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AIR FORCE

PUBLISHED BY THE AIR FORCE ASSOCIATION

MAGAZINE

Aerospace Nation, Aerospace World

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Altitude,

below

400 feet.

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You know,

if I

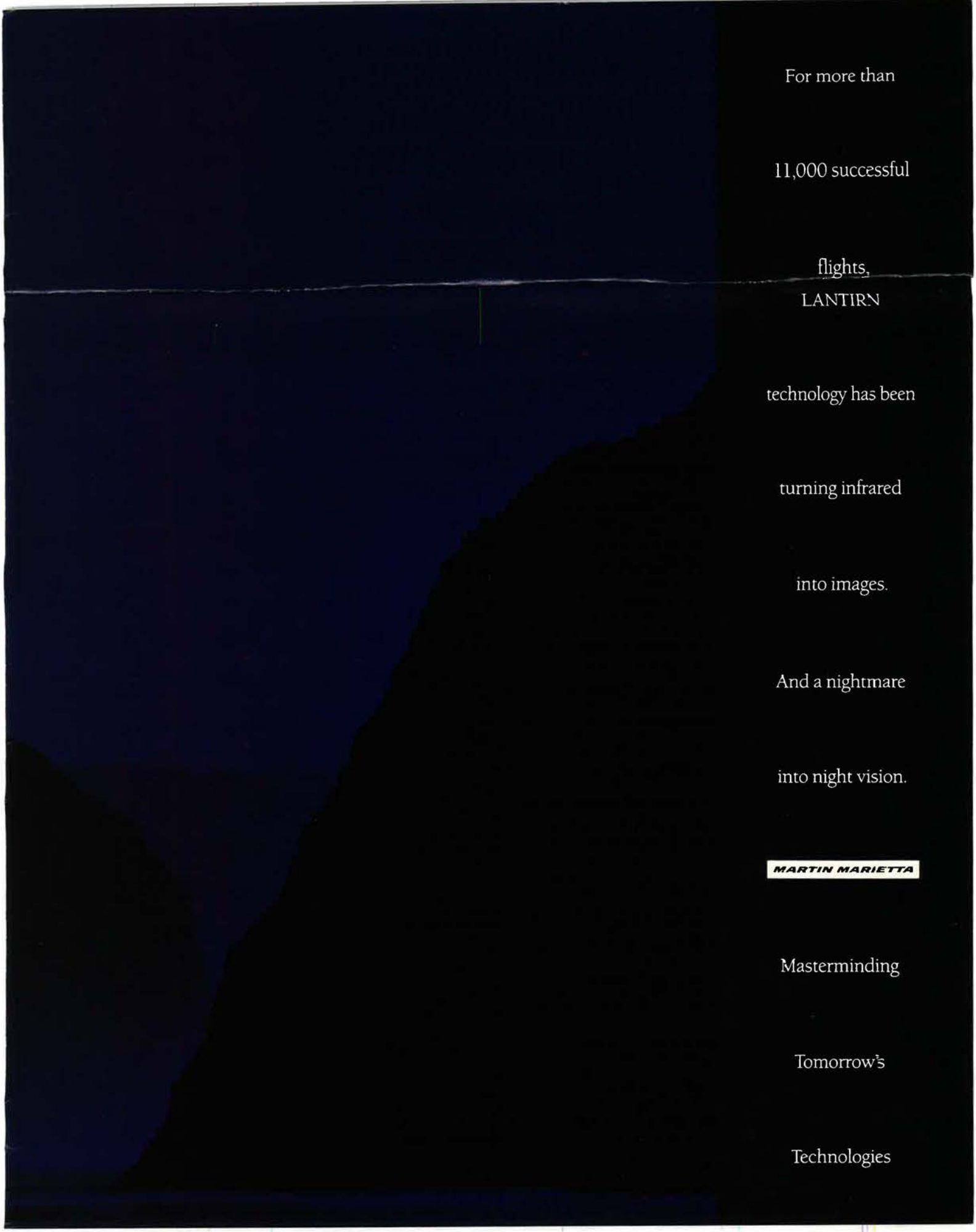
ecouldn't

see, I

might be

a little

nervous."



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GRUMMAN

November 1990, Vol. 73, No. 11

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Departments

About the cover: These French, British, and Soviet aircraft were among those on display at the Farnborough Air Show. For a full report on this industry "status check," see p. 40. Staff photo by Art Director Guy Aceto.

Aerospace Nation, Aerospace World

Convention '90

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Editorial

The 1990–91 Statement of Policy, adopted by delegates to AFA's National Convention on September 17, 1990.

The Year of Decision

NATIONAL defense stands at a turning point. The United States is engaged in a reevaluation, the most comprehensive in forty years, of its security needs and policies.

History will recall 1989 as the year of sweeping change when the Warsaw Pact collapsed and political shock waves spread through the Soviet Union. Enthusiasm grew worldwide for principles and values long espoused by our own nation.

In the main, 1990 has been a year of transition as the nation explored and improvised its initial response to global change. We have heard all manner of plans for lowering our defense posture. Most of these proposals, however, owe more to concern about the budget deficit than to sound strategic evaluation.

Before the invasion and occupation of Kuwait by Iraq, a twenty-five percent reduction to US armed forces was practically assumed, and still deeper cuts were threatened. The Middle East crisis has had a sobering effect on our national exuberance, but it remains to be seen if the reminder is lasting.

We believe 1991 will be the pivotal Year of Decision, in which choices are made that will shape the defense program and national security for the next decade and perhaps beyond. It appears that the primary arena for this debate will be the federal budget for Fiscal Year 1992.

The Air Force Association is concerned that the nation is heading into this Year of Decision without a clear definition of defense requirements, risks, and rational options. We see a definite possibility that the defense program of the future may be based on speculation, optimistic assumptions, arbitrary budget goals, and expectations of a massive peace dividend.

The United States is inevitably a nation with global interests and global responsibilities. Neither our safety nor our interests can be automatically secure. The world of the next decade will be marked by massive and unprecedented change, instability, uncertainty, and the redistribution of power and the demand for power. The old order is changing. The new order is not yet apparent.

AFA warns against a rush to disarm. Once we demobilize our forces and let our defense investment options lapse, recovery in response to unforeseen danger—assuming that such a

recovery is basically feasible—will be an expensive, long-range process. The future may not allow us the luxury of time.

What Defense Must Do. The Air Force Association reaffirms its belief in the strategy of deterrence. Our security is best served when we make war, aggression, or armed intimidation unacceptable risks for potential adversaries.

The first mission of US military power is to deter attack against the American homeland. Our forces must be sufficient not only to defend the United States itself but also, in cooperation with our allies, to protect free world interests in Europe, the Pacific, the Middle East, southwest Asia, Latin America, and other areas. They must defend US interests abroad, including economic lifelines and routes of essential access, and be prepared to project power as demanded by national policy and emerging circumstances.

Credible strategy requires manifest capability to meet a range of threats across the spectrum of conflict. This strategy cannot be calibrated only to the current environment. It must take into account military, economic, and political developments that could affect our security in the years ahead.

In addition to standard strategic and tactical missions, the nation clearly expects the armed forces to be effective in drug interdiction, counterterrorism, and other unconventional roles. It would be a mistake, we believe, to mandate priority for these additional roles at the expense of traditional missions.

The Threat. The paramount threat, Soviet military power, has declined but not disappeared. The Soviet Union in 1990 remains the most militarized nation on Earth. Its strategic nuclear forces continue to increase in numbers, accuracy, and lethality. Soviet conventional forces, even after the expected drawdowns and anticipated arms-control reductions, will be the major military power on the Eurasian landmass.

The Soviet Union is modernizing every component of the strategic force it would retain under the Strategic Arms Reduction Talks. It is developing replacements for its first-line fighter aircraft, which already challenge US fighters in capability. In many areas, including air defense, gains in Soviet force quality are amplifying the direct military threat. These concerns are compounded by the Soviet Union's internal instability and by the uncertainty of its eventual role in the world and its relationship with other nations.

Another dimension of the threat is the proliferation of high technology, nuclear weapons, ballistic missiles, and chemical weapons. We must understand that potential Third World adversaries are no longer a trivial military problem. As recently as last summer, for example, few Americans had

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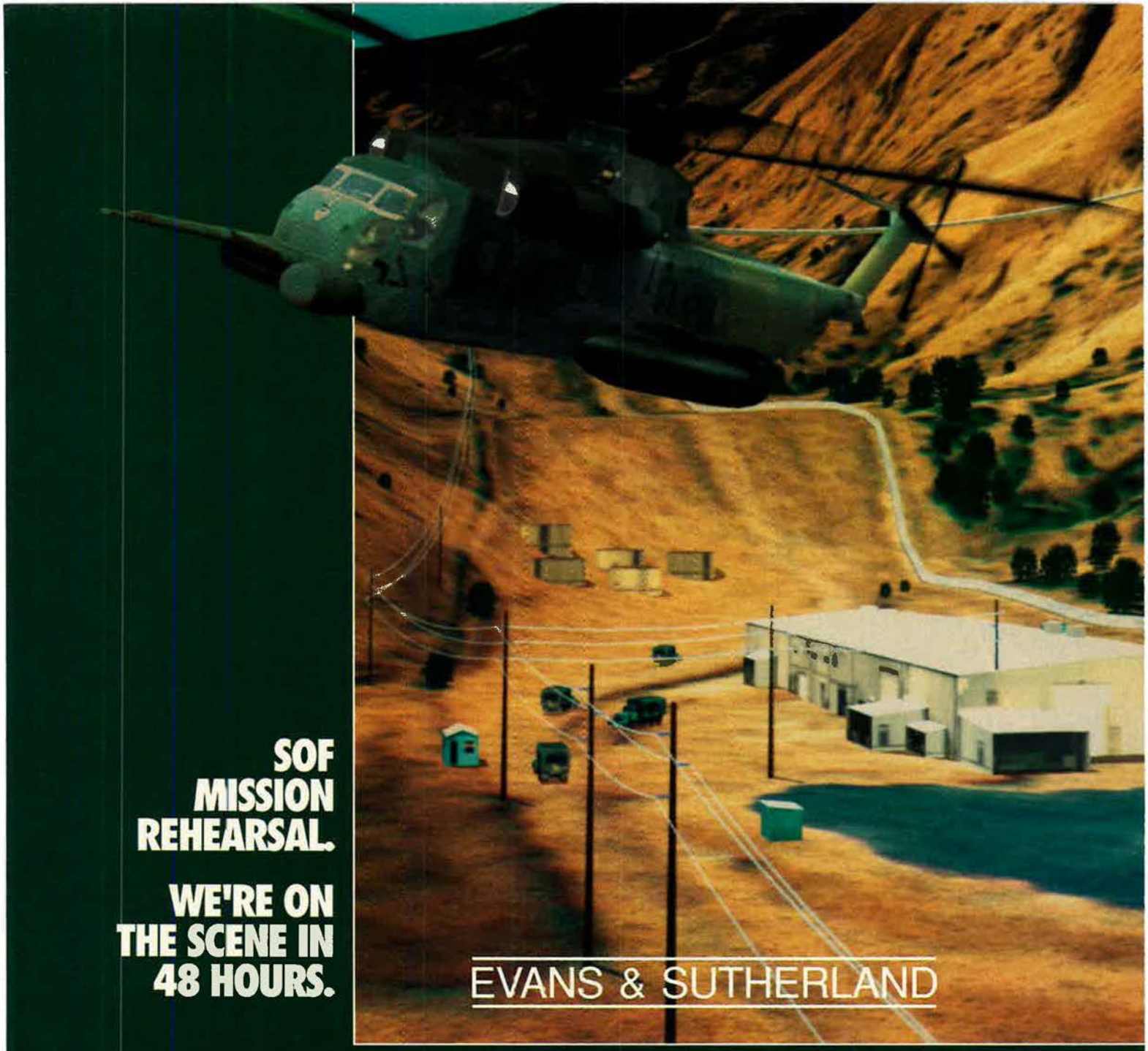

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any serious concern about Iraq, despite the fact that it is strategically situated and that its military establishment is the sixth largest on Earth.

Global instability on a scale not seen before in modern times poses a threat that cannot be defined precisely. Powerful forces of change are at work in Europe and elsewhere. It is impossible to predict their ultimate effect.

Forces and Capabilities. To defend its interests against the array of threats, the United States requires a balanced mix of land, sea, and air forces. The caliber of forces depends on careful management of four variables: force structure, force modernization, readiness, and sustainability. All are important. None can be emphasized absolutely at the neglect of the others.

As numbers decline, quality becomes critical, and the tolerance for marginal effectiveness decreases. If we indulge the delusion that today's systems and capabilities will do for the requirements ahead, US forces will find themselves second best on some future battlefield. Force modernization and technology development must continue.

Most of the present qualities of military force will continue to be important, but we believe certain characteristics will increase in significance.

- *Range.* With overseas deployments and basing less certain and the site of future actions unknown, US forces may be required to project power for greater distances and perhaps from American shores. Even with overseas bases, the need to conduct long-range operations will intensify.
- *Precision.* In wars of the future, it will be necessary to locate and destroy difficult, high-value targets with greater accuracy and weapons efficiency than is possible today. It will become essential to do this from beyond the range of lethal defenses. In lower-intensity conflict, US forces may be called upon to penetrate hostile territory and achieve limited but extremely precise results.
- *Intelligence.* For strategic and tactical warning, arms-control verification, targeting, battle management, general surveillance, and other purposes, US forces of the future will need better information, collected and communicated much more rapidly than is possible today.
- *Mobility.* A reduction in force levels and a diminished US military presence abroad will put more pressure on our ability to deploy forces, along with whatever they require to sustain operations, to the scene of crisis or combat.
- *Endurance.* Forces must be more capable of sustaining operations with less reliance on logistics and maintenance support. Systems must be of high reliability and survivable against sophisticated opposition.

In this context, airpower has certain inherent advantages. It is fast, flexible, long-reaching, and unrestricted by geographic barriers. It can be applied to a diversity of purposes from dropping troops to delivering bombs.

We believe airpower is central to defense requirements of the future. We further believe, however, that sound strategy calls for the coordinated development and employment of all elements of military power. At this juncture, the nation would be poorly served by service rivalry for roles and missions.

Areas of Specific Concern are:

- *Defense Manpower.* Able, experienced, well-trained forces are the single greatest asset a military commander can have in crisis or in battle. A radical drawdown, taken in haste, will surely degrade the ability of the armed forces to perform their missions. On principle—and to preserve morale, motivation, and force quality—the impact on military members and defense employees must be a constant consideration as we reduce and restructure.
- *The Defense Industrial Base.* The decline of the defense industrial base, already a problem of disturbing magnitude, has accelerated dangerously in the past year. US forces depend on a strong industrial base for weapons and technology that keep abreast of the threat. When vital industries disintegrate or disperse to other markets, the capacity will be beyond practical recovery, since rebuilding would take many years.
- *Technology.* Tomorrow's capabilities begin with today's technology base. In periods of retrenchment, when force modernization programs are curtailed, it is critical to continue exploration of promising technologies. This is an investment in a range of options to meet requirements that the future will almost surely bring.

The Question of Resources. An adequate defense is not beyond the nation's means. Defense did not cause the federal deficit, nor has it robbed domestic programs by consuming an excessive share of resources. Over the past twenty years, the relative defense burden and the rising federal deficit have followed generally divergent trends.

The current cost of defense is about five percent of GNP and falling. It is projected that by 1995, defense will account for its lowest share of GNP in fifty years and the smallest percentage of federal outlays since before Pearl Harbor.

Radical reductions, taken without reference to requirements and realities, would be wasteful as well as strategically unwise. Moreover, such reductions will not solve the nation's economic problems, which derive from a different set of circumstances.

Restructuring Responsibly. We believe the United States must continue its role as a force for freedom, stability, and peace in the world. It may now be possible to achieve this—and to protect our national interests and objectives as well—with a reduced military force, provided that Soviet reductions proceed as anticipated and that US reductions are conducted carefully, with understanding, and in a responsible manner.

The Air Force Association pledges increased effort to promote education and public understanding of the issues that will define the coming debate.

In the Year of Decision, it is imperative that we decide wisely, rationally, and in full awareness of our defense requirements. In a dangerous and unpredictable world, we cannot gamble our security on the premises that the future holds no surprises or that freedom needs no defense. ■

This Falcon's calls for extreme

The U.S. Air Force's Increased Performance Engine (IPE) qualifications are tough enough to push any ordinary fighter engine right to the limits.

The F110-GE-129 is passing them with flying colors. In qualifications for the F-16C and flight tests of the first IPE powered F-15E, the F110-GE-129 earned high pilot praise for response and control that extends across the entire flight maps of both aircraft.

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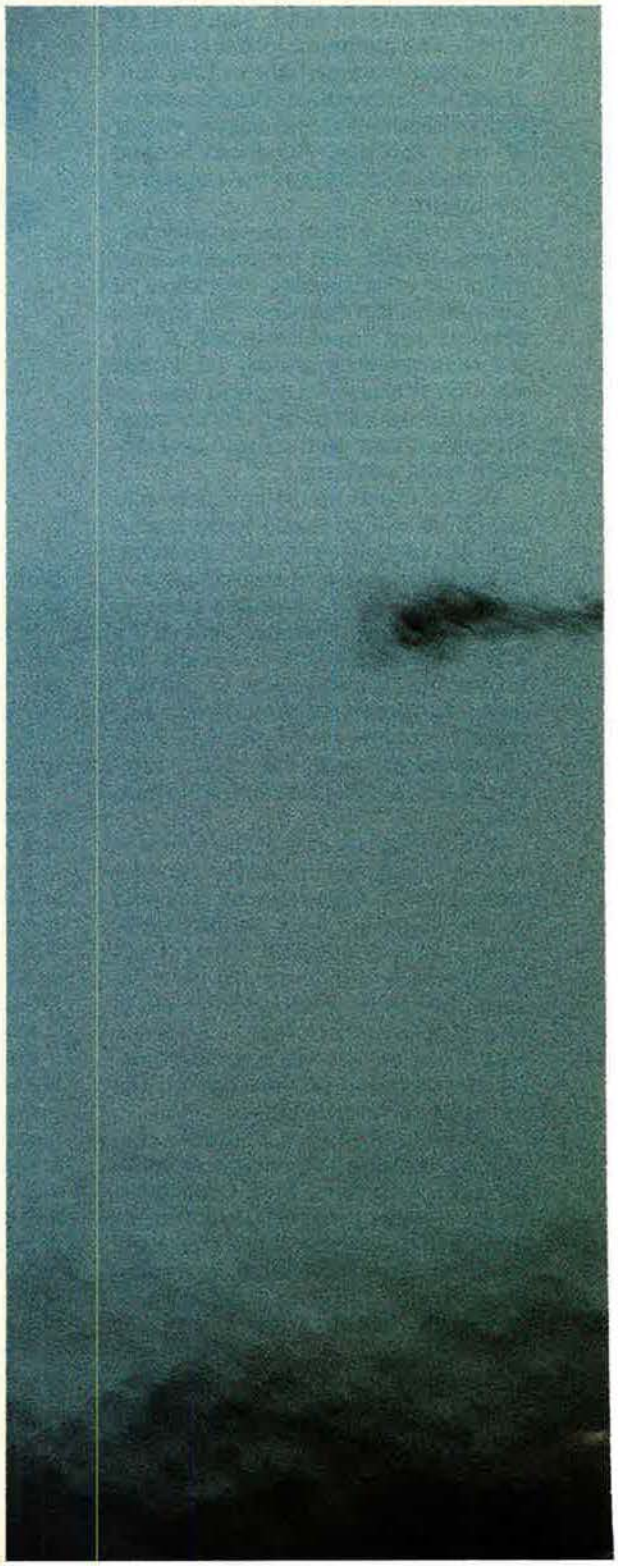

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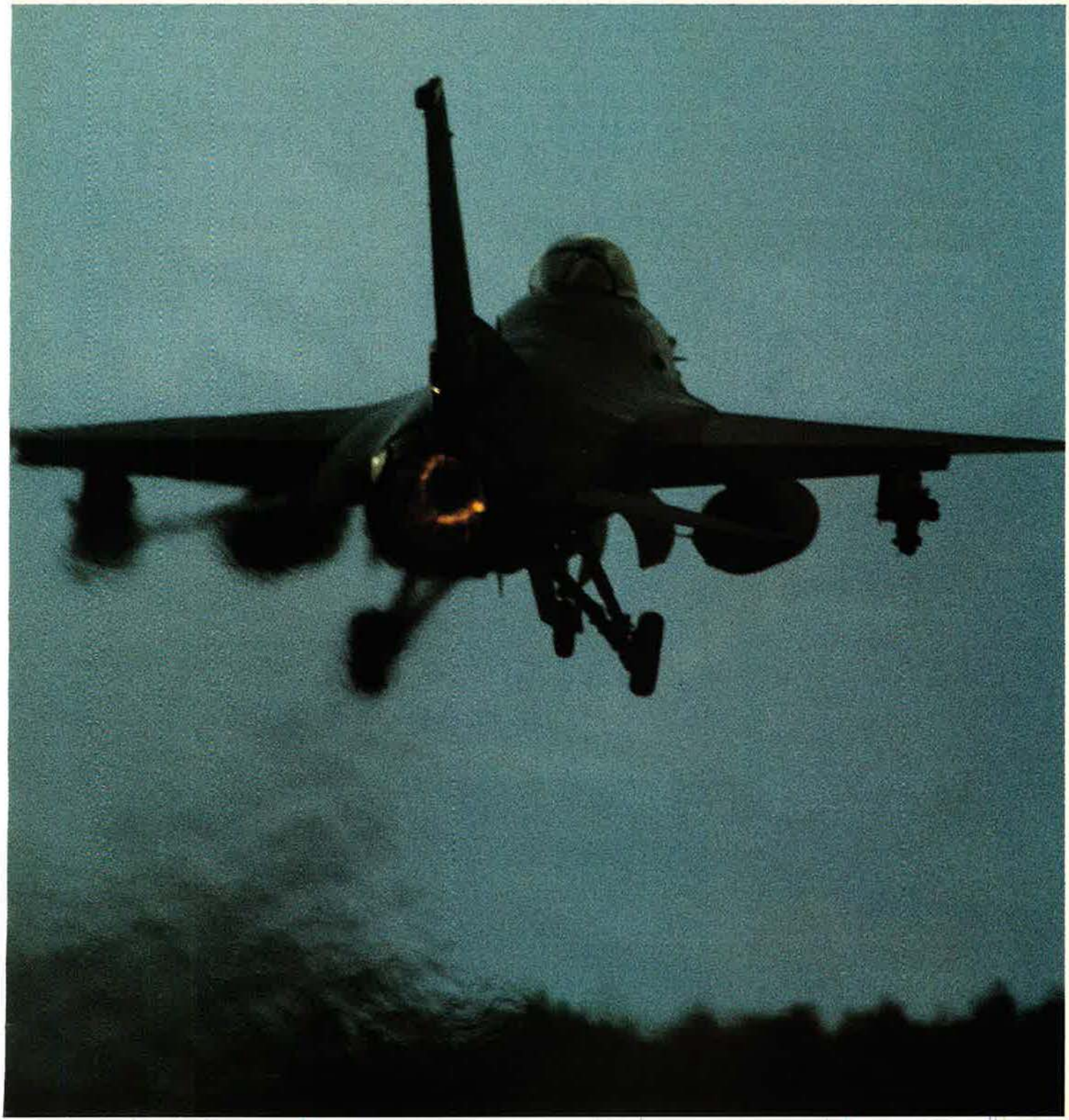

Letters

The Academy's Cost

I can't help but respond to General Milton's "Viewpoint" on the Air Force Academy *[see "The Academy Is an Investment," September 1990 issue, p. 154].* There is no known test that will measure the performance of Air Force officers and conclude that Air Force Academy graduates are superior—in the cockpit, in combat, or in line, staff, or command positions—to ROTC graduates. None.

I've got no grudge against cadets. Its fun to watch their football, hockey, and other teams. But we've got to measure what the Academy provides taxpayers compared to what ROTC training provides.

Select any 100 or 1,000 Air Force officers, without knowledge of their source of commission, and there will be no measurable difference in performance. Some will be a little above and some a little below average. Year in and year out, there will be a few standouts and a few poor performers. There will be no relation between source of commission and quality of performance.

One thing that can be said about Air Force Academy graduates is that they're given more opportunities to excel and that the promotion box is stuffed (giving them better promotion opportunities).

When you compare the cost of an Air Force Academy graduate ($225,000) and that of an ROTC graduate ($58,000), there is no question that taxpayers pay a premium for every Academy graduate. . . .

I flew 250 F-4 combat missions in Vietnam with pilots and backseaters from big schools, small colleges, and the Air Force Academy. There was no noticeable difference in performance.

What does disturb me greatly are those Air Force Academy graduates who got out and are using their education (and flight training) for civilian professions. That really gripes me, and as far as I'm concerned, an Air Force Academy graduate should have a *mandatory* career (with only two exceptions: personal hardship and medical).

The Air Force Academy may be tough, but there's a lot of play and a lot of busywork to keep cadets occupied for four years. A lot of it is never, never used in the Air Force.

In a time when our nation is facing serious financial problems, we can't justify paying nearly a quarter of a million dollars for Academy cadets when comparable results can be achieved for a mere $58,000 through ROTC.

R. Miller
Colorado Springs, Colo.

Life During Wartime

I enjoyed the September 1990 issue more than usual, for two reasons: Bruce Callander's "The Way It Was" *[see p. 46]* and John Frisbee's "The Lessons of North Africa" *[see p. 54].*

The latter was good history and, oddly, in the last few paragraphs presented a good argument for having tacair as part of the Army. FM 100-20 ["Command and Employment of Airpower"] seems to have solved all the problems.

Mr. Callander's piece was a "Sentimental Journey." But the way I heard it was that the reason "Lucky Strike green has gone to war" was because the ink contained copper, a strategic metal.

I wonder about the "dit, da, dit" in the paragraph about how the war had invaded our language. It's Morse code for my initial, which is kind of flattering, but I think "dit, dit, dit, da" was more widely known. It is "V" as in "victory."

Raoul G. Rehrer
Miami, Fla.

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

As a longtime AFA member, I am moved to compliment an increasing trend in your magazine's articles on our military aviation heritage and, in particular, "The Way It Was."

With the fiftieth anniversary of World War II events, a great deal of deserving attention is being focused on attributes of a heritage that we at the Experimental Aircraft Association hope will never be forgotten. I am pleased to think our organizations share more than a bit of common purpose in this regard, and I invite you or any of your associates to know more about us. . . .

Much of Mr. Callander's well-written article is embodied in exhibits [at the EAA Aviation Center], ranging from a Quonset hut "ready room" mission briefing; to unit displays, such as the "Aerial Task Force" exhibit sponsored by the Eighth Air Force Foundation; to re-created home-front experiences, such as a "window" into the final assembly bays of the Willow Run plant, where a B-24 rolled out every fifty-five minutes.

Compliments to Mr. Callander and C. V. Glines *[see "Their Finest Hour," September 1990 issue, p. 110]* for their fine articles, and keep up the great work.

Gregory J. Anderson
Oshkosh, Wis.

Condemned to Repeat

After spending twelve years as an instructor pilot (IP) in the F-111, I was amazed to learn the crew of the B-2 would consist of two pilots *[see "How to Crew a B-2," by Jeffrey G. Canclini, "Letters," July 1990, p. 9].* This ridiculous decision reminded me of the early days in the late 1960s and early 1970s when similar crewing was in effect for the "Aardvark." The rationale, as far as we could figure out, was that, since the aircraft was so incredibly expensive ($15 million), using one pilot was simply too risky.

Initially, I could understand this caution, as the aircraft was never completely flight-tested. However, one day a crew consisting of a former F-105 IP in the right seat and a former F-100 IP in the left seat took off to

"chase" a functional test flight. Both pilots had in excess of 1,000 hours in their respective aircraft prior to checking out in the F-111, so it was not as though they had been once or twice around the traffic pattern in the "Thud" or the "Hun." In the course of that afternoon's events, they lost control of the aircraft and ejected. How much good resulted from having two pilots?

As the F-111 operational squadrons began to take shape, it became evident that crewing the aircraft with two pilots was a poor choice, and the practice was discarded. Pilots could once again do what they were trained to do—fly the aircraft—and WSOs or right-seaters could assume their duties of managing the aircraft systems to employ the entire weapon system safely and efficiently. Both types of crew members benefited from the change, because they weren't required to do jobs for which they were improperly trained.

In the F-111, not only was the pilot WSO in the strange and unfamiliar areas of radarscope interpretation and electronic warfare, but he was also required by regulation to exhibit flying proficiency in his assigned aircraft. This was a job that was difficult for an experienced fighter pilot, let alone a man fresh from pilot training, because it required him to look "cross cockpit," or into the instruments designed for the left-seater, in order to see how the machine was responding to his control inputs. . . . If you failed in this, then you had to face the dreaded flying elimination board. . . .

The Air Force puzzles over pilot retention problems and even jacks the commitment up to ten years, yet continues to do things like this. Why?

Here we go again in the B-2. Am I incorrect in thinking that the rationale is, once again, "This aircraft is so expensive that we cannot risk having only one pilot fly it"? I will bet a hefty chunk of change right now that it will once again be learned that specialization of crew duties will always be the way to go.

Robert Oberg
Arlington, Tex.

Twisted Logic

Twisted logic continues to proliferate in the media, including the military media. The recent AIR FORCE Magazine article "Women in Combat" *[by Brian Green, June 1990 issue, p. 76]* demonstrates this American style of disinformation. A quote from feminist legislator Rep. Patricia A. Schroeder (D-Colo.), "Army policy allows women to be *shot* first, but they can't be the first *to shoot*," is twisted into a blurb at the top of the article that is completely different—"The question isn't if they'll be shot at—it's whether they can shoot back." Of course they can shoot back! Not only the now-famous female Army Captain Bray had a weapon when she helped liberate a dog kennel, but even Air Force nurses were wearing pistols during the recent Panama operation. . . .

Feminism is becoming pervasive in our society. Liberals tend to put feminist "rights" ahead of common sense, and unfortunately the military has fallen into this trap. . . . Feminists are continually trying to push to put women closer to the battle, in combat roles as combatants.

Let's turn the tables slightly and point out an entire group of noncombatants who have also been denied a shot at the top military jobs. Never has a doctor or nurse been a wing or division commander, much less a member of the Joint Chiefs of Staff. Why haven't the liberals or the American Medical Association stood up before Congress and cried for "combat roles" for doctors and nurses so that their careers could be advanced? That doesn't mean doctors and nurses haven't been killed in combat or that doctors and nurses haven't protected their patients using the deadly force of firearms issued to them. Doctors and nurses are "discriminated against" because they serve the best interest of the military and the United

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Associate Publisher
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Arlington, Va. 22209-1198
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States as noncombatants. They are not killers but healers—even of the enemy who are brought to our battalion aid stations. They are also "discriminated against" in that doctors and nurses can be drafted at a much higher age (fifty-five) than the general population. Again, the best interests of the United States are being served when our troops need medical care. . . . The question is not whether a doctor or a woman can fight, but should they fight. The answer is No! . . .

Women enter basic training and the military academies much the same as men, thanks to PL 94-106, a tribute to feminist politicking. What happened was a lowering of physical standards due to the females' being unable to "cut it." I know. I was there when women first entered the Air Force Academy. As a surgeon stationed at the Air Force Academy from 1977 to 1979, I saw many more women than men (statistically speaking) with training-related injuries. The training and the standards were "adjusted," thanks to the efforts of the Defense Advisory Committee on Women in the Service (DACOWITS).

Gradually, initial opposition to women in combat was beaten down by DACOWITS as the active-duty men in the field and the fleet were prohibited from joining the debate. The standards had to be adjusted because hard scientific evidence demonstrated that "female subjects showed no improvement in fitness, weight, percent body fat, or scores in an Army fitness performance test." This work, done in 1978, is quoted in the journal *Aviation, Space and Environmental Medicine* in June 1990. The data is there, just not reported very loudly.

Both the Soviet Union and Israel have had women in combat roles, and the results have been disastrous. Israel pulled its women off the front lines in 1948 when both sides suffered higher casualties. Arabs fought harder when threatened with the humiliation of defeat by women. While USAF employs more than thirteen percent women, the USSR only has a fraction of that number in military service, and they occupy medical and clerical roles. . . .

Afraid of lawsuits from the Equal Employment Opportunity Commission and cowering before DACOWITS, high-level brass are afraid to tell the truth about risks to women in combat and their inability to perform satisfactorily.

The last sentence of the article reads, "However greatly USAF women's opportunities have expanded, they are still barred from the all-important combat specialties." My question is—to *whom* are they important, and why?

Lt. Col. (Dr.) Robert W. Feldtman, AFRES
Houston, Tex.

Where's the Wreath?

I was looking through your August 1990 issue and found the articles interesting and stimulating. Especially good were "The Army and Navy in Space" *[by Richard H. Buenneke, Jr., p. 36]* and "Three Tracks for Simulation" *[by Peter Grier, p. 40]*.

You did, however, have an error in the caption to the photo on p. 23 [of "Aerospace World," by Jeffrey P. Rhodes]. The soldiers surrounding John Eisenhower and Mr. Strobel are not wearing the Combat Infantryman's Badge. They are wearing the Expert Infantryman's Badge (a silver musket on a rectangular blue field). The Combat Infantryman's Badge is the Expert Infantryman's Badge with a wreath around it; the badges the soldiers are wearing do not have the wreath.

Maj. Ronald A. McCreery, USA (Ret.)
Sierra Vista, Ariz.

• *Major McCreery is correct concerning the soldiers' not wearing the Combat Infantryman's (we also left off the suffix "man" in the caption) Badge. However, the original photo shows a number of soldiers wearing an award with the wreath surrounding the badge, and that original was the basis for the caption. As the photo went through the production cycle, those soldiers with the CIB were cropped out, rendering the caption incorrect.*
—THE EDITORS

Ship Slip-Up

I am writing with regard to an item on p. 35 of September's "Aerospace World." The actual designation for *Sea Cliff* is *Sea Cliff* (DSV-4), not "USS *Sea Cliff* (DSB-4)" as you designated it. The vehicle isn't long enough to qualify as a United States Ship. Thank you for your cooperation in this small correction to an otherwise excellent magazine.

Scott C. Bueber
Imperial Beach, Calif.

Rivet Out of Joint

I thoroughly enjoyed "Top Crews" *[by Amy D. Griswold, September 1990 issue, p. 74]*, but I would like to point out that aircraft 14844, pictured on p. 80, is not an RC-135X. It is in fact an

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RC-135V Rivet Joint. In all fairness to the outstanding work of crew S-02/R-18, if they managed to get two missions' worth of high-quality Cobra Eye data out of it, they deserve an award of much higher value than the O'Malley Award.

Mistakes are an occupational hazard in your business, but you have a great success rate for accuracy.

TSgt. Robert N. Simmons, USAF
Papillion, Neb.

• *Sergeant Simmons is correct. The RC-135V was misidentified and had nothing to do with the winners of the O'Malley Award. Aircraft 14844 is assigned to Offutt AFB, Neb., as part of the 55th Strategic Reconnaissance Wing. The photograph was mistakenly delivered in the package of data about Crew S-02/R-18. We regret the error.*—THE EDITORS

Appalling Revenge

In your August 1990 issue "Letters" department, you printed a letter from Lieutenant Colonel Dikkers, "The Simulator's Uses" *[see p. 8]*. I wish he or you had stopped after the first paragraph. I am appalled.

First, I cannot imagine a commander in a combat zone requiring a uniform other than the combat or work uniform. Fortunately, during my year at Da Nang (1968–69), I did not encounter such a ridiculous dress code.

On the other hand, the action described in paragraph three as "revenge" was excessive, irresponsible, and borders on, if it is not in fact, criminal. Why would anyone want to deprive the entire base of rest to protest ill-considered policies? Were the forward air controllers who perpetrated this prank aware that some of the people deprived of sleep would probably be repairing their aircraft and other aircraft the next day, not to mention other critical activities?

While some pranks can be condoned and may even be "amusing," this clearly was not. . . .

Maj. C. Blizzard, Jr., USAF (Ret.)
Makakilo, Hawaii

Flight-Line Parlance

There's history, and then there's *history*. Jeffrey P. Rhodes's article, "What They *Really* Called Them," in the September 1990 issue *[see p. 68]* is a giant leap forward for those of us interested in more than just the shapes and systems of our aircraft.

Mr. Rhodes has touched poignantly on what we might call the social history of the flight line, where over the years hundreds of thousands of men and women have worked long and hard to keep our aircraft flying. It's most entertaining and a real privilege to share some of their feelings about the machines they work on.

Mark Newton
Fall River, Mass.

You left out the Douglas A-20 attack bomber ("Havoc" [official] and "Flying Pike"). . . .

Gerald N. Bingen, Jr.
Racine, Wis.

. . . Beech C-45 ("Secret Weapon") and Douglas A-1 ("MiG-Killer" and "Super Spad"). . . .

Emerson C. Price
Absecon, N. J.

. . . B-66 Douglas Destroyer ("Sooie," because it was a real hog on takeoffs). . . .

Lt. Col. Tom Philpott, USAF (Ret.)
Georgetown, Tex.

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You can now enjoy the beauty and mystery of the famous Lockheed YF-12 that became the SR-71 Blackbird. Experience the "Blackbird" in its role as spymaster of the skies. Also included in this video tribute are the C-141 Starlifter, The C-5A Galaxy, and the power of the C-5B.
#2909 Approx. 70 minutes $39.98

★ SALUTE TO AIRPOWER

This one-of-a-kind video takes you behind the scenes of the spectacular "Airshow" in Texas. Survivors of Pearl Harbor, ground crew members, and the largest collection of WWII planes anywhere highlight this film.
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WWII

★ THE HISTORY OF THE LUFTWAFFE

The Luftwaffe was to become the handmaiden of Hitler's dream of conquest. Controlling the skies was his obsession and the rise and fall of the Luftwaffe mirrors the fate of Germany during the war.
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★ NAZI WAR CRIMES

This film produced by the Soviet Union is about one of the horrific episodes of WWII, Babi Yar. Hitler's SS rounded up over 10,000 people and created a huge mass grave after executing every man, woman, and child. Warning: This film utilizes graphic footage captured from the Nazis during WWII. Extreme caution should be exercised when viewing.
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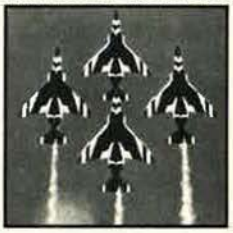

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By **Brian Green,** Congressional Editor

Sticking by Their Cuts

The House held firm on whopping reductions to the basic defense program. The "cut and freeze" approach still looks feasible to many, despite the Gulf crisis.

On September 30, Administration and congressional negotiators agreed on a spending and revenue package that, over the next three years, would further cut the defense budget. It called for reducing budget authority (the amount the Pentagon and other defense agencies can obligate) by an additional $66.4 billion compared to Secretary of Defense Dick Cheney's January 1990 budget plan. Outlays (the amount spent in a given fiscal year) would be cut by $42.4 billion. This would amount to a "no-inflation" freeze, holding budget authority and outlays at $290–$295 billion per year through Fiscal 1993. Discretionary domestic spending would continue to rise at the pace of inflation during this period. By FY 1993 the Pentagon could be spending eleven percent less and obligating fourteen percent less than it does today.

The package provided $297 billion for defense outlays in FY 1991, roughly the level in the Senate authorization bill. About $6 billion for the unexpected Desert Shield operation would also be provided. Desert Shield spending in future years would also be in addition to the defense levels in the agreement.

The total package was intended to reduce the deficit by $500 billion over five years compared to levels projected using FY 1990 spending and revenue laws and adjusted for inflation. Against that baseline, defense could fall as much as $180 billion, although an Administration spokesman indicated that the agreement "allows for a fair competition for resources" in FY 1994 and 1995 within an overall cap on discretionary spending.

In the midst of the Persian Gulf buildup, the largest since Vietnam, and facing the possibility of war in the Middle East, the House of Representatives approved an authorization bill that would have reduced the defense budget by nearly nine percent compared to last year, cut 130,000 active-duty service members, and cut deeply into next-generation weapon systems. It was a bill that Secretary Cheney said he would urge the President to veto unless there were significant revision in conference with the Senate.

The House based its bill on the premises that the cold war was over, that the Soviet strategic threat was diminished, and that the Soviet conventional threat had been "irreversibly" reduced. Consequently, said House Armed Services Committee (HASC) Chairman Rep. Les Aspin (D-Wis.), we should:

- "Protect the readiness and morale of our military people instead of preserving a larger force structure as the Administration planned;
- "Emphasize near-term weapons improvements and future-oriented research and development instead of the lockstep movement to the next generation of weapons platforms proposed by the Administration;
- "Favor deployable forces in place of the Administration's emphasis on strategic nuclear weapons modernization."

These priorities took the form of very deep cuts in personnel and in a number of next-generation weapon systems. In addition to reducing the number of active-duty military personnel, the House bill called for cuts in virtually every significant strategic modernization program. It would have terminated the B-2 Stealth bomber, cut the Strategic Defense Initiative request in half, and dramatically reduced and restructured the ICBM modernization program. In the budget for tactical forces, funding was added to preserve the option of procuring additional F-15E fighter-bombers while delaying full-scale development of the Advanced Tactical Fighter. The AMRAAM (advanced medium-range air-to-air missile) request was zeroed.

The Air Force was hit especially hard in the House bill. The Air Force aircraft procurement account was reduced in the House bill from $14.2 billion to $7.2 billion and the missile procurement account from $9.0 billion requested to $5.6 billion.

Some Democrats maintained that the Iraqi invasion of Kuwait constituted the first serious test of the new House defense priorities, a test they believe the bill passed. HASC member Norman Sisisky, a Virginia Democrat, argued that recent events in the Persian Gulf "put our military in the position of being able to command the air and the sea, thereby giving aid, assistance, and advantage to our ground forces." The need for the B-2 or ballistic missile defense systems in an era dominated by Third World threats was generally derided by defenders of the bill.

The principal concession to the Middle East reality came in the form of a $948 million amendment for military pay, chemical and biological defense equipment, sealift, and C-141 airlifter modifications. These programs were funded by a $600 million cut to SDI, passed by the full House, and a cut of one Navy destroyer.

Some House Republicans expressed a different view of the rationale for the bill. Said HASC member Jim Courter (R–N. J.), "Through a magic formula of misguided priorities, pet programs, and pork-barrel projects, this bill emerged. Some have suggested that the product of this process might charitably be called a strategy. This is not strategy."

Ranking HASC Republican Bill Dickinson of Alabama cited a litany of programs whose inclusion in the budget he attributed to parochial congressional interests. He pointed out that while the House was cutting $24 billion from the DoD request, it added $5.6 billion in unrequested programs "for which there are no longer valid requirements or the force structure to absorb them."

He contended that House actions would block any domestic base closures "for years" at the very time it was cutting personnel levels deeply. ■

An Advanced Development Electronic Warfare System will help Military Airlift Aircraft survive in territory that may have been penetrated by enemy fighters or Surface-to-Air-Missiles (SAMs). The demonstration system is being developed by the team of Hughes Aircraft Company and Tracor for the Air Force Wright Research and Development Center. It includes a Warning, Awareness and Avoidance Subsystem consisting of RF receivers, approaching missile detectors, processors and displays, all integrated by Hughes, with the Chaff and Flare Dispensers and Active Countermeasures made by Tracor.

A laser system acquired, tracked, and destroyed a supersonic target in a test for the Strategic Defense Initiative Organization and the U.S. Navy. The laser system used a Hughes-built collection of mirrors, sensors, and alignment and stabilization equipment, called a Sea Lite Beam Director. Sea Lite is designed to acquire and track a supersonic Vandal missile, focus an external, high-energy laser beam at a point on the moving target, and hold the beam at the same position long enough to disable the missile. The test was the conclusion of a two-year effort to validate the use of a high energy laser system against targets in flight.

A rocket engine less than an inch long and weighing only 3.5 grams (about a tenth of an ounce) will control a space intercept vehicle. The engine was designed for the Lightweight Exo-Atmospheric Projectile (LEAP), a state-of-the-art intercept device under development by Hughes for the U.S. Army. The miniature LEAP rocket produces one pound of thrust by expelling hot gas, produced in a gas generator, in small pulses less than a millisecond in duration. The projectile also includes a long-range imaging infrared seeker and a 4.2 million-instructions-per-second computer that weighs less than an ounce. The LEAP vehicle, which has no warhead, is the smallest and lightest-weight intercept technology being developed for defensive applications.

More than 20 nations protect their sovereign airspace with command, control and communications systems produced by Hughes, the world's most experienced developer of automated air defense systems. The systems are comprised of air defense radars, computers, displays, communications and other electronic subsystems. Target information is transmitted through data links to data processing centers, where computers automatically track and report the aircraft's speed, altitude, and course. The systems are tailored to the requirements of each country based on geography, military equipment, and size and structure of military forces. Nations equipped with Hughes systems include Japan, Switzerland, the U.S., Spain, Canada, Malaysia and European NATO members Belgium, Denmark, Greece, Italy, the Netherlands, Norway, Turkey, the United Kingdom, and West Germany.

A new packaging technology offers the highest circuit interconnect density per unit volume in applications ranging from digital to microwave. Developed by Hughes, the technology, called low-temperature cofired ceramic packaging, places buried interconnects, such as low frequency signal traces and RF stripline, in laminated ceramic material. Buried passive elements, such as resistors and capacitors, can also be incorporated into this monolithic package structure. High packaging density is also achieved by placing devices into cavities and interconnecting within the cavity walls. This new technology offers significant weight and size reductions in several applications, especially active radar antennas.

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Aerospace World

By Jeffrey P. Rhodes, Aeronautics Editor

★ With just over four months to complete its flight-test program, the Northrop/McDonnell Douglas YF-23A Advanced Tactical Fighter prototype achieved important milestones on four of its five flights in late August and early September.

The most important milestone was, of course, the August 27 first flight. Northrop test pilot Paul Metz used about 3,800 feet of runway at the Air Force Flight Test Center at Edwards AFB, Calif., and became airborne at 7:15 a.m. He took the aircraft to 25,000 feet to perform functional system checks. The airplane reached a top speed of Mach 0.7. The landing gear was raised after several minutes, but the left main gear didn't latch properly. The flight lasted fifty minutes.

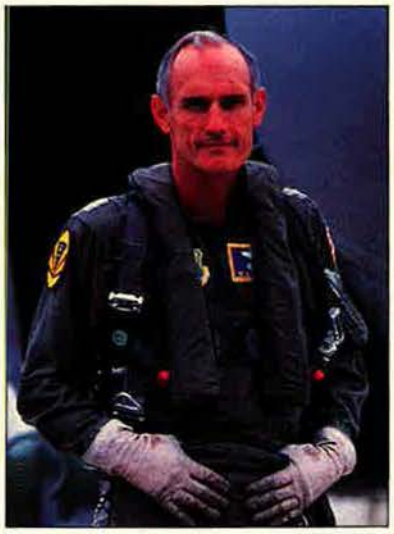
The airplane appears to have excess thrust, as Mr. Metz kept the YF-23 in military power during climbout with the landing gear extended and still pulled away from the F-16 chase plane, which was in afterburner. This YF-23 is powered by two Pratt & Whitney YF119-PW-100 turbofan engines that have approximately 35,000 pounds of thrust each.

The August 30 flight ended after forty-five minutes when warning lights indicated problems with a boost pump and a wing flap. The third flight, conducted September 6, was the first flawless sortie. The aircraft reached 35,000 feet and a speed of Mach .95 during the hour-long flight. Mr. Metz performed the type's first air refueling (from a KC-135) early in a three-hour, six-minute flight on September 14.

In the fifth flight, McDonnell Douglas pilot Bill Lowe flew the airplane at supersonic speeds in level flight without the use of afterburners. Top speed or duration of the period in "supercruise" was not released.

★ Now that US forces are in Saudi Arabia in large numbers as part of Operation Desert Shield, with Iraqi aggression in check for the time being, the morale of US troops is a prime concern. Several companies and agencies recently announced plans

McPeak Named to Replace Dugan



Gen. Merrill A. McPeak, commander in chief of Pacific Air Forces since 1988, has been named to succeed Gen. Michael J. Dugan as Chief of Staff of the US Air Force. General Dugan was relieved from duty September 17 by Secretary of Defense Dick Cheney, who cited "lack of judgment" in statements made by Dugan and reported by newspapers the previous day.

General McPeak's career has been predominantly in tactical forces. A graduate of San Diego State College, commissioned through AFROTC, he spent his early years as a pilot, instructor, and weapons officer in tactical fighter squadrons in the US and Europe. He flew with the Air Force's aerial demonstration team, the Thunderbirds, and logged 269 fighter combat missions in Vietnam.

Among other assignments, he has been commander of the 20th Tactical Fighter Wing, Tactical Air Command deputy chief of staff for plans, USAF deputy chief of staff for programs and resources, and commander of Twelfth Air Force and US Southern Command Air Forces.

Before the surprise events of September 17, General McPeak had been scheduled to become commander of Tactical Air Command.

The "specific sequence" of what happened, Mr. Cheney said, began when he read a front-page story in the September 16 Washington *Post*, filed by one of the reporters who had accompanied General Dugan on a trip to Saudi Arabia.

General Dugan's remarks emphasized the role of airpower if fighting started, and he talked candidly about the matchup of US and Iraqi forces. According to the article, he also said that "Israeli sources" had advised the US to target Iraqi strongman Saddam Hussein, his family, and his mistress.

Mr. Cheney said nothing of this matter in an address to the Air Force Association National Convention the morning of September 17, but went from there to the Old Executive Office Building next door to the White House, where he announced to reporters that General Dugan had been relieved.

"The statements attributed to General Dugan in two newspapers this weekend, and as confirmed by him to me, did not in my mind reveal an adequate understanding of the situation and what is expected of him as Chief of Staff of the Air Force and as a member of the Joint Chiefs," said the Secretary of Defense. Later in the day, Mr. Cheney held another press conference in the Pentagon.

Mr. Cheney's conclusion that he had "no choice" but to fire Dugan was widely endorsed by government officials and commentators in the media.

Many in the defense community, however, felt that Mr. Cheney had less extreme options that would have been sufficient under the circumstances and that, once the decision had been made to relieve General Dugan, Mr. Cheney went to excessive lengths in heaping public criticism on the General.

Some observers described Mr. Cheney's castigation of General Dugan for "demeaning the contributions of the other services" as being particularly gratuitous. As they saw it, the Navy has been permitted considerable latitude in claims made on behalf of a "maritime strategy," and nothing General Dugan said appeared to be a radical departure from that standard.

When Secretary of the Air Force Donald B. Rice mentioned General Dugan's name in a speech at the AFA Convention September 18, the audience responded with a standing ovation.

—John T. Correll

to provide goods or services to aid in the battle against boredom.

Anheuser-Busch announced on September 10 that it was sending 22,000 cases of its O'Doul's Non-Alcoholic Brew (approximately one six-pack per service member in the area) to the Persian Gulf region. This donation continues a tradition Anheuser-Busch started in World War I when a nonalcoholic drink called Bevo was shipped to the troops in France.

AT&T announced on September 13 that it is offering family and friends of military personnel serving in the Middle East free use of the company's network to transmit drawings and letters via facsimile machine. Messages are accepted at the company's 400 phone centers and sent in batches to receiving machines in the Middle East. The military postal service will then deliver the messages during regular mail call.

The USO has initiated a number of morale-building efforts. The Morning Show Network consists of almost 100 participating radio stations contributing to a tape library that allows the troops to listen to news from home mixed with caller messages. A number of stage shows are being planned, and major studios have been contacted about showing first-run movies to the troops. The USO has established centers in the Persian Gulf area and is offering spouse support groups in the US.

In other news, Operation Desert Shield is the first action in which frozen blood units are being shipped overseas to form a ready reserve supply. The blood units must be kept frozen at minus eighty degrees Centi-

November Anniversaries

- *November 14, 1910:* Flying a Curtiss pusher, Eugene Ely makes the first airplane flight from a ship. Taking off from a temporary wooden platform built on the cruiser USS *Birmingham*, the plane drops and touches the water at Hampton Roads, Va., before Mr. Ely regains control. He then lands at the Norfolk, Va., Naval Station.
- *November 6, 1930:* The Congressional Medal of Honor is presented to Edward V. Rickenbacker for service in World War I. A pilot with the 94th Aero Squadron, "Captain Eddie" was the leading US ace of the war with 24.33 victories.
- *November 15, 1940:* The Navy begins air operations from Bermuda, a result of a pact agreed to earlier by the US and Britain. Under the pact, the US received eight British air and naval bases in the Atlantic and Caribbean in exchange for fifty destroyers desperately needed by the Royal Navy to fight German U-boats in the North Atlantic.
- *November 25, 1940:* The National Advisory Committee on Aeronautics announces it will build an $8.4 million engine research laboratory at the Cleveland (Ohio) Municipal Airport. It is now called the Lewis Research Center.
- *November 6, 1945:* The first landing of a jet-powered aircraft on a carrier is made by Ens. Jake C. West in the Ryan FR-1 Fireball, a fighter propelled by both a turbojet and a reciprocating engine. The landing on USS *Wake Island* (CVE-65) was inadvertent; the plane's piston engine failed, and Ensign West came in powered only by the turbojet.
- *November 8, 1950:* The world's first jet-vs.-jet air combat engagement takes place as Air Force Lt. Russell Brown, flying a Lockheed F-80C Shooting Star, guns down a MiG-15 near the Yalu River in North Korea.
- *November 11, 1955:* Crewed by company test pilot B. A. Erickson, John McEachern (test observer), and Charles Harrison (flight engineer), the first Convair B-58 (serial number 55-0660) is flown for the first time from the company's facility in Fort Worth, Tex. The flight lasts thirty-eight minutes.
- *November 26, 1955:* Secretary of Defense Charles Wilson assigns responsibility for development and operations of land-based intercontinental ballistic missiles to the Air Force.
- *November 15, 1960:* The North American X-15 research aircraft is flown with the Reaction Motors XLR-99 "Big Engine" for the first time at Edwards AFB, Calif. Company pilot Scott Crossfield reaches a speed of Mach 2.51 and an altitude of 81,200 feet at a power setting of fifty percent.
- *November 21, 1970:* A group of Army and Air Force volunteers makes a daring raid into North Vietnam to free US prisoners held at the Son Tay Prison Camp near Hanoi. Nearly perfect in its execution, the raid fails to achieve its objective because the prisoners had been moved several days beforehand.
- *November 29, 1975:* The first Red Flag exercise begins at Nellis AFB, Nev., ushering in a new era of highly realistic air-combat training for Air Force pilots.
- *November 26, 1985:* The space shuttle orbiter *Atlantis* lifts off from the Kennedy Space Center in Florida for its second trip into space. The crew of seven, headed by Air Force Lt. Col. Brewster Shaw, deploys three satellites and rehearses space station construction techniques. The mission ends December 3.

Company test pilot Dave Ferguson made the first flight of the Lockheed/Boeing/General Dynamics YF-22A advanced tactical fighter prototype on September 29. Mr. Ferguson flew the aircraft from Lockheed's plant in Palmdale, Calif., to the Air Force Flight Test Center at Edwards AFB, Calif.

The first McDonnell Douglas C-17A airlifter came out of the production hangar at Long Beach, Calif., for the first time on September 16. The aircraft (here with an air data probe attached to its nose) will be pressure-tested at 11.04 pounds per square inch, about fifty percent higher than the pressure it is expected to encounter in an operational situation. The C-17A will fly by June 1991.

grade, but the use of frozen blood allows a larger supply to be maintained for a longer time and allows the stock to be stored closer to the front lines.

The buildup in the Persian Gulf area has necessitated the cancellation of William Tell, Tactical Air Command's biennial air-to-air weapons meet, while Strategic Air Command has shelved Giant Sword, the annual weapons loading meet, and Proud Shield, the yearly bombing and navigation competition. Lack of available airlift plus the need for SAC's tankers to meet commitments related to Desert Shield are the primary reasons for the cancellations.

★ **APPOINTED—Lt. Col. Edward A. Rice, Jr., Maj. Randall H. Kehl,** and **Capt. Willie A. Gunn** have been selected for the **White House Fellows** program. They will serve a one-year internship as special assistants in the executive office of either the President or the Vice President, in a cabinet-level agency, or in an under secre-

Senior Staff Changes

RETIREMENTS: B/G Jon A. **Reynolds;** M/G Roger P. **Scheer;** B/G Daniel J. **Sherlock.**

PROMOTIONS: To be **General:** Jimmie V. **Adams.**

To be **Lieutenant General:** Trevor A. **Hammond;** Michael C. **Kerby;** Robert H. **Ludwig;** Charles A. **May,** Jr.; Michael A. **Nelson.**

CHANGES: L/G (Gen. selectee) Jimmie V. Adams, from DCS/P&O and Cmdr., AFCOS, Hq. USAF, Washington, D. C., to CINC, PACAF; Air Comp. Cmdr., USCINCPAC; and Executive Dir., Pacific Air Combat Ops. Staff, Hq. PACAF, Hickam AFB, Hawaii, replacing Gen. Merrill A. McPeak . . . **M/G Malcolm B. Armstrong,** from Dir., Operational Plans & Interoperability, J-7, Joint Staff, Washington, D. C., to Vice CINC, Hq. PACAF, Hickam AFB, Hawaii, replacing M/G Michael C. Kerby . . . **M/G Albert J. Edmonds,** from ACS/C4, Hq. USAF, Washington, D. C., to Ass't DCS/C4, Hq. USAF, Washington, D. C. . . . **M/G John S. Fairfield,** from Ass't Dep. Dir., Defense Research & Engineering, Strategic & Theater Nuclear Forces, OSD, Washington, D. C., to Cmdr., Hq. AFCC, Scott AFB, Ill., replacing M/G (L/G selectee) Robert H. Ludwig . . . **B/G Richard N. Goddard,** from Ass't DCS/Requirements, Hq. SAC, Offutt AFB, Neb., to Dep. Dir., NSTL Div., JSTPS, JCS, Offutt AFB, Neb., replacing B/G Thad A. Wolfe . . . **M/G (L/G selectee) Trevor A. Hammond,** from Cmdr., Sacramento ALC, AFLC, McClellan AFB, Calif., to Vice Cmdr., Hq. AFLC, Wright-Patterson AFB, Ohio, replacing retiring L/G Robert P. McCoy.

B/G Arthur E. Johnson, from JCS Rep. to Defense and Space Talks, Joint Staff, Washington, D. C., to Ass't Dep. Dir., Defense Research & Engineering, Strategic & Theater Nuclear Forces, OSD, Washington, D. C., replacing M/G John S. Fairfield . . . **M/G (L/G selectee) Michael C. Kerby,** from Vice CINC, Hq. PACAF, Hickam AFB, Hawaii, to DCS/Personnel, Hq. USAF, Washington, D. C., replacing retiring L/G Thomas J. Hickey . . . **M/G Vernon J. Kondra,** from DCS/P&P, Hq. MAC, Scott AFB, Ill., to DCS/Ops., Hq. MAC, Scott AFB, Ill., replacing M/G James J. LeCleir . . . **M/G James J. LeCleir,** from DCS/Ops., Hq. MAC, Scott AFB, Ill., to Dep. Dir., Log. Prgms., DCS/L&E, Hq. USAF, Washington, D. C. . . . **M/G (L/G selectee) Robert H. Ludwig,** from Cmdr., Hq. AFCC, Scott AFB, Ill., to DCS/C4, Hq. USAF, Washington, D. C. . . . **B/G (M/G selectee) Robert M. Marquette, Jr.,** from Cmdr., Strategic Warfare Ctr., SAC, Ellsworth AFB, S. D., to Dir., Off ce of Emergency Operations, White House Military Office, Washington, D. C.

M/G (L/G selectee) Charles A. May, Jr., from Ass't DCS/P&O, Hq. USAF, Washington, D. C., to Ass't Vice C/S, Hq. USAF, and Senior Air Force Member, US Delegation, Military Staff Committee of the UN, replacing retiring L/G Carl R. Smith . . . **B/G (M/G selectee) James C. McCombs,** from Spec. Ass't for Transportation, DCS/L&E, Hq. USAF, Washington, D. C., to DCS/P&P, Hq. MAC, Scott AFB, Ill., replacing M/G Vernon J. Kondra . . . **Gen. Merrill A. McPeak,** from CINC, Hq. PACAF; Air Comp. Cmdr., USCINCPAC; and Executive Dir., Pacific Air Combat Ops. Staff, Hickam AFB, Hawaii, nominated to Chief of Staff, Hq. USAF, Washington, D. C., replacing Gen. Michael J. Dugan, relieved September 17 . . . **M/G (L/G selectee) Michael A. Nelson,** from Cmdr., Sheppard Technical Training Ctr., Sheppard AFB, Tex., to DCS/P&O and Cmdr., Air Force Combat Ops. Staff, Hq. USAF, Washington, D. C., replacing L/G (Gen. selectee) Jimmie V. Adams . . . **B/G Thad A. Wolfe,** from Dep. Dir., NSTL Div., JSTPS, JCS, Offutt AFB, Neb., to Cmdr., Strategic Warfare Ctr., SAC, Ellsworth AFB, S. D., replacing B/G (M/G selectee) Robert M. Marquette, Jr. . . . **Col. (B/G selectee) Joseph C. Wilson, Jr.** from Chief, Strategic Ops. Div., J-3, Joint Staff, Washington, D. C., to JCS Rep. to Defense and Space Talks, Joint Staff, Washington, D. C., replacing B/G Arthur E. Johnson.

SENIOR ENLISTED ADVISOR (SEA) RETIREMENT: CMSgt. Kenneth R. **Meeks,** from SEA, Hq. TAC, Langley AFB, Va.

SEA CHANGES: CMSgt. Robert W. Bailey, to SEA, Hq. USAFE, Ramstein AB, Germany, replacing CMSgt. Willie A. Currie . . . **CMSgt. Robert W. Hall,** to SEA, Hq. PACAF, Hickam AFB, Hawaii, replacing CMSgt. (now CMSAF) Gary R. Pfingston.

SENIOR EXECUTIVE SERVICE (SES) CHANGES: Gary Amlin, from Dep. for Policy & Banking, Ass't Sec., Financial Mgmt. and Comptroller, OSAF, Washington, D. C., to Dep. Ass't Secretary for Accounting, Finance and Banking, Ass't Sec., Financial Mgmt. and Comptroller, OSAF, Washington, D. C. . . . **Donald C. Campbell,** from Dep. Prgm. Dir., Propulsion SPO, ASD, AFSC, Wright-Patterson AFB, Ohio, to Dir., Aero Propulsion and Power Laboratory, WRDC, AFSC, Wright-Patterson AFB, Ohio . . . **Donald W. Hanson,** from Supervisory Electronics Engineer, ESD, RADC, AFSC, Griffiss AFB, N. Y., to Dir., Surveillance, ESD, RADC, AFSC, Griffiss AFB, N. Y. . . . **Ronald L. Orr,** from Logistics Management Office, Sacramento ALC, AFLC, McClellan AFB, Calif., to Dep. Dir., Maintenance, Ogden ALC, AFLC, Hill AFB, Utah, replacing Gene Mortensen . . . **Frederic C. Schwartz,** from Aerospace Engineer, ASD, AFSC, Wright-Patterson AFB, Ohio, to Dir. of Engineering (Advanced Technology Bomber), ASD, AFSC, Wright-Patterson AFB, Ohio, replacing John M. Griffin. ■

tary or deputy secretary's office. They were selected from among the fifteen Air Force officers who qualified as national finalists.

Maj. Rowan W. Bronson, a Wisconsin Air National Guardsman, has been selected as **commandant of the Academy of Military Science,** (AMS) one of three schools at the I. G. Brown Professional Military Education Center at McGhee Tyson Airport in Knoxville, Tenn. A 1981 graduate of the AMS, Major Bronson is the first alumnus to assume command of the school. The Academy of Military Science graduates approximately forty percent of the new officers entering the Air Guard each year and is the Guard's primary precommissioning program.

★ **HONORS—A stamp bearing the likeness of Lt. Gen. Claire L. Chennault,** the pioneer air tactician and famed World War II general who started the American Volunteer Group and was later commander of Fourteenth Air Force in China, was issued in ceremonies on September 6 at Monroe, La. The forty-cent stamp, the latest in the "Great Americans" series, was designed by Chris Calle and is based on a 1944 photograph of General Chennault.

★ **PURCHASES—Chrysler Technologies Airborne Systems** received an $80.2 million contract from Air Force Systems Command's Aeronautical Systems Division on August 20 for the first five of ten planned **C-27A STOL intratheater transports** for Southern Command. The C-27s, Aeritalia G.222 medium airlifters modified to meet Air Force requirements, will fill the airlift gap between CH-47 helicopters and C-130s in Central America, USSOUTHCOM's operating area. The aircraft will be able to move company-sized units and their equipment to remote, unimproved airstrips. After assembly in Naples, Italy, the aircraft will be flown to Chrysler's plant in Waco, Tex., where they will be fitted with new communication and navigation avionics. The first C-27A will be delivered to Howard AFB, Panama, next August. Two more aircraft will be delivered the next month. Chrysler also received a separate, ten-year, $5.5 million Oklahoma City Air Logistics Center contract to provide logistic support for the C-27s.

ITT Gilfillan received an $11.6 million contract from Air Force Systems Command's Electronic Systems Division on September 1 for two initial production **antiradiation missile decoy systems.** The decoy is a miniature radar transmitter that fools incoming enemy antiradiation missiles into attacking it rather than attacking an actual radar station. The decoy can be transported by two people and set up in fifteen minutes. The decoys will be deployed with and connected (via fiber-optic cables) to the Air Force's AN/TPS-75 tactical air defense ra-

LeMay Dead at Eighty-Three

A 1987 article in this magazine described him as "the airman who shook the world." He was also called "The Iron Eagle" and a lot of other things. By whatever name, he was one of the greatest and most memorable figures in the history of airpower.

Gen. Curtis E. LeMay died of a heart attack October 1, at March AFB, Calif. He was eighty-three.

He achieved fame as a leading planner and commander in both the European and Pacific theaters during World War II, but the legendary LeMay did not emerge until later, when his name—as well as his hawk-like face with a cigar clamped authoritatively in his teeth—became practically synonymous with Strategic Air Command.

General LeMay was Chief of Staff of the US Air Force from 1961 to 1965. In 1968, he ran for Vice President on George Wallace's unsuccessful third-party ticket. In his later years, he avoided the public spotlight but never lost his interest in airpower and national defense.

Less than a month before General LeMay's death, Gen. T. R. Milton, USAF (Ret.), interviewed him for an AIR FORCE Magazine column *[see "Last Visit With LeMay," p. 105]* and reported that the old Iron Eagle was still a single-minded advocate of strategic airpower.

Index to Advertisers

dars. Options could total up to $60 million.

Raytheon received a $17.6 million Naval Air Systems Command contract on August 17 for **710 AIM-9M Sidewinder air-to-air missile guidance and control sections** and to provide related hardware and services. This contract represents 100 percent of the FY 1990 competitive buy of Sidewinder missile sections. This tenth annual contract award covers assembly of missile sections for Navy, Air Force, and Foreign Military Sales customers.

The team of **LTV and Hawker Energy Products** received an $84,000 Oklahoma City Air Logistics Center contract to install **a new type of battery system in a Boeing B-52H.** The system consists of two sealed lead acid batteries, battery chargers, indicators, and associated electrical components and wiring. After installation, the B-52H will be returned to normal service at Minot AFB, N. D., and performance of the battery system will be evaluated. The new batteries are expected to give maintenance-free service for several years, rather than the one to three month interval between rechargings of current batteries.

★ **DELIVERIES—Westinghouse** delivered the **first AN/APQ-183 radar for the Navy's A-12A** attack plane to General Dynamics on August 29. Westinghouse was awarded the radar contract in April 1989 after a contract with Norden was terminated. The APQ-183 incorporates air-to-air and air-to-ground modes and features an electronically scanned antenna. The team of GD and McDonnell Douglas is doing final assembly of the A-12 at a USAF-owned plant in Tulsa, Okla.

The first **MH-53J Weapon System Trainer/Mission Rehearsal System** (WST/MRS) **was unveiled** in ribbon-cutting ceremonies at Kirtland AFB, N. M., on August 30. The MH-53J WST/MRS is built around a General Electric Compu-Scene V image generator, an improved base with six degrees of freedom of motion, and a fully instrumented MH-53J Pave Low III helicopter cockpit. GE modified and integrated the WST at its Daytona Beach, Fla., facility and shipped it to Kirtland earlier this year. The WST/MRS offers cockpit procedures, flight task training, and highly realistic, full mission rehearsal. It is one of the most sophisticated simulators ever built. The prime user will be the 1550th Combat Crew Training Wing, the Air Force's Special Operations "schoolhouse."

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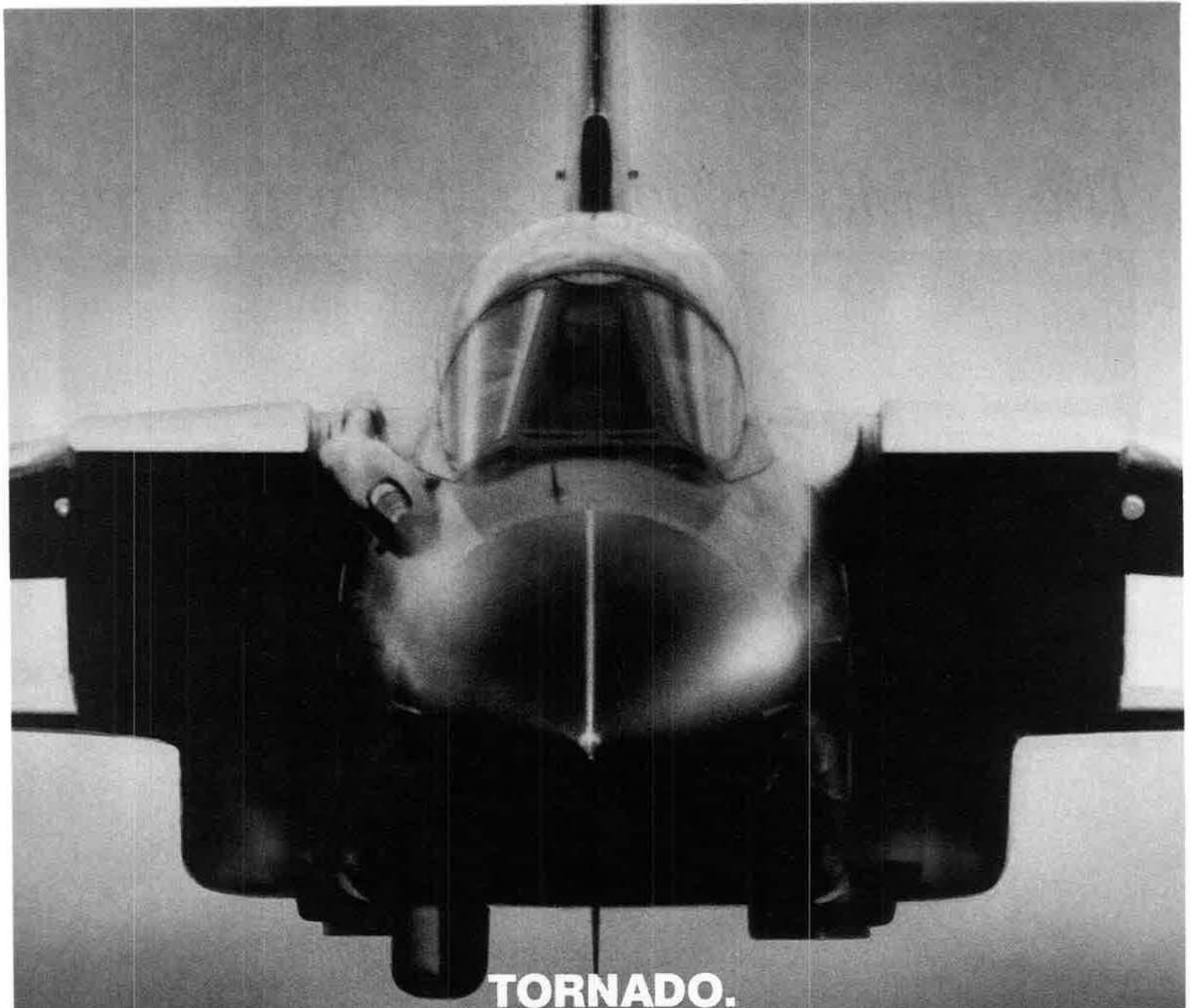

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★ **MILESTONES**—Navy **astronaut Capt. Bruce McCandless II,** the first human satellite, **retired** from NASA and the Navy on August 31. On space shuttle mission 41-B in February 1984, Captain McCandless flew untethered from the payload bay of the orbiter *Discovery* in the Manned Maneuvering Unit, a self-contained life support system/space vehicle he helped design. He lifted off again in *Discovery* this past April on the STS-31 flight, during which he and Kathy Sullivan stood by to make a spacewalk in case there were problems in deploying the Hubble Space Telescope. He also served as capsule communicator on Apollo 11, the first manned lunar landing. His Navy career spanned thirty-two years. He did not announce his future plans.

The **52d Tactical Fighter Wing** claimed the unique distinction of being the **first Air Force unit to participate at an open house at an Eastern bloc military base** on August 19. Two F-16 pilots, Capts. Austin Cooper and Michael Goodman; Maj. John MacKay, the deployment commander; MSgt. Henry Woody, maintenance superintendent; Sgts. Rich DeGraw and Don DePedro; and SrAs. Jeff Dunn and Scott Tegtmeyer made the trip to the Hungarian air base at Kecskemet. The trip was arranged through the American defense and air attaché to Hungary, Col. Ruth Anderson. The members of the 52d TFW were fêted by their hosts prior to the show and were popular targets for autograph-seekers during the open house.

The **last Lockheed C-140A JetStar** in the Air Force **was retired** on August 20. The aircraft was flown to Edwards AFB, Calif. (where it will be put on static display), by Brig. Gen. Frederick A. Zehrer III, the vice commander of Air Force Communications Command. The C-140 was flown by the 1467th Facilities Checking Squadron at Scott AFB, Ill., and was used by its crew of three to check navigational aids, landing systems, and radar approach control equipment at airfields worldwide. The JetStar (serial number 59-5962) was a Vietnam veteran and was one of five C-140s bought for the flight inspection role in 1960.

Pioneer 10, the first spacecraft to leave the solar system, **reached the fifty astronomical unit (AU) distance milestone** on September 22. An AU is the average distance between the sun and the Earth, ninety-three million miles. When Pioneer 10 passed the fifty-AU mark, at 4:19 p.m. EDT, it was 4,647,809,899 miles from Earth and traveling at a speed of 28,900 mph. The spacecraft's eight-watt radio signal has now fallen to a strength of four billionths of a trillionth of a watt by the time it reaches NASA's Deep Space Tracking Network. It takes thirteen hours and forty-seven seconds at the speed of light for the signal to reach Earth.

★ **NEWS NOTES**—On August 30, the **Textron Defense-developed Sensor-Fuzed Weapon** (SFW), a tactical air-launched antiarmor system designed to achieve multiple kills per pass, was **certified as ready to begin** initial operational test and evaluation (IOT&E) by the Air Force Development Test Center at Eglin AFB, Fla. The Air Force Operational Test and Evaluation Center, headquartered at Kirtland AFB, N. M., will conduct the IOT&E tests at Nellis AFB, Nev., Camp Grayling, Mich., and Eglin. Testing must be completed before the Air Force can seek a low-rate production decision next fall. The total production buy of SFWs could be worth up to $3 billion.

Air Force Logistics Command has started a **new program,** Pacer Trim,

that will reduce the Air Force's supply of spare parts. AFLC, which manages more than 900,000 supply items, will reduce both current inventory and future budget requirements for defense materials. The command will emphasize reducing or terminating contracts for spare parts and equipment no longer required as readiness needs change, designing more flexible contracts that can be adjusted as requirements change, and starting disposal actions to clear warehouses of unserviceable inventory.

A **joint NASA/Air Force/industry board** met in late August and **determined that the** Advanced Launch Development Program **(ALDP) booster will be powered by a gas generator cycle engine.** The ALDP engine, similar to the J-2 engines used on the second and third stages of the Apollo moon rocket, will use liquid oxygen and liquid hydrogen as propellants. It will be approximately seven feet in diameter, 12.5 feet tall, and approximately 7,000 pounds in weight. The engine will be in the 600,000-pound-thrust class. The other candidate for the ALDP program (formerly the Advanced Launch System) was a closed expander-type engine, similar to the RL-10 used in the Centaur upper stage booster. The three companies on the panel, Aerojet, Rocketdyne, and Pratt & Whitney, are looking into the possibility of forming a team to reduce risk.

An **Air Force Academy team took first place in the two-seat glider category at the 1990 Sports Class National Glider Championships** held in early August in Littlefield, Tex. Lt. Col. Jim Payne, Capts. Robert Huntsman and George Sciss, and Cadets Joe Rizzuto and Jason White took turns flying an ASK-21 sailplane purchased by the Academy's Association of Graduates. Each day during the week-long competition, the meet's flying director set a minimum flying distance. The Academy's team covered 999.4 miles in 27.1 total hours. The Academy team finished ninth overall in the forty-one-team meet.

You could say the phone was mightier than the sword. C&P Telephone Co. was running out of phone numbers in the Washington, D. C., area and started requiring callers to use area codes for local calls across state and District boundaries. The Pentagon had been using Washington's 202 area code, but the phone company changed that to 703 to reflect the building's location in northern Virginia. That was fine, except for one thing—the 694 prefix that is used on nearly 10,000 numbers in the Pentagon also happens to be the prefix for Stuart, Va., a town of about 1,000 people near the North Carolina border, also in area code 703. It was evident that something had to change. The Pentagon had more numbers, but the town was older, so the Pentagon's prefix was changed to 614.

★ **DIED**—Retired Air Force **Lt. Gen. James T. Stewart,** commander of Air Force Systems Command's Aeronautical Systems Division at Wright-Patterson AFB, Ohio, from 1970 to 1976, of unreported causes on September 3. He was sixty-nine. During his tenure at ASD, General Stewart oversaw the development of the F-15 and F-16 fighters, A-10 attack aircraft, B-1 bomber, and AGM-65 Maverick missile and AGM-69 short-range attack missile. A B-17 pilot during World War II, he served in a number of research and development positions, and he wrote many technical papers. He was an active fund-raiser for the Air Force Museum while at ASD. ■

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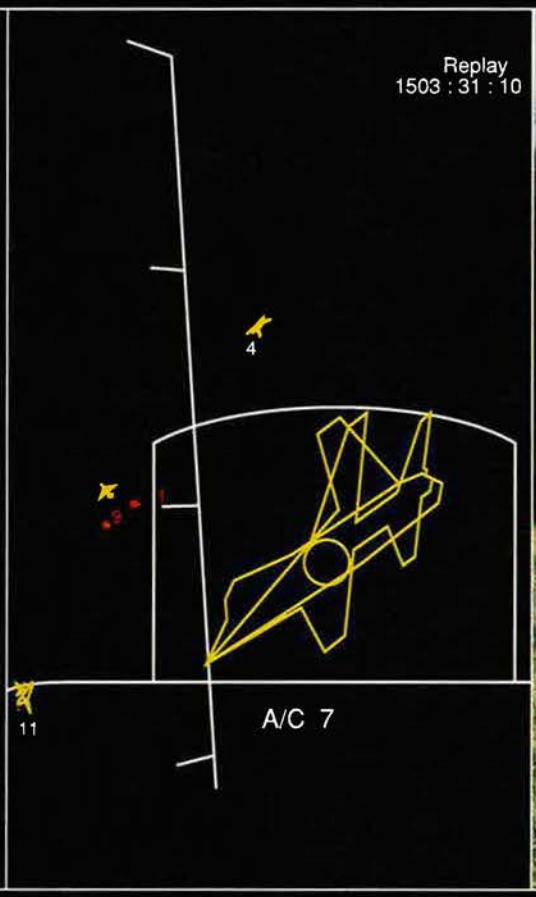

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GENERAL DYNAMICS

A Strong Company For A Strong Country

The "maritime nation" theory isn't wrong. It just misses a more important point.

We Are an Aerospace Nation

By Col. Dennis M. Drew, USAF

For at least a decade, naval partisans have persistently declared the US to be a "maritime nation." They have portrayed the country as a virtual island, dependent on sea lines of communication for prosperity and security and in need of a 600-ship Navy based on fifteen aircraft carriers. The US requires such a fleet, they have argued, to defend its shores, protect trade routes, and project power abroad.

Without question, the navalists were correct, but only in the sense that the country is bordered on two sides by the world's great oceans and does depend on the sea lanes. There is no argument against the proposition that seapower is vital.

First and foremost, however, the United States is an aerospace nation.

Aerospace power has become the dominant element in global military affairs, and aerospace forces provide the foundation of US military power. The aerospace industry is a pillar of the US economy. Air transport and space communications bring Americans together as a nation and integrate the US into the world order.

The great oceans and continents are overarched by air and space. These reaches, free of natural boundaries and obstructions, dominate all that lies below.

Such has been the case from the beginning of powered flight. However, aerospace forces required nine

decades of tumultuous development to evolve into the world's dominant military instrument. On the commercial side, matters moved more rapidly; the aerospace industry has grown to immense proportions and provides one of the few bright spots in US international trade.

In the beginning, aircraft were incidental weapons, envisioned only as tools of improved observation. Other advantages appeared soon. Virtually all of what would become the classic missions of airpower were pioneered in World War I, but airmen and their primitive flying machines had little effect on the course of that war. Even had aircraft not existed, both sides probably would have prosecuted the war in much the same way and arrived at the same result.

Visions of the Prophets

The Great War, however, created powerful visions of what airmen could accomplish if the proper technologies became available. Prophets of airpower—Hugh Trenchard, Giulio Douhet, Billy Mitchell, and Alexander de Seversky—realized the true meaning of the aerial revolution. Aviation made it possible to amass great power quickly over any spot on the earth's surface and to attack any portion of an enemy's strength. For the first time, a military force could strike directly at the enemy's "vital centers" without first defeating the enemy's armies

and navies. After the carnage at Verdun, Ypres, and the Somme, the prospect of quick, cheap, and decisive victories from the air was seductive.

The prophets of airpower promised too much, too soon. In many respects, airmen ever since have paid a heavy price for these excessive and premature promises. In World War II, airpower played major roles in many Allied victories, but the victories were neither quick nor cheap.

Military airpower had its infancy in World War I. It went through a confused and questioning adolescence during the Second World War. How should airpower be controlled? Which missions had the most important claims on manpower and materiel? What were the enemy's "vital centers," and precisely how should they be attacked? How should air defenses be defeated?

In the course of the war, most of the questions were resolved, and the effects of airpower became ever greater and more decisive. One could argue that the maturation of airpower culminated with the surrender of Japan, which was brought on in no small part by the destructive effect of conventional aerial bombardment and, at the end, the atomic bombardment of Hiroshima and Nagasaki.

Airpower had come of age with the advent of atomic weapons and long-range airpower—atomic airpower, as this combination was called in the postwar years. Airpower enthusiasts (including a number of former doubters) believed that the airpower prophets were about to be vindicated. America's atomic airpower, they maintained, surely would yield quick, cheap, and decisive victories and would be useful even in fighting local conflicts.

This belief persisted into the 1950s. As late as January 1957, Defense Secretary Charles Wilson was explaining to Congress that Washington's "basic defense policy is based on the use of . . . atomic weapons . . . in a smaller war, if such a war is forced upon us."

The Impotence of Power

The prophets of airpower had not foreseen that the power of modern nuclear weapons would make them essentially unusable except as a deterrent. Nor had they imagined the resulting emergence of an era of "limited" warfare in which there would be no decisive battles, no overwhelming aerial onslaught, and no quick and cheap victories.

If airpower had been in its adolescence in World War II, Korea and Vietnam provided the equivalent of college and graduate degrees. Airmen began to comprehend the varieties, vagaries, and political imperatives of warfare across the spectrum of conflict.

In the soul-searching that followed defeat in southeast Asia, airmen in large numbers began to understand that they needed to undertake serious study of war rather than passively accept the words of the airpower prophets as revealed wisdom. To this end, the Air War College in the late 1970s launched a major overhaul of its curricula, a move followed shortly by the complementary overhaul of curricula at the Air Command and Staff College.

The watchword "Put more war in the War College" reflected a desire to eliminate the emphasis on management and cost efficiency imposed in the era of Defense Secretary Robert McNamara.

Serious study of war revealed some new realities of the modern battlefield. It became clear that modern mechanized armies could not operate effectively in the face of strong air attack. It was also clear that armies operated much more effectively when assisted by friendly airpower.

In addition, it was only too apparent that surface naval forces could not survive under hostile skies and that, in direct response to this bitter fact, modern navies had become naval air forces. The aircraft carrier had become the capital ship of the new age; other surface ships were relegated to little more than support roles. Hostile aircraft posed major threats even to submarines.

In some important respects, the narrow waters of the southwest Pacific, Persian Gulf, Mediterranean Sea, Baltic Sea, Caribbean Sea, and elsewhere no longer could be viewed as exclusively maritime theaters of conflict. Rather, it was clear that land-based airpower, with range and payload superior to naval airpower, could dominate such theaters.

Faced with the need to provide rapid, worldwide responses to hostile threats, Washington policymakers often looked to long-range airpower as the only viable option.

Technological Explosion

During this period, science made great strides toward solving problems that had inhibited airpower, frustrated airmen, and left the vision unfulfilled. Such problems included, but were not limited to, darkness, storms and other unpredictable weather, inaccurate targeting, and strong air defenses.

Modern aircraft are capable of flying almost anywhere, at almost any time, and under almost any conditions. They can deliver "smart" weapons with great precision. They can survive in hostile environments as never before, using the marvels of electronic countermeasures, terrain-following radar, stealth technologies, and SAM-busting antiradiation missiles. Often they can simply avoid air defenses by launching standoff weapons from afar.

Airpower has become the keystone of military power. Land and naval forces cannot operate effectively in the absence of air superiority by friendly forces. With control of the skies, airmen can deliver devastating blows to enemy land and naval forces in orchestrated joint campaigns. Further, they can strike any portion of the enemy's power structure in independent operations.

In short, land and naval forces, except in the most unusual circumstances, cannot operate without airpower, but airpower can function effectively—perhaps even decisively—without support from land and naval forces.

Airpower redefined and reemphasized the traditional importance of the high ground in military affairs. The advent of aero*space* power is reemphasizing that importance.

Even in their infancy, American capabilities in space are crucially important to military operations, even though these capabilities are tightly controlled and strictly limited by policy and treaty. Space systems provide fast worldwide communications and navigational aids. They have revolutionized military intelligence. The nation relies on space systems—so-called "national

—Staff photo by Guy Aceto

technical means" to verify treaty compliance. Space systems have become invaluable tools in such tasks as predicting the weather, a crucial factor in military operations. In short, space systems are now tools on which American military forces routinely depend.

Even so, the fact that aerospace power today stands as the keystone of national defense does not, by itself, establish that the US is an aerospace nation. The United States is not a garrison state, and its character, prosperity, and success hinge on factors that go well beyond its armed forces.

Staggering Economic Impact

The most critical of these is American economic power. In a few decades, the airplane has wrought staggering changes in the US economy.

The most obvious change is the growth of the aerospace industry itself. Sixty years ago, when steel and auto manufacturing dominated the economy, aircraft manufacturing was essentially a cottage industry dominated by enthusiasts with little business sense and even less capital. Americans traveled by train and by ship. The railroads furiously competed for passengers with lavishly appointed "name" trains on fast schedules; shipping companies did the same, offering fast, luxurious ocean liners.

Even so recently as thirty years ago, air travel was a relative novelty. Civilian jet aircraft were a new phenomenon, and the airways were dominated by prop-driven Douglas DC-somethings. Airmail required a more costly stamp.

Today, Americans, particularly those traveling on business, travel by air. In 1987, the large American flag airlines carried nearly half a billion passengers more than 500 billion miles. The aerospace industry is a strong part of the economy. Aerospace manufacturers directly employ more than 750,000 men and women and indirectly employ many times that number through suppliers and subcontractors. In 1989, the twenty-one largest aerospace equipment manufacturers reported total sales of more than $140 billion.

Perhaps the industry's most important contribution to the economy has been its impact on the balance of foreign trade. While most US export industries have declined, American aerospace manufacturers enjoy thriving overseas markets.

In 1989, the US sold $40 billion worth of civilian aircraft and engines to foreign customers. American aircraft manufacturers produced a trade *surplus* of $28 billion —the largest positive US trade in any product category. That figure does not include sales of US military aircraft. The vaunted positive impact on foreign trade of US agricultural products—an $18 billion annual surplus—pales in comparison.

Meanwhile, the American shipbuilding industry has all but disappeared. Only fourteen American shipbuilders remain in business, kept on life-support by Navy contracts. The steel industry has rusted away, and the automobile industry is staggering under the blows of foreign competition.

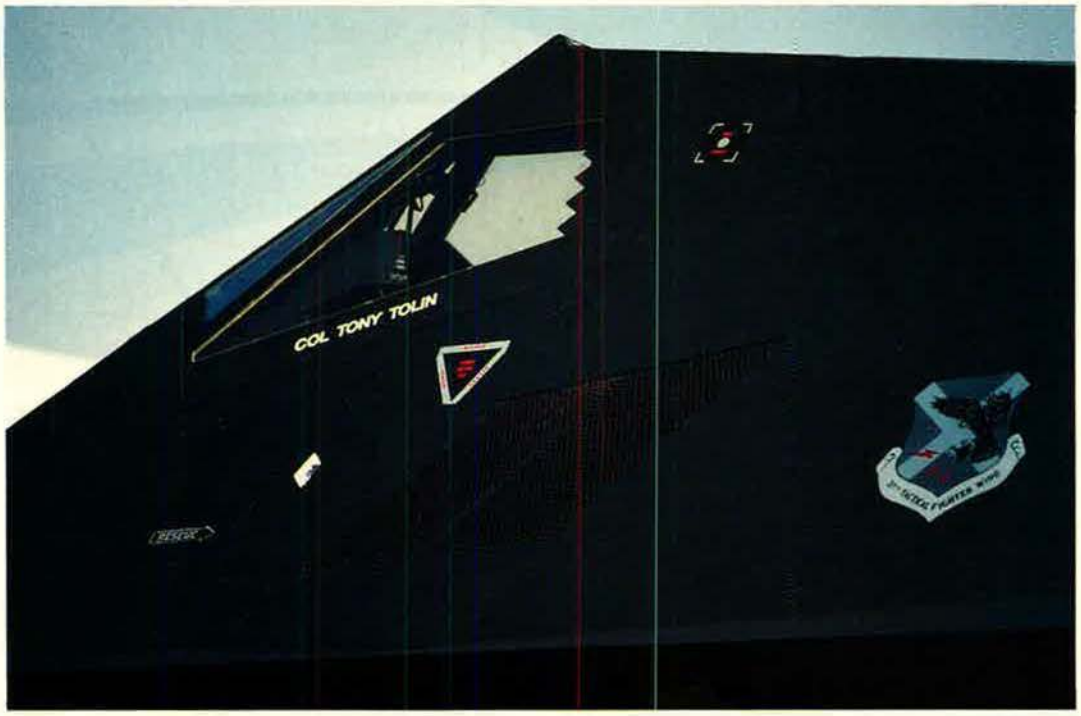
Slipping Behind Yugoslavia

As of March 1990, US shipyards were building one-tenth of one percent of commercial ships on order worldwide, ranking well behind Japan and South Korea, and even behind Yugoslavia and Spain. In the last four years, US shipyards received only one commercial contract for new ships.

While long-unused rail terminals are being converted into shopping malls and bus terminals are being razed to make room for office buildings, gate space at crowded hub airports has become one of the domestic economy's most precious commodities.

Traditional sea lines of communication remain critical to bulk cargo shipping, but they have become irrelevant to passenger traffic and nearly irrelevant to the transport of high-value, low-bulk cargo, such as computers and electronic goods.

Such cargo has fueled the growth of the air freight industry. In 1987, large,



—Staff photo by Guy Aceto

certificated American flag carriers hauled more than 5,000,000 tons of cargo and 1,500,000 tons of mail. Premium-priced, overnight-delivery, air freight services to both domestic and overseas locations have experienced phenomenal growth. Even the conservative US Postal Service has been forced to enter this market or face a permanent loss of significant revenue.

What impact will the "space" part of aerospace have on the US economy? The evidence is that space already has had a pervasive impact on the economy and on the fabric of life in the US. Telephone calls, particularly to overseas destinations, are often completed by bouncing signals off satellites. Americans can hardly watch television without taking advantage of spacecraft. Television's so-called "superstations" broadcast nationwide via satellite to local cable television systems and backyard dish antennas. The advent of national daily newspapers stems, in large part, from the ability to transmit words and pictures, via satellite, to local markets for printing and distribution.

Instantaneous, worldwide communication, made practical by satellites, has helped to integrate the global economy by facilitating trade, electronic fund transfers, and global trading in stocks, bonds, and other financial instruments.

Tracking Storm Systems

Satellites play a key role in weather forecasting, particularly in spotting and tracking dangerous weather systems. Satellites have also helped map the globe, find sources of pollution, and find new supplies of natural resources.

What comes next? The US military is in for considerable change, almost certainly including a significant reduction in size. US political leaders must be aware that airpower dominates modern warfare. They must also consider that, because the Soviet Union has faded as the locus of US strategic planning, military threats could appear suddenly, almost anywhere—a fact most recently demonstrated by Iraq. Speedy reaction may be the most critical element in controlling such dangers, and airpower almost always provides the most rapid response. Though land-based airpower and its sea-based variant often are cast as rivals in Washington budget battles, in the heat of real battle they are complementary.

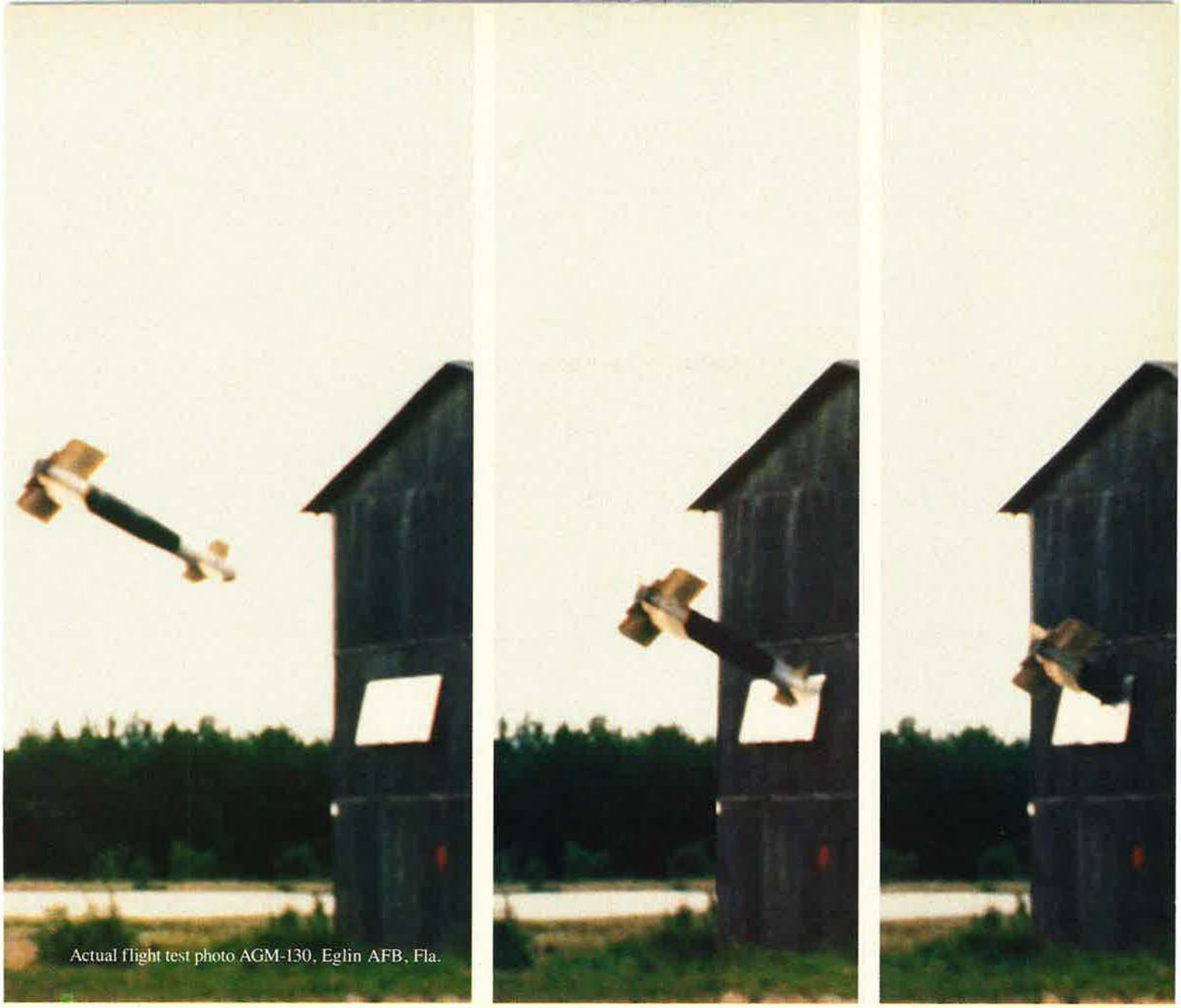
It would be prudent to encourage US aerospace manufacturers to maintain and even strengthen their dominance in the world market.

Future space policy is a subject of controversy. The importance of space capabilities in US military operations and the civil economy makes it imperative that the US continue an aggressive space program. Because space assets are so important, the United States must be able to defend its critical space instruments and its access to and use of space.

All signs are that, in the twenty-first century, "freedom of space" will be at least as important as "freedom of the seas" has been throughout our history.

The US political and military leadership faces daunting problems. Its decisions are sure to shape the nation for decades to come. These decisions must be based on the world as it is and will be, not on the world as it was and never will be again. The United States has been many things—a great agricultural nation, a great industrial power, a continental power, a "post-industrial" nation—and, yes, a maritime nation. It continues to be many of these, but if it is to continue as a great power in control of its own destiny, it must remain, above all, an aerospace nation. ■

Col. Dennis M. Drew, USAF, is Director of the Airpower Research Institute and professor of military strategy and airpower doctrine at the Air Force's Air University, Maxwell AFB, Ala.



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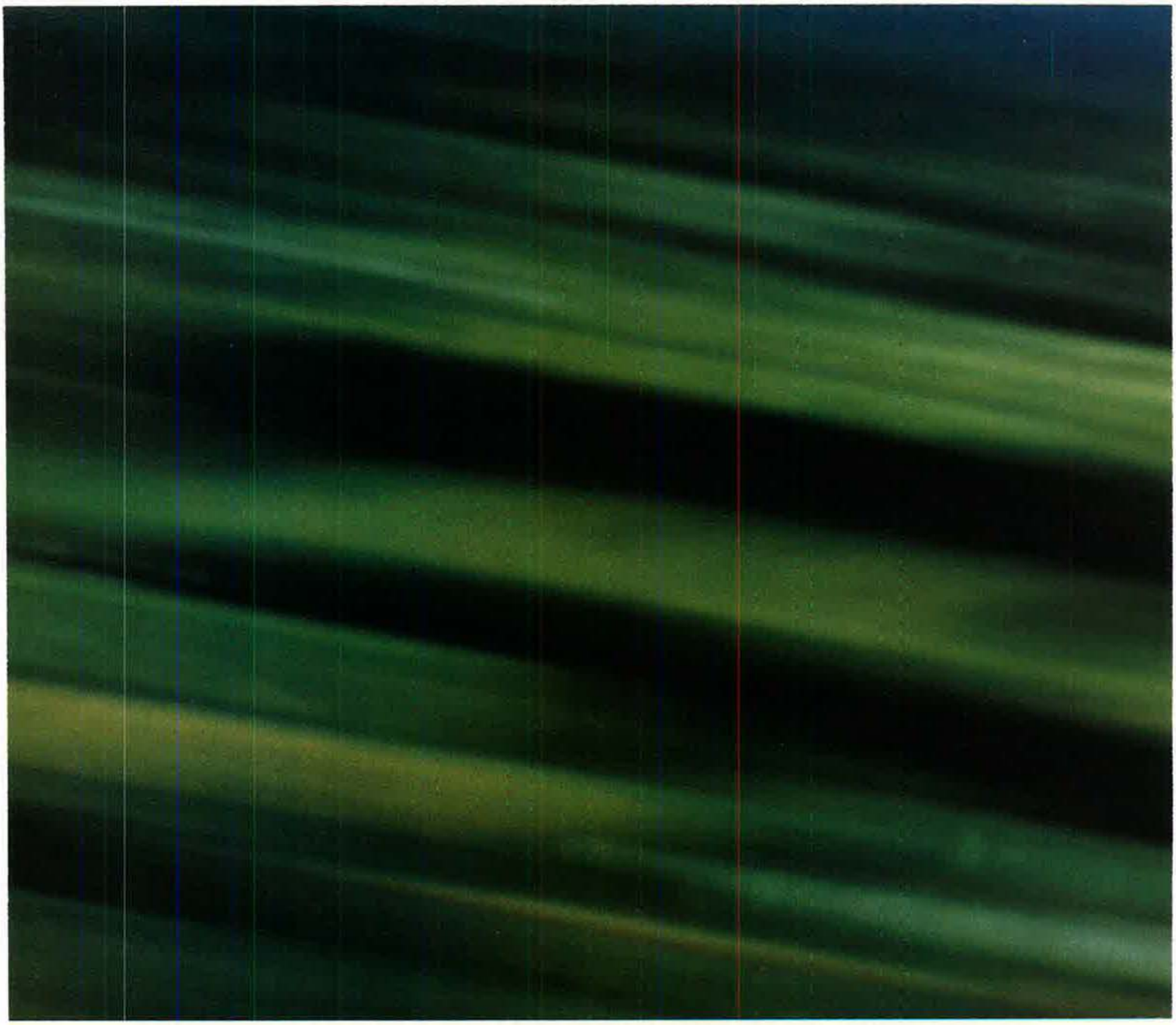

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the ALQ-184.

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

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

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Most briefings began with "Because of the Iraqi invasion...."

Status Check at Farnborough

By Jeffrey P. Rhodes, Aeronautics Editor

Photos by Guy Aceto, Art Director

MORE than anything, Farnborough '90 was a status check for the aerospace industry. Though the industry as a whole may be shrinking, the ninth Farnborough International Air Show made it clear that a great deal still is going on.

British Aerospace (BAe), the home team at Farnborough, dominated the show. BAe was everywhere—from the masterful flying display put on each day by six Harrier pilots to the civil ATP and BAe 146 to the Defence Presentation Park, where BAe's Harrier, Hawk, Tornado, Royal Ordnance mortars and cannons, and simulators were on display in a mock forward-base environment.

On display in the daily flying was one totally new plane, the Embraer CBA-123, a nineteen-passenger regional turboprop craft. The Brazilian CBA-123, with pusher propeller, had fewer than thirty hours of flight-testing before it flew across the Atlantic to participate in the show. The aircraft will be certified next year. In December 1991, Embraer will begin deliveries to eighteen operators, who have more than 150 options on the aircraft.

More impressive than the monstrous size of the Soviet An-225 transport (above) is that it really can fly, as its crew ably demonstrated the first day of the show. As host at the ninth Farnborough International Air Show, British Aerospace put on quite a display of flying and quite a static display, too. The Harrier GR. Mk. 5 at right was part of the company's Defence Presentation Park.


INERT
INERT

The Soviets again put on an impressive display, flying single-seat and two-seat MiG-29s, the gigantic An-225 Mriya transport, and single-seat and two-seat Su-27s—the last of which performed the astonishing "Cobra" high-angle-of-attack maneuver. For pure flying skill, however, the highlight of the show was the aerial ballet performed by Natalya Sergeeva, the new Ladies' World Aerobatic Champion, in the Su-26 aerobatic plane.

US industry was represented by the McDonnell Douglas CF-18 (an F/A-18 Hornet derivative produced for Canada) and the General Dynamics F-16A, both of which were put through their paces. Bell Helicopter had its new four-blade AH-1W attack helicopter demonstrator and an OH-58C Kiowa on static display. An operational Lockheed TR-1A was also on static display.

McDonnell Douglas was also scheduled to bring an AH-64 Apache. However, the designated helicopter missed the show because it was in use in the Persian Gulf area as part of Operation Desert Shield. McDonnell Douglas instead displayed an AH-64 model bearing a sign that read "Called to Duty." Desert Shield, in fact, was much on the minds of everyone; most briefings began with some variation of "Because of the Iraqi invasion. . . ."

Commercial Aviation Booming

Commercial aviation is in the midst of a boom, and the number of companies building parts or support equipment for military and civil airplanes has grown dramatically. These firms were much in evidence during the week-long affair.

Air travel continues to expand at a moderate pace. At a predicted growth rate averaging 5.5 percent a year, the market is expected to post a seventy percent increase by 2000. Estimates are that, over the same period, the world's airlines will buy some $626 billion worth of new jetliners, $186 billion of which will be spent to replace retiring aircraft and $440 billion of which will be used to accommodate growth. Forty-one percent will go to long-range airliners and thirty-four percent to short-range aircraft.

In the civilian aerospace world, Boeing made news by *not* making an announcement. News of the expected launch of the new 777 twin-jet wide-body never materialized during the show. The plane, called 767-X until it is officially announced, will seat 350–375 passengers in a two-class configuration. It will have a range of 4,800 to 5,300 statute miles.

The commercial market for large aircraft is growing steadily, but the market for commuter aircraft is exploding. Among those displaying their commuter airplanes during the show were Dornier (above, in foreground, the Do-228) and Embraer (at rear and above right, the CBA-123 Vector).

The 767-X will have folding wingtips, which will permit operators to reduce the plane's full 197-foot wingspan to 156 feet. That will allow the new plane to use the same airport gates now used by DC-10s, L-1011s, and "regular" 767s. The plane will make extensive use of composite materials, and growth versions are planned.

In the race to power this new airliner, the 85,000-pound-thrust-class GE90 turbofan engine, built by a consortium led by General Electric, is the leading contender. The GE90, with its 123-inch-diameter fan, was displayed during the show as a mockup. Other candidates are the Rolls-Royce Trent (now in test) and the Pratt & Whitney PW4082, also displayed in mockup.

With its 737, 747, 757, and 767 aircraft lines, Boeing has a total back-

log of 1,703 aircraft orders worth $24.4 billion. The company is building thirty-four jetliners a month (seventeen of them 737s) at its plants near Seattle, Wash.

The McDonnell Douglas MD-11 trijet wide-body made its first flight in January. Five aircraft are now undergoing certification testing at the company's Yuma, Ariz., facility. A new-technology follow-on to the successful DC-10 line, the MD-11 should earn its certificate and start revenue service this month.

The MD-11, crewed by only two pilots and distinguishable from its DC-10 cousin by its winglets, is being offered in three versions: passenger type (323 in a two-class arrangement), "combi" (passenger/cargo), and pure freighter. The company has received 158 firm orders and 221 options from thirty-two airlines and hopes to reach a production rate of one a week.

The company's MD-80 family (MD-81/82/83/87/88), seating up to 172 passengers on medium to long routes, continues to sell well; 1,542 aircraft are on firm order or on option. Three new MD-80s come off the Long Beach, Calif., assembly line each week.

Douglas is also offering a new airliner, the MD-90. This aircraft, carrying up to 181 passengers, has much in common with the MD-80 family but will be quieter and more fuel-efficient than its predecessors. This is due primarily to the plane's V2500 turbofan. The 25,000-pound-thrust engine is built by International Aero Engines, a consortium that includes Pratt & Whitney, Rolls-Royce, Japanese Aero Engine, MTU, and Fiat. The MD-90 is scheduled to fly in 1994.

This year, Airbus Industrie, the four-nation consortium of France, Britain, Germany, and Spain, could turn a profit for the first time in its twenty-year history. The company, heavily subsidized by the consortium governments, has firm orders for 1,558 aircraft from ninety-five customers, for a total value of more than $84 billion. Airbus has a five-year order backlog.

The five versions in the A300/A310 family (carrying 218–267 passengers) were the first wide-body, twin-engine jetliners. A300/A310 sales now total 653 aircraft. The medium-haul A320 (150 passengers) and A321 (186 passengers) are Airbus's top sellers, with 698 firm orders. The A321 will start revenue service in 1994.

The twin-engined A330 will seat 335 passengers over medium- to long-haul routes. A330 deliveries will begin in 1993. The four-engine A340 will seat up to 295 passengers over routes of up to 6,650 miles. It will start passenger service in 1992. Sales of the A330/A340 total 197 aircraft.

A major new trend in the commuter airline market is jet propulsion. The first Canadair Regional Jet, a fifty-passenger derivative of the company's Challenger corporate aircraft, will roll out in early 1991. Embraer is offering a jet derivative of its EMB-123 Brasilia, called the EMB-145. It will fly late next year. BAe is entering this market by offering a new version of its 146 aircraft called the RJ70.

EFA Moving Forward

The first European Fighter Aircraft (EFA) prototype will fly in the 1992 Farnborough Air Show. That, at least, is the word from officials of the four-nation EuroFighter consortium, who declared that the program is on schedule.

EFA will be a twin-engine, delta-wing, all-weather fighter optimized for air defense. It will have short takeoff and landing (STOL) characteristics and will be very maneuverable. It will have thirteen underwing and underfuselage hardpoints for fuel tanks, missiles, or other ordnance and an internal 27-mm Mauser cannon.

For participating nations, the construction work share is determined by the number of airplanes each agreed to buy. Germany and Britain each require 250 EFAs, about one third of the total planned production, so thirty-three percent of the work went to British Aerospace and Messerschmitt-Bölkow-Blohm. Italy needs 165 aircraft, so Aeritalia's work share is twenty-one percent. Spain's requirements call for 100 EFAs, and thirteen percent of the work goes to CASA.

Rollout of the first EFA prototype (P01) is scheduled for late 1991, with first flight to come in early 1992. Eight prototypes (including a two-seater) are scheduled to be flying by 1994. Static and fatigue tests will be performed on two nonflying EFA airframes.

The first two EFA prototypes will be powered by the RB199 powerplants found in the trinational Tornado. In 1993, P03, the third prototype, will be the first to fly with the dedicated EFA engine, the Eurojet EJ200. A collaborative effort of Rolls-Royce, MTU, Fiat, and Sener, the EJ200 is a modular, 20,250-pound-thrust engine. Design verification testing has been completed, and full-scale development testing of twelve engines begins soon.

While development of the fighter is going well, European political realities are changing rapidly. The Federal Republic of Germany committed itself to full-scale development of EFA and would have to ante up 4.5 billion marks (about $2.9 billion) in penalties should it pull out of the program now. Even so, the reunified Germany may decline to participate in production. A production decision must be made in 1992 to obtain funding for production in 1993. So far, Saudi Arabia is the only nation outside the consortium to show interest in EFA.

The Race for JPATS

If the evidence at Farnborough is any guide, competition will be fierce for the contract to produce the new Joint Primary Aircraft Training System (JPATS). This is a USAF/Navy program in which the two services will select the US military's new basic trainer. It could very well be one of the last truly large buys of military aircraft. Plans call for production of nearly 900 JPATS aircraft to replace Air Force T-37Bs and Navy T-34Cs.

Because the cost of a new airplane start would be prohibitive, the US services already have decided to use an existing airframe for the JPATS aircraft. Most companies building military trainers are foreign, and these firms are pairing up with US manufacturers to meet provisions of the "Made in America" Act. Many of the foreign competitors are also unable to produce aircraft in that large a volume.

Many serious JPATS contenders flew their aircraft at Farnborough. Officials of some of the announced teams think that the Air Force, which is the lead service, will issue a request for proposal in 1993 that

flew in 1980 and is now in use in nine air forces. Shorts is building the aircraft under license for the Royal Air Force. The two companies are discussing options that include Embraer and Shorts together teaming with a US company or the two firms independently teaming with US companies.

Saab is looking for a US partner to build its proposed Model 2060, a major upgrade of the company's Sk 60 trainer. Company officials are concerned that the JPATS requirements might specify "tandem-seat, single-engine," which would not only be a complete reversal of the requirements that led to the ill-fated T-46, but would also rule out their

will not contain specific requirements, thus enabling a large number of firms to compete. The JPATS contract, which will almost certainly include ground-based simulation and coursework, will be awarded in 1994.

The Lockheed/Aermacchi JPATS team, which offers the latter's MB-339C tandem-seat trainer, is the only announced group that has a simulator company, Hughes Training Systems, as a teammate. The MB-339 first flew in 1976, and the much improved C model entered Italian service last year. The MB-339 is flown by eight national air forces, including that of New Zealand. The MB-339C would be assembled in Lockheed's Marietta, Ga., facility, should that team win.

Grumman and Agusta, which in October 1988 became the first team to form, offer the Italian S.211 tandem-seat trainer. The S.211 was first flown in 1981 and is in use with Singapore, Haiti, and the Philippines. The JPATS variant will be powered by a Pratt & Whitney Canada JT15D-5C turbofan. Grumman will assemble production S.211s in its Calverton, N. Y., plant.

Fábrica Argentina de Materiales Aeroespaciales (FAMA) is paired with LTV and offers a US-missionized variant of the FAMA IA 63 Pampa, the Pampa 2000. The aircraft first flew in 1984 and entered service with the Fuerza Aérea Argentina in 1988. Some seventy-one percent of the IA 63 is made in the US now, including the Garrett TFE731-2-2 turbofan engine.

Though not a lot was "new" at this year's Farnborough show, the static line was still an impressive collection of aircraft. Shown at top are two French Mirages (a 2000, left, and a 2000.5, right foreground), the BAe Advanced Turboprop Aircraft (center), and the An-225 (rear). The flying display, especially among the fighter pilots, was a show of one-upmanship. Above, the Soviet Su-27 Flanker comes in for a landing after its impressive performance.

The Pilatus PC-9 is the only turboprop officially in the JPATS competition. Pilatus, a Swiss company, is teamed with Beech. The tandem-seat PC-9 was first flown in 1984 and has been procured by Switzerland, Myanmar (Burma), Saudi Arabia, and Cyprus. It is built under license in Australia. Both companies believe there will not be any biases against turboprops in the competition. US PC-9s would be assembled in Wichita, Kan.

Another possible contender is the Tucano tandem-seat turboprop. The Brazilian Embraer EMB-312 first side-by-side, twin-turbofan aircraft.

A surprise JPATS entrant could be the Yugoslavian SOKO G-4 Super Galeb. Yugoslav officials have held talks with General Dynamics and Northrop, but nothing definite has come from them. Jaffe Aircraft, a US firm, is marketing the Romanian IAR-99 worldwide but says the plane would need a new engine to be a serious contender. Jaffe hopes to offer its SA-32T turboprop instead. The MB-339, G-4, and IAR-99 are all powered by versions of the Rolls-Royce Viper turbojet, in production since the 1950s.

Gripen Overcoming Adversity

The Saab-Scania JAS 39 Gripen multirole lightweight combat aircraft program is back on track after the crash of the first prototype halted development work. The second prototype flew for the first time May 4 and had made twelve flights by the start of the air show in England.

The JAS 39 has three missions: air defense, attack, and reconnaissance. A single button in the cockpit tells the computer to configure for each mission. The only visible changes can be seen in the external stores—reconnaissance pods, air-to-air missiles, or ground-attack ordnance. The airplane also has an internal 27-mm Mauser cannon.

The small JAS 39 (with a span of twenty-six feet and a length of forty-six feet) is powered by the Volvo Flygmotor RM12, a low-bypass-ratio, afterburning turbofan based on the General Electric F404-GE-400 engine.

Production has started on the first thirty JAS 39 aircraft. Stockholm is expected to order another 110 planes by next spring. The first production aircraft will be completed early so that it can join the four prototypes in the test program. Production deliveries will start in 1993, a year later than expected. Saab has received permission to perform engineering work on, but not construction of, a two-seat JAS 39B operational trainer.

The British Aerospace/Sierra Research C-29A aircraft (foreground) for the US Air Force was displayed next to its civilian cousin, the BAe 125-800 corporate jet. This was the first public display of the C-29A, which is used for combat flight inspection. The aircraft shown here was the third (of six) delivered to Scott AFB, Ill.

The number four JAS 39 prototype will be flying by the end of the year. The number five and number three (avionics test) JAS 39s will be flying next year. In the meantime, the JAS 39's avionics systems have been installed and are being tested in a Saab JA 37 Viggen.

The 1989 crash of the number one prototype was blamed on flaws in the software of the plane's fly-by-wire flight-control system. After the flaws were corrected, Calspan tested the modified control laws (part of the system's software) for the other prototypes in the Air Force's NT-33 variable stability test aircraft. While the first prototype was a write-off, its fuselage remained largely intact and is being used for radar cross section testing.

Finland is giving serious consideration to purchasing twenty JAS 39s and five JAS 39Bs. Other nations showing active interest in the plane include Switzerland, Austria, and India.

Hundreds of companies, from AABE Fabrieken BV to Westland Technologies, Ltd., displayed or flew at Farnborough '90. A wide majority, including Lucas Aerospace (whose display is shown here) don't build airplanes but provide such parts as castings, actuators, overhead storage bins, seats, and exterior decals.

International Joint Ventures

One of the most unusual international joint ventures is a Soviet-American collaboration. Gulfstream and the Sukhoi Design Bureau plan to build a twelve-to-eighteen-passenger supersonic corporate jet. The Supersonic Business Jet (SSBJ) will be powered by three Rolls-Royce/Lyulka engines that will give it a top speed of Mach 2.2 and a range of almost 5,000 statute miles. A proof-of-concept vehicle should be ready in 1993, with certification of the actual SSBJ expected in 1998. Despite the estimated $50 million price tag, Gulfstream officials say a market will exist for 200–250 SSBJs at the turn of the century.

Making its debut at Farnborough was the two-seat, operational training version of the Italian-Brazilian AMX (AMX-T). The small attack aircraft is a joint effort of Aermacchi and Aeritalia in Italy and Em-

Few companies still will singlehandedly undertake a high-risk, big financial investment program on both the military and civilian side of aviation. A number of collaborative efforts were displayed at Farnborough, among them the Italian/Brazilian AMX light attack aircraft. The two-seat AMX-T is at far left.

braer in Brazil. The AMX program began in 1980. More than forty production aircraft have been delivered. Production is scheduled to run through 1994, with Italy receiving a total of 201 single-seaters and thirty-seven AMX-Ts. Brazil will receive sixty-five AMXs and fourteen two-seaters. The AMX-T was displayed with the single-seat AMX, but neither flew. The plane can carry 8,377 pounds of ordnance on its four wing stations and one centerline station and has an internal 20-mm gun.

BAe and Aerospatiale, which joined forces in the 1960s to build the Concorde supersonic transport, head an international effort to build a new-generation supersonic transport. Teamed with Boeing, McDonnell Douglas, and Airbus, the companies are now studying the concept of a 200–250 passenger plane that could fly at Mach 2 with a range of more than 6,500 nautical miles. Development costs are estimated at $10 billion. If the "SuperConcorde" is developed, it will be powered by four variable-cycle engines.

Eurocopter, created by MBB and Aerospatiale, displayed a full-scale mockup of its Tiger antitank/combat support helicopter. The team received a contract last fall, and a prototype is to fly next year. The combat support version for the French (called HAP) will feature a 30-mm cannon and up to sixty-eight ground-attack rockets. Deliveries of seventy-five HAPs to the French army will start in 1997. Deliveries of 212 PAH-2 (German) and 140 HAC (French) antitank versions of the Tiger will start in 1998. The antitank versions will carry eight HOT-2 (and later TRIGAT) missiles and four air-to-air missiles (Stinger or Mistral). Both Tiger antitank versions will carry a mast-mounted sight.

We Don't Build Airplanes, But . . .

Irvin Aerospace started in England in 1926 but now has two major facilities in the US. Many years ago, Irvin made leather jackets for aircrews. The company now builds some 50,000 air-inflatable bomb retarders a year in its Roxboro, N. C., plant. The BSU-49/B retarder for Mk. 82 (500-pound) bombs was displayed. The company also builds spin-recovery and drag parachutes in California and is providing the parachute and associated hardware for the Shuttle Orbiter Landing Parachute System now being tested at Edwards AFB, Calif.

With three main sites of operation (Britain, the US, and France) and many subsidiaries, Lucas Aerospace is one of the largest and most diverse of all aerospace companies. Lucas makes digital engine control systems, hydromechanical pumps and controls, fly-by-light controls, actuators of all types for missiles and aircraft, electrical systems, panel and formation lights, glazing, missile rails, and even rescue hoists. Lucas also had one of the more unusual displays at the show, a cartoon pilot on a TV screen who exchanged wisecracks with passersby.

Simulation is truly a growth area. Far more than just providing procedures training, simulators today are offering full mission rehearsal. During the show, Utah-based Evans & Sutherland displayed some of the pictures produced by its top-of-the-line ESIG-4000 image generator, and it was hard to tell the real F-14 taxiing by from the one the computer had created. The 4000 comes with a "library" of terrain and object features, such as houses or telephone poles, which can be "called up" when needed. The library saves money and allows a simulator to be reprogrammed quickly.

Frazer-Nash made automobiles and later gun turrets for British bombers during World War II, and its principal business now is missile launch rails. From the "idea whose time has come" file, the company displayed its common rail launcher, capable of launching AMRAAM, Skyflash and Sparrow, Aspide, Mica, ASRAAM, Sidewinder, Python 3, Alarm, and Maverick. The rail features interchangeable modules, options for locating infrared missile coolant bottles, and provisions for installing ECM gear.

ITT displayed the newest generation of night vision goggles, the AN/AVS-6 that is now being delivered to the US Army. The goggles are extremely powerful even with very low light levels, and they use military-issue or common AA batteries. These NVGs are lightweight (550 grams) and are made of high-impact plastic. Peripheral vision is quite good.

Martin-Baker started out building aircraft in the 1930s, but the company's business has shifted to building one part—seats. With nearly seventy-five percent of the total ejection seat market ($120 million a year), M-B is the world leader. It has produced more than 65,000 seats since the mid-1940s and expects to record its 6,000th life saved early next year. The company produces nearly 100 seats a month, including the Navy Aircrew Common Ejection Seat (NACES) for the US Navy. ■

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Frank Carlucci, Vice-Chairman
The Carlyle Group

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To our colleagues, associates, and good friends at Ford Aerospace, Ford Motor Company, and Loral Corporation, we offer our sincere best wishes and hopes for the brightest of futures."

Earle Williams, President
BDM International, Inc.

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Instrumentation, Testing, and Training Systems ▫ Energy, Security, Space, and International Programs

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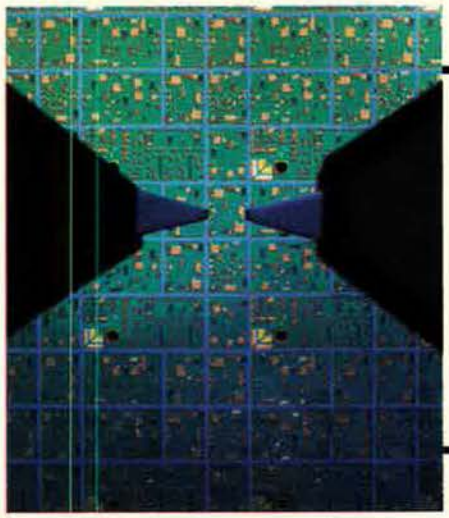
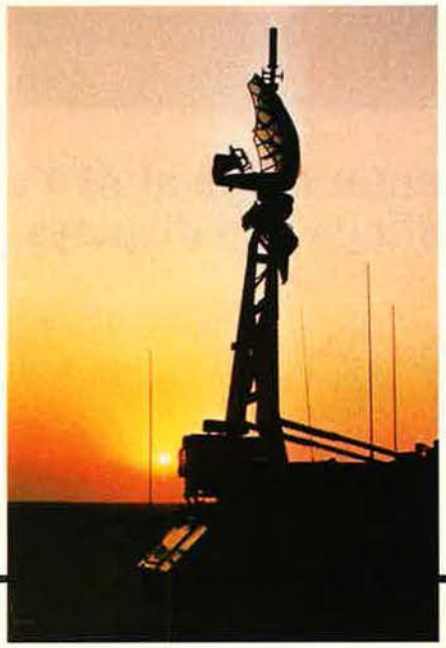


All systems developed at Sanders comprise revolutionary electronic circuitry. Our gallium-arsenide integrated circuits constitute leading-edge technology that will further enhance current electronic warfare, radar and satellite systems.

LEADS TO ANOTHER



Sanders also designs advanced surveillance systems that operate throughout the electromagnetic and acoustic spectra. From air-defense radars and combat direction-finding equipment to communications jammers...

...and antisubmarine warfare systems that are able to detect even the quietest submarines.

Advanced graphics technology can also be found in our high-resolution Miligraphic Displays. Our expertise in information systems also includes software intensive training and simulation systems for a variety of military applications.

We're also breaking new ground in information-processing technology, with a 32-bit mission-data processor that will be integral to the avionics suites of existing and next-generation aircraft. Once processed, vital information is presented in a glass cockpit using liquid crystal displays.

Diverse. Resourceful. Innovative. At Sanders we go far beyond black boxes — combining advanced technology and 40 years of experience to create reliable, affordable, fully integrated engineering solutions. On the ground, at sea, and in the air.

Lockheed Sanders

The ATF held center stage at AFA's aerospace briefings and displays.

Technology in the Spotlight

By Colleen A. Nash, Associate Editor

VISITORS to AFA's Aerospace Development Briefings and Displays became the first to "see" taxi-testing of Lockheed's YF-22 prototype fighter. A film of the September 14 test was released just in time to be shown at the annual exhibition, held September 18–20 in Washington, D. C.

Lockheed (teamed with Boeing and General Dynamics) is in a high-stakes competition with Northrop (teamed with McDonnell Douglas) to build the Advanced Tactical Fighter, the Air Force's next-generation air-superiority aircraft.

Lockheed officials at the show announced that its ATF contender successfully completed a second taxi test. The taxi tests were a prelude to the scheduled late September first flight of the prototype. Northrop's YF-23 entry had already flown several times by then.

In a video, Lockheed program manager Sherm Mullin claimed that the YF-22 represents "a revolutionary approach to a fighter aircraft." The film explained how delays in the enemy's detection of the plane, the result of its use of stealth technology, would translate into offensive advantage: first-look, first-launch, first-kill capability. In the words of Mr. Mullin, "Nonstealth aircraft won't survive."

This year, some 7,000 observers came to the Sheraton Washington Hotel to check out technology displays covering 1.2 acres of floor space. The show featured exhibitions from more than ninety-five of the world's top aerospace concerns. About half of the exhibiting companies provided briefings.

The show featured more foreign companies than ever, and they were eager to promote their technologies in the United States. However, the spotlight was on the homegrown, multibillion-dollar ATF candidates, as the contractor teams begin flight-testing in earnest and the Air Force gets set to pick airframe and engine winners next April.

Visitors to Northrop's booth one morning were among the first to learn that the YF-23 had successfully demonstrated "supercruise" capability during its fifth flight test at Edwards AFB, Calif. Supercruise —the ability to fly at supersonic speed in level flight without using afterburners—is one of several am-

A major attraction at AFA's annual Aerospace Briefings and Displays exhibition was this exotic-looking General Dynamics AGM-129A Advanced Cruise Missile. On public display for the first time ever, the stealthy ACM (this one was a test article) proved riveting for the show's 7,000 or so attendees.

—Staff photo by Guy Aceto

bitious performance requirements laid down by the Air Force.

Neither the speed nor the duration of the flight was disclosed, but Northrop says it will demonstrate supercruise at higher speeds and for longer durations later in the flight-test program.

"Like a Cat"

Paul Metz, Northrop's chief ATF test pilot, said in a video presentation that the YF-23 is "nimble and quick, like a cat." He added that two chase aircraft had to go into afterburner in order to keep up with the YF-23 flying only in military power. On top of that, said Metz, the YF-23 had its landing gear down.

Northrop's video also featured the first footage of the YF-23 completing its first aerial refueling from a KC-135 tanker.

The ATF prototypes were not the only tactical fighters being discussed in the exhibition halls. The Navy A-12 attack plane, built by General Dynamics teamed with McDonnell Douglas, also attracted attention.

As the show opened, GD prominently displayed a model of the stealthy, medium attack aircraft. However, GD took down the model at the behest of the Navy, which was concerned the exhibit had not been properly authorized. Eventually, GD obtained permission to restore the display, and it attracted many onlookers throughout the three-day exhibition.

The Air Force plans to replace its aging F-111s with its version of the A-12 in the 1990s.

Yet another stealthy aircraft, the unearthly-looking Lockheed F-117A, piqued the interest of many. A Lockheed-produced film of a flight of the angular, slightly sinister-looking fighter drew many curious observers.

Because stealth technology plays such a pivotal role in the ATF, Lockheed was not shy about pointing out that the F-117A is "the world's first operational aircraft designed to exploit low-observable technology." Lockheed's literature also touted the fighter's automated mission planning system, quadruple redundant fly-by-wire flight controls, and state-of-the-art digital avionics suite.

While the F-117A is the first fighter aircraft to heavily incorporate stealth technology, the B-2 is today the only bomber that's got it. The narrator of Northrop's B-2 film contended that the US testing community has tried more than forty different methods of defeating stealth technology, but in vain. "So far," Northrop claims, "no one has developed a practical, feasible way to defeat stealth."

As Northrop was preparing for tests of the airplane's low-observable properties, visitors got some insights on this facet of the program. In a video report, test pilot Bruce Hinds said he is confident that the B-2 will fare as well in this type of testing as it has in the flight-testing that has been going on for the past year.

The test pilot added that, in addition to being stealthy, the B-2 is "a very good basic airplane," with range, payload, and speed equal to or better than other Air Force bombers.

LTV Aircraft Products Group, which is providing a portion of the B-2's airframe, highlighted its advanced manufacturing achievements. LTV contends that "from

wingtip to wingtip, the B-2 is accurate to within one-quarter inch [of design specification]," which the firm claims is several times more precise than any other aircraft ever built.

Stealthy Cruise Missile

GD unveiled the first public display—a test article—of the AGM-129A advanced cruise missile (ACM). This follow-on to the AGM-86B air-launched cruise missile (ALCM) offers improved range, accuracy, targeting flexibility, and survivability, the latter primarily a product of its stealthiness.

Company representatives furnished few details but reported that the test program has been successfully concluded and that approximately thirty out of the forty-five missiles produced to date have been delivered to K. I. Sawyer AFB, Mich.

The Air Force has qualified McDonnell Douglas as a second-source ACM contractor, and the company flew its first ACM this summer. However, there are questions about whether the Air Force should maintain both or cut the best deal with one of them and "buy out" the entire order.

The exhibition not only featured the sleek fighters and bombers of the future but the hefty workhorses of the nineties as well.

As McDonnell Douglas representatives were setting up their booth, the company's C-17 transport was moving out of the assembly building at Long Beach, Calif. First flight is set for no later than next June, and a spokesperson said that there is no question that the company will meet that milestone. Word is that the high-payload/long-range airlifter may roll out next March.

Lockheed's literature about its C-130J transport declared that the single most distinctive feature of the revamped theater airlifter is an "advanced two-person flight station with high-resolution, full-color liquid crystal displays plus head-up displays for the pilots."

In another part of the exhibit hall, Messerschmitt-Bölkow-Blohm/Deutsche Aerospace offered a status report on what has been conceived as the European fighter for the 1990s—the European Fighter Aircraft, or EFA. Briefers said that production of major structural components for the prototype is well under way in the four EFA partner nations—Germany, the United Kingdom, Italy, and Spain. First flight of the prototype is slated for early 1992, and delivery of some 800 aircraft to the four air forces is scheduled to begin in 1996.

Consortium representatives described how the EFA will be optimized for short-range, medium-range, and beyond-visual-range air combat and spotlighted such features as advanced materials, sophisticated cockpit management, all-aspect ECM/ECCM, fully integrated digital avionics mission suite, and all-weather, day-and-night capability.

EFA participant British Aerospace also provided an update and said that it expects the export potential of the aircraft to be high.

Competing Powerplants

The world's premier enginemakers were on hand to make a case for their competing ATF powerplants.

General Electric's main message was that its candidate, the YF120-GE-100 variable-cycle engine, has only "half the hot-section parts of today's best fighter engines" yet delivers a "significant increase in dry thrust and a subsonic economy cruise mode" to extend the ATF's service life.

Pratt & Whitney called attention to the engineering and design wizardry that went into the design of its candidate, the YF119-PW-100. The powerplant boasts advanced materials and aerodynamics, improved cooling techniques, and highly reliable digital engine control. However, the star of P&W's exhibit was a full-size mockup of the YF119 flight-test engine, fitted with a two-dimensional thrust-vectoring nozzle. Pratt & Whitney executives said that the mockup was "accurate except for the exhaust nozzle," which was generic in shape and size.

Pratt & Whitney's engine is undergoing flight-testing in the Northrop/McDonnell Douglas YF-23. Lockheed's first YF-22 prototype will fly with the GE YF120 powerplant. Later, engines and airframes will be switched.

Northrop and Raytheon provided fact sheets (and little else) on the new Tacit Rainbow unmanned air vehicle for suppression of enemy air defenses. Designated AGM-136A, the jet-powered system is designed to fly to a target, loiter over the target area, detect radar emissions, and then autonomously attack and disable hostile air defense systems. Northrop representatives said that the weapon's advanced avionics, on-board computer, and autonomous operation make Tacit Rainbow a truly "smart" weapon. Ray-

—Staff photo by Guy Aceto

The British Aerospace booth in the vast display hall proudly and fittingly struck the AFA National Convention's "Battle of Britain" theme. More than ever, this year's show featured the aerospace wares of foreign companies eager to promote their technologies and market their products in the United States. The European Fighter Aircraft (EFA) embodies many such technologies.

theon, teamed with McDonnell Douglas and E-Systems, has been selected to develop for the Army a ground-launched version of the lethal drone. It also has been qualified as a second producer of the air-launched variant for the Air Force and the Navy.

A Hughes Aircraft Co. film emphasized the all-weather aspect of the AIM-120A advanced medium-range air-to-air missile (AMRAAM). Texas Instruments devoted much of its briefing to its AGM-88 high-speed antiradiation missile (HARM), and Boeing's program focused on its development of the new short-range attack missile (SRAM-T), designated AGM-131B.

The latest computing technologies were much in evidence in the exhibition hall. In Raytheon's space, for example, the company exhibited an actual "militarized" VAX computer. The so-called Military VAX system is a military-specification version of Digital Equipment Corp.'s powerful VAX 6200 commercial computer, though it is much smaller. It puts the power of 4,500,000 instructions per second and thirty-two megabytes of memory in a system less than one cubic foot in size. Raytheon manufactures Military VAX under license from DEC.

Company representatives say the new line of computer is aimed at providing off-the-shelf computing power for command and control and fire control in ground, airborne, and shipborne systems. Some program managers have already specified the Military VAX product in weapon designs. The second USAF E-8A Joint STARS aircraft, for example, has been fitted with three light, small, and powerful Military VAX computers.

—Photo by Paul Kennedy

Secretary of the Air Force Donald B. Rice confers with aerospace industry officials while touring the exhibit hall. Dr. Rice addressed the AFA Convention and was in the vanguard of top Air Force officials taking in the displays. Despite the downward trend in defense spending, interest in new systems was high.

—Photo by Paul Kennedy

Ford Aerospace displays the business end of the latest model of its heat-seeking, highly discriminate Sidewinder air-to-air missile. The Convention exhibits provided industry and defense officials with a once-a-year look at the wealth of modern hardware available to US and Allied air forces. Of special note were the Advanced Tactical Fighter (ATF) displays and briefings.

Fighter Communications

Hughes promoted the HIT II Fighter Terminal, designed to provide combat aircraft an antijam, secure, high-capacity, and interoperable data link with other planes and ground stations. Hughes is the leader of a consortium of US and European firms seeking to build the terminals.

The Hughes terminal would give NATO European aircraft a multifunction information distribution system, or MIDS. In the US, the MIDS capability is known as JTIDS, for Joint Tactical Information Distribution System. The NATO version is designed to be less expensive than the US system. Both systems help control Allied fighters from ground centers or early warning planes.

HIT II uses a computer that processes 30,000,000 instructions per second and new-generation monolithic microwave integrated circuits. The firm also makes heavy use of very-high-speed integrated circuits and other components that could be manufactured in Europe. One HIT II innovation: a low-probability-of-intercept data link for short-range communications.

The vast array of cockpit gear spoke well of industry responsiveness to the needs of pilots. Many companies showcased their wares

to reduce pilot work load, displaying the latest liquid crystal displays, head-up displays, and high-tech helmets.

Sextant Avionique, a French firm, gave blue-suiters an up-close look at its proposed six-by-eight-inch liquid crystal display for several of USAF's transport cockpit upgrade programs.

The world's leading supplier of HUD systems, GEC Avionics, told attendees it has already delivered much of its C-17 HUD hardware to McDonnell Douglas.

In the realm of simulators, CAE-Link Corp. discussed the attributes of its training system for the B-2 bomber. Describing its Weapon System Trainer (WST) as "the most complex and capable simulator ever built," Link also pointed out that it has developed the largest real-time simulator using Ada software—some 1,700,000 lines of code. The firm also designed and built the training system for the F-117A Stealth fighter, but representatives remained tight-lipped about it.

Loral Corp. provided information on the merits of its "Hotshot" combat tactics trainer, versions of which are available for both the F-15 and F-16 fighters. The CTT, which looks like a sophisticated video-arcade game, consists of a mock cockpit with authentic stick and throttle and a computer monitor that displays authentic HUD symbology, plus a second computer terminal with keyboard. The whole system requires fewer than eighty square feet of floor space.

In the Enemy's Shoes

Once in the CTT, the pilot can select weapons for the particular mission, select enemy aircraft and armament, dial up the desired enemy pilot skill level and proficiency, and plug in a particular set of tactics. The CTT has a built-in playback and debriefing feature and offers a "freeze" mode by means of

AEROSPACE INDUSTRY IN REVIEW

Companies Represented at the 1990 Aerospace Development Briefings and Displays

AIL Systems Inc.
Advanced Electronic Warfare Technology
Allied Signal Aerospace Co.
Latest Aircraft Equipment from Bendix, Bendix/King, Garrett, AiResearch
Ball Aerospace Systems Group
Highlights of Current Air Force Programs
Bell Helicopter Textron/Boeing Helicopters
The SOF Osprey
Boeing Co., The
Advanced Tactical Fighter (ATF), B-2, ICBMs, Short-Range Attack Missile (SRAM-T)
British Aerospace
Overview of British Aerospace's Capabilities, Defense Products Worldwide
CAE Link Corp.
Training Systems for B-2 Bomber and F-117A Stealth Fighter
Contel Federal Systems
Automated Weather Distribution System (AWDS)
Control Data Corp.
Applications of Control Data Militarized Avionics Processors and Mass Memory Systems in Air Force Programs
Emerson Electric Co., Electronics & Space Corp., Hazeltine Corp.
Airborne Special Applications Radars and C³I Equipment
Evans & Sutherland
Advances in Simulation for the 1990s
Ford Aerospace
Tactical Missile Systems, Electro-optical Defense Products, Services for Engineering USAF Satellite Control Network
GEC Avionics/GEC Ferranti
Total-Capability Electronic Systems for Aviation
General Dynamics Corp.
A "Newscast:" Presentation of General Dynamics/USAF Programs
GTE Government Systems
USAF Command and Control (C^2) Systems, Software Modernization Program
Gulfstream Aerospace Corp.
C-20F Gulfstream
Hercules Aerospace Co.
Hercules Expendable Launch Vehicle Capabilities
Hughes Aircraft Co.
Advanced USAF Missile and Electronics Systems
IBM Corp.
IBM's Role in Global Positioning System, Defense Support System, Combat Talon II
Lear Astronics Corp.
Fly-by-Wire Flight Control and Vehicle Management Systems
Litton Systems, Inc.
MCE & Selected Tactical C^2 Equipment (ATS, TDC, and Digital Gateway)
Lockheed Corp.
The F-22: "A Human Achievement"
Loral Corp.
AN/ALR-56M Advanced Radar Warning Receiver, "On Target"
LTV Aircraft Products
LTV's Role in the C-17 Airlifter, B-2 Bomber, JPATS Trainer, YA-7F
Lucas Aerospace
New Manufacturing Facilities, Techniques to Develop Advanced Products for Tomorrow's Air Force Systems
Magnavox Government and Industrial Electronics Co.
Antijam, Low-Detectable Communications
Martin Marietta Corp.
Filling Today's Needs and Tomorrow's Requirements for USAF
MBB-Deutsche Aerospace
ECR Tornado, EFA, X-31A, and WWFO Aircraft Programs
McDonnell Douglas Corp.
Military Systems, C-17, KC-10, F-15E, YF-23 Advanced Tactical Fighter
Motorola, Inc., Government Electronics Group
Advances in Space Communications
Northrop Corp.
B-2 Bomber, YF-23 Advanced Tactical Fighter
Raytheon Co.
Air-to-Air Missiles, Other USAF Programs
Rockwell International
Collins Government Avionics Div.
Integrated Avionics Systems for Military Aircraft
North American Aircraft
Update on B-1B Bomber, X-30 National Aerospace Plane, X-31 EFM Demonstrator Aircraft
Space Systems Div., Rocketdyne Div., Satellite & Space Electronics Div.
Progress Report on Space Shuttle, Extended Duration Orbiter, Future Shuttle Derivatives, Assured Crew Return Vehicle
Sextant Avionique
Technology/Facilities for Liquid Crystal Cell Production and Display Systems
Sundstrand
Sundstrand Products for USAF Applications
Teledyne CAE
A Leader in Jet Propulsion for More than Fifty Years
Textron, Inc.
Peacekeeper ICBM (with TDSMK21 Reentry Vehicle, Deployment Module) and Sensor Fuzed Weapon
Thiokol Corp.
Solid Propulsion Systems for Manned and Expendable Launch Vehicles
TRW, Inc.
Command Center Technology
United Technologies Corp.
Update of the F119, PW-229, and F117 Engine Programs
Vitro Corp.
Software Reengineering

The following companies displayed, but did not hold briefings.

Aerojet
Aerospatiale, Inc.
Astra Holdings Corp.
AT&T
Bell Aerospace Textron
Bombardier/Canadair Group
Brunswick Defense
Canadian Marconi Co.
Cardion Electronics, Inc.
DATATAPE Inc.
Deere & Co.
Delco Electronics Corp.
Dornier (North America), Inc.
Dowty
ECC International Corp.
EDO Corp.
E-Systems
Fairchild Defense
FlightSafety International
General Atomics
General Electric
Aerospace
Aircraft Engines
Grumman Corp.
Harris Corp.
Honeywell Inc.
Interstate Electronics Corp.
ITT Defense
Jane's Information Group
Kaiser Electronics
Kollsman
Litton Systems Inc.
Aero Products Div.
Applied Technology Div.
Litton Guidance & Control Systems
Loral Corp.
Matra Defense
NavCom Defense Electronics, Inc.
Orbital Sciences Corp.
Recon/Optical, Inc.
Rockwell International Corp., Defense Electronics
Tactical Systems Div.
Autonetics Marine & Aircraft Systems Div.
Autonetics Strategic Systems Div.
Rolls-Royce Inc.
Short Brothers (USA), Inc.
Smiths Industries
Snap-On Tools Corp.
SNECMA
Space Applications Corp.
Standard Manufacturing Co., Inc.
Sun Microsystems
Systems Research Laboratories, Inc.
Systron Donner
Texas Instruments
Westinghouse Electric Corp.
Williams International

which a pilot can assess his situation from a variety of viewpoints—including that of the enemy pilot.

The system uses multiple, parallel-processing Central Processing Units and new, modular software. Company officials say system "uptime" exceeds ninety-five percent.

In the satellite arena, TRW Space & Technology Group advertised its ability to produce a new type of simple, relatively less expensive satellite, which it calls the "Eagle class." Such satellites are known variously as spinsats (single-purpose, inexpensive satellites), lightsats, or "cheapsats."

Though TRW for decades has been heavily involved in the production of large, expensive, multipurpose satellites, its literature claims "we are no strangers to small satellites." TRW built thirty-four of these types of vehicles for the Air Force and NASA during the 1960s and 1970s. In the Eagle venture, TRW has teamed up with Defense Systems, Inc., a leading producer of small spacecraft, to produce a modular spacecraft that can be reconfigured for particular scientific or operational missions.

Several companies conducted briefings on their roles in development and production of the Navstar Global Positioning System (GPS) program. The constellation of twenty-one satellites will give users extremely accurate, three-dimensional information on position, velocity, and time.

General Electric's Astro-Space Division, the newest major GPS subcontractor, offered data on its Block II replenishment space vehicles. GE says that the spacecraft, designated GPS Block IIR, will be launched beginning in 1995.

IBM says that it continues to enhance the capabilities of ground-based command and control systems that handle the GPS launch and daily operations.

Also in the space field, Aerojet provided information about its Special Sensor Microwave Imager Sounder (SSMIS). The SSMIS program aims to develop a new, highly advanced sensor for the next generation of spacecraft that will be built under the Defense Meteorological Satellite Program, DMSP Block 5D-3, now set to appear in the mid-1990s.

The Air Force recently awarded Aerojet a $62.1 million contract to produce the new sensor, which would combine capabilities of three different instruments—microwave imager, temperature sounder, and humidity profiler. It would also have to be more reliable in operation and produce sharper and more accurate weather data. Aerojet will use gallium arsenide devices, hybrid and integrated electronics, and the latest microwave technologies.

Concerns over Iraqi threats to employ chemical weapons against US troops accounted for the steady stream of visitors to the Brunswick Defense booth. The firm displayed its chemical weapon protective gloves. The butyl gauntlets are designed to provide several hours' worth of resistance to mustard agents and the nerve agent sarin. ■

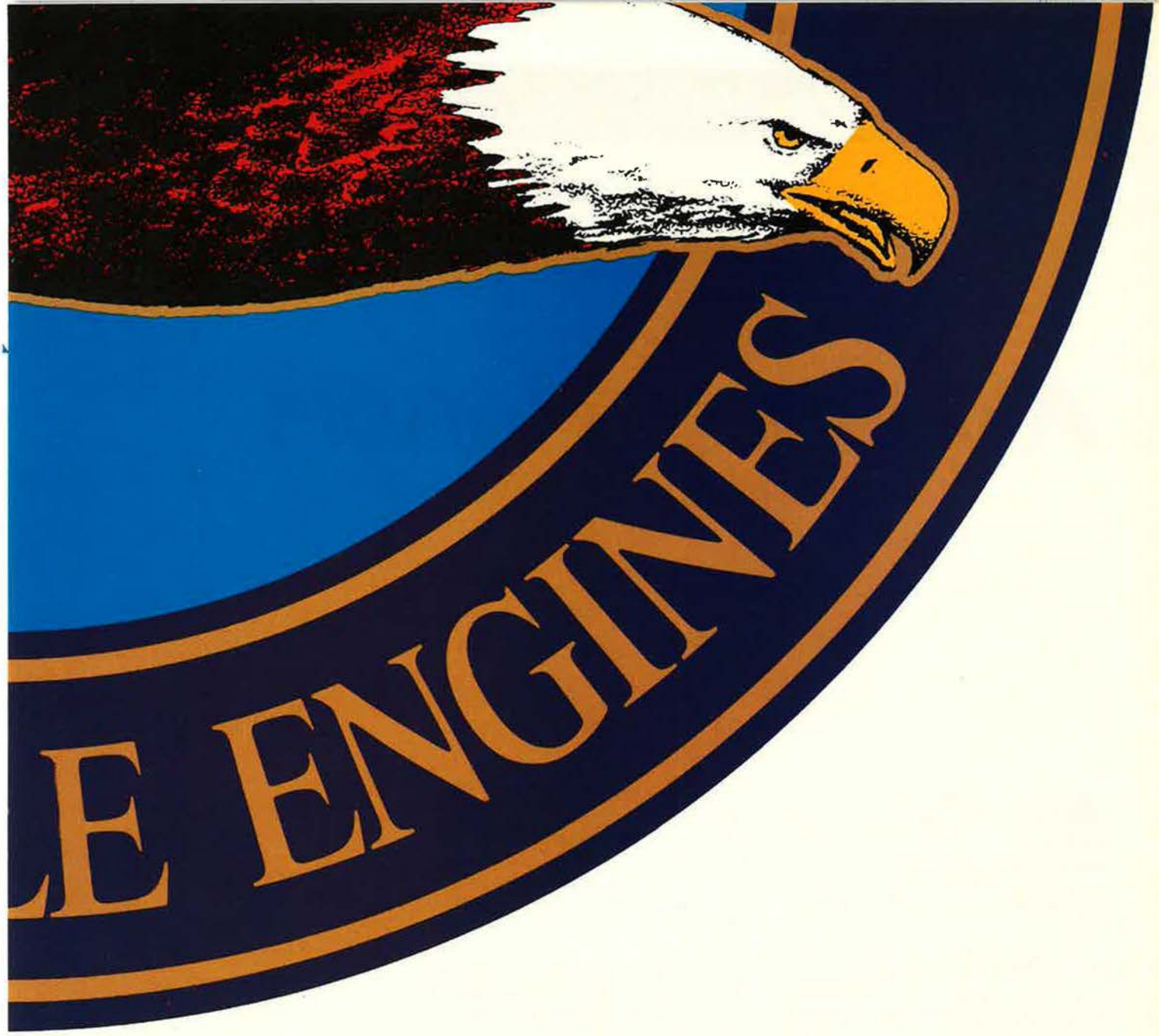
—Staff photo by Guy Aceto

Briefings by exhibitors at the AFA show proved highly instructive for thousands who toured the halls. Typical were these civilian and military officials intent on learning more about the advanced space-launch vehicles prominently on display. Space systems were much in evidence at this year's exhibition.

—Photo by Paul Kennedy

Gen. John M. Loh, who addressed the AFA Convention as the Air Force's Acting Chief of Staff, looks over Pratt & Whitney's full-size mockup of the YF119 flight-test engine. General Electric powerplants, including a hardware display of the B-2 bomber's F118 engine, also were featured in a show that spotlighted modern propulsion technologies and others for military aircraft.

WHAT KIND SHOULD GO



OF ENGINES IN THE ATF?

UNITED TECHNOLOGIES PRATT&WHITNEY

AFA's National Convention spotlighted the Battle of Britain, the year's outstanding airmen, and much more.

A Week of Honors

A FIFTIETH-anniversary tribute to those who fought in the Battle of Britain provided a spectacular climax to the Air Force Association's National Convention, held September 17–20 in Washington, D. C.

The program, presented at the dinner dance on Wednesday evening of Convention week, featured a laser show, a special film, narration by actor Peter Graves, and music by the US Air Force Band, the Singing Sergeants, the Airmen of Note, and the Fanfare Trumpeters of the Royal Air Force Band.

Among the many dignitaries in the audience for the presentation were the British ambassador to the United States and his wife, Sir Antony and Lady Acland.

A dinner on Tuesday night of Convention week honored the Air Force's twelve Outstanding Airmen of the Year.

Election of Officers

Oliver R. Crawford of Austin, Tex., was elected President of the Air Force Association at this forty-fourth National Convention. The theme of the Convention was "Year of Decision."

Outgoing President Jack C. Price of Clearfield, Utah, was elected Chairman of the Board. Thomas W. Henderson of Tucson, Ariz., was elected National Secretary, and William N. Webb of Midwest City, Okla., was reelected National Treasurer.

Gerald V. Hasler of Albany, N. Y., was reelected President of the Aerospace Education Foundation. James M. Keck of San Antonio, Tex., was reelected AEF Chairman of the Board. Thomas J. McKee of Fairfax Station, Va., was elected Vice President, John R. Alison of Washington, D. C., was reelected Treasurer, and Walter E. Scott of Dixon, Calif., was reelected Secretary.

For a list of AEF officers and trustees (as of September 16, 1990), see p. 67.

An Active Week

More than 7,000 people took part in one or more of the Convention-related activities at the Sheraton Washington Hotel. The 367 registered delegates, representing forty-seven states and the District of Columbia, were joined by a host of

—Photo by Paul Kennedy

Secretary of the Air Force Donald B. Rice greets Junior ROTC Cadets while making the rounds at the Air Force Association's forty-fourth National Convention last September in Washington, D. C. Cadets at Winston Churchill High School, Potomac, Md., won an Aerospace Education Foundation award with their essay on "Education: Our First Line of Defense."

others, including senior military and government officials, for the Aerospace Development Briefings and Displays program, featured speeches, and social events. On hand to cover the Convention were more than 200 reporters and other news-media representatives.

President George Bush sent AFA a letter that read, in part: "Since your last National Convention, dramatic changes around the world have brought us into a new era in international relations." The President expressed confidence that, as the services' role is adjusted to new political realities, AFA members "will continue to help keep our Air Force ready to defend peace and freedom around the world."

Meeting concurrently with the Convention were trustees of the Aerospace Education Foundation and the Air Force's command senior enlisted advisors, as well as AFA's Air National Guard Council, Civilian Personnel Council, Enlisted Council, Junior Officer Advisory Council, Reserve Council, and Veterans/Retirees Council.

• *Congressional activity.* Twenty-five state delegations sponsored congressional breakfasts on Tuesday and Wednesday of Convention week. Fifty-six members of Congress participated. Among them were Sam Nunn (D-Ga.), John Warner (R-Va.), James Exon (D-Neb.), John McCain (R-Ariz.), Slade Gorton (R-Wash.), and Dan Coats (R-Ind.) of the Senate Armed Services Committee and Jake Garn (R-Utah), Phil Gramm (R-Tex.), Dennis DeConcini (D-Ariz.), Bob Kerrey (D-Neb.), Frank Lautenberg (D–N. J.), and Quentin Burdick (D–N. D.) of the Senate Appropriations Committee. Attending from the House Armed Services Committee were Andy Ireland (R-Fla.), Jon Kyl (R-Ariz.), Richard Ray (D-Ga.), Buddy Darden (D-Ga.), Gene Taylor (D-Miss.), Herbert Bateman (R-Va.), Owen Pickett (D-Va.), Norman Sisisky (D-Va.), John Tanner (D-Tenn.), James Hansen (R-Utah), Martin Lancaster (D–N. C.), Robert Davis (R-Mich.), and Jim McCrery (R-La.). Attending from the House Appropriations Committee were Jim Kolbe (R-Ariz.), Virginia Smith (R-Neb.), Bernard Dwyer (D–N. J.), and Bob Livingston (R-La.).

• *Other elections.* Five new National Vice Presidents were elected. They are Aaron C. "Burly" Burleson of the Southwest Region, H. R. "Bobby" Case of the South Central Region, Robert W. Gregory of the Northeast Region, Cecil H. Hopper of the Great Lakes Region, and Robert N. McChesney of the New England Region.

Charles A. Gabriel of McLean, Va., H. B. "Buzz" Henderson of Ramona, Calif., Frank M. Lugo of Mobile, Ala., Thomas J. McKee of Fairfax Station, Va., Mary Ann Seibel of St. Louis, Mo., and Walter G. "Gibby" Vartan of Chicago, Ill., were elected to the Board of Directors for three-year terms. James E. "Red" Smith of Princeton, N. C., and Joseph A. Zaranka of Bloomfield, Conn., were elected for two-year terms. P. D. Straw of San Antonio, Tex., was elected for a one-year term.

New Under-Forty Directors joining the AFA Board are John V. Kelly of Linthicum, Md., and Robert W. Marsh of Springfield, Ga.

For a complete list of National Vice Presidents and Directors, including those reelected, see "This Is AFA" on p. 104.

• *Membership report.* At a delegates' reception on Monday of Convention week, outgoing AFA National President Jack C. Price announced that the number of life members and patrons increased by five percent and that community partnerships were up by more than thirty percent.

• *Aerospace Education Foundation.* An essay on "Education: Our First Line of Defense" won the Foundation's annual contest for presentations by Air Force Junior ROTC cadets. The winning entry was from Winston Churchill High School, Potomac, Md. For next year's contest, cadets will submit video presentations of their unit's most worthwhile community project. Sue Ellen Darnell from Frankfort, Ky., won this year's Christa McAuliffe Memorial Award, presented to the nation's outstanding aerospace educator. Ohio State Secretary Stephen E. Finney received the AEF Presidential Citation for his participation in the state's Youth Aerospace Leadership program.

• *Acknowledgments.* Parliamentarian for the AFA National Convention was Martin H. Harris. M. Lee Cordell was Sergeant at Arms. Inspectors of Elections were Earl D. Clark, Jr. (Chairman), Walter E. Scott, and Bruce Robin Stoddard. Nathan H. Mazer chaired the Credentials Committee, serving with Cheryl Lynn Gary and Robert L. Carr.

The Association is particularly grateful to a corps of volunteers who assisted the staff in Convention support: Norm Aubuchon, Scott Boyd, Cecil Brendle, Evie Dunn, Charles and Mary Lucas, Debbie and Gregory Snyder, and John Zipp.

The 1991 Convention will be held at the Sheraton Washington Hotel, Washington, D. C., on September 16–19. ■

—Photo by Paul Kennedy

James M. Keck, newly reelected as the Aerospace Education Foundation's Chairman of the Board, chats with Air Force Acting Chief of Staff Gen. John M. Loh and CMSAF Gary R. Pfingston at the AFA Convention.

—Photo by Susan Kennedy

Cecil H. Hopper, left, president of Ohio State AFA, receives AFA's "Man of the Year" award from outgoing AFA President Jack C. Price during the opening-day awards ceremony. Under Mr. Hopper's leadership, Ohio State AFA won recognition as AFA's top state organization, largely for its program to teach youth about aerospace.

Air Force Association's 1990 Unit Activity Awards

Donald W. Steele, Sr., Memorial Award
AFA Unit of the Year

General E. W. Rawlings Chapter, Minnesota

Outstanding State Organization

Ohio State Organization

Outstanding Chapters

Paul Revere, Massachusetts (more than 900 members)
Cheyenne Cowboy, Wyoming (401–900 members)
Charles A. Lindbergh, Connecticut (151–400 members)
Green Valley, Arizona (20–150 members)

Exceptional Service Awards

Alamo, Texas (Aerospace Education)
Donald W. Steele, Sr., Memorial, Virginia (Best Single Program)
Fort Worth, Texas (Communications)
Carl Vinson Memorial, Georgia (Community Relations)
Central Florida, Florida (Overall Programming)

Arthur C. Storz, Sr., Membership Awards

AFA's most prestigious membership awards are named after Arthur C. Storz, Sr., a former permanent AFA National Director, Life Member, and principal founder of Omaha's Ak-Sar-Ben Chapter. The Storz Membership Award, made possible through a generous endowment to the Association by his son, Art Storz, Jr., has been awarded for membership excellence based on criteria approved by AFA's Board of Directors for the year ending June 30, 1990.

Storz Chapter Awards

Paul Revere, Massachusetts
Leo D. O'Halloran, President

Storz Individual Award

John W. Siedlecki

Air Force Association's 1990 Community Partner Membership Awards

President's Award

This award was created to recognize the chapter that has recruited the greatest percentage of Community Partners (in terms of chapter membership). Chapters must have a minimum of fifteen Community Partners to be eligible for this award.

Lloyd R. Leavitt, Jr., Michigan

Gold Awards

These awards were created to recognize chapters that have recruited a total number of Community Partners equal to or greater than two percent of their overall chapter membership. Chapters must have a minimum of ten Community Partners to qualify.

Admiral Charles E. Rosendahl, New Jersey
Ark-La-Tex, Louisiana
Cape Canaveral, Florida
Carl Vinson Memorial, Georgia
Cheyenne Cowboy, Wyoming
Cochise, Arizona
Del Rio, Texas
Delaware Galaxy, Delaware
Enid, Oklahoma
General David C. Jones, North Dakota
General Ira C. Eaker, Arkansas
Green Valley, Arizona
Guam–Arc Light, Guam
H. H. Arnold Memorial, Tennessee
Happy Hooligan, North Dakota
Huron, Michigan
Joe Walker, Pennsylvania
John C. Stennis, Mississippi
Langley, Virginia
Llano Estacado, New Mexico
Midnight Sun, Alaska
Mid-Ohio, Ohio
Mobile, Alabama
Ogden, Utah
Paul Revere, Massachusetts
Pope, North Carolina
Roanoke, Virginia
Robert H. Goddard, California
Scott Berkeley, North Carolina
Tennessee Valley, Alabama

Achievement Awards

These awards recognize chapters that have recruited a total number of Community Partners equal to one percent of overall chapter membership. Chapters must have a minimum of five Community Partners to qualify.

Ak-Sar-Ben, Nebraska
Anchorage, Alaska
Cape Fear, North Carolina
Central Florida, Florida
Central Oklahoma (Gerrity), Oklahoma
Colorado Springs/Lance Sijan, Colorado
Dale O. Smith, Nevada
Eagle, Pennsylvania
Florida Highlands, Florida
Foothills, North Carolina
Freedom, Pennsylvania
Golden Triangle, Mississippi
Lubbock, Texas
Major John S. Southrey, Massachusetts
Morgan S. Tyler, Florida
Quad Cities, Illinois
Southwest Florida, Florida
Tacoma, Washington
Tallahassee, Florida
Thomas B. McGuire, Jr., New Jersey
Total Force, Pennsylvania
Tucson, Arizona
Wright Memorial, Ohio

Special Awards

North Carolina State AFA
(First state with two chapters having 100 Community Partners each)

Carl Vinson Memorial, Georgia
(First chapter with more than 200 Community Partners)

AFA'S NATIONAL AEROSPACE AWARDS

The H. H. Arnold Award (AFA's highest honor to members of the armed forces in the field of National Security)—To **Gen. John T. Chain, Jr.,** Commander in Chief, SAC, Offutt AFB, Neb., for his extraordinary and courageous leadership in support of strategic modernization during an era of unprecedented change. His tireless commitment to the successful implementation of US strategy has contributed immeasurably to US security.

The W. Stuart Symington Award (AFA's highest honor to a civilian in the field of National Security)—To the **Hon. John J. Welch, Jr.,** Assistant Secretary of the Air Force for Acquisition, Washington, D. C., for his outstanding service to the Air Force and superior leadership in his role as Service Acquisition Executive. His talent and abilities have helped mold a thoroughly professional acquisition organization, setting the standard for the Department of Defense.

The David C. Schilling Award ("The most outstanding contribution in the field of Flight")—To **Air Force Flight Operations–Just Cause,** for the brilliant operation of the total Air Force team in the liberation of Panama. The detailed planning, precision of execution, tremendous coordination and support that the Air Force provided to all services, and the outstanding response of active-duty, Guard, and Reserve forces helped make this operation a sterling success. *(Accepted by Gen. John M. Loh, Acting Chief of Staff, USAF.)*

The Theodore von Kármán Award ("The most outstanding contribution in the field of Science and Engineering")—To the **B-2 Test Team,** Wright-Patterson AFB, Ohio, for exceptional success in testing and evaluating the radically new B-2 design, validating ten years of simulation and ground testing. This endeavor, sustained by hundreds of dedicated civilian and military people, is expanding the horizons of flight and promises to keep the US on the leading edge of aerospace and manufacturing technology. *(Accepted by Maj. Gen. Richard M. Scofield, USAF, Program Director for B-2, and Oliver C. Boileau, President and General Manager, Northrop Corp., B-2 Division.)*

The Gill Robb Wilson Award ("The most outstanding contribution in the field of Arts and Letters")—To **Charles Krauthammer,** Washington, D. C., for his incisive analyses of key national defense issues as a syndicated columnist and televison panelist, contributing to public understanding of US defense requirements at a critical juncture in history.

The Hoyt S. Vandenberg Award ("The most outstanding contribution in the field of Aerospace Education")—To **Rep. G. V. "Sonny" Montgomery (D-Miss.),** Meridian, Miss., for a positive contribution to providing education to more than one million men and women of the US armed forces through the "GI Bill." This innovative legislation has played a key role in the success of the all-volunteer force and in the development of a better-educated citizenry.

The Thomas P. Gerrity Award ("The most outstanding contribution in the field of Logistics")—To **Lt. Col. Dennis W. Goldston,** 10th Tactical Fighter Wing, USAFE, RAF Alconbury, UK, for his unparalleled professionalism as a squadron commander and the wing's chief of supply. His astute management during a time of unprecedented mission changes sets new leadership standards.

The Department of Veterans Affairs Employee of the Year Award—To **Jayne Rhea Oertle,** VA Medical Center, Muskogee, Okla., for her consummately professional nursing efforts as a Clinical Specialist. She developed and expanded an extremely successful alcoholism and drug-abuse treatment program while initiating a support group for female veterans and contributing to a dynamic community outreach program.

The Juanita Redmond Award for Nursing—To **Capt. Michael Bagwell,** Elmendorf AFB, Alaska, for his superior accomplishments, especially in training techniques, that resulted in improved patient care.

The General Edwin W. Rawlings Award for Energy Conservation (Manager)—To **Jack D. Seigler,** Lackland AFB, Tex., for outstanding achievements in energy conservation within the United States Air Force.

The General Edwin W. Rawlings Award for Energy Conservation (Technician)—To **Patricia W. Runyan,** USAF Academy, Colo., for outstanding achievements in energy conservation within the United States Air Force.

—Photo by Paul Kennedy

Newly elected Chairman of the Board Jack C. Price (right) presents AFA's Theodore von Kármán Award. Accepting on behalf of the B-2 test team are Maj. Gen. Richard M. Scofield, USAF's B-2 program director, and Oliver C. Boileau, president and general manager of Northrop's B-2 Division. At left is William N. Webb, re-elected AFA National Treasurer.

AFA CITATIONS OF HONOR

The **3534th USAF Recruiting Squadron,** Salem, Va., for achieving—alone among thirty-four squadrons nationwide—all twenty-one assigned recruiting goals in FY 1989. Despite its relatively high percentage of rookie recruiters, the squadron met 150 percent of several of its goals, including 162 percent of the difficult health-professions goal. *(Accepted by Lt. Col. Carl M. Rydell, Squadron Commander.)*

Maj. Thomas L. Bowlin, USAF, Fort McPherson, Ga., for his exceptional performance as the executive agent for developing and implementing effective, safe, and responsive plans for repatriation of Americans from overseas trouble spots.

A **C-141 crew of the 514th Military Airlift Wing,** McGuire AFB, N. J., for safely landing its aircraft, which had lost its right main landing gear at takeoff. Because of the crew's coordination, profes-

—Photo by Paul Kennedy

Astronaut Bonnie J. Dunbar receives an AFA Citation of Honor from Mr. Price for her performance as a mission specialist in the space shuttle crew that recovered the Long Duration Exposure Facility satellite. Dr. Dunbar was among seven recipients of honor citations at the AFA National Convention. Awards were also given for logistics excellence.

sional execution of duties, and coolness under pressure, they landed safely, sustaining minimal damage to the aircraft and no injuries to passengers or crew. *(Accepted by Maj. Sabine Meacham, pilot.)*

Lt. Col. Michael F. Carpenter, Maj. Gregg M. Burgess, and Maj. Mark S. Olson, Air Force Center for Studies and Analyses, Washington, D. C., for their innovative, comprehensive management as directors of a major study effort that provided the Air Force Chief of Staff with valuable analytical insights for managing the pilot force during a prolonged period of declining retention.

Dr. Bonnie J. Dunbar, astronaut, Houston, Tex., for her exceptional professional performance as mission specialist in successfully recovering the Long Duration Exposure Facility satellite on space shuttle *Columbia,* mission STS-32, saving numerous valuable scientific experiments.

AFA MANAGEMENT AWARDS FOR LOGISTICS

AFLC Executive Management Award—To **Robert J. Conner,** Sacramento Air Logistics Center, McClellan AFB, Calif., for outstanding contribution to management while assigned to Air Force Logistics Command.

AFLC Middle Management Award—To **Kenny Pierce,** Sacramento Air Logistics Center, McClellan AFB, Calif., for outstanding contribution to management while assigned to Air Force Logistics Command.

AFLC Junior Management Award—To **Capt. David L. Bennett,** Warner Robins Air Logistics Center, Robins AFB, Ga., for outstanding contribution to management while assigned to Air Force Logistics Command.

AFA MANAGEMENT AWARDS FOR SYSTEMS

AFA Distinguished Award for Management—To **Gen. John M. Loh,** Acting Chief of Staff, Hq. USAF, Washington, D. C., for outstanding contribution to management while assigned to Air Force Systems Command.

AFA Meritorious Award for Program Management—To **Col. Marty T. Runkle,** Los Angeles AFB, Calif., for outstanding contribution to management while assigned to Air Force Systems Command.

AFA Meritorious Award for Support Management—To **Col. Ronald B. Jones,** Eglin AFB, Fla., for outstanding contribution to management while assigned to Air Force Systems Command.

AIR NATIONAL GUARD AND AIR FORCE RESERVE AWARDS

The Earl T. Ricks Award—To the **crew of Air Force Rescue 284,** 129th Air Rescue Group, NAS Moffett Field, Calif., for outstanding airmanship, crew coordination, and courage in successfully rescuing the survivors of an explosion on a merchant ship in the Pacific. After a lengthy night flight over water in adverse weather, the crew of the H-3 successfully hoisted two badly burned patients and safely delivered them to land-based medical care. *(Accepted by Maj. Gregory A. Bose, Commander.)*

TSgt. Paul J. Woods of George AFB, Calif., honored by AFA as Outstanding Crew Chief of the Year for his performance with US Air Forces in Europe, is flanked by Thomas J. McKee, left, newly elected AEF Vice President, and AFA Board Chairman Jack C. Price.

—Photo by Paul Kennedy

The Air National Guard Outstanding Unit Award—To the **169th Tactical Fighter Group,** South Carolina ANG, McEntire ANGB, S. C., as outstanding Air National Guard Unit of the Year. *(Accepted by Lt. Col. Jerry H. Risher, Commander.)*

The Air Force Reserve Outstanding Unit Award—To the **439th Military Airlift Wing,** Westover AFB, Mass., as outstanding Air Force Reserve Wing of the Year. *(Accepted by Brig. Gen. Frederick D. Walker, Commander.)*

The President's Award for the Air Force Reserve—To an **AC-130A crew of the 919th Special Operations Group,** Eglin AFB, Fla., as outstanding Air Force Reserve Flight Crew of the Year. *(Accepted by Maj. Clay T. McCutchan, Pilot.)*

SPECIAL CITATIONS AND OTHER AWARDS

The General Curtis E. LeMay Strategic Aircrew Award—To **Crew E-21, 37th Bombardment Squadron, 28th Bombardment Wing,** Ellsworth AFB, S. D., as the best overall aircrew in Strategic Air Command. *(Accepted by Maj. Paul J. Curtis, Commander.)*

The General Thomas S. Power Strategic Combat Missile Crew

1990 AFA Membership Awards

The following chapters have qualified for a membership award by showing a net chapter growth based on a comparison of chapter size at the beginning of the membership year, July 1, 1989, and chapter size at the end of the membership year, June 30, 1990.

Diamond Award: 20% net growth or more

Chapters	Presidents
Cape Fear, North Carolina	Norman E. Davis
Cochise, Arizona	Raymond A. Kinney
General Charles A. Gabriel, Virginia	Owen Wormser
General E. W. Rawlings, Minnesota	Charles K. Melby
General Lauris G. Norstad, Belgium	Col. Thomas B. Goslin, Jr.
Greater Rockford, Illinois	James T. Larkins
Green Valley, Arizona	Richard S. Reid
Hahn AB, West Germany	Maj. Stephen L. Martin
Indian River, Florida	Robert B. Stiastny
Llano Estacado, New Mexico	Ken Huey
Lloyd R. Leavitt, Jr., Michigan	Alfred R. Siegert
Lufbery-Campbell, West Germany	Kevin A. Ashley
Lynchburg, Virginia	R. Howard Mahanes
Maui, Hawaii	Charles V. Darby
Ocala, Florida	Charles A. Savage
On Wings of Eagles, Florida	Paul H. Sullivan
Paul Revere, Massachusetts	Leo D. O'Halloran
Peace River, Florida	Bernard L. Hanlon
Rocky Mountain, Utah	Jon W. Shively
Spangdahlem, West Germany	Lt. Col. Byron Beul
Wiesbaden, West Germany	Randall E. Gricius
Wings, New Jersey	Alfred D. Richards

Gold Award: 10% net growth but less than 20% net growth

Chapters	Presidents
Antelope Valley, California	Samuel J. Kilanowski
Bozeman, Montana	John M. Wallace
Central Connecticut, Connecticut	John T. McGrath
Central Maryland, Maryland	Robert B. Roit
Denton, Texas	Robert R. Reed
Enid, Oklahoma	Oscar L. Curtis
Garden State, New Jersey	Phyllis Bush
General Nathan F. Twining, Florida	Robert F. Cutler
Gold Card, Utah	Harry L. Cleveland
Klamath Basin, Oregon	Boyd C. Yaden
Lawrence D. Bell, New York	John W. Siedlecki
Maj. Gen. Robert M. White, West Germany	Lt. Col. Wilfred E. Reny
Mid-Michigan, Michigan	Donald L. Abbott
Mobile, Alabama	Frank A. Brown
New Jersey Public Affairs, New Jersey	James M. Still
Northeast Texas, Texas	Edward C. Mishou
Pioneer Valley, Massachusetts	Robert J. Picknally
Richmond, Virginia	Gary D. Harris
South Bend, Indiana	William L. Wilhelm
Ventura County, California	Robert Patty

Silver Award: 5% net growth but less than 10% net growth

Chapters	Presidents
Amoskeag, New Hampshire	Gualter F. Silva
Athens, Georgia	Robert P. Crow
Atlanta, Georgia	Ben L. Patterson
Barry Goldwater, Arizona	Richard W. Waite
Blue Hen, Delaware	Emmett Venett
Chautauqua, New York	William Stroh
Dacotah, South Dakota	Robert J. Johnson
Eagle, Pennsylvania	Raymond J. Restagno
Eastern Carolina, North Carolina	Dennis M. Biggs
Eugene, Oregon	Edward A. Kelly
Gadsden, Alabama	Andrew A. Chaffin
Jack Manch, Virginia	George Hedrick
Lincoln, Nebraska	C. Howard Vest
Lt. Col. B. D. "Buzz" Wagner, Pennsylvania	Robert C. Rutledge
Mercer County, New Jersey	Frank W. Joslin
Montgomery, Alabama	Don Brown
Richard Bong, Minnesota	Curtis P. Jones
Tennessee Valley, Alabama	John C. Carson
Tidewater, Virginia	William M. Cuthriell
Total Force, Pennsylvania	Lee W. Niehaus
Triad, North Carolina	John D. Strauss
Westchester-Falcon, New York	Cecelia Andretta
York-Lancaster, Pennsylvania	Bernard J. Nichols

Achievement Award: 2% net growth but less than 5% net growth

Chapters	Presidents
Alexandria, Louisiana	Paul J. Johnston
Altoona, Pennsylvania	Anthea L. Germano
Badger State, Wisconsin	James G. Rebholz
Baton Rouge, Louisiana	Clyde C. Thomas
Blue Ridge, North Carolina	James L. Mulligan
Colonel Stuart E. Kane, Jr., Pennsylvania	W. Daniel Douthitt
Corpus Christi, Texas	William A. Pyle
Dale O. Smith, Nevada	Robert E. Ring
Donald W. Steele, Sr., Memorial, Virginia	Mary Anne Thompson
Eglin, Florida	Charles B. Johnson
Falcon, Florida	Craig R. McKinley
Frank P. Lahm, Ohio	Mearl A. Nichols
Freedom, Pennsylvania	Roland von Miedel
General B. A. Schriever Los Angeles, California	Peter P. Beardsley
General Bruce K. Holloway, Tennessee	Billy Linebaugh
General Robert E. Huyser, Colorado	James C. Hall
Ghost Squadron, Texas	Jerald W. Ellington
Happy Hooligan, North Dakota	John Syverson
Houston, Texas	Jerry W. Fee
Kalamazoo, Michigan	William Monica, Jr.
Kitty Hawk, North Carolina	Alton V. Jones
Lt. Gen. Frank Maxwell Andrews, Tennessee	Daniel F. Callahan III
Madison, Wisconsin	Raymond J. Thurber
Morgan S. Tyler, Florida	Harvey B. Snively, Jr.
Ogden, Utah	Dan Hendrickson
Panhandle, Texas	Laurie R. McKee
Pe-To-Se-Ga, Michigan	William L. Stone
Piedmont, North Carolina	Floyd Wilson
Pocono Northeast, Pennsylvania	Joseph D. Sylvester
Portland, Oregon	Robert E. Rayfield
Roanoke, Virginia	Harry E. Williams
Southern Indiana, Indiana	Herman E. Weidner
Southwest Florida, Florida	Carl R. Loiocano
Swamp Fox, South Carolina	Dennie L. Sides
Tallahassee, Florida	Terrance Fregly
Topeka, Kansas	Ernie Dougherty
Tulsa, Oklahoma	Harry B. Burt III
West Suburban, Illinois	James Garbe

Named in Memorial Tribute

These are the names of USAF and AFA leaders and supporters and aviation pioneers who died during the last year.

Lt. William Abbuhl
Maj. Gen. George R. Acheson, USAF (Ret.)
Roy M. Amos
Col. Henry H. Arnold II, USA (Ret.)
Lt. Col. Charles H. Back, USAF (Ret.)
Lt. Col. Kenneth Bailey
Cornelia "Corky" Ball
Myfanwy Bauer
Col. Gerry Black, USAF (Ret.)
Col. Earl L. Bozeman, USAF (Ret.)
Col. Roland H. Brady, USAF (Ret.)
Ernest H. Buehl
Gen. David A. Burchinal, USAF (Ret.)
SSgt. John Campisi, USAF
Maj. Gen. William M. Canterbury, USAF (Ret.)
Jack R. Carnicelli
Maj. Richard W. Chase, USAF
Anthony Christiano
SSgt. Marc H. Cleyman, USAF
Henry Crown
Penny Cummings
Harriet Cychoz
Hoadley Dean
Richard DeLauer
Aaron E. Dickerson
Maj. Gen. William A. Dietrich, USAF (Ret.)
Frank. R. DiPietro
John W. Dixon
Lt. Col. W. Bryant Dougherty, USAF
Larry D. Erickson
Maj. Gen. Terence P. Finnegan, USAF (Ret.)
Herbert O. Fisher
William C. Fisher
Thomas E. Flannigan
Col. Robert E. Foster, USAF (Ret.)
Donald H. Fyock
MSgt. Samuel M. Gardner, Jr., USAF
SSgt. Daniel Garza, USAF
Maj. John M. Gordon, USAF
Joseph M. A. Gumb
Maj. Gen. Dudley D. Hale, USAF (Ret.)
Brig. Gen. Lyle E. Halstead, USAF (Ret.)
Everette L. Harper
Lt. Gen. Ralph E. Havens, USAF
Capt. Robert C. Hazen
MSgt. Rosendo Herrera, USAF
Col. Leon Hoffman
Brig. Gen. Frank O. House, USAF (Ret.)
Brig. Gen. Thomas B. Hoxie, USAF (Ret.)
SSgt. Rande J. Hulec, USAF
Lawrence A. "Pat" Hyland
William Johnston
H. W. "Rocky" Jones
Sam E. Keith, Jr.
Maj. Gen. Marvin E. Kennebeck, USAF (Ret.)
TSgt. Lonty A. Knutson, USAF
Brig. Gen. Ralph E. Koon, USAF (Ret.)
Capt. Christopher S. Lambe
John W. "Hank" Lankford
Judge W. W. Leslie
Carl J. Long, Sr.
Maj. Gen. Arno H. Luehman, USAF (Ret.)
Maj. Gen. Ralph J. Maglione, Jr., USAF (Ret.)
Francis E. Martineau
Dr. Thomas W. McKnew
William H. Montgomery
Gen. Joseph J. Nazzaro, USAF (Ret.)
Maj. Gen. Dan C. Ogle, USAF (Ret.)
Gen. Earle E. Partridge, USAF (Ret.)
TSgt. Daniel G. Perez, USAF
Brig. Gen. Roger E. Phelan, USAF (Ret.)
Gen. Samuel C. Phillips, USAF (Ret.)
Maj. Richard M. Price, USAF
Maj. Gen. Gilbert L. Pritchard, USAF (Ret.)
Joseph W. Purka
Gene Rawlings
Hazel Rawlings
Robert P. Reynolds
Maj. Gen. Paul E. Ruestow, USAF (Ret.)
SSgt. Edward E. Sheffield, USAF
Frank D. "Dale" Shelton
Lt. Col. William A. Shomo, USAF (Ret.)
Capt. Bradley R. Schuldt, USAF
George Sipp
Lt. Col. Melton H. Sipple, USAF (Ret.)
C. R. Smith
Robert C. Smith
Ruth Harrison Spaatz
Penelope B. Stack
Brig. Gen. Eugene A. Stalzer, USAF (Ret.)
Lt. Gen. James T. Stewart, USAF (Ret.)
Hon. Samuel S. Stratton
Lt. Col. Robert Thatcher, USAF (Ret.)
Alan L. Thorvaldson
Lt. Gen. Edward J. Timberlake, USAF (Ret.)
Col. Stewart W. Towle, Jr., USAF (Ret.)
J. Parker Van Zandt
SMSgt. Carpio Villarreal, Jr., USAF
Lt. Gen. David Wade, USAF (Ret.)
Stan Wagenknecht
Chester L. Wells
Dr. Edward C. Welsh
Herbert M. "Bud" West
Bill Wittig
Lt. Col. Harvey F. Yorke, USAF (Ret.)
Col. Gerald O. Young, USAF (Ret.)

Award—To **Capt. Michael J. Morgan and 1st Lt. Scott E. Russell,** who make up **Crew S-200,** 91st Strategic Missile Wing, Minot AFB, N. D., as the best overall combat missile crew in Strategic Air Command. *(Accepted by Capt. Michael J. Morgan, Commander.)*

The Lieutenant General William H. Tunner Aircrew Award—To a **crew of the 16th Special Operations Squadron,** 1st Special Operations Wing, Hurlburt Field, Fla., as the best overall aircrew in Military Airlift Command. *(Accepted by Capt. Mark P. Transue, Commander.)*

The Lieutenant General Claire Lee Chennault Award—To **Maj. Mark J. Svestka,** 52d Tactical Fighter Wing, USAFE, Spangdahlem AB, West Germany, as the outstanding aerial warfare tactician.

The General Jerome F. O'Malley Award—To **Crew S-02/R-18,** 24th Strategic Reconnaissance Squadron, 6th Strategic Reconnaissance Wing, Eielson AFB, Alaska, as the best reconnaissance crew in the Air Force. *(Accepted by Capt. Paul R. Yakes, Jr., Navigator 1.)*

Best Space Operations Crew Award—To **Delta Crew of the 1000th Satellite Operations Group,** Offutt AFB, Neb., as the best space operations crew in the Air Force *[see "Tops in Space," p. 96]. (Accepted by Capt. Randall J. Rees, Commander.)*

The Chief Master Sergeant Dick Red Award—To **SMSgt. Henry M. Russell III,** Alabama ANG, Birmingham, Ala., for outstanding Air National Guard aerospace maintenance.

The Stuart R. Reichart Award for Lawyers—To **Grant C. Reynolds,** Hq. USAF, Washington, D. C., for outstanding achievements in the field of law within the United States Air Force.

The Paul W. Myers Award for Physicians—To **Lt. Col. Raymond P. Ten Eyck,** Wright-Patterson AFB, Ohio, for his outstanding service as a clinician, educator, manager, and researcher. His innovations have vastly improved patients' access to care and have increased medical productivity.

Outstanding USAF Personnel Manager of the Year Award—To **Col. Joseph W. Moran,** USAF, Hq. USAF, Washington, D. C., for his outstanding ability and professional skill in personnel management. He contributed significantly to Air Force effectiveness by accurately forecasting pending major budget and force-program problems and developing appropriate solutions.

Outstanding Crew Chief of the Year Award—To **TSgt. Paul J. Woods,** George AFB, Calif.

Civilian Wage Employee of the Year—To **Michael O'Doherty,** Cheyenne Mountain AFB, Colo., for his superior management of utility support for NORAD, USSPACECOM, and AFSPACECOM.

Civilian Program Specialist of the Year—To **Sharon L. Copeland,** Bolling AFB, D. C., for her inspired operation of computer-based programs, enhancing the effectiveness of the Air Force military justice system.

Civilian Program Manager of the Year—To **Kenneth R. Walters, Sr.,** Scott AFB, Ill., for his pioneering efforts in managing the USAF Environmental Technical Applications Center's narrative climatology study program, providing valuable input for decision-makers at all levels—from staff weather officers worldwide to cabinet members.

Civilian Senior Manager of the Year—to **Terry D. Kasten,** Wright-Patterson AFB, Ohio, for his nationally recognized expertise on all aspects of the National Aerospace Plane program. He has led the way in identifying the tremendous utility of NASP technology to future operational systems.

The Verne Orr Award—To the **3d Security Police Group,** Clark AB, the Philippines, for the most effective utilization of human resources within the United States Air Force. *(Accepted by Col. Michael Higgins, Commander.)*

The Joan Orr Award—To **Brenda J. Kramarczyk,** Kadena AB, Japan, as the Air Force Wife of the Year.

The Outstanding AFROTC Cadet of the Year Award—To **Amy M. Patrin,** Notre Dame University, South Bend, Ind.

The Outstanding CAP Aerospace Education Cadet of the Year Award—To **Cadet Robert Scott Leszczynski,** Akron, Ohio.

The Diane O'Malley Outstanding Angel Award—To **Jennifer McMaster,** Georgia Institute of Technology, Atlanta, Ga.

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Cecil H. Hopper

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Mary Sue Keith
William N. Webb
Nation's Capital Chapter

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William A. Bingham, Jr.
Tommy G. Harrison
John R. Kagel
Joseph W. Kellogg
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Thomas J. McKee
James E. "Red" Smith
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Special Citations

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Florida Cypress Gardens
Edward J. Fox
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C. James Gleason
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M. N. "Dan" Heth
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J. Rilee Lindquist
Charlotte Loos
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Marian Elise Morley
Lt. Col. William G. Morley, USAF (Ret.)
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(19th Air Refueling Wing, Robins AFB, Ga.)
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—Photo by Paul Kennedy

Mrs. H. H. Timken, Jr., holds a plaque signifying that the late Lt. Col. William Bryant Dougherty has been awarded, in memoriam, an Aerospace Education Foundation-sponsored Barry Goldwater Fellowship. With her are AEF President Gerald V. Hasler (left) and AEF Board Chairman James M. Keck, both reelected.

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(Presented at September 17, 1990, luncheon; listed alphabetically)

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The Gulf showdown demonstrates much about defense requirements, Pentagon leaders told the AFA audience.

A Line in the Sand

By James W. Canan, Senior Editor

SECRETARY of the Air Force Donald B. Rice got right down to cases about urgent matters—"the showdown in the Gulf and shaping the future Air Force."

"Freedom at this hour means a line in the sand of Saudi Arabia," he declared.

Secretary Rice struck that stark theme at the Air Force Association's forty-fourth National Convention in Washington last September. He shared common ground with his fellow featured speakers, Secretary of Defense Richard B. Cheney and Gen. John M. Loh, Acting Air Force Chief of Staff.

Operation Desert Shield, the US combined-arms response to Iraq's invasion of Kuwait, set the stage for the AFA Convention and served as its vivid backdrop. By Convention time, Desert Shield, launched six weeks earlier, had convincingly demonstrated the importance of long-range airpower in protecting US national security interests and had left no doubt of the Air Force's ability to apply such power.

"As the storm brewed, the breadth of Air Force global reach and global power struck home," Secretary Rice asserted. "Desert Shield stresses the need for air superiority, modern airlift, and rapid power projection—the heart of Air Force global reach."

General Loh saw Desert Shield as a vindication of Air Force plans and preparations in recent years. He claimed that "our performance in the Middle East underscores correct decisions made through the 1980s" to give the Air Force "higher readiness, more sustainability, greater mobility, and more combat capability than at any time in our history."

Secretary Cheney said the key to the success of Desert Shield at that juncture in "demonstrating American resolve" had been "the ability of the United States military to deploy significant forces in a very short period of time to a very distant part of the world."

He declared, "The United States Air Force has been absolutely crucial in that. The first units that we could get to the scene were, of course, those F-15 squadrons [from the 1st Tactical Fighter Wing at Langley AFB, Va.] that were ready to go at a moment's notice."

Secretary of Defense Richard B. Cheney, keynote speaker at the AFA Convention, said US Operation Desert Shield deployments in the Middle East represented the "'don't screw around' school of military strategy."

—Photo by Susan Kennedy

In the Vanguard

At the AFA Convention, Dr. Rice went into detail about the Air Force's Desert Shield deployments. In the vanguard were fighters and bombers, "deploying first for air defense, then for attack capability," he said, with night-combat capability provided by F-15Es, F-111s, and F-117s carrying precision-guided munitions. He noted that "long-range bombers had Iraq in reach from day one" of Desert Shield.

Secretary Rice emphasized the importance of USAF's "airlift, tanker, reconnaissance, and electronic warfare communities" in "bolstering the fighters and bombers." In keeping with this, "we've integrated our AWACS operations with the Saudis' [AWACS]," he said.

He characterized C^3I as "pivotal" to the far-flung military operation. Accordingly, space systems, all involved with command, control, communications, and intelligence in one way or another, were put heavily into play.

"In Desert Shield, we're seeing the application of air and space power," the Air Force Secretary declared. "We're supporting all the services with space systems—with real-time weather imagery, communications, and navigation. For example, many units have GPS [Global Positioning System] receivers to pinpoint positions in the stark landscape."

Dr. Rice gave the Army, Navy, and Marines their due as partners in Desert Shield, which he described as "above all, a joint operation" that "capitalizes on the strengths of each service as an instrument of national power."

He continued, "As transports carrying joint forces landed every ten minutes, combat planes and ground forces took the front lines. Sealift brought the muscle of other potent Army and Marine units to bear. . . . Airlift delivered the 82d Airborne Division. Naval air converged from two oceans."

He emphasized at the AFA Convention that the US armed forces had come together in common purpose to prevent war, not start one. "Together, we hope to offer enough of a deterrent that no shot will be fired," he told his Convention audience.

"Over and above the military aspect, Desert Shield will be a political crossroads," Dr. Rice declared. "We are not just protecting an old friend and ally. We're shaping the post-containment [of the Soviet bloc] world. A decisive success in this theater will revalidate the rule of international law, reinvigorate the United Nations, and give pause to potential aggressors for decades to come.

"When Iraq capitulates, it will be because they're outclassed by international resolve buttressed by US forces and technology. Technological leadership underpins our stature as a world power. Multinational observers on the scene of the [US] deployment have said, 'So this is what it means to be a superpower.'"

Maintaining superpower status and influence "in this uncertain world" will require the US to field "first-class land, sea, and air forces" to "capitalize on each service's unique capabilities," Dr. Rice asserted.

Draw Down, but Stay Strong

Where the Air Force is concerned, he said, "the idea is to stay

strong as we draw down" under fiscal pressures. He said the active force could shrink by as much as twenty-five percent through the first half of this decade. Now at 545,000 men and women, that force "is already down 60,000 from our mid-'80s peak" and "could be down about 90,000 more" by 1995.

"The Guard and Reserve will assume a higher proportion of the force structure," Secretary Rice predicted. Offering the tactical fighter force as a prime example, he noted that the Air Force expects to bottom out at twenty-eight tactical fighter wings, "with most of them based in the US," and that Reservists and Guardsmen will operate ten and a half—well over a third—of those wings.

The Air Force Secretary warned against losing sight of the need to maintain nuclear capability as the Soviet threat is seen to recede. "Nuclear deterrence will remain the heart of our national strategy," Dr. Rice said. "All three legs of the triad must be credible."

In this vein, the Air Force is "looking at a number of options for an ICBM force" that will provide "a solid deterrent" while conforming to changes in the world and in levels and patterns of US defense spending.

He also declared, "The B-2 bomber will remain on center stage. I've had people ask, 'What's the B-2's mission?' The answer is deterrence—deterrence of all conflict, nuclear and conventional, so that anyone thinking of challenging US interests stays awake at night."

General Loh struck the same note, saying, "Nuclear deterrence will remain our nation's first priority, and the triad will remain the framework for providing it. I don't believe [US-Soviet] tensions have fallen to the point that we should change the foundation on which our deterrence has rested for over thirty years."

Looking to the future of the Air Force in terms of size, structure, and requirements, General Loh said that "back to the future" would be an appropriate way of describing what lies ahead.

"We have forty-three years of experience to tell us what to expect," the Acting Chief of Staff declared. "I can't predict exact locations and sequences of events that will develop in the future, but, based on modern history, I can describe the types of situations and the capabilities we will need to meet those situations."

What the Air Force has in mind, he said, is "providing versatile combat power with conventional forces." Thus it will continue to take advantage of such distinctive attributes as speed, range, lethality, and "flexibility to structure deployments, change locations, and employ forces where they will provide the best leverage.

"We use these characteristics as a team player in the joint and combined operations of our sister services and allies," General Loh declared.

The Cornerstone

Among individual capabilities to be cultivated by the Air Force, General Loh gave marquee billing to "mobility," which he called "the cornerstone of Desert Shield so far."

"Without adequate airlift and sealift forces, America could never have reacted to this type of crisis," said the Acting Chief of Staff. He noted that sealift would "provide the bulk of the follow-on support of our forces" arrayed in Persian Gulf environs, but that "it was our [Air Force] airlift that placed the forces there immediately and at the right time."

Like Secretary Rice, General Loh called attention to the increasing value of space systems in "giving us the 'high ground' during this crisis. These space communications, surveillance, and support systems are crucial to our ability to project American power and influence," he asserted. "They are as fundamental to our operating force structure today as the fighters, bombers, tankers, airlifters, and aircraft such as AWACS."

General Loh said the Air Force is intent on becoming smarter though smaller. It will seek out recruits of "even higher quality," develop "even smarter weapon systems," and "look at new and innovative methods for maintaining readiness. Along with industry, we will explore methods to reduce the time required to develop new weapon systems. We will look for every opportunity to become more efficient."

Among topmost USAF objectives, the General also included "strengthening relationships with security partners" around the world. He made the point that those military relationships are cemented in joint training exercises, such as Red Flag, and by "flying the same aircraft and employing the same tactics."

He said the multinational mobilization in the Middle East, in showcasing "our interoperability with the Egyptians and the Saudis," amply demonstrated the merits of the Air Force's past efforts to cultivate cross-national commonality in equipment and operations.

Secretary Cheney also underscored the importance of international relationships. He took note of "the enormous outpouring from around the world" in opposition to Iraq's takeover of Kuwait, and said that "a key part of that response has been the President's enormous success in mobilizing international world opinion" against the Iraqi regime.

Mr. Cheney added, "The key to getting US military force into the theater was the willingness of our friends and allies—in particular, in this case, the Saudis—to accept US forces on their soil. That was a major step for them."

"Don't Screw Around"

The Secretary of Defense said the swift, strong military reaction of the US in Operation Desert Shield represented "the 'don't screw around' school of military strategy."

He described it as "the notion that if you're going to send American forces to a distant part of the globe and deploy them in a situation such as we're faced with now, you have to assume that they may become involved in hostilities. And if, in fact, they [do], it is absolutely essential to give them all the support we can give them in terms of equipment and backup, so that they're not left, at the far end of the supply line, ill-equipped or of insufficient size to be able to cope with future developments."

Mr. Cheney described and praised those forces from all the services, and said that "the lift capability of our C-141s and C-5s flown by Air Force pilots has been crucial" to the success of the Desert Shield deployments.

—Photos by Paul Kennedy

Addressing the AFA Convention, Air Force Secretary Donald B. Rice, left, and Acting Air Force Chief of Staff Gen. John M. Loh, shown here among AFA exhibits, gave airpower its due in Desert Shield.

In the Middle East crisis and "at a time of fundamental change in world affairs," the Secretary of Defense saw "several important lessons for us as we look to the future." High among them, he said, is "the fact that peace and stability in the world will still depend upon the strength and determination of the United States of America, upon our willingness to be actively involved around the globe where our interests and those of our allies are threatened, [and] upon the presence and the capabilities of US military forces."

The apparently successful outcome of the cold war and other wins for the West in recent times are, he said, "a direct result of the willingness of the United States to stay actively and aggressively involved around the world since the end of World War II."

In this context, the Secretary of Defense presented his case for going easy on defense budget cuts, saying, "Even though this is a time of enhanced prospects for peace between the world's major powers, and even though we're making significant progress in improving our relations with the Soviet Union, without question there is still a fundamental requirement to maintain significant US military forces."

Mr. Cheney asserted that US forces long deployed in Europe and, now, in the Middle East represent money well spent on defense in the past.

He explained, for example, that the ships, planes, and other major weapons now deployed in the Middle East were produced as a result of actions taken by US Administrations and Congresses in the 1970s and 1980s and even, in some cases, in the 1960s.

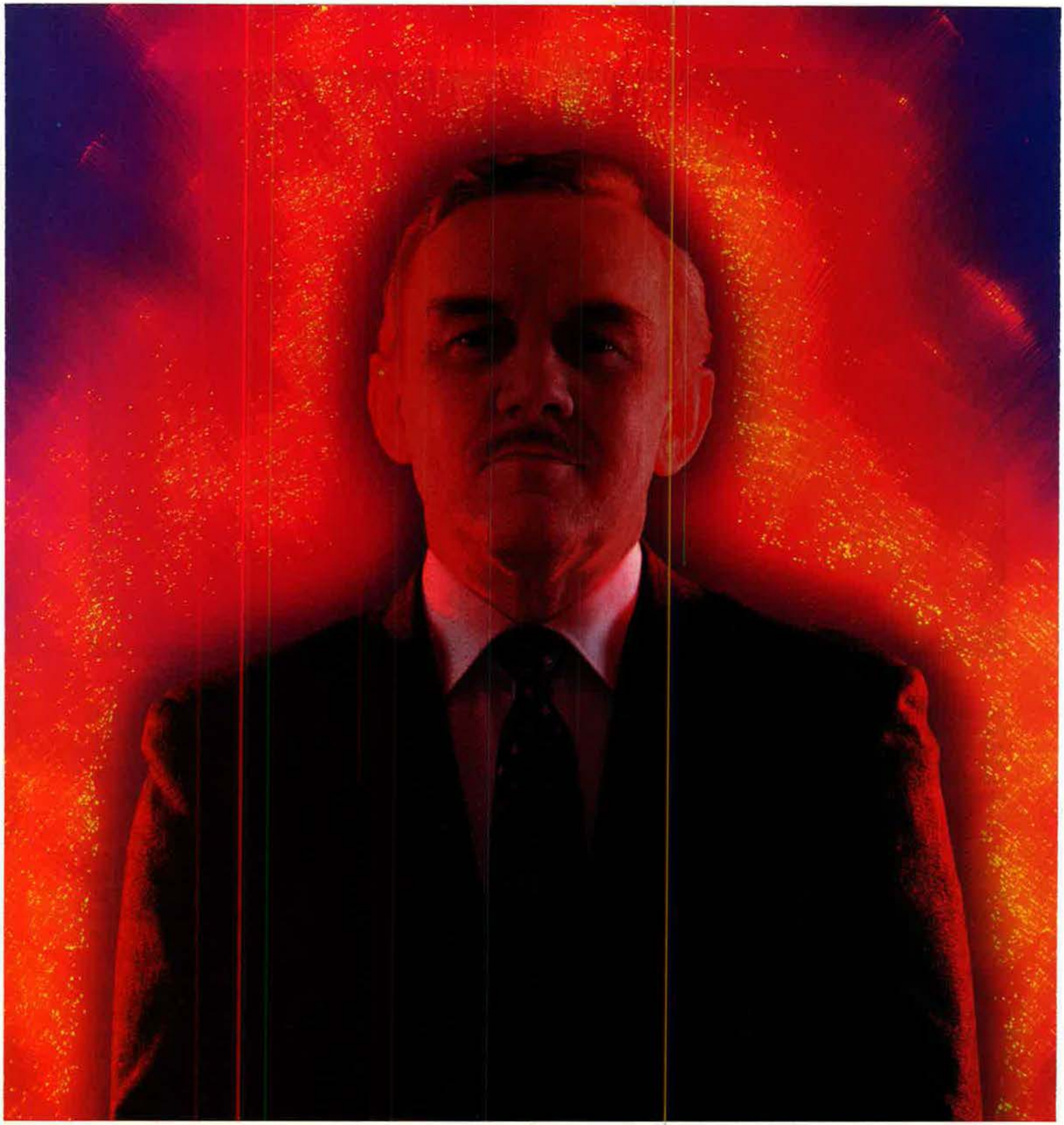
Declared Mr. Cheney, "Decisions made a long time ago—long before I ever got near the Department of Defense—determined the capacity that we have today to respond to this very serious matter. Decisions that we make now in terms of our force levels and capabilities will have an impact for fifteen or twenty years to come.

"To suggest that money spent [on defense] in the past was wasted is, I think, simply incredible."

The Secretary of Defense acknowledged that the US may indeed need a new military strategy. Calling this "a truly momentous period," he said that there have probably been "more major changes in the world in the past twelve months than in the last forty-five years."

"We've seen changes that many of us had never expected to witness in our lifetimes, that call for new thinking and for a more creative response on the part of those of us involved in the nation's defenses," said the Secretary of Defense.

He also said that the Bush Administration was preparing to go public with its new approach to national defense when the Middle East crisis intervened. "The President has given instructions that he wants us to transform our military strategy to reflect the new realities that we've seen in the world, and we've been working on that for the last several months," Mr. Cheney said. ■

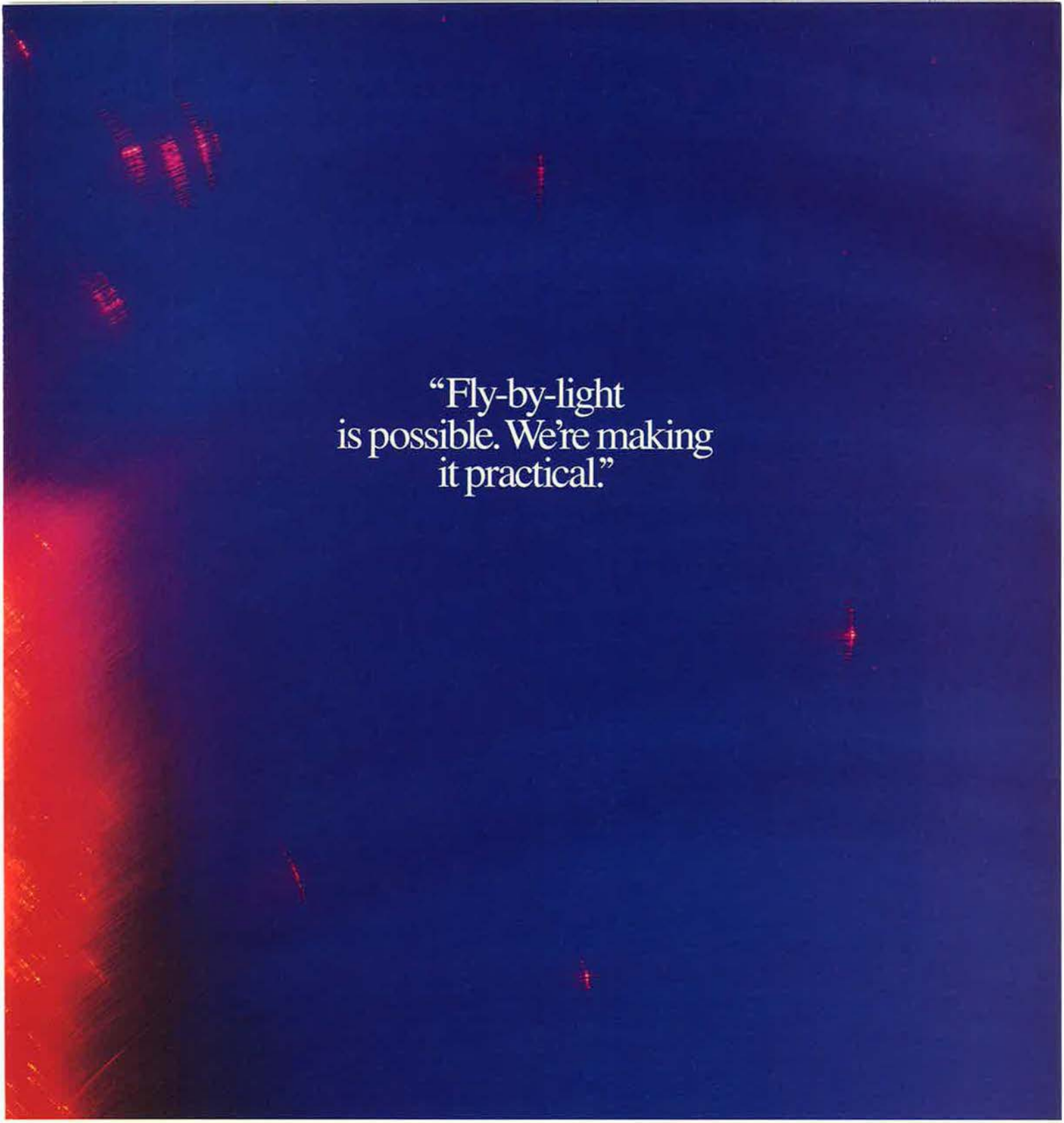


"Fly-by-light aircraft controls are feasible—the U.S. Army's Advanced Digital Optical Control System (ADOCS) proved the concept.

"Developed by Boeing Defense & Space Group's Helicopters division, the ADOCS test bed was the first aircraft to fly with controls based on photonics technology in place of electronic or mechanical systems.

"The challenge now is to develop practical, operational systems for other aircraft.

"There are important incentives. Fly-by-light systems can process more information, faster, than electronic systems; they're immune to electromagnetic interference; they're inherently robust



—reliable and easy to repair.

"Boeing is working on several promising systems, and plans to make decisions on key technologies in a year or so.

"Photonics is essential to aircraft systems of the future. The *near* future. We hope to fly a practical, economical system at mid-decade."

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Tel: 972-3-935-3163. Tlx: 381014 ISRAVIA IL. Fax: 972-3-971-1844.
New York: Israel Aircraft Industries Inc. Tel: (212)620-4400.
Tlx: 125180 ISRAIR. Fax: (212)242-1773.
Brussels: EAT European Advanced Technologies S.A.
Tel: (2)513-1455. Tlx: 62718 ISRAVI B. Fax: (2) 512-8279.

Gallery of Asian and Pacific Airpower

By John W. R. Taylor and Kenneth Munson

Fighters

Ching-Kuo

The need for a new fighter to replace eventually the Chinese Nationalist Air Force's F/TF-104 Starfighters and some F-5E/Fs was apparent in the early 1980s. The US government embargoed sale to Taiwan of anything as advanced as the Northrop F-20 Tigershark, but permitted US manufacturers to cooperate with that nation's Aero Industry Development Center in the design and production of an indigenous defensive fighter (IDF). The influence of General Dynamics on the airframe design of the IDF is clear to see. The afterburning versions of Garrett's TFE731 turbofan were developed jointly by Taiwan's Chung Shan Institute of Science and Technology and the Garrett Turbine Engine Co. Lear Siegler assisted with acquisition and integration of the avionics. These include a Golden Dragon 53 multimode pulse-Doppler radar based on the GE AN/APG-67(V) but embodying features of the Westinghouse AN/APG-66, with a range of 93 miles. A Litton INS was selected, together with three multifunction and one head-up cockpit displays by Bendix/King. A GEC fly-by-wire control system is used, with sidestick controller. The aircraft's missile armament is of Taiwanese origin.

The first of four IDF prototypes, named after the late President of Taiwan, Chiang Ching-Kuo, flew on May 28, 1989. Construction of these aircraft is all-metal, but the possibility of future use of composites for some components is under consideration. Production of the Ching-Kuo was planned to begin in 1990 and could total up to 256 aircraft. Between 40 and 50 of these will be tandem two-seaters, equipped for training and antishipping duties.

Contractor: Aero Industry Development Center, Taiwan.
Power Plant: two Garrett TFE1042-7 turbofans; each 8,340 lb st with afterburning.
Dimensions, Weights, and Performance: not available. Dimensions believed to be similar to those of F-16, and max speed about Mach 1.2 at height.
Accommodation: pilot only.
Armament: one 20 mm M61A gun in starboard side of fuselage; two medium-range Sky Sword II air-to-air missiles under fuselage and four close-range Sky Sword Is on two underwing and two wingtip pylons. For attack role, bombs, cluster bombs, rockets, or air-to-surface missiles may be carried, including three Hsiung Feng II antishipping missiles, plus wingtip Sky Sword Is.

F-1

As its designation indicates, the Mitsubishi F-1 is the first interceptor/close air support fighter designed by the Japanese aerospace industry, and it emerged in much the same way that Northrop's F-5 was derived from the T-38—by adapting a two-seat supersonic trainer to a single-seat configuration. Mitsubishi's T-2 trainer was the first supersonic aircraft to be designed in Japan, and two examples served as F-1 prototypes, deletion of the second cockpit allowing such additional avionics as an inertial navigation system, a radar homing and warning system, and a J/ASQ-1 bombing computer to be installed in its stead. The F-1 first flew in June 1975, entered service with the JASDF in the fall of 1977, and the last of 77 production aircraft was delivered in March 1987. They currently equip the 3d Squadron of the 3d Air Wing at Misawa and two squadrons of the 8th Air Wing at Tsuiki, with which they are expected to remain in service until replaced by the upcoming FS-X (F-16 derivative) fighter in the mid-1990s. Other equipment of the F-1 includes a nose-mounted Mitsubishi Electric J/AWG-12 fire control radar, Ferranti INS, and license-built Thomson-CSF head-up display.

Contractor: Mitsubishi Heavy Industries, Japan.
Power Plant: two Ishikawajima-Harima TF40-IHI-801A (license Rolls-Royce Turbomeca Adour) turbofans; each 7,305 lb st with afterburning.
Dimensions: span 25 ft 10¼ in, length (incl nose probe) 58 ft 7 in, height 14 ft 5 in.
Weights: empty 14,017 lb, gross 30,203 lb.

F-4EJKai, Japan Air Self-Defense Force (Katsumi Hinata)

F-1, Japan Air Self-Defense Force (Katsumi Hinata)

F-5F (foreground) and F-5E Tiger II, Republic of Singapore Air Force

Performance: max speed Mach 1.6, ceiling 50,000 ft.
Accommodation: pilot only, on zero/zero ejection seat.
Armament: one JM61 multibarrel 20 mm gun in port side of front fuselage. Four underwing hardpoints with multiple carriers, plus one under fuselage. Weapon loads can include two Mitsubishi ASM-1 air-to-surface missiles, up to twelve 500 lb or eight 750 lb bombs (including IR- or laser-guided), four pods of 70 mm or 125 mm underwing rockets, four AIM-9 Sidewinder air-to-air missiles (two underwing and two at wingtips), or up to three drop tanks.

F-4E Phantom II

A detailed career outline of the long-serving F-4 can be found in the USAF Galleries in the May issues of AIR FORCE Magazine for the past several years. In Asia, both South Korea and Japan operate the type. The Republic of Korea Air Force was a customer for 66 **F-4Ds** and 65 **F-4Es,** most of which are still in service, and recently ordered a further 24 ex-USAF F-4Es. In Japan, Mitsubishi built 138 of the E model under license (local designation **F-4EJ**), of which 125 currently remain in service with the Air Self-Defense Force. Under a five/six-year service life extension program begun in 1987, 100 of these are to be upgraded to **F-4EJKai** (= modified) standard. Funding for the first 45 had been approved up to FY 1990, and redelivery to the JASDF's 6th Air Wing at Komatsu began in November last year. In addition to some structural changes, the main ingredients of the upgrade program are the installation of a Mitsubishi (Westinghouse license) AN/APG-66J radar; Japanese license-built versions of the Litton LN-39 INS, Kaiser HUD, and Hazeltine AN/APX-79A IFF; and a locally developed fire-control system and radar warning receiver. Missile capability of the F-4EJKai will include AIM-7E/F Sparrows, AIM-9P/L Sidewinders, and Mitsubishi ASM-1 antiship weapons. *(Data for standard F-4E.)*

Contractor: McDonnell Douglas Corporation, USA.
Power Plant: two General Electric J79-GE-17A turbojets; each 17,900 lb st with afterburning.
Dimensions: span 38 ft 7½ in, length 63 ft 0 in, height 16 ft 5½ in.
Weights: empty 30,328 lb, gross 41,487 lb (combat T-O), 61,795 lb (max gross).
Performance: max speed Mach 2 class at 40,000 ft, ceiling 54,400 ft, combat radius 494 miles (defensive counterair) to 786 miles (area intercept).
Accommodation: pilot and weapon systems operator in tandem on zero/zero ejection seats.
Armament: one M61A1 multibarrel 20 mm gun; provision for up to four AIM-7 Sparrow or AIM-9 Sidewinder air-to-air missiles semisubmerged under fuselage; or seven hardpoints (one under fuselage, three under each wing) for up to 16,000 lb of bombs, rocket pods, gun pods, or flares and ECM/camera pods.

F-5E Tiger II

Thirty-one years after the prototype's first flight, Northrop's "Freedom Fighter" and its descendants still equip something like 30 air forces worldwide, including eight in Asia. Most of these aircraft are now of the improved IFA (International Fighter Aircraft) model, the **F-5E** Tiger II and its **F-5F** two-seat combat trainer counterpart; relatively few examples now remain of the original F-5A and F-5B. Largest Asian users of the Tiger II are South Korea and Taiwan, in both of which nations the F-5E/F were the subject of license production programs. In Taiwan, AIDC produced 248 Es and 60 Fs for the Chinese Nationalist Air Force, nearly all of which are still in service. The RoKAF received a total of 159 Es and 64 Fs, of which Korean Air built 48 and 28 respectively between 1981 and 1986; the Korean name for these aircraft is

Chegoong-ho (Air Master). Korea also still has around 50 **F-5A/Bs** from earlier deliveries, as does the Philippine Air Force, which still operates a dozen As and a couple of Bs, and the Royal Thai Air Force (nine As and two Bs, serving alongside 38 more recent Es and six Fs). Other Asian operators of the F-5E and F-5F are the air forces of Indonesia (11 + 4), Malaysia (14 + 3), and Singapore (36 + 7). In Vietnam, a number of F-5A/B/E and RF-5A aircraft were left behind by the US when the South was overrun in 1975, and 20 or more of these are thought to be still extant, although not all are necessarily active. Some or all of the F-5As could in fact be ex-USAF in-flight-refuelable **F-5C** "Skoshi Tiger" models. Four of the above countries also have small numbers of the **RF-5** reconnaissance variants (which see). *(Data for F-5E.)*

Contractor: Northrop Corporation Aircraft Group, USA.
Power Plant: two General Electric J85-GE-21B turbojets; each 5,000 lb st with afterburning.
Dimensions: span (over wingtip missiles) 26 ft 8 in, length (incl nose probe) 47 ft 4 in, height 13 ft 4 in.
Weights: empty 9,723 lb, gross 24,722 lb.
Performance: max speed 1,082 mph at 36,000 ft, ceiling 51,800 ft, combat radius 656 miles.
Accommodation: pilot only, on ejection seat.
Armament: two 20 mm M39A2 cannon in nose; AIM-9 Sidewinder air-to-air missile at each wingtip; one underfuselage and four underwing stations for up to 7,000 lb of bombs, rockets, missiles, or other stores.

F-15J Eagle, Japan Air Self-Defense Force (Katsumi Hinata)

F-16A, Pakistan Air Force (Denis Hughes)

F-104G Starfighter, Chinese Nationalist Air Force (Denis Hughes)

F-15J Eagle

In contrast to the international coproduction agreements made for its F-16 and F/A-18 contemporaries, only one country outside the US has yet been granted a manufacturing license for the F-15: Japan, which is now well into a program to produce a total of 187 of these fighters for the country's Air Self-Defense Force. The program began in 1980, with a first flight in June of the first of two US-built F-15J single-seat prototypes, and continued in 1981 when deliveries began of 12 two-seat F-15DJs, also US-built. Japanese industry then assembled eight single-seaters from CKD kits before assuming full responsibility for subsequent production. By FY 1990 a total of 167 F-15s had been funded for the JASDF, and deliveries are now in excess of 120. First Japanese squadron to achieve IOC, in January 1983, was No. 202 (5th Air Wing) at Nyutabaru. Of the remaining six planned squadrons, five have since been formed: Nos. 201 and 203 (2d Air Wing) at Chitose, Nos. 205 and 303 (6th Air Wing) at Komatsu, and No. 204 (7th Air Wing) at Hyakuri. Five other F-15Js are assigned to the JASDF 8th Air Wing's "aggressor" squadron at Tsuiki. Japanese F-15Js are generally equivalent to the US F-15C, but have a degree of domestic avionics including the radar warning receiver and J/ALQ-8 ECM. *(Data for F-15C.)*

Contractors: McDonnell Douglas Corporation, USA; Mitsubishi Heavy Industries, Japan.
Power Plant: two Ishikawajima-Harima (Pratt & Whitney license) F100-PW-220 turbofans; each 23,450 lb st with afterburning.
Dimensions: span 42 ft 9¾ in, length 63 ft 9 in, height 18 ft 5½ in.
Weights: empty 28,600 lb, gross 68,000 lb.
Performance: max speed more than Mach 2.5, ceiling 60,000 ft, max range with conformal fuel tanks 3,570 miles.
Accommodation: pilot only, on zero/zero ejection seat.
Armament: one JM61A1 six-barrel 20 mm gun in starboard wingroot, with 940 rds. Up to four AIM-9L/M Sidewinder, four AIM-7F/M Sparrow, or eight AMRAAM air-to-air missiles; or three (five if configured with conformal tanks) stations for up to 23,600 lb of bombs, rockets, or other stores.

F-16 Fighting Falcon

Although its Asian export record is somewhat less spectacular than those in Europe and the Middle East, the General Dynamics F-16 has been sold successfully to five nations in the area and will form the basis of an important derivative in a sixth country. Largest operator at present is the Pakistan Air Force, with 40 **F-16As and Bs** already in service and another 11 F-16As ordered in 1989. PAF F-16As are equipped to carry Thomson-CSF Atlis laser/target designation pods. Other customers for the A and B models are the Indonesian Air Force (3 + 4, delivered 1989–90), Republic of Singapore Air Force (4 + 4), and Royal Thai Air Force (8 + 4 delivered from 1988, with six more As now following). The later **F-16C and D** were the subject of an order from the Republic of Korea Air Force (30 + 6), deliveries of which were made between 1986 and 1989.

In Japan, the F-16 was selected in October 1987 as basis for the ASDF's 130-aircraft requirement for a new fighter, known temporarily as the **FS-X,** which will be funded entirely by Japan but undertaken as a joint development program with General Dynamics. Powered by a 29,000 lb st class derivative of the F100 or F110 engine, it will have a larger wing of Japanese design, canards, a longer nose for more (Japanese-developed) avionics, a stretched rear fuselage, and capability for Mitsubishi AAM-3 and/or ASM-2 missiles. Mitsubishi will be the Japanese prime contractor. Prototype construction should begin next year, with first flight planned for 1993 and IOC in 1998. *(Data for F-16C.)*

Contractor: General Dynamics Corporation, USA.
Power Plant: one General Electric F110-GE-100 turbofan: 27,600 lb st with afterburning; or Pratt & Whitney F100-PW-220: 23,450 lb st with afterburning.
Dimensions: span 31 ft 0 in, length 49 ft 4 in, height 16 ft 8½ in.
Weights (GE engine): empty 19,020 lb, gross 27,185 lb (clean), 42,300 lb (with max external stores).
Performance: max speed more than Mach 2.0 at 40,000 ft, ceiling more than 50,000 ft, combat radius 575 miles.
Accommodation: pilot only, on zero/zero ejection seat.
Armament: one M61A1 multibarrel 20 mm gun, with 515 rds, in port side wing/body fairing. One underfuselage and six underwing stations, plus air-to-air missile rail at each wingtip. External stores (load limit 12,000 lb) can include wide range of single or cluster bombs, rockets, laser-guided and electro-optical weapons and sensors, Pave Penny laser tracker pod, FLIR or jammer pods, or drop tanks.

F/A-18 Hornet

After weighing the relative merits of the F-16 and F/A-18 for nearly two years, the Australian government announced its selection of the latter, to fulfill the RAAF's TFF (tactical force fighter) requirement, in October 1981. Seventy-five aircraft were involved in the program, the last of which was delivered in May of this year. It began with two US-built **F/A-18Bs,** and continued with 57 single-seat Hornets and 16 more two-seaters, assembled initially from CKD kits by AeroSpace Technologies of Australia (ASTA) and subsequently manufactured in-country by Australian industry. The single-seaters (Australian designation **AF-18A**) have replaced Dassault Mirage IIIOs with three squadrons of the RAAF: Nos. 3 and 77 at Williamtown and No. 75 at Tindal. The two-seaters (RAAF designation **ATF-18A**) equip No. 2 OCU, also at Williamtown. Australia is upgrading its Hornets, beginning this year, to F/A-18C/D standard with more modern avionics and provision for carrying a Ford Aerospace AN/AAS-38 infrared tracking and laser designation pod. A more recent coproduction program to get under way is that with South Korea, which has placed an order for 120 **F/A-18C/Ds,** of 252 said to be required. The first 12 will be US-built aircraft; then, beginning in 1992, a Korean industry team of Samsung Aerospace, assisted by Daewoo Industries and Korean Air, will assemble 36 more from CKD kits before progressing to coproduction/local manufacture of the next 72 aircraft. A similar partnership program will be undertaken for the aircraft's F404-GE-202 engines. *(Data for F/A-18C.)*

Contractor: McDonnell Douglas Corporation, USA.
Power Plant: two General Electric F404-GE-400 turbofans; each approx 16,000 lb st with afterburning.
Dimensions: span 37 ft 6 in (27 ft 6 in folded), length 56 ft 0 in, height 15 ft 3½ in.
Weights: empty 23,050 lb, gross 36,710 lb (fighter), 49,224 lb (attack).
Performance: max speed more than Mach 1.8, combat ceiling approx 50,000 ft, combat radius over 460 miles (fighter), 662 miles (attack).
Accommodation: pilot only, on zero/zero ejection seat.
Armament: one M61 six-barrel 20 mm gun in nose, with 570 rds. Nine external stations (one on centerline, two on nacelles, two under each wing, and one at each wingtip) for up to 17,000 lb of stores including air-to-air or air-to-surface missiles; single, cluster, or laser-guided bombs; air-launched decoys; laser spot tracker/strike camera, FLIR, or other mission pods; or drop tanks.

F-104G Starfighter

The Chinese Nationalist Air Force in Taiwan is the only Asian operator of the F-104. It has a current strength of nearly 100 single-seaters, mostly **F-104Gs** but including a number of reconnaissance-configured **RF-104Gs.** Although the F-104s are now elderly, US refusal to allow Taiwan to purchase such more modern fighters as the F-16, F/A-18, or F-20 means that the F-104s will probably have to soldier on until they can be replaced by the indigenously developed Ching-Kuo. The CNAF inventory also includes about 40 two-seat Starfighter trainers, mostly **TF-104Gs** but believed still to include about half a dozen older **F-104Ds.**

Contractor: Lockheed-California Company, USA.
Power Plant: one General Electric J79-GE-11A turbojet; 15,800 lb st with afterburning.
Dimensions: span 21 ft 11 in, length 54 ft 9 in, height 13 ft 6 in.
Weights: empty 14,082 lb, gross 28,779 lb.
Performance: max speed 1,450 mph at 36,000 ft, ceiling 58,000 ft, combat radius (max fuel) 745 miles.
Accommodation: pilot only, on ejection seat.
Armament: one M61 Vulcan multibarrel 20 mm gun in forward fuselage. Stations under fuselage (one) and wings (one each side), and at each wingtip, for up to four air-to-air (Sidewinder) or air-to-surface missiles, bombs, rocket pods, or drop tanks.

J-8

Existence of the J-8 was a well-kept secret for two decades before it was revealed officially by China in the mid-1980s: its design had actually begun in 1964, and it flew for the first time on July 5, 1969. This early J-8 was,

however, a very different aircraft from the J-8 II with which we are more familiar today. For clear-weather day fighter duties only, it was evidently a MiG-21/J-7 derivative along similar lines to those that, in the USSR, produced the one-off MiG Ye-152 "Flipper"; it was powered by two Liyang WP7B turbojet engines and was armed with an internal gun and four wing-mounted PL-2B air-to-air missiles. Remarkably, during the "cultural revolution," flight trials (though no other development) were allowed to continue, although it was 1979 before production was allowed to start. This early **J-8** was underpowered and lacked a satisfactory fire-control radar, the latter being quickly remedied in the **J-8 I,** which entered production in 1985, by fitment of a Sichuan SR-4 radar in the intake shock cone. About 100 J-8 Is were built, and the SR-4 was also retrofitted in the comparatively small number of earlier J-8s. No engine or armament changes were made to the J-8 I.

By contrast, the **J-8 II,** which made its first flight on June 12, 1984, was a vastly different aircraft, some 70 percent redesigned compared with its predecessor. Intended for the dual roles of high-altitude interceptor and ground attack, it featured a "solid" avionics-filled nose, fuselage-side intakes, more powerful WP13A II engines, and a number of other improvements. Official Chinese sources claim "several dozen" (say 40–50) in service by early 1990, with production continuing in small economic batches rather than at a regular monthly rate. To be comparable with Western counterparts, the J-8 II still needs a modern avionics suite; this was the subject of the US Peace Pearl program of 1987, under which Grumman received a contract to complete and test two prototypes with a new HUD, INS, databus, and weapon delivery system, to be followed by the supply of 50 refit kits (plus five spare kits) for Chinese installation. However, this was blocked by the US government following the mid-1989 suppression of student demonstrations in Beijing, and in early 1990 the Chinese government itself canceled the contract. The Peace Pearl kits were due to be delivered during 1991–95, and the requirement for something similar undoubtedly still exists. *(Data for J-8 II.)*

Contractor: Shenyang Aircraft Corporation, People's Republic of China.

Power Plant: two Liyang WP13A II turbojets; each 9,590 lb st dry and 14,815 lb st with afterburning.

Dimensions: span 30 ft 7⅞ in, length (incl nose probe) 70 ft 10 in, height 17 ft 9 in.

Weights: empty 21,649 lb, gross 39,242 lb.

Performance: max speed (indicated) 808 mph, ceiling 65,620 ft, combat radius 497 miles, range (max) 1,367 miles.

Accommodation: pilot only, on zero/zero ejection seat.

Armament: 23 mm Norinco Type 23-3 twin-barrel gun, with 200 rds, in underfuselage pack aft of nosewheel bay. One station under fuselage and three under each wing for infrared or semiactive radar homing air-to-air missiles, launch pods for 57 mm or 90 mm rockets, bombs, or up to three drop tanks.

MiG-21/J-7/F-7

Variants of the MiG-21 are flown by ten Asian air forces. Those serving in Afghanistan, Cambodia, North Korea, Laos, Mongolia, and Vietnam were supplied by the Soviet Union, and are as described in the "Gallery of Soviet Aerospace Weapons" in the March 1990 issue of AIR FORCE Magazine. Hindustan Aeronautics built India's several hundred similar **MiG-21FL/21M/21bis** versions under license. China has manufactured those flown by its own Air Force of the People's Liberation Army and by the air forces of Bangladesh and Pakistan.

Production in China was initiated in 1961 by a license agreement for the **MiG-21F-13** fighter and its Tumansky R-11F-300 turbojet. Some pattern aircraft and knocked-down component kits were received, but relations between China and the Soviet Union were severed before the full technology transfer had been completed. It was not possible to fly the first of a small series assembled at Shenyang, under the designation **J-7** (Jianjiji-7; fighter aircraft 7), until January 17, 1966. The "cultural revolution" then caused further problems that hampered for a decade the development and manufacture of progressively improved versions, at Chengdu and Guizhou, as follows:

J-7 I. First version built at Chengdu for PLA Air Force, from 1967. Original Soviet ejection system, with front-hinged canopy that detached with seat to provide blast protection for pilot, was considered unsatisfactory, and few aircraft were accepted.

J-7 II. Initial major production version, first flown on December 30, 1978, and still being built (14 in 1989). WP7B (modified Tumansky R-11) engine. Rear-hinged jettisonable canopy and Chengdu Type II zero-height/155 mph ejection seat. Second 30 mm gun added. New Lanzhou compass system.

JJ-7. Tandem two-seat combat-capable trainer version of J-7 II, developed and built at Guizhou.

F-7M Airguard. Export version of J-7 II supplied to Bangladesh (16), Pakistan (60), and other air forces. WP7B(BM) engine, requiring no separate gasoline starting tank; strengthened landing gear; bird-resistant windshield; zero-height/81 mph ejection seat; two additional underwing hardpoints; upgraded avionics, including GEC Avionics head-up display and weapon aiming computer (HUDWAC), new ranging radar, radar altimeter, IFF, secure communications, and air data computer. Production approved in December 1984 and continuing.

F-7P Skybolt. Modified F-7M to meet requirements of Pakistan Air Force. Martin-Baker Mk 10L ejection seat. Able to carry four, instead of two, air-to-air missiles on underwing hardpoints. Initial batch delivered to Pakistan in 1989.

F-7MP. Designation of latest batch of 75 F-7s for Pakistan, with improved cockpit and navigation system, including Collins AN/ARN-147 VOR/ILS, AN/ARN-149 ADF, and Pro Line II digital DME-42.

J-7 III. Advanced development of J-7 II, first flown on April 26, 1984; in production and in service with PLA Air Force. All-weather day/night capability. Liyang WP13 engine, rated at 14,550 lb st with afterburning. Enlarged nose intake and centerbody for JL-7 J-band interception radar. Sideways-hinged canopy. Improved ejection seat. Twin-barrel 23 mm gun under fuselage; four underwing hardpoints. New fire-control system and Beijing KJ-11 autopilot. Additional fuel in deeper dorsal spine. Wider-chord fin and rudder. Developed and built in partnership with Guizhou Aviation Industry Corp.

J-7E. Little is yet known about this version, except that it has a redesigned wing. Due to fly in prototype form this year. *(Data for F-7M.)*

Contractor: Chengdu Aircraft Corporation, People's Republic of China.

Power Plant: one Chengdu WP7B(BM) turbojet; 13,448 lb st with afterburning.

Dimensions: span 23 ft 5¾ in, length 48 ft 10 in, height 13 ft 5½ in.

Weights: empty 11,629 lb, normal gross 16,603 lb.

Performance: max speed Mach 2.05, ceiling 59,710 ft, range 1,081 miles.

Accommodation: pilot only.

Armament: two 30 mm Type 30-1 guns, with 60 rds/gun. Four underwing hardpoints for PL-2/2A/5B/7 or Magic air-to-air missiles, pods of 18 × 57 mm or 7 × 90 mm rockets, bombs of up to 1,100 lb, or drop tanks.

MiG-29

India was the first foreign nation to receive this outstanding Soviet combat aircraft when delivery of 45 single-seat **MiG-29s** and five two-seat **MiG-29UBs** began in late 1985. These aircraft, which are known by the Indian name Baaz (Eagle), equip Nos. 28 and 47 Squadrons, primarily for air-defense duties. A repeat order was placed one year ago, to equip a third squadron, and India has been offered a license to manufacture MiG-29s. If this is taken up, the aircraft are expected to replace MiG-21s flown currently by 17 squadrons of the Indian Air Force in interception, close air support, and combat area interdiction roles. It appears that, on this occasion, the export aircraft retain all, or most, of the operational equipment carried by those in service in the Soviet Union, including pulse-Doppler radar, an infrared search/track sensor, anti-FOD doors in the engine air intakes, 360° radar warning system, laser rangefinder, and flare packs in the "fences" forward of the dorsal tailfins.

J-8 II, People's Liberation Army Air Force, China (Paul Jackson)

Mirage 2000Hs, Indian Air Force

The only other nation flying MiG-29s in non-Soviet Asia at this time is North Korea, which deployed 30 in an air-superiority role in early 1990. *(Data for MiG-29 "Fulcrum-A.")*

Power Plant: two Isotov RD-33 turbofans; each 18,300 lb st with afterburning.

Dimensions: span 37 ft 3¼ in, length 56 ft 10 in, height 15 ft 6¼ in.

Weights: empty 18,025 lb, gross 33,065–39,700 lb.

Performance: max speed at height Mach 2.3, at S/L Mach 1.06, ceiling 56,000 ft, combat radius 650 miles.

Accommodation: pilot only (two seats in tandem in MiG-29UB "Fulcrum-B").

Armament: six medium-range radar-homing AA-10 (NATO "Alamo-A") and/or close-range AA-11 ("Archer") air-to-air missiles on three pylons under each wing. Provision for carrying AA-9 ("Amos") and AA-8 ("Aphid") missiles. Able to carry bombs; 57 mm, 80 mm, and 240 mm rockets; and other stores in attack role. One 30 mm gun in port wingroot leading-edge extension.

Mirage III

The Pakistan Air Force took delivery of a total of 96 Mirage IIIs and 5s, in a variety of forms, for air-defense, attack, reconnaissance, and training duties. Eighteen **Mirage IIIEPs,** ordered in 1967, were basically standard all-weather low-altitude attack fighters with CSF Cyrano II fire-control and ground-mapping radar, Marconi Doppler, and navigation and bombing computers, but were equally effective for interception of Mach 2 targets. Three **Mirage IIIRPs** with nose-mounted cameras and three **Mirage IIIDP** tandem two-seat trainers were ordered at the same time; the survivors of these 24 aircraft now serve with No. 5 Squadron. Details of the Mirage 5 series can be found in the Attack Aircraft section of this Gallery.

In the spring of 1990 the Australian government agreed to sell to Pakistan 50 **Mirage IIIOs** that had been replaced by F/A-18 Hornets in the Royal Australian Air Force. Delivery had not started by August 1990. Meanwhile, reports from Pakistan suggest that the IIIOs might be used primarily as a source of spares for other PAF Mirages. *(Data for Mirage IIIEP.)*

Contractor: Avions Marcel Dassault-Breguet Aviation, France.

Power Plant: one SNECMA Atar 9C turbojet; 13,670 lb st with afterburning.

Dimensions: span 27 ft 0 in, length 49 ft 3½ in, height 13 ft 11½ in.

Weights: empty 15,540 lb, gross 29,760 lb.

Performance: max speed at 40,000 ft Mach 2.1, at S/L Mach 1.14, ceiling 55,775 ft, combat radius (lo-lo-lo) 305 miles.

Accommodation: pilot only.

Armament: two 30 mm DEFA 552 guns in fuselage; one R.530 air-to-air missile under fuselage and two Magic missiles under wings. Bombs or rocket packs can be carried underwing for attack missions.

Mirage 2000

The Indian Air Force has received a total of 42 single-seat **Mirage 2000Hs** and seven two-seat **2000THs** to equip Nos. 1 and 7 Squadrons. They represent its only genuine modern multirole fighters and, having proved their worth in combat situations in Sri Lanka and the Maldive Islands, the IAF would like more but has to overcome budget constraints. Its current 2000Hs are generally similar to French Air Force Mirage 2000Cs, with RDM multimode Doppler radar (range 62 miles), Uliss 52 INS, head-up and head-down cockpit displays, ECM jammers and chaff/flare dispenser, Spirale passive countermeasures and Serval radar warning receivers. Fly-by-wire flight controls are standard, contributing to a safe minimum speed of 115 mph in stable flight. In air-defense configuration, the aircraft can attain a speed of Mach 2.26 at 39,350 ft within 2½ min of leaving the runway. Indian name for the Mirage 2000H is Vajra (Divine Thunder). *(Data for Mirage 2000H.)*

Contractor: Dassault Aviation, France.

Power Plant: one SNECMA M53-P2 turbofan; 21,385 lb st with afterburning.

Dimensions: span 29 ft 11½ in, length 47 ft 1¼ in, height 17 ft 0¾ in.

Weights: empty 16,534 lb, gross 37,480 lb.

Performance: max speed at height Mach 2.26, ceiling 59,000 ft, range with four 250 kg bombs more than 920 miles.

Accommodation: pilot only.

Armament: two 30 mm DEFA 554 guns in fuselage; five hardpoints under fuselage and two under each wing for max external stores load of 13,890 lb. Two Super 530 and two Magic air-to-air missiles for air-defense role. Typical Mirage 2000 ground-attack weapons include eighteen 550 lb retarded bombs or BAP 100 anti-runway bombs, 16 Durandal penetration bombs, two 2,200 lb laser-guided bombs, six Belouga cluster bombs, air-to-surface missiles, and packs of 18 × 68 mm, or 100 mm rockets.

Attack Aircraft

A-4 Skyhawk

Apart from the Indonesian Air Force's 28 **A-4Es** (and four **TA-4H** trainers), most A-4s in the Asian theater are upgraded versions. The Royal Malaysian Air Force has about 30 **A-4PTMs** (for Peculiar To Malaysia), converted from ex-USN A-4C/Ls by Grumman and upgraded with AIM-9 Sidewinder missiles and an Angle Rate Bombing Set. Six **TA-4PTMs** were similarly converted for training. The Royal New Zealand Air Force has just about completed its Kahu (hawk) program to upgrade its 16 **A-4Ks** and five **TA-4Ks** with new wing spars, an AN/APG-66(NZ) radar, LN-93 inertial navigation system, head-up/head-down displays, a new digital flight control system, radar warning receiver, and chaff/flare ECM. Weapons capability now extends to carriage of Maverick or AIM-9L missiles and GBU-16 laser-guided bombs. The RNZAF aircraft serve with Nos. 2 and 75 Squadrons at Ohakea. Singapore Aerospace is in Phase 1 of a two-phase program to apply a broadly similar upgrade to its Air Force's 54 **A-4S/TA-4S** fleet. This first phase involves an engine refit (with the GE F404) which has already demonstrated a vast improvement in acceleration, takeoff, climb rate, and turn rate. Phase 2, currently under way on two trial aircraft, will upgrade the avionics with HUD/HDDs, LN-93 INS, and other new equipment. The revamped Singapore version is known as the **A-4S-1 Super Skyhawk.** *(Data for A-4S-1.)*

Contractors: McDonnell Douglas Corporation, USA; Singapore Aerospace.
Power Plant: one General Electric F404-GE-100D non-afterburning turbofan; 10,800 lb st.
Dimensions: span 27 ft 6 in, length 41 ft 8⅝ in, height 14 ft 11⅞ in.
Weights: empty 10,250 lb, gross 22,500 lb.
Performance: max speed 701 mph at S/L, ceiling 40,000 ft, range 720 miles (with max weapon load), 2,356 miles (with max internal/external fuel).
Accommodation: pilot only, on McDonnell Douglas Escapac lightweight zero/zero ejection seat.
Armament: two 20 mm cannon in wingroots. Five external stations (one under fuselage, two under each wing) for bombs, rockets, gun pods, and (excluding outboard wing points) drop tanks.

A-37B Dragonfly

This useful little counterinsurgency aircraft, a descendant of the familiar T-37A Tweet trainer, still serves with a dozen or more of the world's smaller air forces, most of them in Central and South America. In the Asian theater, the Republic of Korea Air Force has about two dozen and the Royal Thai Air Force about half that number. Vietnam is thought to have about 25, captured when the south of the country was occupied, though the readiness state of these is uncertain.

Contractor: Cessna Aircraft Company, USA.
Power Plant: two General Electric J85-GE-17A turbojets; each 2,850 lb st.
Dimensions: span (over tiptanks) 35 ft 10½ in, length 29 ft 3½ in, height 8 ft 10½ in.
Weights: empty 5,843 lb, gross 14,000 lb.
Performance: max speed 507 mph at 16,000 ft, ceiling 41,765 ft, range (standard fuel) 460 miles.
Accommodation: crew of two, side by side.
Armament: one 7.62 mm Minigun in front fuselage. Eight underwing stations for various mixtures of bombs, gun pods, rockets, or (four inner stations only) drop tanks.

AT-3 Tsu-Chiang and A-3 Lui-Meng

Like many other jet basic and advanced trainers, Taiwan's **AT-3 Tsu-Chiang** can carry an external weapons load that enables it to offer an effective secondary ground-attack capability. Its design was started in 1975. The first of two prototypes flew on September 16, 1930, and 60 production AT-3s were built in 1982–90. There were press reports two years ago that a single-seat variant, designated **A-3 Lui-Meng,** was in parallel production by the AIDC. This cannot be confirmed, but two standard AT-3s have been upgraded with Westinghouse APG-66 radar and a fire-control system for evaluation in a close air support role. This may have led to some confusion as it is likely that the aircraft would be flown as a single-seater for combat missions. Lear Siegler International is prime contractor for the upgrade program, which may be applied to more than 40 remaining AT-3s if considered cost-effective. *(Data for basic AT-3.)*

Contractor: Aero Industry Development Center, Taiwan.
Power Plant: two Garrett TFE731-2-2L turbofans; each 3,500 lb st.
Dimensions: span 34 ft 3¾ in, length 42 ft 4 in, height 14 ft 3¾ in.
Weights: empty 8,500 lb, gross 11,500 lb as trainer, 17,500 lb with external stores.
Performance: max speed 562 mph at 36,000 ft, 558 mph at S/L, ceiling 48,000 ft, range on internal fuel 1,416 miles.
Accommodation: crew of two in tandem.
Armament: provision for semirecessed machine-gun pack under rear cockpit. Centerline pylon, two under each wing, and wingtip launch rails for 6,000 lb of stores, including rocket packs, cluster and fire bombs, bombs, flare dispensers, and close-range air-to-air missiles (on wingtips).

A-4K Skyhawk, Royal New Zealand Air Force

A-4E Skyhawk, Indonesian Air Force (British Aerospace)

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

F-111C

The Royal Australian Air Force was the first, and is still the only, export customer for the General Dynamics F-111, having placed an order in the late 1960s for 24 examples of a variant designated F-111C. This was generally similar to the USAF's F-111A, differing chiefly in having the longer-span wings of the FB-111A and RAAF-specified avionics. Four ex-USAF F-111As were acquired later, as attrition replacements, after being refitted with F-111C avionics, and four of the original 24 underwent conversion to **RF-111C** strike/reconnaissance configuration. Fifteen of the original aircraft remain in service with the RAAF's Nos. 1 and 6 Squadrons. Capability has been enhanced by the purchase of ten Ford Aerospace AN/AVQ-26 Pave Tack laser designation and ranging pods for carriage by the F-111C, mounted on a rotating cradle in the aircraft's internal weapons bay. Replacing the analog avionics of the RAAF's 22 F/RF-IIICs with digital systems was initiated in 1990, with Rockwell International chosen to head a team of US and Australian contractors.

Contractor: General Dynamics Corporation, USA.
Power Plant: two Pratt & Whitney TF30-P-3 turbofans; each 18,500 lb st with afterburning.
Dimensions: span 70 ft 0 in (spread), 33 ft 11 in (swept), length 33 ft 11 in, height 17 ft 1½ in.
Weights: empty 45,200 lb, gross 92,500 lb.
Performance: max speed 1,450 mph at 40,000 ft, ceiling over 60,000 ft, max range (internal fuel) over 3,800 miles.
Accommodation: crew of two, side by side in zero/zero escape module.
Armament: internal weapons bay used for Pave Tack pod; eight underwing weapon stations (inboard four pivoting as wings sweep) for up to 30,000 lb of bombs, missiles, or other weapons.

G-4 Super Galeb

Until now this jet-powered trainer/light attack aircraft has been produced only for Yugoslavia's own air force, but it was announced in August that the government of Myanmar (Burma) had ordered 20, with options on a further ten, of a version described as the **Galeb Super 2.** This is assumed to be the version designated **G-4M** by SOKO, of which two prototypes are scheduled to fly for the first time in early 1991. Basically an upgraded G-4, retaining the same power plant, the G-4M will differ mainly in having a new nav/attack system and other avionics, including a head-up display, IFF, multifunction displays, and a flight data recorder. External weapon load will be increased from 2,822 lb on the standard G-4 to 3,968 lb or more on the G-4M, including the provision of wingtip missile rails. Deliveries to Myanmar are due to begin in mid-1991. The aircraft will probably be powered by reconditioned engines, as Viper sales to that country are embargoed by the British government. *(Data for standard 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 (clean), 13,955 lb (with max external stores).
Performance: max speed 565 mph at 19,685 ft, ceiling 49,200 ft, combat radius 240–504 miles, max range 1,635 miles.
Accommodation: crew of two, in tandem on zero/zero ejection seats.
Armament: GSh-23L twin-barrel 23 mm cannon, with 200 rds, in removable ventral pod. Four underwing stations for variety of weapons including single or cluster bombs, bomblet dispensers, napalm pods, rockets, 12.7 mm gun pods, or (inboard stations only) drop tanks.

H-7

Very little further information on this important new Chinese warplane has been forthcoming since it was displayed in model form at the 1988 Farnborough International Air Show, although it is known that a static test aircraft has been completed and at least one prototype was flown for the first time in late 1988 or early 1989. In much the same role class as the Soviet Sukhoi Su-24 "Fencer," the H-7 is destined for a main all-weather interdictor/strike function in the PLA Air Force (with a secondary role of air defense interceptor), and as a maritime strike aircraft with the PLA Navy. It is a minor mystery why it has been given a bomber designation, rather than Q for attack, and one report has suggested that its designation is now JH-7, indicating fighter/bomber. Design features include shoulder-mounted swept wings and an all-moving tailplane; avionics are said to include terrain-following radar. *(All data estimated.)*

Contractor: Xian Aircraft Manufacturing Company, People's Republic of China.
Power Plant (prototypes): two Xian WS9 (license Rolls-Royce Spey Mk 202) turbofans, each 20,515 lb st with afterburning; or two Liyang WP13A II turbofans, each 14,815 lb st with afterburning.

Dimensions: span 41 ft 6 in, length (incl nose probe) 61 ft 0 in.
Weight: gross 60,627 lb.
Performance: max speed Mach 1.8 at altitude, ceiling at least 65,600 ft.
Accommodation: crew of two in tandem on zero/zero ejection seats.
Armament: 23 mm twin-barrel gun in nose. Four underwing hardpoints for various external weapons (including C-801 sea-skimming antiship missiles in maritime configuration), drop tanks, or other stores; rail for close-range air-to-air missile at each wingtip.

Hawk

Student pilots of the Indonesian Air Force begin their flying training on piston-engined FFA Bravos, purchased from Switzerland. After subsequent basic training on turboprop Beech T-34C-1s, including formation, ground-attack, and initial interception procedures, they complete their instruction on turbofan Hawk Mk 53s, of which 20 were acquired between 1980 and 1984. Like other Hawks of the **Mk 50** series, the Mk 53s offer a secondary light attack capability. From 1993, the Royal Brunei Armed Forces' Air Wing will receive eight two-seat **Hawk 100s,** with 5,945 lb st Adour 871 engine, a Sidewinder air-to-air missile on each wingtip, and provision for nose-mounted FLIR and laser rangefinder. Brunei will also purchase eight of the much changed single-seat **Hawk 200** multirole combat aircraft, with Adour 871, and provisions for one or two internally mounted 25 mm Aden guns, FLIR and laser rangefinder, or APG-66H radar. *(Data for Hawk Mk 50 series.)*
Contractor: British Aerospace plc, UK.
Power Plant: one Rolls-Royce Turbomeca Adour Mk 851 turbofan; 5,340 lb st.
Dimensions: span 30 ft 9¾ in, length excl probe 36 ft 7¾ in, height 13 ft 1¼ in.
Weights: empty 8,040 lb, gross 17,085 lb.
Performance: max speed 645 mph, ceiling 50,000 ft, combat radius 345–645 miles.
Accommodation: basically crew of two, in tandem. Pilot only in combat role.
Armament: one 30 mm Aden gun pack under fuselage. This can be replaced by a pylon for a nominal 1,000 lb store, with four similar pylons underwing, for ground-attack missions. Typical weapons include pods of 18 × 2.75 in air-to-surface rockets, bombs, and Sidewinder air-to-air missiles.

Hunter

Thirty-three years have passed since the Indian Air Force put into service its first Hunter single-seat fighters. Today, a single squadron, No. 20, not only retains a key operational commitment among the high mountain valleys on India's northern borders but also provides the IAF's Thunderbolts aerobatic team. No. 20 is equipped with **Hunter F. Mk 56s.** Many more aircraft of the same type, as well as two-seat **Hunter T. Mk 66Ds,** serve with the Hunter Operational Flying Training Unit, which serves as the OCU for pilots destined for combat units equipped with such Western aircraft as the Mirage 2000H and Jaguar.

The Air Force of Singapore also continues to operate No. 141 (Merlin) squadron of Hunters alongside its main attack force of A-4 Skyhawks. Most of these are **FGA. Mk 74s** and **F. Mk 74Bs,** but a few **FR. Mk 74As** are flown in a tactical reconnaissance role. Some **T. Mk 75** side-by-side two seat trainers remain in use. *(Data for Hunter FGA. Mk 74.)*
Contractor: Hawker Aircraft Ltd, UK.
Power Plant: one Rolls-Royce Avon 207 turbojet; 10,000 lb st.
Dimensions: span 33 ft 8 in, length 45 ft 10½ in, height 13 ft 2 in.
Weights: empty 13,270 lb, gross 24,000 lb.
Performance: max speed at S/L 710 mph, ceiling 50,000 ft, range 1,840 miles.
Accommodation: pilot only.
Armament: four 30 mm Aden guns, each with 150 rds, in nose. Five pylons under each wing. Two bombs of up to 1,000 lb, two clusters of six 3 in rockets, or two packs each with 24 or 37 × 2 in rockets on inboard pylons. Up to 24 × 3 in rockets on outboard pylons. Alternatively, four external fuel tanks or napalm containers can be carried.

Jaguar

The Indian Air Force chose the Anglo-French Jaguar to fulfill its important DPSA (deep penetration strike aircraft) requirement in 1978, after evaluating the type in competition with the Swedish Viggen and French Mirage F1. It has ordered a total of 116 to date, mostly single-seaters to advanced Jaguar International standard, but including some tandem two-seaters and a number (reportedly 17) specially equipped with Agave radar, a Smiths Industries DARIN (display attack ranging inertial navigation) system, and Sea Eagle missiles for an anti-shipping role.

The first 40 Jaguars for the IAF were assembled by British Aerospace in the UK. On March 31, 1982, Hindustan Aeronautics flew the first of 45 assembled from knocked-down component kits manufactured in Europe. The remaining 31 aircraft have been manufactured almost entirely in India, with production approaching its end. The basic strike aircraft are operated by Nos. 5, 14, 16, and 27 Squadrons; No. 6 Squadron has a mix of the special maritime version of the Jaguar and a few Canberras for its antishipping duties. Compared with early model Jaguars flown by the Royal Air Force and French Air Force, the Indian Jaguars have more powerful engines, provision for carrying two Magic self-defense missiles on overwing pylons, and a new nav/attack system that includes Uliss 82 INS, a Ferranti COMED moving-map display, and Smiths Industries HUDWACS. *(Data for single-seat Jaguar International.)*
Contractors: SEPECAT consortium, France and UK; Hindustan Aeronautics, India.
Power Plant: two Rolls-Royce Turbomeca Adour Mk 811 turbofans; each 8,400 lb st with afterburning.
Dimensions: span 28 ft 6 in, length 55 ft 2½ in, height 16 ft 0½ in.
Weights: empty 15,432 lb, gross 34,612 lb.
Performance: max speed at 36,000 ft Mach 1.6, at S/L Mach 1.1, ceiling 45,000 ft, typical attack radius hi-lo-hi 875 miles, lo-lo-lo 570 miles.
Accommodation: pilot only.
Armament: two 30 mm guns in fuselage; two Magic air-to-air missiles overwing; centerline pylon and two under each wing for 10,000 lb of stores, including eight 1,000 lb bombs, BL755 or Belouga cluster bombs, packs of 68 mm rockets, or a reconnaissance camera pack.

Hawk Mk 53, Indonesian Air Force

Two-seat (left) and single-seat Jaguars, Indian Air Force

F-6, Pakistan Air Force (Denis Hughes)

MiG-17/J-5/F-5

At least 6,000 **MiG-17s** were manufactured in the Soviet Union in the 1950s, in various versions, for air defense and ground attack duties. Some of these remain in service in Mongolia and Vietnam, but the several hundred similar aircraft still operational in China and North Korea were built under license at Shenyang. Before 1955, the Air Force of the People's Liberation Army had flown MiG-15s supplied from the Soviet Union. To launch jet fighter production in China, Moscow provided all necessary design drawings and technology transfer, plus two sample MiG-17F aircraft, 15 knocked-down kits, forgings and raw materials for ten aircraft, and parts for 15 more. Of the 767 aircraft produced at Shenyang in 1956–59, under the designation J-5, most remain in PLA Air Force and Navy use, but some still fly with the Air Force of North Korea. The basic **J-5** (Westernized designation F-5) is equivalent to the MiG-17F (NATO "Fresco-C") day fighter. The **J-5jia** (F-5A) is the Chinese-built MiG-17PF ("Fresco-D"), with Izumrud radar. The WP5 afterburning turbojet fitted to all aircraft built at Shenyang is similar to the Soviet Klimov VK-1F, itself developed from the Rolls-Royce Nene. *(Data for MiG-17F.)*
Power Plant: one Klimov VK-1F turbojet; 7,450 lb st with afterburning.
Dimensions: span 31 ft 7 in, length 36 ft 11¼ in, height 12 ft 5¾ in.
Weights: empty 8,664 lb, gross 13,393 lb.
Performance: max speed at 10,000 ft 711 mph, ceiling 54,450 ft, range 870 miles.
Accommodation: pilot only.
Armament: one 37 mm N-37D and two 23 mm NR-23 guns in nose; underwing pylons for four eight-rocket packs or total of 1,100 lb of bombs.

MiG-19/J-6/F-6

This often-underrated twin-jet fighter was the first Soviet production aircraft able to exceed Mach 1 in level flight. Production in the USSR is thought to have totaled around 2,500 aircraft in 1954–59, in several versions. Most important of these were the **MiG-19SF** (NATO "Farmer-C") day fighter-bomber and **MiG-19PF** ("Farmer-D") limited all-weather fighter with radar in an intake centerbody and lip fairing. The Afghan Air Force still has about 20 Soviet-built MiG-19s. All others to be seen in non-Soviet Asia, with the air forces of Bangladesh (30), Cambodia (at least five), China (2,500), North Korea (100), and Pakistan (125), were produced in China, under the designation **J-6** (export F-6).

Initial production aircraft from the Shenyang factory were judged to be substandard, due largely to problems caused by an attempt to progress too rapidly under the nation's "great leap forward" in 1958–60. Responsibility for the J-6 was transferred to Nanchang Aircraft Factory, which eventually exceeded the Soviet production total. Its three main variants are a single-seat day fighter and a limited all-weather fighter comparable with the MiG-19SF and PF respectively, and the tactical reconnaissance **JZ-6** with an IR linescan/camera pack in the front fuselage. The Guizhou Aircraft Factory delivered a small number of **J-6As,** with all-weather radar, PL-2 infrared homing air-to-air missiles similar to the Soviet AA-2 ("Atoll"), a rocket ejection seat, and other changes. Shenyang designed, and built in 1973–86, a total of 634 **JJ-6** tandem two-seat trainers generally similar to the J-6 day fighter.

The F-6s flown by the Pakistan Air Force were obtained from China when US military aid was suspended after the 1965 Indo-Pakistan war. They were modified in Pakistan to carry Sidewinder air-to-air missiles, and later to have Martin-Baker PKD Mk 10 zero/zero ejection seats. *(Data for J-6 day fighter.)*
Contractor: Nanchang Aircraft Factory, People's Republic of China.
Power Plant: two Shenyang/Chengdu WP6 turbojets; each 7,165 lb st with afterburning.
Dimensions: span 30 ft 2¼ in, length incl probe 48 ft 10½ in, height 12 ft 8¾ in.
Weights: empty 12,700 lb, gross 22,045 lb.
Performance: max speed Mach 1.45 at 36,000 ft, Mach 1.09 at S/L, ceiling 58,725 ft, range 1,366 miles.
Accommodation: pilot only.
Armament: three 30 mm NR-30 guns, in nose and each wingroot. Two pylons under each wing, inboard of hardpoint for external tank, to carry packs of eight air-to-air rockets, air-to-air guided missiles, two 550 lb bombs, or air-to-surface rockets of up to 212 mm caliber.

MiG-23/27

When Soviet forces withdrew from Afghanistan last year, they left the Afghan Republican Air Force sufficient MiG-23 interceptors and MiG-27 ground-attack aircraft for two full squadrons. These fighters are almost certainly equipped to higher standards than the 60 export-model **MiG-23MS** (NATO "Flogger-E") interceptors delivered to North Korea and the 30 **MiG-23B** ("Flogger-F") ground attack/interdictors flown by the Air Force of Vietnam. Details of the differences can be found in the "Gallery of Soviet Aerospace Weapons" in the March 1990 issue of AIR FORCE Magazine.

In February 1980, India ordered 95 **MiG-23BNs** ("Flogger-H"), plus 10 **MiG-23U** ("Flogger-C") tandem two-seat trainers, to replace Marut and Su-7BMKs in Nos. 10, 31, 220, and 221 Squadrons for its TASA (tactical air support aircraft) mission. They proved capable of carrying almost twice the weapon load more than twice as far as the older combat aircraft, with the added speed and agility expected of a modern variable-geometry design. Impressed, the Indian Air Force began reequipping Nos. 223 and 224 Squadrons with **MiG-23MF** interceptors in early 1982, to meet the challenge of Pakistan's newly acquired F-16s. The "MF" ("Flogger-B") has a "High Lark" radar with a search range of 53 miles, compared with the 18-mile range "Jay Bird" in the "MS." It can utilize an infrared sensor and Doppler, and carries more potent AA-7 ("Apex") and AA-8 ("Aphid") missiles instead of the AA-2 ("Atolls") of the MiG-23MS.

MiG-27MLs currently in production by Hindustan

Aeronautics at Nasik are the first MiG-27s to be assembled under license outside the USSR. They appear to be to the full Soviet Air Force "Flogger-J" standard, and have been given the Indian name Bahadur (Valiant). No. 222 Squadron, the last to operate Su-7BMKs, was first to reequip with MiG-27MLs, and has been followed by Nos. 9 and 18, formerly flying Ajeet lightweight fighters. With a total of 165 Nasik-assembled MiG-27MLs ordered to date, eight squadrons will eventually fly this type. *(Data for MiG-27ML.)*

Contractor: Indian aircraft assembled by Hindustan Aeronautics, India.

Power Plant: one Tumansky R-29B-300 turbojet; 25,350 lb st with afterburning.

Dimensions: span 45 ft 10 in spread, 25 ft 6¼ in swept, length 56 ft 1¼ in, height 15 ft 9¾ in.

Weights: empty 23,590 lb, gross 39,685 lb.

Performance: max speed at height Mach 1.77, at S/L Mach 1.1, ceiling 45,900 ft, combat radius lo-lo-lo 240 miles.

Accommodation: pilot only.

Armament: one 30 mm six-barrel gun under fuselage. Seven external hardpoints for 6,615 lb of AS-7 ("Kerry") air-to-surface missiles, AA-8 ("Aphid") air-to-air missiles, 1,100 lb bombs, 57 mm rockets, and other stores.

Mirage 5

The Mirage 5 was conceived as a specialized ground-attack development of the Mirage III. The radar was deleted, and other avionics and systems simplified, to permit increased internal fuel capacity and external stores load within the same gross weight. Options available to customers led eventually to a narrowing of the differences between the equipment standards of the III and 5. Pakistan placed an initial order for 28 single-seat **Mirage 5PAs** and two **5DP** two-seat trainers in 1970; those remaining equip No. 22 Squadron, the Mirage OCU. Ten **Mirage 5RPs,** with nose-mounted cameras, were ordered in 1975, followed by 30 single-seat **5PA2s** and **5PA3s** and two **5DPA2** trainers in 1979. The 5PA2s, with Cyrano IV multimission radar, now serve with No. 33 Squadron of the Pakistan Air Force. No. 8 Squadron has the 5PA3s with Agave radar for compatibility with Exocet antiship missiles. *(Data generally as for Mirage III.)*

OV-10 Bronco

The Bronco has been described as the first aircraft designed from the start for specialized counterinsurgency (COIN) operations. The US Marine Corps issued its requirements for a light armed reconnaissance aircraft (LARA). After a keenly fought competition, the Bronco was announced as the winner. Seven YOV-10A prototypes were ordered, of which the first flew on July 16, 1965. The design emphasis was on simplicity, with a constant chord wing and a slim fuselage pod surmounted by a huge blistered canopy that gave the tandem pilot and observer an unrivaled all-around view. The war in Vietnam left no doubt of the value of such an aircraft, with its impressive weapon load, for forward air control duties as well as light armed reconnaissance and helicopter escort. USAF ordered 157, which were delivered simultaneously with the Marines' 114 production OV-10As in 1968–69.

The production OV-10A was heavier than the prototypes, requiring a 10 ft increase in span and more powerful T76 opposite-rotating turboprops. Export deliveries included 40 similar **OV-10Cs** for the Royal Thai Air Force, most of which continue to equip its Nos. 411 and 711 Squadrons to deal with border clashes that have occurred frequently in the past decade. The Indonesian Air Force operates a single squadron of **OV-10Fs,** generally similar to the OV-10A.

Contractor: Rockwell International Corporation, USA.

Power Plant: two Garrett T76-G-416/417 turboprops; each 715 ehp.

Dimensions: span 40 ft 0 in, length 41 ft 7 in, height 15 ft 2 in.

Weights: empty 6,893 lb, gross 9,908 lb (normal), 14,444 lb (overload).

Performance: max speed at S/L 281 mph, ceiling 24,000 ft, combat radius with 3,600 lb weapon load 228 miles.

Accommodation: crew of two, in tandem.

Armament: two short sponsons each house two 7.62 mm M60C machine guns, with 500 rds per gun. Four pylons under sponsons each have a capacity of 600 lb; a centerline fifth pylon can carry 1,200 lb. Stores can include bombs, fire bombs, cluster bombs, rocket packs, 7.62 mm Minigun and 20 mm gun pods, flares, smoke canisters, and Sidewinder air-to-air missiles.

PC-7 Turbo Trainer

As its name implies, the Pilatus PC-7 was designed specifically for the training role, and further details of its career can be found in the "World Gallery of Trainers" in the December 1989 issue of AIR FORCE Magazine. Swiss government regulations expressly forbid the fitting of armament by the manufacturer, but weapons have been fitted by both of the Asian customers for the PC-7: Myanmar (Burma), which operates 12 equipped for counterinsurgency duties, and Malaysia, which similarly armed a few of its 44 PC-7s to create one light attack squadron. Myanmar (six) and Australia (67) are customers for the redesigned Pilatus PC-9 trainer: the former is reportedly planning to convert these, too, to attack configuration.

Contractor: Pilatus Flugzeugwerke, Switzerland.

Power Plant: one Pratt & Whitney 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 5,952 lb.

Performance: max cruising speed 226 mph at 20,000 ft, ceiling 26,000 ft, max range 1,634 miles, max endurance 3 h 45 min.

Accommodation: crew of two, in tandem. Low-speed/zero-height ejection seats optional.

Armament: at operator's discretion (six underwing attachment points); none fitted or supplied by Pilatus.

Q-5/A-5

The history of the Q-5 is one of triumph over adversity. Initiated at Shenyang as long ago as August 1958 this program to develop a much-redesigned attack version of the J-6 (Chinese MiG-19) was soon reassigned to Nanchang, but was officially canceled in 1961 after the Sino-Soviet ideological split. The project was kept alive unofficially by a small cadre of workers, work resumed in 1963, and the first prototype flew on June 4, 1965. Early prototypes proved very unsatisfactory, yet—notwithstanding the "cultural revolution"—development was allowed to continue, two much-modified prototypes being flown in late 1969. These quickly received state approval, and production deliveries started in the following year.

The original **Q-5** model, given the reporting name "Fantan" by NATO, had a 13 ft internal bay for two 551 or 1,102 lb bombs, with two more mounted externally under the fuselage, plus four underwing stations for rockets or other stores. When the **Q-5 I** (first flight late 1980) appeared, the bomb bay had been blanked off, its space being used for additional fuel tankage, and all four bombs were hung under the fuselage. Other features of the Q-5 I, which entered production in late 1981, included improved engines and pilot seat and a relocated brake-chute. It was followed in January 1985 by production approval for the **Q-5 IA,** with two more underwing stores stations (increasing the external load by 1,102 lb), pressure refueling, improved warning and ECM systems, and other refinements. Current version in Chinese service is designated **Q-5 II.** Some 500–600 Q-5s of all versions are thought to be in Chinese service, including about 100 with the PLA Naval Air Force. These can carry two underfuselage torpedoes or C-801 antiship missiles. A few of the original production Q-5s were adapted to carry nuclear weapons.

There have been three export customers for the Q-5, starting with North Korea, which received 40 Q-5 IAs in the 1980s. A major version since the early 1980s has been the **A-5C,** which has no Chinese Air Force counterpart. Developed specifically for the Pakistan Air Force, the A-5C has a Martin-Baker zero/zero seat and upgraded avionics and is adapted to carry weapons and drop tanks standard on other PAF aircraft, including Sidewinder air-to-air missiles. After completing three A-5C prototypes, Nanchang delivered an initial 52 to Pakistan, to an April 1981 order, followed by 98 more later. Bangladesh ordered 20 A-5Cs in 1987, but delivery of these has not yet been confirmed.

Prototypes were flown in 1988 of two versions with upgraded avionics: the **Q-5K Kong Yun** (cloud) for the PLA Air Force, engineered by a French team led by Thomson-CSF, and the **A-5M,** intended for export, with the new installation managed by Aeritalia. China terminated the Kong Yun program earlier this year. The A-5M, which first flew in August 1988, is designed to combine an AMX-standard nav/attack system and other new avionics with improved WP6A engines of 8,267 lb afterburning thrust and two additional underwing stores points, making 12 external points in all—though the total external load remains unchanged. *(Data for A-5C.)*

Contractor: Nanchang Aircraft Manufacturing Company, People's Republic of China.

Power Plant: two Shenyang WP6 turbojets; each 5,732 lb st dry and 7,165 lb st with afterburning.

Dimensions: span 31 ft 10 in, length 50 ft 7 in (excl nose probe), height 14 ft 9¾ in.

Weights: empty 14,317 lb, gross 21,010 lb (clean), 26,455 lb (max external stores).

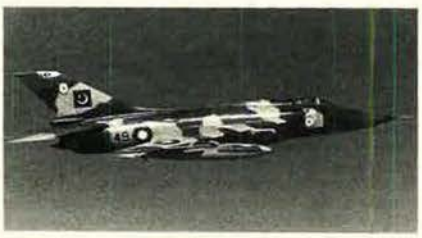
Performance: max speed (clean) 740 mph at 36,000 ft, ceiling (clean) 52,000 ft, combat radius (max external stores) 248–373 miles, range (max internal/external fuel) 1,240 miles.

Accommodation: pilot only, on zero/zero (Pakistan only) or low-speed/zero height ejection seat.

Armament: 23 mm Norinco Type 23-2K gun, with 100 rds, in each wingroot. Ten weapon stations (two pairs in tandem under fuselage and three under each wing) for up to 4,410 lb of stores including bombs, rockets, air-to-air or air-to-surface missiles, other ordnance, ECM pods, or drop tanks, in more than 20 possible combinations. Some Q-5s can carry a single 5–20 kT nuclear bomb.

Mirage 5PA3, Pakistan Air Force (Denis Hughes)

PC-7 Turbo Trainers, Union of Myanmar Air Force



A-5C, Pakistan Air Force (Denis Hughes)

Sea Harrier

This STOVL carrier-based aircraft is widely regarded as the world's supreme air combat fighter, because of its ability to use its "puffer" control jets and thrust vectoring in forward flight ("viffing") to perform exceptional maneuvers in dogfight situations. It is equally suitable for reconnaissance and strike missions, and pioneered the use of ski-jump techniques from aircraft carriers to permit an increase of 2,500 lb in launch weight. Compared with the original land-based Harrier, the Sea Harrier embodies no magnesium components, to avoid corrosion problems at sea, and has a raised cockpit, revised avionics, and a Ferranti Blue Fox radar with air-to-air and air-to-surface modes of operation.

During the Falklands campaign in 1982, the Royal Navy's Sea Harrier FRS. Mk 1s destroyed 22 enemy aircraft without loss in air combat. In January of the following year, the Indian Navy began taking delivery of six similar **FRS. Mk 51s** for operation by No. 300 (White Tiger) Squadron from the aircraft carrier INS *Vikrant.* Ten more were ordered in 1985, followed by a letter of intent for a further seven in 1986, to equip also the INS *Viraat.* The four **T. Mk 60** two-seat trainers ordered by India are based on the nonmaritime Harrier but have Sea Harrier avionics except for Blue Fox radar.

Contractor: British Aerospace plc, UK.

Power Plant: one Rolls-Royce Pegasus Mk 104 vectored-thrust turbofan; 21,500 lb st.

Dimensions: span 25 ft 3 in, length 47 ft 7 in, height 12 ft 2 in.

Weights: empty 14,052 lb, gross 26,200 lb.

Performance: max speed at S/L above 736 mph, high-altitude intercept radius 460 miles, strike radius 288 miles.

Accommodation: pilot only.

Armament: one centerline and four underwing hardpoints for up to 5,000 lb of stores, including 1,030 lb free-fall and 1,120 lb parachute-retarded bombs, rockets, and flares. Four Magic air-to-air missiles can be carried on outboard pylons by Indian Navy aircraft.

Provision for replacing underfuselage strake fairings with two 30 mm Aden gun pods.

Su-7/Su-20/Su-22

Few of the original fixed-wing Sukhoi Su-7BM (NATO "Fitter-A") attack aircraft remain in first-line service in Asia. The Afghan Republican Air Force is believed to have two squadrons of them at Shindand, and the (North) Korean People's Army Air Force has about 30. Both of these air forces, and that of Vietnam, also operate variable-geometry Su-20/22 "Fitters," which are far more formidable combat aircraft. The precise variants that they fly are not known. They probably lack the more advanced equipment fitted to the Soviet air forces' generally similar Su-17s, described in the "Gallery of Soviet Aerospace Weapons" in the March 1990 issue of AIR FORCE Magazine, and Su-22s have a Tumansky R-29B turbojet instead of the Lyulka AL-21F-3 fitted in the Su-17 and Su-20. Even so, a measure of their capability is given by the fact that Su-17s equip about one-third of the Soviet tactical ground-attack force. *(Data for Su-22M-4.)*

Power Plant: one Tumansky R-29B turbojet; 25,350 lb st with afterburning.
Dimensions: span 45 ft 3 in spread, 32 ft 10 in swept, length 61 ft 6¼ in, height 16 ft 5 in.
Weight: gross 42,990 lb.
Performance: max speed at height Mach 2.09, at S/L Mach 1.14, ceiling 49,865 ft, range at high altitude 1,430 miles, at S/L 870 miles.
Accommodation: pilot only.
Armament: two 30 mm NR-30 guns in wingroots, each with 70 rds. Nine pylons under wings and fuselage for more than 7,000 lb of bombs, rocket pods, 23 mm gun pods, and air-to-surface guided missiles.

Su-25

It is seldom recognized how widespread was the use of Sukhoi Su-25K (NATO "Frogfoot-A") close support aircraft by the Soviet forces that fought in Afghanistan. A trials unit had been followed by a single squadron of early production aircraft in 1982. Their initial purpose was to perfect techniques for coordinating low-level close support of ground forces in mountainous terrain by Su-25Ks and Mi-24 ("Hind") gunship helicopters. As crews of USAF A-10s will appreciate, this proved a hazardous assignment against enemy *mujahedeen* armed with the latest types of shoulder-fired surface-to-air missiles, and 23 Su-25Ks were lost in Afghanistan. When the Soviet forces withdrew in 1989, at least one full squadron of Su-25Ks remained in the inventory of the Afghan Republican Air Force. The only other known operator in Asia, outside the USSR, is North Korea, which is reported to have at least twenty.

Details of survivability features that account for some 7.5 percent of the aircraft's normal takeoff weight can be found in the March 1990 issue of AIR FORCE Magazine, in the "Gallery of Soviet Aerospace Weapons." As a result of experience gained in Vietnam, the Su-25K now has dispensers for 256 flares. Its laser guidance system is claimed to place bombs within 16 ft of the target over a standoff range of 12.5 miles.

Power Plant: two Tumansky R-195 nonafterburning turbojets; each 9,921 lb st.
Dimensions: span 47 ft 1½ in, length 50 ft 11½ in, height 15 ft 9 in.
Weights: empty 20,950 lb, gross 32,187–38,800 lb.
Performance: max level speed at S/L Mach 0.8, max attack speed with airbrakes open 428 mph, ceiling 22,965 ft, range with 9,700 lb weapon load 466 miles at S/L, 776 miles at height.
Accommodation: pilot only.
Armament: one twin-barrel 30 mm gun, with 250 rds (sufficient for one-second burst during each of five attack runs) in nose. Eight large underwing pylons for 9,700 lb (being increased to 14,100 lb) of air-to-surface weapons, including pods for 23 mm guns with twin barrels that pivot downward; 57 mm to 370 mm rockets; laser-guided, rocket-boosted 772 to 1,477 lb bombs; and 1,100 lb incendiary, antipersonnel, and chemical cluster bombs. Two small outboard pylons for AA-2D ("Atoll") or AA-8 ("Aphid") air-to-air self-defense missiles.

Bombers and Maritime

Atlantic

In 1975–76, the French Navy sold to the Pakistan Air Force three of the 40 Atlantic maritime patrol aircraft that had been built for it by the SECBAT consortium of companies in five European nations. Despite having "Pakistan Navy" painted on their sides, the three aircraft were delivered to No. 29 Squadron of the Pakistan Air Force, based at Sharea Faisal. They are perfectly standard Atlantics, with a pressurized upper deck in the "double-bubble" fuselage roomy enough to carry a relief crew on long-duration missions. A normal operational crew comprises twelve men, with two pilots, a flight engineer, three observers, a radio navigator, ESM/ECM/MAD operator, radar/IFF operator, tactical coordinator, and two acoustic sensor operators. Equipment includes a retractable radar, MAD tailboom, and an Arar ESM pod on the tip of the fin. Sonobuoys and marker flares are stowed in the rear fuselage. An additional Atlantic was acquired by Pakistan subsequently.

Contractor: SECBAT consortium, France, Germany, Italy, Belgium, and the Netherlands.
Power Plant: two Rolls-Royce Tyne RTy 20 Mk 21 turboprops; each 6,106 ehp.
Dimensions: span 119 ft 1 in, length 104 ft 2 in, height 37 ft 2 in.
Weights: empty 52,900 lb, gross 95,900 lb.
Performance: max speed 409 mph at height, ceiling 32,800 ft, range 5,590 miles.
Accommodation: crew of 12. Provision for 12 other personnel.
Armament: internal weapons bay accommodates all standard NATO bombs, mines, 385 lb depth charges, four homing or nine acoustic torpedoes, or two Exocet air-to-surface missiles. Underwing pylons for two more stores.

E-2C Hawkeye, Japan Air Self-Defense Force (Katsumi Hinata)

F27 Maritime, Philippine Air Force

Canberra

Thirty-three years after India received its first Canberras, these vintage British combat aircraft continue to serve with three squadrons of the Indian Air Force. Two of them, Nos. 35 and 106, fly specially equipped ECM Canberras and photographic PR. 57s, respectively. No. 6 Squadron operates flights of Jaguars and Canberras in an antishipping strike role, including aircraft inherited from the long-disbanded Jet Bomber Conversion Unit (JBCU). Versions flown by No. 6 include the **B(I). 58, B. 66,** and ex-RNZAF **B(I). 12,** plus a few **TT. 42** target tugs. The B(I). 58s are survivors of 71 aircraft of this mark bought by India, whose initial 1957 contract for a total of 80 B(I). 58s, PR. 57s, and T. 4s was larger than all other export orders for new-built Canberras added together. Similar to RAF B(I). 8s except for having an autopilot, additional navigation equipment, and other small changes, they were chosen against strong competition from the less costly Soviet Il-28 and saw combat service in conflicts with Pakistan. They were so highly regarded that India bought B. 66s as refurbished ex-RAF B. 15s and 16s eleven years after the manufacture of new aircraft had ended. Later still, the TT. 42s were modified for target towing by Hindustan Aeronautics by equipping ex-RAF T. 4 trainers to the same standards as RAF TT. 18s. *(Data for Canberra B(I). 58.)*

Contractor: English Electric Company, UK.
Power Plant: two Rolls-Royce Avon RA.7 Mk 109 turbojets; each 7,500 lb st.
Dimensions: span 63 ft 11½ in, length 65 ft 6 in, height 15 ft 7 in.
Weights: empty approx 23,170 lb, gross 56,250 lb.
Performance: max speed 510 mph at S/L, 560 mph at height, ceiling 48,000 ft, range 3,400 miles.
Accommodation: pilot and navigator, side by side, with blister canopy for pilot only.
Armament: in bomber role, up to 6,000 lb of 500 to 4,000 lb bombs carried internally. As interdictor, pack of four 20 mm Hispano guns in bomb bay, plus two 1,000 lb bombs or flares, and 2,000 lb of bombs, rockets, or flares on underwing pylons.

E-2C Hawkeye

Combat experience over the Bekaa Valley in Lebanon provided the best possible proof of the value of the E-2C. The Israelis were able to detect and ambush incoming enemy fighters, so achieving an unprecedented ratio of kills to losses. In Asia, the Japan Air Self-Defense Force has ordered to date a total of 13 E-2Cs identical with those that served the Israelis so well; Singapore has four and intends to buy two more.

Smaller and far less costly than USAF's E-3 Sentry, the E-2 was developed as the US Navy's standard carrier-based airborne early warning and control (AEW&C) aircraft. The prototype flew 30 years ago, on October 21, 1960, pioneering the rotodome type of rotating "saucer" radome that has since become a feature of the most effective US and Soviet AEW&C types. On the E-2C, the rotodome has a diameter of 24 ft and turns at the rate of 6 rpm in flight. Its antennas provide both radar and IFF data, via a General Electric AN/APS-139 advanced radar processing system. At an operating height of 30,000 ft, approaching aircraft can be detected and assessed over a radius of nearly 300 miles. Targets as small as a cruise missile can be picked up at around 170 miles' distance; the movement of enemy ships and land vehicles can be monitored; friendly aircraft can be directed against targets over sea or land, and can be helped to elude enemy defenses by an AN/ALR-73 passive detection system that locates hostile radar emitters over double the range of the radar. The JASDF plans to upgrade the radars of its E-2Cs to the latest APS-145 standard for full overland capability.

Because of the E-2C's naval origins, the rotodome is designed to be lowered hydraulically for stowage on board ship, reducing overall height to 16 ft 5 in. The use of four tail fins (made of glassfiber to minimize interference with radar signals) also keeps down the aircraft's height, and its wings fold.

Contractor: Grumman Aircraft Systems Division, USA.
Power Plant: two Allison T56-A-427 turboprops; each 5,250 ehp.
Dimensions: span 80 ft 7 in (folded 29 ft 4 in), length 57 ft 6¾ in, height (rotodome raised) 18 ft 3¾ in.
Weights: empty 38,063 lb, gross 51,933 lb.
Performance: max speed 372 mph, ceiling 30,800 ft, time on station 200 miles from base 3–4 h, endurance 6 h 6 min.
Accommodation: crew of five, comprising pilot, copilot, combat information center officer, air control officer, and radar operator.
Armament: none.

F27 Maritime

Maritime and surveillance variants of the Fokker F27 Friendship transport aircraft have been available for several years and continue to be offered from the production line of its successor, the Fokker 50. The basic **F27 Maritime** is unarmed and configured primarily for coast-

al surveillance or search and rescue, while the **Maritime Enforcer** can be configured for ASW, ASV, or armed surveillance, weapon installation being done by the operator rather than the manufacturer. No. 27 Squadron of the Philippine Air Force has three F27 Maritimes for unarmed reconnaissance. Three others are in service with the Royal Thai Navy. The latter are armed, but their avionics are not to full Maritime Enforcer standard. *(Data as for F27 Mk 400M except as follows.)*

Dimensions: height 28 ft 6½ in.

H-6D, Aviation of the People's Navy, China

P-3K Orion, Royal New Zealand Air Force

Weights: empty 29,352 lb, gross 45,000 lb (normal), 47,500 lb (max).

Performance: normal cruising speed 287 mph at 20,000 ft, ceiling 29,500 ft, max range (internal fuel) 3,107 miles.

Accommodation: flight crew of two or three, plus two to five systems operators.

Armament: Fokker-installed stores management system only: weapons (selected and fitted by operator) can be carried on two fuselage stations and three under each wing, and can include two or four homing torpedoes and/or depth bombs for ASW, or two air-to-surface missiles for antiship missions. Alternatively, two drop tanks can be carried for extended patrol range.

H-6

In September 1957, five years after the Soviet Union flew the prototype Tupolev Tu-16 medium bomber, China obtained license rights to build the aircraft. Two completed Tu-16s and a set of major assemblies for one aircraft were received at the Harbin Aircraft Factory in May 1959. Assembly of the Chinese prototype took just 67 days, and this aircraft, designated **H-6,** flew for the first time on September 27. The difficulties experienced by Chinese industry at that period caused delay in getting production started. It was decided to transfer the entire program to the Xian Aircraft Factory in 1962–64, and the **H-6A** production prototype eventually flew on December 24, 1968. Meanwhile, an H-6 assembled in 1959 from a knocked-down component kit was modified to carry China's first atomic bomb, which was dropped successfully in 1965.

The H-6A is powered by two Xian-built WP8 turbojets, generally similar to the Tu-16's RD-3M engines. When the bomber entered service, their TBO was 300 hours; by 1983 it had increased progressively to 800 hours. Also at that time, a completely new avionics suite was in production for the bomber, comprising a computer, automatic navigation system, Doppler radar, heading and attitude system, autopilot, and bombing radar. A second version of the aircraft, designated **H-6D,** flew for the first time on August 29, 1981, and was approved for production in 1985. Intended for operation by the Aviation of the People's Navy, the "D" is a carrier for China's C-601 first-generation antishipping missile, one of which is pylon-mounted under each wing. An enlarged cylindrical undernose fairing on the aircraft houses associated missile guidance radar. Other variants of the H-6 are in service as ECCM aircraft and, in small numbers, as launch aircraft for high-speed, high-altitude drones and as engine testbeds. Flight Refuelling Ltd of the UK has designed a probe-and-drogue aerial refueling system for the H-6, but approval for its manufacture has not yet been given. The number of H-6As and Ds in service is believed to total 120. *(Data for H-6D.)*

Contractor: Xian Aircraft Manufacturing Company, People's Republic of China.

S-2E Tracker, Chinese Nationalist Air Force (Denis Hughes)

Power Plant: two Xian WP8 turbojets; each 20,944 lb st.

Dimensions: span 112 ft 2 in, length 114 ft 2 in, height 33 ft 11¾ in.

Weights: empty 84,944 lb, gross 167,110 lb.

Performance: max cruising speed 488 mph, ceiling 39,370 ft, range 2,672 miles.

Accommodation: crew of six.

Armament: six guns, in pairs, in dorsal, ventral, and tail turrets. Two C-601 antishipping missiles under wing. Nuclear or conventional bombs in weapons bay. Chute for flares and marine markers to rear of weapons bay.

Il-28/H-5

Like the contemporary MiG-15 fighter, the Soviet Union's first production jet bomber, the Ilyushir **Il-28** (NATO "Beagle"), was first flown with imported Rolls-Royce Nene turbojets and was then built in huge numbers with VK-1As, developed from the Nene by Vladimir Klimov. Of an estimated 3,000 manufactured in the Soviet Union from 1948, at least half were exported. About 20 of those supplied to Afghanistan are still nominally available, as are small numbers in North Korea and Vietnam. China is the only major operator in 1990. After receiving up to 500 Il-28 bombers from the Soviet Union, its leaders decided to utilize experience gained in repairing and producing spares for these aircraft to create the necessary design drawings and put the aircraft into large-scale production at Harbin as the **H-5** (Hongzhaji-5; bomber aircraft 5).

About 40 percent of the airframe was redesigned. A one-piece wing superseded the original design (which was spliced on the centerline), saving 220 lb of structure weight. Many components, including the tailgun turret, were made common with those of the H-6 (Tu-16), already on the assembly line in China under license. The aircraft's radar, bombsight, and IFF were all new. A prototype flew for the first time on September 25, 1966, and production began seven months later. About 450 H-5s and Il-28s are believed still to be operational in the Air Force of the People's Liberation Army, some nuclear-capable, plus a further 150 serving as torpedo-bombers with the Navy. Short/medium-range tactical reconnaissance requirements are handled by **HZ-5s,** with two day/night cameras in the bomb bay and integral wing fuel tanks that increase the aircraft's combat radius by 50 percent. In addition, 186 **HJ-5s** were manufactured in the 1970s for training bomber pilots. The "Il-28s" of Vietnam might well be H-5s. *(Data for Il-28.)*

Power Plant: two Klimov VK-1A turbojets; each 5,952 lb st.

Dimensions: span 70 ft 4½ in, length 57 ft 11 in, height 21 ft 11¾ in.

Weights: empty 28,500 lb, gross 46,738 lb.

Performance: max speed at 15,000 ft 560 mph, ceiling 40,350 ft, range 1,490 miles.

Accommodation: crew of three, comprising pilot, navigator/bombardier in nose compartment, and radio operator/gunner in tail turret.

Armament: two 23 mm NR-23 guns, each with 100 rds, in nose; two more, each with 225 rds, in tail turret. Up to 6,614 lb of stores in internal weapons bay, typically four 1,100 lb or eight 550 lb bombs. Naval version carries one large or two smaller torpedoes, mines, or depth charges.

Il-38

The Indian Navy is believed now to have five Il-38 (NATO "May") intermediate-range, shore-based, antisubmarine/maritime patrol aircraft, equipping INAS 315 at Dabolim, Goa. The airframe of the Il-38 is basically similar to that of the veteran Il-18 four-turboprop airliner, with a lengthened fuselage and the wing moved forward to offset the effect on the aircraft's center of gravity of internal equipment and stores. Operational equipment includes navigation/weather radar in the nose, search radar in an undernose radome, and an MAD tail-sting. There are two internal weapons/stores bays forward and aft of the wing carry-through structure.

Power Plant: four Ivchenko AI-20M turboprops; each 4,250 ehp.

Dimensions: span 122 ft 9¼ in, length 129 ft 10 in, height 33 ft 4 in.

Weights: empty 79,367 lb, gross 140,000 lb.

Performance: max speed 448 mph at 21,000 ft, range 4,473 miles, patrol endurance 12 h.

Accommodation: crew of twelve.

Armament: variety of attack weapons and sonobuoys in weapons bays.

P-2J

After building 48 Lockheed P-2H (P2V-7) Neptune maritime patrol aircraft under license in the 1950s, Kawasaki began a redesign in 1961 that resulted in the P-2J, first flown as a prototype in July 1966. Differing mainly in having an extended forward fuselage to accommodate more avionics, the P-2J entered production in 1969. Features included AN/APS-80N ventral search radar, a Julie/Jezebel ASW system, HSQ-101 MAD, and HLR-101 electronic support measures. The port wingtip pod contained fuel, the starboard one a searchlight. Eighty-two P-2Js were built for the Japan Maritime Self-Defense Force, equipping six squadrons and two training groups; about 30 of these remain in service. One was test-flown in 1977–78 after fitment of a fly-by-wire control system for variable-stability trials, two others have been converted to **UP-2J(E)** elint aircraft, and two to **UP-2Js** for target towing, ECM training, and drone launch duties.

Contractor: Kawasaki Heavy Industries, Japan.

Power Plant: two Ishikawajima-Harima (GE license) T64-IHI-10E turboprops, each 2,850 shp; and two IHI J3-IHI-7D turbojets, each 3,417 lb st.

Dimensions: span (over wingtip pods) 101 ft 3½ in, length 95 ft 10¾ in, height 29 ft 3½ in.

Weights: empty 41,890 lb, gross 75,000 lb.

Performance: max cruising speed 311 mph at 20,000 ft, ceiling 31,000 ft, max range 2,765 miles.

Accommodation: total crew of 12, including two pilots.

Armament: four Mk 34 torpedoes or sixteen 330 lb depth charges internally; eight 127 mm rockets underwing.

P-3 Orion

First Pacific area customer for this Lockheed maritime patroller was the Royal New Zealand Air Force, to which five **P-3Ks** (equivalent to the USN's P-3B) were delivered in 1966. All five are still in service with No. 5 Squadron, augmented by a sixth (ex-Australian) aircraft acquired subsequently. Australia's own initial order, in 1968, was for ten **P-3Bs,** which also were joined later by a single replacement, this time ex-US Navy. No P-3Bs now remain in RAAF service, having been superseded by an initial ten **P-3C/Update II** Orions (Australian designation **P-3W**) and a further ten to replace the disposed-of P-3Bs. Equipment differences in the P-3W include an AQS-901 processing system for Australian Barra sonobuoys instead of the Proteus and AQA-7 system of the standard P-3C. The P-3Ws equip Nos. 10 and 11 Squadrons of the RAAF. All 20 are shortly to receive an ESM upgrade by IAI Elta Electronics of Israel.

Japan acquired three US-built P-3C/Update IIs before local production (starting with four CKD kits) was initiat-

ed by Kawasaki for the JMSDF, which plans to acquire 100 of this version (Japanese designation **P-3J**). Ninety-six of these have already been ordered (up to FY 1990), of which about 70 have been delivered; they equip six JMSDF squadrons of the 1st, 2d, and 4th Fleet Air Wings at Atsugi (two), Hachinohe (two), Shimofusa, and Kanoya. Two have been converted to **EP-3J** elint aircraft, with more expected to follow. Pakistan has ordered three **P-3C-IIIs,** deliveries of which are due to begin this year to the PAF's No. 29 Squadron. South Korea has announced plans to acquire the type, and the Royal Thai Navy is to receive three ex-US Navy P-3s. *(Data for P-3C.)*

Contractor: Lockheed Aeronautical Systems Group, USA.

Power Plant: four Allison T56-A-14 turboprops; each 4,910 ehp.

Dimensions: span 99 ft 8 in, length 116 ft 10 in, height 33 ft 8½ in.

Weights: empty 61,491 lb, max expendable load 20,000 lb, normal gross 135,000 lb.

Performance: econ cruising speed at 110,000 lb gross weight 378 mph at 25,000 ft, patrol speed at 1,500 ft at same weight 237 mph, ceiling 28,300 ft, mission radius (3 h on station at 1,500 ft) 1,550 miles.

Accommodation: normal crew of 10, including five in tactical compartment in main cabin.

Armament: one 2,000 lb or three 1,000 lb mines, or up to eight depth bombs or torpedoes, or depth bomb/torpedo combinations (including nuclear depth bombs), in internal weapons bay. Ten underwing pylons for torpedoes, mines, rockets, or other stores.

S-2 Tracker and Turbo Tracker

The navies of South Korea, Taiwan, and Thailand all continue to operate versions of this veteran antisubmarine and maritime patrol aircraft, in shore-based forms. South Korea has around 20 S-2As and Fs, dating back to the original XS2F-1 prototype that first flew on December 4, 1952. Powered by two 1,525 hp Wright R-1820-82WA piston engines, the production **S-2A** (initially designated S2F-1) is equipped with an APS-38 search radar in a retractable radome in the center-fuselage, an ASQ-10 MAD in a retractable tail-sting, and a 70 million candlepower searchlight on the leading edge of the starboard wing. It has a long fuselage weapons bay forward of the radome, six underwing hardpoints for additional stores, and sonobuoy stowage in the rear of the engine nacelles. The **S-2F** is generally similar, with added AQA-3 Jezebel passive acoustic search equipment and Julie explosive echo-sounding equipment.

The Royal Thai Navy has about seven S-2Fs and US-2C utility aircraft. Taiwan has the largest fleet of Trackers, with 32 S-2As, **S-2Es,** and S-2Fs. The "E" features an increased span, larger tail surfaces, an enlarged front fuselage to increase crew comfort, increased fuel, and 32 instead of 16 sonobuoys in the nacelles. Jezebel/Julie is standard on this version. All three of these navies have evaluated the viability of having their aircraft converted into **S-2T Turbo Trackers,** with 1,645 shp Garrett TPE331-1-5AW turboprops driving four-blade advanced technology propellers. The only one to decide on such a program is the Taiwanese Navy, which began flight-testing its prototype conversion in early 1989. Grumman converted the first two aircraft and is supplying kits for the other 30 under US Navy FMS contract. The update includes an avionics and ASW package that comprises a MAPADS 902F acoustic processor, ASQ-504(V) MAD, AN/APS-509 radar, ARR-84 acoustic receivers, and an ASN-150 tactical navigation system integrated with the INS and Collins avionics. Maximum speed is increased to 311 mph at 5,000 ft, with a 1,100 lb increase in payload and generally improved field and climb performance. The engine TBO is also increased. *(Data for S-2E.)*

Contractor: Grumman Corporation, USA.

Power Plant: two Wright R-1820-82WA piston engines; each 1,525 hp.

Dimensions: span 72 ft 7 in, length 43 ft 6 in, height 16 ft 7½ in.

Weights: empty 19,033 lb, gross 26,867 lb.

Performance: max speed 253 mph at 5,000 ft, ceiling 22,000 ft, range 1,150 miles.

Accommodation: crew of four, comprising pilot, copilot, and two radar operators.

Armament: one depth bomb or two torpedoes in weapons bay. Depth bombs, torpedoes, or rockets on six underwing hardpoints. Max weapon load 4,810 lb.

Searchmaster

In the 1970s, Australia's Government Aircraft Factories made a brave attempt to remain in the aircraft design and manufacturing business by producing a twin-turboprop STOL utility aircraft named Nomad. This began as a short/medium-range transport for 13 passengers and/or freight in **N22B** form. With a lengthened fuselage, seats for 17 passengers, a commuter interior, and IFR avionics as standard, it became the **N24A.** Specialized versions were given individual names. Thus, the Australian Royal Flying Doctor Service bought some Medicmasters, specially equipped as ambulances for service in the outback. Other civil variants were offered as Surveymasters and amphibious Floatmasters. Military Missionmasters were purchased by four countries (see Transports and Tankers section), and coastal patrol Searchmasters by two Asian military operators.

The basic coastal patrol version is the **Searchmaster B.** This has a Bendix RDR 1400 search radar, with an 18 in forward looking flat-plate antenna in a nose radome, and carries a four-man crew. Twelve were bought for the Indonesian Navy, followed by six more-sophisticated **Searchmaster Ls.** These have a Litton APS-504(V)2 360° search radar, with a 40 in flat-plate phased-array antenna in an undernose "lozenge" radome; Doppler, Omega, or inertial long-range navigation system; and a crew of five. The Royal Thai Navy has five Searchmaster Ls equipped with Barra SSQ-801 sonobuoys. Both of these navies include among their routine tasks the tracking of pirates, and one of the Thai aircraft has a side-looking airborne radar specifically for antipiracy patrols in the Gulf of Thailand, for which the nation receives UN funding. *(Data for Searchmaster L.)*

Contractor: Government Aircraft Factories, Australia.

Power Plant: two Allison 250-B17C turboprops; each 420 shp.

Dimensions: span 54 ft 2 in, length 41 ft 3 in, height 18 ft 2 in.

Weights: empty 5,897 lb, gross 9,100 lb.

Performance: normal cruising speed 193 mph, ceiling 21,000 ft.

Accommodation: crew of five.

Armament: provision for four underwing hardpoints, each for a 500 lb store, including gun and rocket pods.

SH-5

Exhibiting design similarities to both the Japanese US-1A and Soviet Be-12, China's SH-5 (for Shuishang Hongzhaji: maritime bomber) has had a lengthy gestation period. Detail design was completed in February 1970, and the first (static test) prototype 20 months later. Aircraft 02, the first flying prototype, came out of final assembly in December 1973, but did not begin water taxi tests until late 1975 and made its first flight on April 3, 1976. The program apparently languished until 1984–85, when a preseries batch of four more were built and flown, and these were handed over to the PLA Navy in September 1986. They are in service with a trials unit at Tuandao Naval Air Station, Qingdao.

Primary roles for the SH-5 are believed to be antisubmarine and antiship warfare, and maritime patrol and surveillance. It can also be used for minelaying, search and rescue, or carriage of bulk cargo, and the prototype has been demonstrated successfully in a water-bomber configuration. The hull is unpressurized but fully amphibious; wingtip stabilizing floats are nonretractable. Doppler search radar is installed in the nose "thimble" and MAD in the tail-sting. SAR gear, sonobuoys, and other maritime equipment can be carried internally.

It is not certain whether further SH-5 production has yet been approved, but China has a stated requirement for a future overwater patrol aircraft, and the choice would seem to lie between the SH-5 and a maritime version of the land-based Shaanxi Y-8.

Contractor: Harbin Aircraft Manufacturing Company, People's Republic of China.

Power Plant: four Dongan WJ5A turboprops; each 3,150 ehp.

Dimensions: span 118 ft 1¼ in, length 127 ft 7½ in, height 32 ft 1½ in.

Weights: empty (ASW) 58,422 lb, gross 99,208 lb.

Performance: max cruising speed 280 mph, min patrol speed 143 mph, ceiling 22,965 ft, range 2,951 miles (max), endurance (on two engines) 12–15 hours.

Accommodation: flight crew of five, plus systems/equipment operators (normally three) according to mission.

Armament: twin-gun remotely controlled dorsal turret. Four underwing hardpoints for C-101 sea-skimming antiship or other missiles (one on each inboard pylon), lightweight torpedoes (up to three on each outer pylon), or other stores. Internal bay in rear of hull for depth charges, mines, or bombs.

SH-5, Aviation of the People's Navy, China

Surveiller

This is the name given to three special versions of the **Boeing 737-200** that were ordered by the Indonesian Air Force in the spring of 1981 and delivered during 1982–83. Configured for long-range overwater patrol, a duty they share with the IAF's single C-130H-MP Hercules, the Surveillers each have a Motorola SLAMMR (side-looking airborne modular multimission radar) installation that requires a 16-ft-long antenna fairing on each side of the upper rear fuselage. With this equipment, the Surveiller can spot small ships in heavy seas up to 115 miles away, from a patrol altitude of 30,000 ft. All three aircraft can double as government transports, for which they are outfitted with 14 first-class and 88 tourist-class seats in the main cabin. Indonesia is reportedly considering upgrading the Surveillers with the IAI Phalcon conformal phased-array AEW&C system.

Contractor: Boeing Commercial Airplanes, USA.

Power Plant: two Pratt & Whitney JT8D-17A turbofans; each 16,000 lb st.

Dimensions: span 93 ft 0 in, length 100 ft 2 in, height 37 ft 0 in.

Weights (standard 737-200): empty 61,630 lb, gross 124,500 lb.

Performance: max cruising speed 532 mph at 33,000 ft, ceiling approx 40,000 ft, range (max) approx 2,900 miles.

Accommodation: crew of two; 102 passengers in main cabin.

Armament: none.

Tu-142

Since 1970, the Soviet Naval Air Force has operated successively improved versions of the huge "Bear" four-turboprop combat aircraft, under the designation Tu-142, for long-range antisubmarine missions. Still in low-rate production at Kuybyshev, these aircraft have the NATO reporting name "Bear-F," with "Mod" suffixes denoting the different modification standards that have followed the basic model. Details of these can be found in the "Gallery of Soviet Aerospace Weapons" in the March 1990 issue of AIR FORCE Magazine.

In 1988–89, Indian Navy Squadron INAS 312 took delivery of eight refurbished "Bear-Fs" for maritime reconnaissance from its base at Dabolim, Goa. They are believed to be from the original batch of 15 basic Tu-142s that preceded the "Mod 1 to 4" aircraft listed in the March Gallery. Their J-band overwater search-and-surveillance radar is housed in a large radome under the forward fuselage. Fairings at the tailplane tips are thought to contain MAD gear. A normal endurance of around 30 hours can be extended by in-flight refueling.

Searchmaster L, Indonesian Navy (British Aerospace)

US-1A, Japan Air Self-Defense Force (Katsumi Hinata)

Power Plant: four Kuznetsov NK-12MV turboprops; each 14,795 ehp.
Dimensions: span 167 ft 8 in, length 162 ft 5 in, height 39 ft 9 in.
Weight: gross 414,470 lb.
Performance: max speed at 25,000 ft 575 mph, ceiling 41,000 ft, combat radius (unrefueled) 5,150 miles.
Accommodation: basic crew can be supplemented by relief crew members for long missions.
Armament: depth charges, torpedoes, and sonobuoys in two weapons bays in rear fuselage. Two 23 mm guns in manned tail turret.

US-1A

The last of the Japan Maritime Self-Defense Force's PS-1 antisubmarine flying boats was retired in 1989, but its amphibian descendant, the US-1A, continues in service as a long-range search-and-rescue aircraft. The JMSDF has 12 US-1As, deliveries of which began in March 1975, serving with detachments of No. 71 Squadron at the Iwakuni and Atsugi naval bases. They have a nose-mounted AN/APS-80N search radar and an AN/APN-187C Doppler navigation radar; SAR equipment includes flares, rescue hoist, marine markers, loudspeaker, life rafts and a powered lifeboat, and droppable rescue kits. The last six aircraft have improved engines, since refitted to the earlier six.
Contractor: Shin Meiwa Industry Company, Japan.
Power Plant: four Ishikawajima-Harima (GE license) T64-IHI-10J turboprops; each 3,493 ehp.
Dimensions: span 108 ft 9 in, length 109 ft 9¼ in, height 32 ft 7¾ in.
Weights: empty 56,218 lb, gross 94,800 lb (water T-O), 99,200 lb (land T-O).
Performance: cruising speed 265 mph at 10,000 ft, ceiling 23,600 ft, max range 2,372 miles.
Accommodation: crew of three/four; up to 20 seated survivors, or 12 litters and up to three medical attendants or observers, in main cabin.
Armament: none.

Reconnaissance and Special Mission Aircraft

MiG-25

When the Indian Air Force took delivery of eight single-seat **MiG-25Rs** (NATO "Foxbat-B") and two two-seat **MiG-25U** ("Foxbat-C") trainers, in 1981, it acquired photo-reconnaissance capability unique in non-Soviet Asia. The MiGs' maximum speed of Mach 2.82 and ceiling better than 75,000 ft put them out of reach of the surface-to-air missiles and piloted interceptors in service with any of India's potential enemies at that time. Like MiG-25 air defense fighters, these aircraft are manufactured mainly of arc-welded nickel steel, with titanium in areas subject to extreme heating, such as the leading edge of the wings. They are strictly "straight and level" aircraft, with no concessions to maneuverability, but appear to have taken their place in Third World air forces with few problems. Five camera windows and various flush dielectric panels can be seen in the nose of the boxlike fuselage. Equipment is believed to include a Doppler navigation system and side-looking airborne radar. *(Data for MiG-25R.)*
Power Plant: two Tumansky R-15 turbojets; each 24,700 lb st with afterburning.
Dimensions: span 44 ft 0 in, length 78 ft 1¾ in, height 20 ft 0¼ in.
Weights: empty 43,200 lb, gross 90,385 lb.
Performance: max speed at height Mach 2.82, at S/L Mach 0.98, ceiling 75,450 ft, range 994 miles.
Accommodation: pilot only.
Armament: none.

RF-4C/EJ Phantom II

Twelve ex-USAF **RF-4C** Phantoms were acquired by the Republic of Korea Air Force in early 1989. These aircraft, which are being augmented by a further 15 ex-US RF-4Cs this year, are equipped with forward, oblique, and high/low altitude panoramic cameras in the nose, plus side-looking airborne radar (SLAR) and an infrared linescanner (IRLS) in the fuselage. The Japan Air Self-Defense Force operates 13 reconnaissance **RF-4EJs,** which it is planning to modernize with forward-looking radar, inertial navigation, an IR reconnaissance system, and VHF (instead of UHF) radio. An upgraded "prototype" is due to fly in 1992. In addition, the JASDF plans to convert 17 of its existing F-4EJ fighters to RF-4EJs. This latter batch will be equipped with a Mitsubishi Electric elint pod (derived from the French Thomson-CSF Astac) and a Thomson-TRT radar altimeter. *(Data for RF-4EJ similar to those for F-4E; RF-4C has J79-GE-15 engines and length of 65 ft 9 in. Both variants are unarmed.)*

RF-5

South Korea (with six of an original ten), Thailand (four), and Vietnam include in their air force inventories small numbers of the Northrop **RF-5A,** a photoreconnaissance version of the F-5A fighter equipped with four nose-mounted KS-92 cameras and four 100-foot film magazines. Also in service is the **RF-5E TigerEye,** a day/night version combining the F-5E airframe with interchangeable nose pallets containing either standard cameras or an infrared linescanner. Two RF-5Es were delivered to the Royal Malaysian Air Force and two to the Royal Thai Air Force. Singapore Aerospace is currently converting eight of that country's F-5E fighters to RF-5E configuration. *(Data for F-5A; RF-5A similar. RF-5E data generally similar to those for F-5E Tiger II.)*
Contractor: Northrop Corporation Aircraft Group, USA.
Power Plant: two General Electric J85-GE-13 turbojets; each 4,090 lb st with afterburning.
Dimensions: span 25 ft 3 in, length 47 ft 2 in, height 13 ft 2 in.
Weights: empty 8,085 lb, gross 20,677 lb.
Performance: max speed 924 mph at 36,000 ft, ceiling over 50,000 ft, max range 1,565 miles.
Accommodation: pilot only, on ejection seat.
Armament: none.

Transports and Tankers

An-2/Y-5

The prototype Antonov An-2 flew in the Soviet Union 43 years ago, on August 31, 1947. It entered production in the following year. After more than 5,000 had been delivered, responsibility for further manufacture was transferred to WSK-PZL Mielec of Poland, which has since built more than 11,730. China also began producing An-2s under license in the mid-1950s. The Nanchang factory delivered 727 in 1957–68. Shijiazhuang Aircraft Plant had built 221 by the beginning of 1987 and continues small-scale production. Most An-2s are used for agricultural and other civilian work, but the Air Force of the People's Liberation Army (China) has about 300. Others serve with the air forces of Afghanistan, Cambodia, North Korea, Laos, Mongolia, and Vietnam. The specification data below apply to the basic **An-2P** general-purpose transport. Other versions in military service include the **An-2S** ambulance for six stretcher patients and attendants, **An-2TD** paratroop transport and training version with six tip-up seats along each side of the cabin, and the **An-2V/An-2M** floatplanes. All Chinese versions have the basic designation **Y-5** (Yunshuji-5; transport aircraft 5). NATO reporting name for all An-2s and Y-5s is "Colt."
Contractors: WSK-PZL Mielec, Poland, and Shijiazhuang Aircraft Plant, People's Republic of China.
Power Plant: one PZL Kalisz ASz-62IR piston engine (Zhuzhou HS5 in Y-5); 1,000 hp.
Dimensions: span 59 ft 7¾ in, length 40 ft 8¼ in, height 13 ft 2 in.
Weights: empty 7,605 lb, gross 12,125 lb.
Performance: max speed at 5,750 ft 160 mph, ceiling 14,425 ft, range 560 miles.
Accommodation: crew of two and 12 passengers, 2,735 lb of freight, or six stretchers plus attendants.
Armament: none.

An-12/Y-8

More than 900 Antonov An-12 (NATO "Cub") passenger/freighters were built in the USSR. Most were military **An-12BPs,** which entered service in 1959 and became the Soviet Union's standard paratroop and medium-range cargo transports. Replacement with Il-76s has been under way since 1974, but some 300 are still flown by the Soviet air forces. The Indian Air Force has about 15, supplied from the USSR, and 12 are reportedly operational with the Afghan Republican Air Force. Powered by four 3,945 ehp Ivchenko AI-20K turboprops, these pressurized transports are equipped to carry 90 troops, 60 paratroops, or 44,090 lb of freight. This is loaded via a large door under the upswept rear fuselage, but the An-12BP does not have an integral loading ramp.

The Chinese **Y-8** is outwardly indistinguishable from the An-12BP, except for its more pointed nose transparencies. However, it is not manufactured under license, and the production drawings to which Shaanxi is building the aircraft came from Xian. Similarly, the Y-8's turboprops are claimed to embody considerable Chinese redesign and develop more power than the Soviet AI-20K. The first Y-8 flew on December 25, 1974. By early 1989, a total of 31 had been delivered to the commercial airline CAAC and the PLA Air Force, of which two had been transferred to No. 2 Transport Wing of the Sri Lanka Air Force. Only the forward cabin of the basic Y-8 is pressurized, but a fully pressurized 100-passenger version is being developed, with 4,550 ehp WJ6A engines. Design studies for an in-flight refueling tanker version have been made by Flight Refuelling Ltd of the UK. The prototype of a maritime patrol version, designated **Y-8 MPA,** with a large cylindrical undernose radome, has been flying since September 4, 1985. Its equipment includes new avionics, infrared camera, infrared submarine detection gear, and sonobuoys. Another Y-8 has been adapted to carry such helicopters as the S-70C (Black Hawk derivative). A drone carrier is being developed specifically for Chang Hong 1 high-altitude reconnaissance RPVs, and there are reports of an AEW&C version designed and built with Israeli assistance. *(Data for standard Y-8.)*
Contractor: Shaanxi Aircraft Company, People's Republic of China.
Power Plant: four Zhuzhou WJ6 turboprops; each 4,250 ehp.
Dimensions: span 124 ft 8 in, length 111 ft 7½ in, height 36 ft 7½ in.
Weights: empty 78,265 lb, gross 134,480 lb.
Performance: max speed 411 mph at 23,000 ft, ceiling 34,120 ft, range 791 miles with max payload, 3,490 miles with max fuel.
Accommodation: crew of five and 14 passengers in pressurized forward section of fuselage; unpressurized main cabin for 96 troops, 58 paratroops, 60 litter patients, and 20 seated casualties plus three attendants, or two army trucks. Rear loading ramp/door (not on An-12).
Armament: two 23 mm guns in manned tail turret.

An-24/An-26/An-30 and Y-7

First flown in 1960, the An-24 (NATO "Coke") is a twin-turboprop short-range transport in much the same category as the BAe (HS) 748 and Fokker F27 Friendship. The **An-24V Srs II** is the basic transport for up to 50 passengers, and was available also in mixed passenger/freight, convertible, all-freight, and VIP versions, all with 2,550 ehp Ivchenko AI-24A engines. With an added 1,985 lb st RU 19-300 auxiliary turbojet in the starboard engine na-

celle, for performance boost and engine starting, it becomes the **An-24RV.** The **An-24T** is an all-freight version of the 24V with a belly freight door at the rear of the cabin, V ventral fins instead of a single ventral fin, and an electrically powered winch and conveyor to assist loading of up to 10,168 lb of cargo. The **An-24RT** adds an RU 19-300 auxiliary turbojet to raise its payload to 12,566 lb. Asian operators include the air forces of Afghanistan (one VIP), Bangladesh (one), Cambodia (two), North Korea (ten), Laos (six), Mongolia (six), and Vietnam (nine).

The **An-26** (NATO "Curl") is a freighter developed from the An-24, with 2,820 ehp Al-24VT engines, an RU 19-300 as standard, a large rear-loading ramp-door that can slide forward under the fuselage to facilitate loading from a truck, and payload of 12,125 lb. It is in service in Afghanistan (12), Bangladesh (five), China (six), Laos (three), Mongolia (one), and Vietnam (12). Another variant of the series operated by China is the **An-30** ("Clank") aerial survey aircraft, which has an extensively glazed nose, Al-24VT engines, cabin-side doors, a crew of five plus two photographer/surveyors, and a cabin containing a darkroom, survey cameras, control desk, and/or equipment for other types of air survey and prospecting. China took delivery of eight An-30s.

In current production in China is a series of "reverse engineered" developments of the An-24/26 series covered by the basic designation Y-7. Examples delivered to date appear to be operated mainly by the nation's airlines on commuter services, but a prototype of the military **Y-7H-500** flew for the first time in 1988, and production has started at Xian. Features include a loading ramp of the kind fitted to the An-26, winglets, rough-field landing gear, modern avionics, and military versions of the 2,790 ehp Dongan WJ5A I turboprops fitted to the latest commercial Y-7s. Payload will be 38 fully equipped troops, 19 paratroops, or 24 litter patients and one attendant. Hardpoints on the fuselage, as seen on some military An-26s, will carry up to 4,409 lb of stores, including weapons and supply containers. *(Data for An-26.)*

Power Plant: two Ivchenko Al-24VT turboprops; each 2,820 ehp: plus one RU 19A-300 auxiliary turbojet; 1,765 lb st.
Dimensions: span 95 ft 9½ in, length 78 ft 1 in, height 28 ft 1½ in.
Weights: empty 33,113 lb; gross 52,911 lb.
Performance: cruising speed 273 mph at 20,000 ft, ceiling 24,600 ft, range 683 miles with max payload, 1,584 miles with max fuel.
Accommodation: crew of five; normal freight-carrying interior can be converted in 20 to 30 min to carry 40 troops or 24 litter patients and an attendant.
Armament: provision for pylons on the sides of the fuselage for carrying up to 4,409 lb of weapons or supply containers.

An-32

Known as "Cline" to NATO, the An-32 has an airframe generally similar to that of the An-26 but with much more powerful turboprops, triple-slotted trailing-edge flaps outboard of the engines, automatic leading-edge slats, enlarged ventral fins, and a full-span slotted tailplane. Added to improvements to the landing gear retraction mechanism, deicing and air-conditioning systems, electrical system, and engine starting, these changes offer greatly enhanced performance under high-altitude and hot climatic conditions. Typically, the An-32 will operate from airfields 14,750 ft above S/L in an ambient temperature of ISA + 25°C, and then carry three tons of freight for 683 miles with fuel reserves.

Current production of the An-32 is at the rate of 40 aircraft a year, mostly for Soviet military use. Major export customer to date has been India, which took delivery of a total of 123; these have the Indian name Sutlej, after a Punjabi river. Afghanistan is also reported to have at least six An-32s.

Power Plant: two Ivchenko Al-20D Series 5 turboprops; each 5,112 ehp.
Dimensions: span 95 ft 9½ in, length 78 ft 0¼ in, height 28 ft 8½ in.
Weights: empty 37,038 lb, gross 59,525 lb.
Performance: max cruising speed 329 mph, ceiling 30,840 ft, range 534 miles with max payload, 1,243 miles with 12,125 lb payload.
Accommodation: crew of three or four; up to 50 passengers, 42 parachutists and a jumpmaster, 24 litter patients and three medical personnel, or 14,770 lb of freight.
Armament: provision for carrying four bombs or other stores on hardpoints on each side of the fuselage, below the wings.

C-1

Design of this rather portly Japanese medium transport began in the mid-1960s with the objective of developing a replacement for the JASDF's elderly fleet of Curtiss C-46s. Two prototypes, the first of which flew in November 1970, were built by the Nihon Aeroplane Manufacturing Co (NAMC); the program was then turned over to Kawasaki, which completed two preproduction and 27 production C-1s. Deliveries to the JASDF began in December 1974 and ended in October 1981. The last five production aircraft are longer-range models, equipped with an additional fuel tank in the wing center-section. One C-1 was converted in 1984 to **EC-1** configuration. Equipped with a TRDI/Mitsubishi Electric XJ/ALQ-5 ECM system, it is easily recognizable by its bulbous nose and tail radomes, large blister fairings each side of the forward and rear fuselage, and underfuselage antennas. It was delivered in mid-1986 to the JASDF's electronic warfare training unit, with which it is still in service. One C-1 was transformed by Japan's National Aeronautical Laboratory into the **Asuka,** a "quiet STOL" research aircraft with an upper-surface flap-blowing system. Others have been used as flying trials aircraft for Japanese turbofan engines and to launch Japanese-developed air-to-surface missiles.

Contractor: Kawasaki Heavy Industries, Japan.
Power Plant: two Mitsubishi-built (Pratt & Whitney license) JT8D-M-9 turbofans; each 14,500 lb st.
Dimensions: span 100 ft 4¾ in, length 95 ft 1¾ in, height 32 ft 9¾ in.
Weights: empty 53,572 lb, gross 85,320 lb (standard), 99,210 lb (max overload).
Performance: max speed 501 mph at 25,000 ft, ceiling 38,000 ft, max range 2,084 miles.
Accommodation: crew of five, including loadmaster; main cabin accommodates up to 60 troops or 45 paratroops; 36 litters with medical attendants; artillery pieces or small vehicles; or equivalent palletized or other cargo (payload 17,416 lb normal, 26,235 lb max overload).
Armament: none.

An-32 Sutlej, Indian Air Force (Franz Knuchel)

C-1, Japan Air Self-Defense Force (Katsumi Hinata)

C-47 Skytrain, Royal Thai Air Force (Denis Hughes)

C-47 Skytrain

Transports come and transports go, but the ubiquitous **C-47s,** it seems, go on forever. Because of the C-47s' age and some of their locations, estimates of the numbers still extant in the Asian theater vary, but probably close on 100 are in use as military transports, with perhaps slightly more than that of their Soviet license-built counterpart, the **Lisunov Li-2.** Operators of the latter include China (Air Force 50+, Navy 20+) and Vietnam (Air Force 20+). So far as the C-47 itself is concerned, Indonesia's Army and Air Force have about a dozen between them, as does the Air Force of the Laotian People's Liberation Army (including three or more **AC-47** gunships). The Papua New Guinea Defense Force and Philippine Air Force each have about five, Taiwan's Chinese Nationalist Air Force about 20, Thailand 20 or more (Air Force 15+, Navy 3+), and Vietnam 10 or more. *(Data for C-47B except where indicated.)*

Contractor: Douglas Aircraft Company, USA.
Power Plant: two Pratt & Whitney R-1830-90C radial piston engines; each 1,200 hp.
Dimensions: span 95 ft 6 in, length 63 ft 9 in, height 17 ft 0 in.
Weights: empty 18,135 lb, gross 26,000 lb (normal), 31,000 lb (max overload).
Performance: max speed 224 mph at 10,000 ft, ceiling 26,400 ft, range 1,600 miles.
Accommodation: crew of two; up to 27 troops, 18–24 litters, or 10,000 lb of cargo in main cabin.
Armament (AC-47): up to three General Electric 7.62 mm Miniguns in main cabin.

C-119 Flying Boxcar

Taiwan appears to be the last remaining operator of Fairchild's pioneer rear-loading transport. With its twin-boom/podded fuselage configuration, the original C-82 Packet was able to demonstrate in USAF service the advantages of unimpeded rear loading up a ramp or directly into the hold from a truck. The **C-119B,** of which deliveries began in December 1949, was a refined development with far more powerful R-4360 engines, a relocated flight deck at the front of an aerodynamically improved nose, a 14 inch wider freight hold, and accommodation for an additional 20 troops in its paratrooping role. The most-produced version was the **C-119G,** of which 396 were delivered by Fairchild and 88 by Kaiser at Willow Run, with others upgraded from **C-119Fs.** They served in Korea and, notably as gunships, in Vietnam. The 40 C-119Gs of the Chinese Nationalist Air Force are operated by its 20th Tactical Transport Wing from Pingtung, Taiwan.

Contractor: Fairchild Engine and Airplane Corporation, USA.
Power Plant: two Wright R-3350-89A piston engines; each 3,500 hp.
Dimensions: span 109 ft 3 in, length 86 ft 6 in, height 26 ft 6 in.
Weights: empty 40,785 lb, gross 72,700 lb.
Performance: max speed 281 mph at 18,000 ft, ceiling 21,580 ft, range 1,630 miles.
Accommodation: crew of six, comprising pilot, copilot, navigator, radio operator, flight mechanic, and loadmaster; up to 62 troops, or 35 litters and four attendants, or freight (including vehicles).
Armament: none.

C-123 Provider

One of the first postwar transports to feature a rear-loading ramp/door, the Fairchild (originally Chase) Provider had a fairly undistinguished early career, which improved when its twin-piston-engined power plant was later augmented by a pair of small underwing turbojets. Payload capability and short-field performance benefited from this addition, and the C-123 came into prominence during the years of the Vietnam War. Four Asian air forces are known still to fly the type: South Korea (14), Laos (about three), Taiwan (ten), and Thailand (16). *(Data for C-123K.)*

Contractor: Fairchild Hiller Corporation, USA.
Power Plant: two Pratt & Whitney R-2800-99W radial piston engines, each 2,300 hp; and two General Electric J85-GE-17 turbojets, each 2,850 lb st.
Dimensions: span 110 ft 0 in, length 76 ft 3 in, height 34 ft 1 in.
Weights: empty 35,366 lb, gross 60,000 lb.
Performance: max cruising speed 173 mph at 10,000 ft, ceiling approx 25,000 ft, range with max payload 1,035 miles.
Accommodation: crew of two; up to 60 troops, 50 litters with six sitting casualties and six medical attendants, or 15,000 lb of cargo, in main cabin.
Armament: none.

C-130 Hercules

The long career, widespread use, and proliferation of variants of the "Herk" have been well mentioned in other AIR FORCE Magazine Galleries, and a detailed history here would be unnecessarily repetitive. Perhaps surprisingly, quite a number of the late-1950s **C-130A and B** models remain in service in the Asian area, as do nearly as many **C-130Es.** Operators of these "pre-H" variants include the air forces of Australia (12 C-130Es), Indonesia (eight Bs and two KC-130B tankers), Pakistan (four Bs and seven Es), Singapore (four Bs), and Vietnam (ten or more As and Bs). As elsewhere in the world, however, most exported Hercules are from the H series, introduced in 1964 with uprated engines and more modern avionics. The standard **C-130H** is operated by, or on order for, Australia (12), Indonesia (two), Japan (15), South Korea (six), Malaysia (six), New Zealand (five), the Philippines (three), Singapore (four), Taiwan (12), and Thailand (10). Examples of the maritime patrol **C-130H-MP** serve with Indonesia (one) and Malaysia (three), and the latter plans also to acquire three **AEW&C C-130Hs,** equipped with AN/APS-138 and AN/APY-92X mission avionics. Also in service in the Far East is the stretched "Super Hercu-

les," the **C-130H-30,** and its commercial counterpart, the **L-100-30,** which are 15 ft longer than the standard C-130H. These operate with the air forces of Indonesia (nine), South Korea (four, with four more on order), Pakistan (one), and Thailand (three). The Philippine Air Force has three intermediate-length (106 ft 1 in) **L-100-20s.** *(Data for International C-130H.)*

Contractor: Lockheed Aeronautical Systems Company, USA.

Power Plant: four Allison T56-A-15 turboprops; each 4,508 shp.

Dimensions: span 132 ft 7 in, length 97 ft 9 in, height 38 ft 3 in.

Weights: empty 76,469 lb, gross 155,000 lb (normal), 175,000 lb (max overload).

Performance: max cruising speed 374 mph, ceiling 33,000 ft, range with max payload 2,356 miles.

Accommodation: crew of four plus loadmaster; up to 92 troops, 64 paratroops, 74 litters and two medical attendants, or equivalent weight of vehicles, artillery pieces, or cargo in main cabin.

Armament: none.

CN-235

Following four years of successful license production of Spain's CASA C-212 Aviocar in Indonesia, by IPTN, these two manufacturers set up a company named Aircraft Technology Industries (Airtech) to handle the joint design and production of a larger twin-turboprop commuter and utility transport aircraft designated CN-235. Each company assembled one prototype, with simultaneous rollouts in Spain and Indonesia on September 10, 1983. The CASA prototype flew on November 11 that year, followed by the IPTN aircraft on December 30. The first production CN-235 was flown for the first time on August 19,1986. Deliveries began four months later, with an IPTN aircraft for Merpati Nusantara Airlines of Indonesia. The first two Spanish production aircraft were military **CN-235 Ms** for VIP duties with the Royal Saudi Air Force.

By the beginning of 1990, orders had been received for 126 CN-235s, of which nine civil and 25 military examples had entered service. The first 15 aircraft delivered by each manufacturer are to **Series 10** standard, with 1,700 shp CT7-7A engines; subsequent **Series 100** aircraft have more powerful CT7-9Cs, as detailed below. The only current military operators in Asia are the Indonesian Air Force and Navy, for which 24 have been ordered. The naval CN-235 Ms are equipped for ASW missions, with search radar in a large nose fairing. The Papua New Guinea Defense Force plans to order four CN-235 Ms to replace its C-47s (DC-3s), with deliveries in the second half of 1991. *(Data for CN-235 M transport.)*

Contractor: Aircraft Technology Industries (Airtech: CASA, Spain, and IPTN, Indonesia).

Power Plant: two General Electric CT7-9C turboprops; each 1,870 shp, flat rated to 1,750 shp for takeoff.

Dimensions: span 84 ft 8 in, length 70 ft 0¾ in, height 26 ft 10 in.

Weights: empty 18,960 lb, gross 33,290 lb.

Performance: max cruising speed 280 mph at 15,000 ft, ceiling 25,000 ft, range 770 miles with max payload, 2,653 miles with 5,300 lb payload.

Accommodation: crew of three; up to 48 troops, 46 paratroops, 24 litters and four attendants, or 11,025 lb of freight, loaded via rear ramp. Cabin can be equipped for ASW/maritime patrol, EW, or photographic duties.

Armament: three hardpoints for stores under each wing. (Indonesian Navy ASW version can carry two Exocet antishipping missiles.)

DHC-4A Caribou

Most export deliveries to the Asian theater of this twin-piston-engined, general-purpose military transport were made in the late 1960s and early 1970s, and virtually all of those now in service are already undergoing replacement or are expected to do so within the next year or two. The Caribou still serves, for the time being, with the air forces of Australia (17), India (16), and Malaysia (15), and with the Thai border police (two).

Contractor: The de Havilland Aircraft of Canada Ltd.

Power Plant: two Pratt & Whitney R-2000-7M2 radial piston engines; each 1,450 hp.

Dimensions: span 95 ft 7½ in, length 72 ft 7 in, height 31 ft 9 in.

Weights: empty 18,260 lb, gross 28,500 lb.

Performance: max cruising speed 182 mph at 7,500 ft, ceiling 24,800 ft, max range 1,307 miles.

Accommodation: crew of two; up to 32 troops, 26 paratroops, 22 litters with four sitting casualties and four medical attendants, two jeep-size vehicles, or 3 tons of cargo, in main cabin.

Armament: none.

Dornier 228

The twin-turboprop STOL Dornier 228 first flew in Germany on March 28, 1981. It has since been offered in a wide assortment of variants, of which the basic **228-100** series can carry 15 passengers in standard transport form; the 5 ft longer **228-200** series can carry 19 passengers. Specially equipped versions of each series are available for such military duties as troop, paratroop, and freight carrying, ASW/maritime patrol, search and rescue, surveillance and reconnaissance, ground target detection, sigint missions, calibration of ground navigation aids, and ambulance duty.

India decided to purchase 228s in such quantities, for both military and commercial airline use, that it signed a contract with Dornier in 1983 to manufacture up to 150 of the aircraft under license at HAL's Kanpur Division. To meet urgent needs, some completed examples were delivered from Germany, including the first three of 33 for the Indian Coast Guard. Used by No. 750 Squadron for coastal patrol, antipollution, and antismuggling missions, these Series 228-101 aircraft are equipped with 360° scan MEL Marec radar in an underfuselage blister fairing, Litton Omega, an IR/UV linescan for pollution detection, a one million candlepower searchlight, a loudspeaker, marine markers, a sliding cabin door to permit airdropping a 20-man life raft, and provisions for underwing Micronair spraypods to combat oil spills and chemical pollution. If required, an armament of two 7.62 mm Gatling-type guns and underwing air-to-surface missiles can be fitted.

Similar in some respects will be the Indian Navy's 24 maritime surveillance and ASV 228s, with MEL Super Marec radar and antiship missiles for operation from shore bases. Delivery of 50 aircraft to the Indian Air Force has been under way since 1987, to replace the Otters, Devons, and C-47s used by Nos. 41 and 59 Squadrons in utility and logistic support roles. *(Data for 228-100.)*

Contractors: Dornier Luftfahrt GmbH, Germany; Hindustan Aeronautics Ltd, India.

Power Plant: two Garrett TPE331-5-252D turboprops; each 715 shp.

Dimensions: span 55 ft 8 in, length 49 ft 4 in, height 15 ft 11½ in.

Weights: empty 6,570 lb, gross 12,566 lb.

Performance: max cruising speed 266 mph at 10,000 ft, ceiling 29,600 ft, range with max payload 834 miles.

Accommodation: crew of one or two; 15 passengers, or six litter patients and nine seated casualties and attendants in ambulance role.

Armament: none in basic transport role.

F27 Friendship/Troopship

Although known chiefly as a highly successful twin-turboprop, short-haul, civil transport, this familiar Dutch aircraft also proved popular with a number of world air forces as a VIP or troop transport and continues to give service to seven air arms in Asia. Most of these are either **Mk 200s,** similar to the basic commercial airline model, or of the **Mk 400M** dedicated military transport version. Air forces operating F27s include those of Myanmar, Indonesia (400M), New Zealand, Pakistan, and the Philippines. Friendship/Troopships are also operated by the navies of Thailand (400M) and Pakistan, and by the Indian Coast Guard; these, as well as those of the RNZAF, carry out coastal patrol and SAR duties. The Philippine Air Force and Royal Thai Navy each have three specially equipped **F27 Maritimes** (which see) for offshore reconnaissance. *(Data for F27 Mk 400M.)*

Contractor: Royal Netherlands Aircraft Factories NV Fokker.

Power Plant: two Rolls-Royce Dart Mk 552 turboprops; each 2,210 shp.

Dimensions: span 95 ft 1¾ in, length 77 ft 3½ in, height 27 ft 11 in.

Weights: empty 25,696 lb, gross 45,900 lb.

Performance: normal cruising speed 298 mph at 20,000 ft, ceiling 30,000 ft, max range 2,727 miles.

Accommodation: crew of two or three; up to 46 paratroops, 24 litters with nine sitting casualties/medical attendants, or 13,283 lb of cargo, in main cabin.

Armament: none.

HS 748 and Andover

By far the largest user of the Hawker Siddeley (now British Aerospace) 748 is the Indian Air Force, which still has over 50 of the 64 built for it under license by the Kanpur Division of Hindustan Aeronautics. Indian production began with the assembly of four HS 748 **Series 1s** from CKD kits (first flight November 1961) and enced in 1984 after completion of 85 (including 21 civil) **Series 2s.** The 64 for the IAF comprised 12 as VIP transports for the Air Hq Communications Squadron, 29 as aircrew trainers (18 pilot, seven navigation, and four signals), three for aerial survey, and 20 **748(M)** freighters with side-loading cargo door. Current Indian Air Force squadrons include Nos. 11 and 106. The oldest 748s in the area are ten ex-RAF **Andover C. Mk 1s** belonging to No. 42 Squadron of the Royal New Zealand Air Force at Auckland. The Royal Australian Air Force still has all ten of its original 748 Series 2s: eight aircrew trainers at the School of Air Navigation and two as VIP transports with No. 34 Squadron. Two **Series 2As,** with RDa.8 Dart engines, are used for EW training by the Royal Australian Navy. Nepal's single Series 2A doubles as both the Royal Flight VIP aircraft and as a general troop/paratroop transport. VIP transport is also the role for two of the six Series 2/2A aircraft of the Royal Thai Air Force's No. 6 Wing at Don Muang; three other 748s are in use by the 2d Transport Wing of the Sri Lanka Air Force. *(Data for HS 748 Series 2A.)*

Contractor: Hawker Siddeley Aviation, UK (now British Aerospace).

Power Plant: two Rolls-Royce Dart Mk 532-2L/S turboprops; each 2,280 ehp.

Dimensions: span 98 ft 6 in, length 67 ft 0 in, height 24 ft 10 in.

Weights: empty 26,700 lb, gross 44,495 lb.

Performance: max cruising speed 278 mph, ceiling 25,000 ft, max range 1,987 miles.

Accommodation: crew of two; up to 58 passengers in main cabin.

Armament: none.

Il-14

The prototype Ilyushin Il-14 was flown on September 20, 1950. The original intention had been to rectify the deficiencies of the earlier Il-12, which had been developed during World War II to replace the Li-2 (Soviet license-built DC-3). By the time all the design improvements had been made, little of the Il-12 remained, but the effort was worthwhile. Except for its inability to carry the planned 40 passengers, with adequate safety margins, the Il-14 was to prove a sound if unspectacular workhorse through four decades. An estimated 2,200 were produced at the Khodinka works in Moscow between 1953 and 1957, supplemented by smaller-scale manufacture in Czechoslovakia and East Germany. Main Soviet variants were the **Il-14P** passenger transport, usually with 18 seats; **Il-14M** with slightly longer fuselage, eventually seating 32 persons; **Il-14T** freighter with side cargo door; **Il-14F** for photomapping and aerial survey; and **Il-14D** assault transport with bench seats for fully armed troops along the walls of the cabin. The Air Force of the (Chinese) People's Liberation Army still has about 30 transports in service; North Korea and Vietnam each have a few. *(Data for Il-14M.)*

Power Plant: two Shvetsov ASh-82T piston engines; each 1,900 hp.

Dimensions: span 103 ft 11 in, length 73 ft 3½ in, height 25 ft 11 in.

Weights: empty 28,000 lb, gross 38,030 lb.

Performance: max speed 258 mph at 7,875 ft, ceiling 24,275 ft, range 937 miles with 26 passengers.

Accommodation: crew of three; up to 32 passengers.

Armament: none.

Il-76

Like the Soviet Union's own Military Transport Aviation force (VTA), the Indian Air Force acquired Ilyushin Il-76s (NATO "Candid-B") to replace veteran An-12s as its standard heavy transports. Twenty-four of the latest **Il-76MD** version equip Nos. 25 and 44 Squadrons, with the Indian name Gajaraj. Compared with the original military **Il-76M,** the MD has D-30KP-1 upgraded engines that maintain full power up to ISA + 23°C, against ISA + 15°C for earlier D-30KPs. The gross weight and payload are increased; an additional 22,046 lb of fuel increases range with max fuel by 745 miles.

The Il-76 is in the same class as USAF's C-141. It was designed to meet an official requirement for an aircraft capable of hauling 40 metric tons of freight over a distance of 3,100 miles (5,000 km) in less than six hours in the harsh operating environment of Siberia. First flown on March 25, 1971, it demonstrated its potential four years later by setting 25 international records. It lifted a payload of more than 70 metric tons to a height of 38,960 ft, and carried this same load around a 1,000 km circuit at a speed of 532.923 mph. Being fully pressurized, it can carry troops as an alternative to freight. Freight handling is facilitated by rear ramp/doors and advanced mechanical systems for loading, unloading, and positioning containers and other freight inside the 8,310 cu ft hold. Equipment for all-weather operation by day and night includes a computer for automatic flight control and automatic landing approach. The Il-76 is also completely independent of ground facilities at forward or minimally equipped airfields. *(Data for Il-76MD.)*

Power Plant: four Soloviev D-30KP-1 turbofans; each 26,455 lb st.

Dimensions: span 165 ft 8 in, length 152 ft 10¼ in, height 48 ft 5 in.

Weight: gross 418,875 lb.

Performance: cruising speed 466–497 mph at 29,500–39,370 ft, range with max fuel 4,908 miles.

Accommodation: crew of seven, including two freight handlers; up to 140 troops, 125 paratroops, or 105,820 lb of freight.

Armament: two 23 mm twin-barrel GSh-23L guns in manned tail turret. Provision for packs of ninety-six 50 mm flares in landing gear fairings and/or on sides of rear fuselage.

Missionmaster

The Missionmaster is a military version of the short-fuselage N22B Nomad, suitable for personnel and equipment transport, forward area support, surveillance, and maritime patrol missions. The Australian Army uses 22,

under the designation A18, for transport duties; the RAAF has four for training and support missions. Four were purchased for coastal surveillance and transport operations with the Air Transport Squadron of the Papua New Guinea Defence Force. The Air Force of the Philippines uses a small number for transport and weather reconnaissance. The Royal Thai Air Force deploys 20 as part of its large counterinsurgency fleet. *(Details generally as for Searchmaster.)*

Model 707

The Indian Air Force and Royal Australian Air Force each operate two ex-airline Boeing 707-320s as VIP and staff transports. In addition, four other ex-commercial 707-338Cs are currently being converted into tanker combis for the RAAF by AeroSpace Technologies, using kits supplied by IAI Bedek, under a 1989 contract. These aircraft are undergoing structural strengthening as well as interior refit, from which they will emerge equipped with a centerline boom-type refueling system plus underwing installations permitting the carriage of two Flight Refuelling Ltd Mk 32B hose-and-drogue refueling pods. The converted aircraft will be capable of carrying a maximum transferable fuel load of 190,000 lb, equivalent to approx 28,350 US gallons.

Contractors: Boeing Commercial Airplanes, USA; IAI Bedek Aviation Division, Israel; AeroSpace Technologies of Australia.
Power Plant: four Pratt & Whitney JT3D-7 turbofans; each 19,000 lb st.
Dimensions: span 145 ft 9 in, length 152 ft 11 in, height 42 ft 5 in.
Weights (IAI tanker version): empty 145,000 lb, gross 335,000 lb.
Performance: max cruising speed 605 mph at 25,000 ft, ceiling 39,000 ft, max range 3,625 miles.
Accommodation: crew of two or three; main cabin can accommodate up to 219 passengers or combinations of passengers/cargo (max payload approx 89,000 lb) when transferable fuel not carried.
Armament: none.

NC-212 Aviocar

This twin-turboprop STOL utility light transport was designed and developed by the Spanish company CASA, by whom it continues in production. A second production line exists in Indonesia, where it has been manufactured as the NC-212, under license, since 1976. IPTN in Jakarta built 29 **Series 100** aircraft before switching to the **Series 200** a few years later, and this company produces the Aviocars for both current Asian military operators of the aircraft. The major one, naturally enough, is Indonesia itself, whose Air Force has ten, Navy eight, and Army four, though more are believed to be on order. The second Asian customer is the Royal Thai Air Force, which currently has a fleet of eight NC-212s. Features of the Aviocar include a rear ramp/door that can be opened in flight for LAPES (low-altitude parachute extraction system) and other types of airdrop. The Series 200, which first flew in April 1978, has more powerful TPE331 engines and higher max T-O weight than the original Series 100. There is a later Spanish variant, the **Series 300,** but this has not yet entered production in Indonesia. *(Data for Series 200.)*

Contractor: Industri Pesawat Terbang Nusantara (IPTN), Indonesia, under license from CASA, Spain.
Power Plant: two Garrett TPE331-10R-511C turboprops; each flat rated at 900 shp.
Dimensions: span 62 ft 4 in, length 49 ft 8½ in, height 20 ft 8 in.
Weights: empty 9,700 lb, gross 16,975 lb.
Performance: max cruising speed 227 mph at 10,000 ft, ceiling 28,000 ft, max range 1,094 miles.
Accommodation: crew of two; up to 24 troops (or 23 paratroops and a jumpmaster), or 12 litters and four medical attendants, light vehicles, or 5,952 lb of containerized or other cargo, in main cabin.
Armament: none.

YS-11

This indigenously designed Japanese twin-turboprop transport first flew in August 1962, the first of 180 production aircraft following in October 1964. Aircraft of the first batch were designated **YS-11-100,** those of subsequent batches being **YS-11A** followed by dash numbers starting at -200. Most production went to commercial customers, but 23 were delivered to the Japanese armed forces, and all were still in service in early 1990. The JASDF received four 60-seat YS-11-100s, one 60-seat YS-11A-200, one passenger/cargo YS-11A-300, and seven all-cargo YS-11A-400s. Today, eight of these aircraft are used on transport duties, four for ECM, and one for training; they are based at Miho and Iruma. Deliveries to the JMSDF, which ended in February 1974, comprised one -100, four -200s, two -400s, and three -600s. Four are currently allocated to the 61st Squadron at Atsugi for transport duties and have the service designation **YS-11M.** The other six, which serve with the 205th Air Training Wing at Shimofusa and are called **YS-11Ts** by the MSDF, are employed as ASW trainers. *(Data for YS-11A-200.)*

Contractor: Nihon Aeroplane Manufacturing Company, Japan.
Power Plant: two Rolls-Royce Dart Mk 542-10K turboprops; each 3,060 ehp.
Dimensions: span 104 ft 11¾ in, length 86 ft 3½ in, height 29 ft 5½ in.
Weights: empty 33,993 lb, gross 54,010 lb.
Performance: max cruising speed 291 mph at 15,000 ft, ceiling 22,900 ft, max range 2,000 miles.
Accommodation: crew of two; up to 60 passengers.
Armament: none.

Helicopters

AH-1S HueyCobra

Largest Asian customer for TOW-equipped Cobra gunship helicopters is Japan, which acquired two **AH-1Es** (Bell Up-gun AH-1S) for evaluation by the Ground Self-Defense Force, subsequently acquiring a license for Fuji to build the Modernized **AH-1S** (US Army **AH-1F**). Seventy-one of a planned total of 88 had been funded by FY 1990, of which 54 had been delivered by March this year. JGSDF squadrons are based at Obihiro and Hachinohe. South Korea, which received eight examples of the twin-engined **AH-1J** SeaCobra in the late 1970s, followed these about a decade later by ordering 21 AH-1Ss, and has since ordered a further 21, with C-Nite night/low-visibility installations, with options on another 28. Pakistan's Army operates two squadrons of AH-1Ss (20 aircraft), with 10 more on order, and the Royal Thai Army also has ordered four. All are to standards comparable with the US AH-1F, equipped with Kaiser head-up display, Hughes laser rangefinder, Rockwell automatic laser tracker, and IR signal suppressor and jammer. *(Data for US Army AH-1F.)*

Contractor: Bell Helicopter Textron, USA; Fuji Heavy Industries, Japan.
Power Plant: one Textron Lycoming T53-L-703 turboshaft; 1,800 shp.
Dimensions: rotor diameter 44 ft 0 in, length (rotors turning) 53 ft 1 in, height 13 ft 5 in.
Weights: empty 6,598 lb, gross 10,000 lb.
Performance: max speed 141 mph, ceiling 12,200 ft, range 315 miles.
Accommodation: pilot and copilot/gunner, in tandem armored cockpits.
Armament: two weapon stations under each stub-wing; outer stations can each carry four TOW antitank missiles, inboard stations each a launch tube for seven to nineteen 2.75 in rockets. GE undernose turret for 20 mm three-barrel cannon with 750 rds.

Alouette III

French production of the original **SE 3160** began in 1962, ending in 1969 in favor of the **SA 316B** model with uprated Artouste engine; the final French version, of which production ended in 1985, was the **SA 319B,** which differed chiefly in having a 600 shp Astazou XIV turboshaft. License manufacture of the SA 316B by Romania (230) and Switzerland (60) has ended, but it continues in India, where the type is known by the name **Chetak.** Indian production is now thought to exceed 200. Asian operators of the Alouette III, with estimated numbers in current service, include Bangladesh (six ex-Indian Chetaks), Myanmar (ten SE 3160s), Indonesia (Air Force, three armed SA 316Bs), South Korea (Navy, 12 SA 316Bs for ASW), Malaysia (Air Force, 24), Nepal (two Chetaks), and Pakistan (Army 24, Navy 4, and Air Force 12 SA 316B/319Bs, including some for ASW and SAR). India's own fleet of SA 316B/Chetaks now includes at least 175 with the Air Force (some in antitank configuration), ten with the Navy for training, and six with the Coast Guard for search and rescue. Most other Alouette IIIs in the Asian theater are used for liaison and communications duties, or as small transport helicopters. *(Data for SA 316B.)*

Contractors: Aerospatiale, France; Hindustan Aeronautics, India.
Power Plant: one Turbomeca Artouste IIIB turboshaft; derated to 570 shp.
Dimensions: rotor diameter 36 ft 1¾ in, fuselage length (incl tail rotor) 33 ft 4½ in, height 9 ft 9 in.
Weights: empty 2,315 lb, gross 4,850 lb.
Performance: max cruising speed 115 mph at S/L, ceiling 10,500 ft, range (max) 335 miles.
Accommodation: pilot and up to six passengers or equivalent cargo; normally pilot only, or pilot and gunner, in armed versions.
Armament: range of possible weapons can include a tripod-mounted 7.62 mm machine gun with 1,000 rds aft of pilot's seat, or a 20 mm cannon with 480 rds, turret-mounted on port side of cabin. Instead of guns, can carry two or four wire-guided missiles on external rails, or 68 mm rocket pods. ASW version can carry two torpedoes, or one torpedo and an MAD bird.

AS 365/565 Dauphin 2/Z-9

Largest Asian customer for this popular French twin-turboshaft helicopter is China, which acquired an Aerospatiale license in 1980 to build 50 Dauphins for both civil and military use. These were preceded by two French-built examples, and the Chinese manufacturing program is due to end this year. The contract contained an option to continue manufacture beyond the initial 50. The Chinese version, built at Harbin, is designated **Z-9** and has the Chinese name **Haitun,** also meaning dolphin. Initial Harbin Z-9s were equivalent to the French AS 365N, later (**Z-9A**) examples to the improved AS $365N_1$. Military Z-9/9As serve with at least two PLA group armies (Beijing and Shenyang military regions), and are thought to include some equipped for the antitank role; others serve in a shipboard role with the PLA Navy. The Indian Air Force has six French-built AS 365Ns for VIP transport duties, and two other Asian air arms fly the older AS

A18 Missionmaster, Australian Army

NC-212 Aviocar, Indonesian Army Aviation

365C: the Royal Hong Kong Auxiliary Air Force, which has three for patrol/search and rescue, and the Sri Lanka Air Force, whose No. 3 Maritime Squadron at China Bay also conducts patrol missions with two AS 365Cs. This version has a smaller (38 ft 4 in) diameter rotor and 660 shp Arriel 1A engines. *(Data for Z-9A.)*

Contractors: Aerospatiale SNI, France; and Harbin Aircraft Manufacturing Company, People's Republic of China.

Power Plant: two SMPMC WZ8A (license Turbomeca Arriel $1C_1$) turboshafts; each 724 shp.

Dimensions: rotor diameter 39 ft 2 in, fuselage length 38 ft 1⅞ in, height 11 ft 6½ in.

Weights: empty 4,519 lb, gross 9,039 lb.

Performance: max cruising speed 177 mph at S/L, ceiling 19,685 ft, range (standard fuel) 534 miles at 161 mph, (with auxiliary tank) 621 miles at 161 mph.

Accommodation: up to 10 (normal) or 14 (max) persons, including one or two pilots.

Armament: some Chinese Army Z-9/9As may be equipped with externally or door-mounted machine guns and/or antitank guided weapons.

Ka-25

India and Vietnam retain in first-line service Kamov Ka-25 (NATO "Hormone-A") antisubmarine helicopters built in the Soviet Union between 1966 and 1975. The 17 Vietnamese aircraft are operated from land bases. Five similar helicopters were acquired to serve individually on board Soviet-built "Kashin II" class destroyers of the Indian Navy, but are being superseded by Ka-28s. More details of the Ka-25 can be found in the "Gallery of Soviet Aerospace Weapons," March 1990 issue. It is a typical Kamov design, with contrarotating coaxial rotors. Equipment of the "Hormone-A" version includes search radar in a large flat-bottomed undernose radome, dipping sonar, and sonobuoys stored on a rack on the starboard side of the cabin. A major shortcoming is that lack of an autohover capability prevents use of the dipping sonar at night or in adverse weather conditions.

Power Plant: two Glushenkov GTD-3BM turboshafts; each 990 shp.

Dimensions: rotor diameter (each) 51 ft 7¾ in, length of fuselage 32 ft 0 in, height 17 ft 7½ in.

Weights: empty 10,505 lb, gross 16,535 lb.

Performance: max speed 130 mph, ceiling 11,000 ft, range 250–405 miles.

Accommodation: crew of two on flight deck; two or three systems operators in main cabin, which is large enough to contain 12 folding seats for passengers.

Armament: ASW torpedoes, depth charges, and other stores in underfuselage weapons bay.

Ka-27/28

The Kamov Ka-27 was designed to replace the Ka-25, offering much-improved performance and military capability while requiring little more stowage space on board ship than the earlier helicopter. The basic **Ka-27** ASW version and **Ka-28** export model are known to NATO as "Helix-A." Their configuration is similar to that of the Ka-25, with contrarotating coaxial rotors, but the cabin is enlarged, and twin fins are fitted instead of the latter's triple tail unit. Twin turboshafts of the kind installed in Mi-24/25 ("Hind") attack helicopters enable flight to be maintained on one engine at maximum gross weight. Equipment includes an undernose 360° search radar, IFF, radar warning system, ESM, and dipping sonar. The aircraft's autopilot provides automatic approach and hover on a preselected course, using Doppler, making possible use of the dipping sonar at night and in adverse weather conditions. Officially released information claims an effectiveness against submarines cruising at up to 40 knots, at a depth of 1,650 ft, out to 125 miles from the helicopter's base, by day and night.

The Indian Navy is taking delivery of 18 "Helix-As" for operation from its new and upgraded escort vessels. The data that follow apply to the basic ASW Ka-28. Details of other "Helix" variants can be found in the "Gallery of Soviet Aerospace Weapons," March 1990 issue.

Power Plant: two Isotov TV3-117BK turboshafts; each 2,170 shp.

Dimensions: rotor diameter (each) 52 ft 2 in, length of fuselage 37 ft 1 in, height 17 ft 8½ in.

Weight: gross 26,455 lb.

Performance: max speed 155 mph, ceiling 12,000 ft, range 310 miles.

Accommodation: crew of three; up to 16 persons on folding seats in cabin.

Armament: two torpedoes or four depth bombs in ventral weapons bay.

KV107IIA

After being granted exclusive license rights by Boeing (then Vertol) to manufacture and sell its Model 107-II helicopter, Kawasaki flew the first Japanese example in May 1962. Known as the **KV107II**, it was followed in 1968 by the improved **KV107IIA**, with uprated turboshafts and better "hot and high" performance, production of which continued until earlier this year. Apart from eight for the Swedish Navy, all military KV107IIs were for the Japanese armed services: two in mine countermeasures configuration for the JMSDF, 42 as tactical transports for the JGSDF, and 15 for search-and-rescue duties with the JASDF. "Dash" numbers are -3, -4, and -5, respectively. Follow-on orders ensued for seven IIA-3s, 18 IIA-4s, and 39 IIA-5s. The Air Self-Defense Force A-5s are long-range variants, identifiable by their two large external fuel tanks, which increase total capacity to 1,000 US gallons instead of the standard 350 gallons; most are also fitted with an automatic flight-control system. Two of the earlier SAR KV107II-5s are in service with the Myanmar Air Force. *(Data for KV107IIA-4.)*

Contractor: Kawasaki Heavy Industries, Japan.

Power Plant: two Ishikawajima-Harima (GE license) CT58-IHI-140-1 turboshafts; each 1,400 shp.

Dimensions: rotor diameter (each) 50 ft 0 in, fuselage length 44 ft 7 in, height 16 ft 10 in.

Weights: empty 11,576 lb, gross 19,000–21,400 lb.

Performance: cruising speed 150 mph at 5,000 ft, ceiling 17,000 ft, range 222 miles (standard fuel), 682 miles (max fuel).

Accommodation: flight crew of two; up to 25 troops or equivalent cargo.

Armament: none.

Mi-4/Z-5

In October 1951, at a crucial period of the cold war and the war in Korea, Mikhail Mil was ordered by Joseph Stalin to design, build, and fly a single-engine, single-rotor, 12-passenger helicopter within twelve months. There was no time for prototypes. The first preproduction **Mi-4** (NATO "Hound") was completed in just seven months. By the twelve-month deadline, three production Mi-4s were also flying. Then, inevitably, the development problems started. Rotor blade flutter was cured; then an aircraft was lost when blades struck the roof of the flight deck. Remedies were found speedily. Within months, 18 Mi-4s took part in the 1953 Aviation Day flyby over Tushino Airport, Moscow. Three years later, 36 demonstrated the use of helicopters for putting down an assault force of troops and equipment. Eventually, some 3,500 were built, in several military and civil forms; exports were mace to around 30 countries. Of these, Afghanistan, North Korea, Mongolia, and Vietnam each continue to operate a few, some of the Vietnamese aircraft in a naval search-and-rescue role.

China obtained a license to manufacture the Mi-4 as its first nationally built production helicopter in 1956. A prototype was flown on December 14, 1958, but the quality of production aircraft, designated **Z-5** (Zhishengji-5; vertical takeoff aircraft 5), was affected by the emphasis on speed of production during the "great leap forward." Harbin Aircraft Factory revised the manufacturing drawings and flew a new, higher-quality prototype on August 20, 1963. In 1966 metal blades superseded the original wooden rotor blades on the production line and were retrofitted on aircraft already delivered. Of 545 Z-5s built by 1979, Harbin delivered 437 of the basic military version. The Air Force of the PLA still has some 300 of these; the Navy has about 30. *(Data for Mi-4.)*

Power Plant: one Shvetsov ASh-82V piston engine; 1,700 hp.

Dimensions: rotor diameter 68 ft 10½ in, length of fuselage 55 ft 1 in, height 17 ft 0 in.

Weights: empty 11,887 lb, gross 17,196 lb.

Performance: max speed 130 mph at 5,000 ft, ceiling 19,685 ft, range 370 miles.

Accommodation: crew of two on flight deck, sometimes with gondola for an observer/navigator under fuselage; up to 14 fully armed troops in cabin, or 3,836 lb of freight, including vehicles and guns loaded via clamshell rear doors, or eight litter patients and an attendant in ambulance role.

Armament: one 12.7 mm machine gun at front of gondola. Aircraft in Afghanistan have fired air-to-surface rockets, and have ejected flares to decoy shoulder-fired missiles aimed at attacking Mi-24 "Hinds."

Mi-8/17

These two Mil general-purpose helicopters utilize virtually the same basic airframe. The **Mi-8** (NATO "Hip-C/D/E/F/G/J/K") is the original design, with TV2 turboshafts and a starboard-side tail rotor, as described in detail below. The **Mi-17** ("Hip-H") has more powerful (1,950 shp) TV3-117MT engines in shorter nacelles, with the tail rotor relocated on the port side. Variants in service with the Soviet armed forces are equipped for a wide variety of tasks, including airborne communications and ECM (see "Gallery of Soviet Aerospace Weapons," March 1990 issue). The basic "Hip-C" is the standard heavily armed assault transport, able to put down troops, equipment, and supplies behind enemy lines within 15–20 minutes of a nuclear or conventional bombardment/strike. "Hip-F" (the export version of "Hip-E") is even more heavily armed, with a nose machine gun and a triple stores rack on each side of the cabin, able to carry up to 192 rockets in six packs, plus six AT-3 ("Sagger") antitank missiles. These are the versions most widely used by other air forces, including those of Afghanistan, Bangladesh, Cambodia, China, India, North Korea, Laos, Mongolia, Pakistan, and Vietnam. The Mi-8T and Mi-8TB are "Hip-Cs" uprated to Mi-17 standard; the Mi-8TBK is a similar upgrade of "Hip-E." More than 10,000 Mi-8s and Mi-17s have been built in the Soviet Union. *(Data for Mi-8 "Hip-C.")*

Power Plant: two Isotov TV2-117A turboshafts; each 1,700 shp.

Dimensions: rotor diameter 69 ft 10¼ in, length of fuselage 59 ft 7½ in, height 18 ft 6½ in.

Weights: empty 16,007 lb, gross 26,455 lb.

Performance: max speed 161 mph at 3,250 ft, ceiling 14,750 ft, range 311 miles as passenger transport.

Accommodation: crew of two or three; 24 troops on tip-up seats along cabin sidewalls, or 12 litter patients and an attendant, or 8,820 lb of freight or vehicles, loaded via rear clamshell doors and hook-on ramps.

Armament: one 12.7 mm machine gun in nose, twin rack on each side of cabin, able to carry 128 × 57 mm rockets in four packs, or other weapons.

Mi-24/25/35

Known to NATO as "Hind," the **Mi-24** is the Soviet counterpart to the US Army's AH-64 Apache attack helicopter, with the added ability to carry eight combat-equipped troops in its main cabin. Details of the basic variants ("Hind-A" to "Hind-G") can be found in the "Gallery of Soviet Aerospace Weapons," March 1990 issue. The **Mi-25** is the export model of the Mi-24D ("Hind-D") gunship, first observed in 1977, armed with a 12.7 mm four-barrel nose gun, four weapons pylons under its stub-wings, and wingtip launchers for four AT-2 ("Swatter") antitank missiles. The **Mi-35** is the export counterpart of the Mi-24W ("Hind-E"), with up to 12 AT-6 ("Spiral") radio-guided, tube-launched, antitank missiles in pairs on its wingtip and underwing mountings. It has a HUD for the pilot, replacing the former reflector gunsight, an enlarged undernose missile guidance pod, and a fixed searchlight. AA-8 ("Aphid") air-to-air missiles, and the same range of alternative weapons as those of "Hind-D," can be carried on the underwing pylons. The **Mi-35P** is similar to the Soviet forces' Mi-24P ("Hind-F"), with a GSh-30-2 twin-barrel 30 mm gun (with 750 rds) mounted on the starboard side of the nose, replacing the usual Gatling. Mi-25s are known to have been delivered to Afghanistan (more than 60) and India (12). The Indian Air Force is now receiving a further 20 Mi-35s or 35Ps. "Hinds" are also operated by Cambodia (at least three), North Korea (50), and Vietnam (30). *(Data for Mi-35P.)*

Power Plant: two Isotov TV3-117 turboshafts; each 2,200 shp.

Dimensions: rotor diameter 56 ft 9 in, length of fuselage 57 ft 5 in, height 21 ft 4 in.

Weights: empty 18,078 lb, gross 26,455 lb.

Performance: max speed 199 mph, ceiling 14,750 ft, combat radius 99 miles with max military load, 179 miles with max external fuel.

Accommodation: crew of two; flight mechanic, and provisions for eight troops or four litter patients, in main cabin.

Armament: one GSh-30-2 twin-barrel 30 mm gun; up to 12 AT-6 antitank missiles. Alternative loads on four underwing pylons include 32 rd packs of 57 mm rockets, 20 rd packs of 80 mm rockets, UPK-23 pods each containing a GSh-23 twin-barrel 23 mm gun, up to 3,300 lb of chemical or conventional bombs, PFM-1 mine dispensers, or other stores. Provisions for firing AK-47 guns from cabin windows.

Mi-26

Heaviest production helicopter yet flown, the Mil Mi-26 (NATO "Halo") is also the first to have an eight-blade main rotor, enabling the diameter to be smaller than that of the Mi-6. The prototype flew for the first time on December 14, 1977, and Mi-26s were fully operational with the Soviet air forces by 1985. In June of the following year, India began taking delivery of ten, which are operated by No. 126 Squadron of the Indian Air Force. Features include a payload and cargo hold very similar in size to those of a C-130 Hercules, loading via clamshell doors and ramp at the rear of the cabin pod, main landing gear legs that are adjustable individually in length to facilitate loading and to permit landing on varying surfaces, and all equipment necessary for day and night operation in all weathers.

Power Plant: two Lotarev D-136 turboshafts; each 11,240 shp.

Dimensions: rotor diameter 105 ft 0 in, length of fuselage 110 ft 8 in, height 26 ft 8¾ in.

Weights: empty 62,170 lb, gross 123,450 lb.

Performance: max speed 183 mph, ceiling 15,100 ft, range 497 miles with max internal fuel.

Accommodation: crew of five on flight deck; compartment for four persons aft of flight deck, and about 20 tip-up seats along each sidewall of hold. Max seating for about 85 combat-ready troops. Freight loads include two airborne infantry combat vehicles and a standard 44,100 lb ISO container.

Armament: none; but infrared jammers and suppressors, flare dispensers, and color-coded identification flares are standard.

Models 212/412

Nearly a hundred of these twin-turbine helicopters are in service or on order by Asian countries. The lower-powered **Bell 212** is in service with the air forces of Bangladesh (15), Brunei (11), South Korea (7), and Sri Lanka (10), as well as the Royal Thai Army (9) and Navy (8). The **Bell 412,** which has a four-blade main rotor as well as an uprated power plant, has been supplied to South Korea (3), Sri Lanka (4), and the Thai Royal Flight (2). The Sri Lankan aircraft are armed for assault and counterinsurgency roles, while those of the Royal Thai Navy are equipped for antisubmarine use. Most other 212/412s in the region are used for general or VIP transport duties, medevac, or search and rescue. The Indonesian Army is in the process of receiving 28 **NBell-412s,** built locally by IPTN, and Japan's Maritime Safety Agency has four civil Model 212s. The main 212/412 production lines were transferred from the US to Bell's Canadian factory in 1988–89. *(Data for Bell 212, with 412 in parentheses.)*

Contractors: Bell Helicopter Textron, Canada (Industri Pesawat Terbang Nusantara, Indonesia).

Power Plant: one Pratt & Whitney Canada PT6T-3B (PT6T-3B-1) Turbo Twin Pac turboshaft; flat rated at 1,290 shp (1,400 shp).

Dimensions: rotor diameter 48 ft 2¼ in (46 ft 0 in), fuselage length (both) 42 ft 4¾ in, height 12 ft 10 in (10 ft 9½ in).

Weights: empty 5,997 lb (6,495 lb), gross 11,200 lb (11,900 lb).

Performance: max cruising speed 115 mph (143 mph) at S/L, ceiling 13,000 ft (16,500 ft), max range 261 miles (408 miles).

Accommodation: pilot and up to 14 passengers or equivalent cargo.

Armament (both): can include a 12.7 mm or 0.50 in machine gun in ventral turret, plus provisions for externally mounted antitank or antiship missiles, gun pods, or rocket pods.

Model 414-100 Chinook

The Model 414-100, known variously as the International CH-47D or International Military Chinook, is the current export version of this tandem-rotor, medium-lift helicopter, corresponding to the US Army CH-47D. Following delivery of two US-built examples and five knocked-down assembly kits, Kawasaki is building it under license as the **CH-47J** for two of Japan's armed forces. Deliveries by March this year had totaled 13 to the Ground Self-Defense Force (of 39 required) and seven (of 15 wanted) to the Air Self-Defense Force. In 1989 Boeing delivered the first seven of 18 ordered by the South Korean Army, and three others have been ordered by the Royal Thai Army. A Chinese order for six, placed in January 1989, was embargoed after the midyear unrest in Beijing. Taiwan's Army operates, as utility transports, three examples of the **Model 234MLR** Commercial Chinook, which differ in having 4,075 shp AL 5512 engines, a 52 ft 1 in long fuselage, and max gross weight of 48,500 lb. In earlier years, Thailand received four ex-US Army **CH-47As,** and the Royal Australian Air Force 12 **CH-47Cs.** Eleven of the latter survive; after transfer to Army ownership they were withdrawn from service in mid-1989, but could be reactivated if needed. *(Data for Model 414-100.)*

Contractor: Boeing Helicopters, USA.

Power Plant: two Textron Lycoming T55-L-712 turboshafts; each 3,750 shp.

Dimensions: rotor diameter (each) 60 ft 0 in, fuselage length 51 ft 0 in, height 18 ft 7.8 in.

Weights: empty 23,429 lb, gross 50,000 lb.

Performance: typical cruising speed 159 mph at S/L, ceiling 9,100 ft, range 1,279 miles.

Accommodation: crew of two; 33–55 troops, 24 litters and two medical attendants, or vehicles/cargo, in main cabin.

Armament: none.

Model 500MD Defender

Derived from the original US Army OH-6A Cayuse, this agile and versatile little helicopter adapted well to weapons carriage and has proved a popular export item to air forces in Africa, the Middle East, and Asia. Basic model is the **MD Scout Defender,** which can be armed with 14 2.75 in rockets and either a 7.62 mm machine gun or a 40 mm grenade launcher. For the antitank role, the **MD/TOW Defender** can carry four of these missiles, with a nose-mounted sight standard or mast-mounted sight as an option. Third major variant is the **MD/ASW Defender,** equipped with a nose-mounted radar, MAD bird, and two homing torpedoes. The Indonesian Air Force has about a dozen of these helicopters for counterinsurgency duties, while in Taiwan the Navy has an equal number of the ASW model and the Air Force six elderly OH-6As for training. License production has been undertaken in Japan and South Korea, by Kawasaki and Korean Air, respectively, for many years, and is continuing. The RoK Army has upwards of 100 Scout Defenders and about 50 TOW Defenders in service. Those of Japan's GSDF (100+ delivered to date) are used mainly for AOP, liaison, and training; a few are used as trainers also by the Maritime Self-Defense Force. The North Korean Army Air Force is thought still to have most of a reported 86 Scout Defenders acquired via a dubious route in 1988. To follow 20 armed 500MDs received during 1989, the Philippine Air Force is taking delivery of 22 **MD 520s** for light attack and scout missions. *(Data for 500MD/TOW Defender.)*

Contractor: McDonnell Douglas Helicopter Company, USA.

Power Plant: one Allison 250-C20B turboshaft; derated to 375 shp.

Dimensions: rotor diameter 26 ft 5 in, fuselage length 25 ft 0 in, height 8 ft 8 in.

Weights: empty 1,976 lb, gross 3,000 lb.

Performance: max cruising speed 137 mph at S/L, ceiling 13,800 ft, range 266 miles at 5,000 ft.

Accommodation: pilot and copilot/gunner.

Armament: see text above.

Mi-24W (Lech Zielaskowski)

Bell 212, Sri Lanka Air Force

Model 500MD Defender, Republic of Korea Army

Puma

The prototype of this military assault and civilian transport helicopter flew for the first time on April 15, 1965, and the Puma was selected subsequently as one of three types produced under a joint Anglo-French program that included the Gazelle and Lynx. By the spring of 1989, a total of 697 had been built for delivery to 46 countries, 34 of which have used them for military duties. Eleven were assembled from knocked-down components by Nurtanio (now IPTN) of Indonesia, contributing to the total of 12 SA 330L Pumas serving currently with the Indonesian Air Force. This final production version introduced main rotor blades made of composite materials, and has a higher gross weight than earlier models. The Air Force of Nepal has two earlier SA 330Cs with 1,400 shp Turmo IVB engines. The Pakistan Air Force has a single SA 330J, similar to the L, for VIP duties. The Pakistan Army Aviation Wing operates around 35 Pumas as its primary helicopter transport fleet. *(Data for SA 330L.)*

Contractors: SNI Aerospatiale, France, Westland Helicopters Ltd, UK, and Nurtanio, Indonesia.

Power Plant: two Turbomeca Turmo IVC turboshafts; each 1,575 shp.

Dimensions: rotor diameter 49 ft 2½ in, length of fuselage 46 ft 1½ in, height 16 ft 10½ in.

Weights: empty 7,970 lb, gross 16,315 lb.

Performance: max cruising speed 160 mph at S/L, ceiling 15,750 ft, range 341 miles.

Accommodation: crew of two; 16 fully equipped troops, six litter patients and six seated persons, or internal or external freight.

Armament: provisions for side-firing 20 mm gun, two 7.62 mm machine guns, rocket packs, and other weapons.

S-70A/C Black Hawk

Manufacturer's designation **S-70C** signifies a commercial utility version of the H-60 Black Hawk tactical transport helicopter, but several sales have been made to military customers in Asia and elsewhere. Far Eastern customers include the air arms of Brunei (two), China (24), the Philippines (two), Taiwan (14), and Thailand (four for Royal Flight). Between 1987 and 1990 the Royal Australian Air Force received 39 **S-70A-9s** (two built by Sikorsky and 37 assembled locally by Hawker de Havilland), which have now been transferred to Army control. These have T700-GE-701A-1 engines, a modified SH-60B flight-control system, rescue hoist, main rotor brake, folding tail rotor pylon, and an external stores support system (ESSS). Japan's Air Self-Defense Force is beginning to replace some of its KV107IIA-5s in the SAR role with a **UH-60J** version of the UH-60A, with seven funded by FY 1990 of some 46 required; three other UH-60Js have been funded for the JMSDF. *(Data for UH-60A.)*

Contractor: Sikorsky Aircraft, USA.

Power Plant: two General Electric T700-GE-700 turboshafts; each 1,560 shp.

Dimensions: rotor diameter 53 ft 8 in, fuselage length 50 ft 0¾ in, height 16 ft 10 in.

Weights: empty 11,284 lb, gross 16,994 lb (typical), 22,000 lb (max).

Performance: max cruising speed 167 mph at 4,000 ft, ceiling 19,000 ft, range 373 miles (internal fuel), 1,380 miles (max internal/external fuel).

Accommodation: crew of three; 11–14 troops, or 4–6 litters and 1–3 medical attendants, or cargo, in main cabin. Executive configuration for 7–8 passengers. Up to 8,000 lb load on external cargo hook.

Armament: ESSS permits up to 10,000 lb of externally carried stores including up to 16 Hellfire laser-guided antiarmor or other missiles, gun pods, mine dispensers, rockets, or ECM packs on four cabin-side pylons. Two pintle mounts in cabin, each for a 0.50 in or 7.62 mm machine gun.

S-70B Seahawk

Sikorsky currently has two customers for export versions of the US Navy's SH-60B Seahawk, both dating from the mid-1980s. To fill its RAWS (role-adaptable weapon system) requirement, the Royal Australian Navy placed an initial contract for eight of these helicopters in July 1985, ordering eight more in May 1986. These have the Sikorsky designation **S-70B-2** and comprise two US-built aircraft and 14 assembled locally by ASTA (Aero-Space Technologies of Australia); equipment includes MEL Super Searcher radar and a Collins avionics suite. Deliveries are just about complete, and the RAN Seahawks are assigned to the six FFG-7 (*Adelaide*-class) guided missile frigates. Two US-built **XSH-60J** prototypes were delivered to Mitsubishi in 1986, for outfitting with JMSDF-specified avionics and equipment, and the Japanese company is now producing the SH-60J (Sikorsky designation **S-70B-3**) for that service. Twenty-three had been funded up to FY 1990. *(Data for SH-60B.)*

Contractor: Sikorsky Aircraft, USA.

Power Plant: two General Electric T700-GE-401C turboshafts; each 1,900 shp.

Dimensions: rotor diameter 53 ft 8 in, fuselage length 50 ft 0¾ in, height 17 ft 0 in.

Weights: empty 13,648 lb, gross (ASW) 20,244 lb.

Performance: max speed 145 mph at S/L, ceiling 19,000 ft, endurance (SH-60F) 4 hours.

Accommodation: crew of three.

Armament: two Mk 46 torpedoes or two AGM-119B Penguin antiship missiles.

S-76/H-76 Eagle

The Philippine Air Force was the first military export customer for the **Mk II Utility** version of the Sikorsky **S-76,** placing an order for 17 in 1983. Two of these were configured for search and rescue, two others as eight-passenger transports, and one as a 12-passenger aircraft. The other 12 are used either as medevac helicopters or as **H-76 Eagle** armed examples for counterinsurgency duties. During 1990 the Royal Hong Kong Auxiliary Air Force is taking delivery of six of the **S-76A+** model, three of which will be used for SAR, and the RHKAAF has two **S-76Cs** on order for delivery next year. Potentially the largest overseas order could come from South Korea, which has a requirement for 150–175 armed helicopters and has been offered the H-76. Based on the civil **S-76B,** this version is powered by two 960 shp P&W Canada PT6B-36 engines and can be equipped with

armored crew seats, mast- or roof-mounted sight, and other battlefield systems. Armament can include a pintle-mounted 7.62 mm gun in each doorway, externally podded 7.62 mm or 0.50 caliber machine guns or 20 mm cannon, rocket launchers, Hellfire/TOW/Sea Skua/Stinger missile capability, or other weapons. *(Data for S-76A+.)*

Contractor: Sikorsky Aircraft, USA.
Power Plant: two Turbomeca Arriel 1S turboshafts; each 700 shp.
Dimensions: rotor diameter 44 ft 0 in, fuselage length 43 ft 4½ in, height (over tail rotor) 14 ft 5¾ in.
Weights: empty 6,126 lb, gross 10,800 lb.
Performance: max cruising speed 167 mph, ceiling 14,170 ft, range 457 miles.
Accommodation: crew of two; up to 12 passengers in main cabin.
Armament: none.

S-80M

The S-80M is the export counterpart to the US Navy's **MH-53E Sea Dragon** airborne mine countermeasures aircraft, with design features that include enlarged sponsons for considerably increased fuel capacity, in-flight refueling capability, an automatic flight-control system (incorporating automatic approach to/depart from the hover, and automatic tow coupling), and mechanical, acoustic, and antimagnetic systems to deal with all types of sea mine likely to be encountered. On-board systems in the USN version include AN/AQS-14 sonar, AN/AQS-17 mine neutralization set, AN/ALQ-141 electronic sweep gear, and an AN/ALQ-166 towed sled. Japan's Maritime Self-Defense Force has a requirement for 12 **S-80M-1s,** ten of which had been funded up to FY 1990 with the final two probably to be procured in FY 1991. Deliveries, to replace KV107IIA-3s, began in 1989 and had totaled five by mid-1990. *(Data for MH-53E.)*

Contractor: Sikorsky Aircraft, USA.
Power Plant: three General Electric T64-GE-416 turboshafts; each 4,380 shp.
Dimensions: rotor diameter 79 ft 0 in, fuselage length 73 ft 4 in, height 17 ft 5½ in.
Weights: empty 36,336 lb, gross 69,750 lb.
Performance: cruising speed 173 mph at S/L, ceiling 18,500 ft.
Accommodation: flight crew of three, plus systems operators as required.
Armament: none.

Sea King and Nuri

Sikorsky developed the Sea King to meet a US Navy requirement for a helicopter able to combine the antisubmarine hunter/killer roles that had previously required a team of two HSS-1 (SH-34G) Seabats. The first of seven preseries aircraft was flown on March 11, 1959. Deliveries to the Navy of HSS-2 (soon redesignated **SH-3A**) production aircraft, each powered by two 1,250 shp T58-GE-8B turboshafts, began in September 1961. About 25 SH-3As, and 79 similar **SH-3Bs,** built under license by Mitsubishi, continue in service with the Japan Maritime Self-Defense Force. Some are shore-based, but their primary mission is ASW, singly or in three-aircraft flights from destroyers of the JMSDF. Also in JMSDF service are ten **S-61A** transport versions of the SH-3A, used for search-and-rescue duties, and three operated as utility transports. Each accommodates 26 troops, 15 litter patients, or equivalent freight, and retains the boat-hull amphibious capability of the SH-3A. Another major operator of the S-61A is the Royal Malaysian Air Force, which has 35 **S-61A-4s,** named Nuri, with 31 seats, rescue hoists, and auxiliary fuel tanks as standard equipment.

In 1959, Westland Helicopters of the UK signed a license agreement with Sikorsky, under which it was able to utilize the airframe and rotor system of the SH-3, with extensive changes to the power plant and equipment, to meet a Royal Navy requirement for a long-endurance, ship-based, antisubmarine helicopter. In addition to subsequent major production for the UK armed forces, Westland supplied similar helicopters to the navies of Australia, India, and Pakistan, all of which continue to operate these aircraft in ASW and search-and-rescue forms, with Rolls-Royce Gnome engines. The data that follow apply to the current standard production Advanced Sea King. Typical equipment, on the Indian ASW Mk 42B, includes MEL Super Searcher radar, GEC Avionics AQS-902 sonobuoy processor and tactical processing system, Alcatel HS-12 dipping sonar, Chelton 700 sonics homing, Marconi Hermes ESM, and fittings to carry Sea Eagle antiship missiles.

Contractor: Westland Helicopters Ltd, UK.
Power Plant: two Rolls-Royce Gnome H.1400-1T turboshafts; each 1,660 shp.
Dimensions: rotor diameter 62 ft 0 in, length of fuselage 55 ft 10 in, height 15 ft 11 in.
Weights: empty 16,377 lb, gross 21,500 lb.
Performance: cruising speed 126 mph at S/L, ceiling 14,000 ft, radius of action (three torpedoes, 2 hours on station) 144 miles.
Accommodation: crew of four; up to 22 survivors in SAR role.
Armament: provisions for Sea Eagle or Exocet missiles, up to four Mk 46, Whitehead A2445, or Sting Ray homing torpedoes, four Mk 11 depth charges, Ultra Electronics minisonobuoys, smoke floats, marine markers, and other weapons and equipment.

Super Lynx

The Super Lynx is an upgraded export version of the widely used Westland Lynx multirole military helicopter, very like the latest model proposed for the Royal Navy. Production was initiated in 1988, when twelve were ordered for the Republic of Korea Navy, for operation from its ex-USN *Sumner*- and *Gearing*-class destroyers and future HDF-3500 class. Compared with current versions of the Lynx, these helicopters will have advanced technology composites main rotor blades, a reversed-direction tail rotor that reduces noise and improves hovering ability for extended periods at high weights, a higher gross weight, all-weather day/night capability, and extended payload/range performance. Designated **Lynx Mk 99,** the Korean helicopters will be fitted with Racal Doppler 71/TANS N navigation equipment, Seaspray Mk 3 360° radar, and Sea Skua antiship missiles. Deliveries are scheduled for completion next year.

Contractor: Westland Helicopters Ltd, UK.
Power Plant: two Rolls-Royce Gem 42-1 turboshafts; each 1,120 shp.
Dimensions: rotor diameter 42 ft 0 in, length (main rotor blades and tail folded) 35 ft 7¼ in, height (main rotor blades and tail folded) 10 ft 8 in.
Weights: empty 7,255 lb, gross 11,300 lb.
Performance: max cruising speed 159 mph, radius of action (dipping sonar, one torpedo, 2 h 20 min on station) 23 miles.
Accommodation: crew of two; secondary capability for carrying up to nine survivors in search-and-rescue role, or three litter patients and an attendant.
Armament: four Sea Skua or two Penguin antiship missiles, or four Stinger air-to-air missiles. Provision for wide range of gun and rocket installations.

Super Puma

The Super Puma is a development of the original SA 330 Puma with a completely new power plant, uprated transmission, and airframe changes to improve crew survivability, payload, performance, and ease of maintenance. The first prototype AS 332 flew on September 13, 1978, and many versions have since appeared. Available currently are the AS 532UC unarmed military utility helicopter, seating up to 21 troops; AS 532UL with lengthened cabin for 25 troops; AS 532AC armed version of the 532UC; AS 532AL armed version of the 532UL; AS 532SC naval version with folding tail rotor pylon, deck landing assist device, ASW/ASV equipment, and armament; AS 532MC unarmed naval utility version; and **Cougar Mk II** variants with new main and tail rotors, and lengthened cabin for up to 29 troops. Deliveries of Super Pumas have been made to China (6 VIP), Japan (3 army VIP), South Korea (3 army VIP), Nepal (one for Royal Flight), and Singapore (5 search and rescue, 17 transport), assembled in that country by Samco. IPTN of Indonesia manufactures several versions of the Super Puma under license and has delivered six transports and one VIP model to that nation's air force and 26 to the navy for ASW, antiship missions with Exocet missiles, search and rescue, and secondary transport duties. One VIP transport has been exported to the Royal Malaysian Air Force.

S-61A-4 Nuri, Royal Malaysian Air Force (Paul Jackson)

Super Puma, Japan Ground Self-Defense Force (Katsumi Hinata)

Wasp, Indonesian Navy (British Aerospace)

Contractors: Aerospatiale SNI, France; IPTN, Indonesia.
Power Plant: two Turbomeca Makila 1A1 turboshafts; each 1,877 shp.
Dimensions (AS 532SC): rotor diameter 51 ft 2¼ in, length of fuselage 50 ft 11½ in, height 16 ft 1¾ in.
Weights (AS 532SC): empty 10,031 lb, gross 19,841 lb.
Performance (AS 532SC): cruising speed at S/L 149 mph, ceiling 11,480 ft, range at S/L 540 miles.
Accommodation: two pilots and other crew members as required by mission; nine litter patients and three seated persons in ambulance role; transport seating as listed under individual variants.
Armament: for army/air force missions, alternatives include one 20 mm gun, two 7.62 mm guns, two packs of 22 × 68 mm rockets or 19 × 2.75 in rockets. Naval options include two Exocet missiles, two torpedoes and sonar, or MAD and sonobuoys.

UH-1/Model 205 Iroquois

No longer in US production, these single-engined workhorse members of the original "Huey" family still serve with a dozen Asian countries, mostly in transport, utility, or search-and-rescue roles. Operators, with approximate numbers in service, include Australia (Air Force, 25+ UH-1D/H for Army support), Indonesia (Army 16), South Korea (Army 62 UH-1B/H, Air Force ten UH-1D/H), Myanmar (12 205A-1s), New Zealand (Air Force 13 UH-1H), Pakistan (Army ten 205s and five UH-1H), the Philippines (Air Force 15 205A-1s and 75 UH-1H), Papua New Guinea Defence Force (four UH-1H), Singapore (Air Force four 205A/A-1s, 24 UH-1B and 16 UH-1H), Taiwan (Air Force 58 UH-1H, Army 60 UH-1H), and Thailand (Army 75+ UH-1B/D, Air Force 28 UH-1H, Navy four UH-1H). Sole production source for this helicopter is now Fuji in Japan, which has been building the type since 1973. The Japan Ground Self-Defense Force has some 82 **UH-1Bs** and over a hundred **UH-1Hs** (Japanese designation **HU-1H**), of 133 so far funded, in service. *(Data for Fuji-built HU-1H.)*

Contractors: Bell Helicopter Textron, USA; Fuji Heavy Industries, Japan.
Power Plant: one Kawasaki-built Textron Lycoming T53-K-13B turboshaft; 1,400 shp.
Dimensions: rotor diameter 48 ft 0 in, fuselage length 41 ft 10¾ in, height 11 ft 9¾ in.
Weights: empty 5,270 lb, gross 9,500 lb.
Performance: max cruising speed 127 mph, ceiling 12,600 ft, range 290 miles.
Accommodation: pilot and 11–14 troops, or six litters and a medical attendant, or 3,880 lb of cargo.
Armament: normally none.

Wasp

The Westland Wasp antisubmarine helicopter has had a long career, first examples for the Royal Navy having been delivered as long ago as 1963. New Zealand was the only direct-sale export customer in the Pacific Rim area, buying two from the UK in 1966. These were augmented later by the acquisition of ten ex-RN Wasp **HAS. Mk 1s.** The RNZN fleet had dwindled to seven by 1989 but has been brought back to strength by the delivery of a further four ex-Royal Navy Wasps earlier this year. Main use today is for search and rescue and communications. The Royal Malaysian Navy acquired six ex-RN HAS. Mk 1s in 1988, which it uses for a mix of ASW, maritime reconnaissance, and SAR duties. The other Asian operator is the Indonesian Navy, whose nine Wasps are also second-hand, ten having been obtained from the Royal Netherlands Navy in 1981. These, too, perform both ASW and SAR missions. *(Data for HAS. Mk 1.)*

Contractor: Westland Helicopters, UK.
Power Plant: one Rolls-Royce Bristol Nimbus Mk 503 turboshaft; derated to 710 shp.
Dimensions: rotor diameter 32 ft 3 in, fuselage length 30 ft 4 in, height 11 ft 10 in.
Weights: empty 3,452 lb, gross 5,500 lb.
Performance: max speed 120 mph, ceiling 12,500 ft, range 270 miles.
Accommodation: crew of two; can carry up to three more persons on rear seat.
Armament: two Mk 44 torpedoes or up to 550 lb of depth charges. Some Royal Navy aircraft equipped to carry two AS.12 wire-guided missiles for antiship use. ■

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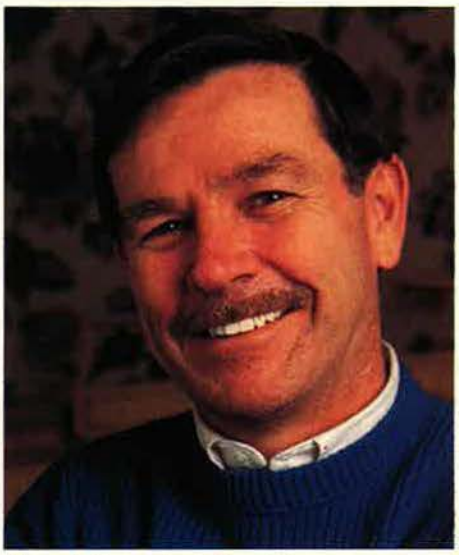

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The second prototype for the Advanced Tactical Fighter rolls out.

Meet the YF-22A

By Jeffrey P. Rhodes, Aeronautics Editor

"THE value of a strong military lies as much in its ability to prevent a war as it does to successfully prosecute one," Gen. Ronald W. Yates, commander of Air Force Systems Command, told the crowd gathered at Lockheed Plant 10 in Palmdale, Calif., on August 29, in the midst of the large-scale US military buildup in the Persian Gulf.

"The Advanced Tactical Fighter," he continued, "represents a potent element of America's future defense capability. It will best serve its intended purpose if it never flies in anger. But as current events [in the Gulf] demonstrate, there are those in the world willing to test American resolve and readiness. That, in a broad sense, is why we need the ATF."

With that—and with the strains of Richard Wagner's "Ride of the Valkyries" reverberating in onlookers' ears—technicians rolled back the hangar curtains to reveal the YF-22A, the Lockheed/Boeing/General Dynamics prototype of the prospective ATF. This rollout was the debut of the second of two differently designed planes that are vying to become the next-generation air-superiority fighter for both the Air Force and the Navy.

Next spring, after four years of development and slightly more than five months of flying the prototypes (two of each plane), the Air Force will end the demonstration/validation phase of the ATF program. It will then select either the YF-22A or its rival, the Northrop/McDonnell Douglas YF-23A prototype *[see "The YF-23 Rolls Out," September 1990 issue, p. 116]*, and begin full-scale development (FSD) of the new plane. In addition, the Air Force will choose one fighter engine company, either General Electric or Pratt & Whitney, to start full-scale development of the twin-engine ATF's advanced powerplants.

For the competing airframe teams and engine-makers, the prize will be a large buy of fighter aircraft, spread across many years. Original Air Force plans, subject to change but for the moment remaining in force, called for production of 750 ATFs to replace, in the next century, the Air Force's fleet of F-15 air-superiority aircraft, which has been in operational service since 1974. In addition, the Navy could choose to buy more than 500 of an ATF variant—the so-called Naval ATF or NATF—to replace its carrier-based, F-14 Tomcat fleet air defense aircraft.

"The requirements the Air Force laid on went way beyond one airplane," said Dave Ferguson, the company test pilot who will be the first to fly the YF-22. Among the ambitious requirements that the Air Force established were that the ATF should be hard to detect in flight, primarily as a result of the use of

low-observable, or stealth, technologies, but that it should also retain high maneuverability. Moreover, the Air Force said the ATF must be able to cruise at supersonic speeds without using afterburners, and thereby have greater combat range than today's fighters. The service also called for the design to be flexible enough to permit the Navy to adapt most ATF features in its next-generation fleet air defense fighter.

Those were not the only tough requirements. In addition, the ATF must be able to operate in the field with much less support equipment and fewer maintenance personnel. Finally, the aircraft has to be much more reliable and break less often than its predecessors but be easier to fix when repairs actually are required.

From Behind the Curtain

"Youngsters entering their teens today will be the pilots protecting US interests and world freedom a decade from now," said Daniel M. Tellup, Lockheed's chairman and chief executive officer, at the unveiling ceremony. "Their skill and valor must be supported with the best technology and innovation our nation can provide—the superb twenty-first-century fighter, the F-22."

The new aircraft, in a paint scheme of dark gray on light gray, similar to that of the F-16, has a deep radome on a diamond-shaped nose section, which is flanked by two rhomboidal intakes. The flat sides of the intakes continue aft and taper off at the point where the large, fully movable stabilators join the fuselage.

The lines of the slab sides are broken up by the single-wheel, forward-retracting main landing gear components, which fit into large wells. The single-wheel nosegear retracts aft. Both the YF-22's nosegear doors and large, single-piece main gear doors remain open when the gear is extended. The main gear doors have serrated edges that help reduce the plane's radar cross section (RCS). Straight, squared-off panel lines tend to offer stronger radar returns than irregular lines. The YF-22's landing gear is made by Menasco.

The most unusual feature about the slab sides is the presence of a bifold door on each side that conceals the YF-22's missiles. Judging from the location of the weapon bays, the missiles evidently will be ejected prior to ignition or will be held in the slipstream by some type of hydraulic arm that would allow the missile time to acquire its target before it is launched. Targeting data for radar-guided missiles could be fed to the weapons while they are stowed in the bays concealed by four long, narrow doors on the plane's underside.

The ATF's mix of weapons remains classified. However, it is known that each of the candidate ATF aircraft will carry both the short-range, heat-seeking AIM-9M Sidewinder air-to-air missile and the radar-guided AIM-120A advanced medium-range air-to-air missile (AMRAAM). Separation tests with both missile types will be conducted during test flights. On the YF-22 there were no wingtip missile rails.

Production planes will incorporate an internal gun of proven design, probably the 20-mm M61A1 used on F-15 and F-16 fighters. Inasmuch as this prototype aircraft is designed only to validate the YF-22's flight characteristics, a gun will not be installed. Media representatives were not allowed to get close enough to the YF-22 at the rollout to see where a gunport would be located.

The plane's cantilever wings are trapezoidal and swept back at a forty-five-degree angle. The wings are thicker at the root, but there appears to be almost no anhedral. Leading edge slats run from a point just past the wing root all the way to the tip. The flaperons are split into a larger, rhomboidal section at the root and a smaller trapezoidal section outboard. The air-refueling receptacle is located behind the cockpit and ahead of the speedbrake. A shoulder-mounted door near the starboard wing root is the auxiliary power unit exhaust.

The two very large fins cant upward at angles of sixty degrees from the horizontal, but the only moving parts are two full-height rudders that take up about one-third of the fin. The registration (N22YF) is painted near the base of the fin on a thick band, which appears to be a stiffener. The plane is civil-registered because it is officially owned by the private contractor team.

The YF-22A is sixty-four feet, two inches long and has a wingspan of exactly forty-three feet. Those dimensions make the new aircraft virtually the same size as the F-15 it is designed to replace. The YF-22 is just six inches longer than the Eagle and has a wingspan that exceeds the F-15's by a mere 2.25 inches. At a height of seventeen feet, 8.9 inches, the YF-22 is 8.6 inches shorter than the F-15.

The aircraft is made of a combination of composites and metals—mostly aluminum, with titanium in the engine compartment. The prototype YF-22 is made of roughly twelve percent thermoplastic composite components and approximately ten percent thermoset structures. The percentage of composite components will increase to around fifty percent on the production aircraft.

"Cost, not technical difficulty, is the problem with composites—both in terms of cost of raw materials and our cost to fabricate," says Sherm Mullin, the Lockheed vice president who serves as YF-22 program manager. "To get the cost of composites down, you have to buy in volume. We don't buy in volume. It is way too premature to decide what materials will go in production aircraft. We have a lot of options. There were a lot of things that were high-risk when we started that are not high-risk now."

More Inside Information

The YF-22A's high-arched, single-piece canopy is similar to that of an F-16 and offers the pilot superior all-around visibility. The leading edge of the canopy rail is serrated; two tooth-like serrations "creep up" on the molded, nearly flat windscreen portion. Inside, the aircraft contains a standard-size head-up display made by GEC Avionics. The zero/zero ejection seat, which sits high in the cockpit, is built by Weber. The prototype has a side-stick controller, but production aircraft will have a height-adjustable center stick.

One major innovation found in the YF-22 is the installation of full-color, multifunction, liquid crystal displays in the cockpit. The displays do not "wash out" in bright light, as do conventional cathode-ray tube displays, and they require less

power to operate and need less cooling than the CRTs. The LCDs are about one-third the depth of a CRT and thus leave more free space behind the instrument panel. The displays are made by General Electric, which has since sold its display interests. "We had a big internal debate [on whether] to go with CRTs or make the leap to LCDs," notes Mr. Mullin. "But we think the [LCD] technology is ready."

There is no debate on the importance of avionics in the ATF development work. In the YF-22, the various avionics systems (including the radar, electronic warfare equipment, and sensors) are tied into one liquid-cooled, thirty-two-bit processor built by Hughes. The common modules and core avionics that make up the integrated avionics suite are expected to provide four times the reliability of the avionics systems in the F-15.

Westinghouse and Texas Instruments are building the radar for both ATF contractor teams. The electronically scanned, phased-array radar features simultaneous multimode operation and has a wide field of view. Consisting of several thousand individual transmit/receive antenna elements, the radar offers variable beam shaping, low sidelobes, and considerably improved detection ranges. The radar is highly reliable; the estimated mean time between failures—for the entire radar, not individual elements—is close to 2,000 hours.

The YF-22 team used a Boeing-owned 757 jetliner as its avionics flying laboratory. Actual brassboard avionics hardware, including the radar and a Martin Marietta/General Electric infrared search and track (IRST) sensor, have been tested on the 757, which also includes airborne testing equipment. Testing in the 757 began this past April. The IRST, however, is not installed on either YF-22 prototype.

Engines provide the final major ATF development area. The first YF-22 prototype is fitted with two General Electric YF120-GE-100 variable-cycle engines. This unique, variable-cycle concept allows the engine to act like a turbofan *and* a turbojet.

The YF120 engine is a very-high-pressure engine that also has a high bypass ratio. This combination provides for low fuel burn during takeoff and subsonic flight. When the bypass doors are shut, nearly all of the air is routed through the core, giving the engine the ability to push the plane at speeds of approximately Mach 1.5 without afterburner. A small flow of air is needed to cool the back end of the engine in order to reduce the engine's (and thus the airplane's) infrared signature.

The second YF-22 prototype will be powered by a pair of Pratt & Whitney YF119-PW-100 engines, which, like the YF120, are in the 39,000-pound-thrust class. P&W, which had a near-variable-cycle engine in the J58 powerplant in the SR-71, has opted instead to extend the current state of the art with the YF119. With a combination of metals or alloys and a digital engine control, Pratt & Whitney has achieved a lightweight engine with a high thrust-to-weight ratio. In early tests of the P&W-powered YF-23, the ATF was able to pull away from the F-16 chase aircraft in military power. The F-16 chase plane pilot had to resort to afterburner to keep up.

Unlike the YF-23, the YF-22 will use thrust-vectoring nozzles. The nozzle was a Lockheed design that both engine builders modified to fit in the YF-22. The large control surfaces, in conjunction with the nozzles, will give the YF-22 pilot the ability to fly at very high angles of attack and allow a great degree of freedom in pointing the aircraft's nose, both of which are important in keeping the hunter from becoming the hunted in an air battle.

Putting the Pieces Together

With portions of the YF-22 being built in three locations (Burbank, Calif., Seattle, Wash., and Fort Worth, Tex.), there was some concern that the parts might not fit perfectly when the sections were brought together. The three assembly facilities were linked through a network to a single computer base, and when the parts were brought together in Palmdale, they fit perfectly without need for shims or fillers.

Lockheed serves as system integrator. In addition, the company developed and constructed all forward fuselage structures and components, including the cockpit. Lockheed was also responsible for displays, controls, the air data system, and all apertures.

Boeing designed and built the wings and aft sections of the fuselage. The company also installed the engines, nozzles, and APU. On the prototype, Boeing is also integrating and demonstrating the functionality of the radar and IRST and is testing the entire avionics system in the 757.

General Dynamics engineered and fabricated all midfuselage structures, empennage, nose, and landing gear. GD performed armament integration and developed the stores management system and inertial navigation system.

After taxi tests, Mr. Ferguson flew the plane for the first time on September 29, ferrying it from Palmdale to Edwards AFB, Calif. When the second YF-22 gets airborne, the pair will be flown twelve times a week until December 31, the end of the ATF demonstration/validation phase.

Final proposals are due to be delivered to Air Force Systems Command's Aeronautical Systems Division at Wright-Patterson AFB, Ohio, by January 2, 1990. The Air Force should reach a decision on a winner in late April. The airframe and engine winners will be announced around May 1. Actual award of the FSD contract likely will slip, and FSD likely will not begin until Fiscal 1992, which means after October 1, 1991. As a result, the winners most likely will receive extensions of their present dem/val contracts in order to continue testing until the start of FSD.

The first preproduction ATF should roll out in 1996, with squadron deliveries starting in the 2000–2002 period. Projected flyaway cost of production ATFs is $43.5 million per aircraft, with a total cost of $53.8 billion in FY 1985 dollars, used as the standard because the financial baseline was laid down in 1985. (In current dollars, unit flyaway cost would be $51.3 million and total program cost $63.5 billion.)

After being developed in virtually total secrecy, the two competing airframes and engines are now in the open, and the race to win the ATF prize is finally entering the home stretch. ■

AFA and the Air Force recognize Delta Crew as the best in the force.

Tops in Space

By Amy D. Griswold, Editorial Assistant

Capt. Randall J. Rees (center) accepts the award for Best Space Operations Crew from AFA President Jack C. Price (right) and AFA Treasurer William N. Webb at the Secretary of the Air Force Luncheon, held during AFA's National Convention.

DELTA Crew from Headquarters 1000th Satellite Operations Group, Offutt AFB, Neb., is the Air Force's "Best Space Operations Crew" of 1989. Part of Air Force Space Command, Delta Crew won the prestigious AFA award for its demonstrated "expertise and professionalism in the operation of the Defense Meteorological Satellite Program" (DMSP).

Each September at its National Convention, AFA honors top crews in the US Air Force. Delta Crew members honored this year were Capt. Randall J. Rees, commander; 1st Lt. Michael P. Gleason and 1st Lt. Randall T. Maxfield, satellite operations officers; Sgt. Frank R. Chavez, satellite ground system operator; Sgt. David J. Elfering and Sgt. Scott B. Walter, satellite commanding system operators; and Sgt. Robert A. Peeters and SrA. Mark R. Jenkins, satellite telemetry systems operators.

All found their knowledge and skills tested by three crises in 1989. In the most spectacular of these, the crew's actions helped to save a $40 million spacecraft.

Rescuing a Satellite

On May 6, 1989, what was to be a routine, fifteen-minute, "state-of-health" contact with a DMSP satellite became anything but routine when the crew discovered that one of the two on-board computers had failed, one of the four reaction wheels that provide orbit stability had also failed, and the spacecraft's power system was operating at twenty-five percent below its normal level.

Captain Rees immediately ordered telemetry analysis of 120 spacecraft subsystem alarms. By the time this was completed, the spacecraft's power system had dropped to fifty-two percent of normal level and was decreasing, while the second computer system had failed as well, leaving the satellite in a flat spin.

The ground system operator, Sergeant Chavez, reconfigured critical ground resource support to maintain forty-eight minutes of continuous contact with the stricken craft. This required rescheduling five Satellite Control Network stations.

Within this precious time, the crew stabilized the satellite's attitude by transmitting a sequence of thruster firing commands. The spacecraft began to gain power, and the crew reprogrammed both computers. Two hours after the emergency arose, the satellite again was stable and providing data.

That was not the only unusual challenge that confronted Delta Crew in 1989. On another occasion, lightning struck the unit's emergency power supply, starting a fire twenty-five feet from the operations center. Delta Crew directed evacuation of personnel, shut down computer centers, and transferred critical command and control software to a backup operations center. Air Force officials say that the crew's quick action not only ensured the safety of personnel and equipment but also ensured continued command and control of the DMSP constellation.

Fighting Solar Winds

Discovery that another DMSP satellite was in an unstable orbit provided Delta Crew with a third crisis in 1989. When the problem became apparent, a ground-based computer conducted telemetry analysis but could not determine the source of the satellite's difficulty. Telemetry analysis performed by the crew, however, showed that the instability was caused not by the failure of an internal subsystem, but by solar winds. The crew's initiative and expertise helped resolve what had been a serious satellite anomaly.

Throughout the year, says the Air Force, Delta Crew met "the most stringent time constraints" for mission data recovery and had the highest crew-evaluation average in the DMSP program, even while training new operational personnel. ■

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A cadet—said to rank one grade lower than a German prisoner—would someday be an officer and was expected to act accordingly.

The Aviation Cadets

By Bruce D. Callander

WHEN you can't get enough college-trained officers to make into pilots, you take what you can get. In two world wars, the Army plucked teenage boys from high school, called them "cadets," and tried to make them into officers and gentlemen while it taught them to fly.

The process was swift and often harsh. One World War I pilot who had been through it defined a flying cadet as "a person subject to military law who ranks just one grade lower than a German prisoner but who must remember that someday he is to be an officer and conduct himself accordingly."

The Army Aviation Section entered that war with thousands of eager applicants and few planes with which to train them. It sent cadets to selected universities for preliminary training, then to flight schools in England and France. Many waited months to go overseas and had to build their own bases when they arrived. They entered combat with scant instruction; losses were staggering.

Between wars, pilot requirements dropped, and officers again filled most of the training slots. The Army let a few cadets enter, but the standards were so high that few qualified, and most who did washed out. Among the handful who made it through was a midwestern youngster named Charles A. Lindbergh.

By the early 1940s, however, the Army Air Corps faced another war and was again short of flyers. In June 1941, Congress created the grade of aviation cadet, and the Army launched a massive flight-training program. Within two years, its annual output would soar to more than 65,700 pilots, 16,000 bombardiers, and 15,900 navigators. In time, the cadet program would expand to train nonrated officers in such fields as communications, armament, weather, and radar.

To get that many applicants, the Army had to lower its age and education requirements. When I applied a few weeks after the December 7, 1941, Japanese attack on Pearl Harbor, I had just turned eighteen and was a high school senior.

Physical requirements remained high, but medical examiners tended to be lenient. When I was found to

In a rare 1942 color photo, cadets at San Antonio Aviation Cadet Center (now Lackland AFB), Tex., line up cheerfully for their pay—a whopping $75 per month. Their preflight training was a combination of basic training and Officer Candidate School, with a touch of West Point.

be underweight for my height, they weighed me again with my clothes on and had me slouch until I measured an acceptable five-ten. They also gave me three tries before I squeaked through the depth-perception test.

Passing the physical made us only "aviation cadet candidates." We could await our official appointments either at home or in the Army as privates, unassigned. I thought a little Army experience would help later, so I enlisted. Three weeks after high school graduation, I was in a tent at Fort Dix, N. J., with several other future cadets and some middle-aged draftees who still thought they had been inducted by mistake.

Life in "Movable Storage"

I soon found that unassigned privates were in a kind of movable storage. When one base became overcrowded, we were sent to another. We pulled KP and guard duty, but our only formal training was in close-order drill.

After about three months, however, we were ordered to Nashville, Tenn., for testing, classification, and appointment. The written exams were easy, but the psychomotor tests, designed to measure coordination, were not. We had to operate make-believe aircraft controls while flashing lights and loud buzzers announced our every mistake. To my surprise, I qualified for all three types of training—pilot, bombardier, and navigator. I chose pilot.

Now officially aviation cadets, we drew $75 per month, the rate of privates on flight status. Our uniform was government issue for officers, except for the cap, which had a blue band and the Air Corps winged propeller instead of the eagle.

We expected to train in the east, but the San Antonio Aviation Cadet Center (now Lackland AFB) was short of cadets, and 200 of us were sent there. As it turned out, the shortage was in bombardier, not pilot, training. It was weeks before we entered the preflight course as Class 43-F.

Preflight was a ten-week combination of enlisted basic training and Officer Candidate School, with a thin topping of West Point tradition. A handful of nonrated "tactical officers" and noncoms ran things, but upperclassmen administered most of the discipline.

With comic precision, we marched everywhere, squaring our corners at every turn. We responded to questioning with clipped, shouted answers. We were addressed as "Mister," a term that upperclassmen could make sound like profanity. For minor infractions, we were ordered to "hit a brace," an exaggerated attention that caused the body to quiver and produce several chins. For more serious crimes, such as being late for formation, we "walked tours" on the parade ground during what was supposed to be our free time.

The class system allowed the school to operate with a relatively small staff and, in theory, gave the upperclassmen useful training in command. In practice, it was little more than a license to bully. What worked at West Point, where the classes were divided by as much as three years, made no sense where they were only a few weeks apart. The Army realized this midway through our stay at preflight; when 43-F became the upper class, hazing was abolished.

We did inherit other senior privileges, however, including that of "open post." After five weeks of confinement, we were allowed daytime visits to San Antonio on weekends. We made the pilgrimage to the Alamo, took in the Breckenridge Zoo, and ate in restaurants like grown-ups. Bars were off-limits to cadets, but the Gunter Hotel had a nonalcoholic Cadet Club, and the gaudy Aztec Theater showed first-run movies.

Mothers and Sisters

When we applied for cadet training, we swore we were single and would not marry during training, but some cadets broke the vow. Center officials maintained the fiction that all female visitors were mothers or sisters, and, by tacit agreement among the cadets, the wooded obstacle course was off-limits to single cadets on visitors' days.

Preflight academics included refresher courses in physics (twenty-four hours) and math (twenty hours) and classes in map reading (eighteen hours), aircraft recognition (thirty hours), and code (forty-eight hours). Gaps in the schedule were filled with more code classes, though most cadets never found a use for that skill.

We also had daily physical and military training. The former included a choreographed routine of side-straddle hops called the "Randolph Shuffle." The latter involved everything from squad drill to formal wing parades.

As officer trainees, we supposedly were exempt from menial tasks, but when the mess hall was short-handed, some of us were tapped for KP. When one cadet protested this inappropriate use of future officers, a tactical officer told him he had been chosen for additional training in mess management and sent him off with the rest of the KPs.

We also stood guard duty, carrying World War I rifles and no ammunition. Although the center had nothing to interest a saboteur, the Army took guard duty seriously, as I discovered one rainy night when a shadowy figure approached my post.

"Halt!" I ordered. "Who goes there?"

"An officer of the post," the shadow replied.

"Throw down your ID, sir, and step back."

He obeyed. I examined his credentials, discovered he was a full colonel, and returned his soggy wallet with a trembling hand.

"Mister," said the colonel. "Why did you call me 'sir' before you identified me as an officer? Do you 'sir' every Nazi spy who comes by?"

He took my name, and I fully expected to be charged with something. It never happened, but I had been conditioned to believe that an officer of any rank held the power of life and death over a mere cadet.

A few weeks later, another incident changed that perspective. Two of us were serving as cadet officers of the day. When the phone rang on the other cadet's desk, he made me answer it. Later, he explained that he didn't know how to use a phone. He also confessed that his GI boots were the first shoes he had ever worn. I spent the night teaching him to use the phone. When I realized that both of us would be second lieutenants a few months later, some of the mystique of officer status faded.

In December of 1942, however, our commissions still seemed far away. After preflight, Class 43-F fanned out to primary flight schools throughout the southwest. With 185 others, I went to Victory Field at Vernon, Tex. There was a permanent party of fifteen officers, but the civilian contractor, Hunter Flying Service, provided ground and flight instructors. The school had neat single-story dorms and a cafeteria-style mess. In contrast with preflight, it had the atmosphere of a small college campus.

Meet Mr. Belton

On the flight line, however, the mood was anything but collegiate. In groups of five, we met our flight instructors. Some were said to be kindly father figures, but most had the temperament of mule skinners and vocabularies to match.

Our Mr. Belton walked us around our trainer with the traditional words, "Gentlemen, this is an airplane," then added, "Hang around it long enough and it will kill you."

I could believe him. A low-winged, two-place monoplane, the Fairchild PT-19A had a 175-horsepower in-line engine and the look of a small fighter. The student rode in the front seat. Behind him, the instructor had dual controls and a one-way speaking tube. The cadet couldn't talk back, but a mirror over the forward cockpit kept his face visible to the instructor.

On my first ride, I was sloppy at the controls. Mr. Belton swore. I made a face, and he racked my knees with the joystick and took over. He threw us into a spin, pulled out within what seemed like inches of the ground, and said: "You've got it. Take us home."

Fortunately, the airplane was well-trimmed and already headed for the field; otherwise I could not have found it. I had blacked out during the maneuver and lost all sense of direction.

My lessons continued in the same pattern, my best efforts provoking a litany of profanity from Mr. Belton. Then, with no warning, he had me land at an auxiliary field and climbed out. "Take it around once," he said, "and see if you can land it in one piece."

I took off well enough, and halfway around the traffic pattern I began to think I could fly. Wrong. As I lined up for landing, I knew I was too far from the field. I pulled back on the stick but didn't think to add power, and the plane fell even faster. It lurched as the wheels hit a fence and tore off. It slid onto the field on its belly and came to rest. Mr. Belton rushed up. When he found me unhurt, he made an entry in the plane's logbook: "Five minutes solo, one landing."

"Do you call that a landing?" I asked.

"You walked away from it," he said. "You'll do better tomorrow."

He was right. After a cursory physical and a lecture from one of the officers, I made my second solo

without incident. Thereafter, I sometimes came in too high or too fast, but I never again landed short.

Though my landings improved, my aerobatic work was a thorn in Mr. Belton's flesh. My loops were flat, my spins were ragged, and my Immelmanns were a mockery of the pilot for which they were named. I learned eventually to tune out the carping tone and listen only to the instructions. I still blacked out in some maneuvers. I managed to control the problem by easing off on the stick. It did not occur to me that I might not be able to do so in a hotter plane.

A Personal War

Indeed, I never thought about flying anything beyond the PT-19. My only goal now was to finish primary. Pearl Harbor and the Nazi menace were abstractions. Mr. Belton had become the enemy. And I beat him. In ten weeks, I had survived one crash, logged ninety-two flying hours, and passed my final check ride.

Of our original 186 cadets, 133 of us graduated. Mr. Belton treated his surviving students to a steak dinner. Our personal war being over, he invited us to call him Ed. As we left, he shook my hand and said, "You're a good pilot. You'll do fine."

This time, he was wrong. For basic flight instruction, we moved back to an Army base at Enid, Okla. Our trainer was the low-winged BT-15 with a 450-horsepower radial engine. It had an enclosed cockpit, a two-way radio, and a tendency to shake under power, a quirk that earned it the nickname "Vultee Vibrator."

Our instructors were all officers. Mine had flown for an airline before he was commissioned as a service pilot. He was soft-spoken and patient. I learned quickly and became the first in my class to solo.

But things soon fell apart. My instructor took leave, and I was passed to a succession of substitutes. Within a week, I was so confused that I couldn't do anything right. I was taken off solo and then given an elimination ride. My air work wasn't bad, but I consistently came in high for my landing and sometimes dropped the plane as much as fifty feet.

I made an appearance before the washout board. If I had been less timid, I might have asked to be washed back a class and given another chance, but I had no fight left. I had accomplished my earlier goal of completing primary, my blackouts were getting harder to control, and I worried about my depth perception. It seemed better to quit before I got into serious trouble.

I was sent back to San Antonio, where I joined hundreds of other washed-out cadets waiting for a crack at another type of school. I chose bomb training because it was shorter and I wanted to get into combat while there was some war left. I already had been through preflight, and so I went directly to the bombardier school at Midland AAF, Tex., with Class 43-13.

Our trainer was the Beech AT-11, a twin-engine transport fitted with a bomb bay and plexiglass nose. We flew with two cadets per plane, one bombing while the other photographed his strikes. Between flights, we practiced on ground simulators and took classes in bombing theory and basic navigation.

We were scored by "circular error," the average distance our bomb strikes measured from the target. My early scores were terrible. Though I improved steadily, my CE remained poor. A few days before graduation, I was called before Lt. Col. John D. Ryan, then our director of training, who later became Air Force Chief of Staff.

To War at Last

This time, I was not too shy to speak up. When Colonel Ryan questioned my poor average, I cited my steady improvement. He said he would consider the point, and I left not knowing whether I would be graduated or washed out again. I found out on graduation day, when I was called up to receive my wings.

I was still nineteen when I was assigned to a B-24 crew and sent to combat training with the 464th Bomb Group at Pocatello, Idaho. In early 1944, we joined the 15th Air Force in Italy. We were required to fly fifty missions, but some tougher targets were given double credit, so we completed our tour with thirty-seven missions after barely seven months overseas.

Back in the US, I asked to return to pilot training, but they weren't taking washouts. I served briefly as a bombardier instructor at Albuquerque, N. M., then entered navigator training at Hondo, Tex. As a student officer, I was exempt from the Mickey Mouse routines of cadet life. It was just as well. The course itself was demanding enough. My dead reckoning was OK, but my celestial navigation was less than spectacular.

We were slated to become bombardier-navigators on the new B-29 Superforts then flying in the Pacific, but we never made it. Two weeks before graduation, the AAF dropped two atomic bombs and ended the war. By then, we had finished ground school and had two more training missions to fly. We were told we could complete the course only if we agreed to serve another six years after graduation. The alternative was to hang around until we were eligible for release. After spending a fortune on the war, it seemed the Army suddenly had become too cheap to lay on the few additional missions to give us dual ratings and put us in the Reserve. Most of us chose to get out, and we were still waiting for release when our class graduated without us.

Five years later, the Korean War broke out, and the newly formed Air Force again was short of aircrews. I volunteered for recall and applied to start navigation training again. At twenty-seven, I was considered too old. But I was informed that, even without further training, I now qualified as a bombardier-navigator on B-26s. Fortunately for me and probably for the Air Force, my term of service ended before I was sent back to combat.

Like the war itself, my cadet experience is something I wouldn't have missed but wouldn't want to repeat. I did take another crack at pilot training, however. In my early fifties, I bought flying lessons and earned my private license, only to confirm what the Army had discovered thirty years earlier. I was a lousy pilot. ■

Bruce D. Callander joined Air Force Times *in 1952, becoming Editor in 1972. His most recent article for* Air Force *Magazine, "The Way It Was," appeared in the September 1990 issue.*

Reviews

By Jeffrey P. Rhodes, Aeronautics Editor

Airmail: How It All Began, by Carroll V. Glines. Today's airlines owe a great debt of gratitude to the pilots who flew for the Post Office between May 15, 1918, and August 31, 1927. Those intrepid flyers proved that a regular schedule could be flown regardless of the weather, time of day, or terrain. Much of the equipment used now —radios, navigation aids, instruments, and landing lights—was first pioneered to make sure mail carriers could complete their "appointed rounds." While concentrating on how the airmail service began, how airmail prompted the growth of the airlines, and how the Army Air Corps kept the program alive, this reprint also covers early airmail methods (pigeons and balloons) and later attempts at mail delivery via rockets and missiles. Tab Books, Blue Ridge Summit, Pa., 1990. 166 pages with photos and index. $14.95.

The Banana Wars: A History of United States Military Intervention in Latin America from the Spanish-American War to the Invasion of Panama, by Ivan Musicant. Of the many factors that led to US intervention in Central America, the principal one was "the need to create a Caribbean bulwark shielding the Atlantic approaches to America's hemispheric jugular vein, the isthmus and canal of Panama," claims the author. The text looks at US actions in Cuba, Haiti, Nicaragua, Panama, and the Dominican Republic early in this century, as well as the Grenada and Panama invasions in the 1980s. In addition to describing the interventions, the book also depicts the personalities involved and the evolution of weapons. Macmillan Publishing, New York, N. Y., 1990. 470 pages with photos, map, notes, bibliography, and index. $24.95.

Dangerous Capabilities: Paul Nitze and the Cold War, by David Callahan. Paul Nitze started working in official Washington in 1940; after serving in six administrations, he left government work in 1989. In between, he was one of the most influential figures of the cold war even though he never served as Secretary of State or Defense and was not known to most Americans. Early in his career, Mr. Nitze was a strong advocate of military buildup; in 1950, he wrote NSC 68, the classified planning document that set the course of US policy for nearly forty years. Later, he viewed negotiation as supreme and served as arms-control "czar" during the Reagan presidency. This is a quite readable account of a remarkable career. Edward Burlingame Books/HarperCollins Publishers, New York, N. Y., 1990. 572 pages with photos, maps, sources, notes, and index. $24.95.

Operation Drumbeat: The Dramatic True Story of Germany's First U-Boat Attacks Along the American Coast During World War II, by Michael Gannon. Two weeks after Germany declared war on the US, five U-boats set sail for the American east coast. In the first twenty-six days of Operation Drumbeat, the crews sank twenty-five merchant ships. The author states that the US Navy knew where the German subs were but did nothing about them, despite having destroyers on hand. On January 24, 1942, the crew of U-123 (the main focus of this book) brought the sub to periscope depth in New York harbor and saw Coney Island. The text discusses the crew's exploits, their lives on board, and the U-boat itself. Harper & Row, New York, N. Y., 1990. 490 pages with photos, appendices, notes, glossary, bibliography, and index. $24.95.

Ridgway Duels For Korea, by Roy E. Appleman. December 1950 was a bleak time for UN forces in Korea. The UN advance had stalled completely in the frozen hills, and the final blow came when Eighth Army Commander Lt. Gen. Walton Walker was killed in a jeep accident. Gen. Matthew B. Ridgway assumed command, restored a sense of determination in the troops, and ended the war of maneuver, prompting the North Koreans to initiate truce talks. This book focuses on the combat history of those six months, mentioning political and diplomatic events only where necessary. Drawn from a wide variety of source materials (including interviews), this is a richly detailed account of the fighting. Texas A&M University Press, College Station, Tex., 1990. 667 pages with photos, charts, maps, appendix, abbreviations list, bibliography, and index. $39.50.

Sky Ships: A History of the Airship in the United States Navy, by William F. Althoff. From 1918 to 1961, the Navy operated three types of vessels—ships, aircraft, and airships. This book is the complete story of the lighter-than-air program—the post-World War I balloons; the four mammoth rigid airships that captured the nation's fancy, but had only fragile political and military support; and the blimps of World War II and after—some of the most interesting chapters in aviation. Filled with many unusual, heretofore unpublished pictures, the text is also a record of the people, places, and historical events surrounding the airships. A work like this has been needed for some time. Orion Books, New York, N. Y., 1990. 304 pages with photos, maps, charts, appendices, notes, bibliography, and index. $35.00.

Other Titles of Note

Bombs Away: The Story of a Bomber Team, by John Steinbeck. This work, now a classic, was commissioned as a piece of Army propaganda in 1942 to dispel the myth that being a pilot was the only worthwhile job on a bomber crew. After spending time at training fields across America, Steinbeck created an "everyman" crew to show how individuals came together to form a fighting team. Paragon House, New York, N. Y., 1990. 185 pages with photos. $9.95.

Fighters: The World's Great Aces and Their Planes, by Edwards Park. The text in this large-format book discusses fighter pilots as specific individuals (from Rickenbacker and Guynemer to Johnson and Hartmann to Jabara and Olds) but also as a breed. This book is dominated by stunning color photographs of fighters from all eras, including World War I. Thomasson-Grant, Charlottesville, Va., 1990. 228 pages with photos. $39.95.

The Illustrated Encyclopedia of General Aviation, Second Edition, by Paul Garrison. From AAA (Antique Aircraft Association) to Z (Zulu time), this book offers alphabetized explanations of commonly used terms, phrases, and abbreviations and a wealth of other information such as specification data and facts on other areas of flying. Tab Books, Blue Ridge Summit, Pa., 1990. 468 pages with photos and charts. $24.95.

Strategic Air Command: People, Aircraft, and Missiles, Second Edition, edited by Norman Polmar and Timothy Laur. A complete encyclopedia of SAC, the first section offers a year-by-year summary of the command's organization and history. The second section is a technical description of SAC's aircraft and missiles. The Nautical & Aviation Publishing Co. of America, Baltimore, Md., 1990. 326 pages with photos and glossary. $26.95.

IN VIDEO—"*Black Jack*'s Last Mission." In 1943, *Black Jack,* a Boeing B-17F, ditched in a New Guinea lagoon. In 1986, the aircraft was located nearly intact by a team of divers. Combining spectacular underwater footage with rare archival scenes, the story of the last mission and the discovery of the aircraft are interwoven to produce a fascinating documentary. 1990, black and white/color. Distributed by ARP Videos, North Hollywood, Calif. $39.95.

Valor

By John L. Frisbee, Contributing Editor

A Distinguished First

A1C Joel Talley was called on to put his pararescue training to the test on his first and most difficult combat mission.

A DISPROPORTIONATELY large number of extraordinarily heroic acts during the war in southeast Asia were performed by crews of the Aerospace Rescue and Recovery Service, now the Air Rescue Service. The most decorated members of those crews were the pararescue jumpers (PJs), the link between a hovering helicopter and a survivor in the jungle or at sea *[see "Valor: USAF's Most Decorated PJ," March 1989 issue, p. 119].*

Of the 2,039 combat saves credited to the 3d ARR Group in southeast Asia between 1966 and 1970, more than a fourth (572) were in 1968. That was the year of Khe Sanh, the Tet offensive, another enemy offensive in May, and the continued infiltration of 22,000 North Vietnamese Army (NVA) troops per month during most of that year. To that combat environment A1C Joel Talley, fresh out of PJ training, was introduced when he joined the 37th ARR Squadron at Da Nang in the summer of 1968. Airman Talley didn't wait long to put his PJ training to use.

On the afternoon of July 1, 1968, Lt. Col. Jack Modica's F-105 was heavily damaged by ground fire over North Vietnam. Modica bailed out northwest of Dong Hoi, some fifty miles north of the DMZ, in a heavily forested area occupied by NVA regulars.

An F-100 Misty FAC fixed Modica's general position and made radio contact with the downed pilot, who was seriously injured. Four A-1 Spads were called in to pinpoint the survivor's location. An HH-3 Jolly Green Giant helicopter was cleared for a rescue attempt but was driven off by ground fire. Two backup Jolly Greens then approached the site but were forced to withdraw. At nightfall, the search-and-rescue (SAR) force was recalled. It now was imperative that Modica be reached as early as possible the next day.

The following morning, July 2, an SAR force returned to the rescue site. During the night, NVA troops had moved in more antiaircraft guns. On the first attempt, one HH-3 suffered extensive battle damage and was

forced to leave. A supporting fighter was hit and crashed with the canopy in place. The mission was suspended temporarily until more support was available.

Several hours later, another SAR force was formed. Joel Talley was the PJ on Jolly Green 21, the low helicopter that would be first into the rescue area. The crew of Jolly Green 21 knew this would be a rough one, into the jaws of a well-established flak trap. Talley later recalled that before this first combat mission he had worried about measuring up to the standards set by such celebrated PJs as Bill Pitsenbarger and Duane Hackney. Now that the time had come, he was too busy to think about it.

Jolly Green 21 penetrated to Colonel Modica's position, saw his smoke, and made radio contact. Modica was unable to help himself. The HH-3 commander spotted a small opening in the jungle near Modica's smoke, and Talley was lowered on the forest penetrator. Once on the ground, blinded by the dense undergrowth and deafened by the HH-3's downwash and by friendly and enemy fire, Talley could not determine where to search for the injured pilot. Looking up, he saw the flight engineer point in the direction of Modica's smoke. Although Talley was only a few yards from the survivor, it took more than fifteen minutes to find the man, whose pelvis was broken, and determine that he must be moved as little as possible but quickly, before enemy soldiers zeroed in on the smoke.

Talley directed the pilot closer, secured Colonel Modica and himself to the penetrator, and radioed the crew to haul them up. As they reached the tops of the trees, intense enemy gunfire erupted, scoring more than forty hits on the rescue bird. Before the two were aboard, the HH-3 broke away, "taking the tops of the trees with us," but the injured man was safe. Talley had done his job with professional competence. That save was the start of a lasting friendship between Jack Modica and Joel Talley.

Talley participated in many more rescues before the end of his tour in southeast Asia, but none more dicey than his first, for which he was awarded the Air Force Cross, the fifth PJ to earn that distinction. In the years since Vietnam, Joel Talley has lived up to his early promise. Today he is a chief master sergeant and senior enlisted advisor in the Azores, still aiding others who need a helping hand. ■

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Viewpoint

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

Last Visit With LeMay

The old Iron Eagle, who drew fire for frank expression of his views, was a single-minded apostle of strategic airpower.

There is something in the human condition that appears to make war an inevitable recurrence. As we have learned to our regret, it is outright folly not to be prepared to win a war, once engaged. A winning strategy should spare lives—at least those on the side of the victor. That, essentially, is the underlying philosophy of strategic airpower advocates.

Curtis LeMay, the old Iron Eagle himself, was a surviving legend of the greatest air war. He was also widely misunderstood. LeMay, not a man given to circumlocution, drew fire because of a few honest views delivered without care for sensitive feelings. His advice to go after the manure pile rather than swatting the flies was, however inelegant, a synthesis of what strategic airpower is all about.

I spent several hours talking with LeMay in September, less than a month before his death October 1. He remained a single-minded apostle of strategic airpower, a credo that he believed since the days at Chelveston in the English Midlands when he commanded the 305th Bomb Group. No one then, from the London brass on down, knew very much about the use of bombers, but Colonel LeMay's ideas carried considerable weight. It was those ideas, and his convincing application of them, that landed him in the Pacific theater in the summer of 1944, by then a major general.

The most conservative estimate of American casualties in a November 1945 invasion of Japan was one million men. That Japan surrendered, despite its huge army poised to defend the home islands to the last man, is generally attributed to the atomic bombs dropped on Hiroshima and Nagasaki and the consequent Japanese feelings of hopelessness. LeMay believed that the atomic bombs were simply the *coup de grâce* and that the war had already been won by the massive B-29 firebomb attacks that had leveled cities and the industries in them. Gen. Hap Arnold, in fact, had sent Curtis LeMay flying back to Washington to inform the Joint Chiefs of Staff of Japan's imminent defeat and the probability that no invasion would be necessary.

If it is true that airpower has never attained victory by itself, it is equally true that no war can be won without it.

The briefing failed to make a discernible impression on those five-star soldiers and sailors—Arnold was away—who evidently passed it off as airpower hyperbole. It is too bad, and not only for Hiroshima and Nagasaki, that the atomic bomb had to be used before LeMay's thesis could be proven, but D-day was close at hand, and it was time to pull out all the stops. The war ended, of course, with those bombs, thus obscuring the contribution of the massive incendiary attacks, together with the naval blockade and the B-29s' mining of Japan's sea approaches.

The pronouncement that airpower has never won a war has been made so often and by so many pundits that it might as well be carved in stone somewhere. In the precise sense, the statement is correct, just as it is correct to say that landpower, or seapower, alone, has never won a modern war. But if it is true that airpower has never attained victory by itself, it is equally true that no war can be won without it. Vietnam, an aberrant conflict where the air forces were used to give signals, not to destroy the enemy's ability to fight, doesn't count. The B-52 Christmas raids brought the North Vietnamese to the conference table soon enough, but the war, in general, was fought with airpower kept on a very tight leash.

Curtis LeMay had a rigid view of what constitutes strategic airpower; according to that view, we have seldom employed it. The massive bombings of Europe by the RAF and the Eighth Air Force were, in his judgment, mostly in preparation for the land invasion to come, while the bombing of Japan obviated the need for a land invasion. That, he contended, is strategic bombing. It is only fair to remember the bloody amphibious operations that provided the bases and made the bombing possible. Nevertheless, it is an interesting theory, one that may be put to the test in the Persian Gulf.

Whatever happens there, airpower is at something of a crossroads. Our long dependence on the threat of nuclear weapons as an equalizer to superior conventional forces would appear to be at an end. Nukes are still essential, given the arsenals of the USSR and lesser powers, but the conventional forces of our longtime cold war adversary no longer seem as menacing, and nukes don't fit the kinds of scenario now being scripted.

General LeMay was, in his years as Commander in Chief of Strategic Air Command, not just a believer in that organization; he practically founded it. In recent times, he had come to wonder if the Air Force major command organizational concept hasn't run its course. Task forces formed for the purpose at hand seemed to him a better and more flexible way to exploit airpower.

The standoff in the Persian Gulf has demonstrated, if there was ever any doubt, that the United States is the world superpower, the only nation with both the will and the forces to respond to world crises. The constitution of those forces in the decade to come should be a matter of urgent concern to the world at large. ■

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Aerol Co., Inc.
Aerospace Corp.
Aerospatiale, Inc.
Aero Systems Engineering, Inc.
AIL Systems Inc., A Subsidiary of Eaton Corp.
Allied-Signal Aerospace Co.
Amdahl Corp.
American Cyanamid Co.
Analytic Services Inc. (ANSER)
Andersen Consulting, Arthur Andersen & Co., S. C.
Anheuser-Busch, Inc.
ARINC Research Corp.
Army Times Publishing Co.
Astra Holdings Corp.
Astronautics Corp. of America
AT&T Federal Systems
AT&T Federal Systems, Greensboro
Atlantic Research Corp.
Atlantic Research Corp., Professional Services Group
Atlantis Aerospace Corp.
Ball Aerospace Systems Div.
Battelle Memorial Institute
BDM International, Inc.
Bechtel National, Inc.
Beech Aircraft Corp.
Bell Aerospace Textron
Bell Helicopter Textron
Beretta U.S.A. Corp.
Boeing Aerospace & Electronics
Boeing Co., The
Boeing Helicopters
Boeing Military Airplanes
Boeing—Wichita Division
British Aerospace, Inc.
Brunswick Corp., Defense Div.
Burdeshaw Associates, Ltd.
CAE Electronics Ltd.
CAE-Link Corp.
Calspan Corp., Advanced Technology Center
Canadair
Canadian Marconi Co.
CASA Aircraft USA, Inc.
Cessna Aircraft Co.
Charles Stark Draper Laboratory, Inc., The
Chrysler Technologies Airborne Systems
Cincinnati Electronics Corp.
Cincinnati Milacron Marketing Co.
Cleveland Pneumatic Co.
Colt Industries, Inc.
Commodore Business Machines, Inc., Federal Systems Group
Computer Sciences Corp.
Contel Federal Systems
Contraves USA
Control Data Corp.
Corning Inc.
Cubic Corp.
Cypress International, Inc.
Datatape Inc.
Digital Equipment Corp.
Dornier Aviation (North America), Inc.
Douglas Aircraft Co., McDonnell Douglas Corp.
Dowty Aerospace North American Marketing
DynCorp
Eagle Engineering, Inc.
Eastman Kodak Co., FSD
ECC International Corp.
EDO Corp., Government Systems Div.
E. I. du Pont de Nemours & Co.
Electronic Data Systems Corp.
Electronic Warfare Associates, Inc.
Emerson Electric Co.
E-Systems, Inc.
Evans & Sutherland
Fairchild Space & Defense Corp.
FCD Corp., Mark IV Industries, Inc.
Ferranti Defense & Space
Ferranti International
Figgie International Inc.
FlightSafety Services Corp.
Fokker Aircraft U.S.A., Inc.
Ford Aerospace Corp.
Garber International Associates, Inc.
GE Aerospace
GE Aircraft Engines
GEC Avionics, Inc.
General Atomics
General Dynamics Corp.
General Dynamics, Electronics Div.
General Dynamics, Fort Worth Div.
Gentry & Associates, Inc.
Geodynamics Corp.
GMC, Allison Gas Turbine Div.
GMC, Delco Systems Operations
Government Employees Insurance Co. (GEICO)
Grumman Corp.
Grumman Data Systems Corp.
GTE Government Systems Corp.
GTE Government Systems Corp., C^3 Sector
GTE Government Systems Corp., Electronic Defense Sector
GTE Government Systems Corp., Strategic Systems Div.
Gulfstream Aerospace Corp.
Harris Electronic Systems Sector
Harris Government Communication Systems Div.
Harris Government Support Systems Div.
Hawker Pacific Inc.
H. B. Maynard & Co.
Hercules Missiles, Ordnance and Space Group
Honeycomb Co. of America, Inc.
Honeywell Inc.
Howell Instruments, Inc.
HR Textron, Inc.
Hughes Aircraft Co.
Hughes Danbury Optical Systems, Inc.
IBM Corp., National Federal Marketing Div.
IBM Corp., Systems Integration Div.
IMO Industries Inc.
Ingersoll-Rand Co.
Israel Aircraft Industries Int'l, Inc.
Italian Aerospace Industries (U.S.A.), Inc. (Aeritalia)
Itek Optical Systems, A Division of Litton Industries
ITT Defense
ITT Defense Communications Div.
Jane's Information Group
John Deere Technologies Int'l, Inc.
Kaiser Electronics
Kaman Aerospace Corp.
Kollmorgen Corp., Electro-Optical Div.
Kollsman
Lear Astronics Corp.
Learjet Corp.
Litton Aero Products
Litton-Amecom
Litton Applied Technology
Litton Data Systems
Litton Guidance & Control Systems
Litton Industries
Lockheed Aeronautical Systems Co.—Burbank
Lockheed Aeronautical Systems Co.—Georgia
Lockheed Aircraft Services Co.
Lockheed Corp.
Lockheed Engineering & Sciences Co.
Lockheed Missiles & Space Systems Group
Lockheed Space Operations Co.
Logicon, Inc.
Loral Corp.
LTV Aircraft Products Group
LTV Missiles and Electronics Group, Sierra Research Div.
Lucas Aerospace Inc.
Magnavox Government & Industrial Electronics Co.
Martin Marietta Astronautics Group
Martin Marietta Corp.
Martin Marietta Electronics & Missiles Group
Martin Marietta Energy Systems, Inc.
Martin Marietta Information Systems Group
Matra Aerospace Inc.
MBB
McDonnell Aircraft Co.
McDonnell Douglas Corp.
McDonnell Douglas Electronic Systems Co.–ISS
McDonnell Douglas Missile Systems Co.
McDonnell Douglas Space Systems Co.
McGuire, Woods, Battle & Boothe
Megatek Corp.
MITRE Corp., The
Motorola, Inc., Government Electronics Group
NavCom Defense Electronics, Inc.
Northrop Corp.
Northrop Corp., Aircraft Div.
Northrop Corp., B-2 Div.
Northrop Corp., Electronics Systems Div.
OEA, Inc.
Olin Ordnance
Orbital Sciences Corp.
Oshkosh Truck Corp.
Pan Am World Services, Inc., Aerospace Div.
Parker Hannifin Corp., Parker Bertea Aerospace
Pilatus Aircraft, Ltd.
Planning Research Corp.
Plessey Electronic Systems Corp.
RAND Corp., The
Raytheon Co.
RBI, Inc.
RECON/OPTICAL, Inc., CAI Div.
Reflectone, Inc.
Republic Electronics Co.
Riverside Research Institute
Rockwell Int'l Aerospace Operations
Rockwell Int'l Collins Government Avionics Div.
Rockwell Int'l Corp.
Rockwell Int'l Electronics Operations
Rohr Industries, Inc.
Rolls-Royce plc
Rosemount Inc.
Sabreliner Corp.
Sanders Associates, Inc.
Scheduled Airlines Traffic Offices, Inc. (SatoTravel)
Schwem Technology
Science Applications Int'l Corp.
Short Brothers USA, Inc.
Smiths Industries, Aerospace & Defence Systems Co.
Snap-On Tools Corp.
SNECMA, Inc.
SofTech, Inc.
Software AG Federal Systems, Inc.
Southwest Mobile Systems Corp.
Space Applications Corp.
Standard Manufacturing Co., Inc.
Stewart & Stevenson Services, Inc.
Sundstrand Corp.
Sun Microsystems Federal, Inc.
Sverdrup Corp.
Systems Control Technology, Inc.
Systems Research Laboratories/ Defense Electronic Systems
Systron Donner, Safety Systems Div.
Talley Defense Systems
Technology Applications, Inc.
Teledyne, Inc.
Teledyne Power Systems Group
Teledyne Ryan Aeronautical
Telephonics Corp.
Texas Instruments, Defense Systems & Electronics Group
Textron
Textron Aerostructures
Textron Defense Systems
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TRW Federal Systems Group
TRW Inc., Avionics and Surveillance Group
TRW Inc., Electronic Systems Group
TRW Space & Defense Sector
TRW Space & Technology Group
UNC Incorporated
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UTL Corp.
Vega Precision Laboratories
Vitro Corp.
Walter Kidde Aerospace Inc.
Watkins-Johnson Co.
Westinghouse Electric Corp.
Williams International
ZF Industries, Inc.

Bulletin Board

Seeking contact with all **Phantom II** "Phanatic Phlyers/Pherrets/Phixers." I would like to know your association with the Phantom, including number of years, squadrons, bases, missions over North Vietnam, and number of flight hours. **Contact:** Dick Kiertzner, 4075 Les Cherbourg Ln., Florissant, MO 63034.

Seeking the whereabouts of USAAF and RAF members who were at **Kindley Field, Bermuda,** from 1943 to 1944. **Contact:** Bill Spaine, 1221 Dimmocks Mill Rd., Hillsborough, NC 27278.

Collector seeks **current military pilot and aircrew member wings,** especially from Central and South America, Africa, the Middle East, and the Far East. Will trade Soviet and East German wings. **Contact:** Albert F. Lohr, Im Wingert 8, 6660 Zweibrücken, Germany.

Seeking the whereabouts of **Robert Orlosky,** who was an air or ground crew chief with the B-17G *Milk Wagon,* 708th Bomb Squadron, 447th Bomb Group, 8th Air Force, based at Rattlesden, Suffolk, England. **Contact:** P. Carr, 19 Lucas Pl., Woughton-on-the-Green, Milton Keynes MK6 3BZ, England.

Seeking information on the whereabouts of Amn. **Dan Rich,** a Florida native who was stationed at RAF Lakenheath, England, in 1964. **Contact:** Simon Andrew Dennis, 40 Deansburn House, Aikman Ave., New Parks, Leicester LE3 9JR, England.

Seeking the whereabouts of **TSgt. Tillman "Red" Paulk,** USAF, who was stationed on Okinawa around 1965 and may have transferred to McGuire AFB, N. J., in 1967. His wife, Fran, was originally from the Manchester, N. H. area. **Contact:** MSgt. Robert C. Lenz, USAF (Ret.), 32 June St., Nashua, NH 03060-5345.

Seeking members who served with the **6th Aircraft Repair Unit, Floating,** in the Pacific theater during World War II. **Contact:** William Blockley, 301 Yuma Ct., Boulder City, NV 89005.

Beginning collector seeks **patches. Contact:** Gary Goldblatt, 7135 Harshmanville Rd., Huber Heights, OH 45424.

Seeking information on and addresses of members of Air Force **Class 57-A. Contact:** William T. Steely, P. O. Box 8568, Horseshoe Bay, TX 78654.

Seeking a copy of the **Amarillo Technical Training Center patch,** with the logo, "Victory Through Knowledge." I would like to have duplicates made for those who served at Amarillo AFB. Also seeking back issues of ***Interceptor* Air Safety Magazine** from 1958 through 1979. **Contact:** Elmer W. Ross, P. O. Box 807, Everett, WA 98206.

Seeking the whereabouts of **Glen Grainger,** who was an instructor at Lodwick School of Aeronautics in Lakeland, Fla., from 1940 to 1945. Also seeking **E. J. Arlett,** who was an instructor at Lodwick Aviation Military Academy in Avon Park, Fla., from 1941 to 1945. **Contact:** Hal Hubener, Lakeland Public Library, 100 Lake Morton Dr., Lakeland, FL 33801.

Seeking contact with **HH-43** pilots and crews who served at Osan AB, Korea, in 1968–1969 and 1970–1972, Phu Cat, Vietnam, from 1969 to 1970, and Takhli, Thailand, from May to September 1972. **Contacts:** Robert P. Worhach, 348 S. Market St., Mount Carmel, PA 17851. Dan Lange, 3390 N.E. 170th St., Citra, FL 32113.

I have twenty-three original issues of ***Impact*** Magazine, which were issued by the office of the Chief of Staff, Intelligence, between June 1943 and October 1945, and which I am interested in selling. **Contact:** Lt. Col. William R. Gadow, USAF (Ret.), 1101 Chelsea Rd., Absecon, NJ 08201-1424.

Seeking information as to where I could purchase World War II **flak suits** used by B-17 crews over Europe. **Contact:** Col. Milton A. Hoffman, AFRES (Ret.), 8128 Wanoa Ave., St. Louis, MO 63123.

Seeking contact with people who knew **Capt. John Archer Griffith,** who was a navigator of a B-26 in Italy in 1944–45 and participated in raids on the Ploesti oil fields. I especially want to know in which unit he served. **Contact:** Everette E. Griffith, Jr., 23408 Via Boscana, Valencia, CA 91355.

Bulletin Board

Seeking information on the whereabouts of USAF **SSgt. Ronald Lafaye** or LaFaille, a French-Canadian stationed at RAF Sculthorpe, England, from 1949 to 1951. **Contact:** J. A. Spindley, 13 Byfield Rd., Manor Park Estates, Scunthorpe, South Humberside, England.

For a book, seeking information and reminiscences from US servicemen who were stationed at **Mount Farm** or **Chalgrove,** Oxfordshire, England, between 1942 and 1945. **Contact:** John Godfrey, 48 Brookside, Chalgrove, Oxford OX9 7SQ, England.

Collector seeks USAF **F-4 patches, scarves,** and **photos** from 1964 to 1988. **Contact:** Jan-Peter van Viegen, Burgwal 9, 3931 HL Woudenberg, Holland.

The **7th Flying Training Squadron,** recently reactivated, is seeking photos and information on former commanders from World War II and the Vietnam War. **Contact:** 2d Lt. James Fournier, USAF, 7FTS/CCA, Vance AFB, OK 73705.

Seeking information on the whereabouts of **Winston Trottor,** who was stationed at Sudbury, England, during World War II. **Contact:** Terence Smith, 20 Quantock Dr., Church Farm, Nuneaton, Warwickshire CV10 8PU, England.

Seeking information on the whereabouts of **Col. Louis Braun,** USAF who was at Spangdahlem AB, West Germany, from 1960 to 1963. Also seeking information on any planned reunions of the 49th Tactical Fighter Wing (7th, 8th, and 9th squadrons), which was also at Spangdahlem during this period. **Contact:** Robert Lattanzi, 48 Gilbert Hill, Chester, CT 06412.

Seeking the whereabouts of **David Edward Crenshaw,** who was in Whangarei, North Auckland, New Zealand, in 1944 and returned to Morganfield, Ky., after the war. **Contact:** Dorothy Jean Whatmough, RD #1, Tangiteroria, Northland, New Zealand.

Seeking the whereabouts of the following people who were at Evreux AB, France, from 1955 to 1957: **MSgt. Richard Mention, SSgt. Frank T. Smith,** and **TSgts. "Laddie" Lyons, Neil Maxey,** and **Thomas Perkins. Contact:** Frank Mebane, P. O. Box 51, Victorville, CA 92393.

Seeking information on history, photos, and memorabilia of the **8th Airdrome Squadron** from 1942 to 1948. **Contact:** Capt. Raymond M. Saunders, USAF, 800 CSG/DDEE, Whiteman AFB, MO 65305-5000.

Seeking information on the whereabouts of **Zebedee Mosey,** who was stationed near Staffordshire, England, in 1967 and later served in Vietnam. **Contact:** Lee P. Jeffery, 50B Earls Ave., Folkestone, Kent CT20 2HA, England.

Seeking aircraft squadron **patches,** flight helmets, especially an HGU-55P helmet, and any other fighter pilot equipment. **Contact:** Willie Jefferson, Jr., 4912 Alabama Ave., Gulfport, MS 39501-8209.

Seeking information, photographs, nose art, and documents related to **PB4Y1 Liberators** and **PB4Y2 Privateers** that served in the Pacific theater during World War II and later during the Berlin Airlift. **Contact:** Ronald R. Sathre, 31262 San Andreas Dr., Union City, CA 94587.

Author seeks contact with members of **F/RF-84F units,** especially in SAC, TAC, PACAF, and ANG. Also interested in details on exercises, air races, and markings. **Contact:** Robbie Robinson, 37 Home Farm Rd., Houghton, Huntingdon, Cambridgeshire PE17 2BN, England.

For a book on the events leading up to the bombing of Hiroshima and the occupation of Japan, seeking contact with **Colonel Tibbets, "Dutch" Van Kirk,** and **Tom Ferebee. Contact:** Walt Stanley, 946 E. Tunnell, Santa Maria, CA 93454.

Seeking information on **Robert "Bob" Dewey Thompson,** a food-service worker stationed near Weatherfield, Essex, England, from 1956 to 1959. Also seeking **Willie Farrar,** who was at RAF Sculthorpe, England, during the same period. **Contact:** Charmaine George, 24 Royal Mint Pl., London E1 8LS, England.

Seeking a pair of World War II Air Force **Gunnery Wings. Contact:** Donald L. Bigsby, 201 Horseshoe Acres, Booneville, MS 38829.

If you need information on an individual, unit, or aircraft, or if you want to collect, donate, or trade USAF-related items, write to "Bulletin Board," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Letters should be brief and typewritten. We cannot acknowledge receipt of letters to "Bulletin Board." We reserve the right to condense letters as necessary. Unsigned letters are not acceptable. Photographs cannot be used or returned.—THE EDITORS

Seeking information on two classmates who graduated from US Army Air Corps Bombardier School, Class 42-17, San Angelo, Tex.: **2d Lt. Robert V. Krengle,** from Boston, Mass., and **2d Lt. Robert W. Hosier,** from Brooklyn, N. Y. Both served in England during World War II and were shot down (separately) over France. Lieutenant Krengle made it back to England, but Lieutenant Hosier was captured and served as a POW in Stalag 1 in Barth, Germany. **Contact:** William S. Boone, 3432 Ardendale, Sacramento, CA 95825.

Seeking contact with former members of **Basic Training Squadron BM11, Flight 3119,** which was stationed at Lackland AFB, Tex., from May to September 1948. Also seeking contact with members of the **548th Reconnaissance Technical Squadron,** Yokota AB, Japan, from 1950 to 1953. **Contact:** CMSgt. Frederick Fass, USAF (Ret.), 2719 Northcrest Rd., Denton, TX 76201.

Researcher seeks contact with personnel who have information on **Matador** and **Mace** missile systems. I especially want information on the physical details of the missiles and their associated ground support and transportation equipment. Most helpful would be graphic information such as photographs, drawings, plan views, and USAF illustrations. **Contact:** Michael Roof, 560B Locust St., Fort Devens, MA 01433.

Seeking a pair of World War II **Flight Officer bars. Contact:** Robert V. Vaughn, Box 1122, Christiansted, Saint Croix, VI 00821-1122.

Seeking the whereabouts of **Maj. James C. Rhodes,** of Pittsburgh, Pa., who flew supplies into Burma in 1946 and whose last known address was in Detroit, Mich. **Contact:** F. Sizeland, 1295 Butler St., Reno, NV 89512.

Seeking contact with veterans of the **512th Tactical Fighter Squadron** or its predecessor, the **628th Bombardment Squadron** (Dive). **Contact:** Lt. Col. Ed Whalen, 512 TFS/CC, APO New York 09094.

For a display case of my **insignia,** I am seeking US Army green paper or fabric to background the ROTC section, dress white shoulder boards, and navy blue sleeve braid. **Contact:** J. Wendell Glass, RFD #1, Box 59, York House Rd., Rabun Gap, GA 30568.

Seeking information on **drones** used for air defense training during World War II, especially the MQM-33, MQM-36, OQ-2, and OQ-14. **Contact:** Mariotti Luca, Via San Stefano 24, 56100 Pisa, Italy.

Seeking information on a **B-26 Martin Marauder** that went down in mid-1944 near Beach Head, Sussex, England, not far from an emergency landing strip called Friston. We have recovered a propeller and engine from this craft (propeller serial number 104658F) and would like to contact any surviving crew members. **Contact:** Derek C. Anscomb, 9 Richmond Park Rd., London SW14 8JU, England.

For a historical research project, seeking contact with members of the **577th Bomb Squadron,** 387th Bomb Group. **Contact:** K. M. Peters, 46 Hillyfield Rd., Whipton, Exeter, Devon EX1 3ND, England.

Seeking the whereabouts of **Robert McKeague Davenport,** whose last known address was with the air cadets at Lackland AFB, Tex., in the mid-1950s. **Contact:** Bob Cooper, P. O. Box 7177, Groton, CT 06340.

Seeking the whereabouts of **Capt. Roger A. Poland,** who was with the 1500th Air Police Squadron at Hickam Field, Hawaii, in November 1950. **Contact:** Maj. Marcus A. "Tommie" Pharr, USA (Ret.), 1239 Whisperwood Dr., Columbus, GA 31907-5872.

Collector seeks contact with other collectors to trade Army and Air Force **patches. Contact:** Chaplain Steve Bias, 5120 Cobb Dr., Dayton, OH 45431.

Collector seeks contact with other collectors to trade **stickers. Contact:** Riley V. Gust, 165 Tuxworth Rd., Centerville, OH 45458-2449.

Seeking contact with anyone who knew **SSgt. Don Burghart** or who served with the 3920th or 7508th Supply Squadron at RAF Brize Norton, England, between 1954 and 1955, or with RED HORSE engineering squadrons in Vietnam. **Contact:** S. Ellis, 2 Sunbury Ln., Battersea, London SW11 3NP, England.

Seeking contact with **Ray A. Bailey, Lawrence L. Knight, Earl E. Phillips, Harold J. Wolff,** and others with knowledge of German POWs at Camp Cooke and its branch camps in California from 1944 to 1946. **Contact:** Jeffrey Geiger, WSMC/HO, Vandenberg AFB, CA 93437-6021.

Seeking information on the whereabouts of **John C. Furnace,** pilot, and **Lester E. Jones,** copilot, both of a B-26 Marauder in the 585th Bomb Squadron, 394th Bomb Group. **Contact:** Charles Bray, 15224 Champaign, Allen Park, MI 48101.

Seeking patches and photos from the **99th Bomb Wing,** which operated B-52s and KC-135s from Westover AFB, Mass., between 1956 and 1972. **Contact:** Robert Egloff, 7 Parker Ave., Westfield, MA 01085.

Unit Reunions

Air War College
The Air War College Class of 1958 will hold a reunion February 28–March 2, 1991, in San Diego, Calif. **Contact:** Col. John G. Williams, USAF (Ret.), 73577 Cabazon Peak Dr., Palm Desert, CA 92260. Phone: (619) 568-0303.

B-26 Marauder Historical Society
The B-26 Marauder Historical Society will sponsor a B-26 fiftieth-anniversary gala April 18–21, 1991, in Baltimore, Md. **Contacts:** George W. Parker, P. O. Box 1051, Columbia, MO 65205. Nicholas G. Chacos, 7917 Maryknoll Ave., Bethesda, MD 20817.

Hawthorne Pilot Training Ass'n
Former Instructors and students of Hawthorne School of Aeronautics, which operated between 1941 and 1945 in Orangeburg, S. C., will hold a reunion April 26–28, 1991. **Contacts:** Harley Cunningham, P. O. Box 826, North Myrtle Beach, SC 29597. Phone: (803) 272-6024. Vic A. Lebednik, P. O. Box 804, Orangeburg, SC 29115. Phone: (803) 534-4008.

PACAF Special Air Missions
PACAF Special Air Missions (SAM) crew members who were assigned with the 6486th Air Base Wing and the 15th Composite Wing and served at Hickam AFB, Hawaii, between 1957 and 1976 will hold a reunion February 17–23, 1991, in Hawaii. **Contact:** Col. Henry R. Passi, USAF (Ret.), 632 Hances Point Rd., North East, MD 21901. Phone: (301) 287-8612.

Wright Field Pilots
Former Wright Field test pilots (1930–60) will hold a reunion July 17–19, 1991. **Contact:** Col. Kenneth O. Chilstrom, USAF (Ret.), 20 Selby Ln., Palm Beach Gardens, FL 33418.

4th Ferrying Group
Air Transport Command's 4th Ferrying Group (Memphis/Nashville, Tenn.) will hold a reunion May 16–18, 1991, in Dayton, Ohio. **Contacts:** Wendell Jordan, P. O. Box 161-H Wildwood Rd., Zebulon, GA 30925. Phone: (404) 567-8112. Robert P. Crow, 125 Valleywood Dr., Athens, GA 30606. Phone: (404) 543-5481.

7th Bomb Wing
Members of the 7th Bomb Wing along with other personnel who served at Carswell AFB, Tex., between 1948 and 1958 will hold a reunion April 19–21, 1991, at the Green Oaks Inn in Fort Worth, Tex. **Contact:** Richard S. George, P. O. Box 330279, Fort Worth, TX 76163.

33d Fighter Squadron
Members of the 33d Fighter Squadron who served in Iceland during World War II are planning to hold a fiftieth-anniversary reunion in July 1991. **Contact:** Sigmund Kusnierczyk, 17434 S. Beckman Rd., Redland, OR 97045. Phone: (503) 631-2462.

Class 38-A
Flying Cadet Class 38-A will hold a reunion March 14–16, 1991, at the Menger Hotel in San Antonio, Tex. **Contact:** Col. Marvin S. Zipp, USAF (Ret.), 4917 Ravenswood Dr. #853, San Antonio, TX 78227. Phone: (512) 675-2844.

Class 41-B
Members of Flying Cadet Class 41-B (Maxwell Field, Ala.) will hold a reunion March 14–17,

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Unit Reunions

1991, at the Monticello Hotel in Montgomery, Ala. **Contact:** Odell Sisler, 2833 Ashley Ave., Montgomery, AL 36109. Phone: (205) 272-9106.

Class 43-E
Members of Class 43-E are planning to hold a reunion in May 1991 in Saint Augustine, Fla. **Contact:** Paul Murphy, 7013 Bellrose, N. E., Albuquerque, NM 87110. Phone: (505) 884-5687.

Class 51-A
Class 51-A will hold a reunion February 8–10, 1991, in Austin, Tex. **Contact:** John E. Stavast, P. O. Box 90664, Austin, TX 78709-0664. Phone: (512) 892-1277.

55th Fighter Group
Members of the 55th Fighter Group and the 442d Air Service Group will hold a reunion April 4–7, 1991, at the Holiday Inn South Holidome in Baton Rouge, La. **Contact:** Paul Reeves, 1485 Carolyn Sue Dr., Baton Rouge, LA 70815. Phone: (504) 924-3168.

55th Strategic Reconnaissance Wing
The 55th Strategic Reconnaissance Wing will hold a reunion April 22–25, 1991, in Las Vegas, Nev. **Contact:** Col. Robert A. Dibbell, 8902 Maple Leaf Dr., Tucson, AZ 85710.

67th Fighter Squadron
Officers and enlisted personnel who served in the 67th Fighter Squadron during World War II (1942–45) will hold a fiftieth-anniversary reunion February 4–6, 1991, at the Days Inn in Surfside Beach, S. C. **Contact:** Ed Young, P. O. Box 3806, Florence, SC 29502. Phone: (803) 669-2900.

78th Fighter Wing
Members of the 78th Fighter Wing (Hamilton AFB, Calif.), which included the 82d, 83d, and 84th Fighter Squadrons, will hold a reunion May 30–June 2, 1991, at Hamilton AFB, Calif. **Contact:** Robert N. Douglass, 1200 Lynwood Dr., Novato, CA 94947. Phone: (415) 892-3451.

81st Tactical Fighter Wing
Members of the 81st Tactical Fighter Wing, which included the 78th, 91st, and the 92d Tactical Fighter Squadrons, will hold a reunion October 8–15, 1991, at the Hale Koa Hotel in Waikiki, Hawaii. **Contact:** Armed Services Tour and Travel, Suite 405, Wailana Building, 1860 Ala Moana Blvd., Honolulu, HI 96815. Phone: (808) 946-4802.

401st Fighter-Bomber Group
Members of the 401st Fighter-Bomber Group/ Tactical Fighter Wing (612th, 613th, 614th, and 615th Fighter Squadrons) who served at England AFB, La., from 1953 on will hold a reunion April 25–27, 1991, in Alexandria, La. Please send a legal-size, self-addressed, stamped envelope for information. **Contact:** Anthony J. Gagliano, 300 Holcomb Blvd., Ocean Springs, MS 39564. Phone: (601) 875-5007.

423d Night Fighter Squadron
Members of the 423d Night Fighter Squadron and the 155th Night Photo Reconnaissance Squadron who served in Europe during World War II are planning to hold a reunion May 17–19, 1991, in Oklahoma City, Okla. **Contact:** William Porter, 7709 Ramsey Rd., Oklahoma City, OK 78132. Phone: (800) 654-4215.

426th TFTS
The 426th Tactical Fighter Training Squadron will hold a reunion for all members (who flew in F-100s, F-4s, and F-15s) in December 1990 in Phoenix, Ariz. **Contact:** Lt. Col. John R. Ladd, USAF, 11246 N. 64th Ln., Glendale, AZ 85304. Phone: (602) 486-0825 or (602) 856-7726.

437th OMS
Veterans who served in the 437th Organizational Maintenance Squadron (OMS) between 1967 and 1971 at Charleston AFB, S. C., are planning to hold a reunion in July 1991, in Charleston, S. C. **Contact:** MRS COCO, Rte. 2, Box 240, Mount Olive, NC 28365. Phone: (919) 658-5136 or (919) 658-9239.

6910th Security Wing
Members of the 6910th Security Wing are planning to hold a reunion June 21–23, 1991, in Bellevue, Neb. **Contact:** Charles or Rita Mansfield, 2503 E. Chandler Rd., Bellevue, NE 68005. Phone: (402) 734-5512 (home) or (402) 291-8300 (work).

British Flying Training Schools
I am trying to locate American cadets who attended British Flying Training Schools (BFTS) in the US during World War II for a fiftieth-anniversary reunion in 1991, in Dallas, Tex. **Contact:** Capt. Ben L. Brown, USAF (Ret.), 9757 Cedarburg Dr., Monclova, OH 43542. Phone: (419) 877-5165.

Keesler AFB
Keesler AFB, Miss., will hold a fiftieth-anniversary celebration beginning in January 1991. Former students, instructors, squadrons, or groups who served at Keesler and who are interested in organizing a reunion during this celebration should contact Keesler Public Affairs Office. **Contacts:** Office of Public Affairs, Keesler AFB, MS 39634. Phone: (601) 377-2254. Harrison County Tourism Commission (800) 237-9493.

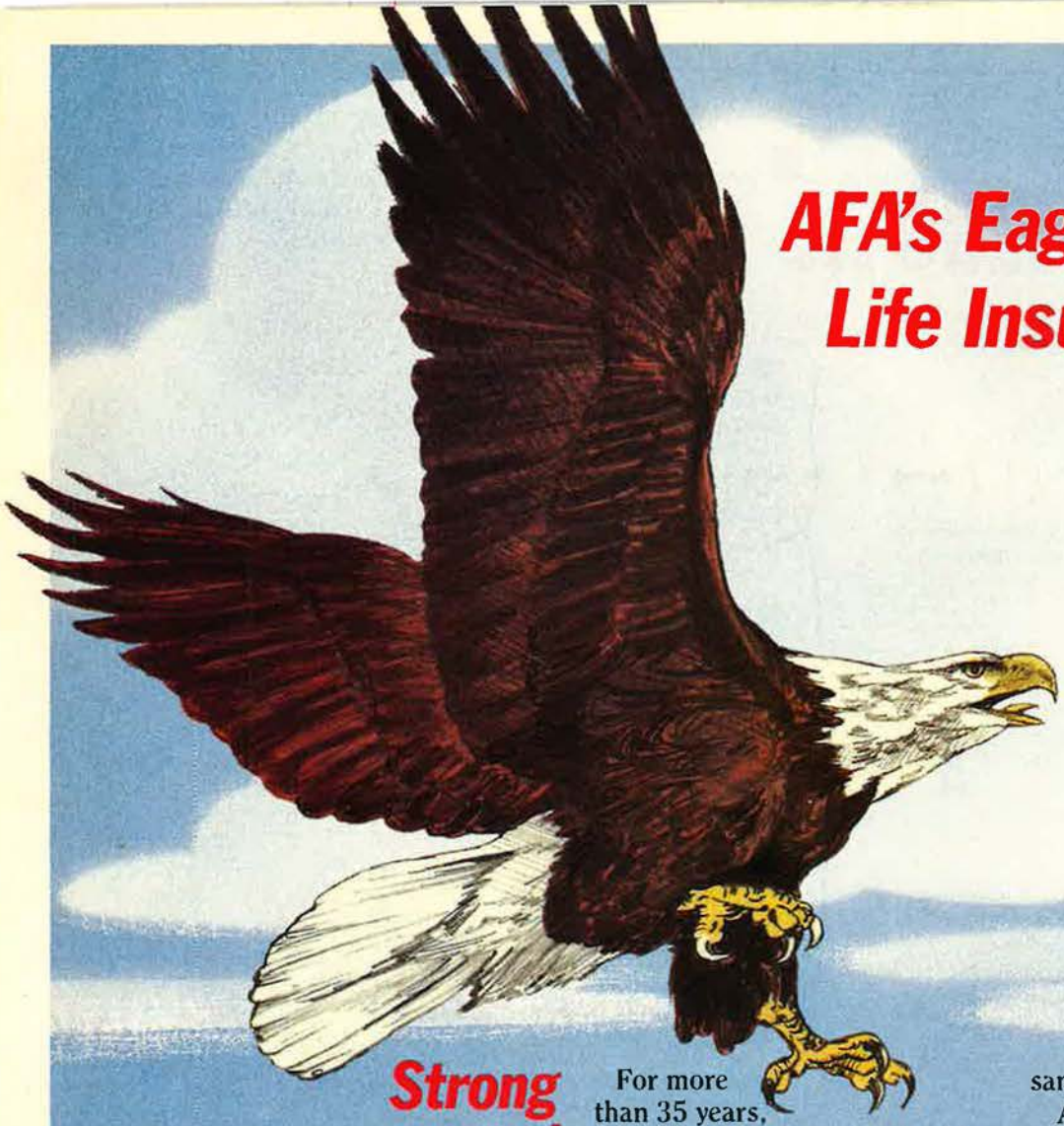
RAF Chicksands
For the purpose of planning a reunion in 1991, I would like to hear from USAF personnel who served at RAF Chicksands, England. **Contact:** William C. Grayson, P. O. Box 4053, Crofton, MD 21114. Phone: (703) 968-3452.

UPT Class 71-07
For the purpose of organizing a reunion, I am trying to obtain current addresses of former Undergraduate Pilot Training Class 71-07 assigned to Laughlin AFB, Tex. **Contact:** Don Johnson, 6201 Jameson, Amarillo, TX 79110. Phone: (800) 344-9389 or (806) 373-6999.

96th Troop Carrier Squadron
For the purpose of organizing a reunion in 1991, I am trying to locate members of the 96th Troop Carrier Squadron, 440th Troop Carrier Group, who served in World War II. **Contact:** Capt. Harold B. Prince, USAF (Ret.) 1169 Oldfield Rd., Decatur, GA 30030.

399th Bomb Group
I would like to hear from anyone who served in the 399th Bomb Group and who would be interested in organizing a reunion. This group served at Gowen Field, Idaho, in early 1943 and went to Wendover Field, Utah, also in 1943. **Contact:** MSgt. Thomas B. Ulam, USAF (Ret.), 716 10th Ave., South, Surfside Beach, SC 29577.

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.



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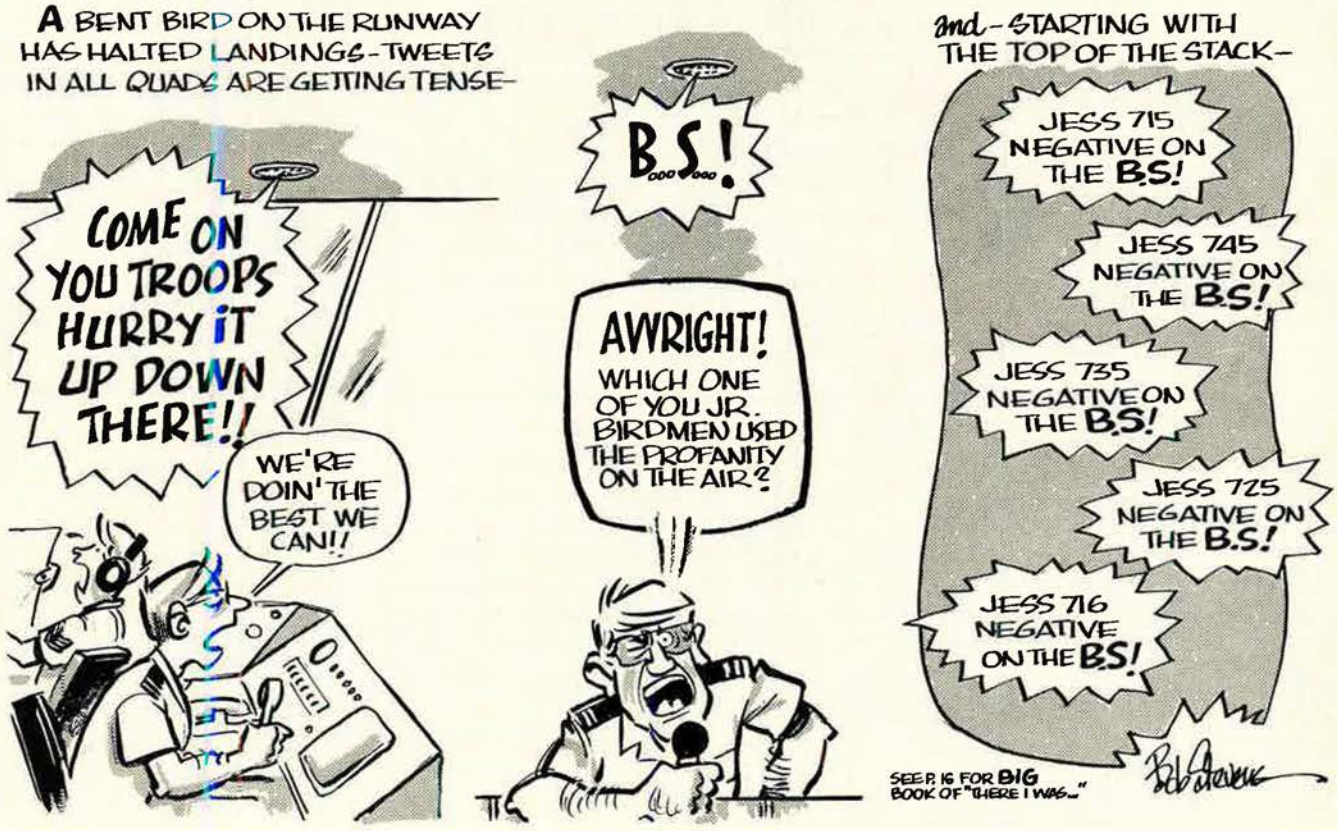
THANKS TO MAJ. WALLY VAN WINKLE, TUCSON, AZ.



SEE P. 16 FOR BIG BOOK OF "THERE I WAS..."

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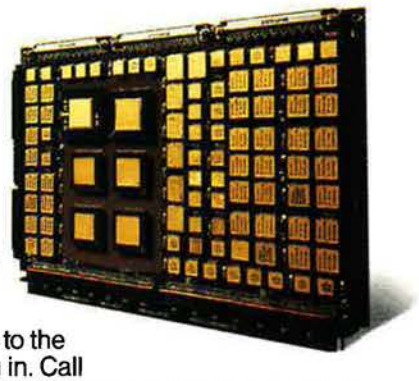

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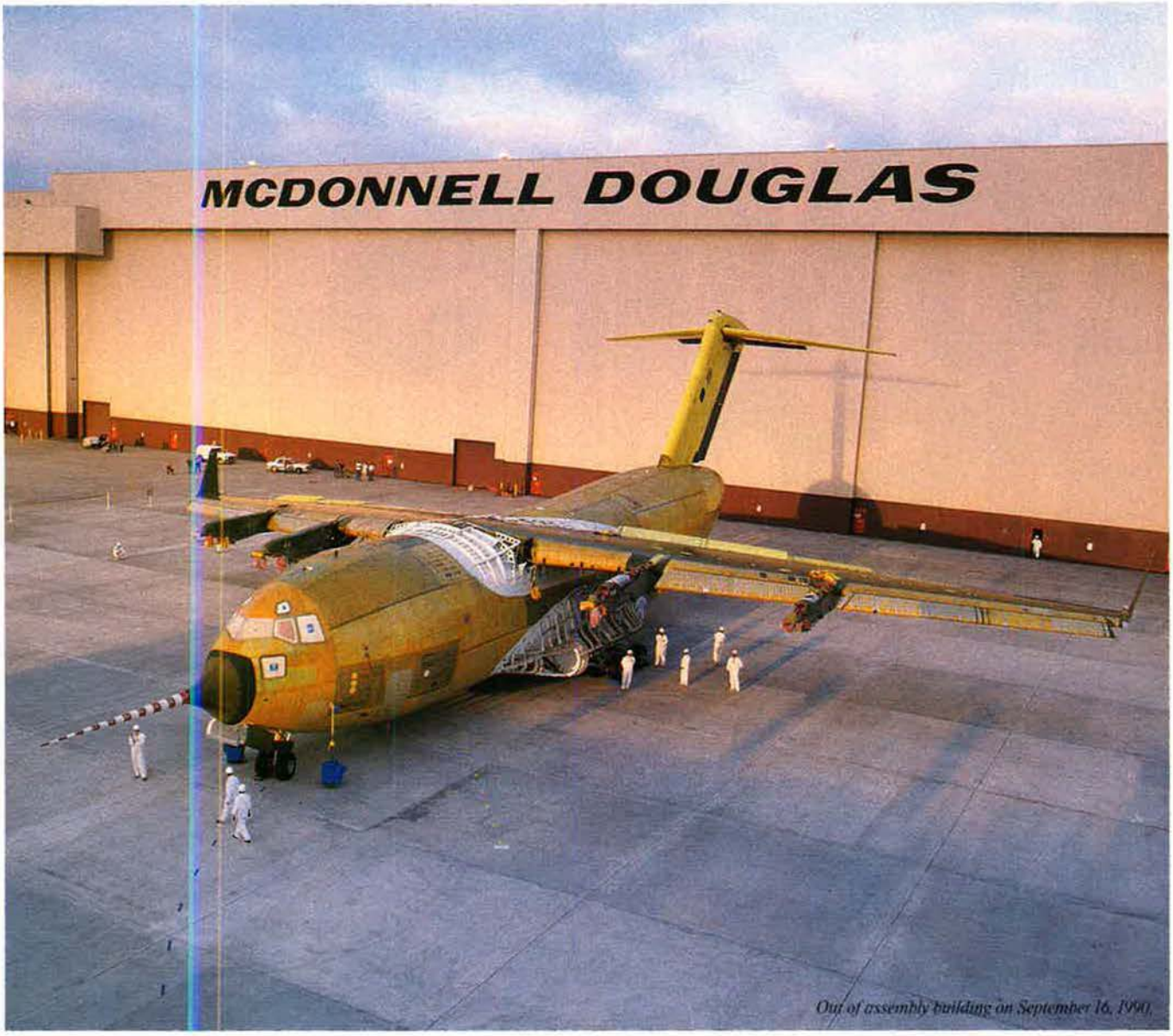

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