical defense regalia for aircrews—the Aircrew Eye/Respiratory Protection (AERP) system. The improved version will better protect aircrews against both chemical and biological agents.

The older device has a filtering mask and a separate hood assembly, both of which fit over the flight helmet. According to AFSC, the system can interfere with pilot performance and may even endanger crew members in an emergency ejection.

The new AERP system is safer and more comfortable. The mask is embedded within the hood, which fits under the helmet. The new AERP also features a blower, a drinking tube, and a ground communications unit. The blower helps to defog the mask and provides filtered air for breathing during ground operations. Mr. May said the system is "completely compatible with all existing Air Force life-support equipment and all ejection seats."

Personal Air-Conditioning

"If we can't turn the planes, we can't fight the war," General Yates told the briefing audience, which is why "we had to find a way for our ground crews to work, even in the new chemical gear, when the temperature is unbearable."

Air Force researchers, and Dr. Reyes in particular, found the way. As the architect of MICS, Dr. Reyes described in detail how his design will help keep flight-line workers cool during Operation Desert Shield.

MICS has three major parts: the air-conditioner, the adapter filter system, and the vest. As Dr. Reyes

explained it, the system hooks into air-conditioners normally used for cooling aircraft electronics systems during repairs. As refrigerated air moves through a hose, it passes through chemical agent filters and into the vest worn by ground crews under their protective clothing. Up to ten airmen can "hook up" to MICS.

Dr. Reyes got the idea for MICS after visiting an Air Force exercise. "I realized that air-conditioners were available on the flight line," he recalled. "All we had to do was match the air-conditioner outlet, clean the air of chemical agents with a filter, and provide enough outlets for the ground crew." Dr. Reyes also pointed out that ground crews can hook up to MICS during their scheduled rest periods.

AFSC figures that MICS will not only help airmen beat the heat but will boost readiness as well. Because flight-line workers will work more efficiently in a chemical defense environment, AFSC says this translates directly into a greater potential for "a higher rate of sorties flown by aircraft."

—Photo by Paul Kennedy

Dr. Robert J. Reyes explains how the system he designed—the Multiman Intermittent Cooling System (MICS)—will help flight-line workers keep cool while operating in the desert heat. Capt. Matt Dorn is shown here wearing the MICS air vest, which ground crews wear under their protective clothing. MICS went directly from R&D to production in only two years, said Dr. Reyes.

Fast Tech

"It is no secret," declared General Yates, "that our Air Force has called upon every ounce of our people's talents and every microchip's worth of our technological superiority during the past six weeks."

In order to get the technology out to the field quickly, said the General, the Air Force is "awarding contracts in record time."

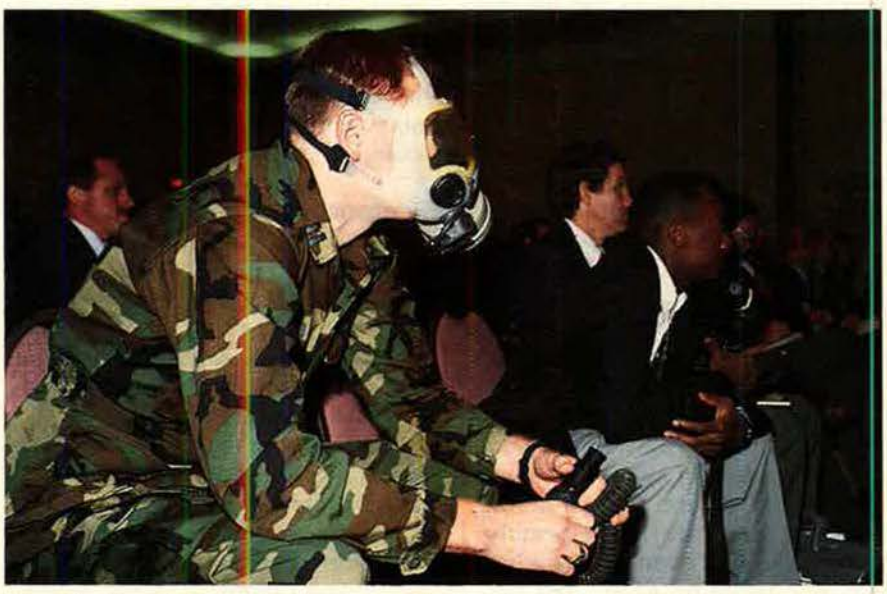
The Air Force awarded a $26.9 million contract for new chemical defense ensembles "just three weeks after requirements were defined," General Yates noted. On September 7, Hoechst Celanese Corp. of Charlotte, N. C., won the contract; it is to complete production of 16,150 aircrew and 35,574 ground crew ensembles by early 1991.

Mr. May said flight-testing of the improved AERP system is being conducted "on an accelerated basis." The Air Force is negotiating an emergency purchase of several thousand systems. Once a contract is awarded, production will begin immediately, with delivery of the first units to the field in three months.

The MICS program is set on fast forward, too. Dr. Reyes explains: "It can take seven to ten years to take a weapon system from the drawing board to operational use. After negotiating with the San Antonio Air Logistics Center at Kelly AFB, Tex., and some successful operation and engineering tests, the Air Force was able to take MICS directly from R&D to manufacturing in only two years."

In late August, San Antonio ALC awarded a $3.86 million contract to Fairchild Aircraft Co. to develop the MICS adapter and several thousand vests.

Dr. Reyes said that the reason AFSC did not have a complete unit for demonstration at the briefing was because "the first units made at Brooks AFB are crated and en route to Saudi Arabia." Dr. Reyes added that production units "should be ready to follow within forty-five days." ■



—Photo by Paul Kennedy

When the threat of chemical warfare in the Persian Gulf emerged last summer, AFSC pushed ahead with development of new personal protective equipment for troops operating in desert heat. Here, Capt. Matt Dorn gets set to show the crowd his MICS air vest that he wears underneath his BDUs.

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Tomorrow's fleet, most of which is on the ramp today, will need help from microelectronics.

New Avionics for Aging Airplanes

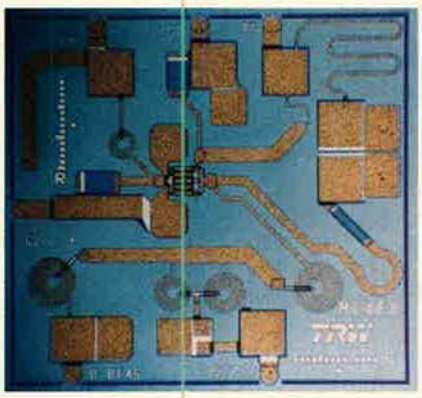
By John Rhea

EIGHTY percent of the aircraft that Air Force pilots will be flying in 2010 can be found on the ramp today. To keep those aircraft flying and capable of performing their missions, upgrades are needed for all principal elements—structures, engines, and avionics.

Of the three, avionics offers the greatest opportunity for high-leverage use of emerging technologies.

Such avionics upgrades are the focus of the Microelectronics Technology Support Program (MTSP) at the Advanced Electronics Technology Center (AETC) at Sacramento Air Logistics Center, McClellan AFB, Calif. Located across San Francisco Bay from Silicon Valley, the organization is the Air Force's high-tech center of excellence in microelectronics *[see "Revolution in the Hangar," by Douglas Baldwin, April 1990 issue, p. 78]*.

Typically, avionics maintenance is performed by a combination of industrial contractors and the in-house AETC work force of more than thirty government engineers. The MTSP effort, however, is extending this approach, explains Jim Dininger, Air Force program man-



—Staff photo by Guy Aceto

MIMIC-type chips like the gallium arsenide signal-mixer above will be used to update the avionics systems of weapon systems like the B-52 (right), some of whose technologies date back to the 1950s and 1960s.

ager at Sacramento. It is pushing to upgrade the electronics of *all* weapon systems facing obsolescence, not just aircraft. Although it is an Air Force program, MTSP may also eventually provide some benefits to other services and nondefense agencies such as the Federal Aviation Administration and the National Aeronautics and Space Administration.

Anticipating Advances

The MTSP concept, in general, is to exploit predictable technological advances of the electronics industry and do so in a planned, coordinated way in order to shorten lengthy development cycles and reduce the number of low-volume procurement actions that drive up unit costs of spares and new systems. It means, in other words, moving each service away from the practice of reinventing the other service's wheel—or computer.

The new program got approval from Air Force headquarters in July 1989. One year ago this month, four companies were selected to provide the MTSP operation with its all-important engineering support services. The winners were Control Data, Honeywell, Hughes, and TRW. The four have been, in effect, "prequalified" to tackle a series of electronics upgrade tasks when and where they are judged to be needed.

Each of the four contractors currently is working on several major tasks. The official statement of work requires them to focus on three areas:

- Engineering analyses, including emulation and reverse engineering, to determine where to replace obsolescent parts.
- Advanced technology insertion, primarily to determine how best to carry out this process.
- Limited production of hardware, in order to get new parts into prototype systems quickly.

As Mr. Dininger explains it, the MTSP is not a "normal" spares procurement contract. Procurement of spares directly from current data is not allowed. However, the contractors are free to reverse engineer, design, develop, and produce prototype spares of a limited number.

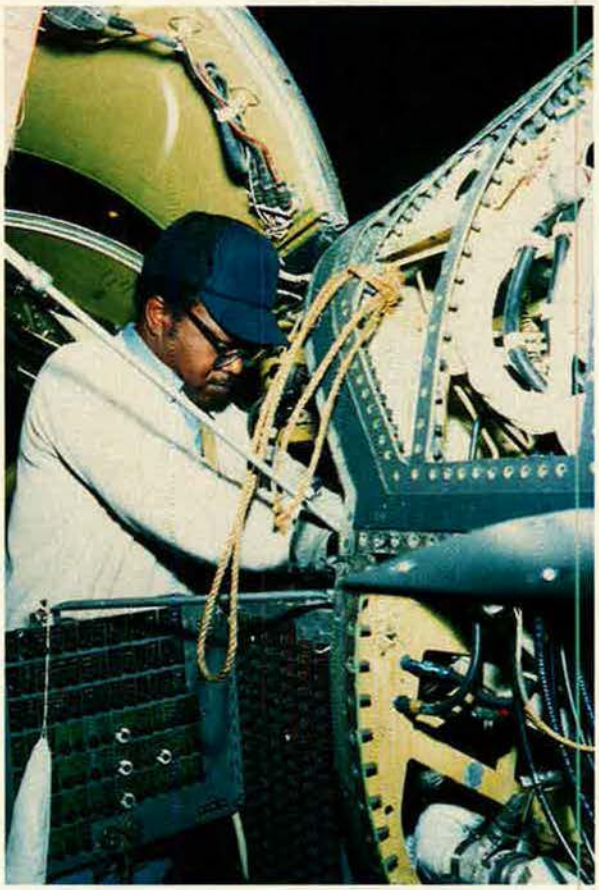
There will probably be subcontracting opportunities for six unsuccessful bidders: General Dynamics, Lockheed, McDonnell Douglas, Rockwell International, Stanford Research Institute, and Westinghouse. Other work is expected to go to producers of microchips.

As Air Force officials see it, the MTSP effort may find its biggest payoff in the application to existing systems of leading-edge component technologies developed under DoD's very-high-speed integrated circuit (VHSIC) and microwave/millimeter wave monolithic integrated circuit (MIMIC) programs, as well as powerful fiber-optic data buses developed elsewhere. For example, engineers are working to produce a VHSIC-based central computer system to replace the F-111's current "black box" type. VHSIC replacement will be a single black box with ten times more memory and four times more speed.

A catch exists, however: This work has to be done without changing the system architecture of an avionics system. Where the upgraded system meets the rest of the weapon system, there must be an identical form, fit, and function.

Greatly complicating this demand is the fact that some technologies dating back to the 1950s and early 1960s can still be found in weapon systems that are operating today; the B-52 and F-111 aircraft and the Minuteman missile are three prime examples. In looking over some older Air Force systems, Mr. Dininger reports, he has found obsolete diode-transistor logic (DTL) circuits. He has not yet seen, but has heard of, an Army system that uses ancient and virtually extinct vacuum tubes.

Nobody makes DTL circuits anymore—or vacuum tubes either, other than for highly specialized functions. The Department of Defense has labeled this problem "diminishing manufacturing sources," and it is analogous to the problem that forces antique car owners to hand-build their own parts: The companies that built them originally have long since gone out of business.



At Sacramento Air Logistics Center, McClellan AFB, Calif., a maintenance technician installs electrical wiring in an FB-111A. With upgraded avionics, including terrain-following radar and a digital flight-control system, the strategic bomber will enjoy a new career with TAC.

More VHSIC Components

Control Data, which began inserting VHSIC components into airborne computers long before MTSP was launched, is preparing to do the same for the older computers of the

F-111 and B-52, says Bob Biggs, the company's MTSP program manager in Minneapolis.

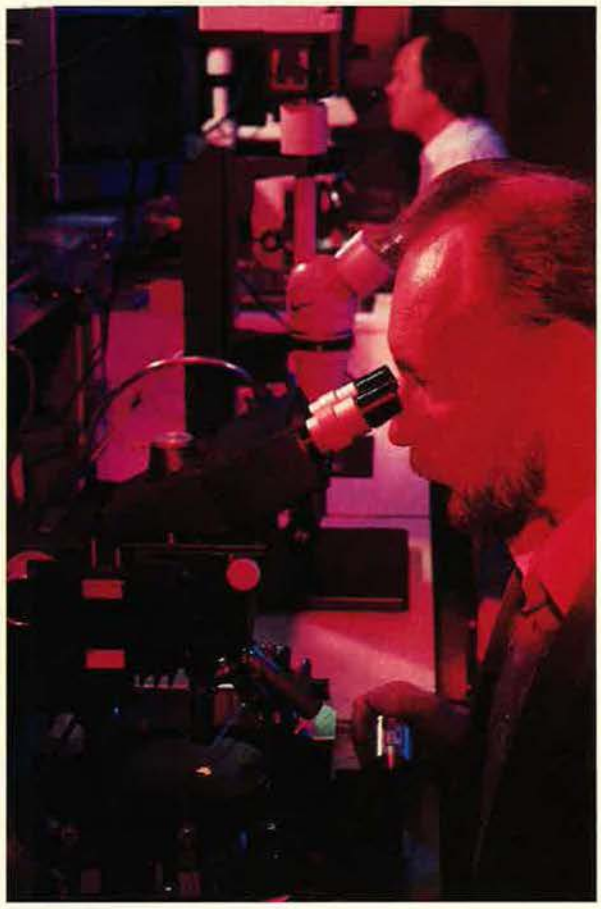
The Air Force assigned Control Data the task of developing the specifications to upgrade the F-111 stores management system to improve its reliability and maintainability. Because the F-111's stores include bombs and fuel tanks, which can wreak havoc if dropped accidentally, reliability is a critical concern. The F-111's service life has been extended once again to the year 2010, and Mr. Biggs sees it as a strong candidate for VHSIC insertion.

Control Data is studying possible new ways to reduce the number of line replaceable units in the B-52 bomber's electro-optical visual system used in battle management and low-altitude operations. In addition, it has work under way in artificial intelligence for application to the Extendable Integration Support Environment (EISE) program. The latter is aimed at replacing manual methods used in flight test stations that check out avionics upgrades before they go into aircraft.

Honeywell's MTSP program manager, Harvey Lange, reports that his team is focusing on emulation of current parts to get a handle on how they can be replaced by more advanced versions.

Mr. Lange lists as his highest priorities those subsystems currently using the oldest parts. These subsystems include power supplies, test equipment, stores management, flight controls, and radar warning receivers. Honeywell had been working on applying VHSIC technology to the F-111's weapons navigation computer before MTSP was launched and reportedly is looking to extend that effort to the F-16 and B-52. This is said to involve a three-chip hybrid package, known as the 1757, that would emulate the existing 1750A architecture.

At Hughes, MTSP program manager Luis Garcia, of the Electro-Optical and Data Systems Group, El Segundo, Calif., puts future upgrading of radars at the top of his priority list. It's not necessarily because radars have more problems, maintains Mr. Garcia, but because there are more of them—on the ground as well as in the air—and they're used more than other subsystems.



The Microelectronics Technology Support Program at the Advanced Electronics Technology Center, part of Sacramento Air Logistics Center, hopes to upgrade the electronics of all weapon systems facing obsolescence, not just aircraft. MTSP research may also benefit other services and nondefense agencies such as the FAA and NASA.

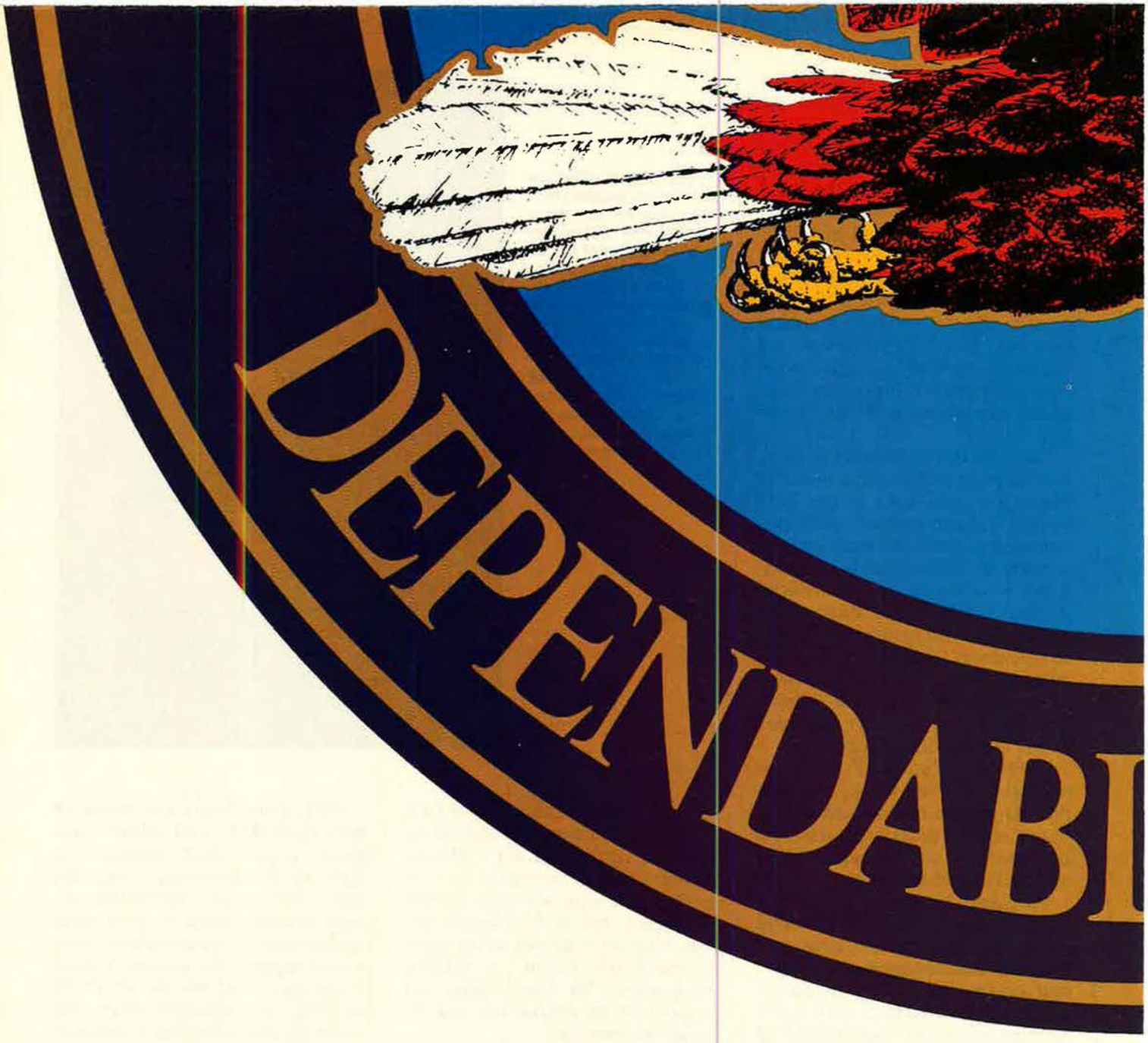
Before the creation of MTSP, Hughes had been working on an upgrade for the Army's M1-A1 Abrams tank. Currently, it is at work on an upgrade task for the Minuteman Mk. 82 fire-control system. Hughes is not yet to the point of specifying VHSIC or MIMIC components, Mr. Garcia adds, but is working on emulations and reverse engineering.

Dr. William L. Reber, MTSP program manager at TRW's Electronic Systems Group in Redondo Beach, Calif., lists three programs under way: development of a MIL-STD 1773 fiber-optic data bus for the F-111, insertion of VHSIC parts to upgrade the AN/FPS-117 minimally attended ground radar computer system, and simulation efforts for EISE, aimed at developing generic software that can be reused on different aircraft. The prototype of the F-111 fiber-optic data bus is due to be completed by the end of this year and flight-tested in 1991.

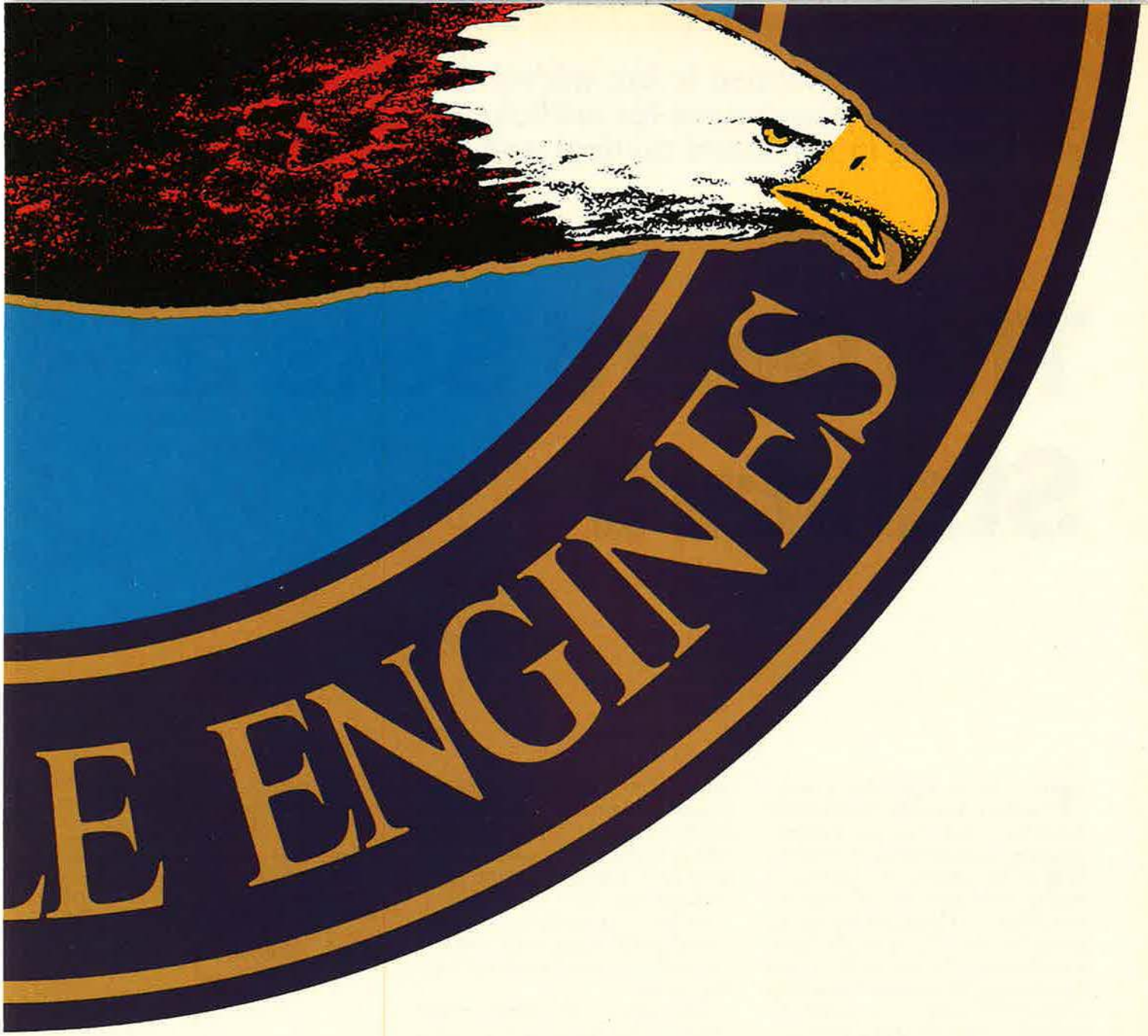
TRW, which was a contractor on both the VHSIC and MIMIC programs, is particularly interested in applying the technology from the latter, with its own monolithic gallium arsenide chips, in such radar applications as preamplifiers. They would replace the present hybrid components and provide improved reliability and maintainability. The company also is looking at opportunities for fiber optics, photonics, and neural networks.

MTSP Manager Dininger, looking beyond the Pentagon's immediate needs, sees possibilities for applying MTSP-derived technology to the needs of FAA and other government agencies. One prime example: runway visibility indicators, which are vulnerable to lightning strikes. The solution being explored by his group calls for replacing conventional copper wires with nonconducting fiber-optic cable, a change that could increase safety in commercial as well as military aviation. ■

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, "The Robots Are Coming," appeared in the September 1990 issue.*



WHAT KIND SHOULD GO



OF ENGINES IN THE ATF?

UNITED TECHNOLOGIES PRATT&WHITNEY

The bare base exercise in the midwest established a benchmark for proficiency and training in Air Guard tactical units.

The Guard Sets a Standard

By Bob Roskuski

THE exercise began July 8 when twelve F-16s of the Air National Guard's 170th Tactical Fighter Squadron took off from their home field in Springfield, Ill. Each was loaded with inert Mk. 82 conventional bombs. Flying 500 feet above ground level at 475 knots, the fighters traversed the 400 miles to the target range in Kansas. There they dropped the ordnance, scoring direct hits. After all twelve F-16s refueled, six turned homeward.

Then came the really interesting part of the exercise.

As the first six F-16s headed home, the remaining six flew to a preestablished "bare base" airfield in Quincy, Ill., set up and manned by support personnel of the 183d Tactical Fighter Group, augmented by communication, air traffic control (ATC), and ground control intercept (GCI) radar units from other commands.

After landing, the F-16s quickly were refitted with AIM-9 Sidewinder missiles for air defense. In this integrated combat turn, armament technicians, assisted by crew chiefs of the 183d Consolidated Aircraft Maintenance Squadron (CAMS), removed 300-gallon centerline fuel tanks and bomb pylons, then refueled the planes. Flight-line crews and alert pilots sweltered in 100-degree heat reflected off the white concrete runway.

Only two hours after arrival, four reconfigured F-16s were ready to scramble to meet intruding "enemy" planes.

The place was the American midwest, and the operation was Falcon Baldwin '90, a carefully planned ANG force-projection exercise. One year in the making, it established a new training proficiency benchmark for Tactical Air Command ANG flying units.

Typically, ANG units deploy and train at established facilities such as Savannah IAP, Ga., or Phelps Collins ANGB in Alpena, Mich. Such field training sites meet the day-to-day needs of visiting units who come to conduct flying operations, providing everything from mess halls and fuel trucks to heated or air-conditioned maintenance shops and well-equipped fire rescue facilities.

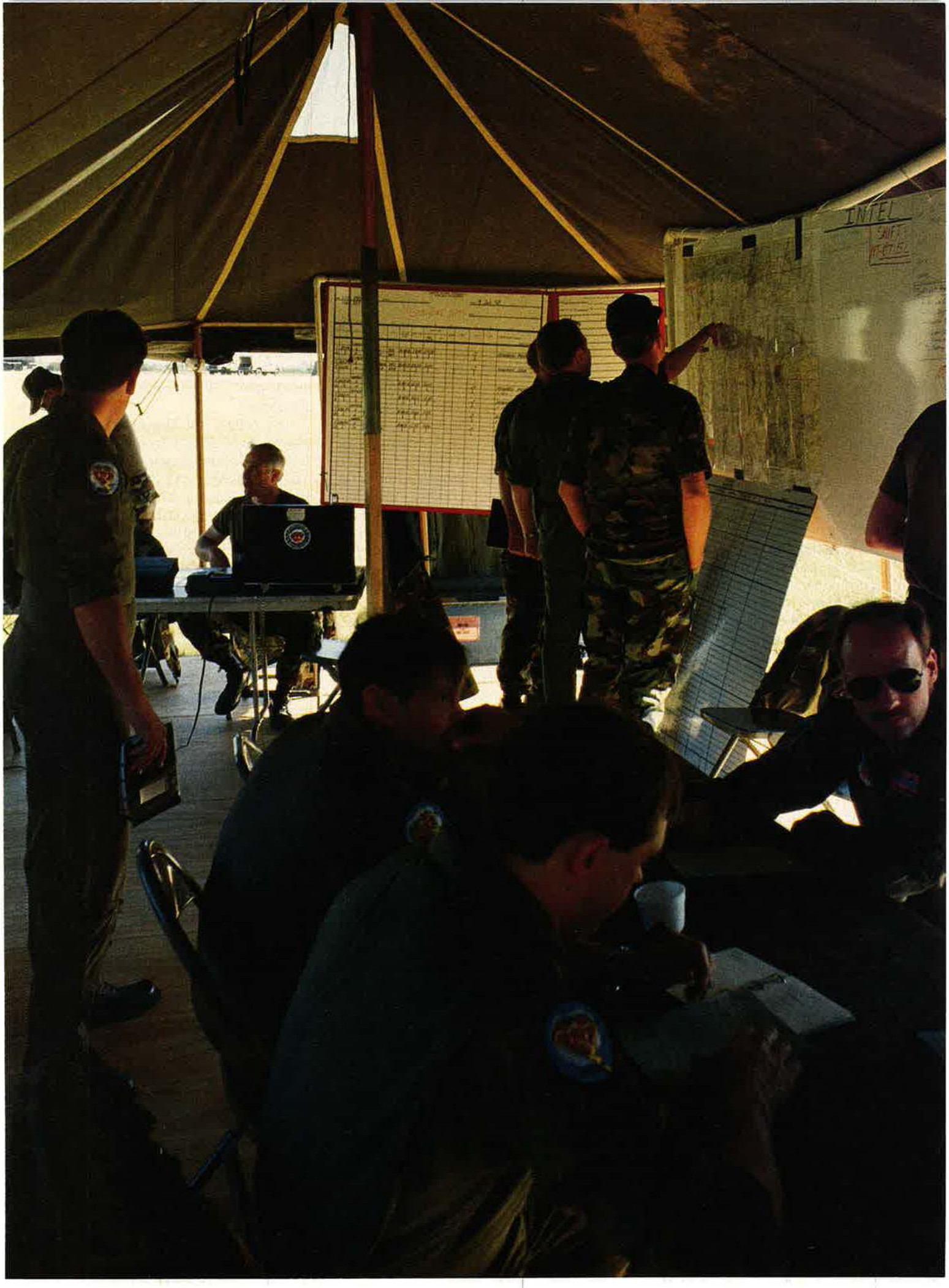
Annual training had settled into a routine in which an ANG unit would deploy hundreds of airmen but actually transport, set up, and operate little, if any, equipment.

Col. Richard E. McLane, air commander of the 183d TFG, parent unit of the 170th TFS that flew in Falcon Baldwin, concluded that routine use of field training sites, year after year, would undermine his unit's ability to plan, improvise, and adapt to adverse operating conditions at so-called "bare bases."

His belief grew out of time spent

Concluding that deployments to well-appointed field training sites had become routine, Air Guard commanders launched Falcon Baldwin to see how their units could cope at a bare base, where all they would have to work with was what they brought in. At right, personnel from the 183d Tactical Fighter Group prepare for an intelligence briefing in the operations tent.

—Photo by Bob Roskuski


INTEL

accompanying the 183d's Civil Engineer Prime BEEF (Base Engineer Emergency Force) detachment at remote strips in Central America. As Colonel McLane puts it, "It became apparent that flying units may be called on to adapt to and operate from locations where all they will have to work with is what they carry in."

An Imposing Challenge

Operating from a bare base requires sophisticated equipment, not to mention spares, tools, food, and the like. Such a deployment is a most imposing challenge.

In order to test his unit's ability to meet such a challenge, Colonel McLane and Lt. Col. Alan Paige, the 183d's deputy commander for operations, scripted Falcon Baldwin. "We wanted to bring together all the people and equipment it takes to operate a bare base," says Colonel McLane, "then collocate them and see if it works."

Up to that time, an undertaking of such magnitude had not been attempted by an individual ANG wing or group. Home states could not provide all the units required for all of the skills and equipment necessary for an exercise as large as Falcon Baldwin '90. Planning had to include not only the National Guard Bureau and a selection of major commands but also officials in states that had to provide certain support units.

The first major task was to locate a workable bare base. The deployment site had to have ample runway length, adequate ramp space, and sufficient open area to be able to marshal equipment and pallets, lay out a tent city, and put down radar and communication emplacements.

Planners quickly settled on Baldwin Airport, near Quincy, Ill. Lt. Col. Wayne Rosenthal, the 183d's deputy commander for resources, explained that the airport has three high-quality runways and enough space to accommodate all the support facilities and equipment that was to be brought in. The airport is located far from town, and this would help minimize aircraft noise in the more populated areas.

It had another attraction. "Quincy has virgin concrete," remarked one F-16 pilot. "The runways and taxiways haven't been beaten up by commercial carriers. It's a nice clean airport."

Also critical to the choice: Quincy Baldwin Airport lay under the southwest corner of Howard Military Operating Area (MOA), a thirty-five-mile-long chunk of dedicated military airspace that reaches from 10,000 to 29,000 feet above ground level. Moreover, under a special FAA waiver, F-16s departing Baldwin could bypass Kansas City Center Control and communicate directly with on-field GCI controllers.

Finding parking space for the F-16s posed a problem. The F-16 has a footprint weight of 30,000 pounds. Ramps near existing Baldwin facilities lacked the strength to support six F-16s parked together. Because of this, Baldwin's manager closed the north-south runway and turned it into ramp space, not only yielding proper strength but also providing a closed taxiway suitable for a tent city, a Prime RIBS (Readiness in Base Services) mobile kitchen emplacement, and vehicle parking.

The Base Comes Alive

As Falcon Baldwin got under way, the airport "base" began to come alive with equipment and personnel, not only from the 183d TFG in Illinois but also from ANG units from six other states. Lt. Col. Ray Boosinger, deputy commander for support of the 183d TFG, managed all support activity save communication and air control. Lt. Col. Robert Canter of Hq., 251st Combat Communications Group, Ohio ANG, handled these two functions plus GCI radar.

Radio, land-line, and microwave communication responsibilities were assigned to the 269th Combat Communication Squadron of the Missouri ANG. Under the direction of Capt. Kent Cooper, the communications site commander, SB-3614 Tactical Switchboards, URC-119 Pacer Bounce radios, and a TRC-97 van with an MRT-2 parabolic microwave antenna provided voice communication among units at Baldwin and between them and the outside world.

Microwave communication requires dedicated antennas at both ends of a communication path. Topographical path profile studies were made to determine the optimum azimuth and deflection angles for both antennas. As it turned out, the flat terrain of central Illinois was excellent for microwave communication.

Personnel from three states made up the air traffic control support group during the exercise.

Indiana's 235th ATC Flight deployed its vehicle-mounted TSW-7 Mobile Control Tower along with metro sensors, visual and voice communications equipment compatible with both civilian and military aircraft, and the tower's environmental control unit. In a two-day road trip, maintenance personnel from the 235th hauled in their equipment, set it up, and remained on site for day-to-day calibration and troubleshooting.

Controllers for the exercise deployed to Baldwin from the 239th Combat Communication Squadron, Missouri ANG, and the 237th ATC Fight, Minnesota ANG. Tower operations were conducted during daylight hours. Military controllers handled all arriving and departing traffic during those hours.

Once the base setup was virtually complete, the F-16s at Springfield began Phase One of the exercise. Mission planners were given "hot" intelligence, providing the exact coordinates of a mock enemy ordnance supply site located in the vast reaches of Smoky Hill air-to-ground range in Kansas. Post-raid assessments confirmed that the target would have been neutralized.

Aggressor interceptors detected and engaged the F-16s. Not a single friendly aircraft was lost. In fact, the F-16s chalked up one "kill" of an enemy plane, verified by post-mission assessment of the F-16's gun-camera video. Refueling took place over portions of Iowa and Nebraska, courtesy of the 126th Air Refueling Wing, Illinois ANG, based at Chicago's O'Hare International Airport.

"Enemy" F-15s

With Phase One of the operation completed, Phase Two began. The six selected F-16 fighters of the 170th moved into their new role of air defense and air interdiction. To provide an "enemy" for dissimilar air combat training, the 49th TFW from Holloman AFB, N. M., sent four F-15s, which bedded down at Springfield's Capital Airport. Illi-

—Photo by Bob Roskuski

Falcon Baldwin '90 included an integrated combat turn of six F-16s. Accomplished quickly in 100-degree heat, the turn required the removal of 300-gallon centerline fuel tanks and, here, weapon pylons, as well as refueling and refitting the aircraft with AIM-9 Sidewinder air-to-air missiles.

nois ANG pilots also came up against F-4s and A-7s flown by ANG pilots from other midwestern states. Against this opposition, pilots of the 170th TFS flew a total of twelve to fourteen sorties daily. In all, they logged sixty flying hours and burned 45,793 gallons of JP-4 jet fuel.

In this phase of the exercise, pilots and ground personnel worked together closely. Collocating a GCI radar emplacement with F-16 fighters provided a unique training opportunity. F-16 pilots and GCI controllers sat shoulder to shoulder during pre- and post-mission briefings.

Maj. Lyle Hartling of the 133d Combat Control Squadron, Iowa ANG, conducted briefings for pilots inside his TPS-43 radar vans. Each pilot observed the video map within the radar image display, clearly depicting the Howard MOA airspace and all traffic maneuvering within it. Watching a controlled intercept unfold on the scope and hearing crosstalk between controllers and aircrew gave each pilot a better understanding of how GCI radar pulls the air defense puzzle together.

Major Hartling reports that the Baldwin site provided the radar system a low screening angle with few obstructions. His controllers could monitor traffic below the MOA, enhancing the safety margin required for operation within the MOA.

Elsewhere, fully equipped Security Police Ground Defense Teams took the opportunity to hone air base defense skills while providing round-the-clock protection of aircraft and other assets. For these security police teams, use of night vision goggles (NVGs) added realism to late-night operations.

With civilian traffic moving nearby, shift sergeants had to find ways to prevent unauthorized access to the site yet avoid offending civilians.

Also operating on the scene were fire-control units. Firefighters attached to the 183d Civil Engineer unit deployed to Baldwin with their fire trucks, the first time they have done so. One P19 unit and one P4 vehicle traveled on a flatbed truck from Springfield to Baldwin Airport, a trip of about ninety miles. Along with them came one P10 rescue truck.

Foam concentrate and other fire rescue materials were transported to the airport on Illinois Army National Guard cargo trucks. Even though Air Force air transport was not available, all materiel was prepared for and placed on pallets in conformity with mobility plan directives, as if they were to be loaded on airlifters rather than trucks.

The 980-Foot-Long Rubber Band

In addition to providing fire and rescue coverage, the 183d Civil Engineer's Prime BEEF Detachment set up a BAK-12 mobile aircraft arresting system to slow down and stop the landing F-16 fighters. Similar to conventional systems in use at many airports, this mobile system was transported to the bare base runway, emplaced, and certified by allowing it to stop an F-16 taxiing at high speed.

Exercise leaders obtained the BAK-12 system, one of only two such systems possessed by the

—Photo by Bob Roskuski

Prime BEEF engineering detachments also participated in the exercise. In addition to providing fire and rescue coverage, they set up this BAK-12 aircraft arresting system, which has been described as a "980-foot rubber band," at Baldwin Airport, Ill., to slow down and gently stop landing F-16s.

—Photo by Bob Roskuski

The week-long exercise exceeded expectations, providing realistic training in several specialties to Guard units from seven states. Indicative of the tight coordination achieved, this F-16 was ready to scramble for an air defense role only two hours after completion of a successful bombing run.

ANG, from Volk Field ANGB, Wis. Once in position, the BAK-12 can be operational in about two hours. In the BAK-12 system, the barrier strap pulls out to a length of 980 feet. As the strap unwinds from drums, internal centrifugal brakes tighten in proportion to the rotation speed of the spinning drums. Rather than giving a pilot the sudden stop experienced in carrier landings, the BAK-12 conveys the sense of hooking into a strong rubber band, which then gently slows the plane.

CAMS personnel were deployed to Baldwin airport with only the bare essentials for the proper care and feeding of F-16s. Their primary training goal was to test their plans and actual capability to support a small package of fighter aircraft for one week at a bare base airfield.

Supply and maintenance NCOICs reviewed the units' war readiness spares kits (WRSKs) to ensure that only required items were included. At the site, WRSK materiel was the first source of supply; all of it was adjacent to the parked fighters. Flight-line maintenance and maintenance control shared a tent pitched about fifty yards from the first F-16 on the line.

Power generators, oxygen carts, and mobile light carts as well as WRSK containers and standard flight-line hardware were all transported on forty-foot-long Army Guard tractor trailers. Fuel trucks came from Springfield.

Falcon Baldwin '90 enabled CAMS managers to determine minimum essential requirements for support personnel, communications, and ground support equipment to back up and sustain flight operations.

Colonel Boosinger reports that setup of all functions and units was accomplished in only two days, the forty-eight hours that preceded the arrival of the first fighter aircraft. According to transportation and logistics specialists with the 183d TFG, the units brought in the equivalent of ten C-130 loads of support material and vehicles, including a forklift to haul pallets.

As logisticians and maintainers were setting up, ANG intelligence units also were preparing for operations. The task of the 183d's intelligence operation was to provide aircrews with mission planning support and scenario data that would meet the requirements. Pilots of the 170th's F-16s were given data on types and numbers of "aggressor" aircraft expected in the Howard MOA.

Packing Up Everything

For these units, Falcon Baldwin '90 provided a detailed lesson on what it takes to run an intelligence section in a bare base deployment. Everything—from maps and charts to tables, chairs, and video playback equipment for gun-camera tapes—had to be packed, palletized, and shipped.

One tent, shared with the 170th TFS operations, provided the intelligence unit with its only operating space. Sharing quarters tended to smooth out communications and mission coordination. In pre-mission and post-mission briefings, GCI controllers contributed comments on tactics, mission histories, communication procedures, and call signs.

Intelligence technicians and pilots regularly reviewed the situation board that was maintained in the operations tent. Surface battle situations were plotted and regularly updated. Every effort was made to involve each pilot, before he took off, with every element of the operation.

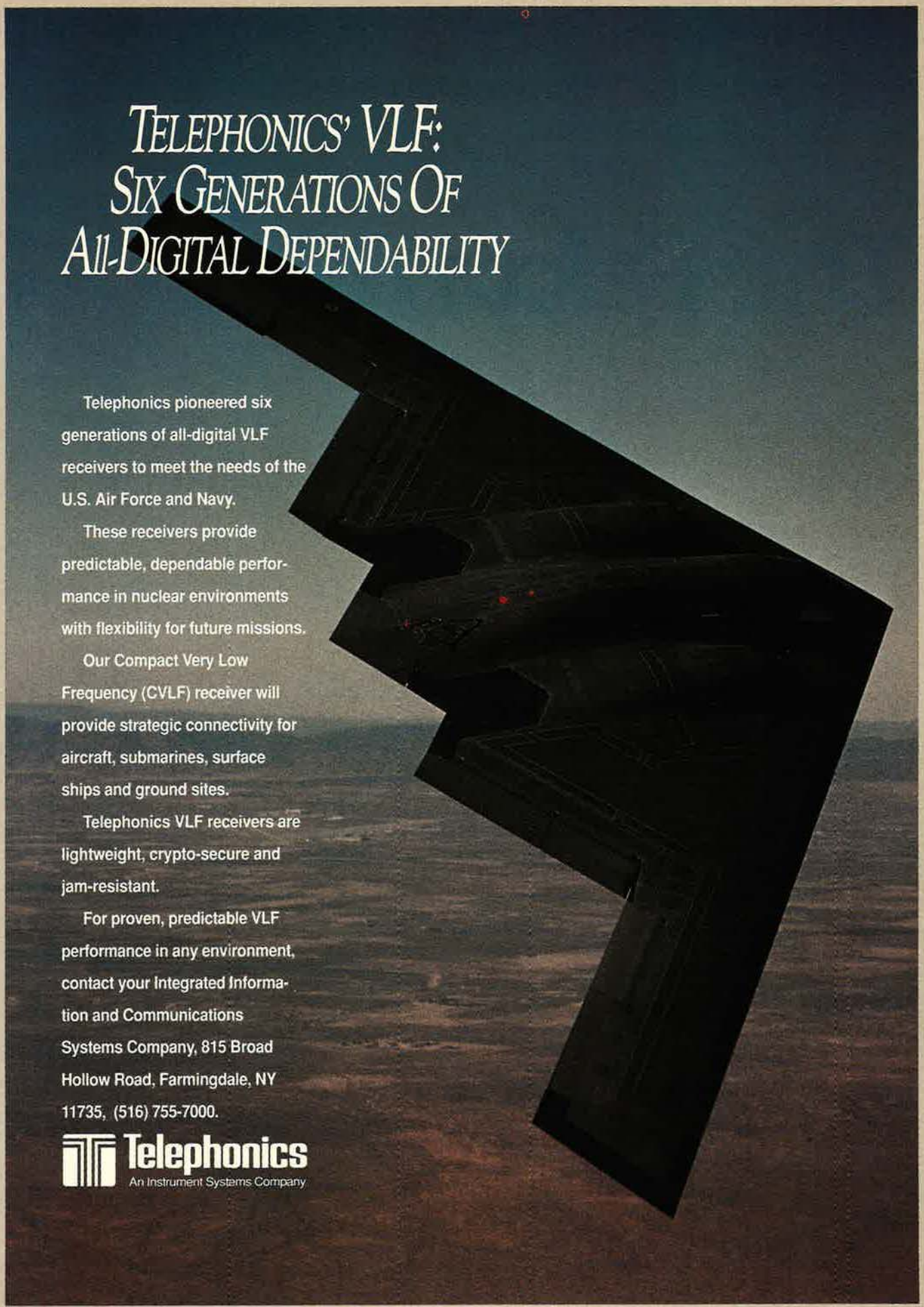
Following each sortie, intelligence, operations, and aircrews would review gun-camera videotapes and evaluate each segment of the mission. Flexibility in mission planning allowed adaptation of those data to subsequent sorties.

Falcon Baldwin lasted one week. In all, 349 ANG men and women took part. Training results, say ANG officers, exceeded expectations. They maintain that the exercise will familiarize the crews with the requirements of air defense scrambles and engagement of dissimilar aircraft.

In the words of Maj. Richard Roth, 170th TFS operations officer: "Each pilot who attended Falcon Baldwin '90 will be better prepared to respond to real-world contingency operations." Benefits for support personnel also figure to be large.

Falcon Baldwin '90 cost only $218,000, much less than the cost of a similar-sized deployment requiring airlift. Perhaps nonmilitary airports of small US cities, free of political and environmental problems found in densely populated urban areas, will become prime ANG and Reserve training grounds of the future. ■

Bob Roskuski is a free-lance writer living in Fort Wayne, Ind. This is his first article for AIR FORCE *Magazine.*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One of the largest local area networks anywhere links 6,000 personal computers at the Air Force Academy.

The Falcon Net

By Sue McMillin

A COMPUTER revolution is sweeping across the Air Force Academy. Sparked a decade ago by a plan to equip the room of each cadet with a personal computer, the drive has steadily gathered force, making the computer as indispensable as textbooks.

Ever since 1986, each new student has been required to buy $1,300 worth of computer equipment and materials before the start of the first class. The amount, which goes primarily to buy a microcomputer and software, is deducted from the cadet's pay.

The Academy's 6,000 PC users are electronically linked in one of the largest local area networks (LANs) in existence, says Col. William Ayen, associate dean for resources. The LAN, known as "Falcon Net," gives cadets and faculty members electronic access to other computers, special broadcasts, and laser printers. This fall, the Colorado Springs, Colo., institution linked up with networks at the US Military Academy and the US Naval Academy.

Cadets use PCs and Falcon Net to check test scores and homework assignments, prepare for chemistry labs, keep track of demerits, and even find rides to ski resorts or home towns.

Using their personal computers as word processors, the cadets write papers by the ream, each day pumping an average of 17,000 pages of electronic text through the electronic network to laser printers. All the printers together have churned out as many as 40,000 pages of manuscript in a day.

Unique display screens on the PCs are transformed, at the flick of a switch, from computer monitors to video monitors that can be tuned to such videotaped programs as "Good Morning America" (without commercials), tutorials on weapons, or poetry readings.

To the Forefront

Once the Academy decided to move, it leaped to the forefront of colleges and universities that are broadly integrating computers into their programs. Academy officials say that such a move is natural, given the technical orientation of the Air Force and the manifold defense uses of computers.

"We're computer-literate when we leave," says Cadet 1st Class Robb Erickson, the fall semester wing commander.

Cadet 3d Class Cristine Hunt maintains that the Academy's program is training her to rely on computers. After being exposed to the "possibilities of computers," the biology and chemistry major says, she can imagine teaming up with computer science experts who write software to solve Air Force problems.

For the first four years, cadets received Zenith microcomputers. This year, Unisys computers were issued. The new computers are faster and have greater memory but cost the same.

Planning to computerize the Academy began early in the 1980s. Officials hoped the move would enhance the education of cadets, but no one realized it would also provide a means to circumvent the cadets' interminably busy telephone lines.

"It decreases work time because you don't have to make multiple phone calls to reach cadets," says Maj. Dave Wetlesen, the dean's executive officer and a former math instructor. "I have a computer at home with a modem. I can call up the net and get messages or send messages."

The Academy created a separate Support Local Area Network (SLAN) that pulls nonacademic staff into the network. The two LANs are run by four VAX 8650 computers, three to manage Falcon Net and one for the SLAN.

Computerizing the Academy cost $16 million. Of that, $7.5 million paid for faculty computers, monitors, and printers. The Falcon Net cost $7.5 million, and the SLAN about $1 million. Contel Information Systems developed Falcon Net; Bolt, Baranek & Newman Communications Corp. built the SLAN.

The networks have separate cable systems; this has prevented each from becoming overloaded, says Brig. Gen. Erlind Royer, the dean of faculty. They use standard cable television components and are linked.

General Royer explains that the Academy investigated using fiber-optic cables, but steered away from them because it viewed fiber optics as an unproven technology.

Satellite Reception

The Academy gives each cadet a special monitor that can receive eighteen broadcast channels. Addition of a satellite receiving dish will expand the number of channels to thirty-six.

Each day, up to 450 broadcasts are sent through the Academy's television distribution division, with program listings available through Falcon Net. Offerings include heritage films, "Nova" programs, films on weapons, and plays.

If viewing a particular program is required for a course, the program will be shown a minimum of three times to ensure that cadets can see it, General Royer says.

Academy officials want eventually to be able to send videotaped programs or lectures to military bases via satellite. But there is no hurry. Colonel Ayen says the Academy wants slow and stable growth in its computer program.

"Decisions that we make today are based in part on where we think we want to be five years from now," Colonel Ayen says. "Part of that is that we don't want to create large budgetary requirements five years down the road."

For the cadets, the daily check of the numerous bulletin boards and electronic mail messages sent over the Falcon Net has become a routine part of campus life. For 1,200 or so freshmen, the "Doolie board" has been an avenue through which to build camaraderie and stave off a sense of isolation.

The Academy can restrict access to bulletin boards. Some can be viewed only by faculty or cadet wing leaders. The Doolie board is available only to freshmen.

Cadet 1st Class Steve Carney says he realized how much he relies on Falcon Net when his computer linkup was out of action for a couple of months, a situation that forced him to borrow time on a fellow cadet's computer. "It was pretty frustrating," he says.

Important messages still come over the telephone or in person, partly because technical problems sometimes leave cadets without assured access. A message sender can request electronic confirmation that an electronic mail message has been received. Cadets and faculty agree that the Academy is working hard to get the bugs out of the system.

Sometimes access to Falcon Net is required. The Physics Department, for instance, puts on the network homework problems and laboratory instructions that must be viewed before students go to work in a particular lab.

To help students avoid the chore of copying vast quantities of boilerplate information, the Electrical Engineering Department puts "lab shells" on the network, says Col. Alan Klayton, department head. His department transmits required videos that help students preview laboratory experiments.

More Fun Than Reading

Colonel Klayton says the computers save time and aid learning; best of all, the cadets enjoy working on them. "Kids like to sit in front of computers," he observes. "They're not always better than books, but kids like [them] better."

Cadets need access to Falcon Net to get printouts of their written work, unless they have their own printers. Because laser printers assigned to each squadron frequently are down for one reason or another, many cadets opt to buy their own printers. Colonel Ayen says the printer problem was recently resolved. Machines had been disabling themselves, he says, when they

came across certain types of nonstandard characters in a file. The Academy changed the software, and, during spring semester, the problem largely evaporated.

Thus far, the Academy has avoided problems that concern everyone who uses a computer network: hackers and viruses. The Academy's success is due, at least in part, to the presence of a number of safeguards built into the system. In addition, say Academy officials, the institution may simply have been lucky. For example, the Academy system proved to be immune to a computer virus that one year ago swept through networks on campuses across the nation. "That was pure luck," says General Royer. "It wasn't anything we did."

The concern over losing academic or personnel records, however, has forced the Academy to keep such vital data on a separate system, Colonel Ayen says.

The Academy did discover that a number of cadets had hacked their way into restricted files, Colonel Ayen says. The Academy, in turn, "recruited" those cadets—almost like double agents—to lead officials to the weaknesses in the system.

One cadet found himself before an honor board for sending a sexist message on a computer assigned to someone else. Capt. Karl Greenhill, director of honor education, says that the infraction was a matter of deception and therefore was handled under the Academy's honor code as a lie.

Most potential misuses of the computers or network would be legal issues rather than honor issues, Captain Greenhill says. The Academy tells all incoming cadets, for instance, that illegally copying software is a crime for which they could be prosecuted.

Cadets say using computers saves time and often helps them get more out of assignments. Faculty members say the cadets are better students since the network was implemented.

Goodbye to the Typewriter

"When I was a freshman I used a typewriter for my first three papers," says Cadet 1st Class Kim Basham, the cadet wing academic officer. Then she mastered the word processing software, and "I don't think I've used a typewriter since."

Cadet Basham, however, did experience every cadet's nightmare: Because of a computer problem, she lost a ten-page paper in the middle of the night. The Academy maintains a computer center to rescue cadets from such travails, but it was

closed. Cadet Basham had no choice but to rewrite the paper on the spot.

Instructors see great improvement in the quality of cadet work and suspect the computer has something to do with it. Colonel Ayen, a former English instructor, maintains that cadets are more likely to refine, rework, and therefore improve their papers because on a computer they can make small changes without having to retype page after page. Says Colonel Ayen, "Things that I accepted five years ago I wouldn't begin to accept today."

The computer invasion of the Academy goes beyond personal computing, special broadcasts, and LANs. There is also a state-of-the-art videodisc language laboratory and a group of professors who are looking at the next generation of computer technology: the compact disk.

"This is the future," says Lt. Col. Mike Bush, as he holds up a CD and smiles. He slips the disk into his specially converted personal computer and begins to pull up data. Then he puts in a music disk and the sound flows into the room from two speakers.

One CD can hold up to 58,000 documents or the equivalent of 270,000 pages of typed manuscript. Already on the market is a CD encyclopedia, going for about $1,000, and this new publishing industry is barely off the ground. Since both the computer and CD industries are working to connect their products, Colonel Bush predicts the effort will drive capabilities up and costs down.

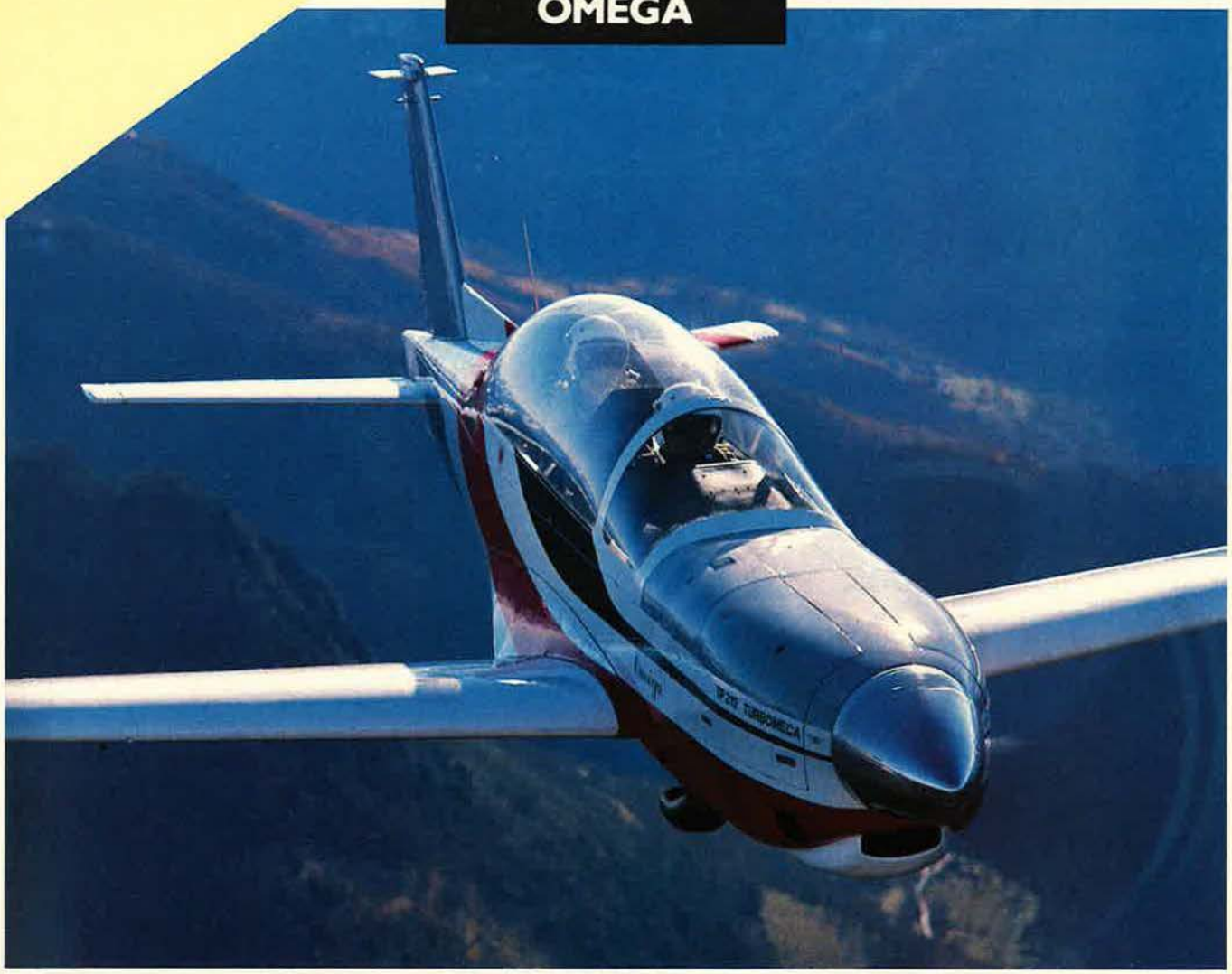
Colonel Bush, a professor of French and the foreign language department's deputy for research, is exploring computer-aided training for government organizations, including Air Force Systems Command, AFSC's Aeronautical System Division, and the National Security Agency. He also helped the Academy develop its Language Learning Center. The learning center uses the large videodiscs for teaching French, German, Spanish, Russian, and Arabic and will soon add Japanese and Chinese, Colonel Bush says. The center has sixteen work stations, with another sixteen on the way.

Already, some 4,000 visitors—including a group of Soviet military officials—have come to examine the Academy's computer-boosted language laboratory. The lab has sponsored special workshops, including a ten-day language course last year for Army and Air Force personnel headed to the Middle East, Colonel Bush says.

In recent years, there also has been much outside interest in the Falcon Net and the broadcast video system. Colonel Ayen points out that the Academy's requirements are different than those of regular Air Force bases, and therefore the system cannot simply be copied for use there. However, he says, many of the lessons learned at the Academy can be shared—and are. ■

Sue McMillin is a reporter for the Colorado Springs, Colo., Gazette-Telegraph. *This is her first article for* Air Force *Magazine.*

OMEGA



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World Gallery of Trainers

By John W. R. Taylor and Kenneth Munson

Piston-Engine Trainers

Airtrainer CT4

The fully aerobatic two-seat CT4B Airtrainer is reentering production, initially to fill an order for eight placed by Australia's NSW Flying College. The original prototype was developed by PAC of New Zealand as a military primary training version of the Australian Airtourer civil *ab initio* trainer. It first flew on February 23, 1972, and was followed by production CT4As and CT4Bs for the air forces of Australia (51), New Zealand (19), and Thailand (24). All of these had been delivered by 1977, each with a 210 hp Continental IO-360-H piston engine. The new series will differ only in having an oil system modified for inverted flight, but PAC is renewing its efforts to market uprated versions of the Airtrainer. Before the end of this year, it hopes to fly a prototype of the CT4CR, with a 420 shp Allison 250-B17 turboprop and retractable landing gear. With a gross weight of 2,650 lb, this will offer a maximum speed of 269 mph, service ceiling of 32,500 ft, and range of 834 miles with maximum fuel. *(Data for CT4B.)*

Contractor: Pacific Aerospace Corporation Ltd, New Zealand.

Power Plant: one Continental IO-360-H piston engine; 210 hp.

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

Weights: empty 1,490 lb, gross 2,400 lb.

Performance: max speed at S/L 178 mph, at 10,000 ft 163 mph, stalling speed (flaps down) 53 mph, service ceiling 17,900 ft, T-O run 733 ft, landing run 510 ft, max range (with reserves) 815 miles.

Accommodation: two seats, side by side. Space to rear for optional third seat or 115 lb of baggage.

Armament: none.

AS 202 Bravo

Although designed by SIAI-Marchetti of Italy, the Bravo has been produced in Switzerland for more than 20 years. The prototype, assembled by FFA, flew for the first time on March 7, 1969. Like the 34 initial production AS 202/15s, it had a 150 hp Lycoming O-320 engine. The major production version has been the still-current AS 202/18A, with a 180 hp engine, of which 180 had been delivered by the beginning of this year. Military customers have included the air forces of Indonesia (40), Iraq (48, of which some were transferred to Jordan), and Morocco (10), plus four for the Royal Flight of Oman and eight for the Uganda Central Flying School. Subvariants differ in having electrical instead of mechanical trim, a 24V instead of 12V electrical system, special instrumentation, and an extended canopy. The Bravo can operate from grass strips and is fully aerobatic. *(Data for AS 202/18A.)*

Contractor: FFA Flugzeugwerke Altenrhein, Switzerland.

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

Dimensions: span 31 ft 11¾ in, length 24 ft 7¼ in, height 9 ft 2¾ in.

Weights: empty 1,565 lb, gross (aerobatic) 2,160 lb, max gross 2,380 lb.

Performance (at max gross weight): max speed at S/L 150 mph, max cruising speed at 8,000 ft 141 mph, stalling speed (flaps down) 56 mph, service ceiling 17,000 ft, T-O run 705 ft, landing run 690 ft, max range (no reserves) 707 miles, *g* limits +6/−3.

Accommodation: crew of two, side by side in aerobatic version; space behind these in utility version for third seat or 220 lb of baggage.

Armament: none.

Bulldog

The Bulldog began life as the Beagle B.125, a military primary trainer version of that company's civil Pup design. It was acquired by Scottish Aviation following Beagle's collapse, SA eventually becoming part of the British Aerospace conglomerate. The Beagle prototype first flew in May 1969, and the first 98 production Bulldogs were **Series 100s** for Sweden (Model 101, known as **Sk61s** in Swedish Air Force service), Malaysia (Model 102), and Kenya (Model 103). Model 121 for Britain's Royal Air Force marked the introduction of the **Series 120** Bulldog, with strengthened wing center-section and higher aerobatic takeoff weight. The RAF ordered 130 as the Bulldog **T. Mk 1.** Other Series 120 customers included Ghana (Model 122), Nigeria (Model 123), Jordan (Model 125), Lebanon (Model 126), Kenya (Model 127), and Botswana (Model 130), all of which still operate Bulldogs; plus Hong Kong, which retired its few Bulldogs about two years ago. Malaysia's aircraft are now used for reserve training only, and those of Nigeria are expected to be replaced shortly. The largest remaining Bulldog fleets are those of the RAF (over 100), Sweden (about 50), and Jordan (20). *(Data for Series 120.)*

Contractor: British Aerospace plc, UK.

Power Plant: one Textron Lycoming IO-360-A1B6 piston engine; 200 hp.

Dimensions: span 33 ft 0 in, length 23 ft 3 in, height 7 ft 5¾ in.

Weights: empty 1,430 lb, gross 2,238 lb (aerobatic), 2,350 lb (max).

Performance: max speed at S/L 150 mph, max cruising speed at 4,000 ft 138 mph, stalling speed (flaps down) 61 mph EAS, service ceiling 16,000 ft, T-O run 900 ft, landing run 500 ft, max range 621 miles, *g* limits +6/−3.

CT4B, Royal New Zealand Air Force

AS 202 Bravo

Bulldog T. Mk 1, Royal Air Force

Accommodation: crew of two, side by side, with optional third seat or 220 lb of baggage at rear.

Armament: normally none, but provision for four underwing points for up to 640 lb of air-to-surface weapons, machine-gun pods, bombs, grenade launchers, or other stores.

CAP 10

Based on the design of the popular Piel Emeraude sporting aircraft, and retaining a wooden airframe with fabric-covered rear fuselage, the **CAP 10** first flew in August 1968 and received French certification just over a year later. Current production model is the **CAP 10 B,** identifiable by its ventral fin and enlarged rudder; this is FAA certificated for day and night VFR operation. Both models are fully aerobatic, and a combined total of 245 had been delivered to various customers by the beginning of this year. Major military customer is the French Air Force, which received 30 CAP 10s and 26 CAP 10 Bs; its aircraft are based at the École de l'Air at Salon de Provence and EFIPN 307 (École de Formation Initiale du Personnel Navigant) at Avord. Six CAP 10 Bs were supplied to the French Navy, equipping Escadrille de Servitude 51 at Rochefort/Soubise. The CAP 10s are used to pregrade French cadet pilots before proceeding to full flying training on the Epsilon or Zéphyr. Twenty CAP 10 Bs were also delivered in the early 1980s to the Mexican Air Force's flying school; these aircraft are equipped almost to IFR standard. *(Data for CAP 10 B.)*

Contractor: Avions Mudry et Cie, France.

Power Plant: one Textron Lycoming AEIO-360-B2F piston engine; 180 hp.

Dimensions: span 26 ft 5¼ in, length 23 ft 6 in, height 8 ft 4½ in.

Weights: empty 1,213 lb, gross 1,675 lb (aerobatic), 1,829 lb (max).

Performance: max speed at S/L 168 mph, max cruising speed 155 mph, stalling speed (flaps down) 50 mph IAS, service ceiling 16,400 ft, T-O run 1,149 ft, landing run 1,182 ft, max range 621 miles, *g* limits +6/−4.5.

Accommodation: crew of two, side by side; space behind seats for 44 lb of baggage.

Armament: none.

Cessna 150/152/172 and T-41 Mescalero

The **Model 150** two-seat lightplane first flew in 1957, early models up to the 150E having an upright fin and rudder and 100 hp Continental O-200-A engine; a swept fin was introduced in 1966, with the Model 150F. From 1977, the 150s were replaced by the **Model 152** range with uprated 110 hp Textron Lycoming O-235 engine. The four-seat **Model 172** preceded them both, having flown for the first time in 1955 and being a trigear derivative of the earlier Model 170. Power plant was a 145 hp Continental O-300-A. Major introductions in 1960 were a sweptback fin and a new standard deluxe model named Skyhawk. A more powerful **R172E** model (210 hp Continental IO-360) appeared in 1964, and uprated engines for the basic Model 172 and Skyhawk were introduced in 1968 (150 hp Lycoming O-320) and 1977 (160 hp O-320) respectively. The **T-41A Mescalero** represented an off-the-shelf procurement of 204 Cessna 172s for USAF, followed by production of three further models all based on the civil Model R172E: 255 **T-41Bs** for the US Army, 52 **T-41Cs** for USAF, and 238 **T-41Ds** for MAP exports to friendly nations. About 250 T-41A/B/Cs continue to serve with the US armed forces. Operators of upwards of 180 T-41Ds, about 80 Cessna 150/152s, and 50 or so Model 172s include Angola, Argentina, Bangladesh, Bolivia, Botswana, Burundi, Chile, Ciskei, Colombia, Dominica, Ecuador, El Salvador, Greece, Haiti, Honduras, Ivory Coast, South Korea, Madagascar, Mozambique, Paraguay, Peru, Philippines, Saudi Arabia, Sri Lanka, Turkey, Uruguay, and Zaïre. *(Data for R172E/T-41D.)*

Contractor: Cessna Aircraft Company, USA.

Power Plant: one Continental IO-360-D piston engine; 210 hp.

Dimensions: span 35 ft 10 in, length 26 ft 11 in, height 8 ft 9½ in.

Weights: empty 1,405 lb, gross 2,550 lb.

Performance: max speed at S/L 153 mph, max cruising speed at 5,500 ft 145 mph, service ceiling 17,000 ft, T-O

run 740 ft, landing run 620 ft, max range 1,010 miles.
Accommodation: four seats, in two pairs; up to 200 lb of baggage aft of rear seats.
Armament: none.

CJ-6A (PT-6A)

The Soviet Yak-18 primary trainer was one of the first aircraft to be mass produced in post-1949 China, 379 being license-built at Nanchang between 1954 and 1958. Two years before this run ended, work on the CJ-6 derivative started at Shenyang, a prototype with a 145 hp Mikulin M-11ER engine flying on August 27, 1958. Disappointing performance led to replacement of this engine by a 260 hp Ivchenko AI-14R, with which a new prototype made its first flight on July 18, 1960. The project was then transferred to Nanchang, where further redesign was followed by flight of the first production-standard aircraft on October 15, 1961. Approximately 1,800 CJ-6s had been built by early 1987, and production still continues. Standard version since December 1965 has been the **CJ-6A,** although a small batch of ten armed **CJ-6Bs** was built in 1964–66. The CJ-6A (*Chuji Jiaolianji,* "basic training aircraft") retains the general configuration of the Yak-18A/CJ-5, but has an all-metal airframe with fully retractable landing gear, fitted with low-pressure tires for operation from grass strips. Export examples, usually referred to by the Westernized designation **PT-6A,** have been supplied to Bangladesh, Cambodia, North Korea, Tanzania, and Zambia, although Cambodia and Tanzania no longer operate the type. *(Data for CJ-6A.)*
Contractor: Nanchang Aircraft Manufacturing Company, People's Republic of China.
Power Plant: one SMPMC (Zhuzhou) HS6A radial piston engine; 285 hp.
Dimensions: span 33 ft 4¾ in, length 27 ft 9 in, height 10 ft 8 in.
Weights: empty 2,584 lb, gross 3,128 lb.
Performance: max speed 178 mph, service ceiling 16,665 ft, T-O run 920 ft, landing run 1,150 ft, endurance 3 h 36 min.
Accommodation: two seats, in tandem.
Armament: none.

Epsilon

The piston-engined Epsilon was developed by Aerospatiale's light aircraft subsidiary, Socata, to meet a French Air Force requirement for a propeller-driven aircraft that would improve the cost-effectiveness of its initial pilot training. The TB 30 prototype flew for the first time on December 22, 1979, the letters in its designation indicating the Tarbes location of the manufacturer. An initial French contract for 30 was placed in March 1982, resulting in the first flight of a production aircraft in June 1983 and the start of deliveries one year later. In all, 150 production Epsilons were ordered for the French Air Force; delivered at the rate of 30 a year, they all went to Groupement École 315 at Cognac/Chateaubernard, with which they had logged a total of 110,000 flying training hours by mid-1989. Esquadra 104 of the Portuguese Air Force has 18 Epsilons, beginning with a Socata-built aircraft handed over in January 1989 and followed by 17 assembled locally by OGMA in Portugal. An armed version, so far supplied only to the Togolese Air Force (four, including one as an attrition replacement), is available for export, with four underwing hardpoints for up to 661 lb of stores when flown as a single-seater. Armed with two twin 7.62 mm machine-gun pods, it can loiter for 30 min at low altitude over a combat area 195 miles from its base. *(Data for standard unarmed Epsilon.)*
Contractor: Socata (subsidiary of Aerospatiale SNI), France.
Power Plant: one Textron Lycoming AEIO-540-L1B5D piston engine; 300 hp.
Dimensions: span 25 ft 11¾ in, length 24 ft 10¾ in, height 8 ft 8¾ in.
Weights: empty 2,055 lb, gross 2,755 lb.
Performance: max speed at S/L 236 mph, max cruising speed at 6,000 ft 222 mph, stalling speed (gear and flaps down) 72 mph, service ceiling 25,000 ft, T-O run 1,345 ft, landing run 820 ft, max range 875 miles, *g* limits +6.7/−3.35.
Accommodation: crew of two, in tandem. Rear seat elevated.
Armament (optional: not on aircraft of French Air Force): two Matra CM pods each containing two 7.62 mm machine guns, or four Matra F2D packs each containing six 68 mm rockets, or two 275 lb bombs, or two grenade launchers, or four survival kits.

Eurotrainer 2000

Since last year's "Gallery of World Trainers" was published, responsibility for the Eurotrainer program has passed from FFA of Switzerland to FFT of Germany, which previously had undertaken design and manufacture of the advanced laminar flow wings. Two prototypes are being built, the first of which is scheduled to fly before the end of this year. Like the eight aircraft ordered in 1988 by Swissair, to replace piston-engined Piaggio P.149s at its national pilot training school, these will now have a Lycoming engine following abandonment of Porsche's aero-engine development plans.

The Eurotrainer will be suitable for IFR training and limited aerobatics and is intended also to meet military pilot selection and *ab initio* training requirements, up to the stage of transition to a tandem-seat turboprop or jet advanced trainer. Its airframe is manufactured of glass-fiber and carbonfiber composites. Deliveries to Swissair are expected to begin in 1992.
Contractor: FFT Gesellschaft für Flugzeug- und Faserverbund-Technologie, Germany.
Power Plant: one Textron Lycoming AEIO-540-L1B5 piston engine; derated to 270 hp.
Dimensions: span 34 ft 0¾ in, length 26 ft 8½ in, height 10 ft 6 in.
Weight: gross 3,262 lb.
Performance (estimated at two-seat trainer T-O weight): max cruising speed at 20,000 ft 251 mph, econ cruising speed at S/L 184 mph, service ceiling 26,000 ft, T-O to 50 ft at 2,000 ft 1,640 ft, endurance (with reserves) 4 h, *g* limits +6/−3.
Accommodation: two or four persons, side by side in pairs.
Armament: none.

HPT-32

This fully aerobatic, side-by-side two-seater was designed to FAR Pt 23 standards, to perform two consecutive training sorties 50 km (31 miles) from its base before needing to refuel. As well as fulfilling the roles of *ab initio,* aerobatic, night flying, instrument flying, and navigation training, it was intended to be suitable for such secondary tasks as liaison, observation, glider and target towing, and search and rescue. The first prototype flew on January 6, 1977, and the third (production standard) prototype on July 31, 1981. Subsequently, 40 were delivered to the Indian Air Force and eight to the Navy.
Contractor: Hindustan Aeronautics Ltd (Kanpur Division), India.
Power Plant: one Textron Lycoming AEIO-540-D4B5 piston engine; 260 hp.
Dimensions: span 31 ft 2 in, length 25 ft 4 in, height 9 ft 5½ in.
Weights: empty 1,962 lb, gross 2,756 lb.
Performance: max speed at S/L 164 mph IAS, max cruising speed at 10,000 ft 132 mph, stalling speed (flaps down) 69 mph, service ceiling 18,045 ft, T-O run 1,132 ft, landing run 720 ft, max range 462 miles, *g* limits +6/−3.
Accommodation: two seats, side by side.
Armament: none.

L-70 Vinka

The only operator of this neat two/four-seater is the Finnish Air Force, for which 30 were built by Valmet. The Vinka (named after a cold Arctic wind) was developed under a 1973 contract, and flew for the first time on March 23, 1973, as the Leko-70 (*Lentokone;* "airplane"). It entered service in 1980, conforming to FAR Pt 23 standards as a two-seat aerobatic and utility aircraft, and as a four-seater for liaison, air ambulance, and other duties. Its major roles are primary, aerobatic, night, instrument, and tactical training, but the Vinka can be used also for casevac, search and rescue, supply dropping, weapon training, target towing, and reconnaissance. Fatigue life in military service is better than 8,000 hours, and it can be adapted for ski takeoffs and landings.
Contractor: Valmet Aviation Industries, Finland.
Power Plant: one Textron Lycoming AEIO-360-A1B6 piston engine; 200 hp.
Dimensions: span 31 ft 7¼ in, length 24 ft 7¼ in, height 10 ft 10¼ in.
Weights: empty 1,691 lb, gross (aerobatic) 2,293 lb, max gross 2,756 lb.
Performance (at 2,205 lb gross weight): max speed at S/L 146 mph, max cruising speed at 5,000 ft 138 mph, stalling speed (flaps down) 53 mph, service ceiling 16,400 ft, T-O run 755 ft, landing run 575 ft, max range (no reserves) 590 miles, *g* limits +6/−3.
Accommodation: crew of two, side by side; space behind these for two more seats or up to 617 lb of baggage.
Armament: two hardpoints under each wing for (as two-seater) total of up to 661 lb of bombs, flare pods, rocket pods, machine-gun pods, antitank missiles, TV or still camera pods, or life raft/rescue packs and a searchlight.

Model 172, Pakistan Air Force (Denis Hughes)

CJ-6A

HPT-32, Indian Navy

M-26 Iskierka

Designed to FAR Pt 23 standards, the Iskierka ("little spark") embodies selected wing, tail, landing gear, and other components of the PZL Mielec M-20 Mewa, Poland's license-built version of the Piper Seneca II. The **M-26 00** prototype was flown for the first time on July 15, 1986, powered by a PZL-F (Polish Franklin) engine. It was followed on June 24, 1987, by the **M-26 01,** with a more powerful Textron Lycoming engine, in the expectation that this might be more attractive to an export market. Main roles foreseen for the Iskierka are civil flight training and pilot selection for military training. Test flying has continued during 1990. *(Data for M-26 01; figures for M-26 00 in parentheses.)*
Contractor: WSK-PZL Mielec, Poland.
Power Plant: one PZL-F6A-350CA piston engine; 205 hp (M-26 00), or one Textron Lycoming AEIO-540-L1B5D piston engine; 300 hp (M-26 01).
Dimensions: span 28 ft 2½ in, length 27 ft 2¾ in, height 9 ft 8½ in.
Weights: empty 2,072 lb (1,874 lb), gross 3,086 lb (2,645 lb).
Performance: max speed at S/L 199 mph (165 mph), stalling speed (flaps down) 69 mph (61 mph), T-O to 50 ft 1,870 ft (1,476 ft), landing from 50 ft 1,772 ft (1,411 ft), max range (with reserves) 1,006 miles (584 miles), *g* limits (at 2,645 lb weight) +7/−3.5 (+6/−3).
Accommodation: crew of two, in tandem. Rear seat elevated.
Armament: none.

Model 201AT Advanced Trainer

Introduced into the Mooney range in 1989, the Model 201AT is a training version of the Mooney 201SE (M20J) four-seat lightplane. It differs in having as standard a 14V DC electrical system, three-position cowl flaps, dual brakes, fully adjustable front seats with inertia-reel shoulder harness, white instrument panel, black control wheels, standby vacuum system, three strobe lights, high-visibility striped external paint scheme, and a Bendix/King IFR training avionics package. The first eleven production 201ATs were delivered to the Embry-Riddle Aeronautical University in Florida and the Florida Institute of Technology. A side-by-side two-seater, designated EFS with a 260-hp AEIO-540 engine, is offered to meet USAF's Enhanced Flight Screener requirement. *(Data generally similar to those of 201SE, which follow.)*

Contractor: Mooney Aircraft Corporation, USA.

Power Plant: one Textron Lycoming IO-360-A3B6D piston engine; 200 hp.

Dimensions: span 36 ft 1 in, length 24 ft 8 in, height 8 ft 4 in.

Weights: empty 1,784 lb, gross 2,740 lb.

Performance: max speed at S/L 202 mph, econ cruising speed at 8,100 ft 175 mph, stalling speed (gear and flaps down) 61 mph CAS, service ceiling 18,600 ft, T-O to 50 ft 1,517 ft, landing from 50 ft 1,610 ft, max range (no reserves) 1,219 miles.

Accommodation: four seats, side by side in pairs.

Armament: none.

Mushshak

The Aircraft Manufacturing Factory (AMF) of the Pakistan Aeronautical Complex (PAC) came into being in 1981 as a license production center for the Swedish Saab Safari/Supporter two/three-seat light aircraft, which had been chosen as training and observation equipment for the Pakistan Army and Air Force. The first 92 aircraft, known by the Urdu name Mushshak ("proficient"), were assembled from kits, but subsequent manufacture has been from raw materials. By early 1990, a total of 191 had been delivered to the Pakistan services, with about two-thirds going to the Army. The United Arab Emirates Air Force is reported to have ordered about 20 Mushshaks in 1989; the Iranian revolutionary guard is believed to have ordered 22 more, after evaluating a first batch of three. Meanwhile, the AMF has tested a Mushshak with a 210 hp Teledyne Continental TIO-360-MB engine in place of the original 200 hp Lycoming, and all current production aircraft have this uprated power plant. A feature of the design is the 5° of wing sweepforward that enhances the view from the cockpit. Provision is made for full IFR instrumentation, radio, and armament. *(Data with 200 hp Lycoming.)*

Contractor: Pakistan Aeronautical Complex.

Power Plant: one Textron Lycoming IO-360-A1B6 piston engine; 200 hp.

Dimensions: span 29 ft 0½ in, length 22 ft 11½ in, height 8 ft 6½ in.

Weights: empty 1,424 lb, gross 1,984 lb (aerobatic), 2,645 lb (max).

Performance: max speed at S/L 146 mph, cruising speed 129 mph, stalling speed (flaps down) 67 mph, service ceiling 13,450 ft, T-O to 50 ft 1,263 ft, landing from 50 ft 1,280 ft, endurance (with reserves) 5 h 10 min, *g* limits (aerobatic) +6/−3.

Accommodation: two seats, side by side, with provision for rearward-facing seat or 220 lb of baggage to rear.

Armament: six underwing hardpoints (two carrying 330 lb each, four 220 lb each) for two 7.62 mm machine-gun pods, two pods of 7 × 75 mm rockets, four pods of 7 × 68 mm rockets, 18 × 75 mm rockets, or six wire-guided antitank missiles.

Pillán

This fully aerobatic and instrument flying trainer was designed by Piper as a spinoff from its Cherokee family, embodying many components of the PA-28 Dakota and PA-32 Saratoga. The first of two prototypes, built by Piper, flew on March 6, 1981. Production was then started in Chile by ENAER, a state-owned company established by the Chilean Air Force. Three aircraft were assembled from kits delivered from the US, and, after changes to the design of the tail unit and deepening of the canopy, series manufacture of the Pillán ("devil") began in September 1984. All 60 of the **T-35A** primary trainers and 20 **T-35B** instrument trainers covered by initial contracts were delivered to the Chilean Air Force by spring 1990. In addition, 40 **T-35Cs** were supplied in kit form by ENAER for assembly in Spain by CASA for the Spanish Air Force, plus one attrition replacement. These serve as primary trainers with the Spanish designation and name **E.26 Tamiz** ("sieve"), indicating their role of sifting or grading trainee pilots. Ten **T-35D** instrument trainers were delivered to the Panamanian Air Force in 1988–89, and a single-seat **T-35S** has been evaluated under a flight-test program started on March 5, 1988. It is powered currently by the standard Lycoming IO-540 but would have a 420 shp Allison 250-B17 turboprop if ordered into production. *(Data for T-35A.)*

Mushshak, Pakistan Air Force (Denis Hughes)

Pillán (Air Portraits)

PZL-130 Orlik (Lech Zielaskowski)

Contractor: Empresa Nacional de Aeronáutica de Chile (ENAER), Chile.

Power Plant: one Textron Lycoming IO-540-K1K5 piston engine; 300 hp.

Dimensions: span 29 ft 0 in, length 26 ft 3 in, height 8 ft 8 in.

Weights: empty 2,050 lb, gross (aerobatic) 2,900 lb, max gross 2,950 lb.

Performance: max speed at S/L 193 mph, max cruising speed at 8,800 ft 166 mph IAS, stalling speed (gear and flaps down) 72 mph, service ceiling 19,160 ft, T-O run 940 ft, landing run 780 ft, max range (with reserves) 748 miles, *g* limits +6/−3.

Accommodation: two seats, in tandem. Rear seat raised.

Armament: none.

PZL-130 Orlik

Designed to cover a wide range of both civil and military pilot training, from preselection through basic, aerobatic, instrument, navigation, and weapons training, the original two piston-engined Orlik ("spotted eaglet") prototypes made their first flights on October 12 and December 29, 1984. They were followed in 1988 by two preproduction aircraft, one with a 330 hp Vedeneyev M-14Pm radial engine and the other with a 280 hp PZL Kalisz K8-AA, the latter aircraft having an increased wingspan of 29 ft 6 in. In parallel development was a turboprop version, the Turbo-Orlik (which see). Both types have been evaluated by the Polish Air Force, which has chosen in favor of the turbine variant. As a result, the piston version, despite having received Polish aerobatic and utility category certification in 1988, seems likely to be abandoned.

Contractor: PZL Warszawa-Okecie, Poland.

Power Plant: one Vedeneyev M-14Pm or PZL Kalisz K8-AA radial piston engine; 330 hp and 280 hp, respectively.

Dimensions: span 26 ft 3 in, length 27 ft 8¾ in, height 11 ft 7 in.

Weights: empty 2,529 lb, gross 3,196 lb (aerobatic), 3,527 lb (max).

Performance (at aerobatic gross weight): max speed at S/L 211 mph, max cruising speed at S/L 180 mph, stalling speed (gear and flaps down) 74 mph, service ceiling 14,000 ft, T-O run 1,115 ft, landing run 821 ft, max range (no reserves) 880 miles, *g* limits +6/−3.

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

Armament: two hardpoints under each wing for practice bombs, gun and rocket pods, or other weapon training stores.

SF.260

Designed by the talented Dott Ing Stelio Frati (the SF in its designation), more than 800 piston-engined examples of this delightful little Italian trainer have been sold worldwide. The SF.260A, B, and C were civil models, the first **SF.260M** military model being an improved and strengthened version of the A which first flew on October 10, 1970, and subsequently became the Italian Air Force's standard primary trainer. From it was developed the **SF.260W Warrior** dual-role trainer/tactical support version, with underwing pylons for up to 661 lb of weapons or other stores. Countries now operating the M, the W, or a mix of both include Belgium, Bolivia, Brunei, Burkina Faso, Burundi, Chad, Ecuador, Ireland, Italy, Libya, Nicaragua, the Philippines, Singapore, Somalia, Thailand, Tunisia, Uganda, Zaïre, Zambia, and Zimbabwe. The current improved and updated civil **SF.260D** has recently been ordered by Fox 51 of Texas, the first seven of which are for its Doss Aviation flying school for USAF cadet pilot preselection duties. Forty other SF.260Ds have been ordered by the Turkish Air Force, in a coproduction deal with the domestic aircraft industry. *(Data for SF.260M.)*

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

Power Plant: one Textron Lycoming O-540-E4A5 piston engine; 260 hp.

Dimensions: span over tiptanks 27 ft 4¾ in, length 23 ft 3½ in, height 7 ft 11 in.

Weights: empty 1,797 lb, gross 2,425 lb (aerobatic), 2,645 lb (max). (SF.260W, max gross 2,866 lb.)

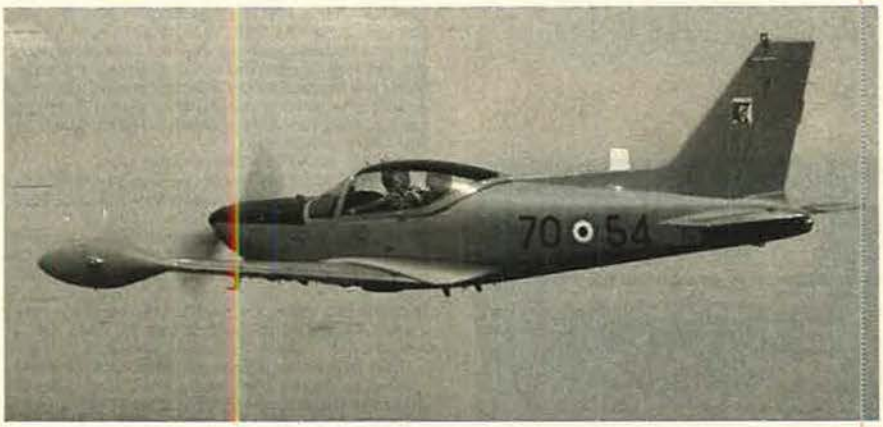
Performance: max speed at S/L 207 mph, max cruising speed at 4,925 ft 186 mph, stalling speed (gear and flaps down) 79 mph, T-O run 1,260 ft, landing run 1,132 ft, max range 1,025 miles, *g* limits (aerobatic) +6/−3.

Accommodation: two seats, side by side, with third seat to rear.

Armament: none on SF.260M.

T-25 Universal

The Universal was designed in 1963, as the Neiva N 621, to meet a Brazilian Air Force requirement, making its first flight on April 29, 1966. Of all-metal construction, it has side-by-side seating under a rearward-sliding canopy. One hundred and forty were built for the Brazilian Air Force between 1971 and 1978, and about 100 of these are still in service in two versions. The **T-25** basic and advanced trainer serves with the 2° Esquadrão de Instrução Aérea and the Academia da Força Aérea, plus some utili-



SF.260M, Italian Air Force

ty units, while the **T-25A** is used in a light attack and reconnaissance role. Neiva also built ten Universals for Chile; these have since been replaced by the ENAER Pillán, but were passed on to the Air Force of Paraguay, with whose flying school about six are still in service.

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

T67M Firefly

The original Slingsby T67A was a license-built version of the French wooden-construction Fournier RF6B light aircraft. All subsequent models, including T67M Firefly two-seat military basic trainers, have airframes of glass-fiber-reinforced plastics. Basic model is the **T67M Mk II** (formerly Firefly 160), first flown on December 5, 1982; this has a 160 hp Textron Lycoming AEIO-320-D1B engine and a new canopy with fixed windshield and upward-hinged/rearward-opening rear section, instead of the one-piece canopy of the civil T67s. The uprated **T67M200** (previously Firefly 200), which flew for the first time on May 16, 1985, has an AEIO-360-A1E. Both models have an inverted fuel/oil system and a 24V electrical system and are certificated to BCAR Section K and FAR Pt 23 in the aerobatic and utility categories. Customers for the T67M200 include the Royal Hong Kong Auxiliary Air Force (four), the Norwegian Government's flying academy (six), and the Turkish Aviation Institute at Ankara (16). Users of the T67M Mk II include the Royal Netherlands Air Force training school and civilian flying schools in Belgium, Japan, Switzerland, and the UK. *(Data for T67M200).*

Contractor: Slingsby Aviation Ltd, UK.
Power Plant: one Textron Lycoming AEIO-360-A1E piston engine; 200 hp.
Dimensions: span 34 ft 9 in, length 24 ft 0¼ in, height 7 ft 9 in.
Weights: empty 1,540 lb, gross 2,150 lb (aerobatic), 2,250 lb (max).
Performance: max speed at S/L 161 mph, max cruising speed at 8,000 ft 150 mph, stalling speed (flaps down) 59 mph, T-O run 725 ft, landing run 870 ft, max range (with reserves) 575 miles, *g* limits +6/−3.
Accommodation: two seats, side by side.
Armament: none.

UTVA-75A

This adaptable Yugoslav light aircraft, designed by Dipl Ing Dragoslav Dimić, has been manufactured at Pančevo for well over a decade, nearly 400 now having been built for civilian flying clubs and the Yugoslav Air Force since the first flight of the **UTVA-75A21** prototype on May 19, 1976. This is the initial two-seat version, used for basic training, glider towing, and a range of utility duties. Light weapon loads can be carried. The **UTVA-75A41** is generally similar, but has four seats in pairs and no provision for armament. It has a gross weight of 2,564 lb and slightly reduced overall performance. Ten preproduction examples were built. The **UTVA-75AG11,** first flown on March 3, 1989, is an agricultural version. The UTVA-75A is sturdily built and can operate from grass or unprepared strips of 500 ft or less. It is said to be entirely safe in an emergency landing, and UTVA claims that it has not suffered a single accident due to workmanship or structural failure. *(Data for UTVA-75A21.)*

Contractor: UTVA—Sour Metalne Industrije, Ro Fabrika Aviona, Yugoslavia.
Power Plant: one Textron Lycoming IO-360-B1F piston engine; 180 hp.
Dimensions: span 31 ft 11 in, length 23 ft 4 in, height 10 ft 4 in.
Weights: empty 1,510 lb, gross 2,116 lb.
Performance: max speed 133 mph, max cruising speed 115 mph, stalling speed (flaps down) 51 mph, service ceiling 13,125 ft, T-O run 410 ft, landing run 328 ft, max range (internal fuel) 497 miles, *g* limits +6/−3.
Accommodation: two seats, side by side.
Armament: pylon under each wing for a bomb, 220 lb cargo container, two-round rocket launcher, machine-gun pod, or drop fuel tank.

Yak-52

Forty-five years ago, the Yakovlev OKB flew the prototype of a primitive-looking tandem two-seat primary trainer designated Yak-18. It became the starting point for a family of aircraft numbered in many thousands, on which pilots of the Soviet air forces, the air forces of other Warsaw Pact nations, and their friends gained their wings. The Yak-52 represents the ultimate development of the series, of which the configuration and structure have changed little through the years, except for the switch from fabric-covered to metal semimonocoque rear fuselage and the use of more powerful engines in smooth cowlings. In addition, the Yak-52 has a unique tricycle landing gear, in which all three wheels remain totally exposed under the fuselage and wings when retracted, to offer greater safety in a wheels-up emergency landing. Announced in late 1978, its manufacture was entrusted to the Romanian aircraft industry. Production at Bacau began in 1979, and the 1,000th example was delivered from this plant in 1987. Expectation that Bacau would also build the Yak-53, single-seat counterpart of the Yak-52, does not seem to have been fulfilled.

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

T67M Firefly, Royal Hong Kong Auxiliary Air Force

UTVA-75A, Yugoslav Air Force (Richard Malachowski)

Turboprop Trainers

EMB-312 Tucano

Continuing its major impact on world markets, Brazil's Embraer company had recorded 507 firm orders for the Tucano ("toucan") military basic trainer by September of this year, plus 101 options. Deliveries totaled 396 by that time. Ten years had passed since the first prototype Tucano made its initial flight on August 16, 1980. The 118 production aircraft ordered by the Brazilian Air Force, as replacements for its Cessna T-37Cs, were all delivered by September 1986; but it placed a contract for 10 more in January of this year, with options on another 40. Export sales began in 1983, when Honduras ordered 10 Tucanos, followed closely by the Egyptian government, which ordered 120, with options on 60 more, for its own air force and that of Iraq. All but the first 10 of these were delivered by Embraer in kit form for assembly by the Arab Organization for Industrialization (AOI) at Helwan, near Cairo. Further orders followed successively from the air forces of Venezuela (30), Peru (20), Argentina (30), Paraguay (6), and Iran (15). Several of these customers, including Honduras, Venezuela, Egypt, and Iran, have placed follow-on contracts. In addition, the reengined S312 version (which see) is being built by Shorts in Northern Ireland for the Royal Air Force. The French Air Force intends to purchase 50 Brazilian-built Tucanos, with strengthened wings like those of the RAF aircraft, improved deicing and demisting systems, and French avionics and instrumentation, and will award options for 30 more.

Contractor: Empresa Brasileira de Aeronáutica SA, Brazil.
Power Plant: one Pratt & Whitney Canada PT6A-25C turboprop; 750 shp.
Dimensions: span 36 ft 6½ in, length 32 ft 4¼ in, height 11 ft 1¾ in.
Weights: empty 3,991 lb, gross (aerobatic) 5,622 lb, max gross 7,000 lb.
Performance (at 5,622 lb weight): max speed at 10,000 ft 278 mph, max cruising speed at 10,000 ft 255 mph, stalling speed (gear and flaps down) 77 mph, service ceiling 30,000 ft, T-O run 1,250 ft, landing run 1,214 ft, max range on internal fuel (with reserves) 1,145 miles, *g* limits +6/−3.

EMB-312 Tucano, Egyptian Air Force (Denis Hughes)

Fantrainer 600, Royal Thai Air Force

Accommodation: crew of two, in tandem on Martin-Baker BR8LC ejection seats. Rear seat raised.
Armament: four underwing hardpoints for up to 2,205 lb of stores, including (typically) two 0.30 in machine-gun pods, four 250 lb bombs, or four 7-tube rocket launchers.

Fantrainer 400 and 600

Designed for primary and basic flying training, to IFR standard, the Fantrainer has been built in two versions: the 400 and the more powerful but otherwise similar 600. The design is unique among current military trainers in having a ducted fan propulsion system, a concept studied and developed by RFB for many years. The turbo-

shaft engine is mounted aft of the cockpits, with shaft drive to a five-blade ducted fan. Sixteen Fantrainer 600s entered service with the Royal Thai Air Force from January 1987 and currently serve in the pilot training role at Kampensaeng. The first one, supplied complete by RFB, had GFRP wings; the other 15 were supplied in assembly kit form, but without wings, being completed on arrival by the addition of composite wings, purchased separately from RFB. In a similar program, RTAF is now assembling, and fitting locally developed metal wings to, 30 Fantrainer 400s, after having received one composite-winged example from the German manufacturer. Twenty of these should be completed by the end of this year, with the final 11 due for completion in 1991. The RTAF is the only customer for the Fantrainer. *(Data for RTAF Fantrainers.)*

Contractors: Rhein-Flugzeugbau GmbH, Germany; and Royal Thai Air Force, Thailand.
Power Plant: one Allison 250-C20B turboshaft of 420 shp (400), or 250-C30 of 650 shp (600).
Dimensions (both): span 31 ft 11½ in, length 31 ft 1¼ in, height 10 ft 4½ in.
Weights: empty 2,811 lb (400), 2,921 lb (600); max gross 4,012 lb (400), 4,122 lb (600).
Performance (600 at max gross weight): max cruising speed at 3,000 ft 214 mph, stalling speed 95 mph, service ceiling 25,000 ft, T-O run 920 ft (400), 820 ft (600), landing run (both) 820 ft, range (internal fuel, 45 min reserves) 737 miles (400), 645 miles (600), *g* limits (aerobatic, both) +6/−3.
Accommodation: crew of two, in tandem. Rear seat elevated. Rocket-assisted escape system standard, ejection seats optional.
Armament: none, but has provision to carry four fuel drop tanks under wings.

HTT-34

In June 1984, HAL began flight-testing a private-venture turboprop version of its HPT-32 side-by-side two-seat basic trainer, under the designation HTT-34. The prototype was produced by modification of the third example of the HPT-32, which was retrofitted with an Allison 250-B17D turboprop. Aft of the firewall, the airframe was virtually unchanged. A preproduction HTT-34 was rolled out of the Kanpur plant in early 1989, but no orders for the aircraft have yet been announced. It is being offered as a fully aerobatic multirole aircraft, suitable for a wide range of *ab initio* training duties, but intended also for communications, search and rescue, reconnaissance, glider towing, and sport flying. VHF, UHF, and ADF avionics are standard.

Contractor: Hindustan Aeronautics Ltd (Kanpur Division), India.
Power Plant: one Allison 250-B17D turboprop; 420 shp.
Dimensions: span 31 ft 2 in, length 26 ft 5¾ in, height 9 ft 5½ in.
Weights: empty 1,909 lb, gross 2,866 lb.
Performance: max speed at 9,850 ft 171 mph, stalling speed (flaps down) 67 mph, service ceiling 26,000 ft, T-O to 50 ft 810 ft, landing from 50 ft 1,247 ft, max range at 11,500 ft 435 miles, *g* limits +6/−3.
Accommodation: two seats, side by side. Space for 44 lb of baggage to rear of cockpit.
Armament: none.

L-90 TP Redigo

Production of the Redigo has begun, to fulfill a Finnish Air Force contract for ten, to be delivered in 1991–92. They will become part of a training system under which student pilots will graduate directly from the Redigo on to the Air Force's Hawk advanced jet trainers. To make this possible, Valmet optimized the design to cover primary and basic, aerobatic, night, instrument, navigation, formation, and tactical flying training, drawing upon experience gained with the earlier, piston-engined L-70 Vinka. Two prototypes were flown, one with an Allison 250 turboprop and the other with a similarly rated Turbomeca TP 319 turboprop. The Allison has been chosen for production Redigos, which also have new vertical tail surfaces, with an unswept fin, revised dorsal fin, and enlarged rudder. Like the Vinka, each can be fitted with a second pair of seats in the rear of the cabin, enabling it to be configured for liaison or observation missions. Other roles can include search and rescue, photographic reconnaissance, and target towing.

Contractor: Valmet Aviation Industries, Finland.
Power Plant: one Allison 250-B17F turboprop; 420 shp (flat rated).
Dimensions: span 34 ft 0½ in, length 25 ft 11 in, height 9 ft 4¼ in.
Weights: empty 1,962 lb, gross (aerobatic) 2,976 lb, max gross 4,189 lb.
Performance (at aerobatic gross weight): max speed at 5,000 ft 208 mph, max cruising speed at 9,850 ft 189 mph, stalling speed (flaps down) 58 mph, service ceiling 25,000 ft, T-O run 640 ft, landing run 689 ft, max range (with reserves) 932 miles, *g* limits +7/−3.5.
Accommodation: crew of two, side by side; space behind these for two more seats or 440 lb of baggage. Zero/zero rocket escape system optional.

HTT-34

L-90 TP Redigo (J. M. G. Gradidge)

Omega

PC-7 Turbo-Trainer, Swiss Air Force

PC-9, Royal Australian Air Force

Armament: none specified, but three hardpoints under each wing can carry a total of up to 1,764 lb of photographic, TV, radar, or reconnaissance pods and two flares, or other stores appropriate to role.

Oméga

After using the first prototype Epsilon (which see) as a test-bed for the Turbomeca TP 319 turboprop engine, Socata took development a stage further, as a private venture, by introducing additional changes to produce the Oméga. Under the new designation TB 31, this made its first flight on April 30, 1989, and made its public debut at the Paris Air Show a few weeks later. Although retaining some 60 percent commonality with the Epsilon, the Oméga has a more fatigue-tolerant airframe, a wider maneuvering envelope, optional ejection seats, and a single sideways-opening bubble canopy instead of the Epsilon's separate rearward-sliding hoods. *(Data as for Epsilon, except as follows.)*

Power Plant: one Turbomeca TP 319A2 turboprop; 488 shp (derated to 360 shp).
Dimensions: length 25 ft 7½ in, height 8 ft 9½ in.
Weights: empty 1,896 lb, gross 3,086 lb.
Performance: max speed at S/L 322 mph CAS, max cruising speed at 15,000 ft 288 mph, stalling speed (gear and flaps down) 74 mph, service ceiling 30,000 ft, T-O to 50 ft 1,870 ft, max range 875 miles, *g* limits +7/−3.5.
Accommodation (optional): Martin-Baker Mk 15FC ejection seats.

PC-7 Turbo-Trainer

Swiss law does not permit Pilatus to export aircraft equipped for combat duties, so the PC-7 is marketed as a fully aerobatic turboprop basic trainer. It can, however, be seen in service in some countries carrying a wide variety of stores on underwing weapon pylons that have been installed under separate contract by armament manufacturers. More than 400 PC-7s have been sold, and most of them delivered, for basic, transition, and aerobatic training, and, with suitable equipment added, for IFR and tactical training. Customers have included the air forces of Abu Dhabi (24), Angola (18), Austria (16), Bolivia (36), Chad (2), Chile (Navy, 10), Guatemala (12), Iran (35), Iraq (52), Malaysia (44), Mexico (75), Myanmar (17), Netherlands (10), Switzerland (40), and some undisclosed countries. The first production PC-7 was flown on August 18, 1978.

Contractor: Pilatus Flugzeugwerke AG, Switzerland.
Power Plant: one Pratt & Whitney Canada PT6A-25A turboprop; 550 shp (flat rated).
Dimensions: span 34 ft 1 in, length 32 ft 1 in, height 10 ft 6 in.
Weights: empty 2,932 lb, gross (aerobatic) 4,188 lb, max gross 5,952 lb.
Performance (at 4,188 lb weight): max cruising speed at 20,000 ft 256 mph, stalling speed (gear and flaps down) 74 mph, service ceiling 33,000 ft, T-O run 787 ft, landing run 968 ft, max range (with reserves) 745 miles, *g* limits +6/−3.
Accommodation: two seats, in tandem; Martin-Baker Mk CH 15A lightweight ejection seats optional. Space for 55 lb of baggage aft of seats.
Armament: see above.

PC-9

Although the airframe of the PC-9 bears a close family resemblance to that of the earlier PC-7, the two trainers share only a 10 percent structural commonality. The PC-9 has a more powerful engine, raised rear cockpit, ejection seats as standard, a ventral airbrake, modified wing profiles and wingtips, new ailerons, a longer dorsal fin, mainwheel doors, and larger wheels with high-pressure tires. The first of two preseries aircraft flew for the first time on May 7, 1984. Since that time, deliveries have been almost entirely to military operators, the first two customers being the Air Force of Myanmar (4, plus 2 more later) and the Royal Saudi Air Force (30). Principal customer is the Royal Australian Air Force, which is acquiring 67 of a modified version known as the PC-9/A, with Bendix EFIS instrumentation, PC-7 low-pressure tires, and bulged mainwheel doors. The first two were supplied in flyaway form by Pilatus, followed by kits for the next six and major components for 11 more. The remaining 48 are being built jointly by Hawker de Havilland and AeroSpace Technologies of Australia (ASTA). Deliveries to the RAAF began on December 14, 1987. Other customers include Angola (5), Iraq (believed 20), Switzerland (4), Cyprus, and the UK. Pilatus has teamed with Beech of the USA in offering a version of the PC-9 to meet the USAF/USN requirement for a Joint Primary Aircraft Training System (JPATS). Germany has bought 10 to replace OV-10B Broncos as target tugs for operation on behalf of the Luftwaffe.

Contractor: Pilatus Flugzeugwerke AG, Switzerland.
Power Plant: one Pratt & Whitney Canada PT6A-62 turboprop; 950 shp (flat rated).
Dimensions: span 33 ft 2½ in, length 33 ft 4¾ in, height 10 ft 8¼ in.
Weights: empty 3,715 lb, gross (aerobatic) 4,960 lb, max gross 7,055 lb.
Performance (at 4,960 lb weight): max speed at S/L 311 mph, max speed at 20,000 ft 345 mph, stalling speed (gear and flaps down) 81 mph, service ceiling 40,000 ft, T-O run 745 ft, landing run 1,368 ft, max range (with reserves) 1,020 miles, *g* limits +7/−3.5.
Accommodation: crew of two, in tandem, on Martin-Baker Mk CH 11A ejection seats. Rear seat raised. Space for 55 lb of baggage aft of seats.
Armament: see remarks under PC-7 entry.

PZL-130T/TM-601 Turbo-Orlik

Adaptation of the piston-engined Orlik (which see) to turboprop power was initiated in 1985, in a program with the Canadian company Airtech. The third Orlik, fitted

with a 550 shp Pratt & Whitney Canada PT6A-25A engine, made its first flight as the Turbo-Orlik prototype on July 13, 1986, but was lost in an accident early the following year. Development, without Airtech, has continued since then, with the completion of two further prototypes: a replacement **PZL-130T,** with the Canadian engine, and a **PZL-130TM-601,** powered by a Czechoslovak Walter M 601 E. Polish Air Force evaluation of the piston- and turbine-engined variants concluded in 1989 in favor of proceeding with the latter, with the Walter engine for a domestic version and the Canadian one for any export customers. An initial production batch of 10 Turbo-Oriliks is now being built, of which five are for the Polish Air Force. Compared with the piston Orlik, the Turbo has a more slender engine cowling, modified landing gear, enlarged dorsal fin, and hydraulic instead of pneumatic actuation of flaps and landing gear.

Contractor: PZL Warszawa-Okecie, Poland.

Power Plant: one Motorlet Walter M 601 E turboprop; flat rated at 660 shp; or Pratt & Whitney Canada PT6A-25A of 550 shp.

Dimensions: as Orlik, except length 28 ft 5¾ in.

Weights (PZL-130T): empty 2,535 lb, gross 3,483 lb (aerobatic), 4,751 lb (max with external stores).

Performance (PZL-130T at aerobatic gross weight): max speed at 15,000 ft 310 mph, max cruising speed at S/L 272 mph, stalling speed (gear and flaps down) 72 mph, service ceiling 32,800 ft, T-O run 821 ft, landing run 1,214 ft, max range (no reserves) 800 miles, *g* limits +6/−3.

Accommodation: as for Orlik.

Armament: four underwing hardpoints for up to 1,411 lb of practice bombs, gun and rocket pods, or other weapon training stores.

S312 Tucano

Despite outward appearances, this British-built version of the EMB-312 Tucano (which see) has only about 25 percent commonality with its Brazilian progenitor. It has a different engine, ventral airbrake, strengthened structure, new cockpit layout, and extensive British internal equipment. It was chosen in March 1985 to replace the Royal Air Force's Jet Provost basic trainers, and 130 have been ordered as Tucano **T. Mk 1s,** with a further 15 on option. The first production example flew for the first time on December 30, 1986, and about 50 had been delivered by September of this year. Deliveries began in June 1988, initially to the Central Flying School at RAF Scampton, which has 15. The first course of students began training on Tucanos at No. 7 Flying Training School, Church Fenton, in December 1989. The 25 aircraft for this unit are being followed by 30 for No. 3 FTS at RAF College, Cranwell, from October this year, and 39 more are due for delivery to No. 1 FTS at Linton-on-Ouse, where they will be introduced from February 1992. The remaining 21 aircraft are for the Refresher Flying Flight at Church Fenton (12) and No. 6 FTS at Finningley (nine for navigator training). Under a January 1990 contract, Shorts is to provide the first 50 Tucanos with strengthened flying controls, modified com/nav equipment, and structural improvements designed to extend fatigue life to 12,000 hours.

For export sales of the Shorts version, four underwing hardpoints provide armament training and light attack capability. The first of 12 **T. Mk 51s** for the Kenyan Air Force flew on October 11, 1989, and deliveries have begun. Prior to the 1990 Gulf crisis, Kuwait had ordered 16 **T. Mk 52s.** These export models have enhanced avionics and increased air-conditioning to compensate for the warmer climates involved.

Contractor: Short Brothers plc, UK.

Power Plant: one Garrett TPE331-12B turboprop; 1,100 shp.

Dimensions: span 37 ft 0 in, length 32 ft 4¼ in, height 11 ft 1¾ in.

Weights: empty (aerobatic) 4,447 lb, gross 6,393 lb (aerobatic), 7,716 lb (max).

Performance (aerobatic, at gross weight of 5,952 lb): max speed 311 mph, normal cruising speed 276 mph, econ cruising speed at 20,000 ft 253 mph, stalling speed (gear and flaps down) 80 mph EAS, service ceiling 34,000 ft, T-O run 1,010 ft, landing run 1,030 ft, max range (internal fuel, with reserves) 1,035 miles, *g* limits +7/−3.6.

Accommodation: crew of two, in tandem, on Martin-Baker Mk 8LCP ejection seats. Rear seat elevated.

Armament: export version can carry up to 1,000 lb of stores on four underwing hardpoints, typically two 500 lb or four 250 lb bombs, four rocket packs or practice bombs, two 0.50 in or two twin 0.30 in machine-gun pods. Aircraft for Kenya equipped with FN Herstal rocket pods and Forges de Zeebrugge 12.7 mm gun pods.

SA-32T Turbo Trainer

First flown on May 31, 1989, the SA-32T is a joint project by the Jaffe and Swearingen companies of San Antonio, Tex., based on Ed Swearingen's high-performance SX300 piston-engined sporting aircraft, but with wings of modified design. Skin thickness of the all-metal airframe has been increased by 50 percent; larger wheels, tires, and brakes are fitted; and the nonpressurized, 3 ft 5 in wide cockpit can be equipped with either a rocket extraction system or side-by-side Martin-Baker lightweight ejection seats, under a redesigned one-piece canopy with miniature detonating cord. The manufacturers claim that the combination of turboprop power and a NASA-designed laminar flow wing section gives handling characteristics similar to those of a jet aircraft, making the SA-32T suitable for forward air control and reconnaissance missions as well as training. An uprated version for single-seat antihelicopter combat is under consideration.

Contractors: Jaffe Aircraft Corporation, and Swearingen Engineering and Technology Inc, USA.

Power Plant: one Allison 250-B17D turboprop; 420 shp.

Dimensions: span 24 ft 4½ in, length 22 ft 6 in, height 7 ft 9¼ in.

Weights: empty 1,560 lb, gross 2,600 lb.

Performance: max speed at S/L 332 mph, normal cruising speed at 20,000 ft 315 mph, stalling speed (gear and flaps down) 76 mph, service ceiling more than 25,000 ft, T-O run 1,400 ft, landing run 1,100 ft, max range (no reserves) 1,105 miles, *g* limits +6/−6.

PZL-130TM-601 Turbo-Orlik (Richard Malachowski)

Tucano T. Mk 1, Royal Air Force

SA-32T Turbo Trainer

SF.260TP

Accommodation: crew of two, side by side; baggage space behind seats.

Armament: none.

SF.260TP

Although it has not achieved the same sales success as the piston-engined SF.260 (which see), the turboprop version of this Italian two/three-seat trainer has attracted orders for more than 60 from military customers which include Burundi (four), Dubai (five), Ethiopia (12), Haiti (five), Sri Lanka (nine), and Zimbabwe (reportedly 25). The TP flew for the first time in July 1980 and is identical to its piston-engined counterpart except for the engine, automatic fuel feed system, and an inset rudder tab. *(Data as for SF.260, except as follows.)*

Power Plant: one Allison 250-B17D turboprop; 350 shp.

Dimensions: length 24 ft 3¼ in.

Weights: empty 1,654 lb, max gross 2,866 lb.

Performance: max speed at 10,000 ft 262 mph, max cruising speed at 8,000 ft 248 mph, T-O run 978 ft, landing run 1,007 ft, max range (with reserves) 589 miles.

T-5

This two/four-seat turboprop primary trainer traces its ancestry back to the piston-engined Beechcraft T-34 Mentor, which was produced by Fuji under a license agreement concluded with Beech Aircraft in 1953. Shortly afterwards, the Japanese company began building its own licensed variants of the Mentor, all differing from the original US design in having wider center-fuselages to accommodate side-by-side seating. These Japanese models have included the LM-1 Nikko four-seat liaison aircraft, LM-2 Nikko (uprated engine and optional fifth seat), KM-2 two/four-seat primary trainer for the Maritime Self-Defense Force, and a two-seat KM-2B counterpart for the Japan Air Self-Defense Force (JASDF designation T-3). In 1984 Fuji replaced the 340 hp piston engine of a company-owned KM-2 with an Allison 250 turboprop, this KM-2D prototype flying for the first time on June 28 of that year. This has led to a program, launched in March 1987, to replace the JMSDF's existing fleet of 31 KM-2s with a KM-2Kai (modified) version of the KM-2D embodying additional changes to the cabin structure and equipment. Deliveries to the JMSDF, under the designation T-5, began in August 1988. Eight T-5s had been ordered by March of this year.

Contractor: Fuji Heavy Industries Ltd, Japan.

Power Plant: one Allison 250-B17D turboprop; 350 shp (flat rated).

Dimensions: span 32 ft 11¼ in, length 27 ft 8¼ in, height 9 ft 8½ in.

Weights: empty 2,385 lb, gross (aerobatic) 3,494 lb, max gross 3,979 lb.

Performance (at aerobatic gross weight except where indicated): max speed at 8,000 ft 222 mph, econ cruising speed at 8,000 ft 178 mph, stalling speed (gear and flaps down) 65 mph, service ceiling 25,000 ft, T-O run 990 ft, landing run 570 ft, range (at max gross weight, with reserves) 587 miles.

Accommodation: crew of two, side by side in aerobatic configuration. Second pair of seats behind these in utility version.

Armament: none.

T-34C

In April of this year, Beech delivered to the US Navy the last of a final batch of 19 of these long-serving turboprop trainers. They had been built as replacements for attrition among the 334 earlier examples that the company had built for the Navy between 1977 and 1984—an outstandingly low incidence of replacement for an aircraft

that has logged well in excess of one million flight hours and has the lowest accident rate of any aircraft in the USN's current inventory. The first YT-34C prototype was flown in September 1973, but the design has, of course, a longer history even than this, having been preceded by two piston-engined early models, USAF's **T-34A** (450 built) and Navy's **T-34B** (423 built). It is the need to replace such a veteran design and the almost equally elderly twin-jet Cessna T-37 that has given rise to the important JPATS (Joint Primary Aircraft Training System) requirement for which many of the trainers in this Gallery are bidding. Beech also built 139 **T-34C-1** armament systems trainers, with FAC and light attack training capability, for Argentina, Ecuador, Gabon, Indonesia, Morocco, Peru, Taiwan, and Uruguay. Most USN T-34Cs serve with Air Training Wing 5 at NAS Milton, Fla.; six others were transferred to the US Army, to serve as chase and photographic aircraft for the Airborne Special Operations Test Board at Fort Bragg, N. C. *(Data for T-34C, except where indicated.)*

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

T-CH-1

Using the airframe of the North American T-28A as a basis, Taiwan's Aero Industry Development Center began design of this turboprop trainer in late 1970, to provide a home-produced basic trainer for the Chinese Nationalist Air Force. The XT-CH-1A first prototype flew on November 23, 1973, followed just over a year later by an XT-CH-1B prototype configured for weapon training and counterinsurgency duties. Construction was all-metal, and design features included large-area slotted flaps and a rearward-sliding canopy over the two tandem seats. Production of 50 T-CH-1s started in May 1976, ending about five years later. The aircraft is no longer used extensively for basic training, but many have been converted for weapon training or light attack, being designated **A-CH-1** in the latter role.

Contractor: Aero Industry Development Center, Taiwan.
Power Plant: one license-built Textron Lycoming T53-L-701 turboprop; 1,450 ehp.
Dimensions: span 40 ft 0 in, length 33 ft 8 in, height 12 ft 0 in.
Weights: empty 5,750 lb, gross 7,500 lb (clean), 11,150 lb (max, with external stores).
Performance (at 7,600 lb gross weight): max speed at 15,000 ft 368 mph, max cruising speed at 15,000 ft 253 mph, stalling speed 58 mph, service ceiling 32,000 ft, T-O run 480 ft, landing run 600 ft, max range 1,250 miles.
Accommodation: crew of two, in tandem.
Armament: four underwing hardpoints for bombs, rocket or gun pods, or other stores.

T-34C-1, Chinese Nationalist Air Force (Denis Hughes)

T-CH-1, Chinese Nationalist Air Force (Denis Hughes)

Jet Trainers

AA300 Rigel

Aerodis America, assisted by the experienced light aircraft engineer David B. Thurston, is developing a family of aircraft utilizing the same basic low-wing, T-tailed, all-composites airframe. First member is a four-seat piston-engined cabin monoplane, with tail-pusher propeller, known as the **AA200 Orion.** Under construction in early 1990 was the pressurized, tandem two-seat **AA300 Rigel,** which Aerodis hoped to fly in September and plans to market for about one-third the price of competing primary jet trainers. It intends to focus sales efforts initially on Third World nations in the Middle East, Asia, and the Pacific basin, although the Rigel has also been proposed as a contender for the USAF/USN JPATS requirement. Also projected, as the third member of the family, is a single-seat light tactical version of the Rigel known as the **AA330 Theta.**

Contractor: Aerodis America Inc, USA.
Power Plant: one Garrett TFE109-3 or Williams International FJ44 turbofan; derated to 1,200 lb st.
Dimensions: span 29 ft 0½ in, length 25 ft 11 in, height 8 ft 8 in.
Weights: empty 1,850 lb, gross 3,350 lb.
Performance (estimated): max speed at 30,000 ft 426 mph, stalling speed (flaps down) 71 mph, range (with reserves) 1,209 miles, *g* limits +9/−6.
Accommodation: crew of two, in tandem, on lightweight ejection seats. Rear seat elevated.
Armament: single stores hardpoint under each wing and one on fuselage centerline.

Alpha Jet, Qatar Emiri Air Force (Denis Hughes)

Alpha Jet

The initial versions of the Alpha Jet were conceived, developed, and built as a Franco-German collaborative program. The first prototype flew on October 26, 1973. Production lines were established by Dassault and Dornier, from which 176 trainers were delivered to the French Air Force and 175 close-support Alpha Jets to the German Air Force, in 1978–85. All had essentially identical structure, landing gear, power plant, and standard equipment; but the German aircraft have since been fitted with uprated (3,175 lb st) Larzac 04-C20 turbofans and are now receiving improved instruments, a stall warning indicator, better landing gear cooling, a three-axis damping system, and provision for carrying two Sidewinder self-defense missiles and a podded 27 mm Mauser gun. Export orders for the trainer/light attack model were placed by Belgium (33), Egypt (30, designated **MS1**), Ivory Coast (7), Morocco (24), Nigeria (24), Qatar (6), and Togo (6). The Arab Organization for Industrialization (AOI) assembled most of the aircraft for the Egyptian Air Force at Helwan. When Dassault developed an alternative close-support version, with added inertial platform, head-up display, laser rangefinder, and radar altimeter, seven were ordered by Cameroon and 15 (as **MS2s**) by Egypt, of which 11 were coproduced by AOI. Several developed versions of the Alpha Jet have been marketed but have not yet been sold. They include the current **Alpha Jet 2** dedicated combat aircraft, for day/night attack, antishipping strike, and antihelicopter missions; and the **Alpha Jet 3** trainer, with a CRT raster HUD combined with a collimated head-level display, rear cockpit CRT monitor, and lateral multifunction displays and keyboards in each cockpit.

Contractors: Dassault Aviation, France, and Dornier Luftfahrt GmbH, Germany.
Power Plant: two SNECMA/Turbomeca Larzac 04-C6 turbofans standard; each 2,976 lb st. Two 3,175 lb st Larzac 04-C20s now standard for German close support aircraft, optional for other variants.
Dimensions (trainer): span 29 ft 10¾ in, length 38 ft 6½ in, height 13 ft 9 in.
Weights (trainer): empty 7,374 lb, gross 11,023 lb, max gross with external stores 17,637 lb.
Performance (at 11,023 lb weight, 04-C6 engines): max speed at 32,800 ft Mach 0.85, max speed at S/L 621 mph, stalling speed (gear and flaps down) 104 mph, service ceiling 48,000 ft, T-O run 1,215 ft, landing run 1,640 ft, radius of action (with reserves) at high altitude 764 miles on internal fuel, 901 miles with external tanks, *g* limits (ultimate) +12/−6.4.
Accommodation: crew of two, in tandem, on Martin-Baker AJRM4 zero height/104 mph, or B10N series zero/zero, ejection seats.
Armament: centerline stores pylon, or pod for 30 mm DEFA or 27 mm Mauser gun. Provision for two hardpoints under each wing for 18-tube rocket packs, bombs of up to 882 lb, cluster bombs, 30 mm gun pods, Sidewinder or Magic air-to-air missiles, Maverick air-to-surface missiles, a reconnaissance pod, drop tanks, and other stores. Max load on five pylons 5,510 lb.

AT-3, Chinese Nationalist Air Force (Denis Hughes)

AT-3

Designed under a 1975 contract, this tandem-seat, twin-turbofan trainer flew for the first time on September 16, 1980. Sixty were built and have served since 1984 as the standard basic and advanced trainers of the Chinese Nationalist Air Force. With a 6,000 lb external stores capacity, the AT-3 has always offered potential for secondary ground attack and maritime strike missions. In 1989, work was begun on upgrading two aircraft for evaluation in a close support role, with added Westinghouse APG-66 radar and fire-control system. If considered viable, the remaining 45 AT-3s will be modified in a similar way. Lear Siegler International is prime contractor for this upgrade program.

Contractor: Aero Industry Development Center, Taiwan.
Power Plant: two Garrett TFE731-2-2L turbofans; each 3,500 lb st.
Dimensions: span 34 ft 3¾ in, length 42 ft 4 in, height 14 ft 3¾ in.

Weights: empty 8,500 lb, gross (clean) 11,500 lb, max gross 17,500 lb.

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

Accommodation: crew of two, on tandem zero/zero ejection seats. Rear seat elevated.

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

C-101 Aviojet

Thirteen years after the first of four prototypes of the Aviojet flew for the first time, on June 27, 1977, its production and development are continuing. Ninety-two of the original **C-101EB** fully aerobatic basic and advanced trainers were built under the designation **E.25 Mirlo** ("blackbird") for the Spanish Air Force. These aircraft have 3,500 lb st Garrett TFE731-2-2J engines. An armed export version, with a 3,700 lb st TFE731-3-1J turbojet, was ordered by Chile (14 **C-101BB-02**) and Honduras (4 **C-101BB-03**). All but the first four of the BB-02s were assembled under license by ENAER in Chile, with partial local manufacture, and have the official Chilean Air Force designation **T-36 Halcón** ("hawk"). During 1982, ENAER and CASA initiated development of a dedicated attack version of the Aviojet, designated **C-101CC-02** in Spain and **A-36** Halcón by the Chilean Air Force. The first of two prototypes flew on November 16, 1983, and 23 similar production A-36s, with more powerful TFE731-5-1J engines, are being manufactured currently for the Chilean Air Force. All Halcóns now have a nose-mounted ranging radar, ventral gun pod, and six underwing weapon pylons. Sixteen basically similar **C-101CC-04s** serve with the Royal Jordanian Air Force. An enhanced training version, with the TFE731-5-1J engine and additional avionics, including a Ferranti HUD, weapon aiming computer, inertial platform, and Doppler velocity sensor, flew for the first time on May 20, 1985, as the **C-101DD.** Its further development is being discussed as a joint venture by CASA and ENAER, which is also negotiating with the Chilean Air Force a follow-on contract for 20 more A-36s. *(Data for C-101CC.)*

Contractor: Construcciones Aeronauticas SA, Spain.

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

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

Weights: empty 7,716 lb, gross (trainer, clean) 10,075 lb, max gross 13,890 lb.

Performance (at 9,921 lb weight, except where indicated): max speed at 15,000 ft with MPR 518 mph, stalling speed (gear and flaps down) 102 mph IAS, service ceiling 42,000 ft, T-O run 1,835 ft, landing run 1,575 ft, ferry range (with reserves) 2,303 miles, *g* limits at 10,582 lb weight +7.5/−3.9.

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

Armament: bay beneath rear cockpit for quick-change packages, including a 30 mm DEFA gun with 130 rounds, twin 12.7 mm Browning machine guns, reconnaissance camera, ECM package, or laser designator. Six underwing hardpoints for up to 4,960 lb of stores, including four LAU-10 rocket packs, six 250 kg bombs, two Maverick air-to-surface missiles, or four BIN200 napalm bombs.

CM 170 Magister

More than 900 examples of this French jet trainer were built between 1953 and 1969, and more than one-third of these are still in service, including about 300 with original customers France (more than 160, including 12 navalized **CM 175 Zéphyrs**), Israel (80), Belgium, Lebanon, and Morocco. Other operators include the air forces of Algeria, Bangladesh, Cameroon, El Salvador, Gabon, Ireland, and Libya, with some of which they perform alternative weapon training/counterinsurgency duties. Most aircraft in service are of the basic Magister version with 880 lb st Marboré IIA turbojets, but the final 137 aircraft were **Super Magisters** (also designated CM 170) with the uprated Marboré VI power plant. A modernized prototype **Fouga 90A,** with elevated rear seat, Astafan turbofan engines, and upgraded cockpit, flew in August 1978 but failed to secure any orders. Between 1981 and 1986 Israel's Magisters, which have the local name **Tzukit** ("thrush"), were rebuilt and upgraded by IAI's Bedek Aviation Division under a program known as AMIT (Advanced Multimission Improved Trainer). These aircraft are unarmed but have a capability for patrol and reconnaissance missions. *(Data for Super Magister.)*

Contractor: Aerospatiale SNI (originally Fouga), France.

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

C-101DD Aviojet

CM 170 Magister, Belgian Air Force

G-4 Super Galeb

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

Weights: empty 5,093 lb, gross 6,280 lb (clean), 7,187 lb (max, with external stores).

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

Accommodation: crew of two, on tandem ejection seats.

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

G-2A Galeb

Designed in the late 1950s and first flown in May 1961, the straight-winged Galeb ("gull") was in production for 21 years (1963–83). About 200 were built for the Yugoslav Air Force, plus six exported to Zambia in 1971 and 50 for Libya **(G-2A-E)** four years later. Libya still has about 30 for training and light attack duties, and some 75–100 are thought to remain in Yugoslav service, although the latter are steadily being replaced by the sweptwing G-4 Super Galeb (which see).

Contractor: Vazduhoplovna Industrija SOKO, Yugoslavia.

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

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

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

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

Accommodation: crew of two, on tandem ejection seats.

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

G-4 Super Galeb

With a configuration very similar to that of the BAe Hawk, the Super Galeb is very different from its straight-winged G-2 predecessor (which see). The two prototypes (first flights July 1978 and December 1979) and a small preproduction batch (first flight December 1980) all had a level tailplane fitted with elevators, but an all-moving tailplane with marked anhedral was made standard for the production version, up to 200 of which are believed to have been ordered for the Yugoslav Air Force. Their first task was to replace that service's aging Lockheed T-33 trainers and Jastreb single-seat light strike aircraft, but they are also replacing, on a one-to-one basis, the earlier G-2 Galebs, and 150 or more **G-4s** have now been delivered. Units include the YAF Academy at Zadar, an advanced training school at Pula, and (from this year) the Academy's Flying Stars aerobatic display team. Although lighter than the Hawk, with a lower-powered engine, the Super Galeb has an impressive weapon-carrying ability which should be significantly improved early next year with the first flight of the new **G-4M** version. This will have an upgraded nav/attack system and other avionics including head-up and other multifunction displays, IFF, a flight data recorder, and rails for wingtip-mounted missiles. This is thought to be the model ordered recently by Myanmar (20); production is expected to start in 1992. The Super Galeb has also been proposed to meet the US JPATS requirement. *(Data for G-4.)*

Contractor: Vazduhoplovna Industrija SOKO, Yugoslavia.

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

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

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

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

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

Armament: removable centerline gun pod containing 23 mm GSh-23L twin-barrel cannon with 200 rds. Two pylons under each wing for such weapons as napalm tanks, cluster bombs containing eight 35 lb fragmentation munitions, containers for 40 antipersonnel or 54 antitank bomblets, 16-tube rocket packs, triple carriers for 220 lb bombs, 12.7 mm gun pods, or drop fuel tanks. Max weapon load 2,822 lb (3,968 lb in G-4M).

Hawk

The **Hawk T. Mk 1,** powered by a 5,200 lb st Adour 151 turbofan, has been the standard basic/advanced flying and weapons trainer of the Royal Air Force since the fall of 1976. Unarmed T. Mk 1s serve with the Central Flying School at RAF Scampton and No. 4 Flying Training School; they are scheduled also to undertake a navigation training role with No. 6 FTS, starting in 1992. Eighty-eight of the 176 Hawks delivered to the RAF, including those of the renowned Red Arrows aerobatic display team, are wired to carry a Sidewinder missile under each wing, in addition to the standard underbelly 30 mm gun pack, to accompany radar-equipped Phantoms and Tornados on medium-range air defense sorties as components of the UK Mixed Fighter Force. These aircraft are designated **T. Mk 1A.**

The initial export **Hawk 50** series, with more powerful (5,340 lb st) Adour 851 turbofan, 70 percent greater disposable load, and 30 percent longer range, was sold to Finland (50 Mk 51, with a 12.7 mm centerline gun instead of the standard 30 mm Aden), Kenya (12 Mk 52), and Indonesia (20 Mk 53). The further improved **Hawk 60** series, with four-position flaps, modified wing leading-edge devices, and other refinements, has attracted orders from Zimbabwe (8 Mk 60), Dubai (9 Mk 61), Abu Dhabi (16 Mk 63), Kuwait (12 Mk 64), Saudi Arabia (30 Mk 65), Switzerland (20 Mk 66), and South Korea (20 Mk 67). More specialized and higher-performance two-seat and single-seat strike versions are respectively designated **Hawk 100 and 200** series. These have been ordered or selected by the air forces of Abu Dhabi (12 Srs 100), Brunei (16 Srs 100), South Korea (100 Srs 100/200), Malaysia (6 Srs 100 and 32 Srs 200), Oman (20 Srs 100/200), and Saudi Arabia (60 Srs 100/200); most will have the optional fit of wingtip rails for Sidewinder air-to-air missiles.

Total Hawk sales now exceed 650, including the US Navy's **T-45A Goshawk,** which is described separately. *(Data for Hawk 60 series.)*

Contractor: British Aerospace plc, UK.

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

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

Weights: empty 8,267 lb, gross 11,350 lb (clean), 18,739 lb (max).

Performance: max speed 644 mph, max Mach number in dive 1.2, service ceiling 50,000 ft, T-O run 1,800 ft, landing run 1,700 ft, ferry range with two drop tanks 2,530 miles, *g* limits +8/−4.

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

Hawk 100

Armament: centerline pack for 30 mm Aden gun with 120 rds, or pylon, plus two pylons under each wing. Within overall max of 6,800 lb, typical loads can include centerline gun pack or reconnaissance pod and four underwing rocket packs; seven 1,000 lb bombs; thirty-six 80 lb runway denial bombs; five 600 lb cluster bombs; four Sidewinder/Magic air-to-air missiles; two Maverick air-to-surface missiles and two drop tanks; or a Sea Eagle antiship missile, two Sidewinders, and two drop tanks.

HJT-16 Kiran

Deliveries of this side-by-side two-seat jet trainer to the Indian Air Force ended during 1989. The prototype of the original version of the Kiran had flown for the first time in September 1964, and deliveries of 118 Viper-engined **Mk Is** to the Indian Air Force began in the spring of 1968. The Mk I, intended for basic flying training only, was followed by a **Mk IA** with a hardpoint under each wing to permit the carriage of practice armament for weapons training. About 80 Mk IAs were built for the IAF and Indian Navy before being supplanted in 1982 by the more powerful Kiran **Mk II.** This version utilizes the same Orpheus turbojet as HAL's Ajeet version of the Folland/Hawker Siddeley Gnat light fighter, together with updated instruments and avionics, an improved hydraulic system, and an additional pair of underwing stations for enhanced weapon-carrying capability in either training or counterinsurgency roles. The Kiran Mk II flew for the first time on July 30, 1976; 61 were produced for the Indian Air Force. *(Data for Mk II.)*

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

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

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

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

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

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

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

I-22 Iryd

The first of four prototypes of the I-22 Iryd ("iridium") jet trainer and light attack aircraft was flown for the first time on March 3, 1985. It is clearly intended as a successor to the long-serving TS-11 Iskra, production of which came to an end at PZL Mielec in 1987 after 550 (including 50 for India) had been manufactured during the previous 24 years. The I-22 is larger and more capable than the Iskra and is able to perform reconnaissance and close support missions in addition to its primary function as an advanced jet trainer. It is designed to cover the full spectrum of pilot, navigation, air combat, and tactical training, day or night and in adverse weather, and is able to operate from unprepared airstrips. Service life has been calculated on the basis of 2,500 flying hours or 10,000 takeoffs and landings, and the airframe is stressed for later introduction, if required, of more powerful engines and an increased ordnance load. In this respect, a 3,305 lb st engine designated K-15 is under development in Poland and may be intended for use in the I-22.

Contractor: Instytut Lotnictwa (Aviation Institute), Poland.

HJT-16 Kiran Mk II, Indian Air Force

I-22 Iryd (Lech Zielaskowski)

IA 63 Pampa (Air Portraits)

IAR-99 Soim, Romanian Air Force

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

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

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

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

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

Armament: one 23 mm GSh-23L gun in underfuselage pack, plus two hardpoints under each wing for up to 2,645 lb of bombs, guided or unguided rockets, or (inboard stations only) drop tanks.

IA 63 Pampa

Development of the Pampa was started in 1979, initially to replace the Argentine Air Force's aging Morane-Saulnier Paris IIIs in the basic, advanced, and weapons training roles. FMA, the national Military Aircraft Factory, enlisted the technical assistance of Dornier of Germany, which, in particular, built the wings and tailplanes of the prototypes. The first of these flew on October 6, 1984. Delivery of the 18 production aircraft ordered at that stage by the Air Force began in May 1988, and 12 were in service with the IVth Air Brigade at El Plumerillo, Mendoza, by the spring of this year. All will be fitted retrospectively with a podded 30 mm gun and underwing weapon pylons in due course. Meanwhile, the Air Force has been evaluating two of the prototypes fitted with more advanced avionics and a HUD. From the 19th aircraft, a more powerful Garrett TFE731-3G engine will become standard. Orders for the Argentine Air Force currently total 100 Pampas; in addition, FMA has teamed with LTV of the US to enter the aircraft for the USAF/USN JPATS competition for a new primary trainer.

Contractor: Fábrica Militar de Aviones, Argentina.

Power Plant: one Garrett TFE731-2-2N turbofan in first 18 aircraft; 3,500 lb st. Subsequent aircraft will have TFE731-3G; 4,500 lb st.

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

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

Performance: max speed at 22,965 ft 509 mph, max cruising speed at 13,125 ft 464 mph, service ceiling 42,325 ft, T-O run (at 8,157 lb weight) 1,477 ft, landing run 1,411 ft, range (standard fuel) 621 miles, max range (auxiliary fuel) 932 miles, *g* limit +4.5.

Accommodation: crew of two, on tandem UPC (Stencel) zero/zero ejection seats. Rear seat elevated.

Armament: hardpoint under fuselage and two under each wing for up to 2,557 lb (with standard fuel) of gun pods, bombs, and rockets. With uprated engine, external load can be increased to 3,748 lb.

IAR-99 Soim

Existence of an indigenously designed Romanian jet trainer first became known in 1983, when an illustration and brief details appeared in an industry leaflet released at that year's Paris Air Show. Powered by a nonafterburning version of the engine—built in Romania under Rolls-Royce license—used in the IAR-93 close support/ground-attack aircraft, the Soim ("hawk") flew for the first time in December 1985. Design features include hydraulically boosted aileron controls and a nonsteerable nosewheel. The Romanian Air Force has ordered 50, with options on 100 more, for both intermediate and advanced training and for a secondary ground-attack role. Deliveries, which began in 1988, had totaled more than 20 by the middle of this year, and the type is being offered for export. Plans are in hand for developed versions with improved nav/attack system, uprated engine, and even afterburning.

Contractor: Aircraft Industry Craiova, Romania.

Power Plant: one Rolls-Royce Viper Mk 632-41M turbojet.

Dimensions: span 32 ft 3¾ in, length 36 ft 1½ in, height 12 ft 9½ in.

Weights: empty 7,055 lb, gross 9,700 lb (training), 12,257 lb (ground attack, with external stores).

Performance (trainer): max speed at S/L 537 mph, service ceiling 42,325 ft, T-O run 1,477 ft, landing run 1,805 ft, max range 683 miles, *g* limits +7/−3.

Accommodation: crew of two, in tandem on zero/zero ejection seats. Rear seat elevated.

Armament: two hardpoints under each wing for bombs, gun or rocket pods, drop tanks, or other stores; underfuselage attachment for 23 mm gun pack with 200 rds.

Jet Squalus F1300 NGT

The initials NGT in the designation of the Jet Squalus (Latin "shark") indicate that it was conceived as an "all-through" trainer to meet a specification similar to that which had been issued for USAF's Next Generation Trainer (Fairchild T-46A) program. Design and prototype construction were entrusted to the much respected Italian engineer Dott Ing Stelio Frati, and the first prototype was built around a TFE109-1 turbofan of the kind developed especially for the T-46A. It made its first flight on

April 30, 1987, and was to be joined this year by a second prototype with an uprated engine. A third prototype, with a pressurized cockpit and other advanced features, is under construction.

The Jet Squalus is intended to be suitable for all stages of flying training from initial pilot screening, primary, and basic through to part of the advanced syllabus, including weapons training. In 1989, the Portuguese government signed a letter of intent for at least 100, to be manufactured in that country by OGMA. Some 30–35 of these would be for the Portuguese Air Force, others for civil agencies and export. The Jet Squalus is also offered as a candidate for the USAF/USN JPATS trainer competition. *(Data for first prototype.)*

Contractor: Promavia SA, Belgium.

Power Plant: one Garrett TFE109-1 turbofan; 1,330 lb st. Second prototype has TFE109-3 of 1,600 lb st.

Dimensions: span 29 ft 8 in, length 30 ft 8½ in, height 11 ft 9¾ in.

Weights: empty 2,866 lb, gross 5,291 lb.

Performance (TFE109-1 engine): max speed at 14,000 ft 322 mph, normal operating speed 299 mph, stalling speed (gear and flaps down) 77 mph, service ceiling 37,000 ft, T-O run 1,100 ft, landing run 1,200 ft, ferry range (max internal fuel at 20,000 ft) 1,150 miles, *g* limits (aerobatic) +7/−3.5.

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

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

K-8 Karakorum 8

Detail design of this tandem two-seat jet trainer was started by NAMC one month after a preliminary model was exhibited at the Paris Air Show in June 1987. Representatives from the People's Republic of China had made it known that they were seeking an international partner in the program. Pakistan subsequently emerged as that partner, at which stage the aircraft was named after the mountain range forming part of the border between the two nations, and its designation was changed from L-8 to K-8. The first of five prototypes was scheduled to fly before the end of 1990, and it is estimated that at least 100 production Karakorums will be required to meet the current needs of the Pakistan Air Force. Like other aircraft in this category, they will not only satisfy all basic flying training roles but will also have a capability for weapons training and light close support combat missions.

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

Power Plant: one Garrett TFE731-2A-2A turbofan; 3,600 lb st.

Dimensions: span 31 ft 7¼ in, length (incl nose probe) 38 ft 0¾ in, height 13 ft 9¾ in.

Weights: empty 5,637 lb, gross (clean) 7,716 lb, max gross 9,259 lb.

Performance (estimated at clean gross weight): max speed at S/L 497 mph, service ceiling 42,650 ft, T-O run 1,345–1,411 ft, landing run 1,674–1,706 ft, max range with internal fuel 870 miles.

Accommodation: crew of two, in tandem on Martin-Baker CN10LW ejection seats. Rear seat elevated.

Armament: one 23 mm gun pod under center fuselage; two hardpoints under each wing for gun or rocket pods, bombs, missiles, drop tanks (inboard pylons only), or a single reconnaissance pod.

L-29 Delfin

Nearly two-thirds of the 3,600 or so Delfins that were built by the Czechoslovak Aero factory were for the USSR, the bulk of the remainder being supplied as the standard jet trainer to all other Warsaw Pact member states except Poland. At least nine other nations received L-29s, of which Afghanistan, Egypt, Mali, and Syria still have the type in their inventories. A Viper-powered prototype flew for the first time on April 5, 1959, but the domestic M 701 turbojet was fitted to the second prototype and became standard in the production **L-29,** which was in continuous production from 1961 until 1974. An **L-29R** version of the Delfin ("dolphin") was produced for light attack duties, equipped with underwing stores pylons and nose-mounted cameras. The single-seat **L-29A Akrobat** model of the early 1970s was not produced in quantity. Many original operators have replaced or supplemented their L-29s with its successor, the L-39 Albatros (which see). *(Data for standard L-29.)*

Contractor: Aero Vodochody National Corporation, Czechoslovakia.

Power Plant: one Motorlet Walter M 701c 500 turbojet; 1,960 lb st.

Dimensions: span 33 ft 9 in, length 35 ft 5½ in, height 10 ft 3 in.

Weights: empty 5,027 lb, gross 7,231 lb (clean), 7,804 lb (max, with external stores).

Performance (at 7,165 lb gross weight): max speed at S/L 382 mph, stalling speed (flaps down) 81 mph, service ceiling 36,100 ft, T-O run 1,805 ft, landing run 1,444 ft, max range with underwing tanks 555 miles.

Jet Squalus F1300 NGT

Model of K-8 Karakorum 8 (Air Portraits)

L-29 Delfins, Soviet Air Force (Tass)

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

Armament: single attachment point under each wing for rocket pod, 7.62 mm machine-gun pod, 220 lb bomb, or drop fuel tank.

L-39/59 Albatros

The **L-39MS,** latest variant of this much-produced successor to the L-29 Delfin, made its debut at the 1990 Farnborough Air Show in the UK. By then, 2,800 earlier models of the L-39 had been delivered since 1974, more than 80 percent of them to the Soviet Union, where they serve as the principal jet trainers for new pilots of the Soviet air forces. The Czechoslovak Air Force uses L-39s for all pilot training, including that of helicopter pilots. Other customers for the **L-39C** basic and advanced flying trainer have included the air forces of Afghanistan, Cuba, and the former German Democratic Republic. The **L-39Z0,** with strengthened wings for additional stores carriage, has been exported in large numbers to Iraq, Libya (some transferred to Egypt), and Syria. Romania and Bulgaria received the **L-39ZA** ground-attack/reconnaissance version; other L-39 operators include Algeria, Bulgaria, Ethiopia, Nigeria, and Vietnam. All of these models have a 3,792 lb st Ivchenko AI-25TL turbofan. Principal changes in the **L-39MS** are the use of a new and more powerful DV-2 turbofan, developed primarily in the Soviet Union but produced in Czechoslovakia. The airframe and avionics have also been upgraded, with all new equipment of Czechoslovak manufacture, including a HUD. Deliveries to the Czechoslovak Air Force will begin next year, together with two aircraft to the Soviet Union for evaluation, followed by production deliveries by the end of 1991. The **L-59** export version will have a Western engine and avionics, but no selection of a suitable power plant has yet been made. L-39/59 deliveries are reducing to a predicted 100 a year, from 150–160, as a result of the political changes in eastern Europe, but are expected to continue until at least 1997–98. *(Data for L-39MS.)*

Contractor: Aero Vodochody Národní Podnik, Czechoslovakia.

Power Plant: one DV-2 turbofan; 4,850 lb st.

Dimensions: span incl tiptanks 31 ft 3½ in, length 40 ft 0 in, height 15 ft 8¼ in.

Weights: empty 9,380 lb, gross 12,202 lb.

Performance: max speed at S/L 490 mph, at 16,400 ft 540 mph, stalling speed (gear and flaps down) 106 mph, service ceiling 38,400 ft, T-O run 2,133 ft, landing run 2,365 ft, range 745 miles.

Accommodation: crew of two, in tandem on zero height/31–503 mph VS-2 ejection seats (Martin-Baker Mk 10 zero/zero seats optional). Rear seat elevated.

Armament: one 23 mm GSh-23 twin-barrel gun in centerline pod; four underwing pylons for a total of 2,425 lb of stores, including bombs up to 1,102 lb, rocket pods, IR air-to-air missiles (outer pylons only), drop tanks, or (port inner pylon only) a daylight camera pod.

MB-326 and Impala

One of many first-generation jet trainers powered by the remarkable Viper engine, the Aermacchi MB-326 prototype first flew on December 10, 1957, with a Viper 8 turbojet. This was changed to a higher-powered Viper 11 (2,500 lb st) in the initial production **MB-326** for the Italian Air Force and the **326B** (for Tunisia), **E** (Italy), **F** (Ghana), **H** (Australia), and **M** (South Africa). The strengthened wings of the E (each with three pylons) were combined with the more powerful Viper 540 to produce the trainer/light attack **MB-326GB** built by Aermacchi for Argentina, Zaïre, and Zambia, and by Embraer for the air forces of Brazil, Paraguay, and Togo. The Brazilian version is known as the **AT-26 Xavante.** Final Italian-built variants, both with a 4,000 lb st Viper 632, were the single-seat **MB-326K** and two-seat **MB-326L,** the former for operational training/ground attack and the latter for advanced training. Atlas Aircraft Corp. in South Africa built 151 examples of the MB-326M under license as **Impala Mk 1** trainers and a further quantity of MB-326Ks as the **Impala Mk 2.** All 11 of the countries mentioned, plus Dubai, still operate various models of the MB-326. *(Data for MB-326GB).*

Contractor: Aermacchi SpA, Italy.

Power Plant: one Rolls-Royce Viper 20 Mk 540 turbojet; 3,410 lb st.

Dimensions: span 35 ft 7¼ in, length 35 ft 0¼ in, height 12 ft 2 in.

Weights: empty 5,920 lb, gross 10,090 lb (training), 11,500 lb (max, with external stores).

Performance (trainer at 8,680 lb gross weight, internal fuel only): max speed 539 mph, max cruising speed 495 mph, service ceiling 47,000 ft, T-O run 1,350 ft,

L-39MS Albatros (Letectvi + Kosmonautika/Václav Jukl)

landing from 50 ft 2,070 ft, range (with reserves) 1,150 miles.
Accommodation: crew of two, on tandem ejection seats.
Armament: three attachment points under each wing for up to 4,000 lb of gun or rocket pods, bombs, wire-guided missiles, camera pack, or drop fuel tanks.

MB-339

The prototype MB-339 first flew on August 12, 1976, and the first production **MB-339A** on July 20, 1978. The 101 MB-339As built for the Italian Air Force included four **MB-339RM** *(radiomisure)* calibration aircraft and 15 **MB-339PANs** for the Frecce Tricolori aerobatic display team, the latter having the normally standard wingtip tanks deleted to aid formation keeping. Primary role of the standard MB-339A is for all phases of advanced training, but the Italian aircraft are camouflaged for use also as an emergency close air support force. Before production ended in 1987, Aermacchi also built a further 57 of this version, which has a 4,000 lb st Viper Mk 632-43 turbojet, for the Argentine Navy (10) and the air forces of Dubai (5), Ghana (2), Malaysia (12), Nigeria (12), and Peru (16). In 1985, Aermacchi introduced the uprated **MB-339B.** No orders were placed, but on December 17, 1985, it flew the prototype of the **MB-339C,** an improved trainer/close air support version with advanced avionics that include a digital nav/attack system. The C model has a modified nose and new vertical tail surfaces. Twenty were built for the Italian Air Force from 1988, and this year the Royal New Zealand Air Force ordered 18, deliveries of which are to begin in March. To replace No. 14 Squadron Strikemasters at Ohakea, these will have HOTAS controls, GEC Avionics radar and nav/attack computer, a Kaiser HUD-WAC, Litton INS, Honeywell radar altimeter, FIAR laser rangefinder, Tracor chaff/flare dispenser, and Elettronica active ECM pod. Aermacchi, Lockheed, and Hughes are teamed for the USAF/USN JPATS competition. *(Data for MBB-339C.)*
Contractor: Aermacchi SpA, Italy.
Power Plant: one Rolls-Royce Viper Mk 680-43 turbojet; 4,400 lb st.
Dimensions: span over integral tiptanks 36 ft 9¾ in, length 36 ft 10½ in, height 13 ft 1¼ in.
Weights: empty 7,297 lb, gross 10,218 lb (training), 14,000 lb (max).
Performance (at training gross weight): max speed at S/L 560 mph, time to 30,000 ft 6 min 42 sec, max range (clean) 1,221 miles, *g* limits +8/−4.
Accommodation: crew of two, in tandem on Martin-Baker IT10F zero/zero ejection seats. Rear seat elevated.
Armament: six underwing hardpoints for rockets of 50 mm to 5 in caliber, 500 lb bombs, 100 mm runway demolition bombs, AIM-9L Sidewinder and Magic air-to-air missiles, AGM-65 Maverick air-to-ground missiles, Marte Mk II sea-skimming antiship missiles, and other weapons.

Microjet 200 B

Despite the obvious attraction of high performance in an aircraft with low initial and operating costs, the future of this diminutive French trainer looks increasingly uncertain, although development flying continues. Since the first flight of a prototype on June 24, 1980, there have been three preproduction Microjets, these making their first flights on May 19, 1983, January 5, 1985, and November 4, 1986. The first of them was lost in a 1985 accident, but the second demonstrated the potential of the design by introducing underwing hardpoints for stores carriage, and reappeared at the 1989 Paris Air Show with vertical extensions to its V tail unit to provide improved directional stability. If the Microjet does go into production, the intention is to increase engine T-O rating progressively to 405 lb st to improve performance and payload, with particular emphasis on the aircraft's ability to undertake an antihelicopter combat role. The following data apply to this projected version.
Contractor: Microjet SA, France.
Power Plant: two Microturbo TRS 18-1 turbojets; each 326 lb st.
Dimensions: span 24 ft 9¾ in, length 21 ft 10½ in, height 9 ft 0⅝ in.
Weights: empty 1,719 lb, gross 2,513 lb (aerobatic), 2,866 lb (max).
Performance (estimated): max cruising speed at 18,045 ft 287 mph, stalling speed (gear and flaps down) 83 mph, service ceiling 30,000 ft, T-O run 2,461 ft, landing run 1,427 ft, max range (with reserves) 461 miles, *g* limits (aerobatic) +7/−3.5.
Accommodation: two seats, side by side. Starboard seat staggered aft of port seat for added comfort.
Armament: no details available.

S.211

Since the first prototype S.211 made its initial flight on April 10, 1981, there have been three confirmed customers for over 50 aircraft, with a possible fourth order reported recently. First, and major, operator is the Republic of Singapore Air Force, which received the first six of 30 as Italian-built complete aircraft and the remaining 24 in

S.211 (Air Portraits)

Su-28 (J. M. G. Gradidge)

T-2, Japan Air Self-Defense Force

T-4, Japan Air Self-Defense Force

CKD (component knocked down) form for assembly by Singapore Aerospace. All of these have been completed. In a similar arrangement, the Philippine Air Force received four Italian-built S.211s, and is now taking delivery of a further 14 being assembled locally by Philippine Aerospace Development Corp. Deliveries to the PAF began in September 1989, and its 18 aircraft will serve with the 100th Training Wing at Fernando AB, the 5th Fighter Wing at Basa AB, and (for ground support) at Mactan AB. Four S.211s were delivered to the air force of Haiti, and a recent report suggests that a similar quantity has been ordered by Uganda. Agusta, with Grumman as its US partner, has proposed the S.211 as a candidate for JPATS and is developing an improved attack version with a lightweight HUD and Omega navigation computer.
Contractor: Agusta SpA (Sesto Calende Works) (formerly SIAI-Marchetti), Italy.
Power Plant: one Pratt & Whitney Canada JT15D-4C turbofan; 2,500 lb st.
Dimensions: span 27 ft 8 in, length 30 ft 6½ in, height 12 ft 5½ in.
Weights: empty 4,078 lb, gross 6,063 lb (clean), 6,944 lb (max, armed).
Performance (at 5,511 lb gross weight): max cruising speed at 25,000 ft 414 mph, stalling speed (gear and flaps down) 86 mph, service ceiling 40,000 ft, T-O run 1,280 ft, landing run 1,185 ft, max range (internal fuel, 30 min reserves) 1,036 miles, *g* limits +6/−3 (clean), +5/−2.5 (with external stores).
Accommodation: crew of two, on tandem Martin-Baker Mk 10 zero/zero ejection seats. Rear seat elevated.
Armament: two hardpoints under each wing for up to 1,455 lb of single- or twin-gun machine-gun pods, cannon pods, rocket launchers, bombs, napalm tanks, cartridge throwers, two camera/IR reconnaissance pods, or two drop fuel tanks.

Su-25/28

The **Su-25UT,** known to NATO as "Frogfoot-B," has been developed from the Su-25K single-seat close support aircraft as an advanced trainer for use by the Soviet Union's paramilitary DOSAAF organization. Except for the UT's humpback appearance, resulting from elevation of the rear seat under a continuous framed canopy, and a taller tail fin, its basic airframe differs little from that of the Su-25K. The **Su-25UB** is similar to the UT, but retains the full armament of the single-seater for weapons training and can be fitted with a tail hook for aircraft carrier deck landing training.
An export version of the trainers, designated **Su-28,** was demonstrated at the 1989 Paris Air Show. It was displayed there without the gun and underwing weapon pylons of the Su-25K and UB, and with a blanking plate replacing the flat nose window for a laser rangefinder and marked target seeker. Up to four underwing auxiliary fuel tanks can be carried for ferrying. *(Data for Su-25UT and Su-28.)*
Contractor: P. O. Sukhoi OKB, USSR.
Power Plant: two Tumansky R-195 nonafterburning turbojets; each 9,921 lb st.
Dimensions: span 47 ft 1½ in, length 50 ft 8 in, height 17 ft 10¼ in.
Weights: normal T-O 29,100 lb, max gross 37,965 lb.
Performance: max speed at S/L 621 mph, min speed (clean) 146 mph, T-O run (clean) 1,640 ft, landing run 1,640 ft, range (clean) 348 miles at low altitude, 652 miles at 23,000 ft, ferry range 1,335 miles, *g* limits (ultimate) +8/−2.
Accommodation: crew of two, in tandem on ejection seats.
Armament: normally none, although provisions retained.

T-2 and T-2A

The XT-2 prototype, which flew on July 20, 1971, had the distinction of being the first supersonic aircraft designed and built by the Japanese aerospace industry. It entered production to meet the requirements of the Japan Air Self-Defense Force for an advanced jet trainer, with weapons training capability. Ninety production aircraft were delivered, of which 28 were configured as **T-2** advanced trainers and the remaining 62 as **T-2A** combat proficiency trainers. Six T-2As were passed to the JASDF's official aerobatic display team, the Blue Impulse, in 1982. Earlier, the T-2 had formed the basis of the Mitsubishi F-1 single-seat close air support fighter, which was also put into series production for the JASDF. Production of the T-2 and T-2A ended in 1988.
Contractor: Mitsubishi Heavy Industries Ltd, Japan.
Power Plant: two Ishikawajima-Harima TF40-IHI-801A (license Rolls-Royce Turbomeca Adour Mk 801A) turbofans; each 7,305 lb st with afterburning.
Dimensions: span 25 ft 10¼ in, length 58 ft 7 in, height 14 ft 5 in.
Weights: empty 13,905 lb, gross 28,219 lb.
Performance (clean): max speed Mach 1.6, service ceiling 50,000 ft, T-O run 2,000 ft.
Accommodation: crew of two, on tandem Daiseru/Weber zero/zero ejection seats. Rear seat elevated.
Armament: one Vulcan JM61 multibarrel 20 mm cannon in lower fuselage, aft of cockpit on port side. Hardpoints on underfuselage centerline and two under each wing for drop tanks or weapons. Wingtip attachments for air-to-air missiles.

T-4

The specification to which the T-4 intermediate trainer was developed called for high subsonic maneuverability and an ability to carry external stores under the fuselage and wings. The first of four prototypes began its flight test program on July 29, 1985, progressing so well that an initial batch of twelve T-4s, of an expected total of around 200, began to enter service with the Japan Air Self-Defense Force in September 1988. Fifteen aircraft equip the 31st Flying Training Squadron of the 1st Air Wing at Hamamatsu, near Tokyo; the 33d and 35th FTS were also expected to be flying T-4s before the end of 1990, as replacements for an aging fleet of Lockheed T-33As and Fuji T-1A/Bs. In addition to its training role, and reequipping the JASDF's Blue Impulse display team, the T-4 is expected to be used for liaison and other duties. Orders up to FY 1990 total 91 production aircraft.
Contractor: Kawasaki Heavy Industries Ltd, Japan.
Power Plant: two Ishikawajima-Harima F3-IHI-30 turbofans; each 3,680 lb st.
Dimensions: span 32 ft 7½ in, length 42 ft 8 in, height 15 ft 1¼ in.
Weights: empty 8,157 lb, gross (clean) 12,125 lb, max gross 16,535 lb.
Performance (at clean gross weight): cruising speed Mach 0.75, service ceiling 50,000 ft, T-O run 1,800 ft,

landing run 2,200 ft, max range (with two drop tanks) 1,036 miles, *g* limits +7.33/−3.
Accommodation: crew of two, on tandem UPC (Stencel) ejection seats. Rear seat elevated.
Armament: two hardpoints under each wing for drop tanks or other stores; underfuselage pylon for target towing equipment, an ECM/chaff dispenser, or an air sampling pod.

T-33A Shooting Star

Elderly though it may be, the Lockheed T-33, in various forms, continues to give useful service to a score or more of the world's air forces, a survey of which shows perhaps 600 examples still playing an active training **(T-33A),** counterinsurgency **(AT-33A),** or tactical reconnaissance **(RT-33A)** role. Largest fleets are those of Canada, whose over 50 **CT-133s** have 5,100 lb st Rolls-Royce Nene engines; and Turkey (75+), Greece (nearly 50), and Japan (over 100). Other operators include Bolivia, Colombia, Ecuador, Guatemala, Honduras, Iran, South Korea, Mexico, Nicaragua, Pakistan, Philippines, Portugal, Taiwan, Thailand, and Uruguay. During its long career, there have been various attempts to "face-lift" the T-33. One of the latest is by Volpar, which is offering a **T-33V** engine retrofit package replacing the Allison J33 turbojet with a 4,750 lb st PW300 turbofan. *(Data for T-33A.)*
Contractor: Lockheed Aircraft Corporation, USA.
Power Plant: one Allison J33-A-35 turbojet; 4,600 lb st.
Dimensions: span 38 ft 10½ in, length 37 ft 9 in, height 11 ft 4 in.
Weights: empty 8,084 lb, gross 11,965 lb.
Performance: max speed at S/L 600 mph, max speed at 25,000 ft 543 mph, service ceiling 47,500 ft, range 1,345 miles.
Accommodation: crew of two, in tandem.
Armament: none in T-33A.

T-37 Tweet

The familiar Tweet, one of the two main types that JPATS is destined to replace later in the 1990s, began life as the Cessna Model 318, which flew for the first time on October 12, 1954, and entered US service as a primary and intermediate trainer in 1957. More than 400 original **T-37As,** with 920 lb st J69-T-9 engines, were reengined to **T-37B** standard, combined production of the two models reaching almost 1,000. The **T-37C,** produced to fill MAP orders only, was generally similar to the B but had provision for underwing armament and tiptanks. Apart from the several hundred still in USAF service, T-37Bs and/or Cs are operated today by the air forces of Chile, Colombia, Germany, Greece, South Korea, Myanmar, Pakistan, Portugal, Thailand, and Turkey. Also in service with several air forces is the **A-37B Dragonfly** attack version, with more powerful J85 engines and heavier armament. *(Data for T-37B.)*
Contractor: Cessna Aircraft Company, USA.
Power Plant: two Continental J69-T-25 (license Turbomeca Marboré) turbojets; each 1,025 lb st.
Dimensions: span 33 ft 9⅓ in, length 29 ft 3 in, height 9 ft 2⅓ in.
Weights: empty 3,870 lb, gross 6,574 lb.
Performance: max speed at 25,000 ft 426 mph, cruising speed at 35,000 ft 360 mph, stalling speed 85 mph, service ceiling 35,100 ft, T-O to 50 ft 2,000 ft, landing from 50 ft 2,545 ft, max range (with reserves) 932 miles.
Accommodation: crew of two, on side-by-side ejection seats.
Armament (T-37C): provision for two 250 lb bombs under wings, or four Sidewinder air-to-air missiles, and for fuselage-mounted camera.

T-38 Talon

As USAF's first supersonic trainer, the YT-38 first flew in April 1959, and nearly 1,200 production **T-38As** were delivered over the next decade, the final contract being placed in 1970. More than 1,100 of these were for USAF, which still has about 800 in service. Forty-six were allocated for US-based training of West German pilots; NASA received 24 on which its astronauts carried out spaceflight readiness training; and 18 others went to the US Navy. More than 130 of the USAF aircraft were modified to **AT-38Bs** for specialized weapons training, with an underfuselage gun pod and practice bomb dispensers. There are three other present-day operators of the T-38A: Portugal, Taiwan, and Turkey, with approximate strengths of 12, 21, and 20, respectively. *(Data for T-38A.)*
Contractor: Northrop Corporation, USA.
Power Plant: two General Electric J85-GE-5A turbojets; each 3,850 lb st with afterburning.
Dimensions: span 25 ft 3 in, length 46 ft 4½ in, height 12 ft 10½ in.
Weights: empty 7,164 lb, gross 12,093 lb.
Performance: max speed at 36,000 ft more than 812 mph, typical cruising speed at 43,400 ft 578 mph, stalling speed (flaps down) 156 mph IAS, service ceiling above 55,000 ft, T-O run 2,500 ft, landing run 3,000 ft, range (with reserves) 1,093 miles.
Accommodation: crew of two, on tandem ejection seats. Rear seat elevated.
Armament: none in T-38A.

T-45A Goshawk

This derivative of the Royal Air Force's British Aerospace Hawk trainer (which see) was selected nine years ago to replace T-2C Buckeyes and TA-4J Skyhawks as the US Navy's new undergraduate jet pilot trainer. Many significant design changes were initiated by the US prime contractor, McDonnell Douglas, to meet USN requirements. These included a new main and nose landing gear, an arrester hook, and airframe strengthening to make the T-45A carrier-compatible. In addition, the basic Hawk airbrake and ventral strakes were replaced, avionics and cockpit displays changed, and a derated version of the Adour installed to prolong engine life. The handling characteristics suffered from these modifications, leading to aerodynamic changes to the wing leading edges and airbrakes, use of a more powerful model of the engine, and further delays. Production was initiated by an FY 1988 Lot 1 contract for 12 production T-45As on January 26, 1988. These are expected to achieve initial operational capability at NAS Kingsville, Tex., next year, and 300 T-45As are planned to enter USN service by 1999, to train up to 600 pilots each year. It is estimated that use of the Goshawks will reduce by 42 percent the number of aircraft needed to meet the Navy's demands, with 25 percent fewer flying hours and 46 percent fewer personnel, as well as saving up to 48 million gallons of fuel per year. *(Data for production T-45A.)*
Contractors: McDonnell Douglas Corporation, USA, and British Aerospace, UK.
Power Plant: one Rolls-Royce Turbomeca F405-RR-401 (Adour Mk 871) turbofan; 5,840 lb st.
Dimensions: span 30 ft 9¾ in, length (including probe) 39 ft 3¼ in, height 13 ft 5 in.
Weights: empty 9,399 lb, gross 12,758 lb.
Performance: max speed at 8,000 ft 620 mph, max Mach number in dive 1.1, service ceiling 42,250 ft, T-O to 50 ft 3,744 ft, landing from 50 ft 3,900 ft, ferry range (internal fuel) 1,150 miles, *g* limits +7.33/−3.
Accommodation: crew of two, in tandem on Martin-Baker Mk 14 NACES zero/zero ejection seats. Rear seat raised.
Armament: one pylon under each wing for practice multiple bomb rack, rocket pod, or drop fuel tank. Provision for centerline stores pylon.

T-37B, Pakistan Air Force (Denis Hughes)

T-38A Talon, Portuguese Air Force

T-45A Goshawk, US Navy

TS-11 Iskra, Polish Air Force (Lech Zielaskowski)

TS-11 Iskra-Bis

The Iskra, developed to replace the piston-engined TS-8 Bies ("fiend"), was Poland's first indigenous jet trainer, and was adopted for its own air force in preference to the L-29 Delfin used by other member nations of the Warsaw Pact. It first flew in February 1960 and entered production in 1963 and service in 1964, initially with a 1,720 lb st HO-10 turbojet engine. This was replaced from 1967 by the 2,205 lb thrust SO-1 engine, from 1969 by the identically rated SO-3, and finally by the SO-3W. Production of 500 Iskras ended in 1979, but the line was reopened from 1982–87 to build 50 more, to offset an order for this quantity placed by the Indian Air Force. There were five variants of the Iskra ("spark"): the **A and B** two-seat primary trainers, with two and four underwing hardpoints respectively; the single-seat **C** for reconnaissance (first flight June 1972); the **D** (similar to the B, but with a wider range of weapons); and the **DF** "combat and reconnaissance" trainer, with three cameras plus the weapon range of the D. *(Data for Iskra-Bis DF.)*
Contractor: WSK-PZL Mielec, Poland.
Power Plant: one Instytut Lotnictwa SO-3W turbojet; 2,425 lb st.
Dimensions: span 33 ft 0 in, length 36 ft 7 in, height 11 ft 5½ in.
Weights: empty 5,655 lb, gross 8,232 lb (clean), 8,465 lb (max, with external stores).
Performance (at max clean gross weight): max speed at 16,400 ft 478 mph, normal cruising speed 373 mph, stalling speed (flaps down) 114 mph, service ceiling 37,725 ft, T-O run 2,150 ft, landing run 2,330 ft, range 783 miles, *g* limits (ultimate) +8/−4.
Accommodation: crew of two, in tandem on lightweight ejection seats.
Armament: 23 mm gun in starboard side of nose; two attachment points under each wing for gun or rocket pods, or small bombs up to 220 lb in size. Provision for one camera under fuselage and one in each air intake fairing. ■

As Chief Master Sergeant of the Air Force, Gary R. Pfingston sets the example for a half million troops.

The Airman's Advocate

By Colleen A. Nash, Associate Editor

THE new Chief Master Sergeant of the Air Force, Gary R. Pfingston, rates today's enlisted force as "better than it has ever been." However, he adds, upcoming budget and force cuts have today's top-notch troops worried about tomorrow.

Since last August, when Chief Pfingston began his tour as the tenth Chief Master Sergeant of the Air Force—its top enlisted man—airmen have asked one question more than any other: "What is the future of my Air Force?"

Implicit in this general question, says the Chief, are several specific follow-ups, such as "Are we going to continue to recruit new people? Will I have a chance to reenlist? Will I have a promotion opportunity? Will I have a career? Will I be able to retire?"

Chief Pfingston answers, "Yes, to all of the above." He acknowledges that life in the Air Force will be different in the future, but he firmly believes that "in most cases, all those things will still be true and available."

The Air Force of the future, predicts Chief Pfingston, will be smaller, but it will be "better trained, more high-tech, and more mobile" and "prepared for the global reach [of airpower] that may become necessary."

A quick look at Chief Pfingston's background reveals what made him the ideal candidate to represent the troops. The Chief has spent nearly half of his twenty-eight-year career in the aircraft maintenance field, first as a B-52 crew chief and later as a maintenance controller and scheduler in Thailand during the Vietnam War. He's been a military training instructor, a first sergeant, and a senior enlisted advisor at base level, a numbered air force, and a major command.

Chief Pfingston doubtless will hear a great deal from the troops during his tenure. Since the position was created in 1967, the Chief Master Sergeant of the Air Force has championed the interests of the enlisted force and advised the Air Force Secretary and Chief of Staff. To gather the knowledge needed to do that, Chief Pfingston will spend three-fourths of his time traveling and meeting with the force.

"I can't answer questions about what people think," he observes, "if I don't visit with them where they work, live, and play."

No Hollow Force

For many, the prospective budget and manpower reductions bring to the surface yet another question: Will these cuts destroy the quality that the Air Force rebuilt at great cost after the "hollow force" fiasco of the mid- and late 1970s? The Chief doesn't think they will.

Why? "Most of us—a lot of us—lived through that time of hollow forces of the 1970s, and I feel very strongly that the senior leaders we have in the Air Force today will not allow that to happen again. We learned our lesson well enough."

Another protection against the erosion of force quality, says the Chief Master Sergeant of the Air Force, is the fact that the Air Force has "gone too far with quality." He explains that "our standards have risen to the point where we see a tremendous increase in productivity, and we are not going to allow that to regress."

Not surprisingly, compensating the force for this quality is one of Chief Pfingston's top priorities.

—Photo by Paul Kennedy

CMSAF Gary R. Pfingston presides over the Outstanding Airmen of the Year dinner held during AFA's National Convention in September. During Convention week, the Chief also met with AFA's Enlisted Council and Air Force Major Command Senior Enlisted Advisors.

"It's not fair," states the Chief, "to ask the force to continue to produce with the tremendous standards that we require—and they continually meet—if we are not properly compensating them in a total package."

Military pay, of course, is the biggest part of that package, and here there is a problem. Not since 1982 has military pay been comparable to private-sector pay. Even after this year's 3.6 percent raise, the compensation of military workers lags 11.4 percent behind that of their civilian counterparts. For the past three years, inflation has outpaced military pay by an average of one percent per year.

Another of Chief Pfingston's priorities is recognition of the achievements of the troops, by which he means "the day-to-day recognition" that goes beyond saying "thank you" to a few individuals. Says he, "We have a very strong Air Force, and it's because it's a team effort, not because of individuals."

The Chief points out that many airmen work "six or seven days a week and work ten or twelve hours a day in some very, very tough locations." He adds that "we need to let those people know how much their efforts are appreciated, for without them, the total mission of this outstanding Air Force wouldn't be accomplished."

The Chief is proud that the enlisted force continues to shoulder more and more responsibilities. He emphasizes, however, that "we can't ask people to accept this delegated responsibility and authority if we haven't properly prepared them."

Chief Pfingston is satisfied with the adequacy of the Air Force's Professional Military Education, or PME, but believes that it's not just PME that produces an exceptionally capable force. "It's also formal training, informal training, upgrade training, proficiency training, qualification training, on-duty, off-duty, day-to-day looking and researching, pamphlets, publications, operating procedures," says the Chief. "The most important thing we do every day in the Air Force is train," he concludes.

Training is not the only area where the Chief has seen a big improvement. "We do a very good job in most cases of taking care of the individual," he says. "We are doing a much better job in the 1990s of taking care of families."

For instance, says Chief Pfingston, the Air Force has established Family Support Centers at most bases. The centers assist Air Force families in many ways, including providing employment assistance to spouses of Air Force personnel and even offering personal financial counseling.

Now a Role Model

Like his predecessors, the new Chief Master Sergeant of the Air Force is now the role model for half a million troops. Chief Pfingston says that, had it not been for a person who served as a role model for him, he would not today be wearing the one-of-a-kind stripes of the Chief Master Sergeant of the Air Force.

"He's a retired chief master sergeant," explains Chief Pfingston, "and he was one of my supervisors while I was a military training instructor at Lackland AFB. He got hold of me when I was a tech sergeant and told me that I had a pretty good future and I needed to go for it.

"At that particular time I wasn't going for it, so he shook me real hard and told me to get my act together. He told me if I wanted to progress in this Air Force that I needed to start doing things that I was capable of doing. And I did that. I wouldn't be where I am if it hadn't been for him."

Chief Pfingston's advice to airmen is simplicity itself. "Be the best you can be in your chosen field," he says, "and in your particular responsibility that you have at a particular time. Sometimes, being anxious about tomorrow [causes] you not to [focus] on today. Most of the time, tomorrow will take care of itself if you are truly focused on today."

Chief Pfingston says he hopes that, at the end of his tour, the force will be satisfied that the Air Force has "worked their issues as hard as we can, provided them with a quality compensation package, and effectively communicated with them about what's going on in their Air Force today and what we expect to be going on with their Air Force in the future." ■

AFA's Gerrity Award honors the logisticians of the 10th Supply Squadron.

A Moving Experience at Alconbury

By Colleen A. Nash, Associate Editor

Lt. Col. Dennis W. Goldston (shown here beside a Maverick missile, one of the A-10's primary weapons) accepted the 1990 Thomas P. Gerrity Memorial Award on behalf of RAF Alconbury's 10th Supply Squadron at AFA's National Convention last September.

WITH Europe in political turmoil, the year 1989 brought an extraordinary number of major mission changes to US Air Force units based at RAF Alconbury in Britain.

The Air Force completed bedding down two new squadrons of A-10 attack planes; arrival of the Thunderbolt II aircraft turned the 10th Reconnaissance Wing into the 10th Tactical Fighter Wing. The Air Force phased out the F-5E fighters assigned to the 527th Tactical Fighter Aggressor Squadron. At nearby RAF Molesworth, the service moved to deactivate the 303d Tactical Missile Wing's Ground-Launched Cruise Missiles, and Alconbury, as the support base for Molesworth, was heavily involved.

The brunt of the logistics change fell on Alconbury's 10th Supply Squadron. It redistributed all of the GLCM support equipment, transferred millions of dollars worth of F-5E equipment, and took aboard A-10 equipment and supplies.

As the commander and chief of supply of the 10th Supply Squadron, Lt. Col. Dennis W. Goldston

accepted AFA's 1990 Thomas P. Gerrity Memorial Award for Logistics Management on behalf of the squadron's 288 members in September at AFA's forty-fourth National Convention in Washington, D. C.

Phasing Out, Bedding Down

The 10th Supply Squadron smoothly and successfully transferred F-5E assets to the US Navy. In addition, 750 line items of F-5E support equipment were shipped out.

Meanwhile, the squadron had to contend with Molesworth's GLCMs. The squadron's Equipment Management Section successfully carried out redistribution of some 5,500 items of GLCM support equipment.

Once these phaseouts were well in hand, the squadron focused on completing the beddown of new A-10s reassigned to Alconbury from their former base at RAF Bentwaters. In all, 1,700 pieces of A-10 equipment were transferred from Bentwaters to Alconbury.

RAF Alconbury's new mission made it imperative to get the new fighter wing up and running as soon as possible. However, a shortage of spares hampered readiness. When the two squadrons transferred from Bentwaters, neither had its own War Readiness Spares Kits (WRSKs).

The 10th Supply Squadron had to build makeshift kits out of the little there was to start with. Shortages resulted in low fill rates for WRSKs and high Total Not Mission Capable/Supply (TNMCS) rates, which means one or more parts are missing from an aircraft and therefore the aircraft cannot perform its mission.

Colonel Goldston and his team set about to change that situation. He directed requisition of the necessary parts, and by the end of 1989, WRSK fill rates had climbed from a low of forty-two percent to a more-than-respectable sixty-five percent. Likewise, the TNMCS rate improved to well within the USAFE standard.

A-10s All Over

By April 1989, one year after the redeployment began, the two A-10 squadrons had become fully operational. One month later, the 10th Supply Squadron encountered new difficulties.

Colonel Goldston explains: "On top of everything else, just thrown in to make it interesting, they had to resurface the runway" at Alconbury. It was closed for the next six months. As a result, says Colonel Goldston, "we had A-10s deployed all over."

Some of the planes went to nearby RAF Wyton, but the rest deployed to Germany, Spain, and Corsica. Consequently, says a USAFE assessment, the squadron's operations support branch became a "traveling road show," packing up spares and people to support A-10 operations at the four separate locations.

One of the biggest challenges posed by the A-10 dispersal, says Colonel Goldston, was "trying to spread out the resources. We had to split up the parts and try to guess where a breakdown was going to occur."

The 10th Supply Squadron used whatever means it could to get critically needed items to the dispersed planes in order to keep them flying. "We moved some things over the road," explains Colonel Goldston. "Sometimes we would go with what we would call 'rail and sail,' where we would take a ferry across the English Channel and then [go by] rail" to the base in Germany.

The aircraft dispersal, says Colonel Goldston, "could've affected our [TNMCS] rates pretty badly." Numerous TNMCS hours were accumulated merely moving an asset from one operating location to another. As Colonel Goldston explains it, the hours are scored against them until maintenance actually gets the part in hand.

"If the airplane had been back at Alconbury," says the Colonel, "then we would have issued [a part] right out of the kit or out of the warehouse, and the time would have stopped.

"But when the airplane is over in Germany or down in Spain, yes, [the part is] in our warehouse and we've got it, but now we've got to get it to Germany or get it to Spain."

Beating the Standard

It's hard to believe, but the TNMCS rate actually fell to a low of 5.6 percent (better than the USAFE standard of six percent) by the end of the runway closure. "We were really proud that, in spite of the fact that we had to eat that transportation time, we were still able to bring the rate down," says Colonel Goldston.

The widely dispersed squadrons received excellent support. In the words of USAFE's formal nomination, "The quality of supply support did not just remain good, it got better." The squadron's successful support effort was a major factor in the 10th TFW's ability to complete its flying hour program.

The mission changes meant more than moving gear in and out. "We had to change our frame of mind," says Colonel Goldston, "and think in terms of mobility. Supply is very big in the mobility mission. A-10s don't fight the war in place at Alconbury. They deploy forward; the WRSK kits go forward and some of our personnel go forward."

One thing that helped the 10th Supply Squadron make the transition, says Colonel Goldston, was practice and lots of it. Throughout the year, his personnel participated in more than a dozen exercises and deployments designed to enhance the fighting capability of the 10th TFW.

By updating the supply portion of the 10th TFW's Mobility Plan and by revising the Forward Operating Location Peacetime Support Plan, Colonel Goldston made sure that his squadron was ready to support contingency operations with updated, accurate, and viable logistics plans. According to USAFE, the 10th Supply Squadron's efforts contributed to the wing's earning an "excellent" operational readiness inspection rating.

Colonel Goldston also led his squadron to the forefront of the 1989 USAF Supply Daedalian competition, a contest among the supply field's units. Alconbury's supply squadron was selected as one of the three best in the Air Force.

"We really have one of the best facilities of any supply organization around," says Colonel Goldston. "A lot of our buildings are either brand-new or have been completely overhauled in the last three or four years. In the old days, our operation was spread out so much that we lost efficiency, but we were able to centralize our activities and gain manpower benefits from that." ■

The strategic airpower concept hinged on putting one man over the target.

Bombardier

By Bruce D. Callander

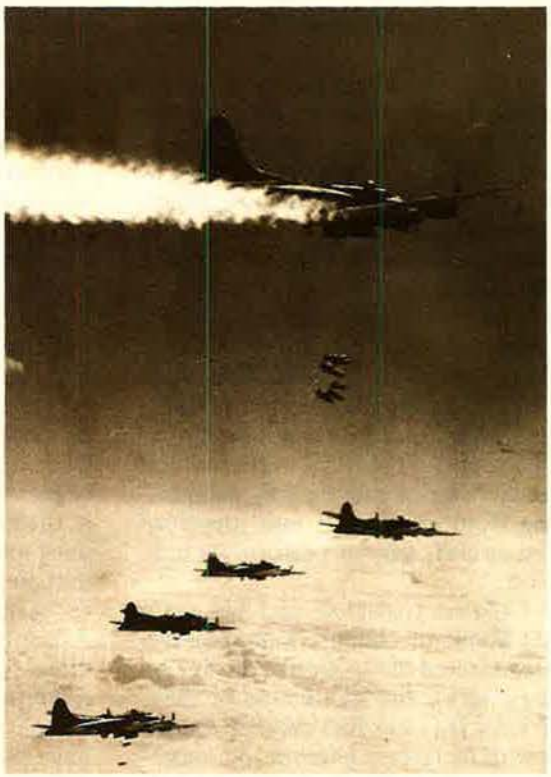
In World War II, the concept of strategic airpower hinged on putting one man over a target long enough to operate a device that looked more like a sewing machine than like a weapon. That man was the bombardier, and the device was the Norden bombsight.

More than a dozen schools were set up solely to teach bombardiers. Young men by the tens of thousands mastered the skill. They plied their trade in everything from fighters to the Superfortresses that leveled Japan. Many lost their lives in the process.

Within a decade, new technology would make the bombardier obsolete. Development of the bombardier specialty in the years before World War II followed an up-and-down course. By the summer of 1940, with Europe once again at war, the US had begun to build a massive centralized training program.

The Army Air Corps opened its first bombardier school at Lowry Field, Colo. Early graduates, most of them still enlisted men, were to serve as instructors in a network of new schools. In June 1941, Congress created the grade of aviation cadet for student pilots, navigators, and bombardiers in the new US Army Air Forces. Most student bombardiers would graduate as second lieutenants or flight officers.

Most new bombardiers were trained in the desert southwest section of the US, which offered ample space for bombing ranges. In Texas, schools opened at Big Spring, Childress, Houston, Midland, and San Angelo. Bombardier training grounds sprang up in New Mexico at Carlsbad, Deming, Hobbs, and Roswell. Others could be found at Higley, Ariz., Shreveport, La., and Victorville, Calif.



Enormous responsibility rested in the hands of the bombardier. At times he actually flew the aircraft. At right, in the nose of an early B-17E, a bombardier manipulates the controls of a Norden bombsight (kept under wraps to ensure its secrecy); above, the bombs fall free despite heavy flak.

Heavy Demand for Crews

The cadets underwent abbreviated officer training in preflight centers and went on to flying schools. Early bombardier courses lasted twelve weeks, but training eventually was increased to eighteen weeks and included some basic DR (dead reckoning) navigation. In the longer term, the Army hoped to combine bombardier and navigator training into a single seven-month course. Heavy demand for combat replacement crews, however, made this impractical. As an alternative, many bombardiers went through navigation training when they returned from combat.

Bombardier students learned basic skills on a ground-bound simulator resembling a house painter's scaffold with a bombsight on top. The self-propelled trainer moved slowly across the floor of a hangar as the bombardier steered it with the knobs of his sight. He aimed at a cardboard target mounted on a small moving box and, as the trainer passed over this "bug," a solenoid-driven pen dotted the hits on the target.

Actual flight training came in the twin-engine Beech AT-11, a military variant of the commercial Model 18 transport that was fitted with a Plexiglas nose and a bomb bay. It carried ten sand-filled practice bombs (the 100-pound M38A2) with small spotting charges in their tails. Students flew in pairs, one working the bombsight, the other filming the result with a handheld camera aimed through a hole in the floor.

On most missions, the student's corrections flowed from the bombsight to a pilot direction indicator on the instrument panel. On planes equipped with autopilot, signals went directly to the flight controls and the bombardier actually flew the aircraft on the bomb run.

Near graduation, students went into the desert to undergo simulated-combat training. They lived in tents, wore fatigues, and, when they weren't flying, dug slit trenches and loaded their practice bombs with sand. In some classes, rival flights added to the realism by bombing each other with sacks of flour.

Bombing practice posed some hazards for local residents. Any number of mistakes at the bombsight could send the bombs far from intended targets and bring claims for lost livestock and damaged buildings. On night missions, lighted oil rigs sometimes were mistaken for the illuminated targets.

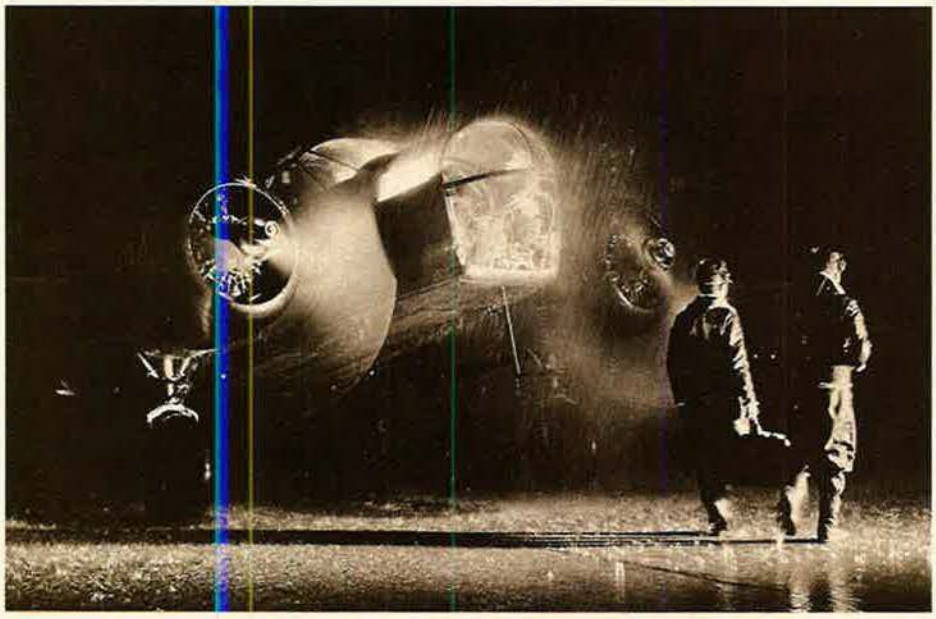
The cadets who overcame such mistakes and maintained acceptable "circular error" (average distance from the center of the target) graduated and were assigned to flight crews. They took another several months of training in operational bombers and then deployed overseas.

Most of the new graduates were snapped up into the crews flying B-17s and B-24s, then classed as heavy bombers. Against the advice of their British counterparts, US bomb units gave up the security of night bombing for the greater accuracy of day attacks. It proved a costly preference until fighters gained enough range to escort the bomb groups to their targets. Even so, daylight bombing was unquestionably more effective.

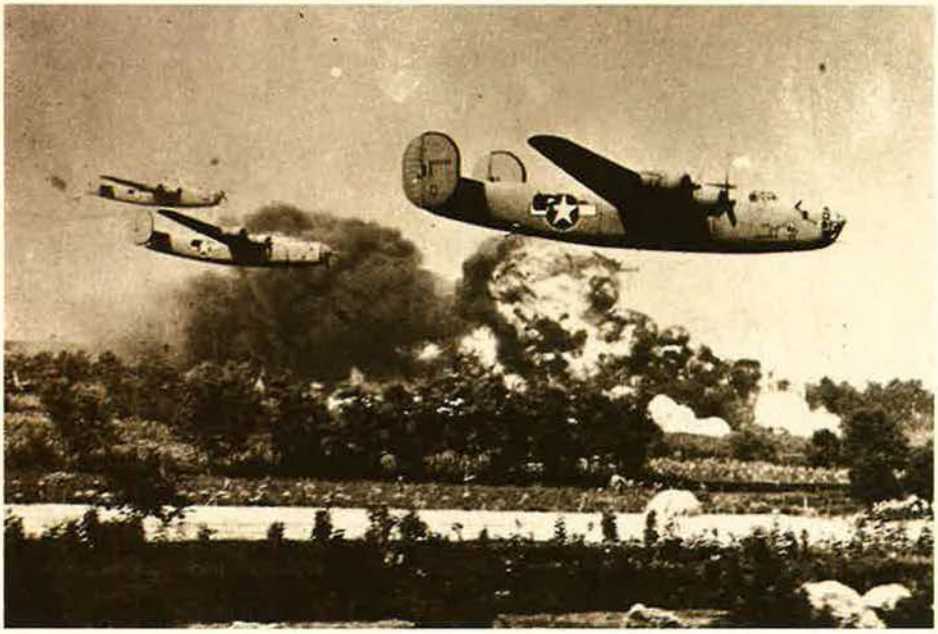
First 100-Bomber Raid

By the summer of 1942, B-17s were hitting targets in occupied France and B-24s were disrupting Japanese shipping in the Pacific. That winter, British-based bombers made their first raids into Germany, US Liberators bombed Bangkok from bases in India, and the Ninth Air Force opened attacks on Nazi-held ports in Tunisia. The following spring, the Eighth Air Force mounted its first 100-plane raid on a single German target, Bremen.

Missions settled into a familiar routine. Half an hour from target, the bombardier would switch on his sight and the formation would turn toward the target. Bomb bays opened, and the bombardier fixed his cross hairs on the target. If they drifted to the right or left, he brought them back into line with one knob and turned another until they held steady. With another set of knobs, he synchronized the sight's tracking speed with the ground speed of the plane. Near the target, corrections became minute, almost undetectable. The plane held course, then gave a gentle lurch as the bombs fell away. The bomb bay doors closed, and the plane swung away from the target for the long flight home.



Actual flight training for bombardiers began in Beech AT-11s like this one, commercial Model 18s fitted with Plexiglas noses and bomb bays. Students trained in pairs, one working the bombsight (here, carried in the bag of the student to the left), the other filming the result.



Bombardiers plied their trade at low levels in both the European and Pacific theaters. At left, B-24s descend into the "Mouth of Hell" at Ploesti, Romania; below, a B-25 heads for New Britain. In the B-25, the bombardier had to load the forward machine guns in addition to his primary duties.

As the size of the formations grew, however, the bombardier's job changed. When flying in a tight formation of several hundred bombers, no single plane could make an individual bomb run without bumping into another. Bombardiers in the lead aircraft of each squadron made course corrections for the whole formation. Those in other planes used their sights mainly to determine release points. Late in the war, the lead ships carried bombing-through-overcast radar known as "Mickey" sets. Other bombardiers did little more than watch for the lead plane to drop its bombs and then release their own.

Barely four months after the attack on Pearl Harbor, bombardiers carried out their most spectacular mission. Lt. Col. James Doolittle led the strike on the Japanese homeland with B-25s launched from an aircraft carrier. Capt. C. Ross Greening, armament officer on the mission, developed a simple but effective bombsight for the low-level raid. It amounted to a metal sighting bar that could be set on a calibrated scale at a predetermined dropping angle. The bombardier simply waited until the target fell in line with the bar and dropped his bombs.

Later, the nose sections of more than 1,000 B-25s and some A-26s were fitted with 75-mm howitzers. With no bombsights to operate, bombardiers spent their time loading fifteen-pound shells into the gun and dodging its twenty-one-inch recoil. Late in the war, a small number of B-25s carried winged torpedoes. The bombardier aimed them with a Norden sight, and the wings detached just before the missiles reached the water. Martin B-26s delivered more conventional torpedoes. Skip bombing was another imaginative technique. Bombs dropped from low altitude hit the ground or the water while still in the horizontal position and bounced onto the target.

Flying in the "Droop Snoot"

A few bombardiers even found themselves in the nose sections of P-38s. As the Luftwaffe lost strength in Europe and there was less need for fighter escort, some P-38s were diverted to bomber duty. A few P-38Js and Ls were fitted with transparent nose compartments that

housed Norden sights or bombing radars. A lead bombardier in one of these "Droop Snoots" did the aiming for the whole formation.

Still, it was in the strategic bombing department that the sheer weight of American airpower was most telling. In March 1945, the AAF mounted its biggest raid on a single target; more than 1,000 bombers dumped 4,738 tons of bombs on Essen. The same month, a 1,000-plane formation hit Berlin—the heaviest daylight raid of the war. Such attacks continued until May 7, when Germany surrendered.

The worst destruction was yet to come. In the Pacific, B-29s of the Twentieth Air Force varied the high-level

Cramped, vulnerable, and under a lot of pressure, the bombardier had his work cut out for him; yet more than 40,000 had been trained for the job by war's end. New technology soon made those bombardiers as obsolete as the Norden bombsights they had operated.

daylight bombing routine by attacking Tokyo at night in a series of low-level incendiary raids. The bombs created fire storms that swept through light frame buildings like hurricanes.

Then, on August 6, 1945, Maj. Thomas Ferebee, bombardier on the B-29 *Enola Gay,* toggled off a new kind of bomb over Hiroshima that had more force than all the munitions delivered to that date. Three days later, the B-29 *Bock's Car* flew over Nagasaki, and bombardier Kermit Beahan released the world's second atomic bomb.

Strategic bombing had taken on a whole new character. The B-29 dwarfed the old heavies. Radar, able to penetrate fog and darkness, was making optical sighting obsolete. The atomic bomb had given a single aircraft many times the destructive power of the old 1,000-plane formation. The days of the traditional bombardier were numbered. More than 40,000 had been trained for the war. With the postwar drawdown, only a handful stayed on.

Some of the old knob-twisters were to have one last hurrah, however. Less than five years after V-J Day, in June 1950, North Korean Communist troops attacked South Korea, and the United States joined UN efforts to drive them back. A large number of veteran World War II bombardiers were recalled to active duty.

Rip van Winkles of the Air

These "retreads" stepped into a new world. The Air Force had become a separate service. Army pinks and greens had given way to the plain blue suit. Bombardier wings had been replaced by an all-purpose observer insignia, and, most startling of all, some of the airplanes didn't even have propellers.

Between tours of active duty during World War II and the Korean War, Bruce D. Callander earned a B.A. in journalism at the University of Michigan. In 1952, he joined Air Force Times, *becoming editor in 1972. His most recent article for* Air Force *Magazine, "The Aviation Cadets," appeared in the November 1990 issue.*

There were only a few of the old birds left, including the Douglas B-26, which had been developed in World War II as the A-26. The recalled bombardiers assigned to the B-26 were classified as bombardier-navigators, even if they had had no navigation training. They used simplified Mk. 9 sights acquired from Britain. Though B-29s from Japan bombed major targets with radar, the Douglas Invaders hit truck convoys and trains from in-country bases.

When the Korean truce came in 1953, most of the recalled bombardiers went home for a second time. Of those who remained, some took additional navigation training to qualify for the new minimum-crew jets. Those who didn't were grounded. Many took off their new observer wings and pinned on the bombardier insignia they had worn during World War II.

The new aircraft observer used electronic gadgets not only to find his way to the target but also to drop his bombs and defend his aircraft. He flew in everything from bombers and transports to tankers and two-place fighters. In time, the generic term "navigator" was applied to all nonpilot officers in an aircrew.

In the mid-1980s, however, the Air Force realized that this jack-of-all-trades approach wasn't working. Navigators might be trained for a wide variety of jobs, but, in practice, they were being used in relatively narrow specialties. The Air Force adopted a new training system giving students a core curriculum in navigation and then specialized training in the aircraft to which they would be assigned.

The original bombardier's job has changed almost beyond recognition. More changes lie ahead. When the Air Force speaks of optical systems in the next century, it has in mind an exotic combination of fiber optics and electronics. The optical bombsight through which the operator strained to see the oil fields of Ploesti is a museum piece, as, in a sense, is the old bomb-aimer himself. His descendants speak a language laden with acronyms and high-tech terminology. This new breed of "offensive systems operator" may know only vaguely that there once was a species known as the bombardier. ■

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Before Mitchell, he wrote about war between the US and Japan. His readers included the Japanese war planners.

The Visions of Hector Bywater

By C. V. Glines

BRIG. GEN. Billy Mitchell usually gets credit for being the first to predict that Japan would one day mount a surprise attack against Pearl Harbor. In 1924, after a lengthy trip to the Far East, he wrote a visionary, 323-page report.

"Attack will be launched as follows," it prophesied. "Bombardment, attack to be made on Ford Island at 7:30 a.m. . . . Group to move in column of flights in V. Each ship will drop . . . projectiles on targets." He also predicted Japan's follow-up assault against the Philippines: "Attack to be made on Clark Field at 10:40 a.m."

Mitchell's estimate regarding Pearl Harbor was off by only twenty-five minutes; regarding Clark Field, by only two hours. All that Mitchell left unreported were the attack dates.

Though Mitchell gets the credit, his prophecy was not original. Years earlier, others had theorized about a US-Japan war. Homer Lea, once a general under China's Sun Yat-sen, told tales of Japanese crossing the Pacific to devastate California, Oregon, and Washington. Ernest Fitzpatrick, a poet, wrote verse in the early 1900s about Japanese subjugation of the US and Mexico.

In 1908, German novelist Ferdinand H. Grautoff wrote *Banzai!*, an imaginary account of future Pacific hostilities; in it, unprepared US forces are defeated. Some details of Grautoff's book are provocative. For example, the fictional US troops are under the command of a "General MacArthur," who at length rallies them to victory.

Then along came Hector C. Bywater, an undercover agent for British intelligence from 1909 through World War I. He traveled widely, doubling as a naval correspondent for the London *Daily Graphic, Pall Mall Gazette,* and *British Naval and Military Record.* In 1921, the League of Nations gave Japan authority over the Caroline, Mariana, and Marshall Islands, all former possessions that Imperial Germany had lost in the war. In light of this, Bywater turned his attention to the Pacific.

Tilting Toward Tokyo

Bywater wrote an extensive study, *Sea Power in the Pacific.* This 1921 book provided a detailed portrait of Japanese and US strengths and concluded that the balance heavily favored Tokyo. The final chapter, "Possible Features of a War in the Pacific," contained sharp insights into the course of such a conflict.

Bywater expanded the chapter into a new book, *The Great Pacific War,* published in 1925. However, because he believed "war is never a paying proposition," Bywater found it "necessary to have recourse to the medium of fiction."

Bywater's 1925 fictional account postulates a Japanese seizure of Manchuria, Formosa, and Korea to obtain raw materials for home industries. The great powers object, but do nothing. The US sends "courteously worded" notes "to prevent the catastrophe of war." During negotiations, Japan launches a surprise attack on the US Navy's Asiatic Squadron cruising off Manila Bay.

The book does not predict a raid on Pearl Harbor. However, its fictional Japanese assault on the Philippines is preceded by carrier-based aircraft attacks on the airfield at Dagupan, a base ultimately replaced by Clark Field. The result is destruction of US naval power in the Pacific. The Japanese go on to conquer the Philippines.

Bywater also predicted an attack on Guam by superior, secretly developed Japanese planes.

Bywater postulated that the US would strike back but would suffer great losses trying to occupy islands close to Japan. The only recourse would be for US forces to retreat and then island-hop to eventual victory, a strategy actually followed in the 1941–45 Pacific war. Bywater's attack scenario foresaw Japanese kamikazes, who would never hesitate "to ram when otherwise balked of their prey, preferring to immolate themselves." He predicted use of torpedo planes, which both sides actually employed with great success in epic sea battles.

The US eventually wins Bywater's imaginary war after staging a "demonstration air raid" on Tokyo. Leaflets are dropped, urging the Japanese to petition the emperor to surrender, precisely as happened. Japanese-mandated islands are turned over to the US "for their future administration," also an accurate prediction.

Rational but Slanderous

Did Bywater's books influence the Japanese? A few weeks after *Sea Power in the Pacific* appeared, it was translated into Japanese by the Naval General Staff in Tokyo and distributed to officers as "material for strategic studies." When *The Great Pacific War* came out, it was also translated and given wide distribution. Both were required reading at the Japanese Naval War College and were debated at the Imperial War College. A foreword to the second book, written by Lt. Cmdr. Tota Ishimaru, notes that it has a "certain degree of rational probability" but characterizes Bywater's prediction of a Japanese loss as "slander."

Bywater's books were available to Japan's naval officer corps; it may be assumed that Fleet Adm. Isoroku Yamamoto, an obsessive student of naval affairs and supreme naval commander in the war, had read them. When *The Great Pacific War* was published, Yamamoto, who spoke and read English, was a naval attaché in Washington. In September 1925, the book was reviewed in the New York *Times* under the headline "If War Comes to the Pacific." Tokyo lodged an official protest, calling the book provocative and sure to inflame US-Japanese relations.

In 1940, Kinaoki Matsuo, an Imperial Navy intelligence officer, wrote *The Three-Power Alliance and a United States–Japanese War.* The book included many references to Bywater's works and called war "inevitable." Matsuo suggested a surprise attack on Pearl Harbor and strikes on the Philippines and Guam. "If Guam and the Philippines fall into [Tokyo's] hands," he wrote, "the United States will be confronted with a serious problem, the solution of which will be almost impossible."

Admiral Yamamoto has been called "the reluctant admiral." He did not believe Japan could win a war with the US. However, once his government committed to it, he followed the basic strategy Bywater had outlined fifteen years earlier. He devised the plan for the attack on Pearl Harbor and simultaneous attacks on Allied possessions in the Pacific. A proponent of carrier aviation, he had instigated war games in May 1940 during which his planes attacked and "sank" opposing battleships, thus substantiating his theories about the value of carrier-based bombers. After the maneuvers, he remarked to Adm. Shigeru Fukudome, his chief of staff, "Well, it appears that a crushing blow could be struck [by torpedo planes] against an enemy surface fleet. It makes me wonder if they couldn't get [the US fleet at] Pearl Harbor."

Hector Bywater and, later, Brig. Gen. Billy Mitchell predicted a Japanese first strike in the Pacific (here, USS Arizona aflame in Pearl Harbor), but US military planners dismissed their prophecies.

A Deaf Ear

US military planners did not heed Bywater's prophecies, just as they did not listen to Billy Mitchell. They believed that Japan did not have the capability to mount sufficient naval forces to sustain aggression across the Pacific. Even if it could be done, said one prominent US naval strategist, US commanders would be "grateful" because Japan would have to spread its forces too thinly.

Two weeks after the December 7, 1941, Pearl Harbor attack, a condensed version of *The Great Pacific War* ran in *Life* Magazine as "the most current book of the week." The book was republished in hard cover as "A Historic Prophecy Now Being Fulfilled." Hanson Baldwin, military editor of the New York *Times,* wrote an introduction calling it "deeply prophetic."

Unfortunately, Bywater's name was quickly forgotten and today is never mentioned in the literature of World War II. He died in August 1940, never to see his prophecy become fact. ■

C. V. Glines is a regular contributor to this magazine. A retired Air Force colonel, he is a free-lance writer and the author of many books, the most recent of which is Attack on Yamamoto. *His most recent articles for* Air Force Magazine *were "The Bat Bombers" and "The Flying Octopus," both of which appeared in the October 1990 issue.*

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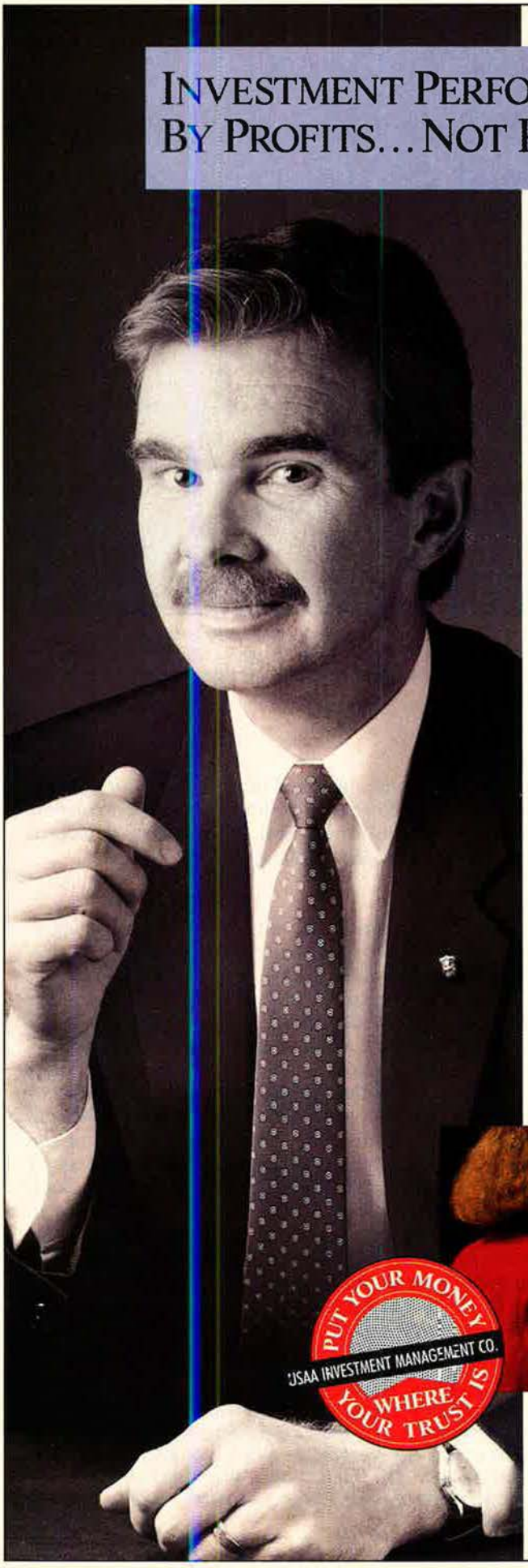

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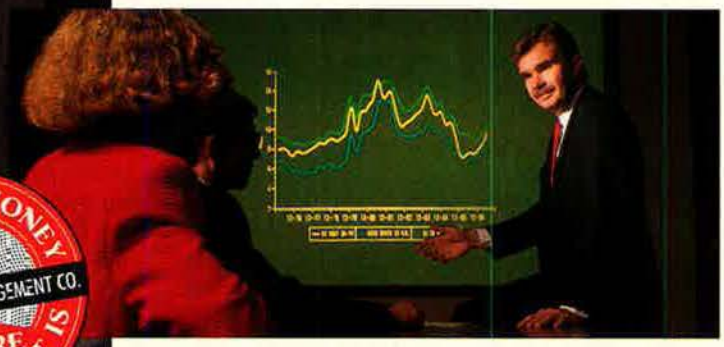


USAA

Reviews

By Jeffrey P. Rhodes, Aeronautics Editor

Aggressors: Tank Buster vs. Combat Vehicle, by Alex Vanags-Baginskis and *Aggressors: Carrier Power vs. Fighting Ship,* by Norman Polmar. The first two books in this new series take a look at two pairs of weapons that "grew up" together in World War II—the tank and the aircraft specifically designed to destroy it, and the aircraft carrier and the battleship it replaced as the primary naval weapon. Beautifully illustrated (including several gatefold pages), these two large-format books offer detailed technical descriptions of the various aircraft, tanks, and ships and their munitions. The books also detail weapons employment but are a touch lacking in the human side of the stories. Both from Howell Press, Charlottesville, Va., 1990. 68 and 64 pages with photos, illustrations, maps, and diagrams. $19.95 each.

Feet Wet: Reflections of a Carrier Pilot, by Paul T. Gillcrist. Naval aviation changed dramatically over the course of Mr. Gillcrist's thirty-three-year career, from propeller-driven aircraft flying off straight decks after World War II to the supersonic F-14s launched by steam catapults from the angled decks of supercarriers today. His perspective is unique. He started out implementing the new developments and was later an agent of change as the admiral in charge of the Pacific Fleet's fighters. Mr. Gillcrist has a superior knowledge of the subject and doesn't mince words—he criticizes the top brass, describes accidents, talks about his flying and combat experiences, and even admits that fighter pilots sometimes make mistakes. Presidio Press, Novato, Calif., 1990. 348 pages with photos, diagrams, and glossary. $22.50.

Maverick: The Personal War of a Vietnam Cobra Pilot, by Dennis J. Marvicsin and Jerold A. Greenfield. Mr. Marvicsin is the maverick of the title, and his nickname was well deserved. He lived to be a helicopter pilot, and, depending on who was talking, he was either the bravest or the craziest of his colleagues. However, he was also a keen observer of what was going on around him, and in this book he vividly describes his experiences. He had volunteered for Vietnam duty, but his initial enthusiasm faded the longer he flew. The death of a close friend affected him deeply, and his pain comes through in his words. This well-written story reads like a novel—it begins with his imprisonment after being shot down by the North Vietnamese and is told through flashbacks. G. P. Putnam's Sons, New York, N. Y., 1990. 269 pages. $22.95.

The Narrow Margin: The Battle of Britain and the Rise of Air Power 1930–1940, by Derek Wood with Derek Dempster. Out of print for more than twenty years, this book has remained the classic reference work on the Battle of Britain. This third edition incorporates many facts that have come to light as official documents were declassified, and the meticulously researched appendices have been expanded. The first two-thirds of the book documents prewar events in England and Germany and the "phony war." The last section is a diary of the Battle of Britain, complete with daily weather recaps, personal accounts, and official write-ups. Smithsonian Institution Press, Washington, D. C., 1990. 384 pages with photos, charts, maps, appendices, bibliography, and index. $39.95.

The Royal Canadian Air Force at War, 1939–1945, by Larry Milberry and Hugh Halliday. The Royal Canadian Air Force's contribution to the Allied victory is an often overlooked segment of World War II history. This book remedies that omission. Entering the war with fewer than 4,000 people, the RCAF was the fourth largest Allied air arm by war's end. Canadian casualties totaled almost 17,000 service members. Using archival sources, interviews, correspondence, scrapbooks, albums, and logbooks, the authors have assembled a complete look at every facet of the RCAF's wartime operation. In addition to technical and organizational information, this work also covers such topics as Canadian war art and aviation medicine. Canav Books, Toronto, Ont., 1990. 480 pages with photos, charts, appendices, and index. $75.00.

"There I Was . . ." 25 Years, by Bob Stevens. Foreword by Gen. James H. Doolittle. His style and point of view have undergone some alterations over a quarter of a century, but Mr. Stevens's ability to draw the humorous side of the flying business is still dead-solid perfect. This book is the compilation of the 300 "There I Was . . ." cartoon features he drew for this magazine between January 1964 and January 1989. The drawings prove that, at least in aviation circles, humor is a universal thing, and what was funny in 1945 still merits a hearty chuckle today. The hardbound book also includes a list of major aerospace events that occurred the month a panel ran, as well as line art of numbered air force and wing, group, and squadron insignias. The Village Press, Bonsall, Calif., 1990. 600 pages with brief text introductions to the cartoons. $49.50.

Other Titles of Note

Japan's World War II Balloon Bomb Attacks on North America, by Robert C. Mikesh. Japan's balloon bomb program late in the war could have done great psychological as well as physical damage, but it was halted because US censorship efforts prevented the Japanese from knowing how effective the effort really was. A reissue from 1973, this is the complete history of the program. Smithsonian Institution Press, Washington, D. C., 1990. 85 pages with photos, maps, charts, appendices, bibliography, and index. $9.95.

Military Phrasebook for Iraqi Arabic, by M. Omar. This booklet, now in vogue in Saudi Arabia, gives Iraqi Arabic phrases for military situations. The phrases are spelled out in plain English rather than using technical phonetics. Also included are commands, how to give and get basic information, interrogation questions, various lists, and an English–Iraqi Arabic glossary. Diplomatic Language Services, Inc., Arlington, Va., 1990. 72 pages. $5.95.

Pilot's Directions: The Transcontinental Airway and Its History, edited by William M. Leary. This book is a reprint of the Post Office's 1921 guide for helping airmail pilots find their way across the country, both from the air and, because of crashes that inevitably came, on the ground. It gives an interesting view of an America that no longer exists and a detailed developmental history of the transcontinental route. University of Iowa Press, Iowa City, Iowa, 1990. 82 pages with photos, maps, and index. $16.95.

The Pineapple Air Force: Pearl Harbor to Tokyo, by John W. Lambert. This is a comprehensive history of the pursuit units of the former Hawaiian Air Force and their evolution as Seventh Fighter Command in World War II. The author primarily uses personal reminiscences to tell the story of the air war in the central Pacific. Phalanx Publishing Co., St. Paul, Minn., 1990. 214 pages with photos, maps, appendices, bibliography, and index. $44.95.

IN VIDEO—"Hot Flying." Some of the best aerial footage from earlier releases is combined on this fast-paced video geared to the nonspecialist. However, it does not condescend to the less-knowledgeable viewer and goes to great lengths to explain what is happening. The video includes vintage (such as the X-2, X-15, and M2F2) and current flight-test footage as well as Navy carrier operations and good action scenes of Air Force F-15s, F-117As, and F-16s. 1990, color. Distributed by *Aviation Week* Video, New York, N. Y. $24.95.

Viewpoint

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

Perspective From Fifty Years

This is where I came in. Despite the accomplishments of airpower, its role in strategy remains a matter of dispute. The arguments have not changed.

Fifty years ago last June, prompted more by curiosity than by any convictions about airpower, I elected to give the Army Air Corps a try. Even the earnest advice of a senior cavalry officer, one who would become famous in the Pacific War, failed to change my mind. His parting shot was typical of attitudes in those days: "If you are going to fly an airplane, why the hell did you bother to get an education?"

By December 1940, those of us who had survived primary school were one step up the ladder in basic training and had begun to think of ourselves as aviators, not simply as escapees from the ground army. That December was, of course, barely a year before Pearl Harbor, and Adolf Hitler had already conquered most of Europe. Only the Battle of Britain had given hope to the remaining free nations. The first decisive airpower engagement, it would take its place alongside Crecy. The longbow, this time, was radar.

It was just as well we sat that one out, for the United States was still a provincial military power. If European nations and Japan were military bigleaguers, we were still strictly bush.

Nevertheless, some Air Corps officers were doing serious thinking. Perhaps Douhet and de Seversky had a bit more influence on that thinking than later events would justify, but the main thrust of their conclusions would have a decisive effect on World War II. Strategic airpower, the concept of overflying the battlefield to mortally wound the enemy in his ability to wage war, became the rationale for the emerging Army Air Forces. It was also, in the course of time, the justification for a separate air force—not only separate but also equal, something my old cavalry friend could not have brought himself to imagine.

There were a few problems with the concept, not the least of which was the unfortunate dogma that the bomber could fight its way into the target, a dogma that was reinforced by the name given to the B-17—the Flying Fortress. The October 14 mission to Schweinfurt—for which I had a front-row seat—lost twenty percent of its attacking force and nearly put paid to the concept of strategic bombing, even though our results that day were precise and costly to the critical German ball-bearing industry. In the fall of 1943, B-17s had an expected life of eleven missions, so it was necessary, after Schweinfurt, to back away from the difficult targets and wait for fighter support.

In many ways, the years after World War II have been confused ones for strategic airpower. During the brief time of our nuclear supremacy, the bomber became simply the instrument of threatened mass destruction. "Peace Is Our Profession" read the curious slogan over bomber base gates.

Korea brought a renewed, though short-lived, emphasis on tactical air. While the B-29s did yeoman work with conventional bombs, the headlines came from MiG Alley.

After Korea, the Air Force settled back on nuclear alert pads. The enemy was the USSR, along with Red China, and any war we would have to fight would be an all-out nuclear one. "All or nothing" was the strategy.

The years rolled on until Vietnam became the American obsession. Our longest war, fought with no clear objective, saw airpower become the plaything of amateur strategists. Skilled and courageous aviators were used, at peril of their lives, to send signals to the hard-bitten realists in Hanoi. The realists won when the political field marshals tired of the game.

Looking back over these past fifty years, certain faces come into view. One is that of "Hap" Arnold, a man with vision and a facility for remembering countless things, even young officers' names. Jimmy Doolittle, still going strong, was an aviation legend when I was just starting out. When he, as Eighth Air Force commander, arrived at our bases in England, it was with a flourish, a buzz job on the tower followed by a chandelle. Ira Eaker had a more sedate manner, but he was a wonderfully considerate commander, and his Eighth Air Force stewardship saw us through the critical first years of the war.

Tommy White always comes to mind. He was an intellectual Chief of Staff but one with a warm and approachable side. Then there is Nate Twining, another Chief with an unbounded store of common sense and integrity. Curt LeMay, of course, will go down in history for his steadfast convictions about strategic airpower. When I first knew him, he had already, as a major, begun to stand out as a man who knew where he was headed. Later, while a colonel in England, he seemed more important than most of the brass in London.

So many come to mind in casting back over the years, too many to list here. We have had our share of visionaries, and, to be honest, of those who went beyond their just deserts.

Now, we are on the verge of another war, if, in fact, it has not already begun by the time this appears. The question of airpower's place in the strategic lexicon continues to be a source of argument, even in the face of indisputable accomplishments. The arguments are the same as those of fifty years ago, or forty years ago, or any point in between.

This, in short, is where I came in, so it is time to end these columns. ■

EDITOR'S NOTE: *T. R. Milton, who has written a monthly column for* AIR FORCE *Magazine since October 1974, hasn't completely escaped us yet. Although this is his last column, he has agreed to write feature-length pieces for us now and then. They will be mostly retrospective in nature, he says.*

Valor

By John L. Frisbee, Contributing Editor

Skip-Bombing Pioneer

In the fall of 1942, a better way of sinking Japanese ships had to be found. Ken McCullar was one of the first to master the new tactic.

A PRIORITY task for the few Fifth Air Force B-17s of the 19th and 43d Bombardment Groups during the summer of 1942 was interdicting the Japanese sea line of communications from Rabaul, New Britain, to enemy forces on New Guinea. AAF doctrine then held to bombing from altitude with nine-plane (when that many were available) squadron formations. Results had not been good, especially against maneuvering ships. Only about one percent of bombs dropped were hitting their targets. Clearly a better way had to be found.

Promising experiments with skip bombing were under way in the US, based on RAF experience. Lt. Gen. George Kenney, commander of Fifth Air Force, was enthusiastic about the new technique. The 63d Squadron of his 43d Bombardment Group set to work in September, testing skip bombing with B-17s against a wrecked ship in Port Moresby Harbor. Approaching the target at 200 mph, aircraft released bombs at 200 feet or lower, about 300 yards from the hulk. The bombs would skip across the water into the side of the ship—if airspeed, altitude, and range were properly coordinated. Modified Australian fuzes were used in the absence of suitable US stock.

Capt. Kenneth McCullar already was credited with sinking or damaging four Japanese vessels, using conventional tactics. He soon became one of the most proficient practitioners of skip bombing, with sixty percent hits in practice runs. Skip bombing looked like the answer, but it added another element of danger to the normal hazards of combat. Chief among these was the nerve-racking experience of flying at point-blank range directly into the muzzles of deck guns on enemy ships. Since the older B-17s didn't have enough forward firepower to keep those guns down, early skip-bombing attacks were made at night, by the light of the moon or flares.

The Japanese were introduced to skip bombing at Rabaul Harbor on the night of October 23, 1942. While six B-17s of the 64th Squadron bombed from 10,000 feet, six 63d Squadron bombers came in at 100 feet to skip their bombs into the sides of Japanese ships. Ken McCullar reported sinking a destroyer with two hits amidships. Two nights later the 63d returned to Rabaul with eight B-17s, about a third of the Fifth Air Force's operational heavy bombers at the time. Captain McCullar was one of four to score hits.

Ken McCullar flew many more skip-bombing missions; one of the most notable was on the night of November 24, when he and other B-17 crews attacked an enemy convoy by flare light. His first run at 200 feet scored a near miss on a destroyer. On his second run, McCullar set the destroyer afire.

Coming back once more, his number one engine was knocked out by flak, and the propeller couldn't be feathered. Too badly shot up for another low attempt, McCullar made a conventional bomb run at 1,200 feet and again was hit. He then climbed to 4,000 feet for a fifth attack and lost number three engine to enemy fire. With only two engines running and three wounded men aboard, he was faced with a return to Port Moresby over 13,000-foot peaks. Number three finally was brought in at greatly reduced power. "Two and a half hours later," McCullar reported, "we were at 10,000 feet, our ceiling, and luckily we found a pass to sneak through, landed OK, and forgot about it."

Twice more Ken McCullar brought his B-17 home on two engines, once from nearly 600 miles from Rabaul where he was on a photoreconnaissance mission. Seventy miles short of Rabaul, a supercharger blew up, killing both engines on the left wing. McCullar completed the mission on two engines and flew back to Port Moresby with excellent photos of the Rabaul area. Two days later, on December 7, he helped turn back a Japanese convoy, returning with more than 100 machine-gun and 20-mm holes in his B-17.

Kenneth McCullar, by this time a major, led a charmed life, it would seem. His skill as a pilot and his determination to complete every mission regardless of the odds had earned him a Distinguished Service Cross. Then, as with so many other combat heroes, the odds caught up with him. On April 12, 1943, while taking off for an attack on a convoy, his B-17 crashed in flames.

"His exploits were already legends that would be told and retold long after the war," General Kenney said. Ken McCullar was a symbol of valor in the dark days of the Pacific war. His courage and resolution should remain an inspiration to those who follow almost a half-century later. ■

AFA State Contacts

Following each state name are the names of the communities in which AFA chapters are located. Information regarding these chapters or any of AFA's activities within the state may be obtained from the appropriate contact.

ALABAMA (Birmingham, Gadsden, Huntsville, Mobile, Montgomery): **William M. Voigt,** 128 Glenview Dr., Birmingham, AL 35213 (phone 205-254-2330).

ALASKA (Anchorage, Fairbanks): **Larry D. Willingham,** 20151 Lucas Ave., Eagle River, AK 99577 (phone 907-694-4034).

ARIZONA (Green Valley, Phoenix, Prescott, Sedona, Sierra Vista, Sun City, Tucson): **William A. Lafferty,** 1342 Placita Salubre, Green Valley, AZ 85614 (phone 602-625-9449)

ARKANSAS (Blytheville, Fayetteville, Fort Smith, Hot Springs, Little Rock): **O. W. Lewis,** 717 E. Walnut St., Blytheville, AR 72315 (phone 501-763-6846).

CALIFORNIA (Apple Valley, Bakersfield, Camarillo, Edwards, Fairfield, Fresno, Los Angeles, Merced, Monterey, Novato, Orange County, Pasadena, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, Sunnyvale, Vandenberg AFB, Yuba City): **Arthur Trost,** 288 Lombardi Cir., Walnut Creek, CA 94598 (phone 415-934-2889).

COLORADO (Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Pueblo): **William D. Croom,** 31 N. Tejon, Colorado Springs, CO 80903 (phone 719-550-5059).

CONNECTICUT (Brookfield, East Hartford, Middletown, Storrs, Stratford, Torrington, Waterbury, Westport, Windsor Locks): **John T. McGrath,** 97 Morgan St., Middletown, CT 06457 (phone 203-344-4636).

DELAWARE (Dover, Milford, Newark, Rehoboth Beach, Wilmington): **Robert M. Berglund,** 128 W. Loockerman St., Dover, DE 19901 (phone 302-674-0200).

DISTRICT OF COLUMBIA (Washington, D. C.): **John J. Stirk,** 1501 Lee Highway, Arlington, VA 22209-1198 (phone 703-247-5820).

FLORIDA (Avon Park, Broward County, Cape Coral, Daytona Beach, Fort Walton Beach, Gainesville, Homestead, Jacksonville, Leesburg, Miami, New Port Richey, Ocala, Orlando, Palm Harbor, Panama City, Patrick AFB, Port Charlotte, Sarasota, Spring Hill, Sun City Center, Tallahassee, Tampa, Titusville, Vero Beach, West Palm Beach, Winter Haven): **Craig R. McKinley,** 735 Palmera Dr. E., Ponte Vedra Beach, FL 32082 (phone 904-741-7120).

GEORGIA (Athens, Atlanta, Columbus, Dobbins AFB, Rome, Savannah, St. Simons Island, Valdosta, Warner Robins): **Dan Callahan,** 100 Ridgecrest Pl., Warner Robins, GA 31088 (phone 912-929-1485).

GUAM (Agana): **Daniel A. Cox,** Box 7252, Tamuning, GU 96911 (phone 671-646-9255).

HAWAII (Honolulu, Maui): **Bob Noack,** P. O. Box 618E, Honolulu, HI 96818 (phone 808-422-2922).

IDAHO (Boise, Mountain Home, Twin Falls): **Chester A. Walborn,** P. O. Box 729, Mountain Home, ID 83647 (phone 208-587-4415).

ILLINOIS (Belleville, Champaign, Chicago, Elmhurst, Moline, Peoria, Rockford, Springfield-Decatur): **Paul M. Cleary,** 911 Meadowlark, O'Fallon, IL 62269 (phone 618-632-6678).

INDIANA (Bloomington, Fort Wayne, Grissom AFB, Indianapolis, Lafayette, Marion, Mentone, South Bend, Terre Haute): **Harold F. Henneke,** 359 W. Edgewood Ave., Indianapolis, IN 46217 (phone 317-786-5865).

IOWA (Des Moines, Marion, Sioux City): **Carl B. Zimmerman,** 608 Waterloo Bldg., Waterloo, IA 50701 (phone 319-234-0339).

KANSAS (Garden City, Topeka, Wichita): **Samuel M. Gardner,** 1708 Prairie Park Ln., Garden City, KS 67846 (phone 316-275-4555).

KENTUCKY (Lexington, Louisville): **James R. Jenkins,** 3276 Carriage Ln., Lexington, KY 40517 (phone 606-278-6848).

LOUISIANA (Alexandria, Baton Rouge, New Orleans, Shreveport): **Doyle D. Blasingame,** 208 Wellington Dr., Bossier City, LA 71111 (phone 318-746-0252).

MAINE (Bangor, Loring AFB, North Berwick): **Richard F. Strelka,** 54 Country Rd., Caribou, ME 04736 (phone 207-492-4381).

MARYLAND (Andrews AFB area, Baltimore, College Park, Rockville): **Ronald E. Resh,** 416 Hungerford Dr., Suite 316, Rockville, MD 20850 (phone 301-294-8740).

MASSACHUSETTS (Bedford, Boston, East Longmeadow, Falmouth, Florence, Hanscom AFB, Taunton, Worcester): **David R. Cummock,** 174 South Blvd., West Springfield, MA 01089 (phone 413-737-5466).

MICHIGAN (Alpena, Battle Creek, Detroit, East Lansing, Kalamazoo, Marquette, Mount Clemens, Oscoda, Petoskey, Southfield): **William L. Stone,** 7357 Lakewood Dr., Oscoda, MI 48750 (phone 517-739-3696).

MINNESOTA (Duluth, Minneapolis–St. Paul): **Doyle E. Larson,** 13509 York Ave. S., Burnsville, MN 55337 (phone 612-890-9140).

MISSISSIPPI (Biloxi, Columbus, Jackson): **Henry W. Boardman,** 10 Bayou Pl., Gulfport, MS 39503 (phone 601-896-8836).

MISSOURI (Richards-Gebaur AFB, Springfield, St. Louis, Whiteman AFB): **Charles E. McGee,** 5231 Lawn Ave., Kansas City, MO 64130-3152 (phone 816-861-5231).

MONTANA (Bozeman, Great Falls): **Jim Banks,** 7 Hill St., Bozeman, MT 59715 (phone 406-507-7629).

NEBRASKA (Lincoln, Omaha): **Ralph Bradley,** 1221 N. 101st St., Omaha, NE 68114 (phone 402-392-1904).

NEVADA (Las Vegas, Reno): **Clarence E. Becker,** 5000 Lakeridge Dr., Reno, NV 89509 (phone 702-825-1458).

NEW HAMPSHIRE (Manchester, Pease AFB): **Frederic C. Armstrong,** 206 Woodland Rd., Hampton, NH 03842-1426 (phone 603-436-6909).

NEW JERSEY (Andover, Atlantic City, Belleville, Camden, Chatham, Cherry Hill, Forked River, Fort Monmouth, Jersey City, McGuire AFB, Middlesex County, Newark, Old Bridge, Trenton, Wallington, West Orange, Whitehouse Station): **Dolores Vallone,** 143 Marne Rd., Hopatcong, NJ 07843 (phone 201-770-0829).

NEW MEXICO (Alamogordo, Albuquerque, Clovis): **Robert H. Johnson,** P. O. Box 9436, Albuquerque, NM 87119 (phone 505-843-6230).

NEW YORK (Albany, Bethpage, Binghamton, Brooklyn, Buffalo, Chautauqua, Griffiss AFB, Hudson Valley, Nassau County, New York City, Niagara Falls, Plattsburgh, Rochester, Staten Island, Suffolk County, Syracuse, Westhampton Beach, White Plains): **Vincent J. Tampio,** 50 Main St., Silver Creek, NY 14136 (phone 716-631-6465).

NORTH CAROLINA (Asheville, Charlotte, Fayetteville, Goldsboro, Greensboro, Greenville, Havelock, Hickory, Kitty Hawk, Littleton, Raleigh, Wilmington): **Norman E. Davis,** P. O. Box 387, Wrightsville Beach, NC 28480 (phone 919-256-6036).

NORTH DAKOTA (Fargo, Grand Forks, Minot): **J. Michael Phillips,** 110 49th Ave. S., Grand Forks, ND 58201 (phone 701-795-3510).

OHIO (Akron, Cincinnati, Cleveland, Columbus, Dayton, Mansfield, Newark, Youngstown): **Fred F. Kubli, Jr.,** 823 Nancy St., Niles, OH 44446 (phone 216-544-7752).

OKLAHOMA (Altus, Enid, Oklahoma City, Tulsa): **Kenneth W. Calhoun,** 9416 Rhythm, Midwest City, OK 73110 (phone 405-736-5641).

OREGON (Eugene, Klamath Falls, Portland): **John Lee,** 3793 E. Nanitch Cir. S., Salem, OR 97306 (phone 503-581-3682).

PENNSYLVANIA (Allentown, Altoona, Beaver Falls, Bensalem, Coraopolis, Drexel Hill, Erie, Harrisburg, Homestead, Indiana, Johnstown, Lewistown, Philadelphia, Pittsburgh, Scranton, Shiremanstown, State College, Washington, Willow Grove, York): **Eugene Goldenberg,** 2345 Griffith St., Philadelphia, PA 19152 (phone 215-332-4241).

PUERTO RICO (San Juan): **Vincent Aponte,** P. O. Box 8204, Santurce, PR 00910 (phone 809-764-8900).

SOUTH CAROLINA (Charleston, Clemson, Columbia, Myrtle Beach, Sumter): **Charles W. Myers,** 42 Palmer Dr., Sumter, SC 29150 (phone 803-775-7352).

SOUTH DAKOTA (Belle Fourche, Rapid City, Sioux Falls): **Robert Jamison,** 1506 S. Duluth Ave., Sioux Falls, SD 57105 (phone 605-339-7100).

TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tullahoma): **Wayne L. Stephenson,** 12409 Valencia Point, Knoxville, TN 37922-2415 (phone 615-966-2569).

TEXAS (Abilene, Amarillo, Austin, Big Spring, College Station, Commerce, Corpus Christi, Dallas, Del Rio, Denton, El Paso, Fort Worth, Harlingen, Houston, Kerrville, Lubbock, San Angelo, San Antonio, Waco, Wichita Falls): **John P. Russell,** P. O. Box 5789, Abilene, TX 79608 (phone 915-695-2340).

UTAH (Bountiful, Clearfield, Ogden, Salt Lake City): **Dan Hendrickson,** 1930 North 2600 East, Layton, UT 84040 (phone 801-776-2101).

VERMONT (Burlington): **Andrew D. Clark,** 4 General Greene Rd., Shelburne, VT 05482 (phone 802-985-3772).

VIRGINIA (Alexandria, Charlottesville, Danville, Harrisonburg, Langley AFB, Lynchburg, McLean, Norfolk, Petersburg, Richmond, Roanoke): **Mary Anne Thompson,** 3146 Valentino Ct., Oakton, VA 22124 (phone 703-734-6401).

WASHINGTON (Seattle, Spokane, Tacoma): **Theodore O. Wright,** 9644 Hilltop Rd., Bellevue, WA 98044-4006 (phone 206-454-5548).

WISCONSIN (Madison, Milwaukee, Mitchell Field): **Gilbert M. Kwiatkowski,** 8260 W. Sheridan Ave., Milwaukee, WI 53218-3548 (phone 414-463-1849).

WYOMING (Cheyenne): **Irene G. Johnigan,** 503 Notre Dame Ct., Cheyenne, WY 82009 (phone 307-775-3641).

AFA's SEVENTH ANNUAL TACTICAL AIR WARFARE SYMPOSIUM

January 31 and February 1, 1991

THE BUENA VISTA PALACE HOTEL ORLANDO, FLORIDA

In conjunction with Tactical Air Command, we are sponsoring our seventh annual tactical air warfare symposium, "Tactical Air Warfare: Planning in a Changing World." This gathering will provide an in-depth exploration of tactical air requirements in the context of technical developments, rapid changes in Soviet doctrine and the magnitude of the Soviet threat, and the emergence of high technology threats in the third world.

In addition to a keynote address by the Commander of Tactical Air Command, top leaders from the Air Force will probe the status and prospects of the role of airpower in conventional and theater warfare. For more information, call Jim McDonnell at (703) 247-5810, or Dottie Flanagan at (703) 247-5805.

GOLF TOURNAMENT

Wednesday, January 30, 1991
12:00 noon
On Walt Disney World's
Palm Course
Contact: Tommy Harrison
(407) 886-1922

TACTICAL FORCES GALA

On Friday, February 1, 1991, the Central Florida Chapter will sponsor its seventh annual black-tie Gala. Proceeds will benefit AFA's Aerospace Education Foundation as well as ROTC, scholarships, and other aerospace education activities. For more information, contact Marty Harris (407) 356-4810.

EXHIBITS AND DISPLAYS

For each Gala table purchased, companies will be allowed 100 square feet of display space. Exhibits will be on display during the two-day Symposium and Gala. For more information on exhibits, contact Carol Bates (407) 356-3812.

Invited Guests

General Merrill A. McPeak, Chief of Staff, USAF

General Robert D. Russ, Commander, Tactical Air Command

General Robert C. Oaks, Commander in Chief, US Air Forces, Europe

Mr. John J. Welch, Jr., Assistant Secretary of the Air Force, Acquisition

Lt. Gen. Jimmie V. Adams, Commander in Chief, Pacific Air Forces (Designate)

Lt. Gen. Gordon E. Fornell, Commander, Electronic Systems Division

Lt. Gen. Henry Viccellio, Jr., Deputy Chief of Staff, Logistics and Engineering

Lt. Gen. Thomas R. Ferguson, Jr., Commander, Aeronautical Systems Division

Maj. Gen. John A. Corder, Commander, Tactical Air Warfare Center

Maj. Gen. Joseph W. Ralston, Director, Tactical Programs, SAF/AQ

Brig. Gen. Richard B. Myers, Deputy Chief of Staff, Requirements, TAC

Registration Form
A 1991 Air Force National Symposium

"Tactical Air Warfare—
Status and Prospects"

The Buena Vista Palace Hotel
Lake Buena Vista, Florida
1-800-327-2990

January 31–February 1, 1991

Advance registration closes Monday, January 21, 1991

No refunds can be made for cancellations after that date. MAIL THIS FORM TO:
Air Force Association
ATTN: Miss Flanagan
1501 Lee Highway
Arlington, Va. 22209-1198
(703) 247-5805

NAME (Print) _____

TITLE _____

AFFILIATION _____

ADDRESS _____

CITY, STATE, ZIP _____

TELEPHONE: (AREA CODE) _____ (NO.) _____

My check covering the Symposium fee of $300 for AFA individual or industrial Associate member, payable to the Air Force Association, is enclosed. The fee includes one (1) Reception/Buffet ticket and (1) Exhibit Hall lunch ticket.

(Note: Fee for non-member is $325.)

☐ Mark here if an extra guest Reception/Buffet ticket is desired. Enclosed is $115 for the additional ticket.

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

Texas Convention

The Air Force Association suffered a blow when its chairman of the board and longtime stalwart, Sam E. Keith, Jr., died from a heart attack last summer. Nowhere was this blow more keenly felt than in Mr. Keith's home state of Texas. Rather than let Mr. Keith's passing crush their spirits, members of AFA's second-largest state organization (more than 20,000 strong) went on to hold a highly successful convention, spurred on by the belief that they would be acting in accord with the late Mr. Keith's wishes.

The Fort Worth Chapter did an exemplary job hosting the convention, which had outstanding military and industrial participation. Representatives from General Dynamics, LTV, Bell Helicopter, Texas Instruments, McDonnell Douglas, FlightSafety International, and others met with Gen. Michael J. Dugan (who has since left the post of Air Force Chief of Staff), the convention's keynote speaker. The audience had high praise for the General's speech, which centered on Air Force personnel issues.

Other highlights of the convention included a tour of nearby Carswell AFB, an F-16 flight demonstration, and an evening awards banquet.

A total of eighteen awards were presented at the convention to outstanding ATC, SAC, and ESC active-duty personnel serving in the Lone Star State. Lt. Gen. Joseph Ashy, commander of ATC, presented the awards. National President Jack C. Price, since elected chairman of the board, presented AFA Special Citations to Charlotte Loos, Ed Fox, Jack Gilchrist, and outgoing State President M. N. "Dan" Heth.

Besides Generals Ashy and Dugan, many Air Force organization commanders were present, including Maj. Gen. Mike Nelson of the Sheppard Technical Training Center and Maj. Gen. Fred Doppelt of Human Systems Division.

Vigorous participation at the convention by civic leaders from the Dallas–Fort Worth Area, including members of the Airpower Council, Military Affairs Committee, and Chamber of Commerce, was a tribute to the efforts of the Fort Worth Chapter to foster good community relations.

AFA and AEF leaders turned out in force at the convention. John O. Gray and Monroe W. Hatch, Jr., former and current executive directors of AFA, respectively, took part in a productive business session, joined by National Directors William McBride, Joe Shosid, E. F. "Sandy" Faust, Bryan Murphy, and P. D. Straw; National Vice President (Southwest Region) Oliver Crawford; National Vice President (Far West Region) Robert Munn; and Texas Executive Vice President Glenn Jones. AEF Board Chairman James M. Keck and President Gerald V. Hasler gave informative reports on aerospace education.

Humanitarian Award

His well-known efforts on behalf of the USO are not the only humanitarian works undertaken by comedian Bob Hope. He has also lent his name to an award presented to recognize support of the Air Force Enlisted Widows Home, which also bears his name. This year's Bob Hope Humanitarian Awards went to the **Iron Gate (N. Y.) Chapter** and the **Eglin (Fla.) Chapter.** Iron Gate was recognized for its annual National Air Force Salute, which for sixteen years has made contributions to help provide "a se-

Officers of the Paul Revere (Mass.) Chapter show Lt. Gen. Gordon E. Fornell, Electronic Systems Division commander, the notification letter selecting their chapter as 1990's Outstanding Chapter (of more than 900 members). Surrounding the General are (seated, left to right) Leo O'Halloran and Mike Salis and (standing, left to right) John Kelly, Claudia Pheulpin, Bruce Macdonald, Ann Marie Neilan, Tony Romanelli, and Dick Galloway.

Outgoing State President M. N. "Dan" Heth registers genuine surprise at being named Texas Man of the Year at the 1990 State Convention. Lt. Gen. Joseph Ashy, ATC commander, and Jack C. Price, then-president of AFA, are just as genuinely pleased to present the award.

cure, serene, and happy home for the widows of Air Force enlisted persons" in the Bob Hope Village. The Eglin Chapter was recognized for sponsoring six Bob Hope Benefit Shows, which resulted in a substantial monetary contribution to the Village.

Retired Air Force Chief of Staff Gen. Larry D. Welch, an AFA national director, presented the awards, accepted by Chapter President Richard Freytag for Iron Gate and by Chapter President Charlie Johnson for Eglin.

Eglin was also honored by Florida State AFA for its good work in sponsoring the Bob Hope shows on behalf of the Village, receiving the Outstanding Single Chapter Program Award and having one of its members, Robert W. Gates, named as Chapter Person of the Year.

Chapter News

In an effort to ensure that the troops in Operation Desert Shield in Saudi Arabia are remembered on the home front, the **John W. DeMilly, Jr. (Fla.) Chapter** sponsored a Yellow Ribbon Day to coincide with the departure of a contingent of the 31st Tactical Fighter Wing's Hospital Squadron to the Middle East. Chapter President Jose Clay, Vice President Wendell Grimsley, and Treasurer Bill Susser spent the day at the Homestead AFB gate, handing out yellow ribbons for people to display in hopes of a safe return for the military men and women.

In a "Salute to Space Systems Division," the **General B. A. Schriever Los Angeles (Calif.) Chapter** presented three awards to employees of the Kirtland AFB, N. M., Air Force Space Technology Center. Marolyn Muller Russell, a contracting specialist, was named Civilian of the Year; Dr. James H. Degnan, a research specialist in the High Energy Plasma Division was named Scientist/Engineer of the Year; and A1C Lonest Bonton, Jr., a construction contract administrator, was named Airman of the Year.

The **Southern Indiana (Ind.) Chapter** hosted Drina Welch Abel (sister of the late Orin Welch), who gave an informative lecture and slide presentation. Mr. Welch, who perished flying Over the Hump in 1943, was a Hoosier aircraft pioneer who built, tested, and flew Depression-era aircraft. Chapter President Hank Weidner and Secretary Marcus R. Oliphant report that Mrs. Abel's presentation was well received.

Education Support

South Carolina AFA did its part for aerospace education at Orangeburg-Wilkinson High School by recognizing Outstanding AFJROTC Cadet Mark Danner, who received his medal from Worth Allen, former president of South Carolina AFA and himself the recipient of an Outstanding Service Award.

Under the aegis of Oklahoma State AFA, in cooperation with the Tulsa Chamber of Commerce, the mayor of Tulsa, and the Eastern Oklahoma National Management Association, Maj. Gen. Joseph K. Spiers, Oklahoma City ALC commander, gave a talk on the state of the Air Force. Here, he is thanked by former AFA National President and Assistant USAF Secretary Harold Stuart (left) and Rodger Randle, mayor of Tulsa.

Farewell to West

AFA is saddened to report the death of Herbert M. "Bud" West. Mr. West, a permanent national director, joined the Association in the 1950s and served as Eglin chapter president, Florida state president, and national vice president (Southeast Region). He had a distinguished, twenty-eight-year military career, retiring as vice commander of the Air Proving Ground Center at Eglin AFB. He is survived by his wife, Marie, two children, and one grandchild.

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

Seeking contact with anyone who knew the following individuals: **Spencer A. Price,** of the 89th Squadron, 80th Fighter Group, in 1944 and 1945; **Donald Albert; Lt. M. Driver;** and 8th Air Force members **SSgt. Stanley H. Ziegler,** of the 509th Bomb Squadron, 351st Bomb Group; **Frank Ziegler,** of the 351st Bomb Group or 20th Fighter Group; and **SSgt. Jack B. Ziegler,** of the 79th Squadron, 20th Fighter Group. **Contact:** Paul Roberts, Flat 2, 2 Hilton Rd., Leeds LS8 4HB, England.

Seeking **aviation-related items,** such as goggles, helmets, oxygen masks, flight clothing, uniforms, parachutes, propellers, and clocks. **Contact:** Col. William L. Evans, USAF (Ret.), 4390 N. 125 W., Ogden, UT 84414.

Seeking the whereabouts of the following members of **B-29 crew #3913,** 6th Bomb Group, 313th Bomb Wing, who served on Tinian during World War II: Capt. Herbert Franks, from Dallas, Tex.; Harry B. (or H. Brad) Johnson, from Grand Rapids, Mich.; John A. Potenza, from Brooklyn, N. Y.; Wallace L. "Pete" Peebles, from Pittsburg, Ill.; and Robert S. Ziegler, from Reedsville, Pa. Also seeking **Martin "Marty" Selitsky,** from Philadelphia, who was in Crew #3915. **Contact:** Phil McQuillen, 1208 Lee St., Unit #95, Leesburg, FL 34748.

Seeking the whereabouts of **Lt. "Fred" Fredinburg, Lt. Ernest L. Jordon,** and **Lt. James Gordon Farley,** who were all fighter pilots with the 40th Fighter-Interceptor Squadron at Johnson AB, Japan, in 1953 and 1954. **Contact:** Bill Mathis, P. O. Box 2414, Midland, TX 79702.

Seeking contact with **TSgt. Phil Harper,** who painted a portrait of **Brig. Gen. William L. "Jerry" Lee** while the General was commander of the 13th Air Force at Clark AB, the Philippines, and also with anyone else who was at Clark AB between 1953 and 1956. **Contact:** A. G. Atkin, P. O. Box 7261, Amarillo, TX 79114.

Seeking contact with anyone who was at **Chambley AB, France,** between 1954 and 1957.

Also seeking members of the 1st Aeromedical Evacuation Group at Pope AFB, N. C., in 1958 and the whereabouts of **Capt. Joe C. Williams,** who was at Langley AFB, Va., in 1961; **Paul Rodgers,** of Camp des Loges, France; and **Jeep Bowers. Contact:** MSgt. C. Rayford Timms, USAF (Ret.), 1616 Rex Dr., Marietta, GA 30066.

Collector of World War II memorabilia seeks **wings, patches, medals,** and uniforms to purchase from veterans. **Contact:** Alden W. Hamilton, P. O. Box 29767, Richmond, VA 23229.

Seeking World War II veterans who served in the 95th, 96th, 97th, or 98th Squadrons of the **440th Troop Carrier Group. Contact:** Donald M. Orcutt, 551 S. Concord St., Seattle, WA 98108.

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

Collector seeks contact with other patch collectors. Especially seeking **patches** from medical/air evacuation, communications, and air refueling units. **Contact:** Sgt. David J. Marti, USAF, 156-B Northeast Dr., Patrick AFB, FL 32925.

Seeking information on the whereabouts of **Capt. Gordon Ettenson,** who was in special operations in Hawaii in 1984. **Contact:** Shane Cerato, P. O. Box 5610, Gold Coast Mail Centre, Queensland 4217, Australia.

Seeking information on the crew members of a B-24, ***Madam Shoo Shoo,*** of the 34th Bomb Group, 8th Air Force, in Europe during World War II. **Contact:** R. C. Harris, Jr., 4813 Burton SE, Albuquerque, NM 87108-3419.

Seeking the following members of the 535th Bomb Squadron, 381st Bomb Group, based at Ridgewell, England, during World War II: **Lt. Elmer Wulf, Lt. Hugh Robinson,** and **Lt. Harlan Kriete. Contact:** Virgil E. Miller, 5100 Emerald Dr., Apt. 2, Lincoln, NE 68516.

Seeking World War II **German aircraft control sticks, data plates,** and **ID tags.** Also want photos of World War II German aircraft. **Contact:** Stephen Polyak, 4306 Declaration Cir., Belcamp, MD 21017.

Seeking the whereabouts of **MSgt. Frederick Bennett,** who was stationed at Ascot near Windsor during World War II. **Contact:** Paul Renn, 23 Northumberland Ave., Islesworth, Middlesex TW7 5HZ, England.

For a history of Air Force explosive ordnance disposal from 1947 to 1985, seeking photos, unit histories, journals, stories from **EOD personnel. Contact:** CMSgt. Marshall "Doc" Dutton, USAF (Ret.), 150 Grand View Ave., Valparaiso, FL 32580.

For a history of **Stalag Luft III,** the prisoner of war camp for allied aircrew at Sagan, Germany, I am seeking information and photos of the camp for the years 1942–45. **Contact:** Charles Rollings, c/o Hatchards, 187 Piccadilly, London W1V 9DA, England.

Seeking contact with anyone who served in the **10th Replacement Unit** at Whittington Barracks near Lichfield, England, in 1944 or 1945. The commanding officer may have been Colonel Killian. **Contact:** Glenys R. Graham, 77 Howdles Ln., Brownhills, Walsall, West Midlands WS8 7PJ, England.

Seeking contact with anyone with information on the crash of the aircraft of **1st Lt. Floyd H. Truesdell,** on August 31, 1943. He was a member of the 422d Bomb Squadron, 305th Bomb Group, having transferred from the RCAF. The aircraft may have been named "Eager Eagle." **Contact:** George Collins, Rte. 1, Box 1032, Niceville, FL 32578.

Seeking information and memorabilia on astronaut **Virgil I. "Gus" Grissom,** for whom my elementary school on Clark AB, the Philippines, is named. **Contact:** Sean Collins, PSC 2, Box 17091, APO San Francisco 96311.

Collector seeks **posters** of the B-2 Stealth bomber and the F-117 Stealth fighter. **Contact:** Rhondel A. Mariano, 1970 Mindanao St., Sta. Mesa, Manila, the Philippines.

Seeking information on a **brass model of a P-38** made from brass jackets and bullets. **Contact:** Minter W. Rudy, 5240 Whispering Creek Dr., Santa Rosa, CA 95403.

Seeking information on the whereabouts of **Dr. Eugene Fubini,** who designed secret equipment to find the distance and direction of enemy aircraft. The equipment was installed on a Mosquito aircraft of the 25th Bomb Group and used on March 25, 1945. Also seeking MIT engineers **Milton Adams** and **Burton Cuck.** All were at the ABL lab at Malverne, England, when the equipment was installed. **Contact:** Norman Malayney, 519 Semple St., Pittsburgh, PA 15213-4315.

Seeking information on and the whereabouts of **Joseph Desantis** (or Desantos), who may have been from Brooklyn, N. Y., and was responsible for communication at Prestwick, Scotland, in 1959 or 1960. He later transferred to Essex. **Contact:** L. Robertson, Minehead House, 25 Hanson St., Flat 11, London W1P 7LQ, England.

Seeking the whereabouts of **Jack Blake,** bombardier, and **William Costa,** navigator, both of whom were members of Crew #30 of the 39th Bomb Group on Guam in 1945. **Contact:** Bob Weiler, 516 Canal Rd., Sarasota, FL 34242.

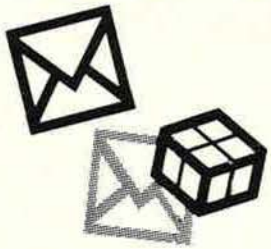
For a history of air defense of the continental US from 1946 to present, I am seeking information and photos of aircraft, crews, and activities of **Air Defense Command,** including Alaskan Air Command and Northeast Air Command. **Contact:** Larry Davis, 4713 Cleveland Ave. N. W., Canton, OH 44709.

Seeking information and photos relating to the 11th, 22d, and 491st Bomb Squadrons of the **341st Bomb Group** that operated in the China-Burma-India theater between May 1942 and December 1943. Also seeking information on **Sgt. Albert Mazo. Contact:** John Mazo, 135 Howe St., Methuen, MA 01844.

Seeking reminiscences, letters, and photos from **GIs who served in Britain** between 1942 and 1945. **Contact:** Juliet Gardiner, 92 Malden Rd., London NW5 4DA, England.

Seeking information on how to get replacement **dog tags. Contact:** Louise Apostle, 2 Green Wing Teal, Hilton Head Island, SC 29928.

For a history of **assisted aircrew escape systems,** seeking photos, documents, anecdotes,



Mailing Lists

AFA occasionally makes its list of member names and addresses available to carefully screened companies and organizations whose products, activities, or services might be of interest to you. If you prefer **not** to receive such mailings, please copy your mailing label **exactly** and send it to:

Air Force Association
Mail Preference Service
1501 Lee Highway
Arlington, Va. 22209-1198

and reminiscences of ejections, ejection seats, or escape capsules. Especially interested in early developments in America, France, and the Soviet Union. **Contact:** Mike Bennett, 57 Cheviot, Wilnecote, Tamworth, Staffordshire B77 4JP, England.

Seeking information on **black airmen** who served in the USAAF during World War II, especially in the 99th Pursuit Squadron, which trained at Tuskegee, Ala., and the 332d Fighter Group, based in Michigan. **Contact:** James H. Hall, P. O. Box 65, Hampton, VA 23669.

Seeking information on the whereabouts of **Bill MacFarlane,** who piloted a B-17 in England during World War II. His copilot's name was Don, and another crew member was named George. **Contact:** Roy Abbs, 9 Sharman Ave., Watton, Norfolk IP25 6ED, England.

Seeking information, anecdotes, and photos relating to US personnel at **Aldermaston Airfield,** England, from 1942 to 1945. **Contact:** J. Ruth Clough, 41 Franklin Ave., Tadley, near Basingstoke, Hampshire RG26 6EY, England.

I have a **model P-40 Flying Tiger** available for display. It was purchased by war photographer Bob Bryant in Kuelin, China. It is signed by several historic figures, including Gen. Claire Chennault, Lt. Gen. Joe Stilwell, and Adm. Chester Nimitz, among others. **Contact:** Craig T. Weeks, 10930 Bigge St., San Leandro, CA 94577.

Collector seeks patches, pilot scarves, and decals from the **509th BMW, "Bloody" 100th BMW,** and all other tenant flying units of Pease AFB, N. H., from 1956 to the present. Also seeking memorabilia of the 340th BMG at Carswell AFB, Tex., from 1968 to 1971 and all units of the 380th BMW stationed at Plattsburgh AFB, N. Y., from 1971 to the present. **Contact:** Curt Lenz, 32 June St., Nashua, NH 03060-5345.

Collector seeks color USAF **squadron patches** from any command. Will trade Panamanian Defense Force patches from Operation Just Cause. **Contact:** Tag Stewart, P. O. Box 2256, APO Miami, FL 34001.

Seeking unit **patches** from these organizations: 35th TFW, 67th TFW, 18th TFW, 4th TFW, 347th

Unit Reunions

Yuma Army Airfield
Officers and cadet graduates who served at Yuma Army Airfield during World War II will hold a reunion February 21–23, 1991, at Yuma, Ariz. **Contact:** Lloyd D. Collins, 325 Myrtle St., Laguna Beach, CA 92651. Phone: (714) 494-4695.

2d Ferrying Group
Members of the 2d Ferrying Group, which was based at New Castle AAB, Del., between 1942 and 1946, will hold a reunion April 30–May 3, 1991, at the Newark-Fremont Hilton Hotel in Newark, Calif. **Contact:** Temple Robinson, 5961 E. 18th St., Tucson, AZ 85711. Phone: (602) 747-4466.

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.

26th Fighter Squadron
Members of the 26th Flying Training Squadron will hold a reunion for veterans of the 26th Fighter Squadron January 19, 1991, at Vance AFB, Okla. **Contact:** Capt. Peter W. Gretsch, USAF, Project Officer, 26th Flying Training Squadron, Hq. 71st Flying Training Wing (ATC), Vance AFB, OK 73705-5000. Phone: (405) 249-7285 or AUTOVON: 962-7285.

Class 41-B
Members of Flying Cadet Class 41-B (Brooks and Kelly Fields, Tex.) will hold their fiftieth-anniversary reunion March 13–15, 1991, in San Antonio, Tex. **Contact:** Frank M. Newman, 8511 Eaglecrest, San Antonio, TX 78239.

Class 43-E
Aviation Cadet Class 43-E (WCTC/SETC) has scheduled a reunion for May 23–26, 1991, at the Ponce de Leon Hotel in St. Augustine, Fla. **Contact:** Paul J. Murphy, 7013 Bellrose N. E., Albuquerque, NM 87110. Phone: (505) 884-5687.

55th Strategic Recon Wing
The 55th Strategic Reconnaissance Wing's past and present members will celebrate its fiftieth anniversary at their annual birthday ball January 26, 1991, at the Red Lion Inn in Omaha, Neb. **Contact:** Captain Kelker, 55th Strategic Reconnaissance Wing, Offutt AFB, NE 68113-5000.

456th Bomb Group
The 456th Bomb Group will hold a reunion April 24–28, 1991, in Tucson, Ariz. **Contact:** Jim Watkins, 11415 Minor Dr., Kansas City, MO 64114. Phone: (816) 942-5594.

7499th Support Group
Members of the 7499th Support Group, which included the 7405th, 7406th, and 7407th Support Squadrons, who served in Germany from 1948 on will hold a reunion April 25–28, 1991, in Tucson, Ariz. **Contact:** Ronald L. Hummel, 723 N. Plumer, Tucson, AZ 85719. Phone: (602) 623-4168.

Army Nurse Corps
Seeking information regarding reunions of the Army Nurse Corps; the 33d, the 64th, and the 70th General Hospital; and the 94th Evacuation Hospital in North Africa and Italy during World War II. **Contact:** Ruby Frazier, 1538 Barton Dr., Sunnyvale, CA 94087. Phone: (408) 245-0830.

2d Troop Carrier Squadron
For the purpose of planning a reunion in 1991, I would like to hear from personnel who served between 1943 and 1945 with the 2d Troop Carrier Squadron in the China-Burma-India theater.

TFW, 355th TFW, 33d TFW, 31st TFW, 97th BW, and 57th FIS. Also seeking patches of maintenance personnel for the following aircraft: T-33, F-100, RF101, RB66, RB57, F-105, F-4, and KC-135. **Contact:** J. D. Collins, 926 Rossview Rd., Clarksville, TN 37043.

Writer seeks aerial and ground-level photos and picture postcards of Europe from World War II and previously. **Contact:** Boris Feldblyum, 8510 Wild Olive Dr., Potomac, MD 20854.

Seeking contact with **John Sexton,** who was a crew chief on O-2A aircraft at Ramstein AB, West Germany, from 1970 to 1974. **Contact:** John Hayes, 8531 Oleander Ave., California City, CA 93505.

Seeking Air Force **special operations unit patches. Contact:** Christopher Diehl, 15137 Stillfield Pl., Centreville, VA 22020.

The **Aviation Reconnaissance Association (Marine Corps)** is seeking Marines who served in the air or on the ground, enlisted or commissioned, who are interested in joining this new association. **Contact:** Aviation Reconnaissance Association, P. O. Box 15091, Pinellas Park, FL 34666.

Seeking the whereabouts of **Lt. Herbert H. Chalsky,** who was stationed at High Wycombe, Windsor, England, in 1943. **Contact:** D. Anthony, 46 Coverack Close, Southgate, London N14 4QP, England.

Seeking recollections of former 8th Air Force personnel who landed with the aid of the **FIDO airfield fog dispersal system** during World War II. **Contact:** Geoffrey Williams, 8 Meadow Rd., Margate, Kent CY9 5JJ, England.

Seeking contact with people who remember **Art Donahue** either as a flight instructor at Laredo, Tex., in 1939–40 or in the RAF. **Contact:** Col. Kenneth L. Weber, USAF (Ret.), 1911 Southern Hills Dr., Borden, IN 47106.

Seeking information on **seat belts** used in aircraft. **Contact:** Alfredo N. Ferreiro, PASS, Av. Vallarta 4327, Suite 3-B, Fracc. Camino Real, Zapopan, Jalisco 45040, Mexico.

Contact: Albert O. Wilkat, 7520 N. W. 7th St., Plantation, FL 33317. Phone: (305) 792-6017.

5th Bomb Group
Seeking information regarding a reunion of the 5th Bomb Group, 13th Air Force, stationed on Guadalcanal in 1943. **Contact:** Maj. Stanley Pietuck, USAF (Ret.), P. O. Box 330331, Elmwood, CT 06133.

40th Fighter-Interceptor Squadron
For the purpose of planning a reunion in 1991, I would like to hear from pilots who served in the 40th Fighter-Interceptor Squadron under Col. William D. Chalek and Maj. Freeling H. Clower at Johnson AB, Japan, in 1953 and 1954. **Contact:** Bill Mathis, P. O. Box 2414, Midland, TX 79702.

Class 42-E
Seeking information regarding the possibility of holding a reunion for members of Class 42-E. **Contact:** Col. Percy C. Smith, USAF (Ret.), 221 Highland Dr., Warner Robins, GA 31088. Phone: (912) 922-5634.

Class 55-V
I would like to hear from members of Class 55-V who would be interested in holding a reunion. **Contact:** Robert H. Barnes, 35 Golden Ave., Apt. 22-A, Battle Creek, MI 49015.

72d Bomb Wing
For the purpose of planning a reunion, I am trying to locate members of the 72d Bomb Wing and the 53d Weather Squadron who served between 1967 and 1973 at Ramey AFB, Puerto Rico. **Contact:** SMSgt. John J. Davis, AFRES, 27031 S. W. 119th Ct., Naranja, FL 33032. Phone: (305) 258-5151.

111th Strategic Recon Wing
Members of the 111th Strategic Reconnaissance Wing, which was stationed at Fairchild AFB, Wash., the 57th Air Division (15th Air Force), and the 117th Bomb Squadron (Langley AFB, Va.) are planning a fortieth-anniversary reunion in 1991. **Contacts:** John Howe, 2618 Oriole Rd., Broomall, PA 19008. Phone: (215) 356-7234. Jack Peters. Phone: (201) 449-2080.

305th Troop Carrier Squadron
Members of the 305th Troop Carrier Squadron are planning to hold a reunion in 1991. **Contact:** Jim Hayhoe, 139 Gay Dr., Ventura, CA 93003.

323d Fighter-Interceptor Squadron
For the purpose of holding a reunion, I would like to hear from members of the 323d Fighter-Interceptor Squadron who served between 1953 and 1954 at Larson AFB, Wash. I would also like to hear from personnel of the 431st Fighter-Interceptor Squadron who served between 1954 and 1956 at Wheelus AB, Libya. **Contact:** Paul F. Hibner, 2702 Pontiac Dr., Alamogordo, NM 88310. Phone: (505) 437-0377.

421st Air Refueling Squadron
I would like to hear from officers who served between 1960 and 1965 in the 421st Air Refueling Squadron (Yokota AB, Japan) who would be interested in holding a reunion. **Contacts:** Louis De Marco, 116 Poplar St., Hammonton, NJ 08037. Phone: (609) 561-6737. Thomas Hattaway, 3612 Quando Dr., Orlando, FL 32812. Phone: (407) 857-2729.

440th Troop Carrier Group
The 440th Troop Carrier Group Association is searching for veterans who served with the 95th, 96th, 97th, and 98th Troop Carrier Squadrons, which were assigned to the 440th Troop Carrier Group. **Contact:** Donald M. Orcutt, 551 S. Concord St., Seattle, WA 98108. Phone: (206) 762-3677.

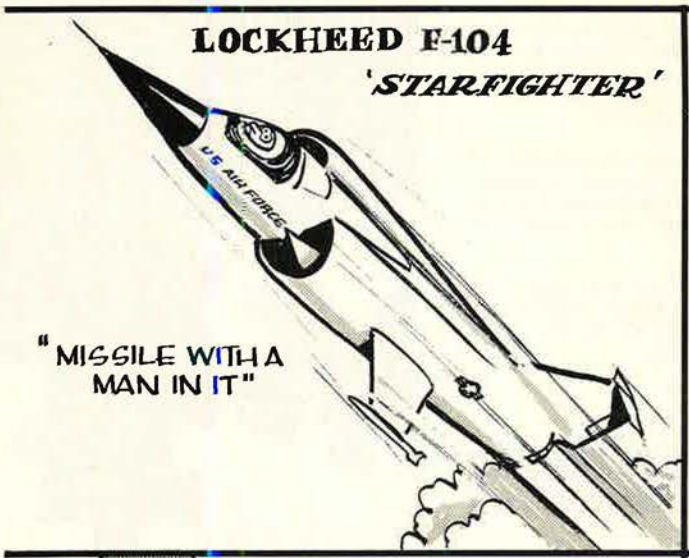
583d SAW Battalion
Seeking members of the headquarters company of the 583d Signal Aircraft Warning Battalion who would be interested in holding a reunion or just getting in touch. **Contact:** Doug Burkett, 1000 Drexel Hills Blvd., New Cumberland, PA 17070. Phone: (717) 774-0244.

Bob Stevens'

"There I was..."

LAST SEPTEMBER THIS MAGAZINE RAN AN ARTICLE ENTITLED "WHAT THEY *REALLY* CALLED THEM" BY JEFF RHODES. AIRCRAFT WERE LISTED BY THEIR OFFICIAL NAMES *and* ALSO BY THE MONIKERS GIVEN 'EM BY THE TROOPS. THE PIECE PROMPTED LETTERS GIVING US MORE ALIASES -POLITE *and* IMPOLITE. THEY'RE FUN TO DRAW, SO HERE'S MORE "NICKNAMES".

LOCKHEED F-104 'STARFIGHTER'



"MISSILE WITH A MAN IN IT"

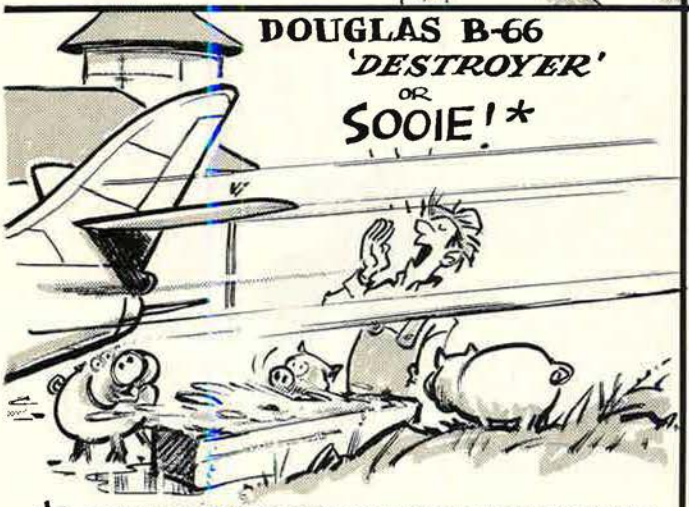
GENERAL DYNAMICS F-111

OFFICIAL NAME: NONE
(THANK HEAVENS!)

"FLYING EDSEL"

★ AS IN McNAMARA

DOUGLAS B-66 'DESTROYER' OR SOOIE!*



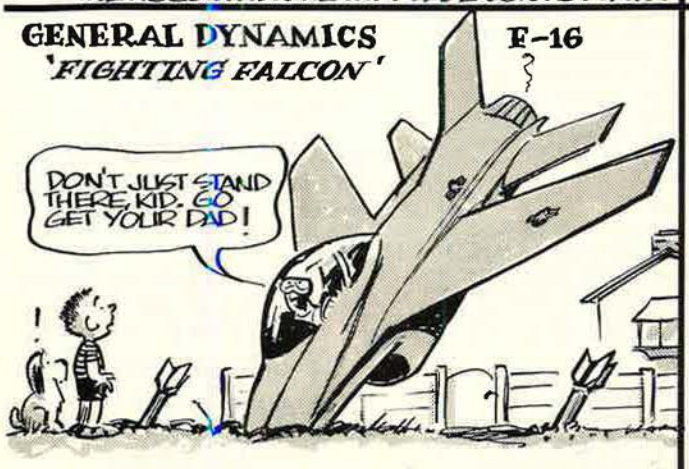
★ FOR ITS PROPENSITY TO ROOT AROUND WITH THE HOGS WHEN HEAVILY LADEN ON HOT DAYS.

CESSNA O-2

OFFICIAL NAME: NONE
NICKNAME:
'DUCK"*

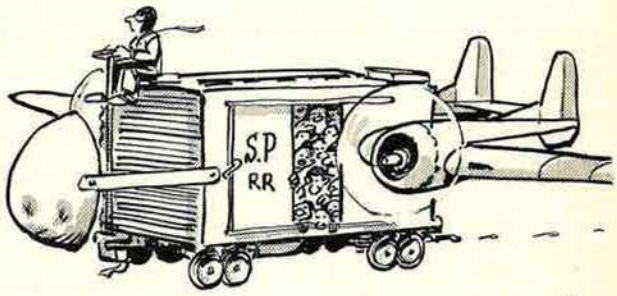
★ FROM THE WAY ITS GEAR RETRACTED...

GENERAL DYNAMICS F-16 'FIGHTING FALCON'



"LAWN DART"

FAIRCHILD C-82 'PACKET' and C-119 'FLYING BOXCAR'



"DOLLAR NINETEEN" OR "CROWD KILLER"*

★ THIS NAME GENERIC FOR *ANY* LARGE MACHINE THAT CAN BE STUFFED WITH PEOPLE

Bob Stevens

THE FUTURE OF AUTOMATIC TEST EQUIPMENT IS ON THE LINE.

Mission readiness, operational flexibility, and lower costs are the challenges of the 90s. Two programs at General Dynamics Electronics Division are already meeting those challenges: the F-16 Improved Avionics Intermediate Shop (IAIS) and the Integrated Maintenance Information System (IMIS).

The F-16 IAIS is being designed to perform diagnostic testing for the latest radars, EW systems and other complex avionics right on the flight line. It can also be easily and economically deployed anywhere in the world to keep our front-line aircraft up and flying.

The new IMIS under development will also help flight line technicians do their jobs more quickly and easily because it integrates electronic technical orders, diagnostics, and supply and management data with on-line maintenance data -- all in one hand-held unit.

These two programs plus our focused R&D efforts assure that the challenges of the 90s in avionics testing and maintenance will be met, all up and down the line.

For further information on our F-16 IAIS and IMIS programs, please contact our Director of Marketing at (619)573-7515.

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TO FLY UP,

DOWN,

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AND

SIDEWAYS, AT MACH 2,

200 KNOTS, AND STANDING

STILL, AROUND THE WORLD

-AND

OUT OF IT.

And we do it with some of the best instructors in the business—experienced pilots, flight engineers and boom operators with years of active military duty behind them—not to mention combat experience and a few air medals. Instead of turning to alternate career paths after retirement, these skilled warriors joined our team. Now, as part of McDonnell Douglas, they're leading new generations to the high levels of skill and knowledge it takes to handle the military's mightiest aircraft. Putting this store of wisdom to work isn't just rewarding for those men and women who teach and invaluable for their students, it's good business for the services, too. Just ask SAC, TAC, MAC and the Navy—they know from experience.

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