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AIR FORCE MAGAZINE

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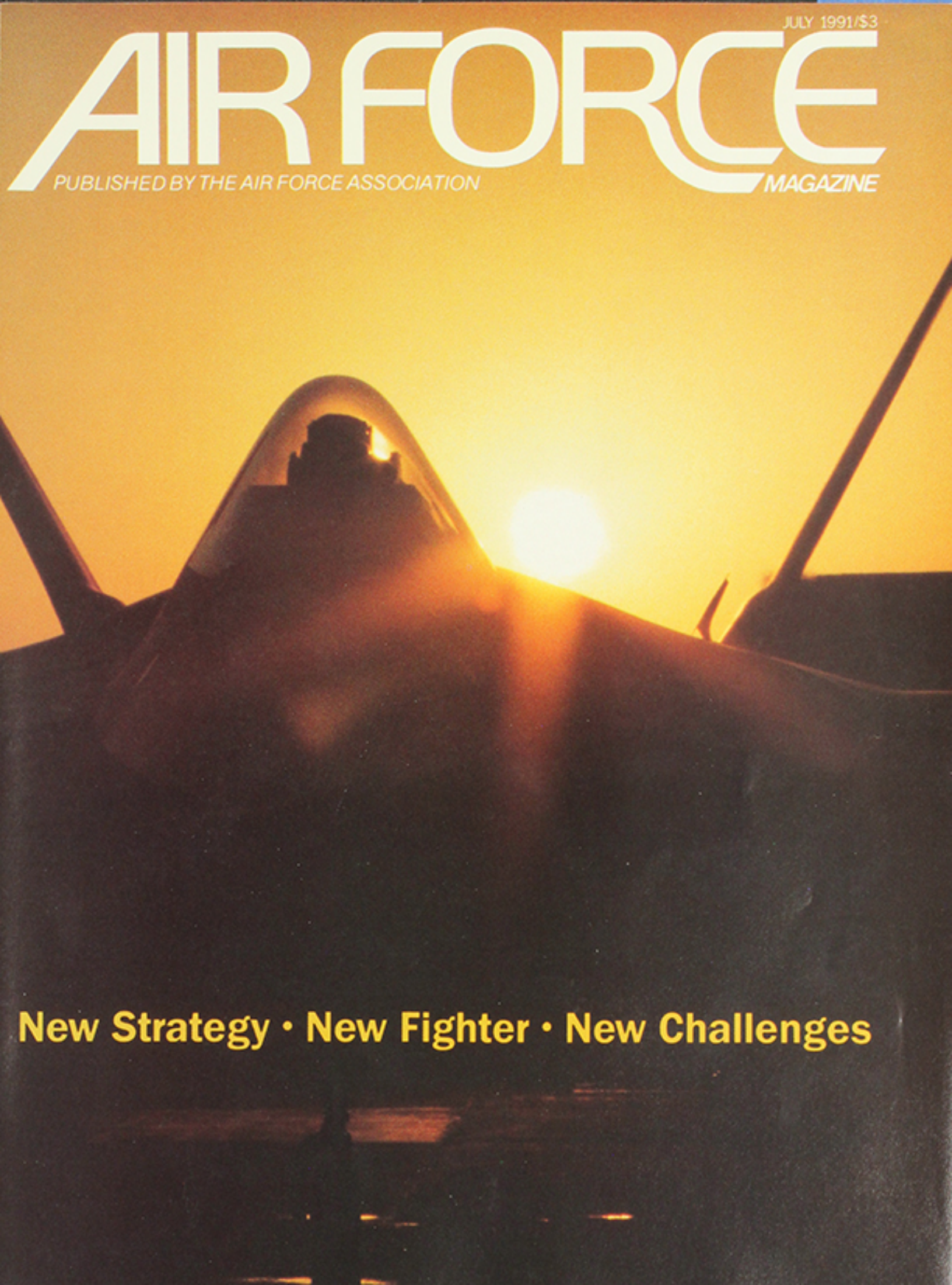

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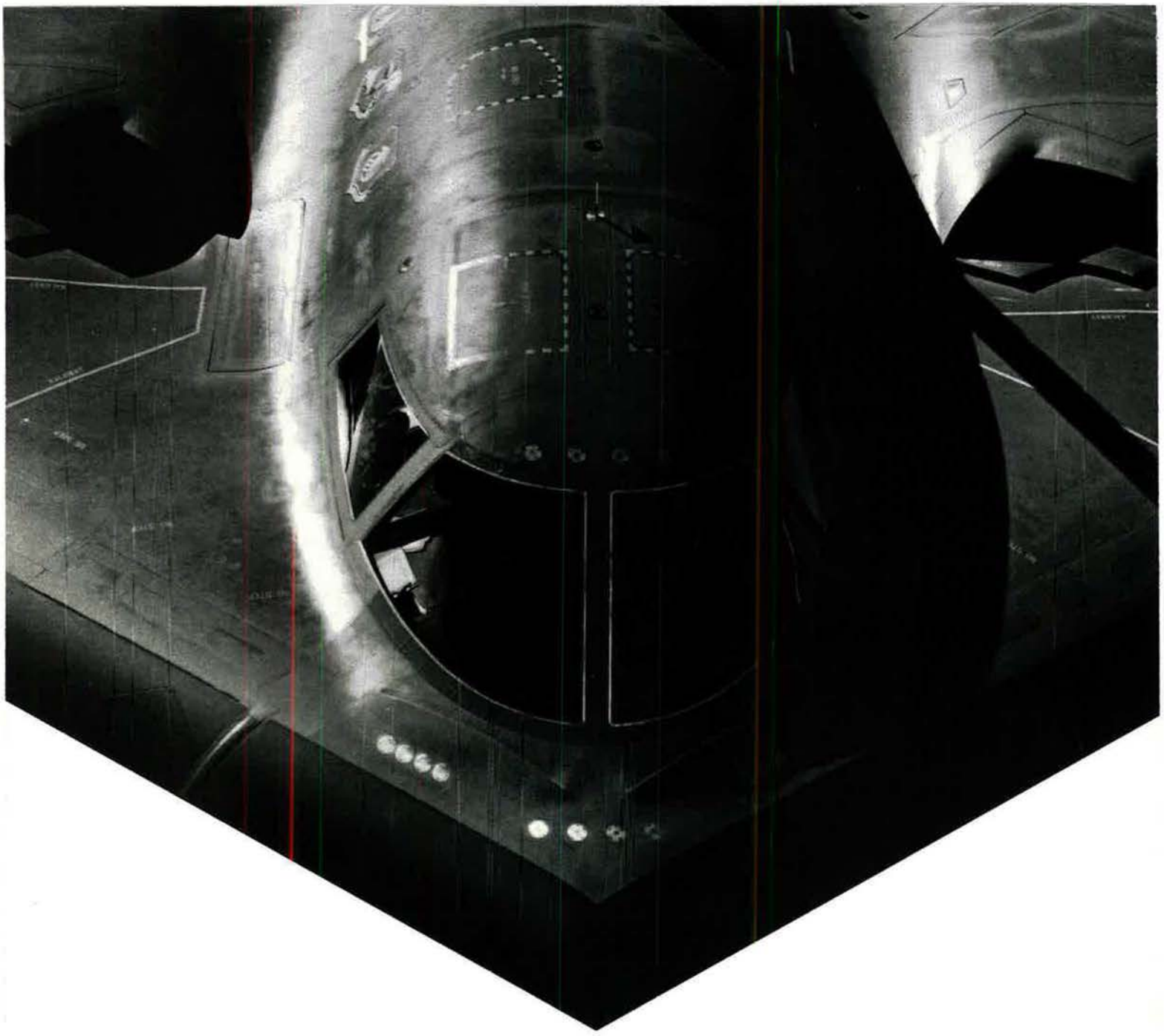

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July 1991, Vol. 74, No. 7

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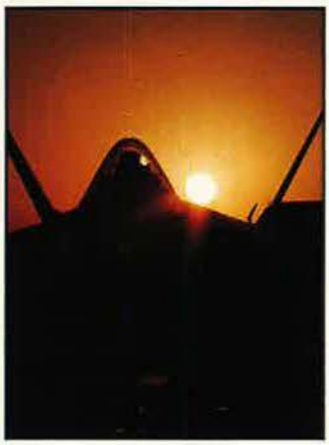

About the cover: A new day dawns for the Air Force with the advent of its newest fighter, the Lockheed F-22. Photo courtesy of Lockheed Corp.

New Strategy, New Fighter, New Challenges

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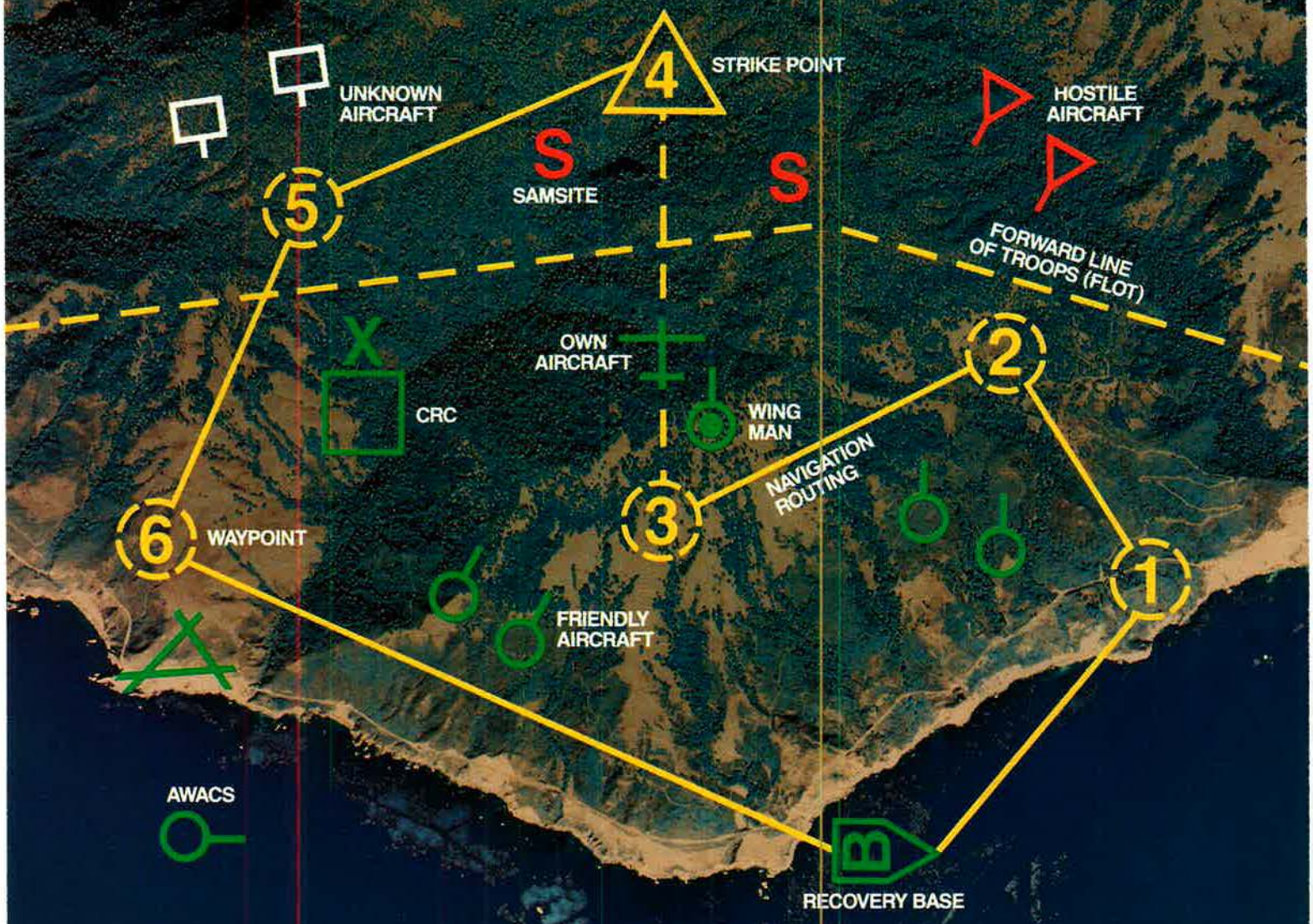

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Editorial

By John T. Correll, Editor in Chief

A Hole in the Strategy

THE public at large hasn't taken much notice of it yet, but the United States has a new defense strategy. As explained by the Joint Chiefs of Staff, the important changes are summarized in three major themes—*forward presence, crisis response,* and *reconstitution.*

"Forward presence" is a misnomer. In reality, it signifies a retreat from the concept of forward defense. Fewer US troops will be stationed abroad. At home, smaller forces will be restructured for response to "urgent" problems in "compelling" locales. Beyond that, the new strategy counts heavily on ample warning time, reinforcement, mobilization, and "reconstitution" of forces.

"In the final analysis, reconstitution may well prove to be the linchpin of America's long-term security," the Joint Chiefs said in the military net assessment they sent to Congress in March. Reconstitution may also prove to be a hole in the strategy, as it depends in large part on a defense industrial base that may not be there when the time comes.

The Joint Chiefs are well aware of that vulnerability and went to some lengths in documenting it in their report. The decline of the industrial base, a chronic problem through the 1980s, has worsened precipitously. By 1997, the Joint Chiefs estimate, it might take four years to restore production capability to the 1990 level, which in itself was a somewhat discouraging benchmark.

Even as the nation watched the Gulf War on television, many of the firms that had produced the impressive weapons were releasing workers, closing plants, and searching for nondefense business. In many ways, the war reflected an industrial base that no longer exists.

The problem is not solely one of sources of supply. The technological superiority of US armed forces is also at risk. Dependence on foreign suppliers is increasing, particularly for computer chips, machine tools, bearings, and optics.

It appears that the government's main response will be to let the market fires burn themselves out. There are both practical and political reasons for that passive approach.

With defense budgets dropping toward 3.6 percent of Gross National Product, the technology market is dominated by consumer and commercial demand. Defense is too small to call the shots, so the extent to which the problem *can* be controlled is questionable.

The Joint Chiefs say they're counting on "reconstitution," which depends on an industrial base that may not be there.

The Pentagon could make direct investments to preserve industrial infrastructure and keep production lines warm, but the funding would be at the expense of other priorities in a budget that has already been cut severely.

On the political front, the Bush Administration is adamantly opposed to "industrial policy." It prefers to let the market sort out winners and losers and wants no part of government-industry combines of the kind made famous by the Ministry of International Trade and Industry (MITI) in Japan.

Within these limits, the Pentagon is engaged in several positive actions. To adapt to the commercial market, it is abolishing all the military-unique product specifications it can. The industrial base is a regular consideration as new systems pass through acquisition review. Manufacturing technology programs seek to stimulate productivity.

The spotlight centers on two other initiatives, both getting a considerable push from Congress. The first is an effort to identify critical technologies and promote US growth in them. The second, which goes by "flexible manufacturing" and other names, holds that the distinction between defense industry and other industry is mostly artificial and ought to be eliminated.

These ideas have obvious merit, but basic problems remain. It is not enough, for example, to develop critical technologies. Without actual production, the supplier-subcontractor base continues to evaporate, and US industry drops further behind in the ability to manufacture what it invents.

We cannot assume generic industries, flexible or otherwise, will be responsive to defense needs. It is equally plausible that they will prefer to stick to the consumer market, where the sales are bigger, the profits better, and the aggravations fewer.

As the situation stands now, government efforts may be able to moderate in marginal ways the decline of the defense industrial base, but they cannot control the drop or determine where the eventual landing will be.

This is not good news for a nation that has just adopted a new strategy in which force reconstitution takes on added importance and is seen by the Joint Chiefs of Staff as the probable linchpin of long-term security. ■

LTV/FMA team has 130-year headstart on JPATS.

In the search for our country's next trainer, LTV evaluated more than two dozen candidates from around the world.

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The Pampa 2000 is a team effort from LTV and Fabrica Militar de Aviones (FMA) of Argentina. LTV has more than 70 years' experience in aviation, making history with aircraft like the F4U Corsair and the A-7 Corsair II. FMA has been building military aircraft for more than 60 years. Since 1988, the Pampa has proven itself with a flawless record in the Argentine Air Force. Together, LTV and FMA are making the Pampa 2000 a world-class JPATS contender.

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

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Letters

An Orgy of Humility

In "The Decision to Fight" *[see May 1991 issue, p. 6]*, John T. Correll refers to the "political desperation" of the liberal soothsayers' new view that the "Vietnam Syndrome," *i.e.*, defeat in Indochina humbling the US, was a good thing.

If these liberals really believe that humbling experiences are a "good thing," I invite them all to engage in an orgy of humility by admitting their errors regarding all the weaponry that functioned so effectively in Iraq. Or am I expecting too much from those who imagine themselves inhabiting Olympian heights?

Glenn O. Plaumann
Glendale, Ariz.

Fallacies and Loopholes

"The Decision to Fight" is full of fallacies and loopholes in logic. The central theme, "Desert Storm set the right example for when and how US troops should be committed to combat," is biased hindsight; it's easy to draw such a conclusion because the military was extraordinary in carrying out the operation. Unfortunately, that conclusion is illogical.

Mr. Correll dares to assert that the Gulf War met all the conditions of the "Weinberger Doctrine." Weinberger's six tests are criteria by which a decision is made to commit US troops abroad. It is fallacious to look back to see if a war met the criteria. In fact, at the time the President approved of a plan to liberate Kuwait (*i.e.*, on or about November 1, 1990), his decision had not met at least three of the six tests.

First, although the defense of Saudi Arabia was certainly deemed vital to our national interest, the liberation of Kuwait was not vital—it was humanitarian. Second, the commitment to liberate Kuwait had not yet gained the support of the American people or Congress. (Congress did not grant the President the authority to go to war until January 12, 1991.) Third, when the decision was made to commit troops, the deployment was not "a last resort" (the sixth test), because economic sanctions had not been given enough time to work and diplomatic efforts had not been exhausted.

Thank goodness the coalition managed to achieve its military objectives in spite of an ill-conceived decision to go to war. The success of the military not only saved Kuwait, it also saved the Bush Administration.

If, as Mr. Correll states, "the Gulf War set a new precedent for the exercise of power," then it appears we still won't really abide by any sort of logical criteria when we decide to commit our troops abroad. And if, as Mr. Correll suggests, we should "stop worrying about adventurism or indiscriminate involvements abroad," then we might as well give up believing in the democratic process.

Jim Stevens
Morristown, N. J.

Dedicated AWS

Your May 1991 issue was extremely interesting and informative. I particularly enjoyed Robert Dudney's "McPeak on the War" *[see "Washington Watch," p. 21]*. As the article implied, the extremely poor weather and resultant mission degradation had to be very frustrating. I know that dedicated Air Weather Service (AWS) people agonized over weather inputs to the operational commanders—as they have done in both peacetime and wartime operations for many years.

It was disappointing, then, to see AWS dropped from the Military Airlift Command organizational chart. The report from MAC also failed to note the change that affects 4,300 of Air Weather Service's finest.

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

No more AWS? I hear that weather support will also be realigned. The people who staff AWS will now work directly for operational commanders. To mark the change, we should say to those people in AWS, "Great Job!" We ex-AWS folks wish you good luck and good observing/forecasting.

Col. John R. Sweeney,
USAF (Ret.)
Northfield, Vt.

USAF's Other Navy

As commander of the 1st Test Squadron at Clark AB, the Philippines, I take exception to "The Drone Pilots" *[see March 1991 issue, p. 94]*. It seems that the 82d Tactical Aerial Targets Squadron commander is unaware there is another Weapon System Evaluation Program (WSEP) squadron in the Air Force. In fact, 1st Test Squadron is the oldest air-to-air WSEP squadron in the tactical air forces. Nicknamed Combat Sage, it has been active since 1967.

The squadron operations division is composed of F-4, F-15, and F-16 aircrews and its own air weapons controllers. These veteran aircrews and controllers provide AIM-7, AIM-9, and AIM-120 academics to approximately 350 PACAF fighter aircrews annually. The squadron provides nearly 200 live missile-firing opportunities to PACAF's fighter aircrews each year in a realistic training environment complete with multiple, evasive targets equipped with on-board chaff and flares, flying Soviet tactics and complemented with standoff electronic countermeasures jamming aircraft. To support the operation, the squadron's Remotely Piloted Vehicle division has its own fleet of fifty subscale BQM-34 and MQM-107 drones as well as its own drone tracking and control system.

The 1st Test Squadron also has its own Navy, sporting three 120-foot recovery ships, four Navy SEPTARs (approximately sixty-five feet), and three Zodiac boats. The squadron's test and evaluation division has its own flight test engineers, aircraft maintenance personnel, and other specialists who analyze the success or

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Letters

failure of every missile fired, adding to the common WSEP database as well as preparing the numerous post-deployment and annual reports.

The 120 officers, enlisted, and civilian personnel who make up 1st Test Squadron continue to perform the USAF-directed Weapon System Evaluation Program in the Philippines and appreciate the opportunity to set the record straight.

Lt. Col. Charles C. Harrington, USAF
Clark AB, the Philippines

Dreaming Shoe Clerks

I could not help but snicker over the photograph that accompanied "Changes Under the Canopy" *[see April 1991 issue, p. 50].*

It seemed absurdly appropriate to depict a person in a gray business suit "flying" the simulated aircraft using neither stick nor throttles. No one in a green bag (*i.e.,* flight suit) would be caught dead performing such a ludicrous task. I hope to God my hard-earned tax dollars aren't funding research that removes the pilot's physical link to his craft. I'd hardly call this an "improvement."

Is this yet another brick that paves the road toward pilotless aircraft? Keep dreaming, shoe clerks!

Maj. Ray Castagnaro, N. C. ANG
Durham, N. C.

More Missing Wings

I would like to inform you of a grave injustice (or oversight) concerning your list of active-duty forces of Desert Storm published in the March issue *[see p. 34].* There were two Tactical Airlift Wings missing from the list: the 463d TAW, Dyess AFB, Tex., and the 374th TAW, Yokota AB, Japan. . . . I'd like to set the record straight now, so that all those individuals who have proudly and faithfully served during Desert Shield and Desert Storm will be properly recognized.

The 374th TAW deployed more than 400 people and associated equipment to the Persian Gulf, most of them serving in the 1676th Tactical Airlift Squadron-Provisional (TASP), which deployed with eight C-130Es. Personnel of both Yokota wings, whether deployed or not, have worked long hours under difficult conditions to maintain the high level of combat readiness required in the Pacific region. Not an easy task even when all our forces are at home.

The 1676th TASP is made up of 240 members from five squadrons of the 374th TAW: 21st TAS, 345th TAS, 374th AGS, 374th EMS, and 374th Hq. The squadron established itself as one of the finest tactical airlift units in Desert Storm. Despite austere conditions and Scud missile attacks, the squadron compiled an impressive combat record.

We are still in Saudi Arabia at this writing, proudly serving our country and doing the outstanding job that has become synonymous with the name of the 374th TAW. The "Desert Eagles," the pride of the Pacific and best airlift unit in MAC, stand ready to serve—anywhere, anytime!

Lt. Col. Edward J. McClure, Jr., USAF
Saudi Arabia

The Bravest Man

My statement may not have the authoritative impact of Gen. George Kenney's, but I would like to join him in declaring that Gerald R. Johnson was "the bravest man I ever knew" *[see "Valor," March 1991 issue, p. 14].* I would like to point out that Johnson did not "end the war as a lieutenant colonel and commander of the 49th Fighter Group." He was promoted to colonel on July 16, 1945, and replaced as commander by Lt. Col. Clay Tice.

I have some details about his last mission that are somewhat at variance with those provided by Mr. Frisbee. I heard them from Colonel Johnson's twin brother, Harold. According to his brother, Johnson *was* piloting the plane, and he picked up two passengers in Okinawa on his way to Honshu for a total of six people aboard the B-25 Mitchell. There were only five parachutes. After ordering everyone to bail out and with the fuel almost gone, Johnson headed the plane out to sea, intending to use the life raft after ditching. His copilot (whose name I do not know) stayed aboard with Johnson, and both men disappeared without a trace. Johnson AB, Japan, was later named to honor this American hero.

James Gallagher
Baltimore, Md.

Under LeMay's Nose

If Gen. Curtis LeMay had ordered the removal of gunners from the B-29s as reported by Norman Polmar *[see "Intelligence and Guts," May 1991 "Letters," p. 12]* and some historians, the 314th Bomb Wing—right under LeMay's nose on Guam—which had to fly the extra miles to the targets, didn't obey it.

Hundreds of others and I flew the March 9–10, 1945, mission, and my crew returned to Tokyo at night and in

broad daylight many times afterward and flew the war's and our last mission. . . . At no time did we leave our gunners behind. The idea behind carrying no guns on March 9–10 was to keep us from shooting our own planes.

It was the popular sentiment at that time to keep the crews together through thick and thin. Leaving the gunners behind would mean they would have to fly with crews they didn't train with in order to stay overseas long enough to complete their combat tours.

It would have been a good idea keeping the gunners with the guns, especially to the survivors of those who went down with the B-29s. . . .

To those who want to better understand Curtis LeMay's true character, I recommend his biography, *Iron Eagle*, by Thomas Coffey.

Alfred K. B. Tsang
Indianapolis, Ind.

Insulted No More

I am a life member of AFA and currently serve as an Air Force exchange pilot with the Marines. Ever since we deployed aboard the USS *Iwo Jima* in August 1990 in support of Desert Shield in the Persian Gulf, I have taken the normal abuse expected from the Marine Corps and the Navy. One of the better "insults" was to be constantly reminded that "the US has never won a war since the Air Force became a separate service." As the impressive accounts of the Air Force's "work" during Desert Shield and Desert Storm continue to pile up, it gives me great pleasure not to hear that one anymore.

The superior performance of the entire Air Force system, from the bombers, tankers, fighters, airlifters, and special operators to the supply corps and the maintainers, proved that the "youngster service" is and will be at the forefront of combat power.

Let's keep up the good work!

Capt. Raymond F. Moschler, USAF
Jacksonville, N. C.

The Right to Know

John Correll's editorial about Operation Desert Storm news coverage was right on target *[see "Nitwitness News," April 1991 issue, p. 6]*. Even a casual observer could not help but notice the news media's definite bias against all things electronic, technical, scientific, or military. Your contention is correct: The real bottom line with the media is who can outscoop whom.

In many ways, it is somewhat ironic. The media continually hide behind

the public's right to know and the First Amendment, yet refuse to face the fact that the American public knows more than they do and is willing to accept some news restriction in the name of operational security.

If the American people have learned one thing from Desert Storm, it is this: Our military works. Its weapons deliver results with minimum collateral damage, and our crews are well trained. Nothing the liberal news media—not even Colman McCarthy—can do can distort these facts.

Lt. Col. Thomas O. Jahnke, USAF
Kadena AB, Japan

Loring's Heroism

I would like to comment on Col. George Bernhard's letter about Major Loring *[see "Loring's Exploits," April 1991 issue, p. 12]* without intending in any way to demean Colonel Bernhard.

I remember the Japanese suicide planes—"Baka Bombs"—and held them in the same contempt as Colonel Bernhard does. There is no parallel to be drawn between their mission and Major Loring's act of heroism. The Japanese pilots of those aircraft volunteered to die for an unknown future mission, whereas if Major Loring had displayed this mindset upon entry into the US Army Air Forces, he never would have been accepted as an officer.

His was an act of heroism because he saw a chance to save many lives by silencing those guns. He didn't (couldn't) sit back and coolly calculate the odds. Undoubtedly he had the impulse to cut and run, but he chose to follow another impulse. Those UN forces lost no more men to those guns.

Most acts of heroism are not premeditated but are impulsive acts to correct a situation that had heretofore frustrated the actor.

I have no doubt, had the opportunity presented itself, Colonel Bernhard would have done the same thing as Major Loring. He didn't become a colonel in my Air Force by having civilian logic and principles as guidelines.

MSgt. James M. Jackson, USAF (Ret.)
Seoul, South Korea

Inflated Claims

I much enjoyed Bruce Callander's "The Aces That History Forgot" *[see April 1991 issue, p. 92]* but thought that I should add a couple of observations from my own research.

First, I am surprised that Mr. Callander chose "wizzos" (WSOs, or Weapon Systems Operators—the backseaters in F-4s) as his example of the Vietnam-era "descendants" of aerial gunners of World War I and World War II. There were, in fact, two honest-to-God tailgunners aboard B-52s, who, in December 1972, used .50-caliber machine-gun fire (shades of Leipzig and Berlin) to shoot down a pair of MiG-21s during Operation Linebacker II. I believe these men (SSgt. Samuel O. Turner and AIC Albert E. Moore) each received the Silver Star for these feats.

With regard to the "kills" attributed to the air gunners of World War II (a figure of 6,259 confirmed victories is given for gunners in 8th Air Force alone), it in no way detracts from the incredible bravery and hard work of these men to note that postwar analysis has shown that such claims—even the numbers "confirmed" by A-2 at higher command echelons—were extremely inflated.

Even in the book cited by Mr. Callander, *Aerial Gunners: The Unknown Aces of World War II*, the authors give examples of overclaiming, such as those during an 8th Air Force raid to Romilly-sur-Seine, France, where despite officially "confirmed" gunner figures of twenty-one destroyed and thirty-one probables, the postwar documents show just *five* German fighters lost.

None of this detracts from the valor of air gunners, but statistics relating to how many planes they shot down are often grossly inaccurate. However, their efforts often were successful even without actual kills: The streams of tracer-laced .50-caliber ammunition that they so vigorously sent out at enemy interceptors often caused their opponents to aim poorly, break off attacks early, and generally fail to shoot down as many bombers as they otherwise would have.

That meant more bombs got to the target, which is what really mattered.

Mike Minnich
Toronto, Canada

McGuire's Unit

Please tell me that was a typographical error in "Valor" in the March 1991 issue *[see "The Bravest Man I Ever Knew," p. 14]*.

I am referring to the statement about Maj. Thomas B. McGuire's being transferred to the 457th Fighter Group in Fifth Air Force. He was transferred to the 475th Fighter Group. I commanded his old squadron, the 431st Fighter Squadron, at Itazuke AB, Japan, in 1948, one of three fighter squadrons in the 475th Fighter Group.

It is amazing to me how Mr. Frisbee digs up all the interesting information for the "Valor" series. Keep up the good work.

Lt. Col. Bert McDowell, Jr., USAF (Ret.)
Irving, Tex.

Apples and Oranges

"Milk Run," by John L. Frisbee *[see April 1991 issue, p. 100]*, was excellent, but his reference to combat violence, comparing Eighth Air Force flights over Europe to those that occurred during the Vietnam and Korean Wars, only muddied the waters. He stated, "In thirty-three months, nearly 44,000 Eighth Air Force bomber and fighter crewmen were killed or missing in action, compared to some 33,000 battle deaths for *all* US forces in Korea and 47,000 in Vietnam" (emphasis his).

To the casual reader, this would indicate that the Vietnam War had the highest death rate. Just the opposite is true. A better way to look at the figures would be on a monthly basis. The figure for the thirty-three months of the World War II period would be 1,333 per month; for the thirty-seven months of the Korean War, 919 per month; and for 108 months (1964–73) of heavy US involvement in Vietnam, 435 per month.

Art Rideout
Fallbrook, Calif.

Mr. Frisbee replies:

The figures I used were intended to give readers an impression of the violence of the air war over Europe. They do, however, compare apples and oranges, since the World War II figures include KIAs and MIAs compared to battle deaths in the other two wars. The monthly ratios are much worse than you indicate, since they compare only the Eighth Air Force to all *services in Korea and Vietnam.*

Acknowledgment

The A-10 "Thunderhog" cartoon on p. 70 of our September 1990 issue was based on a mural from the 355th TTW ready room, as credited, but we have learned since that it was originated by Hank Caruso in his "Aerocatures Calendar for 1982" and is copyrighted by him. We regret that proper credit was not given to Mr. Caruso in our usage.

The Chart Page

Edited by Colleen A. Nash, Associate Editor

Funding for Critical Technologies
(in $ millions)

Technology	Actual Budget FY 1987–91	Budget Request FY '91	Actual Budget FY '91	Budget Requests by Fiscal Year '92	'93	'94	'95	'96	'97
Software Engineering	384	115	133	149	148	153	155	156	157
High Performance Computing	414	80	108	172	219	273	301	349	350
Machine Intelligence & Robotics	551	116	162	146	142	145	144	144	143
Simulation & Modeling	1,230	202	300	334	343	340	335	344	344
Photonics	710	75	167	186	190	180	179	190	173
Sensitive Radars	669	110	169	196	201	192	188	191	192
Passive Sensors	2,065	460	428	530	554	523	512	514	509
Signal & Image Processing	753	130	221	235	230	232	234	240	219
Signature Control (unclassified only)	572	120	120	109	102	89	87	86	88
Weapon System Environment	929	180	213	232	238	246	249	252	260
Data Fusion	288	50	96	106	109	108	98	98	93
Computational Fluid Dynamics	428	55	118	94	95	99	101	105	108
Air-Breathing Propulsion	968	180	227	224	211	185	190	193	201
Pulsed Power	541	95	95	76	76	81	80	80	82
Hypervelocity Projectiles & Propulsion	710	120	153	183	205	201	200	197	196
High-Energy-Density Materials	409	76	82	84	86	95	93	96	98
Composite Materials	1,089	170	204	193	197	211	218	224	229
Superconductivity	345	88	58	56	51	54	54	55	57
Biotechnology	79	100	69	65	66	68	69	71	72
Flexible Manufacturing	105	17	27	25	28	29	31	32	31
Semiconductor Materials & Microelectronic Circuits	1,955	370	534	479	481	487	488	490	510
Planned Total Funding for Defense Critical Technologies—S&T with SDIO	15,194	2,909	3,684	3,874	3,972	3,991	4,006	4,107	4,112
Projected Total Funding for all Technology Development Activities—S&T and SDIO	NA	9,784	9,048	11,095	11,413	11,749	11,501	10,895	10,542

The Defense Department annually identifies for Congress the technologies that are "essential for maintaining the qualitative superiority of US weapon systems." These figures incorporate relevant funding from the DoD Science & Technology program, including the Strategic Defense Initiative Organization. Funding levels are not adjusted for inflation.

Source: DoD's *Critical Technologies Plan*, May 1, 1991.

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Capitol Hill

By Brian Green, Congressional Editor

The Soviets in Europe

Even with arms-control constraints, the USSR would keep about 100 divisions and a lot of airpower west of the Urals.

For the foreseeable future, the USSR will maintain in the Atlantic-to-the-Urals (ATTU) region up to 100 active and reserve ground divisions that can be mobilized for attack—even if the Conventional Forces in Europe (CFE) treaty goes into effect sometime soon.

That is the latest word from the Central Intelligence Agency and Defense Intelligence Agency, whose analysts testified in May before Congress's Joint Economic Committee.

In addition, the Soviet air forces will be less affected than other Soviet forces by short-term cutbacks. It has a large number of fighters in operation and many are new models, says C. Patrick Deucy of DIA.

The Soviet military continues to lay a major claim on national resources despite internal economic collapse, political instability, and deteriorating conditions on both fronts, according to the intelligence agencies. Mr. Deucy predicts that the crisis in the Soviet Union will worsen over the next several years, and "a transition out of this crisis period will likely involve shifts in leadership and varying degrees of violence, which have the potential to threaten US and allied interests."

Combined Soviet air forces in the ATTU region will remain the largest in Europe, still composed mostly of aircraft with offensive rather than defensive roles, says DIA. The agency adds that the Soviets are retaining the bulk of their fixed-wing force in the ATTU region and are focusing their modernization and restructuring on the NATO central region.

The DIA testimony notes that production of the most modern tactical aircraft in the Soviet inventory remains steady, although total output of combat aircraft dropped in 1990.

According to the testimony, Soviet tactical air strength in Europe is further enhanced by the subordination of several hundred tactical aircraft formerly under command of Soviet air forces to Soviet Naval Aviation. Even after CFE limits are imposed, the Soviets will retain up to 400 landbased naval aircraft in the ATTU region.

While Soviet air forces remain formidable, force reductions in Eastern Europe and the dissolution of the Warsaw Pact "have eliminated the threat of a short-warning Soviet offensive on NATO territory," Mr. Deucy testified. He claims that implementation of the CFE accord would provide even longer warning time. Soviet mobilization for offensive operations would take three to four months. This force, in DIA's judgment, would probably not be sufficient to defeat a reinforced NATO—"assuming NATO retains its full CFE entitlement."

The DIA claims that, while theater force restructuring and reductions limit Soviet military capabilities, "strategic modernization continues to enhance Soviet capabilities." Deployment of the road-mobile SS-25 ICBM (roughly equivalent to the Air Force's proposed Small ICBM) and two new variants of the SS-18 heavy ICBM (the US has no equivalent) continue.

"At least two new ICBMs—follow-ons to the SS-24 and SS-25—are in development," DIA said. A START Treaty would result in a Soviet strategic force that is "smaller . . . more balanced, reliable, and survivable . . . [with] more accurate weapons. . . . START will have only a minor impact on Soviet capabilities to hold key North American and Eurasian targets at risk."

Soviet strategic defenses, including surface-to-air missiles, fighter interceptors, and underground facilities for Soviet civilian and military leadership, are also being upgraded.

"Political and economic instability probably will have only a limited effect on strategic force modernization, which is expected to continue at a moderate pace," according to the DIA official.

Soviet military trends are unclear. The intelligence organizations maintain that defense spending and production have declined significantly over the past two years, the military suffers from low morale and poor discipline, and Soviet economic deterioration "will eventually affect defense industry." Nevertheless, the defense industry remains largely intact, insulated from many of the economic difficulties, and very few defense factories have been converted to civilian use.

Furthermore, "Soviet military R&D remains broad-based and well-endowed with resources. We have no evidence that major weapon development programs have been canceled, although some programs probably have been slowed. . . . We expect the Soviets to place even greater R&D emphasis on . . . air defense; cruise missiles; target acquisition systems; and space-based command, control, communications, and reconnaissance."

Strategic Systems Knocked

In its version of the Fiscal 1992 defense authorization bill, the House deleted all B-2 bomber procurement funds, ripped the Strategic Defense Initiative, and approved only the modest request for ICBM modernization. The Senate will act on the bill later this summer.

Even so, Rep. Bill Dickinson (R-Ala.), the ranking Republican on the House Armed Services Committee (HASC), described these actions as "a true disaster." Said Representative Dickinson: "The bill now has no coherent strategic modernization plan. . . . We are unilaterally disarming ourselves right now."

By a vote of 287-127, the House rejected a measure to approve President Bush's original defense budget, which would have restored B-2 and SDI funding.

In providing no procurement funds for the B-2, the bill would, in effect, terminate the program at the fifteen aircraft already authorized. HASC Chairman Les Aspin (D-Wis.) indicated that the House and Senate will have to compromise between the Administration request for seventy-five B-2s and the fifteen that have been authorized by the House. "I would hope that the number would be pretty close to fifteen," he said. ■

Aerospace World

★ It's an age-old question: "What did you do in the war?" For the 48th Tactical Fighter Wing based at RAF Lakenheath, UK, the answer is: "plenty." One recent Air Force report shows that, on receiving orders to mobilize for Persian Gulf duty, the 48th TFW swiftly deployed 1,400 wing personnel and sixty-six of its seventy F-111F fighter-bombers to Taif, near the Red Sea coast of Saudi Arabia.

The movement of people and equipment is reported to be the most massive deployment by a single fighter wing in the history of the United States Air Forces in Europe (USAFE). It included dispatch of some six million pounds of cargo and eighteen million pounds of munitions.

During the first four weeks of the Persian Gulf War, pilots of the 48th flew mostly at night and concentrated on Iraqi airfields, communications facilities, bridges, and ammunition and fuel dumps. They then turned their attention to Iraqi armored forces and hard targets. Some of the 48th TFW's confirmed kills included 245 hardened aircraft shelters, 113 bunkers, 160 bridges, and 920 Iraqi tanks and armored personnel carriers.

In all, F-111Fs of the "Statue of Liberty Wing" dropped 7.3 million pounds of precision guided munitions in forty-two days.

Capt. Brad Seipel of the 493d Tactical Fighter Squadron is credited with steering two GBU-15 TV-guided 2,000-pound bombs into an oil pumping manifold, capping a massive Kuwaiti oil spill and helping to contain an unprecedented ecological disaster in the Gulf. While no 48th TFW crew member was killed in combat, Capts. Art Reid and Tom Caldwell died in a crash during a night training mission.

Now that the war is over, members of the 48th TFW are concentrating on trying to make the most of the wing's hard-won wartime lessons. "We're putting down what we learned so we won't repeat mistakes," said Col. Tom Lennon, 48th TFW commander. "What we don't want to do is what Saddam did: fight the next war the way we fought the last one."

—USAF Photo by TSgt. Rose S. Reynolds

Three F-111s from the 48th Tactical Fighter Wing based at RAF Lakenheath, UK, fly over the desert of Saudi Arabia. Both squadrons of the 48th TFW are represented by these aircraft. The gray aircraft on the right is an EF-111 of the 336th Tactical Fighter Wing from Mountain Home AFB, Idaho.

The F-111 already had emerged, in earlier USAF assessments of the war, as a workhorse of the campaign (*see "Aerospace World," June 1991 issue, p. 13).* Air Force officials believe that the count of confirmed kills underestimates the actual damage wreaked by the F-111s. They say that the total kill of armored vehicles may be as high as 1,500.

★ CBS medical reporter Dr. Bob Arnot spent part of the war aboard an unidentified Military Airlift Command C-130 on a medical evacuation flight. In a moving account of his experience, he recalled the pilot's landing near a battlefield on a rain- and wind-swept night without benefit of a runway. Fifty wounded soldiers, some in critical condition, were loaded into the back of the aircraft. One soldier had just come from brain surgery, and another was able to breathe only with the assistance of an Air Force medic who breathed into the wounded soldier's lungs for the entire return flight.

"All of the doctors, nurses, and technicians performed heroically," reported Arnot. "Here they were, flying into the battle area in terrible weather, landing on nothing more than hard-packed sand, risking their lives to save others."

What struck Arnot as the most amazing aspect of the mission was that all fifty of the wounded soldiers were Iraqis.

★ With the recent release of new reports and statements of senior officers, it becomes clear that the war brought forth heroic efforts back in the US, too. Many worked overtime to rush badly needed weapons—many still in development—to the Persian Gulf. The Air Force's E-8 Joint STARS aircraft was the most celebrated of these systems.

The service's Rapid Response Program, which was established for Operations Desert Shield and Desert Storm, greatly accelerated the development and fielding of a host of weapon systems, including a 40-mm antiarmor round for guns used on

AC-130 gunships, proximity rounds for 105-mm shells, integration of the GBU-15 guidance kit with the I-2000 hardened-target bomb, and a Block III software upgrade for more than 1,000 HARM defense suppression missiles.

Of all the efforts, however, none was more unusual than that required to field the 5,000-pound GBU-28 bomb designed to destroy hard, deeply buried targets. In November 1990, USAF officials say, it became clear that Iraq had just such deep, fortified targets in the form of command-and-control bunkers. The Air Force realized that the current BLU-109 warhead of the 2,000-pound GBU-27 bomb was not powerful enough for the job of destroying these bunkers.

Along came Al Weimorts, a lab engineer at Air Force Systems Commands Armament Laboratory at Eglin AFB, Fla. He suggested that the service could build a longer and heavier bomb, but discovered that off-the-shelf materials to build it apparently were not available. It was then that an employee at Lockheed Corp., which manufactures the F-117A's principal ordnance, recalled that the Army had stockpiled some old gun barrels that might work in a pinch.

On January 25, the Eglin-based weapons lab asked the Army to begin machining the barrels to a bomb specification. A little more than two weeks later, Tactical Air Command approved the GBU-28 for use, and Texas Instruments was asked to conduct wind tunnel tests and reprogram a chip in the GBU-27 guidance kit to accommodate the larger bomb.

On February 16, the first bomb body machined from an eight-inch-diameter Army artillery tube was flown from Schenectady, N. Y., to Eglin. Eight days later, the first—and only—test bomb was dropped from an F-111 at Tonopah Test Range, Nev. The huge weapon penetrated so deeply into the ground (more than 100 feet) that the Air Force found it uneconomical to try to retrieve it.

At Eglin some weeks later, after Air Force technicians and contractor personnel had worked around the clock, the body of the first live GBU-28 was hand-loaded with molten tritonal explosive. Because of the weapon's extraordinary length (nearly nineteen feet), technicians had to dig a three-foot hole below the explosive loading fixture. On February 26, the first bomb was shipped to Saudi Arabia. Air Force officials say that it was still warm to the touch when USAF personnel loaded it onto the airlifter.

Within five hours of landing in-country, it was plummeting toward a classified Iraqi command-and-control bunker that Air Force officials say was destroyed.

"Normally the acquisition system is quite complicated and can take years [to yield a product] under some circumstances," said Col. Allen Koester, assistant vice commander at ASD. "One of the interesting things that came out of the Rapid Response Program is the folks in Washington, D. C., recognized that they could accelerate the process. . . . It was a positive lesson."

★ In other "lessons learned" news, Gen. Charles McDonald, commander of Air Force Logistics Command, testified before Congress that one of the key pillars of the Desert Storm success was the existence of adequate war reserve stocks. The service's large supply of critical spare parts and other items, largely the result of strong funding in the mid-1980s, lay behind the ninety-percent-plus mission capable rates of many flying units.

General McDonald warned, however, that funding for such war reserve materiel (WRM) has dropped significantly since 1987. In the Fiscal Year 1991 budget, Congress deleted the

entire $373 million request for WRM. While that may not have an immediate effect on operations, the cut in funds is expected to have a sharp, negative impact on the Air Force down the road.

"Because of Fiscal 1991 funding, we project a loss of several thousand sorties in Fiscal 1993," General McDonald told the Senate Armed Services Committee's Subcommittee on Readiness, Sustainability, and Support.

Mindful of the logistics challenges that the services face, Secretary of Defense Dick Cheney traveled to Saudi Arabia in early May to propose that the United States store more military equipment and supplies in the region. He is reported to have carried a detailed plan for such an expanded US presence in the Gulf, as well as a letter from President Bush to King Fahd. There was no official Saudi reaction to the proposal.

★ Rep. Les Aspin, (D-Wis.), who chairs the House Armed Services Committee, urged President Bush to name a civilian-led commission to study the facts of and draw credible lessons from Operation Desert Storm. He maintained that the panel should be modeled on the commission appointed by President Franklin D. Roosevelt to conduct the US Strategic Bombing Survey following World War II.

While he noted that each service is conducting its own review of the Gulf War, Representative Aspin maintains that the nation needs "a comprehensive, objective review from an overall perspective that cuts across service lines and is not bound to any one organizational approach."

In his remarks, which were made to the American Institute of Aeronautics and Astronautics, Representative Aspin said that the main goals of such a commission should be to analyze the contribution to the victory of specific military strategies, tactics, and weapons; to examine the relevance of the Gulf War to other potential conflicts; and to identify any weak spots in US defense preparations.

Some thought they saw such weak spots. Sen. John Glenn (D-Ohio) and Sen. Wendell Ford (D-Ky.) issued a critical report to the Senate in the wake of a fact-finding trip in March to Saudi Arabia, Kuwait, and Iraq. The report includes negative reviews of the nation's strategic sealift, tactical air reconnaissance, mine detection and sweeping, and air combat identification.

Anniversaries

- *July 13–21, 1921:* In a series of tests off the coast of Virginia, Army airplanes from Langley Field, Va., sink three ships, including the captured German battleship *Ostfriesland*, demonstrating the vulnerability of naval craft to aerial attack.
- *July 2, 1926:* US Army Air Service becomes US Army Air Corps.
- *July 1, 1931:* United Air Lines is formed as a holding company for Boeing Air Transport and National Air Transport.
- *July 28, 1931:* Amy Johnson begins her flight from England to Tokyo in a de Havilland DH.80A Puss Moth. She arrives less than nine days later on August 6.
- *July 20, 1936:* Twenty Ju-52/3m bomber transports arrive in Seville and begin transporting Nationalist troops from Morocco early in the Spanish Civil War. In the world's first large-scale airlift operation, 7,350 troops with artillery are carried to Spain in about six weeks.
- *July 8, 1941:* The RAF makes a daylight attack on Wilhelmshaven using Boeing Fortress Is. This is the first operational use of the B-17 Flying Fortress.
- *July 1, 1946:* In Operation Crossroads, a USAAF B-29 drops an atomic bomb over seventy-three naval vessels anchored at Bikini atoll in the Pacific Ocean.
- *July 21, 1946:* The McDonnell XFH-1 Phantom becomes the first pure turbojet aircraft to operate from a US aircraft carrier, the USS *Franklin Roosevelt*.
- *July 20, 1951:* The first flight of the first of three Hawker Hunter prototypes (WB188) is made from Boscombe Down, Wiltshire, UK.
- *July 1, 1961:* NORAD begins operation of SPADATS, designed to catalog electronically all man-made space objects.
- *July 21, 1961:* The US puts its second man in suborbital flight over the Atlantic Missile range, Capt. Virgil I. "Gus" Grissom in the Mercury capsule *Liberty Bell 7*.
- *July 18–21, 1966:* During the Gemini 10 mission, astronauts Michael Collins and John Young demonstrate the capability to rendezvous with and work on satellites in Earth orbit by retrieving a scientific experiment from an orbiting Agena craft.
- *July 26, 1971:* The US achieves its fourth moon landing with the Apollo 15 mission. The twelve-day mission marks the first use of the Lunar Roving Vehicle.
- *July 3, 1976:* In an Israeli commando assault on Entebbe airport, the Israelis destroy four MiG-17s and seven MiG-21s.
- *July 8, 1976:* The Swiss Air Force receives delivery of its 160th and last Hawker Hunter at Emmen Air Base.
- *July 28, 1976:* Flying a Lockheed SR-71A strategic reconnaissance aircraft, Capt. E. W. Joersz and Maj. G. T. Morgan, Jr., USAF, establish a new world speed record of 2,193.17 mph.
- *July 29, 1976:* The governments of West Germany, Italy, and the UK sign a Memorandum of Understanding covering the production of 809 Panavia Tornado multirole combat aircraft.
- *July 7, 1981:* The MacCready Solar Challenger makes the first crossing of the English Channel by a solar powered aircraft. The five-hour, twenty-three-minute, 180-mile flight from Cergy Pontaire near Paris to Manston Airfield, Kent, is piloted by Steve Ptacek.

★ Testifying before the House Armed Services defense policy panel, former Navy Secretary John F. Lehman, Jr., warned that Naval aviation was only five to ten years away from "chaos," unless the Navy radically alters its present course. The controversial former Navy Secretary sharply criticized Secretary Cheney's decision to develop an extended range F/A-18E/F for the so-called "outer air battle" of fleet defense instead of pushing ahead with a strike version of the F-14D. His argument was bolstered by remarks made by Congressional Budget Office officials that, without a major cash infusion, Naval aviation will be in serious trouble by decade's end.

Specifically, Mr. Lehman said that transforming the F/A-18 into a different aircraft with a new tail, fuselage, and wings will cost as much as $5 billion. The current version of the Hornet, he said, can't perform the deep strike mission because it lacks the range and armament capability. Mr. Lehman prefers upgrading the F-14 and making it into a long-range strike aircraft with more modest modifications. During his years as Navy Secretary (1981–87), Lehman vigorously promoted the development of the A-6F to handle the attack mission over the next decade and the F-14D to perform fleet defense.

Countering those arguments was Vice Adm. Richard Dunleavy, the Navy's chief requirements officer. He told Congress that the Navy opted for F/A-18C/Ds and stretch-model E/Fs instead of the F-14D "Quick Strike" variant because the Hornet is far more reliable, has fewer accidents, and requires fewer maintenance personnel than does the older and less advanced F-14. The Admiral characterized start-up costs for the two programs as "a wash."

SSgt. Jeff Charous and a military working dog, Troll, keep watch for intruders at their desert base. The dog teams, four from the 96th Security Police Squadron, Dyess AFB, Tex., and two from Carswell AFB, Tex., worked only at night, guarding the perimeter of the base. Because there were not enough kennel spaces to house all of the deployed canines, the dogs shared living quarters with their handlers.

The House Armed Services Committee gave an early indication of its thinking on the controversy in the 1992 military authorization it voted May 8. It approved the requested $435 million in 1992 and the $1 billion in 1993 to upgrade F/A-18s to E/F versions, as well as the requested $2.2 billion for forty-eight new F/A-18Cs and Ds.

However, the committee also added $50 million for research and development of the F-14D Quick Strike development program and provided $679 million to upgrade nineteen F-14A+ aircraft to F-14D standard. The first funding for concept definition of the A-X replacement for the canceled A-12 program was also included.

According to Admiral Dunleavy, the Navy wants the A-X medium attack plane to have a gross takeoff weight of between 60,000 and 70,000 pounds and a "dry" weight of roughly 43,000 pounds. For stealthy attack, all weapons would be carried internally, and the internal load requirement is 4,500 to 8,000 pounds. Missions requiring less stealth could see the addition of 4,000–7,500 pounds of external ordnance. Mission radius is about 700 nautical miles, down from 785 required of the A-12. Flyaway cost would be an estimated $60 million–$70 million in FY 1991 dollars.

★ **NEWS NOTES—Philippine negotiators reaffirmed their hardline stance** on the US bases issue by stating that, if the **US** didn't back down on its position, its **forces would have to withdraw when the lease expires in September.** However, a leading Philippine politician, Sen. Leticia Shahani, said that a compromise might be reached if the Philippine side offered to extend the duration of a new treaty and if the US increased compensation.

In other news on foreign bases, **the Pentagon slashed the cost of the Air Force's planned base in Crotone, Italy,** to less than one half of its original cost in a last-ditch effort to save the project. The initial 1989 Pentagon proposal for the Air Force base at Crotone would have cost the US $425 million. In the face of congressional resistance last year, the project was scaled back to $288 million, and the Pentagon suggested that the base would be used to house only two squadrons of F-16 fighters rather than the three originally planned. The FY 1991 military construction budget approved by Congress, however, includes no funding for construction of Crotone.

Pointing out that the base could serve as a staging area for deployments to the Middle East as well as a key to reinforcing the volatile southern flank of NATO, the Army's Gen. John R. Galvin, Supreme Allied Commander, Europe, warned that a US decision not to move ahead with Crotone would be "a very serious strategic mistake."

The General's argument: "If you look where we've had problems over the past few years that have required deploying forces, they've all been around the southern region of NATO. Crotone sits dead center in that region. If we miss the chance to build it, we will regret it in years to come."

Gen. Ronald Yates, commander of **Air Force Systems Command,** said that the service has **adopted new guidelines** and regulations calling for early clarification of "live-or-die" weapon system requirements. He told reporters on May 15 that failure of the contractor to meet these standards could cause the service to slow or even halt a program.

The new guidelines are designed not only to reduce program risk, but also to make clear to outside observers exactly which performance criteria are indeed critical to the success of the weapon system in question. General Yates explained that, had the new guidelines been in place during development of the B-1B bomber, that program would have been stopped in the mid-1980s in order to let the service deal with problems in the defensive avionics system. "The point is that in the future . . . we won't go forward if we don't realize our goals on those major live-or-die issues," said General Yates.

The General emphasized that not every significant technical parameter can or should be labeled "critical." If that were the case, program schedules would become hostage to every minor setback. "If there are 200 to 300 significant technical parameters in a program, there are probably five to ten live-or-die issues," said the General.

For only the seventh time in forty space shuttle missions, **NASA diverted a shuttle from its normal landing site** at Edwards AFB, Calif., because of bad weather and had it land at Cape Canaveral, Fla. *Discovery* touched down on May 6th after completing an eight-day mission devoted to "Star Wars" research.

The flight was the first military mission in the space shuttle program that was exempt from a news blackout. During the flight, which was plagued by a number of equipment failures, the crew captured images of atmospheric light, or aurora. It also gathered data to differentiate between natural and nuclear sources of X-ray radiation as a potential aid in verifying adherence to nuclear test treaties. In a detection experiment, the crew also released and recovered a $94 million satellite that studied the shuttle's own exhaust plumes.

In a surprise voice vote on an amendment to the FYs 1992 and 1993 defense budget, the **House Armed Services Committee voted** on May 8 **to allow women to fly combat missions** in the Air Force, Navy, and Marines. The measure was seen as reflecting acceptance of the roles women played in the Panama and Persian Gulf conflicts. It would permit, but not require, the military services to place women in assignments such as fighter or bomber pilot, navigator, or weapon system officer. The measure still faces floor debate in the House and has not been considered in the Senate, where chances of passage are rated as generally poor.

According to a study by the RAND Corp., a force of only **seventy-five B-2 Stealth bombers using conventional munitions could destroy more than half the tanks in an attacking armored division in one day.** The study thus agreed with the Administration's

The Sky Owl unmanned aerial vehicle system demonstrated basic performance capabilities and operational interfaces with launch, control, and recovery systems in its first test flight, on May 20 near El Mirage, Calif. Sky Owl is the McDonnell Douglas Missile Systems Co. and Developmental Sciences Corp. entry in the short-range UAV competition directed by DoD's UAV Joint Project Office.

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position that the US should buy seventy-five of the bombers, stating that the force would be critical in any war with the Soviet Union. While conceding that the bomber is expensive, the study went on to say that most of the B-52's cost "is now behind us." If the B-2s are not purchased, RAND recommends, USAF should immediately begin work on an advanced air-launched conventional cruise missile to arm bombers already in the force.

In May, the **Air Force's new personal weight control program** got under way at bases around the world. While service members no longer have to weigh in annually or semiannually, the Military Personnel Center (MPC) will use a computer-generated list that randomly identifies candidates for no-notice weigh-ins. All bases will receive a new list each month.

Body fat percentages will determine whether an individual meets USAF standards. More information on the new weight program and its governing regulation, AFR 35-11, is available from unit orderly rooms or consolidated base personnel offices.

Elsewhere on the personnel front, under a new policy, **lieutenant colonels and colonels may now apply to retire** at their current rank **with two years' time in grade** instead of three. Prior-enlisted officers may now also retire as officers after eight years of commissioned service instead of ten years. Some medical officers are excluded from this program. The Air Force has been authorized to implement this reduced requirement to help lower the number of officers on active duty.

★ **HONORS**—By aggressively cutting the time required to award contracts, the **Phillips Laboratory** at Kirtland AFB, N. M., **won the 1990 Air Force Outstanding Contracting Unit Award** in the category of central, research and development, or systems contracting. The lab's contracting directorate reduced contract award time from 151 days in 1989 to seventy-seven days in 1990.

The Air Force MPC announced that **six officers were selected** to participate in the 1991 **RAND Research Fellows Program.** After the one year program, the officers usually receive a three-year assignment to the sponsoring agency. The selected officers are: Capt. James E. Bennett, Kirtland AFB, N. M., sponsored by the Air Force Assistant Chief of Staff for Studies and Analyses; Lt. Col. Michael G. Anderson, McConnell AFB, Kan., sponsored by Air Force Systems Command; Maj. Duane W. Deal, Grand Forks AFB, N. D., sponsored by the Air Force Deputy Chief of Staff for Plans and Operations; Capt. David G. Minster, Bolling AFB, Washington, D. C., sponsored by the Air Force Assistant Chief of Staff for Intelligence; Maj. Thomas A. Shimchock, Kirtland AFB, N. M., sponsored by the Air Force Deputy Chief of Staff for Logistics and Engineering; Capt. Thomas C. Walker, Hq. USAF, sponsored by the Air Force Deputy Chief of Staff for Personnel.

Military Airlift Command safety programs won both the **Secretary of the Air Force Safety Award and the Daedalians' Award** for the most effective safety programs. It was only the fifth time in the twenty-four-year history of the awards that a single organization won both.

Senior Staff Changes

RETIREMENTS: L/G James S. **Cassity,** Jr.; L/G Charles R. **Hamm;** B/G Richard C. **Milnes II;** Gen. John A. **Shaud;** M/G Sam W. **Westbrook** III.

PROMOTIONS: To be **General:** James B. **Davis.**

To be **AFRES Major General:** Earl A. **Aler,** Jr.; John H. **Burris;** Rodney L. **Linkous;** Robert A. **McIntosh;** Clark O. **Olander;** John P. **Van Blois.**

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B/G Henry M. Hobgood, from DCS/Pers., Hq. TAC, Langley AFB, Va., to C/S, Hq. TAC, Langley AFB, Va., replacing B/G Paul E. Stein . . . **B/G Kenneth G. Miller,** from Cmdr., Def. Contr. Mgmt. Cmd., Western Dist., DLA, El Segundo, Calif., to Prgm. Dir., C-17 SPO, ASD, AFSC, Wright-Patterson AFB, Ohio, replacing B/G (M/G selectee) Michael J. Butchko, Jr. . . . **B/G Kenneth A. Minihan,** from DCS/Intel. and Dep. Dir., Intel., TACOS, Hq. TAC, Langley AFB, Va., to Dir., Policy, Plans, & Prgms., ACS/Intel., Hq. USAF, Washington, D. C., replacing retired Col. John P. Casciano . . . **M/G Raymund E. O'Mara,** from Dep. Dir., Force Employment Plans, JSTPS, JCS; DCS/Strat. Planning; and Dep. Dir., Strat. Planning, STRACOS, Hq. SAC, Offutt AFB, Neb., to Dep. USCINCLANT and C/S, Hq. USLANTCOM, Norfolk, Va., replacing M/G (L/G selectee) Martin J. Ryan, Jr. . . . **M/G William J. Porter,** from Dir., Pers. Plans, DCS/Pers., Hq. USAF, Washington, D. C., to Dir., Pers. Prgms., DCS/Pers., Hq. USAF, Washington, D. C., replacing M/G John E. Jackson, Jr.

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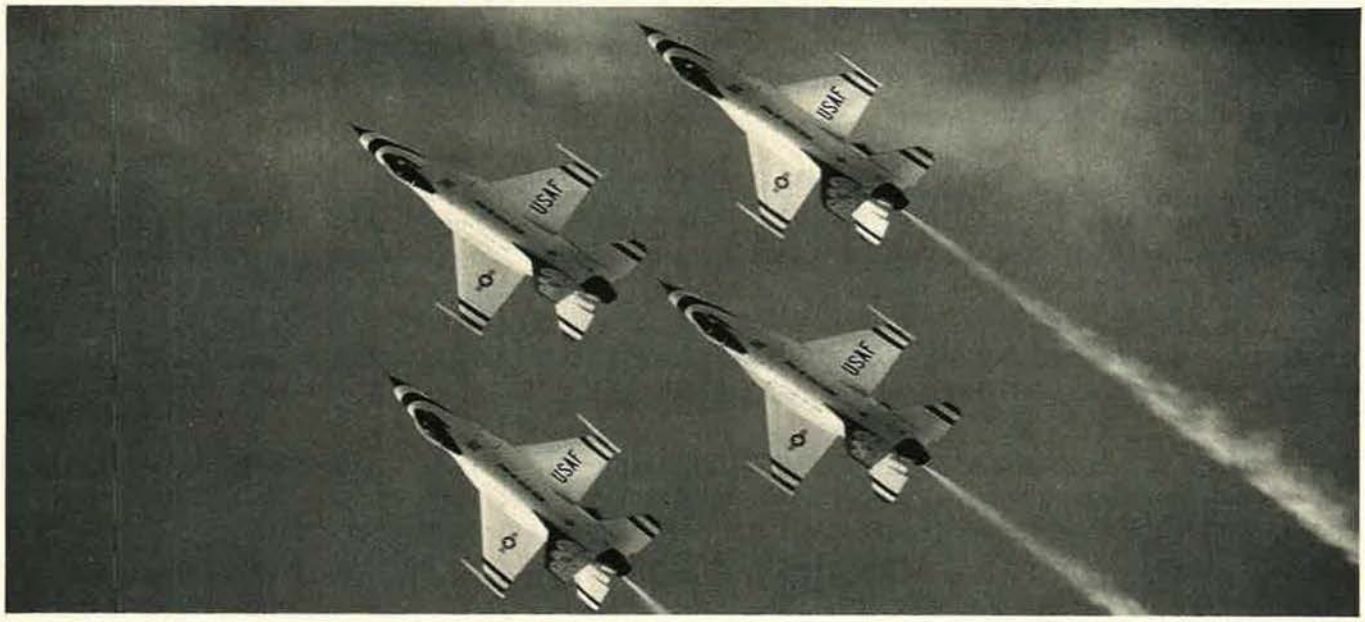

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Inexpensive aluminum clips help trim nearly $200,000 from the cost of a satellite. The clips were designed and used by Hughes to hold major structural elements of the new HS 601 communications satellites together. Previously the satellites were bonded together, a time-consuming process because of the close tolerances involved and the approximately one week required for each bond to cure. With about 250 structural joints per satellite, the clips save nearly $200,000 in hands-on labor per spacecraft. Another benefit of the technique is the elimination of bond testing. Verifying the torque, a much faster process, is all that's required with the new process.

A time-monitoring system helps track the cost and location of radar system parts during manufacture. The system, currently operating at Hughes, uses special terminals at each work station to read bar-coded information from employee ID badges and work orders at the beginning and end of each task. The data, including who worked on the task and the elapsed time, are used in labor tracking systems and an MRP-2 system to compile cost and performance figures. They also aid in quality inspection, production control, and the tracking of the location of every part during the assembly process.

A unique helmet-mounted visor display system will enable helicopter pilots to safely fly high-speed, nap-of-the-earth missions at night as well as in daylight. The Helmet Integrated Display and Sighting System, under development by Hughes and Honeywell, permits high resolution, television-like imagery to be displayed on the pilot's visor superimposed over the actual outside scene, without obscuring it. A magnetic head tracker, connected to an infrared sensor beneath the aircraft, enables the pilot to control the sensor merely by turning his head in the direction he wants to look. The system gives the pilot true head-up, eyes-out display capability for all parts of a mission and for all head motions.

Music listeners can hear dramatic 3-dimensional sound from conventional mono and stereo recording or broadcast sources, thanks to a sound reproduction technique developed by Hughes. This Sound Retrieval System (SRS) creates the ambiance and dynamic range of a live performance or studio recording. It retrieves and restores spatial information using real-time processing techniques that, like the human ear, recognize the direction from which a sound originates. Because its circuitry has been reduced to a single microchip, SRS is likely to be incorporated into a wide variety of audio products.

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★ **MILESTONES**—Within a week of each other, **both superpowers destroyed** the last of their nuclear **missiles covered under the** Intermediate Nuclear Forces **(INF) Treaty.** On May 6, the US destroyed the last of 846 Pershing 2 missiles covered by the INF accord. On May 12, the Soviet Union responded with the destruction of the last of 1,846 SS-20s.

On May 17, the **last Convair F-106B was retired** by NASA during ceremonies held at Langley Research Center, Hampton, Va. First delivered in 1959, the F-106B served as a testbed for F-106 series upgrades and was released from the Air Force inventory in 1970. The last piloted F-106B will be on display alongside other historic NASA and Air Force aircraft at the Virginia Air and Space Center.

Aircraft No. 8075 stationed at Travis AFB, Calif., became the **first C-141B to pass the 40,000-hour milestone.** One of thirty-three C-141s assigned to the 60th Military Airlift Wing, it was also the first C-141A to fly past the 10,000- and 25,000-hour marks. The C-141B is the "stretched" version of the A model.

The Air Force began the **largest depot maintenance program** it has ever undertaken when work began in April on the first of 118 C-141s, scheduled to have their wings removed, center wing box replaced, and wings reinstalled. While a project this size would normally be performed by the aircraft's manufacturer, in this case it is being handled at the Warner Robins Air Logistics Center, Robins, AFB, Ga. In 1988, USAF maintenance workers discovered fatigue cracks in the center wing lower panels of C-141s undergoing center wing repairs, thus touching off the program, which will continue through 1996.

In late April, the **new US space shuttle orbiter, *Endeavor,* was rolled out** in a ceremony at Palmdale, Calif., where it was assembled by Rockwell International's Space System Division. *Endeavor* is the fifth operational orbiter Rockwell has built for the US space shuttle program.

The Air Force's Phillips Laboratory at Kirtland AFB, N. M., successfully completed a **Strategic Defense Initiative low-power laser experiment** that demonstrated the system's ability to relay a laser precisely over long distances. Known as the Relay Mirror Experiment, the system involved a mirror-carrying satellite, which was traveling at more than 17,000 mph approximately 280 miles above the Earth, and two Earth sites in Hawaii. A low-power laser beam was successfully relayed from just east of Kihei to a site atop Mount Haleakala on Maui, using the orbiting mirror.

★ **PURCHASES—NASA Lewis Research Center awarded General Dynamics Commercial Launch Services, Inc.,** a $112 million contract for performance of **launch services for the Solar and Heliospheric Observatory** (SOHO) mission. Work under the contract is to begin immediately and end shortly after the SOHO spacecraft's scheduled launch aboard an Atlas IIAS vehicle in July 1995.

Lifebank Inc. of Valhalla, N. Y., is trying to sell the Defense Department on the idea of creating **"DNA Dogtags"** for all military personnel, so there will never again be an "Unknown Soldier." When Operation Desert Storm was launched, the company was reportedly already discussing that possibility with the Defense Department. Lifebank currently operates the only commercial blood storage facility for DNA identification. DNA is found in virtually every human cell in a pattern unique to each individual. An affiliated firm, Lifecodes Corp., used the technology to help identify remains from the USS *Stark,* ravaged by fire after being struck by two Iraqi-fired Exocet missiles during the Persian Gulf "Tanker War."

★ **DIED—Red Hopper,** chief designer of the *Spruce Goose* and former associate of industrialist Howard Hughes, on April 19th in a nursing home in Santa Monica, Calif. He was eighty-five.

Hopper, a graduate of the California Institute of Technology, joined the Hughes Aircraft Co. in 1939 as chief designer. The *Spruce Goose* that he designed for the company and the US Government during World War II was a plywood flying boat fifty percent larger than a Boeing 747. It was intended to carry cargo and troops across the Atlantic. The government lost interest in the project after the war, but in 1947 Hughes piloted the aircraft on its only flight, which covered several hundred yards in Long Beach, Calif., harbor. Hopper was at Hughes's shoulder, giving directions.

Paul Brickhill, seventy-four, author of *The Great Escape* and other war novels, of unknown causes. He worked as a journalist on *The Sun* newspaper in Sydney, Australia, before joining the Royal Australian Air Force during World War II. He trained as a fighter pilot in Canada, flew with a squadron in England, and was shot down over the Tunisian desert in 1943. Brickhill spent the remainder of the war in a prisoner-of-war camp that became the setting of *The Great Escape,* written in 1949. ■

Index to Advertisers

US forces are drawing down, pulling back, and following a plan the Joint Chiefs regard as a "moderately high risk."

The New Defense Strategy

By John T. Correll, Editor in Chief

THE United States has a new defense strategy, built around smaller forces and a different set of assumptions.

The threat of a short-warning, global war starting in Europe, the scenario that drove US defense planning for more than forty years, is no longer central.

In the new scheme of things, potential conflict in Europe assumes the status of a major regional contingency. In both Europe and the Pacific, the old concept of forward defense gives way to "forward presence" with fewer US troops stationed abroad.

The Air Force will keep a few tactical or composite wings in Europe and the Far East. Both the Army and the Air Force will rely heavily on National Guard and Reserve units for the reinforcement of Europe.

By the mid-1990s, US active-duty military strength will drop from 2.1 million to 1.6 million. Six Army divisions, ten fighter wings, and 110 Naval vessels go also.

"We are planning to eliminate those forces—be they active or Reserve—whose justification has been based on the previous threat of short-notice global war," Secretary of Defense Dick Cheney told Congress.

The big changes affect mainly the general-purpose forces and the planning for conventional conflict. The armed forces will be restructured for response to five general scenarios in which they might plausibly be required to deploy and fight. *(See chart on p. 27.)*

Fortunately, the most dangerous and difficult scenarios are the ones least likely to occur, but the Pentagon says that plans must take them into account because "the consequences of failure are so grave they cannot be ignored."

Fewer adjustments have been possible in strategic nuclear aspects of US strategy because the Soviet buildup of strategic nuclear forces continues relentlessly. Five or six new long-range ballistic missiles are under development, and the prospect is that Soviet strategic forces will have been fully modernized by the mid-1990s.

The Pentagon estimates, however, that Soviet ability to project conventional power beyond its borders

will continue to decline, whether by intent or as a by-product of economic troubles.

"We believe we will have sufficient warning of the redevelopment of a Soviet threat of global war so that we could reconstitute forces over time if needed," Secretary Cheney says.

That concept—reconstitution of forces—is pivotal in the new strategy. Crisis response forces, reaching far and hitting fast, are supposed to handle "urgent" threats in "compelling" locales. Anything bigger would depend on mobilization, reinforcement, and other measures.

Global change is only part of the motivation for the new strategy. Bowing to the inevitability of deep budget reductions, the Pentagon devised the best plan it could with the limited funding and forces that will be available.

Delayed Debut

The Bush Administration was all set to begin telling the public about the new strategy last August. In fact, the President outlined it in a speech August 2, but the news that day was dominated by Saddam Hussein's invasion of Kuwait.

The Gulf War over, Secretary Cheney and others have re-begun their explanation of a defense program that has been cut steadily since 1986 and will be reduced further by about twenty-five percent over the next five years or so.

The Pentagon declares that the new strategy represents its best judgment of threats and requirements, but at the same time, remains wary about how well this approach will work.

Secretary Cheney calls the outlook through Fiscal Year 1993 "a reasonably safe proposition." Depending on how circumstances develop beyond then, he holds open the possibility of asking the President and Congress to reconsider the reduction plans.

In an unclassified version of the *1991 Joint Military Net Assessment,* made public in April, the Joint Chiefs of Staff conclude that the revised defense program "provides minimum capability to accomplish national security objectives." It has a number of weak spots, leading to "an overall assessment of moderately high, but acceptable, risk."

Although the threat from the Soviet Union has lessened appreciably, the Joint Chiefs warn that "risk in the defense program is increasing because of key vulnerabilities emerging in the defense industrial base, underfunded R&D, sustainment shortcomings, strategic mobility shortfalls, and strategic defense deficiencies."

If the United States had to fight two regional contingencies at the same time or back-to-back, there would be shortages in airlift, sealift, prepositioned equipment, and supplies.

When the Pentagon gamed its scenario for a major crisis in the Middle East, the results were disturbing. Once the Desert Storm forces pull out, it would take forty-nine days—a week longer than the time line allowed in the scenario—to put in all of the forces, equipment, and materiel required to handle the contingency.

"The continued erosion of defense capability, left unchecked, will undermine the foundations of the US force structure and preclude the fostering of US interests," the Joint Chiefs conclude. "We are moving rapidly toward unacceptable risk."

Secretary Cheney reminded a gathering of former Congressmen April 17 that the 1st Tactical Fighter Wing from Langley AFB, Va., which responded splendidly when Operation Desert Storm opened last year, did not look nearly so good a decade ago.

"Within fourteen hours, we had the 1st Tactical Fighter Wing, a significant part of it, on the ground in Saudi Arabia, ready to go to war," he said. "Ten years before, the 1st Tactical Fighter Wing flunked its operational readiness inspection. Out of seventy-two aircraft in the wing back in 1980, only twenty-seven were combat-ready. The rest were hangar queens because of the lack of spare parts. If we do not make the right decisions as we go through the period immediately ahead when we're building down the force, we're going to wind up with exactly that kind of capability in the future."

Forward Presence

Compared to forward defense, the official explanation says, "forward presence is less intrusive in its deployments and more flexible in its response to unexpected requirements."

The difference would show up sharply in Europe, with perhaps half of the US forces pulling out by 1999.

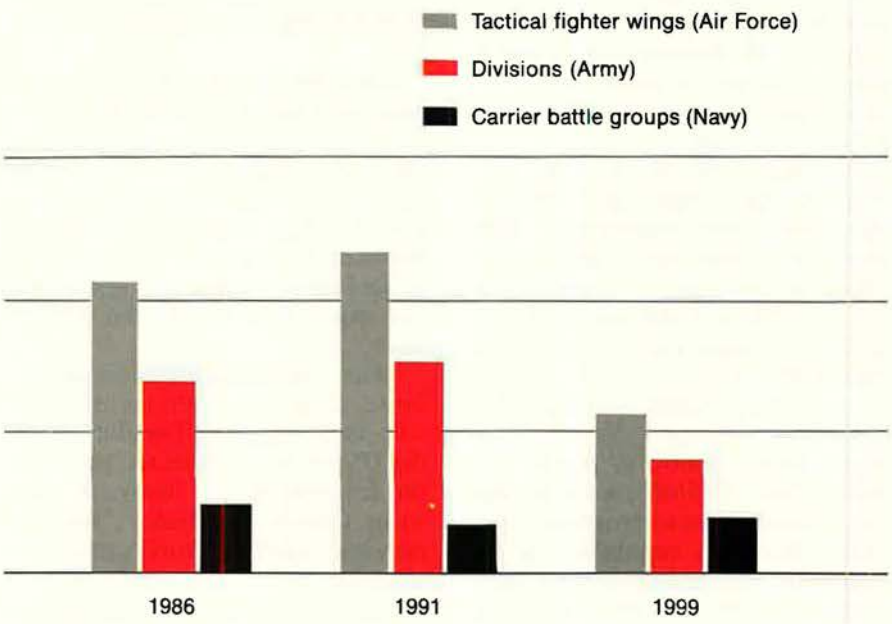
Adm. David E. Jeremiah, Vice Chairman of the Joint Chiefs of Staff, told the Senate Armed Ser-

Scenarios for Conflict

Scenario	Probability of Occurrence	Consequences of Failure	Level of Violence
Peacetime engagement (counterinsurgency, counternarcotics)	Medium to high	Very low	Low
Lesser regional contingencies	Medium	Low	Low to medium
Major regional contingency, West (Asia, Pacific)	Low to medium	Medium	Medium to high
Major regional contingency, East (Middle East, Persian Gulf)	Medium to high	High	High
War escalating from European crisis: potential for global conflict	Very low	Very high	Very high

The Joint Chiefs of Staff cite five conventional conflict scenarios, defining "plausible circumstances that might call for the application of US power."

US Drawdown in Europe



The difference between "forward defense" and "forward presence" will be seen in the diminishing level of US troops in Europe. The new strategy regards the threat to Europe as a regional contingency, albeit a major one.

vices Committee April 11 that the final decision had not been made, but that he expected "the active component of the Atlantic forces will eventually include a forward presence in Europe of a heavy Army corps with at least two divisions, a full-time Navy and Marine presence in the Mediterranean, and Air Force fighter wings possessing the full spectrum of tactical capability."

A chart Admiral Jeremiah gave the committee shows three Air Force fighter wings in Europe, backed up by two active-duty and eleven reserve fighter wings in the United States. "The bulk of the reserve components of the services have been allocated to the Atlantic forces," he said.

"We will keep a continuous Naval presence in the [Persian] Gulf, and we expect to exercise ground and air forces there regularly," Admiral Jeremiah added.

In the Pacific, the Air Force will station a few wings of fighters forward in Korea and Japan. The Army will keep one division in Korea. Otherwise, US presence will be the Navy and the Marine Corps, with reinforcements available from ground and air units in Hawaii and Alaska.

Four Army divisions, seven Air Force fighter wings, intertheater airlift, Naval forces from the Atlantic and Pacific, and special operations forces from all services will be employed as contingency forces.

"Because the emphasis in contingency response is on timeliness, the forces are versatile, primarily light, and drawn from the active components," Admiral Jeremiah said. In addition to the fighter wings and airlifters, the Air Force will contribute conventional strategic bombers, command and control aircraft, intelligence platforms, and other assets.

The Active-Reserve Mix

The Air Force, which has always used its Guard and Reserve components far more effectively than the other services have, will take most of its reduction in active-duty units. By the mid-1990s, the tactical forces will consist of fifteen active-duty and eleven reserve forces wings, a considerably closer ratio than at present.

Army Guard and Reserve components will be cut substantially. Two of the six Reserve divisions will be eliminated, and another two will convert to "cadre" status. Cadre units would have a full complement of equipment but greatly reduced manpower and training.

Air Guard and Reserve forces performed very well in the Gulf War, as did many reserve units from the other services, but their overall image was shaken when some Army National Guard roundout brigades reported in sorry shape and could not be sent to the war zone without remedial preparations.

Secretary Cheney points out that a quarter million Guardsmen and Reservists were called up and "performed absolutely magnificently." The only real problems, he says, were in three National Guard units.

"It's not any condemnation by any means of the Total Force concept or for the role of the reserves at all," he says. "What it does require is a minor adjustment in our assumptions about the readiness level of those ground combat brigades." Among the early adjustments was firing the commander of one of the problem units.

The annual report of the Joint Chiefs states flatly that "our assessment concludes that Army RC (reserve component) roundout brigades are not responsive to no-notice or short-notice contingencies."

Reconstitution and Sustainment

In many ways, the success of the new strategy hangs on two big assumptions: that there will be adequate warning time to reconstitute forces if required and that the reconstitution concept will work.

The *Joint Military Net Assessment* says that "reconstitution may well prove to be the linchpin of America's long-term security."

The report says that US forces "are potentially inadequate in the long-warning, global-war scenario because of mobilization shortfalls in personnel, training, and the industrial base." It cites sustainment shortages that include munitions, petroleum reserves, medical supplies, chemical-biological defense equipment, and various kinds of prepositioned stocks.

In an escalating European crisis, the Joint Chiefs project that "it would likely be six to twenty-four months before industrial base mobilization or surge production could begin to deliver critical items."

With the defense industry in general decline, the Joint Chiefs are concerned that sources for some products "may shrink to unacceptably low levels." The Pentagon relies on a dwindling handful of suppliers for such commodities as aircraft engines, radars, gun mounts, aluminum tubing, and optic coatings.

The Joint Chiefs estimate that by the end of 1997, "it would take two to four years to restore production capability to 1990 levels for items whose lines have gone cold."

Even now, the Defense Department must depend on foreign sources for machine tools, precision ball bearings, computer chips, optical components, and other products *(see table below)*. The extent of dependence on foreign suppliers is increasing steadily.

The limiting factor in several contingency scenarios is a shortage of airlift and sealift. In 1990, for example, the US had less than a third the number of militarily useful dry-cargo ships it did as recently as 1970.

For years, the Defense Department's nominal goal for airlift capability has been 66 million ton-miles per day. The current capability, counting the Civil Reserve Air Fleet, is 48 million. When the Air Force fields the C-17 airlifter, capacity will rise to 55 million, somewhat lower than previous projections because C-17 procurement has been cut from 210 aircraft to 120.

The Technology Revolution

"For some time, the Soviets have been writing about a military technological revolution that lies just ahead," Secretary Cheney told Congress. "They liken it to the 1920s and 1930s, when revolutionary breakthroughs, such as the blitzkrieg, aircraft carriers, and amphibious operations, changed the shape and nature of warfare.

"We have already seen the early signs of this revolution in the recent breakthroughs in stealth, information, and other key technologies," he said. "Whatever we do, the Soviets and others will be pursuing this revolution diligently. Revolutionary military capabilities are a reality with which our future strategy must deal."

At present, no country is ahead of the United States in any overall area of technology, but *Joint Military Net Assessment (see chart on p. 30)* shows the Soviet Union with significant leads in some areas of pulsed power and Japan significantly ahead in some areas of machine intelligence and robotics, photonics, semiconductors, microelectronic circuits, superconductivity, and biotechnology.

If the trend continues, the Joint Chiefs foresee that "many countries, including potential adversaries, may threaten US technological superiority in many areas of potential military significance."

The Defense Department investment in science and technology has declined over the past twenty-five years, even when the defense budget was rising. "Private industry has

Where Suppliers Are Short

Product or item	Number of Suppliers
Airborne radars	2
Aircraft engines	2
Aircraft landing gear	3
Aircraft navigation systems	2
Aluminum tubing	2
Doppler navigation systems	2
Gun mounts	2
Image converter tubes	1
Infrared systems	2
MILSPEC-qualified connectors	3
Needle bearings	2
Optic coatings	1
Radomes	2
RPV/missile/drone engines	2
Specialty lenses	2
Titanium extrusions	1
Titanium sheeting	3
Titanium wing skins	2

—USAF photo by Ken Hackman

Although reconstitution of forces is a major theme of the new strategy, the defense industrial base continues to decline. The armed forces depend on a handful of suppliers for the items listed here, and the* 1991 Joint Military Net Assessment *says, "We do not have either the authority or the resources to ensure that even this level of infrastructure will remain in the future."

The Critical Technology Balance

Critical Technologies	Soviet Union	NATO Allies	Japan	Others	
Air-breathing propulsion	■■	□□□	□□		
Biotechnology materials and processes	■■	□□□	□□□□	□□	Various
Composite materials	■■	□□□	□□□	□□□	Israel
Computational fluid dynamics	■	□□	□□	□□	Sweden and Israel
Data fusion	■■	□□	□□	□□	Israel
High-energy-density materials	■■■	□□□	□□□		
Hypervelocity projectiles	■■■	□□	□□		
Machine intelligence/robotics	■	□□□	□□□□	□□	Finland, Israel, and Sweden
Parallel computer architectures	■	□□	□□	□□	Switzerland, Israel, and Hungary
Passive sensors	■■	□□	□□		
Photonics	■■	□□	□□□□		
Pulsed power	■■■■	□□	□□		
Semiconductor materials and microelectronic circuits	■	□□	□□□□	□□	Israel
Sensitive radars	■	□□	□□	□□	Sweden
Signal processing	■■	□□	□□	□□	Sweden, Israel
Signature control	■■	□□	□□		
Simulation and modeling	■	□□□	□□□		
Software producibility	■	□□	□□	□□	Various
Superconductivity	■■	□□	□□□□	□□□	Switzerland
Weapon system environment	■■■	□□□	□□		

Position of Soviet Union relative to United States:

- ■■■■ Significant leads in some niches of the technology
- ■■■ Generally on a par with United States
- ■■ Generally lagging except in some areas
- ■ Lagging in all important aspects

Position of others relative to United States:

- □□□□ Significant leads in some niches of the technology
- □□□ Generally on a par with United States
- □□ Generally lagging except in some areas
- □ Lagging in all important aspects

not been able to make up the difference," the Joint Chiefs say. "The result has been a serious erosion in US technological leadership in the international community."

Historically, about sixty-one percent of the defense budget has gone for operations and support of forces and thirty-nine percent to the investment account (procurement and R&D). Of the investment share, approximately thirty percent has gone to R&D.

Over the next five years, Navy R&D spending will follow the historical averages, and the manpower-intensive Army will be well below them. The strongest push for R&D will be by the Air Force, which plans to pour 47.4 percent of its resources into the investment account, trading force structure for force modernization.

Secretary of the Air Force Donald B. Rice told the House Armed Services Committee February 26 that, in the near future, getting off an accurate first shot will no longer be enough to win a fighter engagement. "We are rapidly moving into an age in which the other guy will get his shot off before the missile impacts him, and the result of that engagement is that both of you are dead," Secretary Rice said. "That is the box we are moving into in air-to-air combat with the fighters that are currently being produced—not with the projected new generation of fighters—and that, we think, is untenable."

It is not yet certain, however, that a thrift-minded Congress will actually allow the Air Force to spend the amounts it has earmarked for a new fighter and other development and force modernization programs.

Meanwhile, some of the regional contingencies described in the new strategy are becoming more difficult propositions. In a prediction he repeats often, Secretary Cheney says that "by the year 2000, it is estimated that at least fifteen developing nations will have the ability to build ballistic missiles—eight of which either have or could be near to having nuclear capabilities. Perhaps thirty countries will have chemical weapons, and ten will be able to deploy biological weapons as well."

Elaborating on that in his April 17 talk to former Congressmen, Secretary Cheney said that "nobody in the developing world is likely to be able to match our technical sophistication in terms of precision guided munitions and stealth in the future, but what they are likely to do, and what may turn out to be the poor man's low-cost military option, will be a relatively crude ballistic missile with a relatively crude warhead on top, but that's enough to create real problems." ■

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TRW

The new fighter's first battle will be in the budget wars.

The F-22 Enters the Fray

By Robert S. Dudney, Executive Editor

IN THE two months since it was chosen to be USAF's fighter of the future, the new F-22 has inspired a mixture of extravagant praise and sharp criticism. Which impulse proves to be stronger could decide the fate of this advanced tactical fighter.

On one hand, even critics marvel at the sheer technical virtuosity of the F-22, which Air Force Secretary Donald B. Rice selected on April 23 to be the successor to the F-15 air-superiority fighter in the next century.

At the same time, the F-22 confronts imposing opposition on the political front. Skeptics in Congress and elsewhere question the requirement for this plane at a time when the Soviet Union is imploding and USAF arms, recently on display in the Persian Gulf War, are triumphant. Others claim the US simply cannot afford the F-22.

The Economist of London, usually sympathetic to Pentagon requests, captures the essence of the controversy surrounding the F-22 with this question: "Does America really need to leap a whole generation ahead in fighter technology, to build an aeroplane that can beat undreamed-of Russian fighters of the undreamed-of Russia of the next century?"

The Air Force answers with an emphatic "yes." The service's case was summarized by Gen. John M. Loh, commander of Tactical Air Command, in May testimony to Congress.

"We need the F-22 for three reasons," said General Loh. "First, air superiority is our most critical mission because it gives all our forces the freedom of action and the ability to conduct all other air and ground missions. Second, the Soviets continue to modernize all elements of their air defense system and are willing to export them virtually around the world. . . . Finally, it is impossible to give the aging F-15 the combination of stealth, supersonic cruise, supportability, and weapons that we get with the F-22."

At issue, says Secretary Rice, is nothing less than "air superiority into the next century." He says that the Soviet MiG-29 and Su-27 and France's Mirage F1 already must be counted as aerodynamic equals of the F-15.

The Air Force needs the highly maneuverable F-22 to maintain air superiority into the next century. TAC Commander Gen. John M. Loh praises the new fighter's "stealth, supersonic cruise, supportability, and weapons," which he asserts would be "impossible" to install on the aging F-15.

Even some who favor building the F-22 nevertheless question the need for building a full complement of 648 fighters. Secretary Rice notes that the figure equates to five and one half tactical fighter wings, the number planned for air-superiority aircraft in the twenty-six-wing force of the mid-1990s and beyond.

Affordability At Issue

Finally, there are those who claim the F-22 is just too expensive, whatever its merit. They note official estimates that the Air Force will have spent some $98 billion on this airplane by the time it pays for its final order in 2014.

That figure has been calculated in "current" dollars, with lots of inflation factored in. In constant 1992 dollars, the total is about $72 billion —$13 billion for development and $59 billion for production articles. That's still a big sum, but not out of line for a major defense program.

In budgetary terms, says Secretary Rice, the program is in "very good shape" at least through Fiscal 1994 and perhaps Fiscal 1995. He says USAF must provide more money in Fiscal 1996 and Fiscal 1997, the final two years of the six-year defense program.

However, the Congressional Budget Office, in a widely publicized report released April 22, said USAF would have trouble affording the ATF. The author, Robert Hale, speculated that the F-22 would soak up fighter funding and spell trouble for a new Multirole Fighter in development to replace the F-16. Hale warns that, if USAF buys more than a few wings of F-22s, it will not have enough money to hold on to even a twenty-six-wing force. Air Force officials take the position that the CBO report is based on worst-case assumptions and distorts the true picture.

The Air Force's April 23 decision marked the culmination of an extensive demonstration and validation phase of ATF development that began in October 1986. The F-22, based on YF-22 prototype aircraft, would be the first new air-superiority plane since the F-15 became operational in 1974. The decision propels the new fighter program into full-scale development.

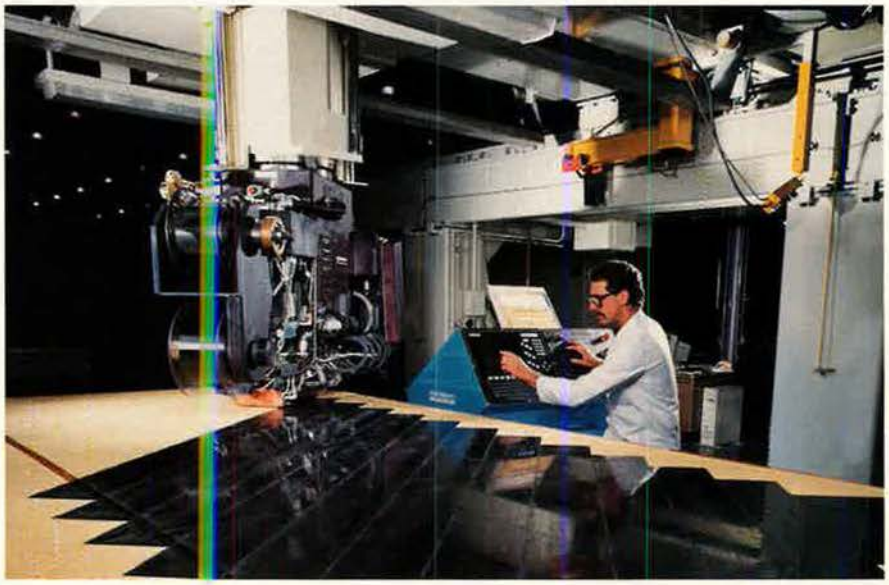
At the same time, the Air Force selected the Pratt & Whitney F119 engine to power the F-22. The P&W entry defeated the General Electric F120 powerplant.

The F-22's Pratt & Whitney powerplant will have two-dimensional thrust-vectoring nozzles tailored to meet the Air Force's aerodynamic and low-observable requirements. They are able to vector thrust to a maximum of twenty degrees.

The YF-22 aircraft, which won out over the Northrop/McDonnell Douglas YF-23 entry, was designed by prime contractor Lockheed Corp. in Burbank, Calif., where the forward part of the fuselage was built. Boeing Co. in Seattle, Wash., built the wings, aft fuselage, and much of the YF-22's avionics. General Dynamics Corp. built the mid-fuselage and landing gear in Fort Worth, Tex. Lockheed, the integrator, assembled the F-22 in one of its Palmdale, Calif., facilities. During the FSD phase, this arrangement will continue, with the important exception that Lockheed will assemble the fighters at its plant in Marietta, Ga.

Twenty-seven subcontractors are signed up for various parts of the development effort. *(See p. 38.)*

Secretary Rice says that first flight of an FSD aircraft is to take place forty-eight months after the signing of the FSD contract, or in about mid-1995. The Lockheed/



The use of composites will help the F-22 approach USAF's weight requirement for the ATF. Up to forty percent of the prototype was said to be made up of these nonmetallic materials. Thermosets and thermoplastics may be used on the production F-22.

Boeing/General Dynamics team will build thirteen FSD aircraft, although two will be static test planes and will not fly. FSD will run through Fiscal 1999. Production begins in late 1997 and the first production aircraft will be assembled in 2001.

USAF's Demands

From the outset, the Air Force insisted that its next-generation fighter must not only be fast, stealthy, and agile but also supportable, maintainable, and affordable. Evidence is that the F-22 will be all of those things, and perhaps more.

The Lockheed YF-22 prototype has a diamond-shaped nose section and trapezoidal, cantilevered wings that sweep back at an angle of forty-five degrees. With a length of sixty-four feet, two inches and a wingspan of forty-three feet, Lockheed's ATF is about the same size as the F-15 Eagle that it will replace.

Compared to the Northrop/McDonnell Douglas team, the Lockheed-led group presented a plane of relatively conventional design and appearance. The overarching goal was to produce what Lockheed officials call a "balanced design"—that is, a fighter aircraft that exhibited not only stealth and supercruise qualities but also superior agility in air-to-air combat and great reliability and ease of maintenance.

That the F-22 came out this way is no accident. In public comments since the April announcement, Lockheed officials have confirmed what many had already deduced: that the contractor team was determined to maintain the F-22's agility by resisting the temptation to overemphasize speed and stealthiness.

This determination, the officials maintain, stems from a basic belief that the age of the dogfight is not over and that fighters of the future still will have to be good at close-in, confusing, fighter-vs.-fighter turning engagements.

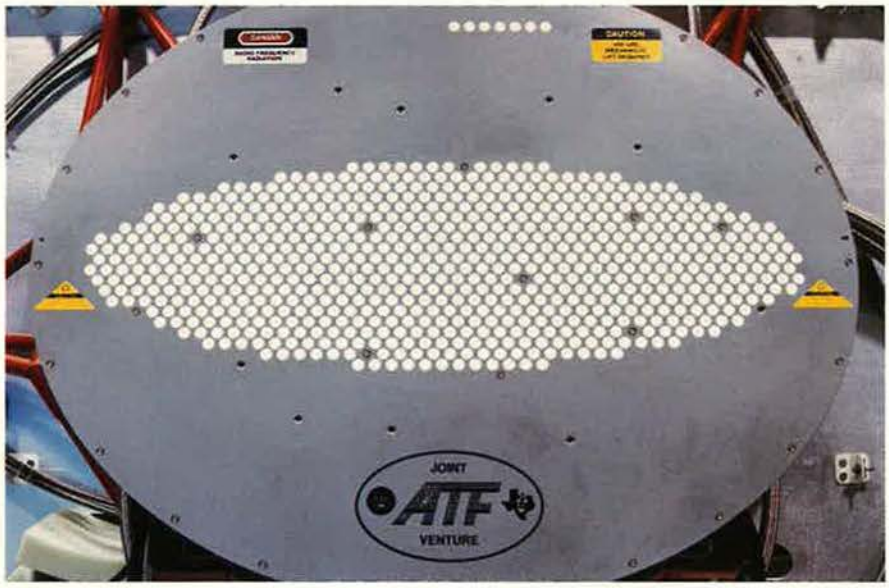
The Air Force maintains, however, that there was no *pronounced* clash of development styles and that selection officials were dealing in "shades of differences" between the YF-22 and YF-23 and the two engines. Said Secretary Rice: "It would not be a fair statement that one of these airplanes is noticeably more maneuverable than the other. Nor is it a fair statement that one of them is noticeably stealthier than the other."

Indeed, by no means does the F-22 stint on low-observable technologies. The YF-22 (and the YF-23, also) met or exceeded all requirements for reduction of the radar cross section and other aspects of low observability, say Air Force officials. Precise data are classified, but the Air Force believes that the ATF will not only be stealthy, but "very" stealthy. This result validates a view held by the program manager, Brig. Gen. (Maj. Gen. selectee) James Fain, that stealthiness could be achieved—and would have to be achieved—without sacrificing performance and supportability.

The YF-22 prototype was built of composites and metals, mostly aluminum. Composite content of the airframe is said to be up to forty percent nonmetallic. Moreover, it is possible that a large number of thermoset and perhaps thermoplastic composites will be used extensively on the production F-22, the better to reduce the aircraft's weight.

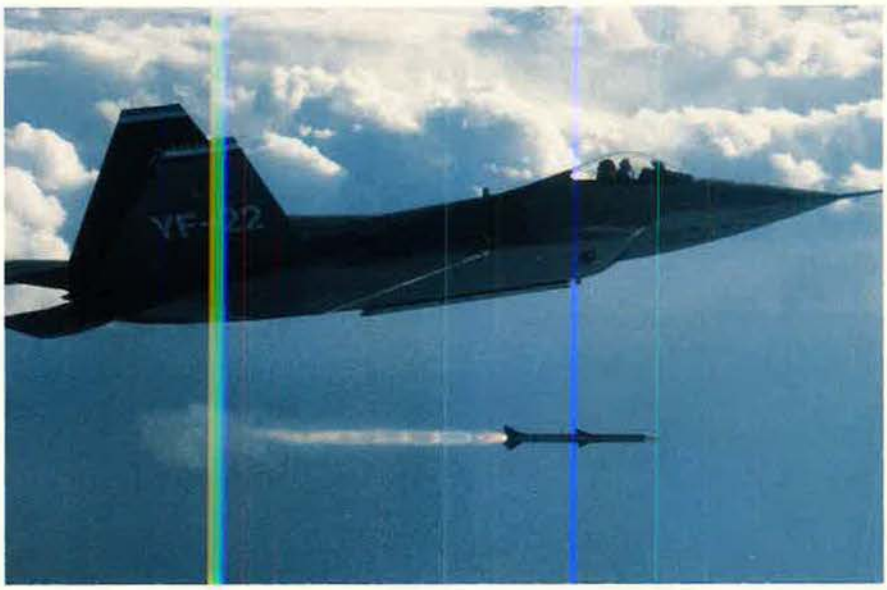
Pushing to Lose Weight

The company will seek to do this



The F-22's radar features this active, electronically scanned array antenna that is designed to operate in about twenty-five modes and provides the aircraft with long-range target acquisition, target track, and fire-control capability.

The F-22 got the nod only after a strenuous competition with the Northrop/McDonnell Douglas YF-23. The competition included midair refuelings, hours of supersonic flight, and agility demonstrations at angles of attack up to sixty degrees.



The F-22 will carry all of its weapons internally. During tests last December, the prototype YF-22 successfully launched an AIM-120 AMRAAM (above), having earlier launched an AIM-9 Sidewinder.

because, in the FSD phase, F-22 weight-reduction will remain a high priority. The fighter seems certain to exceed a 50,000-pound gross weight limit laid down in the original package of parameters.

On the YF-22 (and YF-23), some original ATF features had been eliminated, in keeping with USAF's weight and $35 million unit flyaway cost objectives. In early trade studies, the ATF's transonic maneuvering capability was reduced by one half G. The ATF will have short-landing capability, but USAF long ago dropped the original requirement for thrust reversers.

In the same trade studies, the fighter's internal weapons carriage capability was lowered. In test flights, the YF-22 fired the AIM-120 AMRAAM and AIM-9 Sidewinder missile. The new fighter will carry internally what USAF calls "a full complement" of this type of air-to-air armament, but the exact number is classified.

In test flights during the last year, the YF-22 prototype demonstrated remarkable agility. Lockheed's planes flew seventy-four flights. The aircraft showed it could operate at a sixty-degree angle of attack without losing effective combat control. The two YF-22 prototypes accumulated several hours of flying time at supersonic speeds, during which the planes showed an ability to maneuver well at high Mach numbers.

Compared to the YF-23, the YF-22 has a more conventional design. Seeking to "balance" stealth and supercruise with reliability and ease of maintenance, Lockheed was also determined not to sacrifice agility.

A big reason for this maneuverability is that the YF-22 has been fitted with specialized thrust-vectoring nozzles. The F-22 will be similarly equipped with two-dimensional vectoring nozzles tailored to meet the Air Force's aerodynamic and low-observable requirements. The nozzles are hydraulically actuated and vector thrust to a maximum of twenty degrees.

Air Force Systems Command's Aeronautical Systems Division (ASD) proved the concept of thrust-vectoring in recent years with its F-15 STOL/Maneuvering Technology Demonstrator program. Once perfected, the thrust-vectoring feature will enhance the F-22's power to take off on short runways and make tight turns.

The winning Pratt & Whitney F119 engine shows that the Air Force's ambitious requirements for the new aircraft's engine sparked a major boost in propulsion technologies. Both P&W and GE technologists discovered ways to greatly increase thrust, reduce weight, and enhance the reliability of fighter engines.

The ATF engines have radically new compressor designs. The compressor blades are short and fat, rather than long and thin as are the fighter engine blades of today. This development makes it possible to reduce the number of compressor stages and overall length of the engine. These moves reduce weight, save space, and make the engine less likely to break. In the F119 powerplant, fewer blades and parts are needed. Those that remain are sturdy and less likely to malfunction in harsh operating environments.

The F119 is a low-bypass, easy-to-maintain powerplant of the 35,000-pound-thrust class, though insiders maintain that its true power level exceeds that figure. During prototype flight test, the F119 made sixty-five flights covering 113 hours. No in-flight mishaps occurred.

Overmatching the F-15

Specific fuel consumption is lower than in the fighter engines of today, a feature that will give the F-22 a longer combat radius. Plans call for the F-22, in military power, to have a larger speed/altitude operating envelope than does the F-15 using its afterburner.

In many ways, it is the F-22's exotic, supersophisticated avionics suite that lies at the heart of the new fighter. Much work is yet to be done over many years in the task of creating a totally "integrated" layout of ATF avionics.

The task entails pulling together all functions and support technologies in a coherent system of thoroughly blended elements that will make obsolete today's standard avionics systems. The prize for this massive effort will be a single central electronic nervous system able to coordinate sensors, flight and propulsion controls, weapon controls, cockpit displays, and countermeasures.

The technology most critical to the integrated avionics system is integration itself. F-22 developers are devising means to fuse awesome amounts of data from multiple sources to satisfy a variety of needs, from target classification to weapon selection to optimum flight path.

General Dynamics will provide an advanced electronic warfare system and a new communications-navigation-identification system, both of which stem from USAF development programs.

The F-22's Pave Pillar–style architecture is based on common modules that can be packaged as a unit and used in multiple applications. Expensive "black boxes" will disappear; the new aircraft will use complex software to sort out electronic signals and distribute data to various displays.

In this, the pivotal technology is the very-high-speed integrated circuit (VHSIC) semiconductor. VHSIC chips are smaller and faster than today's chips but are expensive and difficult to manufacture.

Radar, electronic warfare, communications, navigation, identification of friendly and enemy aircraft, and fire control are the most basic functions of today's avionic systems. The integrated avionics system will give the pilot the data needed for decision-making and task management without burdening him with details of system operation, as is the case today. Further, the system will be highly reliable and fault tolerant. It will support rapid mission turnaround, high sortie rates, and long periods of operation in austere locations.

Though some have questioned the need for the technological leap embodied in the F-22, USAF Secretary Rice has no such doubts. Citing aircraft advances in the USSR and elsewhere, he says, "We are not interested in an even match in the skies."

The F-22 cockpit will boast multifunction, flat-panel, color displays that allow the pilot to select the display and the level of detail. The panels also will give pictorial representations and symbols to convey information about threats and targets. F-22 designers plan to use active-matrix, liquid-crystal displays, which are lightweight, use little power, are reliable, and can be viewed even in harsh glare. They are, however, expensive.

F-22 Sensors

As for sensors, the F-22 may eventually contain an infrared detection system. It is highly likely that the new aircraft will be equipped with a high-power, phased-array radar, which will contain an active, electronically scanned array antenna.

This system would be the operational result of the Air Force's so-called "Ultra Reliable Radar" program, launched in 1983 with the aim of building a radar with a solid-state array based on gallium arsenide devices. Contractors Westinghouse, Texas Instruments, and IBM all produced portions of the multimode radar. The system will have greater detection range than today's fighter radars. It also is expected that enemy aircraft will have much more difficulty detecting and intercepting the ATF radar emissions.

The F-22 promises to set new standards for reliability and maintainability *(see "Staying Power" by James W. Canan, p. 42).* The Lockheed-led industrial team confidently predicts that life-cycle operating and support costs for a typical F-22 squadron of twenty-four aircraft will be substantially less than those for an equivalent-sized F-15 unit today.

For all the airplane's capabilities, the Air Force is only too aware it faces a tough job selling the F-22 to Congress. It thinks, however, that it has no option but to press ahead. Production is the best of the available options.

Maj. Gen. Joseph W. Ralston, director of Tactical Programs at USAF headquarters, told Congress in April that the Air Force has looked at upgrading the F-15 and the F-16 but that this would at best merely keep the Air Force even with the front-line Soviet and Western equipment and not ahead, as the F-22 would do.

"We're not interested in an even match in the skies," says Air Force Secretary Rice. "We're interested in maintaining American air superiority." ■

MAJOR F-22 SUBCONTRACTORS

COMPANY	COMPONENT
AiResearch Los Angeles Div., South Bend, Ind.	Wheels and Brakes
Allied-Signal Aerospace Co., South Bend, Ind.	Wheels and Brakes
Curtiss Wright Flight Systems, Fairfield, N. J.	Leading Edge Flap Driver System, Side Bay, and Weapons Bay Door Drive
Digital Equipment Corp., Merrimack, N. H.	Systems/Software Engineering Environment (S/SEE)
Dowty Decoto, Inc., Yakima, Wash.	Hydraulic Actuators
EDO Corp., College Point, N. Y.	Missile Launchers
Fairchild Defense, Germantown, Md.	Data Transfer Unit (DTU) Mass Memory
GEC Avionics, Atlanta, Ga.	Head-Up Display (HUD)
General Electric Co., Utica, N. Y.	Electronic Combat
Harris, Melbourne, Fla.	Avionics Bus Interface (ABI) Fiber Network Interface Unit (FNIU) Fiber Optic Bus Components (FOBC)
Hughes Radar Systems Group, Los Angeles, Calif.	Common Integrated Processor (CIP)
Kaiser Electronics, San Jose, Calif.	Controls and Displays Graphics Processor Video Interface (GPVI)
Kidde-Graviner Ltd., Slough, UK	Fire Retardation Equipment
Lear Astronics Corp., Santa Monica, Calif.	Vehicle Management System Modules
Lockheed Sanders, Inc., Nashua, N. H.	Common Automatic Test System (CATS) Software Controls and Displays Electronic Combat Graphics Processor Video Interface (GPVI) Mission Planning Element (MPE)
Menasco, Inc., Fort Worth, Tex.	Nose/Main Landing Gear
Motorola, Inc., Scottsdale, Ariz.	Computer Security (KOV-5)
National Water Lift Pneumo Corp., Kalamazoo, Mich.	Flight Control Actuators
Parker-Hannifin Corp., Irvine, Calif.	Flight Control Actuators, Reservoirs
Rosemount Inc., Burnsville, Minn.	Air Data Probes
Simmonds Precision, Vergennes, Vt.	Fuel Management System
Sterer Engineering, Los Angeles, Calif.	Nose Wheel Steering
Texas Instruments, Inc., Dallas, Tex.	Radar Vehicle Management System Core Hardware
TRW Avionics & Surveillance Group, San Diego, Calif.	Communications, Navigation
United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.	Environmental Control System (ECS)
Westinghouse Electric Corp., Baltimore, Md.	Radar
XAR, Inc., City of Industry, Calif.	Aerial Refuel Receptacle

Source: Lockheed Aeronautical Systems Co.

Q: Which aerospace company has produced more military flight control systems than any other?

A:
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- ☐ General Electric
- ☐ Honeywell/Sperry
- ☑ Lear Astronics

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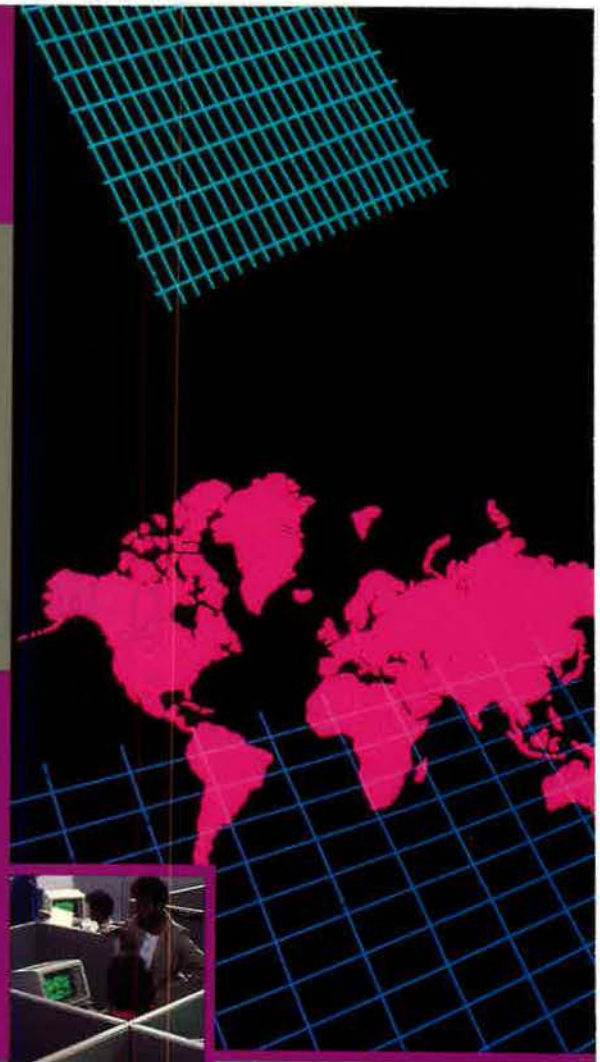

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The search-and-rescue mission is only part of the story.

CAP's Half Century

By Amy D. Griswold, Editorial Assistant

THE Civil Air Patrol (CAP) this year celebrates a half century of national service. Its national convention, to be held August 9–10 in Washington, D. C., is the centerpiece of the celebration.

CAP was established December 1, 1941, under the Office of Civilian Defense as a way to help aviation enthusiasts and owners of light aircraft use their skills and equipment to protect the United States in World War II. During the war, CAP antisubmarine patrol crews flew 86,685 missions along the Atlantic and Gulf coasts, most for reconnaissance only.

Once, a German U-boat escaped into deep water after having been trapped for half an hour on a sandbar. After that incident, CAP crews carried demolition bombs and depth charges. CAP Coastal Patrol planes spotted 173 submarines. The CAP pilots attacked fifty-seven of these boats, dropping eighty-three bombs and depth charges. They sank two U-boats.

Wartime CAP members flew patrols along the Mexican border, watching for enemy agents trying to sneak into the United States. They provided some airlift of war supplies and towed aerial targets for gunnery practice.

In 1946, CAP became a permanent peacetime institution and, two years later, the Air Force's official civilian auxiliary.

Today, CAP is a volunteer, nonprofit organization with more than 60,000 members, of whom about one-third are teenagers in the cadet program. The Air Force provides a staff of 105 military and civilians who work at Hq. CAP-USAF at Maxwell AFB, Ala., as well as 160 CAP-USAF liaison workers in CAP's eight geographic regions and fifty-two wings.

Each state, as well as Puerto Rico and the District of Columbia, has a CAP wing. These units are subdivided into groups, squadrons, and flights. There are approximately 1,900 individual units.

CAP has three main missions: emergency services, aerospace education, and the cadet program.

The emergency services mission is the most visible and probably the most familiar of CAP's activities. It includes search and rescue (SAR), disaster relief, and civil defense. The Air Force relies heavily on the SAR services of CAP members, who fly eighty percent of the SAR mission hours directed by the Air Force Rescue and Coordination Center at Scott AFB, Ill.

In 1989, CAP responded to the twin disasters of Hurricane Hugo and the San Francisco earthquake by airlifting supplies, flying officials on damage-assessment sorties, and working with other agencies to set up emergency shelters and restore ground communications.

In addition to traditional emergency services, CAP has assisted the US Customs Service in its counternarcotics efforts since 1985. Unarmed CAP crews fly reconnaissance missions along US borders. They also fly similar missions for the Drug Enforcement Administration and the US Forest Service.

CAP's second mission area is education. The organization sponsors 200 aerospace education workshops annually at colleges and universities across the country.

CAP also develops and distributes educational materials that teachers can use in their classrooms, helping approximately 5,000 teachers in this way each year.

In conjunction with NASA and the Federal Aviation Administration, CAP sponsors the National Congress on Aviation and Space Education, the annual national convention for aerospace teachers.

The cadet program seeks to "develop the potential of young people through physical fitness, leadership training, and moral, military, and aerospace education," according to CAP's 1990 Annual Report to Congress. Cadets receive training in flying, survival skills, rescue, first aid, radio communications, navigation, weather, and aviation.

Cadets participate in such special activities as the International Air Cadet Exchange or Cadet Officer School, located at Gunter AFB, Ala. Cadets also compete for scholarships at the local, state, and national level.

After completing initial training, CAP cadets receive the Gen. Billy Mitchell Award, which entitles them to enlist in the Air Force at pay grade E-3. Each year, about 200 cadets do so. ■

By the turn of the century, airplanes may be rugged and reliable enough to go for days with minimal maintenance.

—USAF photo by TSgt. Rose Reynolds

Staying Power

By James W. Canan, Senior Editor

AIR Force tactical aircraft demonstrated staying power in Operation Desert Storm that was almost beyond belief. Throughout six weeks of unrelenting, round-the-clock missions, USAF's air-to-air and attack fighters sustained readiness rates unprecedented in modern warfare.

The planes also set all-time records for wartime sortie rates and could have done even better. They were flown nowhere near their physical limits. Even though aircrews outnumbered the airplanes and took turns in cockpits to keep them flying, the crews were too few to do all the missions that the planes themselves could have managed.

"Our airplanes were often on the ground not because they were incapable of flying, or because they were being worked on, but because we literally didn't have anyone available to fly them," explains Brig. Gen. William E. Collins, Air Force special assistant for Reliability and Maintainability at the Pentagon.

There is every reason to believe that Air Force planes will become even more dependable than they proved to be in Desert Storm. The trend is clear. Latest variants of contemporary fighters emerged from production much more rugged, and requiring less logistical support, than did earlier models in previous years. Even greater reliability and maintainability are expected of the coming generation of Air Force aircraft, exemplified by the hot, stealthy Advanced Tactical Fighter (ATF).

The reason is that the Air Force has succeeded in making R&M a way of life.

General Collins claims that the astounding mission capable rates racked up by Air Force planes in Desert Storm reflect the service's "tremendous emphasis on reliability, maintainability, and supportability" in recent years. Actions taken in the acquisition and logistics arenas have made USAF's flying machines, from airlifters to fighters, much harder to break, a whole lot easier to fix, and, thus, far more combat-capable than ever before.

General Collins observes, "If your airplanes can't be flown and your equipment frequently breaks, you're left with very little in the way of combat capability."

Technicians replace a radar receiver in an F-111. New avionics systems and avionics upgrades are prominent among Air Force programs to improve the reliability and maintainability of planes and other major systems. USAF's focus on R&M has paid off handsomely, as shown by Operation Desert Storm, and bigger gains are said to lie ahead.

The Air Force began going all-out for reliability and maintainability about seven years ago. It set a new policy called "R&M 2000" that put R&M on a par with performance among top-priority requirements for new systems, gave the operating commands more say in setting R&M standards for those systems, and directed the R&D commands and their contractors to pay attention to R&M throughout the acquisition process—from drawing boards to production lines—for all systems.

Days Without Downtime

Among other things, USAF aims to make its planes so rugged and readily reparable by the turn of the century that they will be able to fly for days on end without downtime for failures and go anywhere, anytime with minimal maintenance and logistical support.

The Air Force is getting there. Mission capable rates of its combat aircraft in sand-blown Persian Gulf environs ranged from the "low" side of nearly eighty-six percent for the F-117A Stealth fighter and nearly eighty-nine percent for the F-4G Wild Weasel to highs of ninety-five-plus percent for the F-15E, F-16C, and A-10 attack aircraft. The F-15C air-superiority fighter and the F-111F attack plane achieved readiness rates of roughly ninety-four percent and ninety-two percent, respectively.

The F-111Fs went to war while their avionics suites were being upgraded. Even the partial modernization of those suites reportedly helped to keep the F-111Fs from faltering for weeks at a time during some of the war's most arduous attack missions.

Avionics upgrades have been prominent among preplanned product improvement (P^3I) programs aimed at making all kinds of Air Force systems more reliable and maintainable. Such programs have proliferated and have proved well worth the candle. The F-111 provides a case in point.

Several Thousand Hours

USAF set about modernizing the F/FB-111 fleet's avionics suites a few years ago. Results in terms of reliability are impressive. For example, the mean time between failures (MTBF) of the plane's Doppler radar set stretched from forty-nine hours to several hundred hours; of its inertial navigation system, from nineteen hours to several thousand hours.

Avionics modernization programs also have done wonders in recent times for the reliability of F-4E fighters, all now retired from the active-duty combat force, and of RF-4C tactical reconnaissance planes and F-4G Wild Weasels, both of which were doughty performers in Desert Storm.

Desert Storm left no doubt that "we're right on track with R&M 2000," says General Collins. "We can now see the kinds of improvements in reliability and maintainability that we expected to see. Combat readiness of Air Force weapon systems in Desert Storm was better than their peacetime readiness almost across the board."

There were favorable extenuating circumstances. The planes flown by Desert Storm squadrons were those with the best R&M records in their respective wings and were chosen for combat at least partly on that basis. "We put our best foot forward," says General Collins. "We sent the first team."

The Air Force also had plenty of time before the shooting started to set up sophisticated, on-the-scene supply and maintenance infrastructures in support of its combat aircraft. Fuel was plentiful.

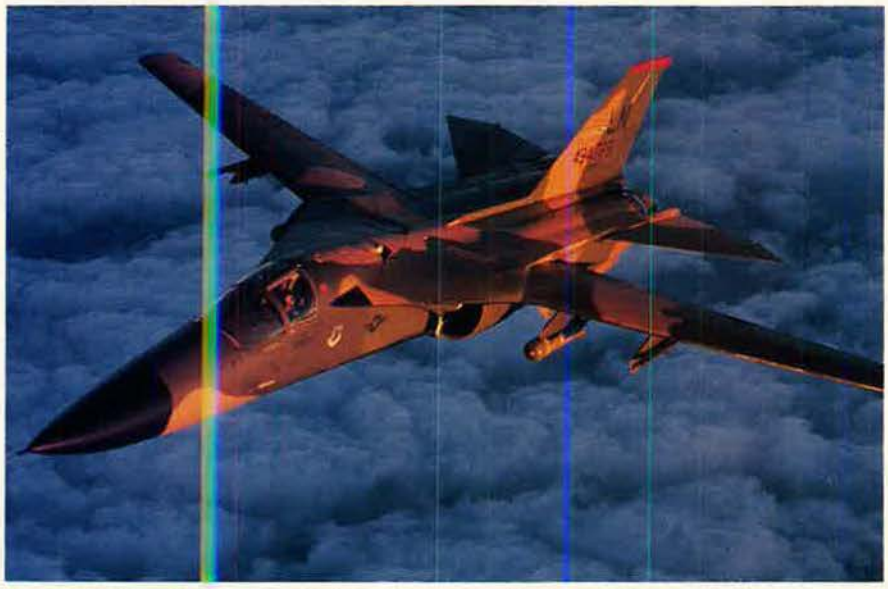
None of that detracts from the display of durability that Air Force planes put on under Desert Storm duress.

The F-15E, among the hardiest of high-performance aircraft in Desert Storm, was designed and developed in deference to R&M demands. Each F-15E emerged from production equipped with a new ring-laser gyroscope, an advanced APG-70 radar, and a state-of-the-art, solid-state engine monitor, all of which were designed to give the dual-role fighter an edge in R&M over previous F-15 variants. USAF did not ignore those variants, though. It has modified them right along, keeping an eye on R&M, and F-15Cs among them held up handsomely through the war.

During Desert Storm, Brig. Gen. Richard B. Myers, Tactical Air Command's Deputy Chief of Staff for Requirements, told an Air Force Association symposium in Orlando, Fla., that the F-15E's ring-laser gyro had demonstrated "a fifty-five-fold increase in reliability" over the navigation system in older-model F-15s.

The F-16, which ranked right up there with the F-15E as a ready-to-go wartime fighter, is a little different matter—more "an evolutionary R&M success story," as General Collins describes it.

F-16 production had long since begun by the time the Air Force focused on R&M. Thus, "reliability



—USAF photo by SrA. Chris Putnam

An F-111 of the 48th Tactical Fighter Wing, RAF Lakenheath, UK, returns from a Desert Storm sortie. All USAF planes in the Gulf War chalked up hard-to-believe mission capable rates under demanding conditions and could have done more.

and maintainability were not up-front considerations" in the F-16 program and, instead, have been built into it "through a succession of block upgrades" in the course of its production, he explains.

One such upgrade gave the fighter a new electrical power source billed as a "high-reliability, maintenance-free battery." Its MTBF turned out to be 1,500 hours—thirteen times better than the battery it replaced.

The R&M-on-the-run technique seems to have worked fine for the F-16, which now needs relatively little logistical backup to keep in shape to fly.

A good gauge of an aircraft's reliability and maintainability is the extent of the support equipment that it requires—for example, the number of line replaceable units (LRUs) in the War Readiness Spares Kits deployed with the aircraft. The more LRUs in the kits, the lower the plane's reliability.

—Lockheed photo by Eric Schulzinger

Lockheed Aeronautical Systems Co. used portable software (above) to integrate its computer network in designing its YF-22 Advanced Tactical Fighter (below) for the utmost in reliability and maintainability together with unprecedented performance.

By such reckoning, the F-16 is demonstrably superior—and hardly by chance. "Many of the changes in the [production] block updates of the F-16 were made with an eye to reducing its support equipment, costs, and people," General Collins says. Deployment of F-16 units in peacetime Coronet Warrior exercises demonstrated the need for such changes.

Reliability Through Technology

They seem to have done the trick. It takes 2,776 LRUs costing $82 million to support a twenty-four-plane squadron of F-111s, 2,092 LRUs costing $25.5 million to support a squadron of F-15Cs, and 1,220 LRUs costing $14.6 million for a squadron of F-16s. It is no coincidence that the F-111, the F-15, and the F-16, respectively, represent the technologies of the 1960s, the 1970s, and the 1980s—which makes another point.

"Oftentimes, we can achieve reliability only through new technology," General Collins declares. He points out, for example, that the reliability of contemporary solid-state electronics equipment, featuring embedded circuitry, is incomparably greater than that of vintage vacuum-tube electronics gear with its failure-prone profusion of connective wiring.

"Applying technology for the express purpose of R&M, not just for the sake of doing something new, opened up many possibilities for us," he declares.

Exploring those possibilities is the aim of USAF's four-year-old Reliability and Maintainability Technology Insertion Program (RAMTIP) at Wright-Patterson AFB, Ohio. Among RAMTIP advances: liquid-crystal transistor displays, which are to replace analog displays on airlifter instrument panels, and the On-Board Inert Gas Generating System (OBIGGS).

OBIGGS is clearly an R&M boon. Built as a prototype for the C-17 airlifter, the system collects inert nitrogen gas from the atmosphere and pumps it into fuel tanks, displacing the air that collects there and, thus, reducing the risk of fuel-vapor explosions. USAF's development of a related system, the On-Board Oxygen Generating System (OBOGS) should enable it to dispense with unwieldy land-based liquid oxygen (LOX) facilities.

The Air Force is bent on shucking off such support facilities. They impede the deployment and complicate the combat operations of its tactical units. At this time of accent on global reach for USAF, the mobility and flexibility of those units are what it's all about.

To that end, composite wings are

the coming thing for USAF. Unlike traditional single-mission, unitary-aircraft wings, each composite wing will embody mixed types of airplanes capable of carrying out many kinds of missions; for example, air-superiority fighters, general-purpose fighters, long-range attack aircraft, tankers, and radar picket planes, all based in one place under one commander.

A richly diverse composite wing will begin taking form early next year at Mountain Home AFB, Idaho. The wing is expected to consist of F-15Cs, F-15Es, F-16Cs, E-3 AWACS planes, KC-10s, and, sooner or later, B-52s. Composite wings with different makeups are slated for Seymour Johnson AFB, N. C., and Pope AFB, N. C. The wing at Pope will support the Army's 82d Airborne Division at nearby Fort Bragg.

—Staff photo by Guy Aceto

An EF-111 is groomed at a hangar at Mountain Home AFB, Idaho. Several other types of aircraft are slated for Mountain Home in a new composite wing that USAF plans for the base. Highly reliable planes are prerequisites for composite wings.

Better R&M Is the Foundation

Progress in R&M makes composite wings practical. Air Force planes hold up well, as Desert Storm demonstrated, and have many parts in common, notably in avionics and engines. This makes more things possible in the maintenance world, which can now be reorganized to support wings made up of assorted aircraft types.

Declares General Collins, "Traditionally, composite wings implied terrific logistical problems. We wouldn't even be able to consider composite wings if we hadn't reached the level of supportability that we have today."

The Air Force has long consisted of monolithic wings, each structured around a certain kind of plane for a given mission. Maintenance shops on the home base of each wing specialize in the upkeep of its mission-specific planes at two levels—flight-line shops and intermediate repair facilities at a farther remove. Repair jobs beyond the capabilities of base shops are performed in depots with all the right equipment in logistics centers around the US and in Europe and Japan.

The idea now is to do away with intermediate-level maintenance facilities wherever possible and to concentrate on-base repair work in flight-line shops. Such streamlining is considered crucial to the successful formation and operation of composite wings.

Lt. Gen. Henry Viccellio, Jr., Air Force Deputy Chief of Staff for Logistics and Engineering, makes the point that R&M is the key. Addressing AFA's Orlando symposium, he asserted, "We've simply got to keep our momentum going in the R&M arena. It means something to us that the F-16C requires—in terms of dollar value—only one fifth the spares needed to support the F-111, and only about half those needed to support the F-15C. In today's environment, where we're trying to reduce our reliance on intermediate-level repair, it is imperative that we sustain that progress."

Such progress takes many forms, none more striking than the miniaturization and mobility of all kinds of maintenance gear. Test equipment is one example. A new "suitcase tester" designed and built to support F-15E squadrons "was set up and repairing parts within ninety minutes of its arrival" in Saudi Arabia, General Viccellio said. Powered by a portable generator, it withstood 110-degree heat through nearly five hours of continuous operation on broken parts. Setting up the cumbersome equipment that the new

—USAF photo by TSgt. Hans Deffner

An F-15E strike fighter from Seymour Johnson AFB, N. C., moves in to refuel somewhere over Saudi Arabia. A portable "suitcase tester" designed to support F-15E squadrons did yeoman work in difficult circumstances before and during the war.

mobile tester replaced would have required up to forty-eight hours, and the old stuff might not have worked under such conditions.

"We're looking for opportunities to expand our applications of this type of technology, folding it in with new concepts of intermediate maintenance," General Viccellio said. He pointed out that miniaturized, mobile maintenance equipment made up of solid-state electronics and lightweight materials is itself much more reliable and easier to maintain, and "saves us manpower, spares, and number of C-141s needed to deploy a unit for combat."

Cheap, Simple Drop Tanks

Advanced materials also hold promise for "breakthroughs in expendable drop tanks," General Viccellio told his AFA audience. Drop tanks now in service cost too much and are too difficult to maintain in storage, so USAF is on the hunt for "cheap, simple [tanks] applicable to many aircraft, made for one-time use, and biodegradable," he said.

Batteries are big players in plans to lighten maintenance loads and to streamline maintenance setups on air bases. Several types of planes besides the F-16 now feature extraordinarily dependable batteries that, claims General Collins, "require no maintenance, because their liquid electrolyte is held in a sponge. They simply won't leak, not even if holes are poked in them."

Introduction of the never-quit batteries may mark the beginning of the end for battery shops, always thought to be irreplaceable fixtures on operational bases. Those shops are burdensome—labor-intensive, vulnerable to attack, and inherently hazardous in their handling of acids—but the bases have never been able to do without them.

Fixing engines is a large part of the maintenance work load and a major reason why bases need intermediate-level facilities. This is especially the case with fighter engines, which run hotter and work harder than other types and are more finicky as a result. Now the engine-fixing picture is also changing.

Air Force fighter engine contractors have steadily improved the reliability of their powerplants through a succession of improved variants in recent years. The latest, most dependable models of the General Electric F110 and Pratt & Whitney F100 fighter engines powered F-15s and F-16s in Desert Storm and were heroes of their R&M success story.

Design engineers use this 3-D computer graphic of an F-15E in the process of computational fluid dynamics. CFD is central to the Computer Assisted Design of modern aircraft, and CAD is the key to "upfront" R&M of those planes.

The best is yet to come. Fighter engines now in the making should be even more unyielding under stress and should make life easier in air base maintenance shops.

Featuring light, heat-resistant materials; inherently strong, single-crystal turbine blades; and digital electronic controls that go like clockwork, those powerplants are expected to be so reliable that they "will basically make it possible for us to do without jet-engine intermediate maintenance" at fighter-wing and composite-wing bases, General Collins predicts.

Defeating the Troublemakers

It has always been axiomatic that avionics subsystems and components are the biggest troublemakers in military aircraft. This may still be the case, but much less so than before. Referring to reliability goals for electronic systems on modern aircraft, "I think we're just about there," General Collins asserts.

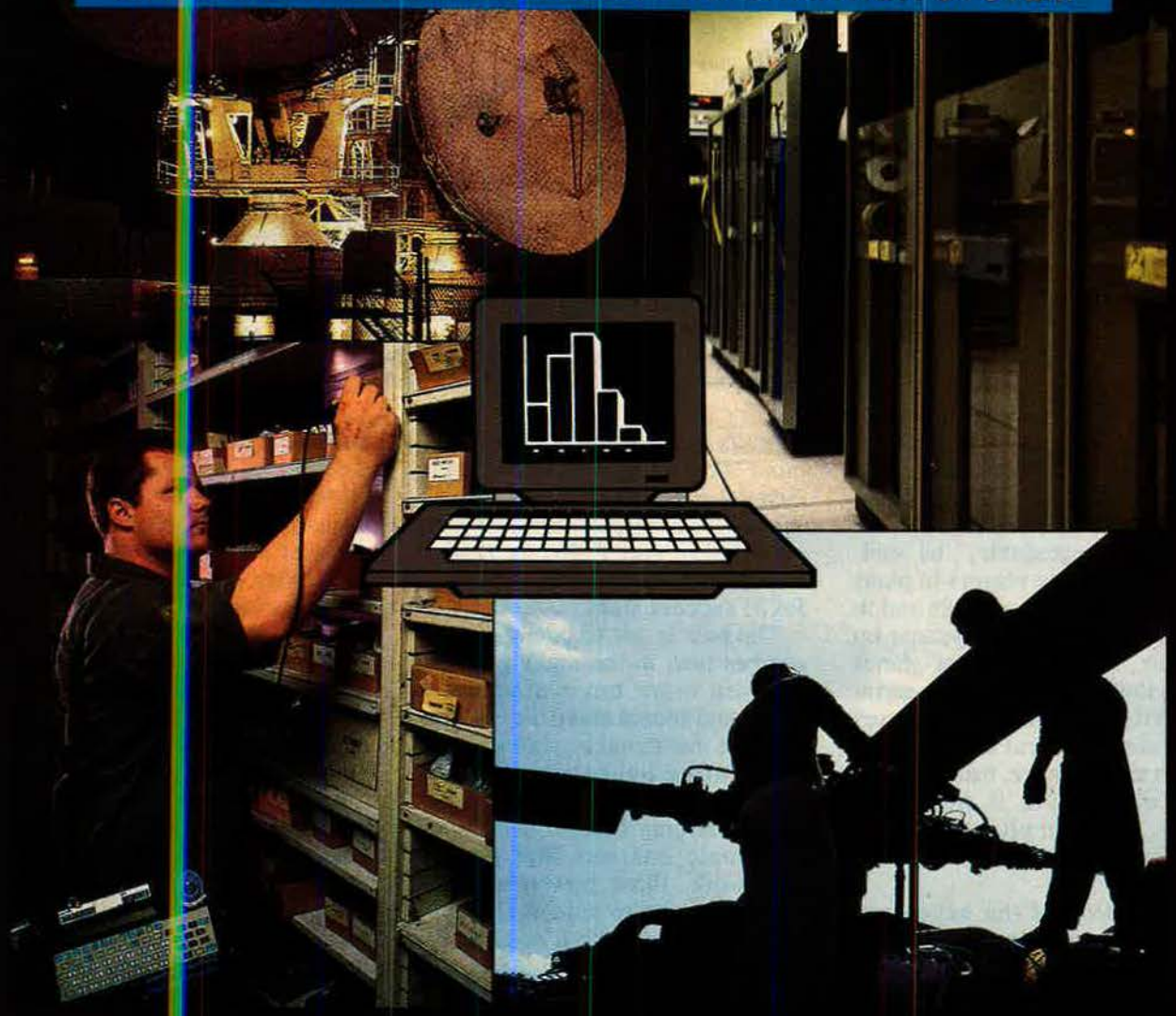
Semiconductor chips have come a long way in reliability. The Air Force and its electronics contractors have pretty much solved problems with heat, shock, and vibration—to the point that the chips almost never burn out anymore and are capable of 20,000 hours of operation. This remarkable progress raises hopes for eventual development of so-called "ultrareliable" electronic equipment that will be capable of functioning without failure throughout its intended lifetime. Not long ago, such equipment fell into the pipe-dream category.

"We've made great strides in understanding why things fail and in building this knowledge into the CAD [Computer-Aided Design] process," says General Collins. He adds that CAD is being refined to the point that computers will soon be able to tell airplane design engineers where to put, and where not to put, each component for the utmost in R&M.

CAD gave rise to the ATF, the B-2 Stealth bomber, and the C-17 airlifter. R&M stood out among design requirements for all those planes. The Air Force wants them to make do with fewer maintenance personnel than are required to support currently operational fighters, bombers, and transports. The trend is propitious: the newer the fighter, the fewer maintenance technicians it needs. For example, each F-111 now requires the support of thirty-nine maintenance specialists; each F-15, twenty-five; and each F-16, twenty-two. The Air Force's goal for the ATF is nine such specialists at the most—and a fighter that never quits. ■

REMIS

RELIABILITY & MAINTAINABILITY INFORMATION SYSTEM



EIMSURS
Equipment Inventory Multiple Status and Utilization Reporting Subsystem

PPS
Product Performance Subsystem

GCSAS
Generic Configuration Status Accounting Subsystem

Litton
Computer Services

U.S. Air Force and Litton
working together to build on the success of Desert Storm and support the objectives of R&M 2000.

By **John L. Frisbee,** Contributing Editor

Of Tradition and Valor

Are there limits to a commander's responsibility for his men? Donald Pucket thought not.

AIR Force attacks on the oil refineries at Ploesti, Romania, probably are best remembered—by those who were not there—from dramatic pictures of a B-24 emerging at chimney-top level from smoke and flame engulfing one of the targets. That was the August 1, 1943, raid, the first major Ploesti strike. There were many to follow after Allied bases were secured in Italy and the 1944 bombing campaign against German oil supplies came into full swing. The refineries were hit twenty-four times in the spring and summer of that year, largely by heavy bombers of Italy-based Fifteenth Air Force, until production was completely shut down in mid-August.

The 98th Bombardment Group was heavily committed to the oil campaign, flying against synthetic plants in central Europe as well as Ploesti area refineries. (The 98th had won a Distinguished Unit Citation for its part in the August 1943 raid. Its commander, Col. John R. Kane, was one of five men to be awarded the Medal of Honor for valor that day.) The refineries, because of their small size, were the more difficult of the oil targets. Smoke generators at Ploesti often made it necessary to use recently received M2X radar equipment to find a target. Antiaircraft fire remained heavy almost to the end, and enemy fighter pilots were more persistent than in other parts of Europe.

On July 9, 1944, the 98th was scheduled for another Ploesti mission from its base at Lecce, Italy. In the left seat of a 343d Squadron B-24 was 1st Lt. Donald Pucket, only six months out of pilot training and a relative newcomer to the 98th. Because of his maturity—Pucket was approaching twenty-nine years of age—and leadership, he was marked for advancement. Two weeks earlier he had been awarded the Distinguished Flying Cross for leaving formation to defend a battle-damaged straggler that was being attacked by fighters, even though his own Liberator had been severely damaged by flak.

Now, shortly after "bombs away" over Ploesti, Pucket's aircraft was hit by enemy fire. The flight engineer was killed, six other crew members wounded, two engines knocked out, control cables cut, fuel lines damaged, and the oxygen system set on fire. Pucket turned the controls over to copilot Lt. Robert Jenkins and went to the rear of the plane to assess damage and help the wounded. Using a hand crank, he opened the jammed bomb bay doors to clear out gasoline and hydraulic fluid, then jettisoned the guns and all other movable equipment.

The B-24 continued to lose altitude rapidly. It was apparent that they could not reach friendly territory. Pucket ordered the crew to bail out, but three of the wounded were unable to follow his orders. As the others abandoned the plane, they pleaded with Pucket to follow them. He refused. With the controls unmanned and the B-24 in a dive, there was no time for him to drag the wounded men to the open bomb bay and push them out. Instead, he fought his way to the cockpit, hoping to regain enough control to make a successful belly landing. It was too late. The B-24 crashed on a mountainside and exploded. Donald Pucket had given his best—his life—in an attempt to save three crewmen. His loyalty to the men under his command and his acceptance of responsibility for them was in keeping with Air Force tradition. His sacrifice that day is forever a part of the Air Force heritage of valor.

Lt. Donald Pucket received the Medal of Honor for heroism on July 9, 1944, in action over the inferno known as Ploesti, Romania. B-24s continued to pound this vital target (this photo was taken a month later) until it was completely shut down August 15.

Lt. Donald Pucket was awarded the Medal of Honor posthumously, the seventh and last man to be so honored for extraordinary heroism in the Ploesti campaign. The presentation was to be made to his widow at Boulder, Colo., on August 12, 1945. The ceremony probably was unique in the history of the Medal of Honor. Loeren Pucket refused to accept her husband's Medal until certain words in the citation, which she felt disparaged the courage of the men who died with him, had been removed. That aspersion, she knew, Donald Pucket would not have tolerated. ■

Optical and infrared sensors have their advantages, but when push comes to shove, you still can't beat radar.

The Basic Beam

By Larry Grossman

EXPERTS long have viewed radar as a two-edged sword. Its strong, distinctive signals detect objects at great distance and with great clarity, but the beam also serves as a beacon to the enemy's sensors. Air Force engineers are developing new, passive sensors, based on electro-optic and infrared properties, which suggests that radar may be a fading technology.

Don't be misled. Radar is sure to remain a key part of Air Force sensor systems into the next century. The Air Force's inclination is not to abandon radar. Far from it; engineers have refocused their energy on developing new technologies to reduce radar's vulnerability to interception and give it new life.

Radar has great inherent strengths. It can detect small, fast-moving objects, even in the foulest of pea-soup weather. In addition, it provides high-resolution images of detected objects. Air Force experts say that, for these reasons, passive electro-optical (EO) and infrared (IR) technology will be used to supplement, rather than supplant, conventional radar systems.

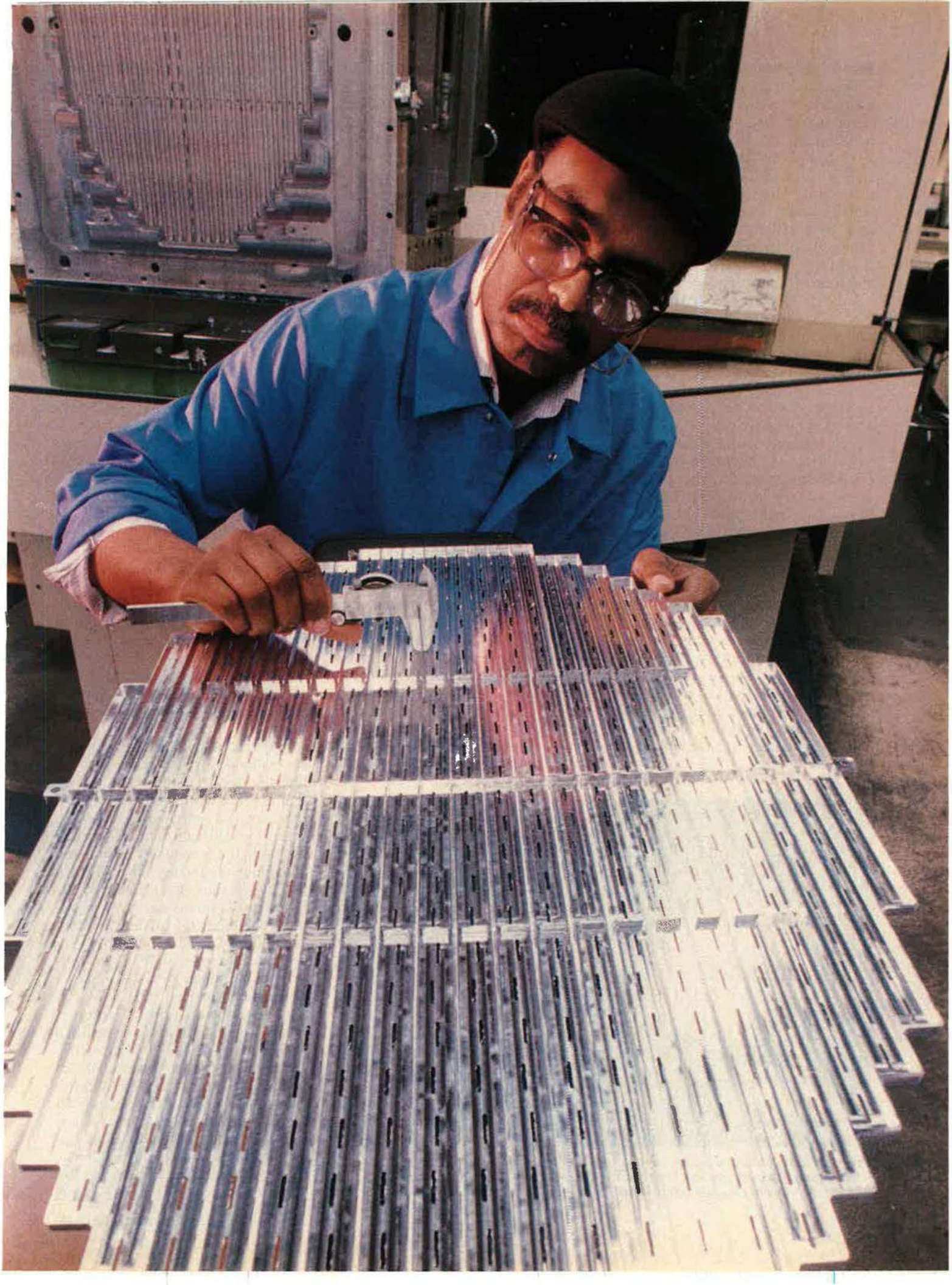
"The combat identification problem is so tough that we want to take advantage of all observables across the electromagnetic spectrum," says Fred Demma, chief of the Surveillance Technology Division at Air Force Systems Command's Rome Laboratory, Griffiss AFB, N. Y. "The optimum sensor suite is very scenario- and threat-dependent. So, as the threat changes, you want to have the instantaneous capability to change your sensor suite."

Demma points out that radar's active waves give it a discrimination capability unmatched by today's IR systems. Radar can conduct velocity filtering, whereby it uses differences in velocity to distinguish a decoy from a real target.

In addition, its all-weather utility is unique, explains George McFarland, head of the radar unit at Wright Laboratory's Avionics Directorate, Wright-Patterson AFB, Ohio. "The primary advantage of radar," says McFarland, "is that it can detect targets in all weather conditions and they can also operate at standoff ranges whereas some EO systems are very limited."

Adds Jim Cusack, chief of Rome Lab's EO Surveillance Division and a top IR specialist: "There is nothing more ineffective than a smart weapon that can't see. . . . If an [IR] optical instrument . . . cannot penetrate the environment, it doesn't matter whether it's an active or a passive sensor. If the system cannot see, it's irrelevant to discuss the probability-of-interception issue at all."

A Westinghouse technician works on an F-16's APG-68 radar antenna at a plant in Baltimore, Md. The all-weather utility of radar along with its high-resolution imagery ensure that the Air Force will seek to reduce radar's vulnerability to interception rather than find ways to do away with it entirely.



War-Tested Radars

Advanced radar systems, complemented by EO/IR devices, were well tested during the Persian Gulf War's air campaign. At the heart of USAF's F-15 fighter lie the Hughes-built APG-63 and APG-70 radars, which provide the air-superiority fighter with capability to detect enemy aircraft to a distance of 100 nautical miles. It has look-down shoot-down capability. The F-15's size allows installation of a large aperture antenna.

Like its APG-63 predecessor, the new APG-70 uses gate-array technology, enabling a programmable signal processor to operate at nearly 35 million operations per second. That is five times the speed of older signal processors. Increased speed and storage capability, say Air Force officials, is essential in today's complex, high-tech air-to-air combat environment, where faster reactions are no longer "nice-to-have" but "must-have" attributes.

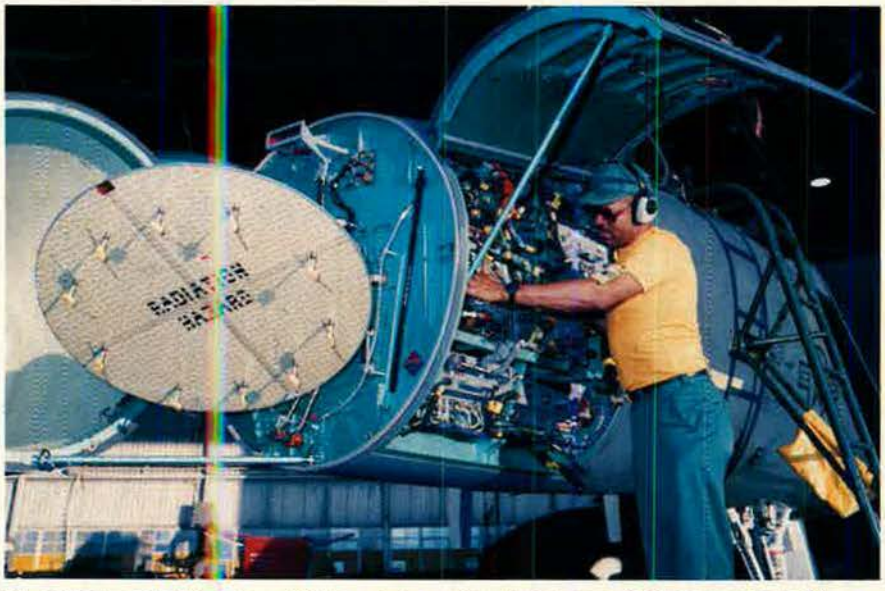
The programmable signal processor in the APG-70 sorts out useful information from background clutter, says Jacques C. Naviaux, marketing manager for Hughes Aircraft Co.'s Radar Systems Group in Los Angeles. Mr. Naviaux adds that the ratio of useful information to junk "is about one part in 10,000, so there's a lot of sorting out that has to be done." Airplanes equipped with APG-70s have spotted, engaged, and destroyed test vehicles flying at 500 feet.

The APG-70 allows the F-15 pilot to spot his enemy before being seen, giving him time to prepare and launch a radar-guided AIM-7 Sparrow or heat-seeking AIM-9 Sidewinder missile. The computer-driven radar automatically acquires its target by illuminating it with high-pulse repetition-frequency radar energy. The beam locks on to the target and displays location data to the pilot.

Radar was critical to the Navy and Marine Corps A-6E Intruder attack planes in the Gulf War. The APQ-156 radar gives the A-6E the ability to fly all-weather precision attacks—a capability unique among US Navy and Marine Corps aircraft. For low-altitude flying, the A-6E's two-man crew relies on radar-derived terrain-clearance displays. It can be used during weather that would render forward-looking infrared (FLIR) systems ineffective.

The Navy's F/A-18 Hornet uses a Hughes APG-65—an all-weather, multimode radar—to lock on to and destroy aircraft and ground targets. Hughes officials explain that, because the radar has programmable signal and data processing, the Navy does not have to optimize it for either the air-to-air or air-to-ground mission. The APG-65's programmable signal processor performs 7.2 million operations per second.

In its air-to-air role, the APG-65 radar demonstrates look-down shoot-down capabilities, as well as complete search, target-track, and automatic acquisition modes. Ten targets can be tracked simultaneously, while eight are displayed in order of priority.



The F-15E's APG-70 radar, which contains a signal processor that can perform 35 million operations per second, has enabled aircraft equipped with it to detect, engage, and destroy targets flying as low as 500 feet amid background clutter.

LPI and Fat Beams

In future airborne radars, say Air Force and contractor officials, the key will be to reduce the probability that an enemy sensor will detect or intercept a US fighter's radar pulses. These systems use what are called low-probability-of-intercept (LPI) technologies.

"Because a radar's beams are fatter than those of EO systems, we have to be very concerned with somebody intercepting them," says Rome Lab's Mr. Demma.

Radar designers are intent on building into their systems special coatings and waveforms that allow radar propagation media to penetrate the atmosphere at an angle and rate that would require a very sophisticated receiver to intercept the radar beam. The only alternative to this pursuit of advanced LPI technology is to avoid using radar at all. "I would admit that if you didn't have to turn on a radar and radiate, you wouldn't," says Hughes's Mr. Naviaux, "but there is no other sensor that gives you a long-range, all-weather, and high-accuracy capability."

Applications of LPI technologies are evidently already under way. Although the Air Force F-117A Stealth fighter relies completely on EO systems for navigation and targeting, which means that it cannot fly in bad weather, the service is taking full advantage of advances in LPI technology for the radar system in the B-2 Stealth bomber and a very-low-observable (VLO) Advanced Tactical Fighter (ATF).

Since January 1987, the new Hughes-designed APG-181 radar—earmarked for use in the B-2—has been aboard the Air Force's specialized KC-135 avionics flying test-bed at Edwards AFB, Calif. The APG-181 uses twenty-one separate modes for target search, location, identification, and acquisition; weapon delivery; terrain-following and terrain-avoidance; and navigation system updates. Hughes officials say that, although these features also are inherent in the B-1B's Westing-

house-built APQ-164 offensive radar, the B-2 Stealth bomber's radar modes are unique in their LPI design.

Air Force and Hughes officials will not discuss the specifics of the B-2's LPI capabilities—or those of any other aircraft radar, for that matter. They do say, however, that by integrating a collection of individually effective design and operating techniques, it is possible to slash both the range and effectiveness of radio-frequency-interception sensor systems.

Hughes has completed development of the APG-181's software modes. Production radars are being delivered to the Air Force. Radar systems for all fifteen B-2s authorized by Congress are now under contract, requiring Hughes to deliver production units through February 1993.

Aboard the KC-135 test-bed, the radar has logged more than 1,600 hours of operations on more than 300 flights. For security reasons, transmission of radar signals has been severely restricted. Air Force technicians have made heavy use of radar simulation and special procedures for software development.

Though it won't discuss specifics, the Air Force has clearly given top priority to reducing the probability of interception of signals from the B-2 bomber's radar. Integration of the APG-181's twenty-one separate modes is central to this effort.

Better Two Than One

Unlike most other aircraft in the US inventory, the B-2 has two radar antennas. "It's conceivable that, on the B-2, there could be twenty-four-hour missions, and the Air Force is willing to pay for the redundancy in the system," Mr. Naviaux says.

The Air Force developed the APG-181 antenna design to complement the low radar cross section of the B-2 airframe. The service requires that the antennas have extremely low scattering properties, even when they are illuminated by frequencies in or out of their operating band.

Naviaux says that the LPI characteristics of the APG-181 radar are revolutionary but that many of the radar's modules are interchangeable with the F-15E's APG-70 and the Navy F-14D's APG-71. Other components of the B-2 radar were developed from systems aboard F-15C/D/Es and F/A-18s.

The newest entry in the Air Force's stable of tactical fighters will also depend on revolutionary radar technologies to ensure its survivability. Like that of the B-2, the radar at the heart of the Lockheed/Boeing/General Dynamics F-22 ATF will rely on LPI techniques to enhance the plane's VLO properties.

The ATF radar has not yet received an official Air Force designation. The system grew out of the service's Ultra Reliable Radar program, launched in 1983 to build a solid-state radar array using gallium arsenide devices in its active circuits.

The ATF's active, electronically scanned, phased-array radar, developed by Westinghouse Defense Avionics Division in Baltimore, uses several hundred composite transmit/receive modules in the system's array instead of a single transmitter tube and a single amplifier. The architecture of the radar design "allows us to do things that haven't been allowed with conventional radars in the past," says Jack Russell, Westinghouse's ATF department manager. Those revolutionary "things," however, are classified.

One feature of the URR that has been incorporated in the ATF radar is graceful degradation. On conventional radars, if one transmitter tube fails, the whole radar system goes down. By contrast, a phased-array radar fails one module at a time.

With transmitters and receivers distributed throughout the radar's antenna, greater range can be achieved with the same or less power, which, as Mr. Russell explains, is "a relatively dear commodity in an airplane."

The ATF's composite, VLO design is enhanced by LPI technologies in the radar system. In the words of Westinghouse's ATF program manager, James Winzell: "We've incorporated the active ESA radar into the weapon system so that it becomes one part of the ATF's total sensor system. So, when we talk about low probability of detection, it's important to remember that the system's getting information from all its sensors."

One way to achieve LPI goals, say Westinghouse officials, is to control active emission. Because of the independent modules of the phased array, this can be done. This contrasts with the iron limits of a conventional system, which is either on or off.

At the Speed of Light

The search capability of the electronically scanned array increases the volume of the ATF radar's tracking capacity to thirty-five times that of a mechanically scanned system. In practice, this capability allows the pilot to know instantaneously what is above and below him, because the radar changes direction at the speed of light, rather than at a slower, mechanically controlled rate.

At the Wright Laboratory's Avionics Directorate, engineers are de-

—USAF photo by TSgt. Donald McMichael

One of the star performers of the Gulf War was the E-3 Sentry AWACS aircraft. The Air Force is now looking at ways to combine the capabilities of AWACS and Joint STARS, a standout in air-to-ground surveillance, into a single radar.

veloping technologies to permit current and future airborne reconnaissance and strike radar sensors to perform in severe electronic countermeasures environments. "It's an ongoing effort to counter jamming techniques, because as fast as we develop counter-countermeasures, of course, there are counters developed for the counter," says Mr. McFarland. "It's a continuous game played between radar people and ECM people," he says.

Under another program, the Air Force hopes to combine electronic warfare functions and radar functions into a single antenna. This Electronic-Combat Multifunction Radar Technology (EMRT) program finds Hughes and Raytheon, under similar $6.2 million contracts awarded in August 1989, investigating a wide variety of advanced radar concepts and component technologies that might be used in twenty-first century integrated avionic sensor suites, according to McFarland.

The overall goal, he says, is to identify and develop affordable, adaptable, and flexible radar architectures compatible with the demands of future Air Force weapon systems. "The EMRT program is really a long-term technology effort that is looking at trying to make radars of the future as adaptable as they can possibly be in the environment they're employed," says McFarland. "Since it's very hard to predict what the threats may be in the future, the best that we can do today is to try to make the radars of the future be a lot more flexible than they are currently. It's very difficult to predict what people will be using in the year 2000 to jam radars."

Hughes will build a breadboard four by four phased-array concept demonstrator. To cover the required bandwidth, Hughes officials say, they will break it into four segments and have a separate transmitter and receiver for each subband. As the instantaneous bandwidth decreases, transmitter efficiency improves. In the future, perhaps a full array would be built that could lead to a flight test in the mid-1990s.

Air Force Systems Command's Electronics Systems Division (ESD) at Hanscom AFB, Mass., and the Rome Lab are jointly pursuing technologies expected to enable the Air Force to fly an advanced Airborne Warning and Control System (AWACS) by the year 2010.

"The idea is to combine the capability of AWACS and Joint STARS in a single radar system," said Gen. Ronald W. Yates, commander of AFSC, at a recent meeting of the Armed Forces Communications and Electronics Association (AFCEA). "We like to think of it as son of AWACS," says Mr. Demma.

The conformal-array radar demonstration program includes work on advanced phased-array radar technology. According to Mr. Demma, the cylindrical shape of civilian transport planes used as platforms of systems like AWACS and Joint STARS would make a perfect antenna for a powerful radar. "Essentially, we are looking at developing technologies to put antennas and transmit/receive devices right into the skin of the airplane, allowing for a tremendous amount of coverage," he says.

Furthermore, the area of the plane's fuselage is much greater than the current pancake Rotodome perched atop AWACS or the twenty-six-foot-long canoe slung under the Joint STARS aircraft. Area equates to power, producing an extremely sensitive system.

Air Force officials say that five to seven years are needed to get the conformal array radar into a flight-test program. In the meantime, ESD's AWACS office manages the Radar System Improvement Program (RSIP) for upgrading the Air Force's fleet of Boeing-built E-3A Sentry AWACS. The Air Force wants to upgrade its E-3s to improve detection of small targets.

In 1989, ESD awarded Westinghouse a $234 million contract and Boeing a $59 million contract to commence the AWACS upgrade. The goal of RSIP, which is expected to cost nearly $700 million, is to double the sensitivity and range of the Westinghouse APY-1 and APY-2 radars. The capacity of the radars will be increased through the addition of a new, much more powerful Control Data computer, changes in signal processing techniques, and changes of waveforms and bandwidths.

Demma emphasizes, however, that surveillance problems of the future will be so difficult to resolve that neither radar nor EO systems alone will suffice. "Radar and EO/IR systems have their inherent pluses and minuses," he says. "When paired, they're better than they are individually, and that's how we're going about solving the problems of future surveillance." ■

Larry Grossman, a free-lance writer in Washington, D. C., is a former writer for Military Forum *Magazine and a staff member of the House Armed Services Committee. This is his first article for* Air Force *Magazine.*

Reviews

Always Fighting the Enemy: A World War II Chronicle, by Luther C. Cox. In his epilogue, Cox writes, "Those taken prisoner by the Germans and held captive deep within the heartland of Europe, as did all other Allied flyers captured, never ceased 'Always Fighting the Enemy' for the ultimate: ESCAPE! Their deeds were no longer with guns and planes, but with great ingenuity and equally great determination such as they displayed in aerial combat." Mr. Cox's book is about "deeds"—of B-24 Liberator pilots who flew raids over western Europe unescorted and of unfortunate airmen who fell into Nazi hands. Cox's book is really two books, both well-done: the first (about one-third of the text) is a personal account of his missions, packed with fascinating detail painstakingly reconstructed from mission records, navigational charts, and master planning charts. The second is a gripping tale of his odyssey as a POW, including the Death March from Stalag Luft III to Moosburg. Gateway Press, Inc., Baltimore, Md., 1990, 363 pages with photos and appendices of official orders. $19.95.

Lightning Over Bougainville: The Yamamoto Mission Reconsidered, by R. Cargill Hall. This book stems from an April 1988 symposium titled "Yamamoto Mission Retrospective," held at the Admiral Nimitz Museum in Fredericksburg, Tex. On April 18, 1943, American P-38s from Henderson Field on Guadalcanal engaged Japanese A6M3 Type 32 Zeros over the Solomon Sea and downed two G4M1 Betty medium bombers that the Zeros were accompanying. The bombers were carrying the commander in chief of the Japanese Combined Fleet and architect of the attack on Pearl Harbor, Adm. Isoroku Yamamoto, and members of his staff. As Tom Crouch points out in the foreword, "From the interception of the coded message announcing the Admiral's itinerary, through the high-level discussions of the wisdom and the morality of the venture, to the meeting of American and Japanese aircraft at the precise time and place predicted, this is a whopping good yarn." The book provides numerous perspectives, both Allied and Japanese, on the still-controversial mission. One stems from a June 1990 interview with Hisashi Takahashi, the Japanese pilot of one of the downed bombers on the mission with Admiral Yamamoto. Smithsonian Institution Press (Smithsonian History of Aviation Series), Washington, D. C., 1991, 220 pages with photos, appendices of related documents, and index. $21.95.

On the Banks of the Suez: An Israeli General's Personal Account of the Yom Kippur War, by Avraham (Bren) Adan. In October 1973, Israel was taken by surprise and only the regular army was prepared to meet the attacks from the Egyptian and Syrian armies. Israel's main force, the reserve army, was just beginning to mobilize and move to the front. "Israel paid dearly for this surprise, which affected the conduct of the entire war and its consequences," writes General Adan. In this account of the 1973 War, Adan provides a soldier's point of view. He was not just any soldier. As commander of an armored division in the Sinai zone of operations, he fought numerous battles, one of which has been compared to Hannibal's famous victory in 216 BC over the Roman army at Cannae. Adan does not dwell on the failure of Israel's government to anticipate the attack. Instead, he focuses on the men, machines, and tactics used to avoid disaster. Presidio Press, Novato, Calif., 1991, 479 pages with photos, one tactical map, one chart, and index. $24.95.

Icebreaker: Who Started the Second World War? by Victor Suvorov. The answer to this question seems clear—the Nazis, right? Not according to Suvorov, who maintains that the Soviet Union was the real instigator. He writes, "From the 1920s on, sparing neither resources nor effort, nor indeed time, Stalin revived the strike power of German militarism." Indeed, Stalin saw the Nazis as the spark of the world revolution that would establish communism everywhere. Stalin's game plan was to "let the Nazis start another war and destroy every state in Europe, every political party, every parliament, every army, and every trade union." Then the Soviets would come in and pick up the pieces. Throughout this book, Suvorov paints a picture that challenges conventional history. He also includes fascinating details of Stalin's plan. Those interested in airpower will be intrigued by the book's description of the Soviet KT, or "winged tank," which flew in 1942. Viking, New York, N. Y., 1990, 364 pages with photos, a few maps, and index. $22.95.

Way of a Fighter: The Memoirs of Claire Lee Chennault. This is a limited-edition reprint of Major General Chennault's memoirs, first published in 1949. Although more than eighty books have been written about the Flying Tigers, *Way of a Fighter* is the only one penned by Chennault. Like many early advocates of airpower, Chennault was a maverick. Early in his career, he took on Lt. Col. Henry H. "Hap" Arnold about the role of fighters in defending against enemy bombers and in accompanying friendly bombers. Chennault was a pioneer of aerial combat tactics, but most of his contributions were made after his "retirement" from the Air Corps. Invited by Madame Chiang Kai-shek to help train the Chinese Air Force, he ended up fighting the Japanese alongside the Chinese from 1937–38. He returned to Washington for a time, then found himself back in China at the head of the American Volunteer Group, made up of reserve officers and enlisted men lured out of the Army Air Corps and the Naval and Marine Air Services. James Thorvardson & Sons, Tucson, Ariz., 1991, 375 pages with photos and index. $34.95.

Other Titles of Note

Forward into Battle: Fighting Tactics from Waterloo to the Near Future, by Paddy Griffith. An updated edition of the 1981 book that challenged many assumptions about the nature of tactics and technology, this version includes lessons from the 1982 war in the Falkland Islands and that same year's Israeli campaign in Lebanon. His analysis of the role of technology vis-á-vis other elements, such as morale and training, provides much insight, especially in light of the recent Gulf War. Presidio Press, Novato, Calif., 1990, 228 pages with tactical maps, notes, bibliography, and index. $24.95. In a second work, *The Ultimate Weaponry: What It Is and How It Will Be Used,* Griffith provides a detailed look at modern equipment, tactics and doctrine, covering everything from small-unit movement to bombing tactics. This volume contains excellent illustrations and color photos. St. Martin's Press, New York, N. Y., 1991, 224 pages with glossary, bibliography and index. $29.95.

The Armored Fist, by the editors of Time-Life Books, is the third in a series called "The New Face of War." Devoted to armor operations, the book appeared too soon after Desert Storm to incorporate much data from the Persian Gulf campaign, but it does include excellent photographs and descriptions of earlier maneuvers of the 24th Infantry Division in Desert Shield. Pitched to a general audience, the book includes fine illustrations throughout, superb photos of equipment, and discussions of the 1973 Yom Kippur War, the role of the Apache helicopter and A-10 Thunderbolt II (popularly known as "Warthog") in armored warfare, airlift, and realistic training. Time-Life Books, Alexandria, Va., 1990, 176 pages with bibliography and index. $14.99. ■

Trained for defense suppression in Europe, they proved to be flexible and effective in the sky over Iraq.

The Weasels at War

By Capt. Dan Hampton, USAF

ON January 17, the Air Force's Wild Weasels once again went to war, this time against the forces of Iraq. This was significant because, one year before the start of Desert Storm, Washington decided that the Air Force would have to be able to fight a war without having a full-up Wild Weasel on hand.

The classic Wild Weasel task is to attack and thereby suppress radar-controlled surface-to-air missile (SAM) sites. A Vietnam-era pilot once described the process as "three-dimensional chess where cheating is legal." Sometimes the assault is direct. Sometimes Weasels use feints, distraction, and intimidation.

I am an F-16C pilot assigned to the 23d Tactical Fighter Squadron from Spangdahlem AB, Germany—the only mixed F-4G/F-16C squadron in the world. Until the US began preparing for combat against Iraq, the 52d Tactical Fighter Wing, to which the 23d belongs, was a single-mission, all-missile kind of wing, trained to fly in the low-altitude European war that never was.

Yet we were sent to a different theater—the Middle East—to go to war against a vastly different type of enemy. The 23d, for example, found itself based in Turkey, conducting attacks from the north against Iraqi targets. Flexibility is the key to airpower, so we flexed. We knew the locations of most of Iraq's essential surface-to-air missile (SAM) sites and radars, so the actual targeting wasn't that hard.

However, instead of punching a hole in a true integrated air defense network, we had to knock out concentrated SAM batteries around strategic targets. Moreover, we were operating up to 250 miles into Iraq, exposing us to more threats, so we didn't own the low-altitude environment as our training regimen had always assumed.

In addition to having lots of familiar Soviet equipment, Iraq also used some modern Western defense systems. We had never expected to fight against them. Their capabilities, particularly the French systems, were largely unknown at the outset of war. Thus, the situation was a far cry from the big East-West war in Europe that was always our most likely scenario.

In the Wild Weasel/F-16 team's training for that kind of conflict, the

This four-ship flight (two F-16s and two F-4Gs) armed with Sidewinders and HARMs prepares to take off on a suppression of enemy air defenses (SEAD) mission. These flights operated at medium altitude up to 250 miles into enemy territory, quite different from the low-altitude, forward edge of battle area tactics called for in the war-in-Europe scenario.

fundamental tactic was to employ a mixed four-ship or six-ship flight of aircraft in a relatively static Restricted Operation Zone (ROZ) along the forward edge of the battle area. The idea was that the F-4G, using the APR-47 system, would detect and pinpoint the enemy's mobile surface-to-air missile batteries and then shoot them in the face with the AGM-88 high-speed antiradiation missile (HARM).

The Soviet Union's integrated air defense system was dense and formidable, with an estimated 10,000 intercept radars, 4,000 interceptor aircraft, 13,000 surface-to-air missile systems, and 12,000 antiair guns. In the 1980s, it showed new agility in use of electromagnetic frequencies and new skill in cloaking telltale emissions, among other advances.

In going against this kind of system, the F-4G is extremely well suited, for two basic reasons.

Last-Minute Updates

First, the F-4G's APR-47 radar attack and warning system can pass real-time target information to the HARM up to the second that it comes off the rail, which is a nice capability to have when you are confronting a rapidly changing tactical battlefield. Second, the F-4G crew has an Electronic Warfare Officer (EWO), the extremely talented guy in the back seat who is half engineer and half magician. He extracts information from a clutter-filled screen and translates it into bad news for the other side.

The other half of the hunter-killer concept called for the F-16, with its magical radar and high maneuverability, to be the close air-to-air escort and backup HARM shooter. The squadron planned to use the F-4G fighter primarily to target the pop-up Soviet-bloc mobile threats whose locations rapidly changed. For its part, the F-16 equipped with the HARM was to be employed in either of two ways.

First, in general terms, a range-known shot was used to attack a specific site, usually a strategically located SAM, for which we had coordinates. Before the mission began, the pilot of the F-16 was to program all the targeting information into the HARM system. The HARM shot from an F-16 does not get real-time updates, so the so-called "probability of kill" (PK) of the shot would depend on how close a pilot gets to his programmed target parameters. It may sound easy to do, but when one is flying at 550 knots only about 250 feet above ground, or in the chaos of combat, it can be tough.

The other F-16 method of delivery is called the range-unknown shot. Essentially, the F-4G locates an emitting radar and points the F-16 at it for its shot. This allows for a much more flexible type of missile delivery, but there is a penalty. The weapon has a much shorter effective range, which means the pilot must get a lot closer to the SAM that he is trying to kill.

In both methods of HARM delivery, the F-16 depends *absolutely* on the F-4G's power to see the emitter, determine its location and range, and pass this critical data to the F-16. Without the F-4G, or a suitable replacement, we would waste a lot of missiles.

That is where the 23d TFS stood last August when the Iraqi armed forces invaded Kuwait and Washington began preparations for launching a military attack on Iraqi defens-

es. By the time the war began on January 17, quite a lot had changed.

In a major change from the war-in-Europe scenario, the entire strike package would operate deep in enemy territory, thus being denied low-altitude cover and finding itself exposed to every SAM acquisition radar and missile system in the theater.

Very quickly, the air operation became a medium-altitude war, fought at that height in order to avoid fire from the 4,000 or so pieces of anti-aircraft artillery that Iraq deployed.

The Go/No Go Item

As a result, the presence of Wild Weasels became a go/no go item for each and every strike package. One day, about Day Eight of the war, something strange happened. The skies above the battlefield became deathly quiet. Not even a whimper. We came home, scratched our heads, and tried to figure out this new trick. We had gotten good intelligence that the Iraqis had moved some mobile, short-range SAMs up into the mountains along the border with Iran. Combined with the movement of the Iraqi Air Force's Mirage F1s and MiG-23s to the northern bases, this move began to look a lot like a trap.

What was really happening, of course, was that Iraq had mounted a massive exodus to Iran of its best aircraft to save what was left in order to fight another day. We saw the dismantling and storage of many sites, the use of deception when they were capable of it, and, surprisingly, almost total emission control on the part of their air defense systems.

Thus, after the second week of the war, AAA was our biggest enemy. The Iraqi defense forces employed anything from rapid-fire 23-mm rounds to the big 100-mm stuff. The concentration and intensity of the gunfire varied according to the target's worth and the Iraqi mood of the day. However, we saw only occasional ballistic (that is, unguided) SAM launches.

This forced a reevaluation of our purpose. With no Iraqi radars operating, we frequently returned home with unfired HARMs. The local Air Force leadership, however, allowed us to adapt to a situation that no one predicted. The suppression of enemy air defenses (SEAD) mission has always been loosely defined, and this time it worked to our advantage.

Our answer to all of this was the formulation of what I call DEAD (Destruction of Enemy Air Defenses), and it was deadly. Our basic reasoning, and justification for using bombs, CBUs, and Maverick missiles was that, if the enemy is in little pieces on the desert, then he's about as suppressed as can be.

The HARM, good as it is, does little damage to the actual SAMs, because it homes in on the emitting radar. Because they are undamaged, these SAMs can still be launched ballistically, modified for infrared use, or used in other unexpected ways. Also, the radars themselves can be repaired or replaced.

Gone Forever

We concluded that the only way to kill a site permanently would be to bomb it to splinters. If the sites are not popping off SAMs in your face, why not go ahead and destroy them outright?

We flew a twelve-ship Weasel package in each of the two daytime mass packages plus an eight-ship flight as part of each nighttime package. As we substituted DEAD for SEAD, we kept one mixed four-ship flight as dedicated HARM/Shrike shooters for the times the SAMs did come up. The Weasel/HARM flight always covered a vulnerability window when the strikers were in the immediate target area and at the greatest risk.

The other mixed, four-ship flight had a Maverick/HARM loadout and responsibility for using their precision ordnance to surgically remove very specific high-value targets. Since they also carried HARMs, they could suppress enemy defenses for themselves if the need arose or go on to support the strike package.

The last flight was an all F-16 four-ship, which carried Mk. 82s, Mk. 84s, CBU-58s, and the weapon of choice—CBU-87s.

For the most part, the Iraqis preferred to keep their heads down, so the result was an infrequent need for the bombers to defend against SAM launches while rolling down the chute. When SAMs did come up to shoot, they got spanked hard.

The Hunter/Weasel teams also covered the vulnerability time, but during the egress, they took their Maverick missiles and went hunting. Their target list is much too long to recite. They shot about fifty Mavericks during the last month of the war. I can say that they turned the lights out in northern Iraq; they destroyed virtually every hydroelectric powerplant in the area. They also shot early warning radars, ground-control-intercept radars, direction-finding facilities, jets parked in the open, and so forth.

Originally, the Killer/Weasel flight of F-16s had the job of de-

Captain Hampton's F-16, shortly after refueling, heads into Iraq to protect the F-4Gs against air-to-air threats (note Sidewinder missiles) and bust Iraqi SAMs' radars (note HARMs). Later in the war, SEAD became DEAD (Destruction of Enemy Air Defenses).

stroying Iraqi AAA sites. However, we soon realized that one Killer flight per package couldn't carry enough weaponry to do much damage against the mass of AAA emplacements in Iraq. So we began to target those specific SAM sites that were still a threat, our reason being that every site taken out by our bombs was one that could not be repaired to bother us the next week.

The CBU-87B turned out to be all it was advertised to be and more. Because it has no delivery restrictions and can be tailored for use against virtually any target, it was ideal for the medium-altitude attacks we were using. In fact, "devastating" is a better word. In one attack against a SAM in northern Iraq, we saw the CBU-87 create nine secondary blasts in the target area. Post-attack reconnaissance photos confirmed the kill. The terrain surrounding the site was chewed up to the extent that it looked as if it had just been plowed. We called it the "shotgun" school of bombing.

Of course the situation kept changing and probably the biggest advantage of operating from a composite wing was our adaptability in the face of shifting circumstances on the battlefield.

Day Raid on Baghdad

For instance, the raid mounted on February 19 was the first daylight attack on Baghdad that was launched from the north. On this raid, we reconfigured the mixed flights with wall-to-wall HARMs in anticipation of heavy SAM activity. During this and several other raids, the strikers were stretched a little thin, so our F-16s carried Mk. 82s or Mk. 84s and flew as bombers.

We fought a smart fight and did what was required to get the job done. If this meant changing or adding to former peacetime missions, then we did it. Much of the credit for this flexibility goes to the wing staff that ran the northern show.

The Wild Weasels of the Northern Theater of Operations passed their combat test with honors. As of February 26, our 100-aircraft package had racked up some 13,000 combat hours flying over Iraq without suffering a single combat loss. Some 3,000 of those hours belonged to the mixed-force Weasels. The F-4G/F-16C combination showed itself to be a viable and flexible fighting team.

The wing did have some battle damage and lost one F-16 on the Turkish side of the border, but no one suffered a silk letdown into enemy hands. The F-4G with its radar and SAM destruction weapons, AIM-7 face-shot capability, and precision Maverick delivery proved that it still has teeth. Added to this is its ability to provide that real-time threat information so vital to mission commanders and flight leads during combat.

The F-16C proved itself to be the versatile, precision-bombing strike platform that it was advertised to be. The Wild Weasel F-16s have done a little of everything. We started as HARM shooters and air-to-air escorts. For about a week, we picked up a commitment to provide High-Value Airborne Asset protection, a role normally performed by the F-15. We even had a Zulu alert (*i.e.*, twenty-four-hour alert) mission for a few days.

We became SEAD/DEAD bombers and accounted for destruction of nine SAM sites and twenty-four AAA emplacements in addition to other critical targets.

We were prepared, if the need had arisen, to load out with Mavericks. Also, in the last days of the war, the Air Force sent into the theater four F-4Es equipped with Pave Tack. Had the war not ended, the Weasel F-16s would have carried and dropped laser guided bombs. ■

An F-4G heads back to Turkey after delivering its ordnance. The F-4G's EWO, described by Captain Hampton as "half engineer and half magician" takes information from his clutter-filled screen and "translates it into bad news for the other side."

Dan Hampton is a captain in the US Air Force. This is his first article for AIR FORCE *Magazine.*

From the creation of Materiel Command to a longer work week in Iceland, the DMR is shifting into high gear.

The Defense Management Makeover

By Peter Grier

Two years after it was launched, the Defense Department's campaign to strengthen business practices across the board has moved out of its first, tentative stage and into high gear. The program, based on Defense Secretary Dick Cheney's 1989 Defense Management Report (DMR), first concentrated on acquisition system changes. Phase two will focus on management streamlining.

For the Air Force, phase two will bring changes ranging in intensity from a gigantic merger of Systems Command and Logistics Command to a lengthening of the work week for service personnel based in Iceland. From the grass roots of the Air Force have come more than 500 suggestions for DMR implementation. Even the Air Force's headquarters is due for a major reduction in size.

"Our task now is obviously to turn our attention towards execution [of the DMR blueprint]," says USAF Under Secretary Anne N. Foreman. "We have a great deal on the plate, and we know that."

Official estimates maintain that the DMR process will save $70 billion Pentagon-wide by 1997. Much of the savings will come from reductions in the numbers of workers. Under the DMR plan, some 44,000 military and 50,000 civilian jobs are to be cut.

Many of the Pentagon's numerous information and accounting systems will be consolidated. The services' logistics and supply networks for items they share will be combined. Plans call for the Army, Navy, Air Force, and Marine commissary systems to merge by October 1.

"The general approach that we're taking is one of making some fairly rudimentary but important restructuring of the Department of Defense," said Deputy Secretary of Defense Donald J. Atwood, Jr., at a recent DMR briefing.

The roots of the DMR effort lie in the procurement controversies of the late 1980s. When Secretary Cheney assumed office, President Bush directed him to undertake a thorough review of the way his new department did business. The overall purpose was to make sure the Pentagon was fully implementing the recommendations of the Packard Commission. The review was also to keep an eye out for other ways

to improve overall defense management and acquisition procedures.

The result was the so-called Defense Management Review (later, "Report"), which the Pentagon made public in the summer of 1989. Subsumed into the DMR mandate were some changes already in the works, such as the renovation of the acquisition chain of command and creation of the posts of Program Executive Officers (PEOs), who were assigned the task of overseeing groups of major programs.

Other DMR initiatives, such as the consolidation of the various defense accounting systems, put into effect broad Packard efficiency recommendations. Implementation of the whole package became a key project for Mr. Atwood.

Inside Teams

Inside teams have been organized to track DMR implementation. The Air Force, for instance, formed a DMR executive review group that watches the progress of changes ordered by the Defense Secretary and weighs suggestions for further DMR reforms. In the months following DMR publication, the group met four or five times a week, for hours at a stretch. The meeting pace has since slowed to once every two or three weeks.

DMR initiatives that are being implemented in the Air Force combine sweeping changes ordered by the Pentagon, which affect all military management, with service-specific moves that originated in the Air Force itself. The overall impact will be significant: By 1997, the Air Force will have cut roughly 20,000 civilian manpower spaces and 4,800 military spaces.

Ms. Foreman says the DMR should not be taken as evidence that the Air Force was poorly managed in the past but as an affirmation that, in a tough budget environment, every dollar pared from overhead can be spent on the force.

The new DMR process is not without strains. Many changes impinge on long-established service practices or disturb the balance of power between the military services and the Office of the Secretary of Defense. The DMR implementers are talking about real money; $70 billion in savings, should it actually be realized, would be nearly sufficient to finance the projected cost of the F-22 Advanced Tactical Fighter program. Even so, DMR workers labor in obscurity. "It's a very hard thing to get folks on Capitol Hill to focus on," said Secretary Cheney. "It's ho-hum time, when you sit down with the public generally."

The Big Changes

Significant progress toward eliminating redundant military management has been made in the last two years, according to Secretary Cheney and Mr. Atwood. Among the top-down, DoD-directed changes in management functions:

- Information management. The Pentagon spends about $10 billion a year on data processing and software design for business systems. Each military department and DoD agency has had its own system, and many of them cannot "talk" to each other.

To help get a handle on this problem, Secretary Cheney set up an office for corporate information management, reporting to the Assistant Secretary of Defense for C³I. Information systems will be consolidated under this office, eliminating 100 of these systems. Some thirty payroll systems alone will be cut.

- Financial and accounting systems. One problem that could cause the Pentagon to lose control of weapon costs is the lack of a good flow of cost information. A Defense Finance and Accounting System (DFAS) is being set up under the direction of the Comptroller's office to centralize control of 250 separate DoD accounting systems in six financial centers.

Today, most base commanders would have a hard time saying how much it costs to run a post, as construction figures would flow through one system, operation and maintenance through another, and so forth. The point of the new DFAS is to "cross-fertilize, so that every base commander has at his fingertips exactly what it costs to do business there," said Mr. Atwood.

- Research and technology. The authority of the post of Director of Defense Research and Engineering is being upgraded as the Pentagon tries to rationalize R&D and advanced engineering activities in military labs. A key part of this effort will be streamlining each service's bureaucracy. The Navy is consolidating research in four warfare centers; the Army is proposing to centralize lab management in a new Combat Materiel Research Center. The Air Force is creating four "superlabs" from fourteen existing laboratories and research facilities.

In a tough budget environment, every dollar pared from overhead can be spent on the force.

The four proposed Air Force superlabs are Wright Laboratory, headquartered at Wright-Patterson AFB, Ohio, focusing on air vehicle technology; Rome Laboratory, centered at Griffiss AFB, N. Y., and focusing on C³I technology; Armstrong Laboratory, based at Brooks AFB, Tex., and dealing mainly with human systems; and Phillips Laboratory at Kirtland AFB, N. M., focusing on space and missile systems.

Formation of these superlabs will involve little movement of personnel. Small management staffs will be relocated. Later on, geographically separate parts of each lab might be moved.

• Contract management. The first big DMR-inspired change was the formation of the Defense Contract Management Command under the aegis of the Defense Logistics Agency.

In the past, contractors faced different interpretations of procurement regulations from separate service contract offices. Under DLA, contract management now attempts to present what Mr. Atwood calls a "common interface" to suppliers.

• Intelligence. After a comprehensive review, restructuring of military intelligence operations is now under way. Each service will group all intelligence activities under a single command. Theater intelligence activities of combatant commands will be consolidated within Joint Intelligence Centers.

In Hawaii, for example, three different intelligence processing and analysis bureaucracies grew over the years to support Pacific Command. Consolidation will shut down two printing plants and two data-processing centers and will eliminate approximately forty percent of the personnel roster—trimming outlays by twenty-three percent over five years.

• Depot maintenance. The Department of Defense does $10 billion worth of in-house upkeep. Since each service is charged with its own maintenance, each has its own system, often running at less than half capacity.

The services will still control their maintenance organizations. A new council headed by the Defense Logistics Agency chief will oversee each depot's functions and will urge elimination of duplicative efforts. The Navy is creating two aviation industrial hubs, for instance. The Air Force will take over the job of maintaining Navy C-130s.

• Supply systems. Right now, the Pentagon and the services have a total of thirty-four supply depots, 3,500 warehouses, and more than 110 million square feet of storage space. DoD has begun consolidating this network under the control of the Defense Logistics Agency. Five depots in the San Francisco Bay area are being consolidated as a trial run.

Because many supply depots are within fifty miles of each other, the Pentagon figures that more efficient depot distribution could bring big savings on transportation costs. Currently, shipping of parts costs the military $500 million a year. Depots as a whole are a $40 billion annual operation.

• Acquisition. One of the DMR's prime objectives was improvement of the defense buying process across the board. Big changes already in motion in 1989 got a boost from DMR recommendations. The primary one is the new, streamlined acquisition chain of command, which stretches from the Under Secretary of Defense for Acquisition, to service acquisition chiefs, to service Program Executive Officers (PEOs), to major program managers.

The DMR has resulted in a tougher acquisition milestone review process, says Mr. Atwood, meaning fewer weapons will slide by when they fail to meet requirements. Acquisition regulations have also come under DMR scrutiny. Fourteen percent of military specifications and standards will be canceled. Seventy-six percent of acquisition directives and instructions will be eliminated or substantially revised.

Much of the first year of the DMR process focused on these acquisition changes, and Secretary Cheney and Mr. Atwood cite them as evidence that they have been successful in the effort to cut unnecessary layers of decision-making out of the procurement process.

Not everyone in the military services, however, liked the idea of cutting senior officials out of the chain. Thus, it is acquisition reforms that have earned the DMR its most bitter criticism.

The Irate Admiral

In March, the chief of the Naval Sea Systems Command, Vice Adm. Peter M. Hekman, Jr., blasted acquisition reform in remarks to a Navy League conference, saying new PEO-related changes "violate the principle of accountability under a common superior." He complained that he was accountable to Congress for procurement money, but power was moving up the chain of command to the Office of the Secretary of Defense. Shortly afterwards, Admiral Hekman retired.

Air Force Under Secretary Foreman says that the DMR acquisition reforms are sound. The point of the DMR, she asserts, is to make clear where accountability lies. "A clear management chain where one can identify the four people who have responsibility for a given program is exactly the kind of system that you need to push responsibility and to permit accountability," she says.

In the Air Force, the new acquisition chain of command has been up and running since February 1990. There are six Air Force PEOs, each of whom oversees five to seven programs. The B-2 program director reports to the service acquisition executive, Assistant Secretary John J. Welch, Jr.

Five of the six Air Force PEOs are military officers. One, the Information Systems PEO, is a Senior Executive Service civilian. Plans call for all PEOs and their staffs to be located in the Pentagon.

Under Secretary Foreman says that the DMR acquisition reforms are sound. The point . . . is to make clear where accountability lies.

For the Air Force and the Department of Defense, better business practices should not be viewed as ends in themselves.

Of course, many of the DMR changes pushed by the Office of the Secretary of Defense would not have been adopted by the services had they been left to make the call. For example, service officials always have been concerned solely with whether their financial systems worked, and not whether it made sense to combine them with similar systems from other services.

"Some of these you must look at from a Department of Defense perspective," Ms. Foreman concedes. "From an Air Force perspective, we had systems that we felt worked very well."

Under a so-called "best of breed" concept, certain service information systems that are clearly superior will become the standard. The Defense Logistics Agency, for example, is adopting an Air Force information system to help manage the consolidation of supply depots.

Of the DMR changes that the Air Force originated, perhaps the biggest is the merger of AFSC and AFLC. In the first phase of the DMR process, both organizations planned significant restructuring. AFSC, for instance, planned a cut of 8,000 positions by 1995. Even at that point, the Air Force DMR review board was considering consolidation. As the new PEO acquisition structure swung into operation, it became clear to the board that combining the two buying commands made sense.

Air Force Communications Command faced a similar process. In the DMR phase one, it was streamlined, with base communications and combat communications units transferred to the major air commands. In DMR phase two, the Air Force decided to disestablish AFCC as a major command.

As part of second-phase DMR moves, numbered reserve air forces have been eliminated. Numbered active air forces have been reoriented toward purely operational warfighting, with a consequent elimination of 500 management slots.

Overall, Air Force major command manpower will be reduced by some 5,400 positions. The cuts will be phased in over three years, starting in Fiscal 1991. Deputy slots were combined. Totally eliminated are the inspector general personnel watching over the shoulders of major command inspectors at operational readiness inspections.

Less Outside Help

One big DMR change will be a reduction of outside technical help. For the last thirty years, much of the engineering support for AFSC weapon development and testing has been provided by Federally Funded Research and Development Centers (FFRDCs) and other outside contractors. A review of support requirements projects holds that $550 million can be cut with "minimal impact on mission success," according to Air Force budget documents.

At the other end of the scale, $8 million will be saved by streamlining the Air Force Intelligence Agency. Twenty-eight positions will be eliminated—seventeen by cutting administrative support, eleven due to changes in mission requirements. The Air Force Watch and Soviet Awareness Program will close down, and the Soviet Translation and Publication Program will be reduced.

Slated for elimination are thirty-two military positions at Air Force sites in Iceland. These cuts will not be accomplished through streamlining, but by increasing the work load of those left at this remote location. The official forty-hour week will expand to forty-eight hours, says the Air Force.

Other small DMR projects include limiting program managers to two Headquarters prebriefings before Defense Acquisition Board (DAB) briefings (projected $600,000 savings through 1997), issuing special credit cards for charging fuel purchases at commercial airports ($19 million savings), and reducing the frequency of AIDS antibody testing from every two years to every five years ($7 million savings).

For the Air Force and the Department of Defense, say officials, better business practices should not be viewed as ends in themselves. Even if all DMR recommendations are implemented, the Pentagon will not run like a corporation. That is because the military is different. In acquisition, "we will from time to time have failures," said Secretary Cheney at his DMR briefing.

The Navy's A-12 combat aircraft is a case in point. Whether the new acquisition chain of command might have headed off the A-12 debacle is something that will never be known for sure. The program's cost overruns and technical problems began before the system was put in place, but it is likely that, even under the PEO regime, the program would have run into trouble. Indeed, some critics warn that the new system might make such fiascoes *more* likely. "No system will work if people don't do their job," said Mr. Atwood. ■

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The industrial base behind Operation Desert Storm may not be there next time.

A Warning From Industry

By F. Clifton Berry, Jr.

"ATTENTION to the defense industrial base is an even more urgent matter today, as defense business with industry declines. Even during the buildup of the early and mid-1980s, the total number of contractors engaged in defense work went down significantly."

Robert T. Marsh, Chairman of Thiokol Corp. and a retired general who formerly headed Air Force Systems Command (AFSC), issued that warning in March 1990 in congressional testimony. For years he has sounded alarms about the erosion of the nation's defense industrial capability. Today, however, he is far from alone. The vitality of the defense industrial base has become a source of heated political debate and deep concern.

After reflecting on past lack of concern and considering the situation in 1991, General Marsh concludes that before solutions are attempted, a fundamental question must be answered: "What is US national security policy, and what are its goals?" That question provides a starting point for rational searches for resolution of the decline in the industrial base. If assessments of national security requirements are on target and if future national strategy envisions reconstituting forces and equipment, then the defense industrial base is a matter for concern.

Why should the state of the base be a cause for anxiety? Haven't the nation's armed services just finished waging the most successful military campaign in recent memory, if not in history? Didn't the high-tech weapons produced by US defense firms work extremely well? Weren't they available in adequate numbers?

Well, yes. However, many experts and officials maintain that the more important question is this: Would the Pentagon be able to carry off another Desert Storm–type operation somewhere else a few years from now, if it had to? The answer, unfortunately, is "maybe not," or even "probably not."

"It is indeed an irony," says Bernard L. Schwartz, chairman and chief executive officer of Loral Corp., "that, at the moment our weapons are the world's envy, the industry that produced them is being badly damaged."

Industry Whipsawed

In a May address to the American Institute of Aeronautics and Astronautics, Lockheed Chairman Daniel M. Tellep struck an equally somber note, pointing specifically to the industry's deep financial troubles. US defense firms, he noted, have written off $5 billion in the last few years alone on fixed-price development contracts. Whipsawed between painful government contracting rules and diminishing profitability of the defense business, says Mr. Tellep, the industry for the first time sees "the emergence of genuine concerns for the financial health of our industry and the ability of this nation to sustain an adequate defense industrial base."

For years, the defense business has been beset by the increasing complexity of regulations, strangling oversight, and no improvement in the overall process. Defense executives cite excessive regulation and oversight and the procurement miasma for having changed the acquisition climate from cooperative to adversarial.

As a result, says Loral's Mr. Schwartz, "I cannot hire auditors and lawyers fast enough, while at the same time I am forced to lay off scientists and engineers."

In 1988, the Air Force Association and the USNI Military Database issued "Lifeline in Danger," a study that called attention to the difficulties that the defense industry would encounter if the Pentagon ever pushed it to surge or meet all-out mobilization needs. In the nearly three years since AFA's study, the nation has fought a short, sharp war in Panama and a longer, sharper, and larger war in the Persian Gulf.

In neither conflict was the United States required to undertake the classic mobilization as envisioned in "Lifeline in Danger."

Nor did the defense base have to surge to produce major systems to meet the demands of Desert Storm. Industry surged to produce spares and consumables for the Gulf conflict, but had no need to produce new fighters, tanks, or ships. Indeed, the spigot was turned off sharply when President Bush suspended offensive action on February 28.

Even as air supremacy was being established over Iraq in late January, the market for defense equipment was dwindling. On February 4, the Pentagon sent Congress a budget request that cuts defense spending by twenty-five percent over six years.

Defense Secretary Dick Cheney said that, in coming years, defense will require "vigorous defense research and development, the fielding of advanced military systems as soon as necessary, and the preservation of critical elements of America's defense industrial and technology base."

Adapting Forces

Some, however, worry whether those elements will be there. Adm. David E. Jeremiah, the Vice Chairman of the Joint Chiefs of Staff, gave the uniformed military point of view on future defense industrial requirements, and it was bleak.

He told Congress that his greatest worry in adapting US armed forces to the new US defense strategy concerns industrial capabilities and the decline of US investment in research and development to maintain its technological edge. He expressed concern about the "vitality and responsiveness of the resource base and the ability to compete with foreign countries." He called this a national—as opposed to purely military—problem "beyond the capability of defense industry alone to rectify."

Such Pentagon cries of alarm sound good. However, the contractors can be forgiven for harboring a certain cynicism; they have heard it before. For example, in November 1989, Congress legislated a requirement for the Department of Defense to take action "for the improvement of the defense industrial base." The law required a report from the Secretary of Defense by March 15, 1990, on the condition of the defense industrial base.

The Defense Department submitted an interim report to Congress on March 15, 1990, and a final report on October 15, 1990, seven months after the law required. It said that the Department of Defense (DoD) "is developing a defense industrial base strategy to bolster R&D and manufacturing capabilities" and that "DoD has launched a number of important initiatives [on the industrial base]." Among these initiatives were adding the topic to the Defense Science Board agenda and consolidating industrial base and manufacturing policy and planning into a single office.

However, the report was spotty on the critical topics of profitability, debt burdens, and other financial factors. It was long on analysis but short on remedies. Those are not only topics that Congress mandated; they are life-and-death business considerations for defense industry executives.

"We all agree that a smaller industry is both inevitable and OK," says Malcolm R. Currie, chairman and CEO of Hughes Aircraft, "as long as it is technically and competitively vital and profitable."

That sentiment is echoed by John McLuckey, president of Rockwell's Defense Electronics Systems. "A smaller industrial base is inevitable," the Rockwell executive maintains. "In that situation, the remaining defense contractors must be financially sound."

Mr. Schwartz notes that, when one scans the developments of the past five years, a grim financial picture begins to come into focus. "Defense industry stocks have lost forty percent of their market value," he says. "Our price/earnings ratio is about half that of the Standard & Poor's 400, and lenders are starting to redline our industry."

Clearly, past practices have damaged the financial health of the defense industrial base. If these are perpetuated, an ever-weaker arms industry is guaranteed. In the view of most industry officials, the industry's financial health is just as important as technological leaps in devising rational defense policies for the future.

Not a Free Market

General Marsh, the former AFSC commander, maintains that questions about the goals of national security must be answered before a rational search for solutions begins.

As some see it, however, a "solution" of sorts is being imposed *ad hoc* on the industry, and it is not likely to produce a stronger industry.

"There's already a policy," claims Ralph Hawes, former executive vice president of General Dynamics Missiles and Electronics. "It is, 'Let the free market rule.' But defense business does not operate in a free market. It is a monopsony situation, with a single buyer that makes the rules, not a free market situation at all."

Most executives believe that the quest for a solution to industry's ills is impeded when government officials take the view that the defense base is a monolithic, homogeneous entity.

One who argues for greater differentiation in the government's handling of the industry is D. Travis Engen, executive vice president of ITT Corp. and head of its defense unit. Mr. Engen believes that, in its approach to the industry, the country's options are pretty clear-cut:

- Do nothing,
- Pursue piecemeal solutions,
- Take an "enterprise approach."

Mr. Engen clearly prefers the latter course, which he explains will entail using "sector-specific" remedies. These solutions take into account the varying concerns and characteristics of the multiple sectors of the base.

Taking this approach could bring about, in Mr. Engen's view, "differential acquisition policies." Under such an approach, the relative importance of a sector would to a large degree dictate the acquisition policies. It might be necessary to "preserve a core of very special sectors," says Mr. Engen, with the Pentagon inclined to impose policies of considerable specificity. Other sectors could to a much greater extent "enjoy the commercial advantages" of their technologies and production capacities and operate under much looser DoD supervision.

Mr. Engen sees opportunities in treating the industrial base this way. With regulations differing by sector, DoD and industry could be more efficient in use of both time and resources.

The US will have to go to this type of system sooner or later, argues Mr. Engen, because development cycles for military systems continue to lengthen and technologies of the internal components have increasingly shorter lives. In short, the companies will have less and less commercial justification for seeking defense business.

Unique Technology

One of the nation's premier defense technologists, former Under Secretary of Defense William Perry, maintains that some exotic technologies are defense-unique and must be treated in a special way. These are included in what Mr. Engen describes as a "core of very special sectors." Examples include antisubmarine warfare, stealth technology, and air-to-air missiles, among others. In Mr. Perry's view, other technologies may be dual-use in nature, with applications in both defense and commercial sectors. Some examples are semiconductors, computers, software, and telecommunications.

Mr. McLuckey concurs that the country needs to view the defense industry as a kind of mosaic, consisting of a variety of different sectors. They can be broken out into commodity types as Mr. Engen suggests. Or, says Mr. McLuckey, defense companies will respond to a weakened defense market in two ways, depending on their degree of diversification.

Those companies that serve multiple industries, if they cannot earn adequate returns from the defense business, will redirect their assets and investments to other, more rewarding segments of their companies that serve other markets.

On the other hand, if companies without clear alternatives to the defense business are not successful financially, their weakness will hurt the Department of Defense because they will not be able to make independent research and development (IR&D) and capital investments to produce the leading-edge, top-quality products this nation needs. In either case, the military and the nation lose.

Mr. Currie, the Hughes CEO, also sees opportunities for the industry, if "some innovative enabling actions are taken by the government" to capture such companies for a revitalized base.

He advocates incentives such as "constructive tax policies, legal antitrust liberalization, and protection of intellectual property rights." He notes that there is a great need for "patient capital" to provide the underpinning for research and development and to make the investments that convert R&D into marketable products.

Dan Pinick, president of Boeing's Defense and Space Group, also emphasizes the importance of research and development that can be turned into more efficient production of weapons that could be essential in future contingencies. The production might be at low rates. However, he observes, the only items that can be surged are those already in production.

To encourage the necessary R&D to maintain and advance the technology base, Mr. Pinick and other executives advocate a shift of policy in which the Pentagon would pay full reimbursement of a contractor's IR&D expenditures. At present, such reimbursement is flexible, and has ranged from seventy-two to eighty percent of total outlay.

Dual-Track Approach

Hughes's Mr. Currie concurs with regard to stimulating research and development and underscores the necessity for producibility. He calls it a "conscious dual-track approach, balancing system upgrades by injection of advanced technology and simultaneously pursuing competitive quantum leap demonstrations and limited production prototypes." That dual-track approach, he believes, would maintain the vitality of a smaller defense sector.

Leaders of defense companies may vary in their products and their companies' financial health, but they agree on at least three important points.

First, government and industry, now at each other's throats, need to forge a more cooperative and constructive relationship and break down the adversarial wall between them.

Second, the government must take steps that will enable smart management teams to improve the financial health of their companies. Mr. Currie calls it "patient capital." Mr. Schwartz of Loral talks of "low-cost capital." They and others advocate government fiscal policies that will encourage and stimulate research and development.

Third, Washington—the executive and legislative branches together—needs to establish what Mr. Schwartz calls "predictable federal budget support" for defense programs, support that would be exemplified by multiyear procurement contracts. This, executives argue, would dampen the wild swings of year-by-year budget cliffhangers and enable management to carry out prudent planning and investment for the longer haul. ■

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The Aerospace Education Foundation joins *USA Today* and NASA in a special classroom project.

The News from Space

By Arthur C. Hyland

FROM Seattle to Richmond, twelve school districts recently took part in a "newspaper-in-the-classroom" project sponsored by AFA's Aerospace Education Foundation. The project gave students a chance to explore high-technology issues about space.

The newspaper *USA Today,* in partnership with the National Aeronautics and Space Administration, developed a blended math–science–social studies curriculum called "Visions of Exploration: Past, Present, and Future." The program challenged students to think about space explorations and the technology needed for such ventures.

AEF worked with *USA Today*, selecting more than 200 classes in grade schools and middle schools to participate. Classes were chosen in areas where AFA chapters could monitor the program. Students received the newspaper one day per week for six weeks.

Students also received "Explorer's Journal," a student guide to assist in their studies. Teachers were given a curriculum guide and teaching plan, developed by *USA Today.*

The "Explorer's Journal" led students through the project with various activities and information. The journal and teaching plan emphasized NASA's four principal education initiatives for the twenty-first century: Mission to Planet Earth, Return to the Moon, On to Mars, and Exploration of the Solar System. Also, the development of the journal and teacher's guide was timed to coincide with the International Space Year in 1992 and to commemorate the 500th anniversary of Columbus's explorations of the New World.

Assisting *USA Today* in its efforts was an advisory team, including representatives from NASA, the National Science Teachers Association, the National Geographic Society, the International Reading Association, the National Air & Space Museum, and the 4-H Youth Development Group.

AEF President Gerry Hasler said that AFA chapters General E. W. Rawlings (Minn.), Albuquerque (N. M.), Wright Memorial (Ohio), Richmond (Va.), Greater Seattle (Wash.), Sacramento (Calif.), Green Valley (Ariz.), Austin (Tex.), Mile High (Colo.), Langley (Va.), Tacoma (Wash.), and Charles A. Lindbergh (Conn.) participated.

"It is not our idea to turn an entire classroom into scientists or engineers," Hasler said. "However, we hope that through the Visions program, all students will realize the contributions science and math have on our daily lives, and gain an appreciation, if not a direct interest." ■

Students learned about space exploration in a recent six-week course sponsored by AFA's Aerospace Education Foundation. NASA and USA Today developed the curriculum, "Visions of Exploration: Past, Present, and Future." AFA chapters in twelve states monitored the project.

Arthur C. Hyland is a staff member of the Aerospace Education Foundation.

Gallery of Asian and Pacific Airpower

By John W. R. Taylor and Kenneth Munson

Bombers and Maritime

Atlantic

In 1975–76, the French Navy sold three of its Atlantic maritime patrol aircraft to Pakistan. Despite having "Pakistan Navy" painted on their sides, they were delivered to No. 29 Squadron of the Pakistan Air Force, based at Sharea Faisal. A fourth Atlantic was acquired later. They have a pressurized upper deck in the "double-bubble" fuselage roomy enough for both the normal operational crew (two pilots, a flight engineer, three observers, a radio navigator, ESM/ECM/MAD operator, radar/IFF operator, tactical coordinator, and two acoustic sensor operators) and a relief crew for long-duration missions. 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. Lockheed P-3C Orions are now on order to replace the PAF's Atlantics.

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.

Canberra

The Indian Air Force has operated versions of this vintage British combat aircraft for thirty-four years. Its initial contract for a total of 80 Canberra B(I).58s, PR.57s, and T.4s, chosen in preference to less costly Soviet Il-28s, was larger than all other export orders for new-built Canberras added together. Surviving **B(I).58s** now equip No. 6 Squadron in an antishipping strike role, side by side with **B.66s** (refurbished ex-RAF B.15s and 16s), ex-RNZAF **B(I).12s,** a few **TT.42** target tugs modified by Hindustan Aeronautics from ex-RAF T.4s, and Jaguars. The remaining **PR.57s** are flown on photographic duties by No. 106 Squadron. No. 35 Squadron has specially equipped ECM Canberras and MiG-21s. *(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

Smaller and far less costly than USAF's E-3 Sentry, the E-2 first flew in prototype form thirty years ago, on October 21, 1960, and entered production as the US Navy's standard carrier-based airborne early warning and control (AEW&C) aircraft. It pioneered the now-standard rotodome type of rotating "saucer" radome, with antennas that provide both radar and IFF data, via a General Electric AN/APS-139 advanced radar processing system in current E-2Cs. At an operating height of 30,000 ft, approaching aircraft can be detected and assessed over a radius of nearly 300 miles. Smaller targets, such as cruise missiles, can be picked up at a distance of around 170 miles; the movement of 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 twice the range of the radar. To facilitate stowage on board ship, the Rotodome can be lowered hydraulically, reducing the aircraft's overall height to 16 ft 5 in; the wings fold.

In Asia, the Japan Air Self-Defense Force has eight E-2Cs, with five more on order, to equip three squadrons by 1995. Singapore has four and intends to buy two more. The radars of the Japanese aircraft will be upgraded to the latest APS-145 standard for full overland capability.

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/F50 Maritime and Enforcer

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/F50 Maritimes** are unarmed and configured primarily for coastal surveillance or search and rescue, while the **Maritime Enforcer** versions 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, and three others are in service with the Royal Thai Navy. The latter are armed, though their avionics are not to full Maritime Enforcer standard. Earlier this year the Republic of Singapore Air Force ordered four F50 Maritime Enforcer Mk 2s, with four more on option. *(Data for F50 Maritime Enforcer Mk 2.)*

Contractor: Fokker Aircraft BV, the Netherlands.
Power Plant: two Pratt & Whitney Canada PW125B turboprops; each 2,500 shp.
Dimensions: span 95 ft 1¾ in, length 82 ft 10 in, height 27 ft 3½ in.
Weights: empty 32,620 lb, gross 45,900 lb (normal), 47,500 lb (max).
Performance: normal cruising speed 298 mph at 20,000 ft, ceiling 25,000 ft, max range (internal fuel) 4,237 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. Two underwing drop tanks can be carried to extend patrol range.

H-6

China obtained license rights from the USSR in September 1957 to build the Tupolev Tu-16 medium bomber. Two completed Tu-16s and a set of major assemblies for one aircraft reached the Harbin Aircraft Factory in May 1959, and the Chinese prototype, designated **H-6,** flew for the first time on September 27. An H-6 assembled that year from a knocked-down component kit was modified to carry China's first atomic bomb, which was dropped successfully in 1965. Difficulties experienced by Chinese industry in the early 1960s delayed a production start, but following transfer of the program to Xian Aircraft Factory in 1962–64, the **H-6A** production prototype eventually flew there on December 24, 1968.

The H-6A's Xian-built WP8 turbojets are 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. At that time also, 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, designated **H-6D,** which first flew on August 29, 1981, was approved for production in 1985. Intended for operation by the PLA Naval Air Force, it is a carrier for China's C-601 first-generation antiship missile, one of which is pylon-mounted under each wing. An enlarged cylindrical undernose fairing houses associated missile guidance radar.

E-2C Hawkeye, Republic of Singapore Air Force

Other variants are in service as ECCM aircraft and, in small numbers, as launch aircraft for high-speed high-altitude drones, and as engine test-beds. The number of H-6As and H-6Ds in service is believed to total about 120. *(Data for H-6D.)*

Contractor: Xian Aircraft Manufacturing Company, China.
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 underwing. Nuclear or conventional bombs in weapons bay. Chute for flares and marine markers to rear of weapons bay.

Il-28/H-5

Of an estimated 3,000 Ilyushin **Il-28s** (NATO "Beagle") 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 1991. 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, spliced on the centerline, saving 220 lb of structure weight. Many components, including the tail gun turret, were made common with those of the H-6 (Tu-16), already on the assembly line in China under license. The 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 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 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's INAS 315 (Winged Stallions) squadron was commissioned at Dabolim, Goa, in October 1977, with the first three of five refurbished Il-38 (NATO "May") intermediate-range, shore-based, antisubmarine/maritime patrol aircraft that it now operates. The airframe of the Soviet-built 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.

Design Bureau: Ilyushin OKB, USSR.
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.

N22 Searchmaster

This twin-turboprop STOL utility aircraft began as the Nomad, 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 with individual names include the civil Medicmaster, equipped as an ambulance for service in the Australian outback, the Surveymaster, and the amphibious Floatmaster. Military versions are the Missionmaster (see "Transports and Tankers" section) and the maritime Searchmaster.

The basic coastal patrol **Searchmaster B** has a Bendix/King RDR 1400 search radar, with an 18 in forward looking flat-plate antenna in a nose radome, and carries a four-man crew. Twelve serve with the Indonesian Navy's No. 800 Squadron, as do six more-sophisticated **Searchmaster Ls.** These have a Litton APS-504(V)2 search radar, with a 360° scan, 40 in flat-plate phased-array antenna in an undernose "lozenge" radome; Doppler, Omega, or inertial long-range navigation; and a crew of five. The Royal Thai Navy has five Searchmaster Ls, equipped with Barra SSQ-801 sonobuoys. Both navies include among routine tasks the tracking of pirates, and one Thai aircraft has 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.

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 were converted to **UP-2Js** for target towing, ECM training, and drone launch duties; two others were fitted with HLR-105/-106 EW systems, serving with the JMSDF's No. 81 Squadron at Iwakuni as **UP-2J(E)** elint aircraft.

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 customer for the P-3 was the Royal New Zealand Air Force, to which five **P-3Ks** (equivalent to the USN's P-3B) were delivered in 1966. Since augmented by a sixth (ex-Australian) aircraft, they serve with No. 5 Squadron; upgrade plans are at present in abeyance. Australia's first 10 **P-3Bs,** also joined later by a single (ex-USN) aircraft, were replaced by 10 **P-3C/Update II** Orions (Australian designation **P-3W**) and a further 10 **Update II.5s.** Equipment differences in the P-3W include an AQS-901 processing system for Australian Barra sonobuoys. The P-3Ws, which equip Nos. 10 and 11 Squadrons, are being upgraded by BAe Australia with new Doppler radar, a digital magnetic tape system, and new intercom.

Japan acquired three US-built P-3C/Update IIs before local production (starting with four CKD kits) was initiated by Kawasaki for the JMSDF, which plans to have 110 eventually, to Update II or III standard. Ninety-eight have so far been ordered, of which about 70 have been delivered; they equip seven JMSDF squadrons of the 1st, 2d, and 4th Fleet Air Wings at Atsugi (two), Hachinohe (two), and one each at Shimofusa, Naha, and Kanoya. Two are electronic surveillance **EP-3Cs** (NEC/Mitsubishi suite with 230-mile capture range; first delivery March 1991); two others are **UP-3C** ECM trainers, and one is an **NP-3C** for navaid calibration. Pakistan has ordered three P-3C/Update IIIs for use by the PAF's No. 29 Squadron, replacing Atlantics. South Korea's Navy has ordered eight Update IIIs for 1995 delivery, and the Royal Thai Navy is to receive three or more ex-US Navy P-3Bs. *(Data for P-3C/Update III.)*

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.

Il-28

N22 Searchmaster L

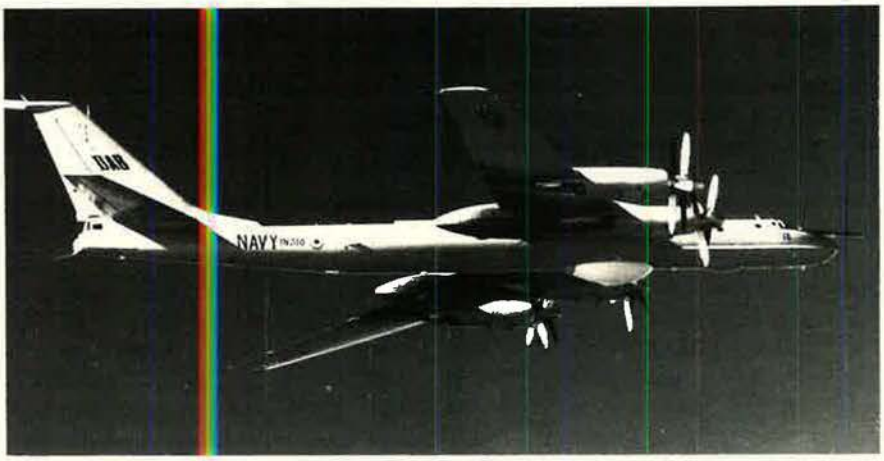
P-3C Orion, Japan Maritime Self-Defense Force (Katsumi Hinata)

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

Once the standard carrier-based antisubmarine and maritime patrol aircraft of the US and other navies, the Tracker soldiers on in shore-based form in Asia, nearly forty years after the XS2F-1 prototype flew on December 4, 1952. South Korea has around 20 of the original

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



Tu-142M, Indian Navy (US Navy)

piston-engined **S-2As** and **S-2Fs,** with APS-38 search radar in a retractable radome in the center-fuselage, ASQ-10 MAD in a retractable tail-sting, a 70 million candlepower searchlight on the leading-edge of the starboard wing, and sonobuoy stowage in the rear of the engine nacelles. The S-2F differs from the A primarily in having added AQA-3 Jezebel passive acoustic search equipment and Julie explosive echo-sounding equipment.

Taiwan's Navy has 32 S-2As, **S-2Es** and S-2Fs. Compared with the F, the S-2E has an increased span, larger tail surfaces, an enlarged front fuselage to enhance crew comfort, increased fuel, and 32 instead of 16 sonobuoys in the nacelles. In early 1989, Taiwan flight-tested a prototype conversion of one of its Trackers to **S-2T Turbo Tracker** standard, with 1,645 shp Garrett TPE331-1-5AW turboprops driving four-blade advanced technology propellers. It decided to update its entire fleet to S-2Ts. Grumman converted the first two aircraft and was authorized to supply kits for the other 30 under US Navy FMS contract. The update includes an avionics and ASW package comprising 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. The Royal Thai Navy evaluated similar conversion of its six S-2Fs and US-2C utility aircraft but decided to retire them instead. *(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.

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 the 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.

Surveiller

This is the name given to three special examples of the **Boeing 737-200** ordered by the Indonesian Air Force in the spring of 1981 and delivered during 1982–83. Configured for long-range overwater patrol, a duty which 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, which 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 up as government transports, for which they are outfitted with 14 first class and 88 tourist class seats in the main cabin. Boeing's Defense & Space Group has a four-year program, with Indonesia's IPTN as subcontractor, to upgrade the Surveillers with a new nose-mounted search radar, Cossor IFF interrogator, long-focal-length camera, improved mission avionics, controls, displays, and data processing (including a real-time SLAMMR display), and updated nav/com equipment. Redelivery of the upgraded aircraft is to begin in 1993.
Contractor: Boeing Commercial Airplane Group, 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-142M

Long-range antisubmarine versions of the four-turboprop Tu-142, among the world's largest combat aircraft, have been flown by Soviet Naval Aviation since 1970. Known to NATO by the reporting name "Bear-F," with "Mod" suffixes denoting successive modification standards, they are described in greater detail in the "Gallery of Soviet Aerospace Weapons" in the March 1991 issue of AIR FORCE Magazine.

In 1988 Indian Navy Squadron INAS 312 received eight Tu-142M Bear-F Mod 3s for maritime reconnaissance missions from its base at Dabolim, Goa. Their J-band overwater search-and-surveillance radar is housed in a large radome under the center-fuselage. A fairing that projects rearward from the tip of the tailfin contains MAD gear. The aircraft's basic endurance of around 30 hours can be extended by in-flight refueling.
Design Bureau: Tupolev OKB, USSR.
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 407,850 lb.
Performance: max speed at 25,000 ft 575 mph, ceiling 41,000 ft, combat radius (unrefueled) 5,150 miles.
Accommodation: basic crew of ten (commander, copilot, five weapon system operators, flight engineer, flight signaler, gunner) 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 received 12 US-1As, and one more is on order. Deliveries began in March 1975, and eight are now in service with detachments of No. 71 Squadron at the Iwakuni and Atsugi naval bases. They have nose-mounted AN/APS-80N search radar and AN/APN-187C Doppler navigation radar; SAR equipment includes flares, rescue hoist, marine markers, loudspeaker, life rafts, a powered lifeboat, and droppable rescue kits.
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 or four; up to 20 seated survivors, or 12 litters and up to three medical attendants or observers, in main cabin.
Armament: none.

Fighters

A-1 Ching-Kuo

The need for a new fighter to replace eventually the Republic of China Air Force's F/TF-104 Starfighters and some F-5E/Fs was apparent in the early 1980s. Although the US government embargoed sale of the Northrop F-20 Tigershark to Taiwan, it permitted US manufacturers to cooperate with that nation's Aero Industry Development Center in designing and building an indigenous defensive fighter (IDF), and the influence of General Dynamics on the IDF airframe is clear to see. Garrett developed an afterburning version of its TFE731 turbofan jointly with Taiwan's Chung Shan Institute of Science and Technology. The avionics include a 93-mile-range Golden Dragon 53 multimode pulse-Doppler radar, based on the GE Aerospace AN/APG-67(V) but embodying features of the Westinghouse AN/APG-66; Litton INS; and one head-up and three multifunction cockpit displays by Bendix/King. A GEC fly-by-wire control system is used, with side-

stick controller. The aircraft's missile armament is of Taiwanese origin.

The first prototype, named after the late President of Taiwan, Chiang Ching-Kuo, flew on May 28, 1989, and a two-seater plus two more single-seaters have since flown. Production, which could total up to 256 (including perhaps 40–50 tandem two-seaters, equipped for training and antishipping duties), has begun; service entry is planned for late 1992 or early 1993.

Contractor: Aero Industry Development Center, Taiwan.
Power Plant: two Garrett TFE1042-70 turbofans; each 8,340 lb st with afterburning.
Dimensions, Weights, and Performance: not available. Dimensions believed to be slightly smaller than 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.

A-1 Ching Kuo, Chinese Nationalist Air Force

F-1

First interceptor/close air support fighter designed by the Japanese aerospace industry, the Mitsubishi F-1 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 single-seat configuration. Mitsubishi's T-2 was the first supersonic aircraft designed in Japan. Two examples served as F-1 prototypes, deletion of the second cockpit allowing such additional avionics as an inertial navigation system, radar homing and warning system, and 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 until replaced by the upcoming FS-X (F-16 derivative) in the mid-1990s. Other F-1 equipment includes nose-mounted Mitsubishi Electric J/AWG-12 fire-control radar, Ferranti INS, and license-built Thomson-CSF HUD.

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.
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-4EJ, Japan Air Self-Defense Force (Katsumi Hinata)

F-5E Tiger II, Chinese Nationalist Air Force (Denis Hughes)

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

F-4E Phantom II

A detailed career 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. The Republic of Korea Air Force was a customer for 66 **F-4Ds** and 65 **F-4Es,** most of which are still in service. A radar/HUD/mission computer upgrade is planned. 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 has been approved, and redelivery to the 6th Air Wing at Komatsu began in November 1989. 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 the Asian area. 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 remaining of the original F-5A and F-5B. Largest Asian users of the Tiger II are South Korea and Taiwan. In both of these nations, the F-5E/F was the subject of license production programs. In Taiwan, AIDC produced 248 Es and 60 Fs for the Republic of China 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; Korean name for these aircraft is Chegoong-ho ("Air Master"). Korea also still has around 50 **F-5A/Bs** from earlier deliveries, as has 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 (28 + 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 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

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 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 1991 a total of 177 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 XJ/APQ-1 radar warning system 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 AIM-120A 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 and FS-X

Affordability has enabled the F-16 to establish its market leadership in Asia during the past year. A late switch

from the F/A-18 to the F-16 as South Korea's major combat aircraft for the 1990s, and a large order from Pakistan for additional F-16s, have followed Japan's choice of an advanced derivative of this fighter as its next-generation equipment. Having taken delivery already of 51 **F-16As** and **Bs,** equipped to carry Thomson-CSF Atlis laser target designation pods, Pakistan will begin receiving 60 more next year. Other customers for the A and B models are the Indonesian Air Force (8 + 4, delivered 1989–90), Republic of Singapore Air Force (4 + 4, delivered 1990), and Royal Thai Air Force (14 + 4, delivered from 1988). The Republic of Korea Air Force began with 30 of the later **F-16Cs** and six **Ds** in 1986–89. It has since equipped ten of them with LANTIRN day/night low-altitude navigation and targeting pods. A further 120 F-16s, with improved weapon delivery systems and AMRAAM capability, are to be coproduced by South Korean manufacturers and General Dynamics.

The 100–130 **FS-X** fighters required by Japan's Air Self-Defense Force are planned currently to be advanced developments of the F-16C, 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 F110 engine, the FS-X will have a larger all-composites wing of Japanese design, ventral canards, a longer nose for more (Japanese-developed) avionics, a stretched rear fuselage, and compatibility with Mitsubishi AAM-3 and/or ASM-2 missiles. Mitsubishi is the Japanese prime contractor. First flight is scheduled for 1995 and the production decision for 1996. *(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

The only Asian operator of the Hornet is Australia, which selected it to fulfill the RAAF's TFF (tactical force fighter) requirement, in October 1981. Completed in May 1990, the program began with two US-built two-seat **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 manufactured subsequently in-country by Australian industry. The single-seaters (Australian designation **AF-18A**) replaced Dassault Mirage IIIOs in 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 to F/A-18C/D standard with more modern avionics and provision for carrying a Loral AN/AAS-38 infrared tracking and laser designation pod. *(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 Republic of China 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 replaced by the indigenous Ching-Kuo. The RoCAF 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.

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

Australian F/A-18 (Royal Australian Air Force)

F-16A Fighting Falcon, Royal Thai Air Force

J-8

J-8 design began in 1964, and it flew for the first time on July 5, 1969. A clear-weather day fighter, it was a MiG-21/J-7 derivative along similar lines to those which, in the USSR, produced the Mikoyan Ye-152 "Flipper"; it was powered by two Liyang WP7B turbojets and was armed with an internal gun and four wing-mounted PL-2B air-to-air missiles. During the "cultural revolution," flight trials (though no other development) were allowed to continue, production being authorized in 1979. 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 fitting a Sichuan SR-4 radar in the single intake shock cone. About 100 J-8 Is were built; the comparatively few earlier J-8s were retrofitted with SR-4 radars.

The **J-8 II,** which first flew on June 12, 1984, is a vastly different aircraft, some 70 percent redesigned. Intended for the dual roles of high-altitude interceptor and ground attack, it features a "solid" avionics-filled nose, twin fuselage-side intakes, more powerful WP13A II engines, and other improvements. Chinese sources claim "several dozen" (say 40–50) in service by early 1990, with production continuing in small economic batches. The J-8 II still needs a modern avionics suite, but the US Peace Pearl program of 1987, under which Grumman was to develop this, was blocked by the US government in 1989, and in early 1990 the Chinese government itself canceled the contract. *(Data for J-8 II.)*

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

Power Plant: two Liyang WP13A II turbojets; each 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

Ten Asian air forces continue to fly this diminutive Soviet fighter, which originated in the 1950s. The MiG-21s serving in Afghanistan (50), Cambodia (20), North Korea (150), Laos (40), Mongolia (12), and Vietnam (175) are standard versions supplied by the Soviet Union. Hindustan Aeronautics built under license India's several hundred similar **MiG-21FL/21M/21bis** models, now equipping 17 squadrons. China manufactured those flown by its own Air Force of the People's Liberation Army (more than 250) and by the air forces of Bangladesh (16) and Pakistan (95). All have the NATO reporting name "Fishbed."

Production in China was initiated in 1961 by a license agreement for the **MiG-21F-13** and its Tumansky R-11F-300 turbojet. Relations between China and the Soviet Union were severed before technology transfer had been completed, and the first of a small series assembled at Shenyang, under the designation **J-7** (Jianjiji-7; "Fighter Aircraft 7"), did not fly 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 December 30, 1978, and still being built. 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. Export designation **FT-7.** Pakistan has ordered 15 **FT-7Ps,** deliveries of which should be completed this summer.

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

F-7P Airguard. 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 of 20 delivered to Pakistan in 1989, later increased to 80. PAF name **Skybolt.**

F-7MP. Similar to F-7P, 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, equivalent to Soviet MiG-21bis, with blown flaps, first flown April 26, 1984; in production and in service with PLA Air Force. All-weather day/night capability. Liyang WP13 engine of greater power, giving 29,530 ft/min initial climb rate. Enlarged nose intake and centerbody for JL-7 J-band interception radar. Sideways-hinged canopy. HTY-4 improved ejection seat. Twin-barrel 23-mm gun under fuselage; four underwing hardpoints. New fire-control system, IFF, radar warning system, ECM, flight data recorder, 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.

F7-3. Export version of J-7 III.

J-7E. Little is known about this version, except that it has a redesigned wing. *(Data for F7-3.)*

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

Power Plant: one Liyang WP13 turbojet; 14,550 lb st with afterburning.

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

Weight: normal gross 17,968 lb.

Performance: max speed Mach 2.1, ceiling 59,050 ft, range 596 miles (internal fuel only), 1,034 miles with three drop tanks.

Accommodation: pilot only.

Armament: Type 23-3A twin-barrel 23-mm gun under fuselage. Four underwing hardpoints for two or four PL-5B air-to-air missiles, pods of 12 × 57-mm or 7 × 90-mm rockets, bombs of up to 1,100 lb, or drop tanks (one 190 and/or two 127 US gallon).

MiG-29

In late 1985, India became the first foreign nation to take delivery of **MiG-29s.** Its 45 single-seaters and five two-seat **MiG-29UBs,** known by the Indian name **Baaz** ("Eagle"), equip Nos. 28 and 47 Squadrons, primarily for air-defense duties. A follow-on order, to equip a third squadron, is pending, and India has been offered a license to manufacture MiG-29s. If this is accepted, the fighters 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. On this occasion, Indian export aircraft appear to retain all or most of the operational equipment fitted to 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. NATO reporting name of the MiG-29 is "Fulcrum."

The only other nation flying MiG-29s in non-Soviet Asia is North Korea, which deploys 30 in an air-superiority role. *(Data for basic MiG-29.)*

Design Bureau: Mikoyan OKB, USSR.

Power Plant: two Sargisov (Leningrad/Klimov) 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 24,030 lb, gross 34,390–40,740 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).

Armament: six medium-range radar/IR homing AA-10 (NATO "Alamo-A/B") 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 GSh-301 gun in port wingroot leading-edge extension.

Mirage III

Survivors of the 24 Mirage IIIs ordered for the Pakistan Air Force in 1967 now serve with Mirage 5RPs in No. 5 Squadron. They consisted of 18 **Mirage IIIEP** all-weather low-altitude attack fighters with CSF Cyrano II fire-control and ground-mapping radar, Marconi Doppler, and navigation and bombing computers; three **Mirage IIIRPs** with nose-mounted cameras; and three **Mirage IIIDP** tandem two-seat trainers. The IIIEPs are equally effective for interception of Mach 2 targets.

Pakistan has recently acquired from Australia the 52 **Mirage IIIOs** that were replaced by Hornets in the RAAF. Some are expected to be used as a source of spares for the PAF's original Mirage force. *(Data for Mirage IIIEP.)*

Contractor: Avions Marcel Dassault-Breguet Aviation, France.

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

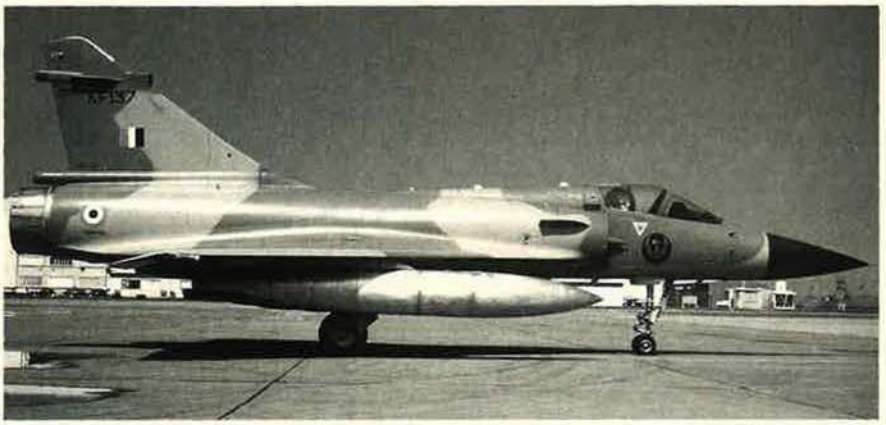
Dimensions: span 27 ft 0 in, length 49 ft 3½ in, height 13 ft 11½ in.

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.

MiG-29 demonstrator (Peter J. Cooper)

Mirage IIIRP, Pakistan Air Force (Denis Hughes)



Mirage 2000H, Indian Air Force (Ivo Sturzenegger)

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.

Sukhoi Su-27

The arrival on the international market of this formidable counterair fighter represents a serious challenge to the traditional superiority of Western combat aircraft. By far the most competent air-to-air fighter yet deployed in the Soviet Union, it already has fly-by-wire flight controls and a highly advanced, integrated fire-control system. This enables the track-while-scan coherent pulse-Doppler radar, IRST sensor, and laser rangefinder to be slaved to the pilot's helmet-mounted target designator and displayed on the wide-angle HUD. The 1970s-vintage cockpit seen in Su-27s at the last two Paris and Farnborough air shows is being superseded by a "glass" cockpit on the latest versions. A flight refueling probe will be optional, to increase the remarkable current range of more than 2,500 miles on internal fuel. Standard land-based versions are the basic single-seat **Su-27** (NATO "Flanker-B"), which can carry a reconnaissance pack on its centerline pylon, and the **Su-27UB** (Flanker-C) tandem two-seat, combat-capable trainer.

The People's Republic of China is reported to be the first export customer for the Su-27, with deliveries to begin before the end of this year. No other details are yet available of this first major arms deal between China and the Soviet Union for thirty years. *(Data for basic Su-27.)*

Design Bureau: Sukhoi OKB, USSR.

Power Plant: two Saturn/Lyulka AL-31F turbofans; each 27,557 lb st with afterburning.

Dimensions: span 48 ft 2¾ in, length excl noseprobe 71 ft 11½ in, height 19 ft 5½ in.

Weight: gross 48,500–66,135 lb.

Performance: max speed Mach 2.35 at height, Mach 1.1 at S/L, ceiling 59,055 ft, combat radius 930 miles.

Accommodation: pilot only.

Armament: one 30-mm GSh-301 gun, with 149 rounds, in starboard wingroot extension. Up to ten air-to-air missiles, including pairs of AA-10A/B/C/D (NATO "Alamo-A/B/C/D") or AA-9 ("Amos"), and four AA-11 ("Archer") or AA-8 ("Aphid").

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 recently 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, 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 2 of a program to apply a broadly similar upgrade to its

air force's 52 **A-4S/TA-4S** fleet with Nos. 142, 143, and 145 Squadrons. The first phase involved an engine refit (with the GE F404) which demonstrated a vast improvement in acceleration, takeoff, climb rate, and turn rate. Phase 2 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

At least ten air forces, most of them in Central and South America, continue to operate this small counterinsurgency aircraft, based on USAF's T-37A Tweet trainer. In the Asian theater, the Republic of Korea Air Force has about two dozen and the Royal Thai Air Force about half that number.

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.

A-CH-1

The A-CH-1 light attack and weapons training aircraft is a conversion of the T-CH-1 turboprop trainer that Taiwan's Aero Industry Development Center based on the airframe of the North American T-28A to meet a Republic of China Air Force requirement. The XT-CH-1A basic trainer prototype flew on November 23, 1973, followed just over one year later by an XT-CH-1B prototype configured for weapons training and counterinsurgency missions. Fifty production T-CH-1s were built over a period of five years, from May 1976. They are no longer needed in such numbers in the training role, and many have been converted into A-CH-1s.

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

AT-3 Tsu-Chiang

Design of Taiwan's AT-3 jet basic and advanced trainer started in 1975. The first of two prototypes flew on September 16, 1980, and 60 production **AT-3As** were delivered in 1984–90. Two of these were upgraded in 1989 with Westinghouse AN/APG-66 radar and a fire-control system for evaluation in a close air support role, Smiths Industries being prime contractor for the program. As a result, 20 AT-3As have been converted to this **AT-3B** standard to equip one RoCAF squadron, replacing an earlier proposal to develop a single-seat attack version known as the A-3 Lui-Meng.

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 fuselage. 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 (on wingtips) close-range air-to-air missiles.

A-4K Skyhawks, Royal New Zealand Air Force

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

RF-111C, Royal Australian Air Force (Paul Jackson)

AU-23 Peacemaker

Developed in the US by Fairchild Industries, this militarized version of the Swiss Pilatus Turbo-Porter STOL utility transport is one of many aircraft adapted since World War II for counterinsurgency and border-control duties in Third World countries. Fifteen were acquired by USAF for evaluation under the Credible Chase program, in competition with the Helio AU-24A. Thirteen of these were transferred to the Royal Thai Air Force in the early 1970s, under the Pave Coin program. Twenty more were acquired by Thailand from 1975, and Peacemakers continue in use by the RTAF for armed utility missions.

Contractor: Fairchild Industries, USA.
Power Plant: one Garrett TPE331-1-101F turboprop; 650 shp.
Dimensions: span 49 ft 8 in, length 36 ft 10 in, height 12 ft 3 in.
Weight: gross 6,100 lb.
Performance: max speed 175 mph, ceiling 22,800 ft, range 558 miles.
Accommodation: pilot and provision for up to nine passengers on seats that are quickly removable for freight carrying. Hatch in floor for dropping supplies or leaflets, or for a camera installation.
Armament: four underwing hardpoints for total load of 1,400 lb, and one underfuselage hardpoint for 590 lb. Armament and equipment can include gun or rocket pods, bombs, napalm, smoke grenades, a loudspeaker pod, cameras, etc. One side-firing 20-mm M197 gun or two 7.62-mm Miniguns in cabin.

F/RF-111C

The only export customer for the General Dynamics F-111, the Royal Australian Air Force, placed an order in the late 1960s for 24 of a variant designated **F-111C.** This was generally similar to 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 refit with F-111C avionics, and four of the original 24 underwent conversion to **RF-111C** strike/reconnaissance configuration. The latter retain their attack capability, but are equipped with a Honeywell AN/AAD-5 infrared linescan, three film cameras, and a TV camera. The first conversion was undertaken by GD at Fort Worth, the other three in Australia from US-supplied kits. Capability of the F-111Cs has been enhanced by the purchase of ten Loral AN/AVQ-26 Pave Tack laser designation and ranging pods, carried on a rotating cradle in the aircraft's internal weapons bay.

Twenty-two F/RF-111Cs remain in RAAF service, with Nos. 1 and 6 Squadrons at Amberley. Replacement of their analog avionics with digital systems was initiated in 1990, with Rockwell International chosen to head a team of US and Australian contractors that includes Hawker de Havilland (airframe modifications) and Smiths Industries. *(Data for F-111C.)*

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.

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 a static test aircraft has been completed and at least one prototype flew 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.

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 height, 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

The first version of the Hawk was built as the standard advanced flying and weapons trainer of the Royal Air Force. Half of those delivered were fitted subsequently with Sidewinder air-to-air missiles, and declared to NATO for point defense and participation in the RAF's Mixed Fighter Force. Export versions have had progressively greater capability for light attack, air defense, and reconnaissance duties, and have led to dedicated combat versions of the Hawk. Four versions have been sold in Asia, as follows:

50 series. Combat-capable tandem two-seat trainer, with 5,340 lb st Adour 851 turbofan and gross weight of 17,085 lb. Twenty Mk 53s supplied to Indonesian Air Force in 1980–84.

60 series. Development of 50 series, with 5,700 lb st Adour 861, modified wing leading-edges and flaps, strengthened landing gear, and wingtip Sidewinders. Disposable load increased by 33 percent and range by 30 percent, with improved field performance, acceleration,

rate of climb, and turn rate. Twenty Mk 67s ordered by South Korea for 1992–93 delivery.

100 series. Ground attack development of 60 series. Basically two-seater, but likely to carry only pilot on combat missions. Adour 871 turbofan. New combat wings for improved maneuverability. Provision for extended nose for FLIR and laser rangefinder. F-16 type INS, head-up display/weapon aiming computer, radar warning system, HOTAS (hands on throttle and stick) controls, multipurpose color CRTs, provision for ECM. External load 6,800 lb. Ten Mk 108s ordered by Malaysia. Deliveries begin 1994.

200 series. Single-seat multirole combat aircraft; 80 percent airframe commonality with series 100. Modified wing leading-edge; taller tailfin; new front fuselage, with provision for radar, FLIR, and laser rangefinder. Built-in cannon armament frees centerline pylon for stores; max external load 7,700 lb. All five pylons cleared for 8*g* maneuvers with 1,100 lb loads. First order for 18 Mk 208s, with wingtip Sidewinders, from Malaysia for 1994–95 delivery. *(Data for series 200.)*

Contractor: British Aerospace plc, UK.
Power Plant: one Rolls-Royce Turbomeca Adour 871 turbofan; 5,845 lb st.
Dimensions: span over Sidewinders 32 ft 7½ in, length 37 ft 4 in, height 13 ft 8 in.
Weights: empty 9,100 lb, gross 20,065 lb.
Performance: never-exceed speed at height Mach 1.2, max speed at S/L 644 mph, ceiling 50,000 ft, radius of action 120–765 miles.
Accommodation: pilot only.
Armament: one or two 25-mm Aden guns, each with 100 rounds. Five pylons for bombs of up to 2,000 lb, pods of 18 × 2.75 in air-to-surface rockets, Sea Eagle antishipping missile, Sky Flash, Sidewinder, or other air-to-air missiles, laser-guided munitions, reconnaissance or EW pods. Wingtip Sidewinders optional.

Hunter

Instead of retiring its Hunter single-seat fighters after 34 years of service, as expected, the Indian Air Force is studying the feasibility of fitting them with Magic II air-to-air missiles. No. 20 Squadron operates its **Hunter F. Mk 56s** among the high mountain valleys on India's turbulent northern borders and also provides the IAF's Thunderbolts aerobatic team. Many more aircraft of the same type, together with two-seat **Hunter T. Mk 66Ds,** equip the Hunter Operational Flying Training Unit that serves as the OCU for pilots destined to fly the Mirage 2000H and Jaguar.

No. 140 (Osprey) Squadron of the Air Force of Singapore also continues to operate Hunters, alongside the main attack force of A-4S Skyhawks at Tengah. Most are **FGA. Mk 74s** and **F. Mk 74Bs,** but a few **FR. Mk 74As** serve 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 antishipping 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.

MB-339C

First flown on December 17, 1985, the MB-339C is an upgraded model of Aermacchi's earlier MB-339A, which equips the Italian and several foreign air forces (including Malaysia) as a basic/advanced trainer and ground attack aircraft. Further MB-339A details can be found in the "World Gallery of Trainers" in last December's AIR FORCE Magazine. Differences in the C model include a more powerful engine, modified nose contours, larger permanent wingtip fuel tanks, and a fully integrated digital nav/attack system with a HUD in each cockpit, enabling either crew member to instigate air-to-ground weapon delivery. In May 1990, the Royal New Zealand Air Force ordered 18 MB-339Cs to replace its elderly BAe Strikemasters, phase-out of which has already started. Deliveries began in March this year and are to be completed by August 1993; as part of the deal, Aermacchi is buying back some or all of the Strikemasters for possible refurbishment and resale.

Contractor: Aermacchi SpA, Italy.
Power Plant: one Rolls-Royce Viper Mk 680-43 turbojet; 4,400 lb st.
Dimensions: span 36 ft 9¾ in over tip tanks, length 36 ft 10½ in, height 13 ft 1¼ in.
Weights: empty 7,297 lb, gross (with external stores) 14,000 lb.

Hawk 200 series prototype

Jaguar, Indian Air Force (Paul Jackson)

MB-339As, Royal Malaysian Air Force (Paul Jackson)

Performance: max speed 558 mph at S/L, 508 mph at 30,000 ft, ceiling 46,700 ft, range 1,266 miles with two 86 US gal drop tanks and 10 percent reserves.
Accommodation: two crew in tandem, on zero/zero ejection seats.
Armament: three hardpoints under each wing for up to 4,000 lb of stores including gun pods, single or cluster bombs, rocket launchers, air-to-ground or antiship missiles, or (outboard stations only) air-to-air missiles.

MiG-17/J-5/F-5

MiG-17s seen in Afghanistan, Mongolia, and Vietnam are survivors of the 6,000+ fighters of this type built in the Soviet Union in the 1950s for air defense and ground attack. 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-5|Ia** (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

Around 2,500 MiG-19s were manufactured in the Soviet Union in 1954–59, as the first Soviet production aircraft able to exceed Mach 1 in level flight. The most important versions 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. About 24 continue to serve with the Afghan Air Force. All others to be seen in non-Soviet Asia were produced in China, under the designation **J-6** (export **F-6**). The first few, built at Shenyang during the period of China's disastrous "great leap forward" in 1958–60, were substandard. Responsibility for the J-6 was transferred to Nanchang Aircraft Factory, which has since exceeded the Soviet production total. Its major 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. 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 based on the J-6 day fighter.

Air forces equipped with J-6/F-6s include those of Bangladesh (30), Cambodia (at least five), China (2,500,+ 300 with Naval units), North Korea (100), and Pakistan (125). The PAF aircraft 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. Under a recent deal, Myanmar (Burma) is reported to have ordered two squadrons of F-6s, and one of Chengdu F-7s, for immediate delivery. *(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

The Indian Air Force began equipping with this Soviet

variable-geometry combat aircraft family in February 1980, when it ordered 95 **MiG-23BN** (NATO "Flogger-H") ground attack fighters, and ten **MiG-23U** ("Flogger-C") tandem two-seat trainers, to replace Maruts and Su-7BMKs in Nos. 10, 31, 220, and 221 Squadrons. Two years later, it reequipped Nos. 223 and 224 Squadrons with **MiG-23MF** ("Flogger-B") interceptors, to offset the challenge of Pakistan's newly acquired F-16s. The MF has a "High Lark" radar with a search range of 53 miles, compared with the 18-mile-range "Jay Bird" in the normally exported **MiG-23MS** ("Flogger-E"). It can have an infrared sensor and Doppler, and is armed with more effective AA-7 ("Apex") and AA-8 ("Aphid") air-to-air missiles rather than the AA-2 ("Atolls") of the MS.

The **MiG-27M** ground-attack aircraft in current 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 Soviet Air Force's late-model "Flogger-J" standard, and have the Indian name **Bahadur** ("Valiant"). No. 222 Squadron, the last to operate Su-7BMKs, was first to receive MiG-27Ms, and has been followed by Nos. 2, 9, 18, and 22, marking the end of Ajeet lightweight fighter operation by the IAF. With 165 Nasik-assembled MiG-27Ms ordered to date, eight squadrons will eventually fly this type.

The Afghan Republican Air Force inherited sufficient MiG-23 interceptors and MiG-27 ground-attack aircraft to equip two full squadrons when Soviet forces evacuated Afghanistan in 1989. They are almost certainly equipped to higher standards than the 60 export-model MiG-23MS interceptors delivered to North Korea and 30 **MiG-23B** ("Flogger-F") ground-attack/interdictors flown by the air force of Vietnam. *(Data for MiG-27M.)*

Design Bureau: Mikoyan OKB, USSR.
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.

A-5Cs, Pakistan Air Force

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 began life 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

First aircraft designed from the start for specialized counterinsurgency operations, the Bronco was intended initially to meet US Marine Corps requirements for a light armed reconnaissance airplane. The first of seven YOV-10A prototypes flew on July 16, 1965; deliveries of 114 production OV-10As to the Marines, and 157 to USAF, were made in 1968–69. The OV-10As were heavier than the prototypes, requiring a 10 ft greater wingspan 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 Nos. 411 and 711 Squadrons to deal with frequent border clashes. No. 3 Squadron of the Indonesian Air Force, at Baucau, operates **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 1990 AIR FORCE Magazine. Swiss government regulations expressly forbid fitting of armament by the manufacturer, but weapons have been fitted by both Asian customers for the PC-7: Myanmar (Burma), which acquired 17 and equipped them for counterinsurgency duties, and Malaysia, which similarly armed a few of its 44 PC-7s to create one light attack squadron. Myanmar (four) and Australia (67) are customers for the redesigned Pilatus PC-9 trainer; the former may have converted 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

Initiated at Shenyang in August 1958, the Q-5 is a much-redesigned attack version of the J-6 (Chinese MiG-19). Reassigned to Nanchang, it was canceled in 1961, but kept alive by a small cadre of workers. Work was resumed officially in 1963, and the first prototype flew on June 4, 1965. Early prototypes proved unsatisfactory, but development was continued, two much-modified prototypes flying in late 1969. Production deliveries started in the following year.

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

First export customer was North Korea, which received 40 Q-5 IAs in the 1980s. In major production since the early 1980s has been the **A-5C,** developed specifically for the Pakistan Air Force. This has a Martin-Baker zero/zero seat, upgraded avionics, and is adapted to carry weapons and drop tanks standard on other PAF aircraft, including Sidewinder AAMs. After completing three A-5C prototypes, Nanchang delivered 54 to Pakistan, to an April 1981 order. Bangladesh reportedly ordered 20 A-5Cs in 1987, but delivery of these has not yet been confirmed.

Prototype development has been completed by Alenia of Italy of an **A-5M** (modified) variant with upgraded Western avionics. Intended for export, it first flew in August 1988 and combines 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 stations 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 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.

Sea Harrier

This STOVL carrier-based combat aircraft demonstrated its capability during the Falklands campaign in 1982, when Royal Navy Sea Harrier FRS. Mk 1s destroyed 22 enemy aircraft without loss in air combat. Key to its exceptional maneuverability in dogfight situations is that it can use its "puffer" stability control jets and thrust vectoring in forward flight ("viffing"). Compared with more familiar land-based Harriers, the Sea Harrier has a radar with air-to-air and air-to-surface modes, and is free of magnesium components that could cause corrosion problems at sea. It pioneered the use of ski-jump techniques from aircraft carriers to permit an increase of 2,500 lb in takeoff weight, and is equally suitable for air defense, strike, and reconnaissance missions.

The Indian Navy received the first of six Sea Harrier **FRS. Mk 51s** in January 1983, for operation by No. 300 (White Tiger) Squadron from the carrier INS *Vikrant* (recommissioned recently with a ski-jump ramp after major refit). Ten more aircraft were ordered in 1985, followed by a further seven in 1986, to equip the INS *Viraat*. Deliveries began in December 1989, with the added ability to carry Sea Eagle antishipping missiles and air-to-air Magic IIs. 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 Sea Eagle air-to-surface missiles, 1,030 lb free-fall and 1,120 lb parachute-retarded bombs, rockets, and flares. Four Magic II 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

The Afghan Republican Air Force is believed to have two squadrons of vintage Sukhoi Su-7BM (NATO "Fitter-A") fixed-wing attack aircraft at Shindand; the North Korean People's Army Air Force has about 30. Far more formidable are the variable-geometry Su-20/22 Fitters operated by Afghanistan and Vietnam. The precise variants

that they fly are not known. The Su-22s have a Tumansky R-29B turbojet instead of the Lyulka AL-21F-3 fitted in the Su-17 and Su-20. They are almost certain to lack the more advanced equipment of the Soviet air forces' Su-17s, described in the "Gallery of Soviet Aerospace Weapons" in the March 1991 AIR FORCE Magazine. *(Data for Su-22M-4.)*

Design Bureau: Sukhoi OKB, USSR.
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 up to 9,370 lb of bombs, rocket pods, 23-mm gun pods, air-to-air and air-to-surface guided missiles.

Su-25

Recent wars in Afghanistan and the Persian Gulf have shown that, even in the virtual or total absence of airborne opposition, air forces can suffer notable losses from ground defenses. The destruction of 23 Soviet Su-25K (NATO "Frogfoot-A") close support aircraft, mostly to shoulder-fired surface-to-air missiles fired by the Afghan *mujahedeen,* must limit enthusiasm for this type of combat aircraft, despite the fact that survivability features account for some 7.5 percent of the Su-25's normal gross weight. At least one full squadron was left with the Afghan Republican Air Force when the Soviets withdrew from its country. Nobody doubts the potential value of aircraft that can place bombs within 16 ft of a target over a standoff range of 12.5 miles, thanks to an efficient laser guidance system, but it needs dispensers for 256 IRCM flares in an effort to stay alive.

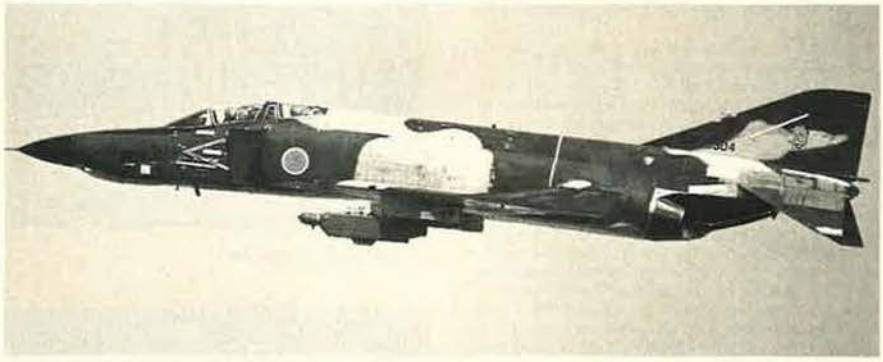
Design Bureau: Sukhoi OKB, USSR.
Power Plant: two Tumansky R-195 nonafterburning turbojets; each 9,921 lb st.
Dimensions: span 47 ft 1½ in, length 50 ft 11½ in, height 15 ft 9 in.
Weights: empty 20,950 lb, gross 32,187–38,800 lb.
Performance: max level speed at S/L Mach 0.8, max attack speed with airbrakes 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.

Reconnaissance and Special Mission Aircraft

MiG-25

With a maximum speed of Mach 2.8 and ceiling better than 75,000 ft, the eight single-seat **MiG-25Rs** (NATO "Foxbat-B") and two two-seat **MiG-25U** ("Foxbat-C") trainers delivered to the Indian Air Force in 1981 gave it a reconnaissance capability unmatched in non-Soviet Asia. They are strictly "straight and level" aircraft, with no concessions to maneuverability, but appear to have presented no problems to the pilots of India, and other Third World nations that have since received "Foxbats." Construction is mainly of arc-welded nickel steel, with titanium in areas subject to extreme heating, such as the wing leading-edges. A compartment in the nose can accommodate any one of a variety of reconnaissance packages. That installed in "Foxbat-B" has, typically, five camera windows and flush dielectric panels for side-looking airborne radar (SLAR). *(Data for MiG-25R.)*

Design Bureau: Mikoyan OKB, USSR.
Power Plant: two Tumansky R-15BD-300 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 2.83, at S/L Mach 0.98, ceiling 75,450 ft, operational radius 560 miles.



RF-4EJ Phantom II, Japan Air Self-Defense Force (Katsumi Hinata)

Y-5, People's Liberation Army Air Force, China

Accommodation: pilot only.
Armament: none.

O2-337 Sentry

The Sentry was developed for nations seeking versatile aircraft that are different and/or less costly than standard production types. Six were delivered to the Royal Thai Navy at the beginning of the 1980s, followed by four more in October 1983. To fulfill such small orders, Summit normally rebuilt used Cessna T337 airframes to zero-time status, before reequipping them for specific tasks. These could include counterinsurgency, forward air control, helicopter escort, light ground attack, convoy protection, maritime patrol, six-seat personnel or light cargo transport, aerial photography, psychological warfare, airborne discharge, VIP transport, medevac, and high-altitude missions. Day or night capability could be provided.

Contractor: Summit Aviation Inc, USA.
Power Plant: two Continental TSIO-360 turbocharged piston engines in "push and pull" configuration; each 225 hp.
Dimensions: span 38 ft 2 in, length 29 ft 10 in, height 9 ft 2 in.
Weights: empty 3,160 lb, gross 5,200 lb.
Performance: max speed 206 mph at 10,000 ft, ceiling 28,500 ft, range 1,353 miles.
Accommodation: pilot and up to five passengers.
Armament: up to 350 lb of stores on each of four underwing pylons, including 7.62-mm gun pods, 12.7-mm gun pods, rocket packs, bombs, markers, flares, Adsids (Air-delivered seismic intrusion detectors), and a combined search radar and speaker system.

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, since augmented by a further nine, have CAI/Fairchild/Itek forward, oblique, and high/low altitude panoramic cameras in the nose, plus a TEREC (tactical electronic reconnaissance) system that includes Loral AN/UPD-8 side-looking airborne radar, Texas Instruments RS-700 infrared linescanner (IRLS), and Litton AN/ALQ-125 ESM. Some also carry Pave Tack reconnaissance pods. The Japan Air Self-Defense Force operates 13 reconnaissance **RF-4EJs,** which it is planning to modernize with Texas Instruments AN/APQ-172 forward-looking radar, inertial navigation, an IR reconnaissance system, digital displays, and VHF (replacing UHF) radio. First upgraded example is due fo fly in 1992. In addition, the JASDF plans to convert 17 of its existing F-4EJ fighters to RF-4EJs. Seven of this latter batch will be equipped with a Mitsubishi Electric elint/ESM 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 10), 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 originally with four nose-mounted KS-92 cameras and four 100-foot film magazines. Some RoKAF aircraft are now thought to have the same TEREC installation as that country's RF-4Cs (which see). Also in service is the **RF-5E TigerEye,** a day/night version combining the F-5E Tiger II 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.

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 Antonov An-2 first flew in the Soviet Union on August 31, 1947, and 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 11,950. China also began producing An-2s under license in the mid-1950s. Nanchang factory delivered 727 in 1957–68. Shijiazhuang Aircraft Plant had built 221 by early 1987 and continues small-scale production. Most An-2s are used for agricultural and other civilian tasks, but the Air Force of the People's Liberation Army (China) has about 250. Others serve with the air forces of Afghanistan, North Korea, Laos, Mongolia, and Vietnam. The specification data below apply to the basic **An-2P** general-purpose transport. Other versions in military use include the **An-2S** ambulance, **An-2TD** paratroop transport and training version with six tip-up seats along each side of the cabin, and **An-2V/An-2M** floatplanes. All Chinese versions have the basic designation **Y-5** (Yunshuji-5; "Transport Aircraft 5"). NATO reporting name for 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 litters plus attendants.
Armament: none.

An-12/Y-8

Replacement of **An-12BP** paratroop and medium-range cargo transports (NATO "Cub") with Il-76s has been under way for seventeen years, but several hundred remain in Soviet and foreign military service. Retirement due to airframe fatigue has reduced the hard-worked Indian Air Force fleet to about 15; the Afghan Republican Air Force is thought to have 12. Powered by four 3,945 ehp Ivchenko AI-20K turboprops, these pressurized transports carry 90 troops, 60 paratroops, or 44,090 lb of freight. Loading is via a door under the upswept rear

fuselage, but the An-12BP lacks an integral ramp for vehicles.

Except for its more pointed nose transparencies, the Chinese **Y-8** is outwardly indistinguishable from the An-12BP. It is manufactured without a license, and its redesigned Chinese turboprops have a higher rating than the AI-20K. It also introduced a rear-loading ramp/door. The first Y-8 flew at Xian on December 25, 1974. Production was allocated to Shaanxi, which had delivered 31 to the commercial airline CAAC and the PLA Air Force by early 1989, including two transferred in 1987 to No. 2 Transport Wing of the Sri Lanka Air Force as **Y-8Ds.** Basic military version is the **Y-8A,** which has been adapted to carry such helicopters as the S-70C Black Hawk derivative. Standard civil versions are the **Y-8B** for passengers and freight, and the **Y-8F** livestock carrier. Only the forward cabin of the basic Y-8 is pressurized, but a fully pressurized 100-passenger **Y-8C,** developed with Lockheed assistance and with 4,550 ehp WJ6A engines, flew on December 17, 1990.

The prototype of a maritime patrol version, designated **Y-8X,** with a large drum-shaped undernose radome, has been flying since September 4, 1985. Its equipment includes Western avionics, infrared camera, infrared submarine detection gear, and sonobuoys. A **Y-8E** drone carrier has been developed specifically for Chang Hong 1 high-altitude reconnaissance UAVs, as well as an AEW&C version, with Marconi assistance. *(Data for standard Y-8A.)*

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 78,237 lb, gross 134,480 lb.

Performance: max speed 411 mph at 22,965 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, or 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

This series of transport aircraft began with the prototype An-24 (NATO "Coke") twin-turboprop short-range transport, first flown in 1960. Basic production version is the 50-passenger **An-24V Srs II,** with 2,550 ehp Ivchenko AI-24A engines, which was available also in mixed passenger/freight, convertible, and VIP configurations. The **An-24T** all-freight version was generally similar, but with a belly freight door at the rear of the cabin and an electrically powered winch and conveyor for its 10,168 lb of cargo. With an added auxiliary turbojet in the starboard engine nacelle, for performance boost and engine starting, the designations became **An-24RV** and **An-24RT,** respectively, with a payload hike to 12,566 lb for the freighter. Asian operators include the air forces of Afghanistan (one VIP), Bangladesh (one), Cambodia (two), North Korea (ten), Laos (six), Mongolia (six), and Vietnam (nine).

Developed from the An-24, the **An-26** freighter (NATO "Curl") has 2,820 ehp AI-24VT engines, an auxiliary turbojet 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 military service in Afghanistan (14), Bangladesh (five), China (six), Laos (three), Mongolia (one), and Vietnam (10). China also acquired eight **An-30** ("Clank") aerial survey aircraft, which have an extensively glazed nose, AI-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.

In China, Xian Aircraft Manufacturing Company produces a family of "reverse engineered" developments of the An-24/26 series covered by the basic designation Y-7. The 71 aircraft delivered by the beginning of this year are operated mainly by the nation's airlines on commuter services, but a prototype of the much refined **Y7H-500,** developed by Xian, flew for the first time on December 8, 1989, and is in production for both military and civil use. 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. Other data are generally as for the current Soviet An-26, below:

Design Bureau: Antonov OKB, USSR.

Power Plant: two Ivchenko AI-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.

An-26 (Air Portraits)

C-47, Papua New Guinea Defence Force

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

The An-32 (NATO "Cline") 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. Together with 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 rate of the An-32 is 40 aircraft a year, mostly for Soviet military use. India took delivery of 123 to replace its C-47s, C-119s, and DHC-4s, and these are named **Sutlej,** after a Punjabi river. Afghanistan is reported to have at least six An-32s.

Design Bureau: Antonov OKB, USSR.

Power Plant: two Ivchenko AI-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, equipped 38,158 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

This portly Japanese medium transport was designed in the mid-1960s, to replace the JASDF's elderly Curtiss C-46s. The first of two NAMC-built prototypes flew in November 1970, the program then being turned over to Kawasaki, which completed two preproduction and 27 production C-1s. Deliveries began in December 1974 and ended in October 1981. A navigation system upgrade is expected to start in 1992. The last five aircraft are longer-range models, with an additional fuel tank in the wing center-section. One C-1 was converted as the *Asuka* quiet STOL research aircraft; others have been test-beds for Japanese turbofans and for air-launch of Japanese air-to-surface missiles. One aircraft was delivered in 1986, in **EC-1** configuration, to the JASDF's electronic warfare training unit. Equipped with TRDI/Mitsubishi Electric XJ/ALQ-5 ECM, it is recognizable by its bulbous nose and tail radomes, large blister fairings each side of the forward and rear fuselage, and underfuselage antennas.

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.

C-47 Skytrain

Transports come and transports go, but the ubiquitous **C-47s,** it seems, go on forever. Because of their age and some of their locations, estimates of the numbers still extant in the Asian theater vary, but probably close to 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. Indonesia's Army and Air Force have about a dozen C-47s 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 Defence Force and Philippine Air Force each have about five, Taiwan's Republic of China 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 (twin-boom/podded fuselage) transport. The **C-119B,** of which deliveries to USAF began in December 1949, was a refined development of the original C-82 Packet with far more powerful R-4360 engines, a relocated flight deck at the front of an aerodynamically improved nose, a 14 in 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 saw war service in Korea and, notably as gunships, in Vietnam. The 40 C-119Gs of the Republic of China Air Force are operated by its 20th Tactical Transport Wing from Pingtung, Taiwan. *(Data for C-119G.)*

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, including 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-engine 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. Three Asian air forces are known still to fly the type: South Korea (14), Laos (about three), and Taiwan (10); Thailand's 16 are now mainly grounded. *(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

One of the world's truly great aircraft, the Hercules will soon enter its 40th year of continuous production. The appropriateness of its name is apparent from the fact that quite a number of the late-1950s **C-130A and B** models remain in service in the Asian area, as well as many **C-130Es.** Operators of these variants include the air forces of Australia (12 C-130Es), Indonesia (eight Bs and two KC-130B tankers), Pakistan (four Bs and five Es), Singapore (four KC-130Bs), and Vietnam (at least six As and Bs). As elsewhere, however, most current 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, with three more planned), South Korea (six), Malaysia (six), New Zealand (five), the Philippines (three), Singapore (four), Taiwan (12), and Thailand (three). Examples of the maritime patrol **C-130H-MP** serve with Indonesia (one) and Malaysia (three), and the latter plans to acquire also 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 Hercules," the **C-130H-30,** and its commercial counterpart, the **L-100-30,** which are 15 ft longer than the standard C-130H. They are operated by the air forces of Indonesia (seven), Singapore (2), South Korea (four, with more on order), and Thailand (three). Pakistan has one, and the Philippine Air Force two, 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 M/MP

CASA and IPTN set up Aircraft Technology Industries (Airtech) to handle the joint design and production of this twin-turboprop commuter and utility transport. 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. The first two Spanish production aircraft were military **CN-235 Ms** for VIP duties with the Royal Saudi Air Force.

By the beginning of 1991, orders had been received for 134 military examples, of which 28 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. Main military operators in Asia are the Indonesian Air Force and Navy, for which a total of 24 have been ordered. The Naval **CN-235 MPs** are being developed for ASW missions, with search radar in a large nose fairing. Three other CN-235 Ms have been ordered by the Royal Air Wing of Brunei.

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 19,400 lb, gross 36,376 lb.

Performance: max cruising speed 280 mph at 15,000 ft, ceiling 25,000 ft, range 932 miles with max payload, 2,706 miles with 7,936 lb payload.

Accommodation: crew of three; up to 48 troops, 46 paratroops, 24 litters and four attendants, or 13,227 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; max weapon load 7,716 lb. Indonesian Navy CN-235 MP can carry two Exocet antishipping missiles.

Dornier 228

The Dornier 228 STOL transport first flew in Germany on March 28, 1981. It has since been offered in a wide variety of variants, of which the **228-100** series (now out of production) can carry 15 passengers; the 5 ft longer **228-200** series (of which the -212 is now the standard model) can carry 19 in its civil form. Specially equipped versions 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, ground navaid calibration, and ambulance.

India contracted with Dornier in 1983 to manufacture up to 150 of the aircraft under license at HAL's Kanpur Division, preceded by delivery of a few German-built examples. HAL-built 228s are now being delivered to the Indian Air Force (43), Coast Guard (36), and Navy (26). The 228-101s used by the ICG's No. 750 Squadron for coastal patrol, antipollution, and antismuggling missions have 360° scan MEL Marec radar in an underfuselage blister fairing, Litton Omega, an IR/UV linescan for pollution detection, a 1 million candlepower searchlight, loudspeaker, marine markers, a sliding cabin door to permit air-dropping 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.

Nos. 41 and 59 Squadrons of the Indian Air Force, whose version has a large rear-fuselage cargo door, use the 228 for various utility and logistic support roles. The Indian Navy's maritime surveillance/ASV 228s, with MEL Super Marec radar and antiship missiles, operate from shore bases. Three maritime reconnaissance 228s were ordered in 1990 by the Royal Thai Navy. *(Data for 228-212.)*

Contractor: Dornier Luftfahrt GmbH, Germany; Hindustan Aeronautics Ltd, India.

Power Plant: two Garrett TPE331-5-252D turboprops; each 776 shp.

Dimensions: span 55 ft 8 in, length 54 ft 4 in, height 15 ft 11½ in.

Weights: empty 7,183 lb, gross 14,110 lb.

Performance: max cruising speed 269 mph at 10,000 ft, ceiling 28,000 ft, range with max payload 645 miles.

Accommodation: crew of one or two; 22 troops (or 21 paratroops plus jumpmaster), or six litter patients plus nine seated casualties and attendants in ambulance role.

Armament: none in basic transport role.

C-130H Hercules, Royal New Zealand Air Force

CN-235 MP prototype

F27 Friendship, Pakistan Air Force

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 748 is the Indian Air Force, which still has more than 50 of the 64 built for it under license by the Kanpur Division of Hindustan Aeronautics: 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 IAF squadrons include Nos. 11 and 106. India plans to modify some IAF 748s to ASWAC (airborne surveillance, warning, and control) configuration, for which an aerodynamic prototype, with an empty 15 ft 9 in diameter dorsal Rotodome, made the first test flight last November.

Oldest 748s in the Asian theater are the 10 ex-RAF **Andover C. Mk 1s** of No. 42 Squadron, Royal New Zealand Air Force, at Auckland. The Royal Australian Air Force still has all 10 of its original 748 **Series 2s:** eight aircrew trainers at the School of Air Navigation and two VIP transports with No. 32 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 flown by the Republic of Korea Air Force, and two of the six Series 2/2As 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 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.

IAI-201 Arava

Production of this Israeli general-purpose STOL transport was dominated by the IAI-201 military version,

which first flew in March 1972; more than 70 were built. Three were delivered to the Papua New Guinea Defence Force and three to the Royal Thai Air Force. The former uses them for border patrol as well as normal transport duties; RTAF Aravas have specialized avionics by Elta of Israel, and are employed as elint aircraft. The pod-and-boom Arava has a hinged tailcone that opens through more than 90° to give unrestricted access to the 450 cu ft cabin.

Contractor: Israel Aircraft Industries.

Power Plant: two Pratt & Whitney Canada PT6A-34 turboprops; each 750 shp.

Dimensions: span 68 ft 9 in, length 42 ft 9 in, height 17 ft 1 in.

Weights: empty 8,816 lb, gross 15,000 lb.

Performance: max cruising speed 198 mph at 10,000 ft, ceiling 25,000 ft, max range 621 miles.

Accommodation: crew of one or two; up to 24 troops, 16 paratroops with two dispatchers, 10 litters with two medical attendants, small vehicles, or equivalent cargo, in main cabin.

Armament (optional): fuselage-side attachments for two 0.50 in single-gun packs, with pylon below each pack for a six-round rocket pod.

Il-14

The Ilyushin Il-14 prototype first flew on September 20, 1950. Except for an inability to carry the full planned payload of 40 passengers, with adequate safety margins, production versions proved sound if unspectacular workhorses through four decades. An estimated 2,200 were delivered from the Khodinka works in Moscow between 1953 and 1957, supplemented by smaller-scale manufacture in Czechoslovakia and East Germany. About 30 Il-14s remain in service in transport roles with the Air Force of the Chinese People's Liberation Army. Afghanistan has ten; North Korea and Vietnam each have a few.

Design Bureau: Ilyushin OKB, USSR.

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

In the same class as USAF's C-141, the Il-76 (NATO "Candid-B") was designed to haul 40 ton loads of freight over a distance of 3,100 miles (5,000 km) in under six hours in the harsh operating environment of areas like Siberia. It first flew on March 25, 1971, and set 25 international records four years later, lifting a payload of more than 70 metric tons to a height of 38,960 ft, and carrying this same load around a 1,000 km circuit at a speed of 532.923 mph in the process. More than 680 Il-76s have since been built, with production continuing. Like the Soviet Union's own Military Transport Aviation force (VTA), the Indian Air Force chose Il-76s to replace veteran An-12s as its standard heavy transports. Twenty-four **Il-76MDs** 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. Gross weight and payload are increased; an additional 22,046 lb of fuel increases range with max fuel by 745 miles.

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. Being fully pressurized, the Il-76 can carry troops as an alternative to freight. 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 minimally equipped airfields. *(Data for Il-76MD.)*

Design Bureau: Ilyushin OKB, USSR.

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.

Islander/Defender

The Islander was designed as a simple, easy to manufacture, maintain, and service STOL transport for ten persons. More than 1,140 had been built by early 1991, including military Defenders sold to over 20 export customers. The 16 Indian Navy aircraft are Maritime Defenders, used for communications duties and, with a large nose radar, for maritime patrol. The Bendix/King RDR-1400 radar provides a 60° scan on each side of the flight path, over a radius of 35 miles, and can detect a 1,075 sq ft target in sea state 4 to 5 at a range of more than 40 miles from optimum altitude. Four underwing hardpoints can carry dinghy packs, flares, a loudspeaker pod, or a variety of weapons. The 22 Islanders used by the Philippine Air Force for utility missions, and the four flown by the Philippine Navy on transport and search-and-rescue duties, came from the PADC license assembly line at Pasay in Metro Manila.

Contractors: Pilatus Britten-Norman Ltd, UK: Philippine Aerospace Development Corporation (PADC), the Philippines.

Power Plant: two 260 hp Textron Lycoming O-540-E4C5 or 300 hp IO-540-K1B5 piston engines.

Dimensions: span 49 ft 0 in, length 35 ft 7¾ in, height 13 ft 8¾ in.

Weights (300 hp engines): empty 4,244 lb, gross 6,600 lb.

Performance (300 hp engines): max cruising speed 164 mph at 7,000 ft, ceiling 17,200 ft, range 1,220 miles with underwing tanks.

Accommodation: pilot, and up to nine passengers, eight parachutists and a dispatcher, three litter patients and two attendants, or freight.

Armament: four underwing pylons optional; inboard pair each have capacity of 750 lb, outboard pair 350 lb. Typical loads include twin 7.62-mm machine gun pods, 250 lb or 500 lb bombs, rocket packs, rocket clusters, wire-guided missiles, flares, antipersonnel grenades, and smoke and marker bombs.

N22 Missionmaster, Papua New Guinea Defence Force

Il-76MD, Indian Air Force (Paul Jackson)

Model 707

The Indian Air Force and Royal Australian Air Force each operate two ex-airline Boeing 707-320s as VIP and staff transports; four others provide similar capability for the Pakistan Air Force. In addition, four ex-Qantas 707-338Cs are currently being converted by Israel Aircraft Industries and Hawker de Havilland as tanker combis for No. 33 Squadron of the RAAF, based at Richmond. After structural strengthening and interior refit, they emerge equipped with a centerline boom-type refueling system plus a Flight Refuelling Mk 32B hose-and-drogue pod at each wingtip. The converted aircraft can carry a maximum transferable fuel load of 190,000 lb, equivalent to approx 28,350 US gallons. An updated flight deck includes Litton LN-92 ring laser INS, Bendix/King multifunction displays, IFF, and Tacan. One 707 was redelivered in April this year; all four are due back in service by mid-1992.

Contractors: Boeing Commercial Airplanes, USA; IAI Bedek Aviation Division, Israel.

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.

N22 Missionmaster

The Missionmaster is a military version of the short-fuselage N22B Nomad, for personnel and equipment transport, forward area support, surveillance, and maritime patrol. Four are used for coastal surveillance and transport by the Papua New Guinea Defence Force's Air Transport Squadron; the Philippine Air Force's 220th Airlift Wing has about a dozen for utility or tactical transport and weather reconnaissance; and the Royal Thai Air Force includes 22 in its large counterinsurgency fleet. Largest user is Australia: the RAAF with four for training and support, the Army now increasing its fleet to 23 as its Turbo-Porters are phased out. *(Data generally as for Searchmaster: see Bombers and Maritime section.)*

NC-212 Aviocar

The C-212 twin-turboprop STOL utility light transport was designed and developed by the Spanish company CASA, and since 1976 has been manufactured in Indonesia as the NC-212. IPTN in Jakarta built 29 **Series 100s** before switching to the **Series 200** a few years later, and this company produces the Aviocars for all three current Asian military operators. The major one is Indonesia itself, whose Air Force has ten, Navy eight, and Army four, though more are believed to be on order. The Royal Thai Air Force has a fleet of eight, and two have reportedly been ordered by the Union of Myanmar Air Force. 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 1991. 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 cur-

rently 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-1 HueyCobra/SeaCobra

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 obtaining a license for Fuji to build the Modernized AH-1S (US Army **AH-1F**). Seventy-one of a planned total of 88 have so far been funded, of which 54 had been delivered by March this year. Their cockpits are to be made compatible with use of NVGs, and NEC is to supply 33 Hughes C-Nite thermal imaging sights by 1996. The JGSDF plans five Cobra squadrons, the first three of which are based at Metabaru, 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 may increase this to as many as 72. Pakistan's Army operates two squadrons of AH-1Ss (20 aircraft), and the Royal Thai Army has four. All are to standards comparable with the US Army's AH-1F. *(Data for 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, fuselage length 44 ft 7 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.

AS 330 Puma

The prototype of this military assault and civilian transport helicopter flew for the first time on April 15, 1965. By 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 **AS 330L** Pumas (10 still serving) built for that country's air force. This final production version introduced main rotor blades made of composites, and has a higher gross weight than earlier models. The Air Force of Nepal has two earlier **AS 330Cs** with 1,400 shp Turmo IVB engines. The Pakistan Air Force has a single **AS 330J,** similar to the L, for VIP duties. Pakistan's Army Aviation Wing still operates around 35 Pumas as its primary helicopter transport fleet, but is seeking their replacement. *(Data for AS 330L.)*

Contractors: Aerospatiale SNI, France; Westland Helicopters, UK; IPTN, Indonesia.

Power Plant: two Turbomeca Turmo IVC turboshafts; each 1,575 shp.

Dimensions: rotor diameter 49 ft 2½ in, fuselage length 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.

AS 332 Super Puma/AS 532 Cougar

The Super Puma differs from the original AS 330 Puma in having 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. Current military variants, now redesignated **AS 532 Cougar,** are the AS 532UC unarmed military utility helicopter, seating up to 21 troops; AS 532UL with lengthened cabin for 25 troops; AS 532AC and AL armed versions of the UC and UL respectively; short-fuselage AS 532SC naval version with folding tail rotor pylon, deck landing assist device, ASW/ASV equipment, and armament; and proposed **Super Puma/Cougar Mk II** variants with new main and tail rotors, plus a further-lengthened cabin for up to 29 troops.

Deliveries of French-built "Mk Is" have been made to

AH-1S HueyCobra, Japan Ground Self-Defense Force (Katsumi Hinata)

AS 332 Super Puma, Japan Ground Self-Defense Force (Katsumi Hinata)

China (six VIP), Japan (three army VIP), South Korea (three air force VIP), Nepal (one for Royal Flight), and Singapore (five search and rescue, 17 transport), assembled in that country by Samco. IPTN (Indonesia) manufactures the helicopter under license. It has delivered six transports and one VIP model to that nation's air force, and 26 are being delivered to the navy for ASW, antiship missions with Exocet missiles, search and rescue, and secondary transport duties. One VIP transport has been exported by IPTN to the Royal Malaysian Air Force.

Contractors: Aerospatiale SNI, France; IPTN, Indonesia.

Power Plant: two Turbomeca Makila 1A1 turboshafts; each 1,877 shp.

Dimensions: rotor diameter 51 ft 2¼ in, fuselage length 50 ft 11½ in (stretched versions 53 ft 5½ in), height 16 ft 1¾ in.

Weights: empty 9,546 lb (UC/AC) or 9,920 lb (SC), gross (all) 19,841 lb with internal payload, 20,615 lb with sling load.

Performance (AS 532SC): cruising speed 149 mph at S/L, ceiling 13,450 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.

AS 365 Dauphin 2

The largest Asian customer for this popular French twin-turboshaft helicopter is China, which acquired an Aerospatiale license in 1980 to build 50 Dauphins (now completed) for civil and military use, and was negotiating 20 more earlier this year. 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 an antitank role; others serve on shipboard duties with the PLA Navy. The Indian Air Force has six AS 365Ns as VIP transports, while two of the older **AS 365Cs** are used for coastal patrol by No. 3 Maritime Squadron of the Sri Lanka Air Force at China Bay. This version has a smaller (38 ft 4 in) diameter rotor and 660 shp Arriel 1A engines. Last year Aerospatiale redesignated its naval/army/air force Dauphin variants as **AS 565 Panthers,** but no Asian customers have yet been reported for these improved models. *(Data for Z-9A.)*

Contractors: Aerospatiale SNI, France; Harbin Aircraft Manufacturing Company, People's Republic of China.

Power Plant: two SMPMC WZ8A (license Turbomeca Arriel 1C1) 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 equipped with door- or externally-mounted machine guns and/or "Red Arrow 8" antitank missiles.

Ka-25

India and Vietnam have Kamov Ka-25 (NATO "Hormone-A") antisubmarine helicopters, built in the Soviet Union between 1966 and 1975. The 15 Vietnamese aircraft are operated from land bases. Seven similar, refurbished, helicopters were bought for operation by the Indian Navy on ASW missions from its *Kashin II*-class destroyers, with secondary surveillance and search-and-rescue duties. They are being superseded by Ka-28s.

The Ka-25 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 autohover capability prevents use of the dipping sonar at night or in adverse weather.

Design Bureau: Kamov OKB, USSR.

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

Although the Ka-27 requires little more stowage space on board ship than the Ka-25 it was developed to replace, it offers much improved performance and military capability. The basic **Ka-27PL** ASW version and export **Ka-28** are known to NATO as "Helix-A." Their general configuration is similar to that of the Ka-25, with contrarotating coaxial rotors, but the cabin is enlarged, and twin fins replace the latter's triple tail unit. Twin turboshafts of the kind installed in Mi-24/25 attack helicopters enable flight to be maintained on one engine at max gross weight. Equipment includes an undernose 360° search radar, dipping sonar, IFF, radar warning receivers, and ESM. The 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. 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 ten Ka-28 Helix-As for operation from its new and upgraded *Kashin*-class ships, plus three for training duties. 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" in the March 1991 AIR FORCE Magazine.

Design Bureau: Kamov OKB, USSR.

Power Plant: two Leningrad/Klimov (Isotov) TV3-117BK turboshafts; each 2,225 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, plus sonobuoys, 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 1990.

Apart from eight for the Swedish Navy, all military KV107IIs originally 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 Union of Myanmar Air Force for search-and-rescue duties. *(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, Joseph Stalin ordered Mikhail Mil 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. Eventually, some 3,500 were built, in various military and civil forms; exports were made to around 30 countries. Of these, Afghanistan, North Korea, and Mongolia each continue to operate a few.

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 manufacture during the "great leap forward." Harbin Aircraft Factory revised the production drawings and flew a new, higher-quality prototype on August 20, 1963. Of 545 Z-5s built, 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.)*

Design Bureau: Mil OKB, USSR.

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. Mi-4s in Afghanistan have fired air-to-surface rockets, and have ejected flares to decoy shoulder-fired missiles aimed at attacking Mi-24 "Hinds."

Mi-6

Largest helicopter in the world at the time of its first flight, in September 1957, the Mi-6 (NATO "Hook") is now overshadowed by its replacement, the Mi-26. Several hundred remain in Soviet military service, to haul guns, armor, vehicles, supplies, freight, and troops in combat areas. Vietnam is reported to have at least ten, and Laos one. When utilized in a flying crane role, with slung cargo, the fixed wings that offload the main rotor in cruising flight are usually removed.

Design Bureau: Mil OKB, USSR.

Power Plant: two Soloviev D-25V turboshafts; each 5,500 shp.

Dimensions: rotor diameter 114 ft 10 in, length of fuselage 108 ft 10½ in, height 32 ft 4 in.

Weights: empty 60,055 lb, gross 93,700 lb.

Performance: max speed 186 mph, ceiling 14,750 ft, range 385 miles with 17,637 lb payload.

Accommodation: crew of five; 70 combat equipped troops in main cabin, or 41 litter patients and two attendants, or 26,450 lb of internal cargo, or 17,637 lb of slung cargo.

Armament: provision for 12.7-mm machine gun in nose.

Mi-8/17

The Mil Mi-8 and Mi-17 general-purpose helicopters utilize virtually the same airframe, which was first shown in public just thirty years ago, and they share the same NATO reporting name "Hip." The **Mi-8** is the original production configuration, 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. In total, more than 10,000 helicopters of the two types have been manufactured in the Soviet Union; variants are equipped for a wide variety of tasks, including airborne communications and ECM (see "Gallery of Soviet Aerospace Weapons," March 1991 issue).

The basic Mi-8 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. The Mi-8 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 non-Soviet air forces including, in Asia, 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. *(Data for Mi-8 "Hip-C.")*

Design Bureau: Mil OKB, USSR.

Power Plant: two Leningrad/Klimov (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

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 (NATO "Hind-A" to "Hind-G") can be found in the "Gallery of Soviet Aerospace Weapons," March 1991 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, and an enlarged undernose missile guidance pod. 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.)*

Design Bureau: Mil OKB, USSR.

Power Plant: two Leningrad/Klimov (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.

Mi-35P demonstrator (Paul Jackson)

Model 412, Indonesian Army

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

The Indian Air Force is the only military operator of the Mi-26, the heaviest production helicopter yet flown, outside the Soviet Union. Use of eight blades on the main rotor, once considered impractical, enabled Mil's General Designer, Marat Tishchenko, to keep the diameter smaller than that of the Mi-6, which the Mi-26 (NATO "Halo") supersedes. The prototype flew for the first time on December 14, 1977, and Mi-26s were fully operational with Soviet air forces by 1985. India's No. 126 Squadron began taking delivery of ten in June of the following year. Features of Halo include a cargo hold and payload very similar in size to those of a C-130H 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.

Design Bureau: Mil OKB, USSR.

Power Plant: two Zaporozhye/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

More than 100 of these twin-turbine helicopters are in military 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 (seven), the Philippines (one), and Sri Lanka (nine), as well as the Royal Thai Air Force (one), Army (34 ordered), and Navy (eight). Japan's Maritime Safety Agency has four civil Model 212s. The **Bell 412,** which has a four-blade main rotor and uprated power plant, has been supplied to or ordered by South Korea (three), the Philippines (two), Sri Lanka (four), and the Thai Royal Flight (one). Those of Sri Lanka are armed for assault/counterinsurgency roles; 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 process of receiving 28 **NBell-412s,** built locally by IPTN. Bell production was transferred to its Canadian factory in 1988–89. *(Data for Bell 212, with 412 in parentheses.)*

Contractors: Bell Helicopter Textron, Canada; 412 also by 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. NBell-412 certificated for FN EMA (external mounting assembly) permitting carriage of 7.62-mm or 12.7-mm gun pods, or pods of 70-mm unguided air-to-ground rockets.

Model 414-100 Chinook

Following delivery of two US-built examples and five knocked-down assembly kits, Kawasaki is building the Model 414-100 International Military Chinook under license for two of Japan's armed forces, as the **CH-47J.** This version corresponds to the US Army CH-47D. Deliveries by April this year totaled 18 to the Ground Self-Defense Force (of 39 required) and ten (of 15 wanted) to the Air Self-Defense Force. In 1989–90, Boeing delivered the first 12 of 18 ordered for the South Korean Army; three others have been delivered to the Royal Thai Army. Taiwan's Army operates, as utility transports, three **Mod-**

el 234MLR Commercial Chinooks, 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. *(Data for Model 414-100.)*
Contractor: Boeing Defense and Space Group, 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/530MG Defender

Developed from the US Army's OH-6A Cayuse, this small and agile helicopter can carry a useful weapons load, making it attractive to many air force customers in Africa, the Middle East, and Asia. Basic model is the **MD Scout Defender,** powered by a 375 shp Allison 250-C20B turboshaft, and which can be armed with fourteen 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 TOW missiles, with a nose-mounted sight standard or mast-mounted sight as an option. Third major variant is the **MD/ASW Defender,** with nose-mounted radar, MAD bird, and two homing torpedoes. The Indonesian Air Force has about a dozen of these helicopters for counterinsurgency duties; in Taiwan the Navy has a similar quantity of the ASW model and the Air Force six elderly OH-6As for training. License production has been undertaken in both Japan and South Korea, by Kawasaki and Korean Air, respectively, for many years, and is continuing. The RoK Army has more than 150 Scout Defenders and about 50 TOW Defenders. Those of Japan's GSDF (111 delivered; 15 more authorized in FY 1991) are known as **OH-6Ds,** and used mainly for AOP, liaison, and training; nine have been delivered for use as trainers 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 uprated **530MGs** for light attack and scout missions. *(Data for 530MG Defender.)*
Contractor: McDonnell Douglas Helicopter Company, USA.
Power Plant: one Allison 250-C30 turboshaft; derated to 425 shp.
Dimensions: rotor diameter 27 ft 4 in, fuselage length 23 ft 11 in, height 8 ft 7 in.
Weights: empty 1,979 lb, gross (normal) 3,100 lb, (overload) 3,750 lb.
Performance: max cruising speed 142 mph at 5,000 ft, ceiling over 16,000 ft, range 230 miles at 5,000 ft.
Accommodation: pilot and copilot/gunner.
Armament: pylon on each side of cabin for twin-round packs of TOW 2 missiles, pods containing two 7.62-mm or one 0.50 in machine gun, and launchers for seven or twelve 2.75 in air-to-surface rockets. Stinger air-to-air missiles and 7.62-mm Chain Gun being qualified.

S-58T

Sikorsky pioneered this twin-turbine conversion of the piston-engined S-58/CH-34 helicopter at the end of the 1960s, flying it for the first time in August 1970. The conversion, which received VFR certification from the FAA in April 1971 and IFR approval just over two years later, is marketed as a kit, and the rights to it were acquired from Sikorsky by California Helicopter at the end of 1981. Since that time kits have been sold for in-country conversion by the Indonesian Air Force (12) and Royal Thai Air Force (18). Most of these aircraft remain in service.
Contractor: California Helicopter International, USA.
Power Plant: one Pratt & Whitney Canada PT6T-6 Turbo Twin Pac turboshaft; 1,875 shp.
Dimensions: rotor diameter 56 ft 0 in, fuselage length 47 ft 3 in, height 14 ft 3½ in.
Weights: empty 7,577 lb, gross 13,000 lb.
Performance: cruising speed 127 mph at S/L, hovering ceiling OGE 6,500 ft, range 278 miles.
Accommodation: crew of two; up to 16 passengers in cabin.
Armament: none.

Sea King and Nuri

The Sea King was developed by Sikorsky to meet a US Navy requirement for a helicopter combining the anti-submarine hunter/killer roles that had previously required a team of two HSS-1 (SH-34G) Seabats. Deliveries to the Navy of **SH-3A** production aircraft, each with 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. Also in JMSDF service are ten **S-61A** transport versions, used for search-and-rescue, and three operated as utility transports. Each accommodates 26 troops, 15 litter patients, or equivalent freight, and retains the amphibious boat-hull of the SH-3A. The Royal Malaysian Air Force has 35 **S-61A-4s,** named **Nuri,** with 31 seats, rescue hoists, and auxiliary fuel tanks as standard equipment. It plans to upgrade them with Honeywell Primus 500 radar and AN/APN-209(V) radar altimeter, and Marconi ANV-301 Doppler nav system.

In 1959, Westland Helicopters of the UK was licensed 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 Sea King production for the UK armed forces, Westland supplied similar helicopters to the navies of Australia, India, and Pakistan, all of which continue to operate them in ASW and search-and-rescue forms, with Rolls-Royce Gnome engines. Typical equipment, on the Indian ASW Mk 42B, includes MEL Super Searcher radar, Doppler nav, GEC Avionics AQS-902 sonobuoy processor and tactical processing system, Alcatel HS-12 dipping sonar, Chelton 700 sonics homing, Marconi Hermes ESM, Louis Newmark automatic flight-control system, and fittings to carry Sea Eagle antiship missiles. *(Data for current Advanced Sea King.)*
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 A244S, or Sting Ray homing torpedoes, four Mk 11 depth charges, Ultra Electronics minisonobuoys, smoke floats, marine markers, and other weapons and equipment.

S-70A/C and UH-60J/P Black Hawk

The manufacturer's designation **S-70A** identifies a military tactical utility version of the US Army's UH-60A Black Hawk combat transport helicopter. Far Eastern operators include the air arms of Australia, Japan, and the Philippines (two **S-70A-5s**). Japan's Air Self-Defense Force is replacing some of its KV107IIA-5s in the SAR role with a version designated **UH-60J;** seven had been funded by FY 1990 of some 46 required, with three more funded for the JMSDF. The first UH-60J was US-built, the rest are being assembled by Mitsubishi. The 39 Australian **S-70A-9s** (two built by Sikorsky and 37 assembled in Australia by Hawker de Havilland between 1987 and February of this year) were intended originally for the RAAF but are now under Australian Army control. They have T700-GE-701A-1 engines, a modified SH-60B flight-control system, rescue hoist, main rotor brake, folding tail rotor pylon, and external stores support system (ESSS).

Following purchase in 1990 of three **UH-60L** Black Hawks with 1,857 shp T700-GE-701C engines, the latest US Army standard, the Republic of Korea Army is to receive an initial batch of 80–90 generally similar **UH-60Ps,** license-built by Korean Air. Other Asian customers have bought **S-70Cs,** which are essentially commercial utility derivatives of the UH-60A, including the air arms of Brunei (two), China (24 **S-70C-2s**), Taiwan (14), and Thailand (four for Royal Flight). *(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.

OH-6D, Japan Ground Self-Defense Force (Katsumi Hinata)

XSH-60J, Japan Maritime Self-Defense Force

S-70B and SH-60J Seahawk

Three countries in Asia have ordered S-70Bs, which are export versions of the US Navy's SH-60B Seahawk. To fill its RAWS (role-adaptable weapon system) requirement, the Royal Australian Navy placed an initial contract for eight in July 1985, ordering eight more in May 1986. These have the Sikorsky designation **S-70B-2** and comprise two US-built helicopters and 14 assembled by ASTA (AeroSpace Technologies of Australia). Equipment includes MEL Super Searcher radar and a Collins avionics suite. Deliveries are nearing completion, the S-70B-2s being assigned to the six FFG-7 (*Adelaide*-class) guided missile frigates, with which the aircraft saw active service in the Persian Gulf War.

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 producing the **SH-60J** (Sikorsky designation **S-70B-3**) for that service. Thirty had been funded up to FY 1991. Ten S-70Bs, actually designated **S-70C(M)-1s,** are being delivered to Taiwan for operation from eight new frigates to begin entering service in 1993. *(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, range with 1 h loiter 170 miles.
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,** with an order for 17 in 1983. Two of these were con-

figured 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 armed **H-76 Eagles** for counterinsurgency duties. During 1990 the Royal Hong Kong Auxiliary Air Force took delivery of six of the **S-76A+** model, three of them for SAR missions; two **S-76Cs** are on order for delivery to the RHKAAF in 1991–92. *(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

This is an export counterpart of the US Navy's MH-53E Sea Dragon airborne mine countermeasures aircraft. Compared with the CH-53E transport, from which it was derived, it has enlarged sponsons for considerably increased fuel capacity, in-flight refueling capability, an automatic flight-control system (with automatic approach to/depart from hover, and automatic tow coupling), and mechanical, acoustic, and antimagnetic systems to deal with all types of sea mines likely to be encountered. Onboard 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 expected to be procured in FY 1991. Deliveries, to replace KV107IIA-3s, began in 1989. *(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.

SA 316/319 Alouette III

Although the Alouette III light helicopter has been in production for nearly thirty years, several hundred remain in service in Asia, in a number of versions. French production of the original **SE 3160** began in 1962 and ended in 1969, when it was superseded by the **SA 316B** with uprated Artouste engine. Final French version was the **SA 319B,** with a 600 shp Astazou XIV turboshaft, which remained in production until 1985. 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 be around 300. Asian operators of the Alouette **III**, with estimated numbers in current service, include Bangladesh (six ex-Indian Chetaks), Indonesia (Air Force, three armed SA 316Bs), South Korea (Navy, 12 SA 316Bs for ASW), Malaysia (Air Force, 24), Myanmar (Burma) (ten SE 3160s), Nepal (four Chetaks), and Pakistan (Army 24, Navy 4, and Air Force 12 SA 316B/319Bs, some for ASW and SAR). India's own fleet of SA 316B/Chetaks includes at least 175 with the Air Force (some in antitank configuration), three squadrons (INAS 321, 331, 561) with the Navy, 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.

SA 321 Super Frelon and Z-8

During 1977–78, the Chinese PLA Navy received 10 **Super Frelons,** similar to the antisubmarine SA 321G developed for the French Navy but less fully equipped.

Alouette III, Pakistan Air Force (Denis Hughes)

SA 321G Super Frelon, Aviation of the People's Navy, China

Super Lynx prototype (J. M. G. Gradidge)

Some reportedly have French-built search radar; all were delivered with an early type dipping sonar, but at least three later received more modern Thomson-Sintra HS-12 for an SSBN escort role. Until the advent of the Z-9 Dauphin, they were the only PLA Navy aircraft operated from ships' platforms. To supplement the small number available, China's Helicopter Design and Research Institute developed the virtually identical **Z-8.** A prototype flew on December 11, 1985, and one Z-8 was delivered to the PLA Navy for service trials in August 1989. Initial production has been approved, for various military/naval and civil applications. *(Data for Z-8.)*

Contractor: Changhe Aircraft Factory, People's Republic of China.

Power Plant: three Changzhou WZ6 turboshafts; each 1,550 shp.

Dimensions: rotor diameter 62 ft 0 in, fuselage length 65 ft 10¾ in, height 21 ft 10¼ in.

Weights: gross 28,660 lb.

Performance: max cruising speed 154 mph at S/L, ceiling 10,000 ft, range 497 miles.

Accommodation: crew of two or three; up to 27 troops, or 15 litters plus a medical attendant.

Armament (ASW Super Frelon): four homing torpedoes or two Exocet antiship missiles.

SA 342L$_1$ Gazelle

The Gazelle was the smaller of the two French members of the three-helicopter collaboration program between Aerospatiale and Westland, which began in the late 1960s. About 1,500 were sold for civil and military use in more than 40 countries worldwide, including China, which acquired eight for antitank duties with its army aviation units. They were used, along with Z-9s, to quell the Tiananmen Square demonstrations in mid-1989.

Contractor: Aerospatiale, France.

Power Plant: one Turbomeca Astazou XIVM turboshaft; 858 shp.

Dimensions: rotor diameter 34 ft 5½ in, fuselage length 31 ft 3¼ in, height 8 ft 11⅞ in.

Weights: empty 2,198 lb, gross 4,410 lb.

Performance: max cruising speed 161 mph at S/L, ceiling 13,450 ft, range 440 miles.

Accommodation: up to five persons including pilot.

Armament: externally mounted weapons can include rocket pods and wire-guided or other antitank missiles. One or more machine guns can be carried, either pod-mounted externally or pintle-mounted in cabin doorway.

Super Lynx

This upgraded export version of the widely used Westland Lynx multirole military helicopter is very like the latest model developed for the Royal Navy. Production was started in 1988, when the first batch of an eventual 31 **Lynx Mk 99s** was ordered by the Republic of Korea, for operation in antiship/ASW roles from its ex-USN *Sumner*- and *Gearing*-class destroyers and future HDF-3500 class. Compared with earlier 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. Equipment on these Korean helicopters includes Racal Doppler 71/TANS N navigation avionics, Seaspray Mk 3 360° radar, GEC-Plessey AN/ASQ-503 dunking sonar, Mk 46 torpedoes, Sea Skua antiship missiles, Magnavox AN/SSQ-41 passive sonobuoys, and CAE AN/ASQ-504 MAD.

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.

UH-1 Iroquois/Model 205

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. Sole production source is now Fuji in Japan, which has been building the type since 1973. The Japan GSDF has more than 25 **UH-1Bs** and more than 100 **UH-1Hs** (Japanese designation **HU-1H**), of 133 so far funded, in service. Other operators, with approximate numbers in service, include Australia (Army 25 UH-1H), Indonesia (Army 16), South Korea (Army 15 UH-1B and 47 UH-1H, Air Force five UH-1D/H), Myanmar (12 205A-1), New Zealand (Air Force 14 UH-1H), Pakistan (Army ten 205 and five UH-1H), the Philippines (Air Force fifteen 205A-1 and 72 UH-1H), Singapore (Air Force four 205A/A-1, 24 UH-1B and 16 UH-1H), Taiwan (Air Force 58 UH-1H, Army 60 UH-1H), and Thailand (Army 75-plus UH-1B/D, Air Force 28 UH-1H, Navy four UH-1H). *(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, augmented later by 10 ex-RN Wasp **HAS. Mk 1s.** The RNZN fleet had dwindled to seven by 1989, but was brought back to strength with four more ex-RN Wasps in 1990. 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; it is awaiting six more from the same source. The other Asian operator is the Indonesian Navy, whose nine Wasps are also secondhand, 10 having been obtained from the Royal Netherlands Navy in 1981. These, too, perform 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 were equipped to carry two AS.12 wire-guided missiles for antiship missions. ■

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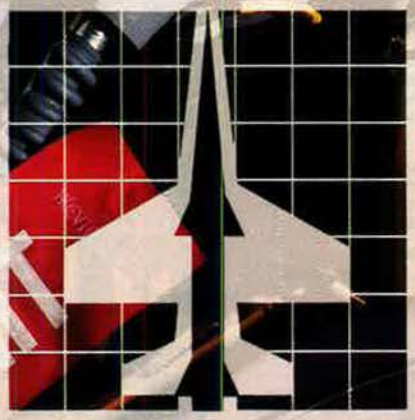

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AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

Iron Gate Salutes the Troops

Yellow ribbons were everywhere at the twenty-eighth annual National Air Force Salute, held by AFA's New York City Iron Gate Chapter in April. The time-honored reminders of loved ones far from home were in place to reinforce the theme of the event. Billed as a tribute to the troops of Desert Storm, this year's ball pushed the champion fund-raiser's total to $1,844,300, earmarked for USAF-related charities.

For the first time in more than a decade, two recipients of the chapter's top honor, the Maxwell A. Kriendler Memorial Award, were chosen. The award is named for the chapter's founder.

Lt. Gen. Charles A. Horner, commander of Central Air Forces, was honored for his skill in leading the coalition's air forces to victory over Iraq. The award citation noted the major contribution of airpower to coalition success in the Gulf and called General Horner "the right man at the right time" to implement it. Still in Saudi Arabia, the General was unable to attend but accepted the award via videotape from his command tent in the desert.

Air Force Secretary Donald B. Rice shared the Kriendler Award with General Horner. Saluted as an architect of and eloquent spokesman for the Air Force's "Global Reach, Global Power" policy, Secretary Rice was also praised for his keen mind and analytical and determined approach to national security affairs.

Chapter President Tom McKee presented an AEF Ira Eaker Fellowship to his predecessor, Richard A. Freytag, who had a highly successful two-year term as head of Iron Gate. Col. Ruth Anderson, air attaché to Hungary; Gregory S. Kolligian, sponsor of the Kolligian Trophy flying safety award (named for his brother Lt. Koren Kolligian); and Brig. Gen. Charles E. Franklin, AMRAAM's system program director, also received Eaker Fellowships.

In addition to supporting AEF, the fund-raiser contributes money to the Air Force Assistance Fund, Falcon Foundation, Air Force Historical Foundation, USAF Museum, National Aviation Hall of Fame, Civil Air Patrol and Air Force Academy flight awards, and the Soldiers', Sailors', and Airmen's Club, which was founded in 1919 to provide reasonably priced food and lodging to transient military personnel.

The black-tie audience at the Air Force Salute was entertained by cabaret singer Karen Akers. Next year's salute will take place in New York on April 4.

—James A. McDonnell, Jr.

—Photo by Sid Burns

The Iron Gate Chapter's Air Force Salute has raised almost $2 million dollars and always draws a host of USAF and AFA VIPs. Pictured here are (left to right) Brig. Gen. Charles Franklin, Gregory Kolligian, USAF Chief of Staff Gen. Merrill A. McPeak, Chapter President Tom McKee, Salute Coordinator Dorothy Welker, Air Force Secretary Donald B. Rice, Salute Foundation Chairman Dick Freytag, and Col. Ruth Anderson. Secretary Rice and CENTAF Commander Lt. Gen. Charles A. Horner received the Kriendler Award. General Franklin, Mr. Kolligian, Mr. Freytag, and Colonel Anderson received Eaker Fellowships.

Sacramento Banquet

The F-117A provided some of the most dramatic video footage and spectacular results of Operation Desert Storm. The **Sacramento (Calif.) Chapter** got the inside story about the missions and accomplishments of this star performer from Col. Alton C. Whitley, Jr., commander of the 37th Tactical Fighter Wing from Tonopah Test Range, Nev. Colonel Whitley, speaking at the chapter's annual awards banquet at McClellan AFB, Calif., riveted the audience's attention by describing some of his nineteen combat missions over Iraq. Colonel Whitley was no stranger to combat prior to Desert Storm, having flown more than 200 combat missions in southeast Asia.

Also at the banquet, nineteen military and business leaders from the Sacramento area were selected as exceptional performers. Maj. Gen. Michael Pavich, commander of Sacramento Air Logistics Center, presented the awards. Chapter President Al Litzler and Capt. Ron Lovas shared the duties of master of ceremonies.

National Vice President (North Central Region) John E. Kittelson awards AFROTC Cadet Justin W. Boldenon the certificate naming him 1991's Outstanding Cadet in AFROTC Det. 780 at South Dakota State University.

Newly returned from Operation Desert Storm. Col. Alton C. Whitley, Jr., commander of the 37th TFW, addresses the Sacramento Chapter's annual awards banquet. Colonel Whitley flew nineteen F-117 Stealth fighter missions over Iraq.

Chapter News

The **Albuquerque (N. M.) Chapter** used the dedication of the Phillips Laboratory at nearby Kirtland AFB as the occasion to present its $500 Phillips Scholarship Award to AFROTC Cadet Kelly Golis of the University of New Mexico. Mrs. Sam Phillips presented the award at the dedication, which was also attended by Chapter President Charles Vesely and Chapter Secretary Jimmy Richardson.

The **Central Florida Chapter** has begun to distribute some of the funds gathered at its annual Tactical Air Forces Gala. Four AFROTC Cadets from the University of Central Florida received full tuition scholarships. Chapter President Tom Churan and Det. 159 Commander Lt. Col. John Linn were on hand for the presentation. Cadets Don Wasik, Danny Huynh, Ben Ofomo, and Larry Floyd will receive full tuition for this semester, courtesy of the Central Florida Chapter. In another worthwhile effort, the chapter made a substantial donation to Group 6 of the Florida Wing of Civil Air Patrol. Lt. Col. David La Montagne, Group 6 commander, accepted the check from Mr. Churan. Capt. June Lawson, commander of the Winter Park Squadron, represented Group 6's fifteen member squadrons at the presentation.

Lt. Jeffrey Zaun, USN, looking fit after his ordeal as a prisoner of the Iraqis, talks with Edgar Wolf, Jr., AFA charter life member, at a banquet in Cherry Hill, N. J., honoring all the local participants in Operation Desert Storm. Mr. Wolf presented Lieutenant Zaun a gift AFA membership.

Coming Events

July 12–13, **Louisiana State Convention,** Bossier City, La.; July 13, **Kansas State Convention,** Wichita, Kan.; July 19–20, **Colorado State Convention,** Lowry, Colo.; July 19–21, **North Carolina State Convention,** MCAS Cherry Point, N. C.; July 19–21, **Pennsylvania State Convention,** Pittsburgh, Pa.; July 19–21, **Texas State Convention,** San Antonio, Tex.; July 21, **Delaware State Convention,** Dover, Del.; July 25–28, **Florida State Convention,** St. Augustine, Fla.; July 26–27, **Arkansas State Convention,** Hot Springs, Ark.; July 26–28, **Oklahoma State Convention,** Altus, Okla.; July 26–28, **Virginia State Convention,** Crystal City, Va.; July 27, **Michigan State Convention,** Wurtsmith AFB, Mich.; August 2–3, **Minnesota State Convention,** Hinckley, Minn.; August 3, **Indiana State Convention,** Bloomington, Ind.; August 3, **Mid-America Ball,** St. Louis, Mo.; August 3, **Oregon State Convention,** Klamath Falls, Ore.; August 15–17, **California State Convention,** Edwards AFB, Calif.; August 22–24, **Utah State Convention,** Ogden, Utah; August 24, **Nevada State Convention,** Reno, Nev.; September 6–7, **Washington State Convention,** Seattle, Wash.; September 6–7, **Wisconsin State Convention,** Milwaukee, Wis.; September 15, **Montana State Convention,** Malmstrom AFB, Mont.; September 15–18, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C.

AFA leaders gathered to honor the memory of the late Col. Dale Shelton by awarding a Medal of Merit to his widow, Mrs. Jo Shelton. Oklahoma State President Ken Calhoun and National Vice President (Southwest Region) Aaron Burleson presented the medal to Mrs. Shelton in recognition of her husband's significant contributions to the **Langley (Va.) Chapter.** Colonel Shelton's daughter Joanna was also present at the ceremony.

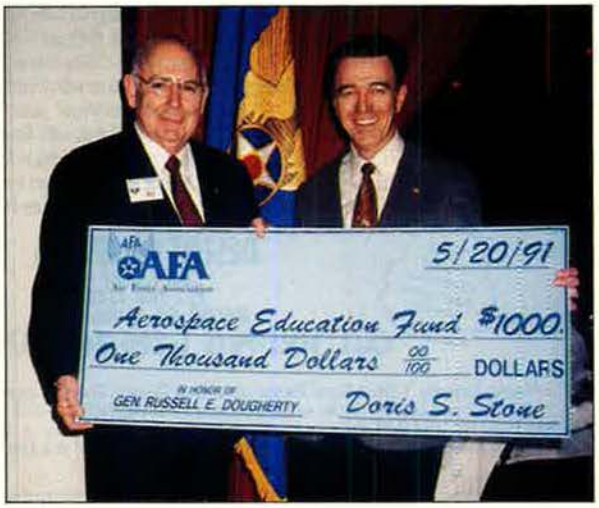
Carr, Chadwick Honored

Robert L. Carr, a founding father of AFA and a permanent national director, was nominated recently for the Pittsburgh *Post-Gazette*'s annual Jefferson Medal/Outstanding Citizen Award. His work for AFA and efforts on behalf of the Civil Air Patrol were cited as reasons for his nomination. In addition to his duties as president of the **Greater Pittsburgh (Pa.) Chapter,** Mr. Carr devotes his energy to both the young and the old—speaking at area high schools, developing leadership skills through chapter sponsorship of an AFJROTC program, and visiting and arranging activities at local veterans hospitals. He also recently received a Certificate in Recognition from AFROTC for his "outstanding support and significant contributions" to the program.

Marion Chadwick, for thirty-five years an unstinting supporter of AFA goals, received a plaque from former Executive Director John O. Gray, in recognition of her long service to Florida AFA. She has held seven chapter presidencies, served as state executive vice president, and managed numerous state conventions.

Have AFA News?

Contributions to "AFA/AEF Report" should be sent to Dave Noerr, AFA National Headquarters, 1501 Lee Highway, Arlington, VA 22209-1198. ■



Former AFA Executive Director Russell E. Dougherty (left) accepts $1,000 on behalf of AEF from Massachusetts State President David Cummock. Mr. Dougherty was the guest speaker at a state awards ceremony that also saw the 439th MAW invested as a Jimmy Doolittle Fellow for its work in Desert Shield and Desert Storm.

Bulletin Board

Seeking copies of **USAF Officer guide books** and publications on the history and leadership of the US Air Force. **Contact:** Donald Davis, 1015 Faber Dr., Orlando, FL 32822.

Seeking information on the whereabouts of **Leslie Harry Nelson,** who was stationed at RAF High Wycombe, UK, in 1964–65 and whose last known address was in Minnesota. **Contact:** Deborah Nelson, 11 Oak Hanger Close, Hook, Hampshire RG27 9QA, England.

Seeking a **23d Tactical Fighter Squadron "Fighting Hawks" fiftieth-anniverary patch.** Also seeking other pilot memorabilia and patches. **Contact:** Ian Lee Ruhl, 12101 SE 96th Pl., Renton, WA 98056.

Seeking information and photos of World War II **USAAF nose art** and named aircraft. Especially interested in the artists who painted the nose art, service records of named aircraft, and details of any naming ceremonies. **Contact:** Ray Bowden, 50 Argyle Rd., Ealing, London W13 8AA, England.

Seeking photos, slides, and videos of the Boeing 707 #27000 **Air Force One.** I will pay duplication costs. **Contact:** Tom Trapp, 1746 James Rd., St. Paul, MN 55118.

Seeking memorabilia from **Garden City AAB** Kan., for a display about the base. **Contact:** Samuel M. Gardner, 1708 Prairie Park Ln., Garden City, KS 67846.

Collector and historian seeks genuine **World War II USAAF memorabilia,** patches, wings, and uniforms. **Contact:** Alden W. Hamilton, P. O. Box 29767, Richmond, VA 23229.

Seeking to purchase sheet music or recordings of such **World War II–era songs** as "I Wanted Wings," "Oh! There Are No Fighter Pilots Down in Hell," and "These Bones Shall Rise Again." **Contact:** Edward J. O'Brien, 14 Water St., Assonet, MA 02702.

Seeking information on **Charles E. Kalkstine,** who was stationed at RAF Menwith Hill, North Yorkshire, England, and married Audrey Patricia McDougall in the base chapel on October 4, 1961. **Contact:** David J. Westwood, 3 Brandon Close, Heatherside, Camberley, Surrey GU15 1BQ, England.

Author seeks contact with USAF members and dependents who were at **RAF Chicksands,** England, between 1950 and 1959. **Contact:** W. Grayson, P. O. Box 4053, Crofton, MD 21114.

Seeking the whereabouts of **Lt. Col. Doug Pearson,** who was stationed at Edwards AFB, Calif., in the mid-1980s. Also seeking **Lee Pearson,** a test pilot of the AV-8B Harrier II. **Contact:** Ronald Savich, 13 Midwood Rd., Marlton, NJ 08053.

Seeking names and addresses of people who served at main or advance **Hq. Ninth Air Force** between October 1943 and December 1945. **Contacts:** Harold Stuart, 4590 E. 29th St., Tulsa, OK 74114. Ben Wright, 455 Worth Ave., Palm Beach, FL 33480.

Seeking contact with crew members, passengers, and any others who are familiar with the **SB-17 flight from Japan to Korea** on the first day of the Korean War. **Contact:** James A. Scheib, 990 Silverleaf Dr., Dayton, OH 45431.

Researcher seeks contact with pilots who trained with the RAF at the **British Flying Training Schools** in Tulsa, Okla., or elsewhere in the US during World War II. **Contact:** Gail S. Ravitts, 2410 Devonshire Dr., Rockford, Ill. 61107.

Seeking the whereabouts of everyone whose dependents attended **Gen. H. H. Arnold High School** in Wiesbaden, West Germany, between 1969 and 1974. **Contact:** Judy Downer, 3818 N. A St., Tampa, FL 33609.

Seeking information and **photos of the nose art** on the B-24s/PB4Ys named *Louisiana Belle* (#42-50806), *Louisiana Lady* (#42-78175), *Louisiana Lullaby* (#42-63986), and *Louisiana Lil* (#59474). **Contact:** R. Fontana, 4435 Veterans Blvd., Matairie, LA 70006.

Seeking relatives and friends of crew members of 758th Bomb Squadron, 459th Bomb Group, Westover Field, Mass., who were lost on a train-

ing mission December 12, 1943. **Contact:** J. Devney, 90 Kimbark Rd., Rochester, NY 14610.

Seeking information on the whereabouts of **Albert H. Roddy** of Tulsa, Okla., and **Elbert L. Hammond** of Rupert, Idaho, for a reunion of Barrack 43, Combine 9, Stalag Luft III. **Contact:** Stanley A. Janners, 4509, W. 102d Pl., Oak Lawn, Ill. 60453.

Seeking information on **F-4 Phantom aircraft at Andersen AFB, Guam,** during and after the Vietnam War. **Contact:** Capt. James Folan, 633d ABW/HO, APO San Francisco, CA 96334-5000.

Seeking contact with people who served in **Ninth Air Force** during World War II and are interested in forming a new association. **Contact:** Jack Yarger, 1100 Browning Ave., N. W., North Canton, OH 44720.

Researcher and historian seeks contact with former members of the **1st Transport Group (Provisional),** 9th Air Force, stationed in Europe during World War II, possibly near Chartres, France. **Contact:** Dale Titler, P. O. Box 7361, Courthouse Rd. Station, Gulfport, MS 39506.

Collector seeks information on blood chits issued during the **Cuban missile crisis. Contact:** Jeffrey D. Guidry, 114 Oak Leaf Dr., Slidell, LA 70461.

Seeking the whereabouts of **Cpl. Richard Parkhurst,** who served in the US Army in England in 1945. **Contact:** C. A. Robertson, 53 Ryedale, Wallsend, Tyne and Wear NE28 8TT, England.

Collector seeks **patches** dating from World War II to the present. Also seeking A-2 jacket. **Contact:** Ben Georgeson, 2501 S. Sycamore, Kerman, CA 93630.

Historian and publisher seeks contact with former members of the **30th Bomb Group** for a history of World War II activities in the Pacific. **Contact:** J. W. Lambert, 1051 Marie Ave., St. Paul, MN, 55118.

Seeking information on and **photos of military jets** used by the US and Soviet Union. **Contact:** Gerardo Dones, 83-736, Necochea, Pcia. de Buenos Aires, Argentina.

Seeking contact with **Ricky Lee Martin,** who served with the Navy on the USS *Canopus* and was stationed in Scotland in the mid-1970s, where he knew Alice Brown. **Contact:** Mary Brown, 386 Dawlish Dr., Bentilee, Stoke-on-Trent, Staffordshire ST2 ORW, England.

Seeking the whereabouts of **Alfred W. Zimmerman,** who was stationed at Horham, England, during World War II, and whose last known address was in Taylor, Tex. **Contact:** Margaret Cawood, 1419 Quamasia, McAllen, TX 78504.

Seeking the whereabouts of members of the **33d Troop Carrier Squadron,** 374th Troop Carrier Group, World War II, especially pilot Lt. Frederick R. Call. **Contact:** Bob Monson, 1310 Daveric Dr., Pasadena, CA 91107-1644.

Seeking information on the whereabouts of **SSgt. W. C. Haseman,** who was stationed at Great Haseley Manor near Oxford, England, during World War II, and whose last known address was in Pittsburgh, Pa. **Contact:** G. Smith, 11 Temple St., Iffley Rd., Oxford OX4 1JS, England.

Seeking a World War II USAAF **392d Bombardment Squadron** shoulder patch. **Contact:** Lee Swintosky, 68 Court House, St. Paul, MN 55102.

Seeking information on the whereabouts of the following members of the **535th Bomb Squadron,** 381st Bomb Group, based at Ridgewell, England, during World War II: Lt. Russell C. Mosley, TSgt. John A Cuesta, TSgt. Bill R. Buttry, and SSgt. Edward J. Franklin. **Contacts:** Leo Nugent, 1505 Canterbury, Grand Prairie, TX 75050. Leslie A. Rose, 3684 Hwy. 140, Catheys Valley, CA 95306.

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. Items or services for sale or otherwise intended to bring in money will not be used. Photographs cannot be used or returned.—THE EDITORS

Seeking Air Force evaluations of the **Fiat G-91/R** and photographs of this aircraft dating from 1960 to 1962. **Contact:** Keith Wood, 5503 China Clay Dr., Kearns, UT 84118.

Seeking information on and photos of the **F-117A Stealth fighter. Contact:** Ari Meerwon, Bosem St., 10/15, Gilo, Jerusalem 93903, Israel.

Seeking contact with anyone who has **miniature World War II aerial gunners wings** for sale or trade. **Contact:** Col. A. F. Streck, USAF (Ret.), 1436 Nolehu Dr., Honolulu, HI 96818-1915.

Seeking contact with veterans of the **48th Fighter Group** (1941–45) who have information on aircraft serial numbers and nose art or photographs. **Contact:** Thomas L. Suminski, 2841 S. W. 82d, Oklahoma City, OK 73159.

Seeking contact with anyone who knew **2d Lt. Mitchell J. Savin,** who was stationed at Graham AFB, Fla., at the time of his accident on July 23, 1956. I would especially like to contact Peter Slattery. **Contact:** Nancy R. Savin, 803 Laurel Ave., Bridgeport, CT 06604-2046.

Seeking the whereabouts of **Capt. Charles Lee Prince, USAF,** who served in the Marine Corps in the Pacific during World War II and whose last known duty station was with ROTC at the University of Alabama in Tuscaloosa, Ala. **Contact:** James Harman Roadcap, Jr., 1051 Greendale Rd., Harrisonburg, VA 22801.

Seeking information on how I can obtain **bombardier and navigator wings. Contact:** Lt. Col. John M. Sonenson, USAF (Ret.), 3320 Plantation Dr., #3, Valdosta, GA 31602.

Seeking information on the World War II **B-29 *Virginia Tech,*** which was purchased with money raised by students and alumni of the school during the series E bond drive. **Contacts:** Michael D. Miller and Frances K. Dorish, 346 Brodie Hall, Virginia Tech, Blacksburg, VA 24060-0002.

Seeking photos and patches from **K. I. Sawyer AFB,** Mich., and **Elmendorf AFB,** Alaska, from 1965 to the present. Also seeking any other photos of USAF jets in flight. **Contact:** Paul Bero, #192686, Box E, Jackson, MI 49204. ■

Unit Reunions

Air Weather Recon
Air Weather Reconnaissance veterans will hold a reunion September 26–29, 1991, in Fort Walton Beach, Fla. **Contact:** Ralph Ruyle, Rte. 6, Box 527, Crestview, FL 32536. Phone: (904) 689-1244.

Battle of the Bulge
Veterans of the Battle of the Bulge will hold a reunion September 5–8, 1991, in Charleston S. C. **Contact:** Nancy C. Monson, P. O. Box 11129-R, Arlington, VA 22210-2129.

Bolling Field
World War II veterans who were stationed at Bolling Field, D. C., will hold a reunion October 11–14, 1991, at the VFW Hall in Morningside, Md. **Contact:** CMSgt. William Fahr, USAF (Ret.), 34 Weather Oak Hill, New Windsor, NY 12553. Phone: (914) 564-7523.

Bradley Field
The fiftieth anniversary of the opening of Bradley Field, Conn., will be celebrated on August 17, 1991, not August 18, 1991 as reported in "Unit Reunions" in the April 1991 issue. **Contact:** Helen Snyder, 1463 Boulevard, West Hartford, CT 06119. Phone: (203) 561-3096.

Caterpillar Ass'n
Members of the Caterpillar Association will hold a reunion September 13–14, 1991, at the Sands Regency Hotel in Reno, Nev. **Contact:** Lt. Col. Johnny Brown, P. O. Box 1321, Kenosha, WI 53141. Phone: (414) 658-1559.

Romania POWs
Former POWs held in Romania during World War II will hold a reunion September 19–22, 1991, at the Hyatt Regency Hotel in Fort Worth, Tex. **Contact:** Harry B. Harris, 2100 Santa Fe, Wichita Falls, TX 76309.

SHAEF Vets
Members of the SHAEF/ETOUSA Veterans Association (Supreme Headquarters, Allied Expeditionary Force/European Theater of Operations, US Army) will hold a reunion October 12–13, 1991, at the TraveLodge Hotel on the River in San Antonio, Tex. **Contact:** Alan F. Reeves, 2301 Broadway, San Francisco, CA 94115. Phone: (415) 921-8322.

USAF Paralegal Ass'n
USAF paralegal personnel will hold a reunion October 11–13, 1991, in San Antonio, Tex. **Contact:** CMSgt. Louis Medina, USAF (Ret.), 16510 Burr Hill, San Antonio, TX 78247.

USAF Retired Medical
Retired Air Force Medical Service Corps veterans will hold a reunion October 31–November 3, 1991, in San Antonio, Tex. **Contacts:** Col. William M. Johnson, USAF (Ret.), 1855 Carriage Rd., Powell, OH 43065-9703. Phone: (800) 678-9772 (Ed Nugent).

14th Air Force
Members of the 14th Air Force "Flying Tigers" will hold a reunion September 3–5, 1991, at the Nugget Casino Resort in Reno, Nev. **Contact:** Duayne R. Huston, 3445 Sunset Park Cir., Dubuque, IA 52001. Phone: (319) 583-1184.

20th Tactical Recon Squadron
Members of the 20th Tactical Reconnaissance Squadron who served during World War II in the China-Burma-India theater will hold a reunion October 2–6, 1991, in Hot Springs, Ark. **Contact:** Stanley A. Gawlik, 661 Woodland Dr., Tallmadge, OH 44278. Phone: (216) 633-5750.

27th Bomb Group
Members of the 27th Bomb Group (World War II) will hold a reunion October 17–19, 1991, at the Holiday Inn Midtown in Savannah, Ga. **Contact:** Paul H. Lankford, 105 Hummingbird Dr., Maryville, TN 37801. Phone: (615) 982-1189.

33d Photo Recon Squadron
The 33d Photo Reconnaissance Squadron will hold a reunion September 27–30, 1991, at the Sheraton Valley Forge Hotel in King of Prussia, Pa. **Contact:** Warren C. Harnish, 5012 Keylock Rd., Mechanicsburg, PA 17055. Phone: (717) 766-2313.

36th/49th/50th/86th Fighter Groups
Fighter pilots of the 36th, 49th, 50th, and 86th Fighter Groups will hold a reunion October 29–31, 1991, at the Golden Nugget Hotel in Las Vegas, Nev. **Contact:** Floyd White, 3482 Villa Hermosa Dr., Las Vegas, NV 89121.

40th Bomb Group
Members of the 40th Bomb Group and the 28th Air Service Group will hold a reunion October 2–6, 199l, at the Delta Resort in Orlando, Fla. **Contact:** Flo Mallory, P. O. Box 9252, Treasure Island, FL 33740. Phone: (813) 360-3613.

45th Air Depot Group
Members of the 45th Air Depot Group and attached units will hold a reunion October 10–13, 1991, in Fayetteville, N. C. **Contact:** Charles F. Guemelata, 119 Aigler Blvd., Bellevue, OH 44811. Phone: (419) 483-4371.

46th Troop Carrier Squadron
Veterans of the 46th Troop Carrier Squadron, 317th Troop Carrier Group, 5th Air Force, will hold a reunion September 12–15, 1991, at the Hilton Inn North in Columbus, Ohio. **Contact:** Tom Soltis, 23332 Roger Dr., Euclid, OH 44123. Phone: (216) 732-9492.

Class 51-H
Class 51-H instructors and USAF/Norwegian pilot training class members from Craig, Connally, Goodfellow, Perrin, Randolph, Reese, Vance, and Williams AFBs will hold a reunion December 12–15, 1991, in San Antonio, Tex. **Contact:** John E. Orr, P. O. Box 11071, Fort Worth, TX 76110.

64th Troop Carrier Squadron
Members of the 64th Troop Carrier Squadron (World War II) will hold a reunion October 24–26, 1991, in Tucson, Ariz. **Contact:** Lt. Col. Irwin K. Holdener, USAF (Ret.), 1836 La Rienda Ave., Tucson, AZ 85715. Phone: (602) 290-1428.

75th Troop Carrier Squadron
Veterans of the 75th Troop Carrier Squadron and Hq. Squadron of the 435th Troop Carrier Group will hold a reunion October 4–6, 1991, in Dayton, Ohio. **Contact:** Robert C. Richards, 139 Kiser Dr., Tipp City, OH 45371. Phone: (513) 667-3827.

79th Airdrome Squadron
Members of the 79th Airdrome Squadron, 5th Air Force, will hold a reunion October 3–6, 1991, at the Executive Inn in Louisville, Ky. **Contact:** Fred H. Hitchcock, 29 Blueberry Hill Ln., Sudbury, MA 01776. Phone: (508) 443-6679.

94th Bomb Group
The 94th Bomb Group will hold a reunion October 9–13, 1991, at the Marriott Hotel in Dayton,

Ohio. **Contact:** Wade C. Wilson, 1941 Harris Ave., San Jose, CA 95124. Phone: (408) 377-4787.

100th Air Service Squadron
Members of the 100th Air Service Squadron will hold a reunion October 6–8, 1991, at the Super Eight Motel in Oshkosh, Wis. **Contact:** Fred Swinnerton, 292 Orange Ave., Ashland, OR 97520. Phone: (503) 482-3437.

310th/311th/312th Ferrying Squadrons
Members of the 310th, 311th, and 312th Ferrying Squadrons will hold a reunion September 26–28, 1991, at the Sheraton Hotel in Colorado Springs, Colo. **Contact:** Rocky Bravo, 2712 N. W. 64th St., Oklahoma City, OK 73116. Phone: (405) 843-4480.

339th Fighter Squadron
The 339th Fighter Squadron will hold a reunion September 18–22, 1991, at the Red Lion Inn Hotel at the Seattle/Tacoma International Airport in Seattle, WA. **Contact:** Richard Cowles, 745 Harrison St., Belding, MI 48809. Phone: (616) 794-2083.

347th Fighter Group
Members of the 347th Fighter Group along with the 12th and 44th Fighter Squadrons and the 18th Fighter Group, 13th Air Force, will hold a reunion September 18–22, 1991, at the Red Lion Inn Hotel at the Seattle/Tacoma International Airport in Seattle, WA. **Contact:** Doug Canning, 700 Brookside Rd., Maitland, FL 32751.

356th Fighter Group
Members of the 356th Fighter Group and associated units (World War II) will hold a reunion October 3–6, 1991, in Norfolk, Va. **Contact:** Kenneth J. Male, 2988 Hillcrest Rd., Schenectady, NY 12309. Phone: (518) 783-0207.

362d Fighter Group
The 362d Fighter Group (World War II) will hold a reunion October 1–6, 1991, in St. Louis, Mo. **Contact:** C. F. Mann, 1525 Carol Dr., Memphis, TN 38116. Phone: (901) 332-3587.

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.

388th Fighter-Bomber Wing
Members of the 388th Fighter-Bomber Wing stationed at Clovis AFB, N. M., and Etain AB, France, between 1954 and 1957 will hold a reunion October 17–20, 1991, in San Antonio, Tex. **Contact:** Wilson M. Petefish, 102 Madrid Dr., Universal City, TX 78148. Phone: (512) 658-0613.

398th Bomb Group
Veterans of the 398th Bomb Group and attached units (World War II) will hold a reunion November 6–9, 1991, in San Diego, Calif. **Contact:** George R. Hilliard, 7841 Quartermaine Ave., Cincinnati, OH 45236-2313.

421st Night Fighter Squadron
The 421st Night Fighter Squadron, 5th Air Force, will hold a reunion October 10–13, 1991, at Days Inn Hotel in New Orleans, La. **Contact:** Bill Gorman, 3258 N. Embry Cir., Chamblee, GA 30341. Phone: (404) 455-4444.

457th Bomb Group
Members of the 457th Bomb Group (World War II) will hold a reunion October 31–November 2, 1991, in Gulf Shores, Ala. **Contact:** Homer Briggs, 811 N. W. B St., Bentonville, AR 72712. Phone: (505) 273-3908.

463d Bomb Group
Veterans of the 463d Bomb Group will hold a reunion November 6–10, 1991, at the Sheraton Plaza Hotel in Orlando, Fla. **Contact:** Rev. Eugene Parker, Rte. 3, Box 188, New Matamoras, OH 45767. Phone: (614) 473-1515.

466th Bomb Group
The 466th Bomb Group will hold a reunion September 17–21, 1991, at the Marriott Hotel in New Orleans, La. **Contact:** Louis Loevsky, 16 Hamilton Dr. E., North Caldwell, NJ 07006. Phone: (201) 226-4624.

490th Bomb Squadron
Members of the 490th Bomb Squadron, 341st Bomb Group (China-Burma-India), will hold a reunion August 28–September 1, 1991, in Pittsburgh, Pa. **Contacts:** Ivo Greenwell, 5122 W. 27th St., Tulsa, OK 74107. Chet Rogawski, 6200 N. Meade Ave., Chicago, IL 60646. Phone: (312) 763-8504.

493d Bomb Group
The 493d Bomb Group, 8th Air Force, will hold a reunion September 18–22, 1991, in New Orleans, La. **Contact:** John F. Conway, 58 College Ave., Poughkeepsie, NY 12603. Phone: (914) 454-8074.

582d Air Resupply Group
The 582d Air Resupply Group will hold its reunion September 27–29, 1991, in Portland, Ore. **Contact:** Len Conkling, 3644 N. E. 142d Ave., Portland OR 97230. Phone: (503) 281-1135 or (503) 255-3130.

932d Aeromedical Airlift Group
The 932d Aeromedical Airlift Group (Air Force Reserve) stationed at Scott AFB, Ill., will hold a reunion October 4–5, 1991, at Scott AFB. Former members who served in this unit or its predecessors are also invited. **Contact:** CMSgt. Bill Moyer, 1839 N. Rodgers, Alton, IL 62002. Phone: (618) 465-2300.

4600th CAM Squadron
Officers and enlisted personnel of the 4600th Consolidated Aircraft Maintenance Squadron, Air Defense Command, who served at Peterson AFB, Colo. will hold a reunion August 2–4, 1991, in Colorado Springs, Colo. **Contacts:** Leo D. Hrdlicka, 8191 Cora Rd., Littleton, CO 80125. Phone: (303) 791-7593. Dwaine H. Howard, 3191 Anderson Rd., Antioch, TN 37013. Phone: (615) 366-2044.

6147th Tactical Control Group
Members of the 6147th Tactical Control Group "Mosquitos," who served in the 5th Air Force during the Korean War, will hold a reunion October 9–13, 1991, at the Holiday Inn Riverwalk North in San Antonio, Tex. **Contact:** Billy G. Turner, 8702 Midcrown Dr., San Antonio, TX 78239. Phone: (512) 655-0755.

7th Air Division
For the purpose of planning a reunion, I am seeking former members of Det. 4, 7th Air Division, who served at RAF Ruislip, England, between August 1952 and August 1954. **Contact:** Charles Artman, P. O. Box 345, Batavia, NY 14021.

Class 82-02
I would like to hear from members of Class 82-02 (Columbus, Miss.) who would be interested in holding a reunion February 1992 in the Tampa/St. Petersburg, Fla., area. **Contact:** Todd Petersen, 106 E. 23d St., Sioux Falls, SD 57105. Phone: (605) 339-2028. ■

DON'T LET MEDICAL EXPENSES SOAR GET PROTECTION WITH AFA's CHAMPLUS®

A CHAMPUS Supplement Which Helps Limit Your Unreimbursed Medical Expenses.

CHAMPUS is a federally-funded health benefits program designed to help service families pay for medical care in civilian medical facilities, including doctor charges. However, with CHAMPUS there is a gap as to what percentage of medical expenses get reimbursed and what you have to pay out-of-pocket. That's why you need CHAMPLUS®. As a member of the Air Force Association, you are eligible to purchase one of the best CHAMPUS Supplements available, with competitively low rates.

FEATURES THE NEW EXPENSE PROTECTOR BENEFIT

This benefit limits out-of-pocket expenses for CHAMPUS covered expenses in any single calendar year to $1,000 for any one insured person (or $2,000 for all insured family members combined). Once those out-of-pocket expense maximums are reached, CHAMPLUS® will pay 100% of CHAMPUS covered charges for the remainder of that year.

An example of how the Benefit works:

You are hospitalized for 35 days and the hospital charges you $330 per day -- $95 per day more than allowed by CHAMPUS. Your out-of-pocket expense would be $3,325. With the Expense Protector Benefit your cost would be limited to $1,000. All covered costs over this amount -- for the entire calendar year -- would be paid.

ELIGIBLE APPLICANTS

All AFA members under age 65 who are receiving retirement pay based on their military service, spouses under age 65 of active duty or retired members and their unmarried dependent children under age 21, or 23 if in college, are eligible. Upon reaching age 65, your coverage will automatically be converted to AFA's Medicare Supplement Program.

RENEWAL PROVISION

Your coverage will continue as long as you remain eligible for CHAMPUS benefits, the Master Policy with AFA remains in force, your membership continues, and you pay your premiums.

There is no waiting period for active duty members who enroll within 30 days of retirement if their dependents have been insured for two years previously.

EXCEPTIONS AND LIMITATIONS

There is a 12-month waiting period for conditions which were treated 12 months prior to the effective date of insurance. After the coverage has been in effect for 24 consecutive months, all pre-existing conditions will be covered. Children of active duty members over age 21 (age 23 if in college) will continue to be eligible if they have been declared incapacitated and if they are insured under CHAMPLUS® on the date so declared. Coverage for these older age children will only be provided upon notification to AFA and payment of a special premium amount.

EXCLUSIONS

This plan does not cover and no payment shall be made for: routine physical examinations or immunizations; domiciliary or custodial care; dental care (except as required as a necessary adjunct to medical or surgical treatment); routine care of the newborn or well-baby care; injuries or sickness resulting from declared or undeclared war or any act thereof or due to acts of intentional self-destruction or attempted suicide, while sane or insane; treatment for prevention or cure of alcoholism or drug addiction; eye refraction examinations; prosthetic devices (other than artificial limbs and artificial eyes), hearing aids, orthopedic footwear, eyeglasses and contact lenses; expenses for which benefits are or may be payable under Public Law 89-614 (CHAMPUS).

LOOK AT WHAT AFA CHAMPLUS® PAYS

Care	Retired	Active Duty
Inpatient civilian hospital care	the 25% of allowable charges not paid by CHAMPUS, plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year	the greater of the total daily subsistence fees, or the $25 hospital charge not paid by CHAMPUS
Inpatient military hospital care	the daily subsistence fee	the daily subsistence fee
Outpatient care (covers emergency room treatment, doctor bills, pharmaceuticals, and other professional services; see exclusions for limitations)	the 25% of allowable charges not paid by CHAMPUS, after the deductible has been satisfied, plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year	the 20% of allowable charges not paid by CHAMPUS after the deductible has been satisfied, plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year

CHAMPLUS® offers many attractive benefits. For a complete description of the Plan, including exceptions and limitations, please refer to the Certificate of Insurance, or call our Insurance Division toll-free at

1-800-727-3337
x4905

To enroll in the program, complete the application. →

RATES

For Military Retirees and Dependents
QUARTERLY PREMIUM SCHEDULE
In-Patient Benefits Only

Member's Attained Age*	Member	Spouse	Each Child
under 50	$25.27	$54.15	$17.97
50-54	37.76	59.03	17.97
55-59	55.35	63.18	17.97
60-64	66.13	79.66	17.97

For Military Retirees and Dependents
QUARTERLY PREMIUM SCHEDULE
In-Patient and Out-Patient Benefits

Member's Attained Age*	Member	Spouse	Each Child
Under 50	$39.00	$79.32	$40.84
50-54	51.25	87.34	40.84
55-59	70.85	115.33	40.84
60-64	89.00	132.80	40.84

*Note: Premium amounts increase with the member's attained age.

For Dependents of Active Duty Personnel
ANNUAL PREMIUM SCHEDULE

In-Patient Benefits Only

	Member	Spouse	Each Child
All Ages	None	$12.89	$7.72

In-Patient and Out-Patient Benefits

	Member	Spouse	Each Child
All Ages	None	$51.52	$38.61

APPLICATION FOR AFA CHAMPLUS®

Group Policy GMG-FC70
Mutual of Omaha Insurance Co.
Home Office: Omaha, Nebraska

Full name of Member_____
Rank Last First Middle

Address_____
Number and Street City State Zip Code

Date of Birth_____ Current Age____ Height_____ Weight_____ S.S.N._____
Month/Day/Year

This insurance coverage may only be issued to AFA members. Please check the appropriate box below: ❑ I am currently an AFA Member ❑ I enclose $21 for annual AFA membership dues. (includes subscription ($18) to AIR FORCE Magazine)

PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (check one)
❑ AFA CHAMPLUS® PLAN I (for military retirees & dependents)
❑ AFA CHAMPLUS® PLAN II (for dependents of active-duty personnel)

Coverage Requested (check one)
❑ Inpatient Benefits Only ❑ Inpatient and Outpatient Benefits

Person(s) to be insured (check one)
❑ Member Only ❑ Member & Children
❑ Spouse Only ❑ Spouse & Children
❑ Member & Spouse ❑ Member, Spouse & Children

PREMIUM CALCULATION

All premiums are based on the attained age of the AFA member applying for this coverage. Plan I premium payments are normally paid on a quarterly basis, but, if desired, they may be made on either a semi-annual (multiply by 2), or annual (multiply for 4) basis.

Quarterly (annual) premium for member (age ____) $_____
Quarterly (annual) premium for spouse (based on members' age) $_____
Quarterly (annual) premium for ____ children @ $ $_____
Total premium enclosed $_____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Insured Dependents Relationship to Member Date of Birth (Month/Day/Year)

_____
_____
_____

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such preexisting conditions will be covered after this insurance has been in effect for 24 consecutive months.

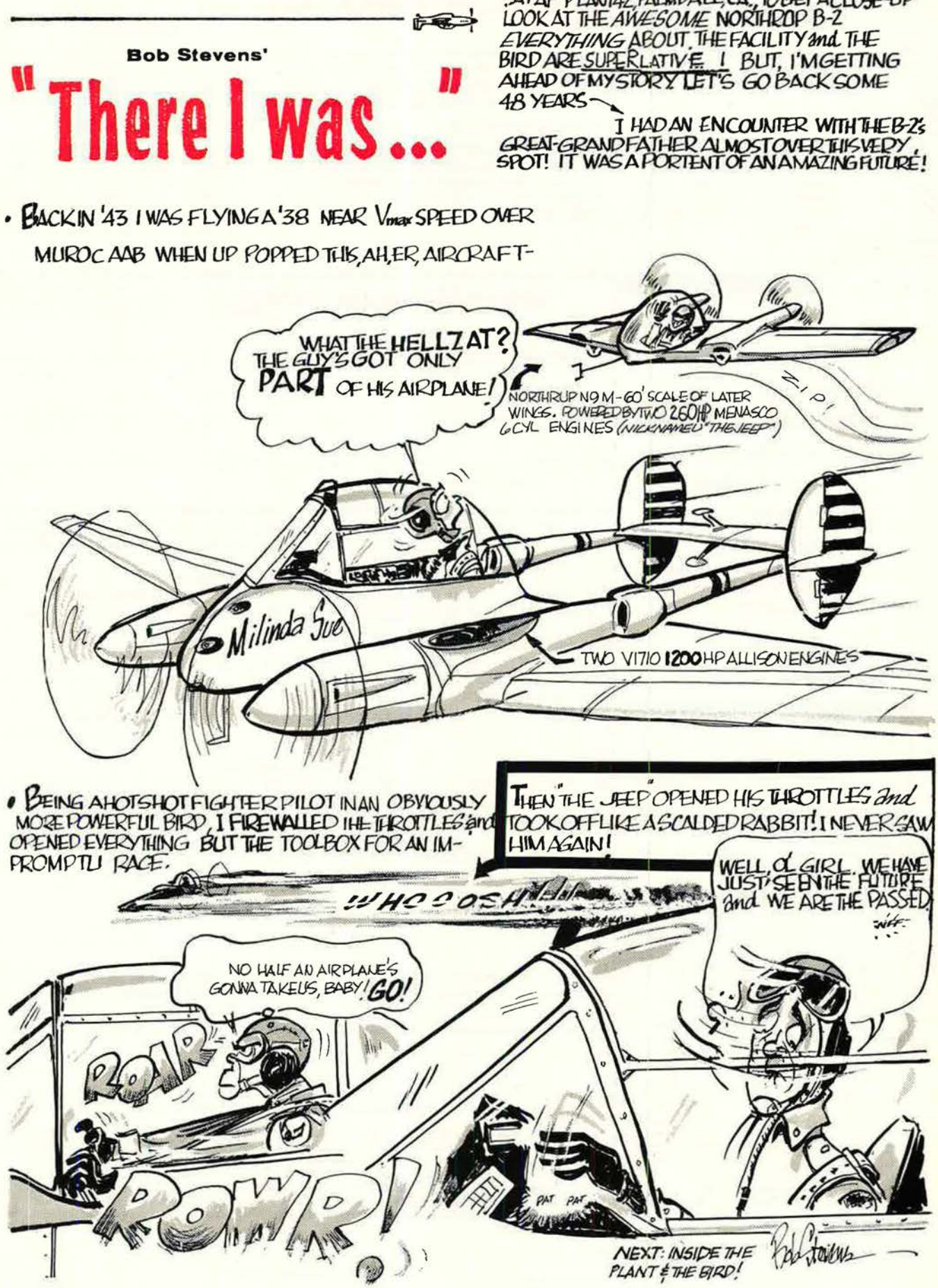
Date_____, 19____ _____
(Member's Signature)

Form 6173GH App.

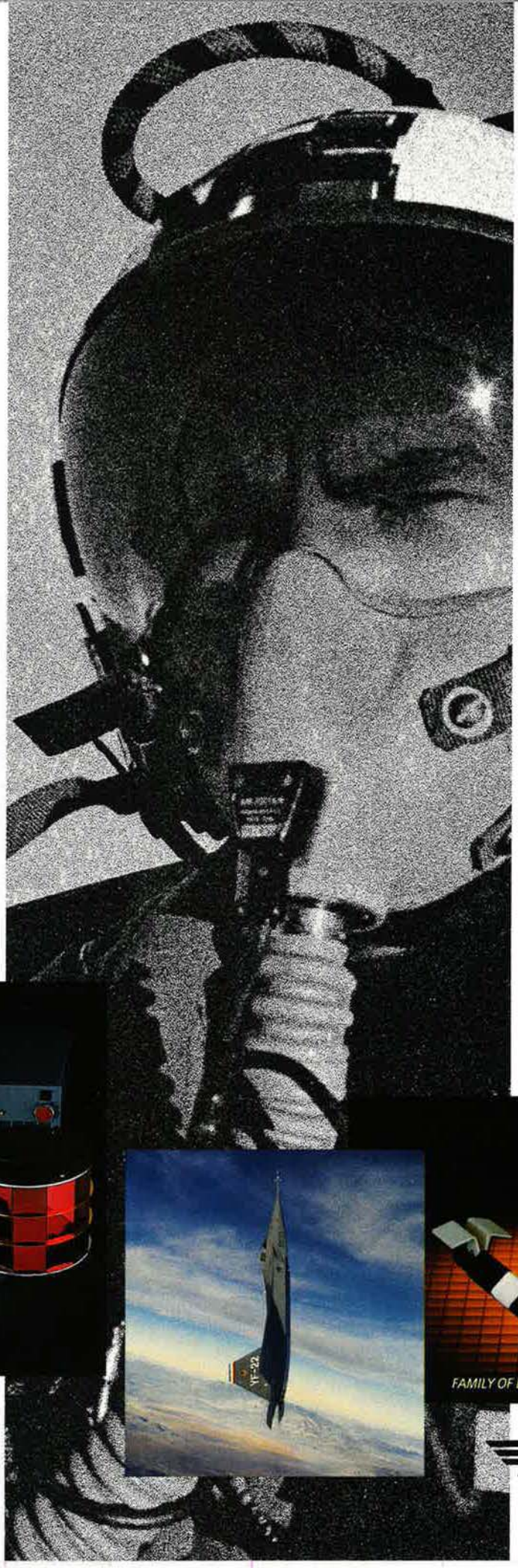
Application must be accompanied by a check or money order. Send remittance to: Air Force Association, Insurance Division, 1501 Lee Highway, Arlington, VA 22209-1198

Bob Stevens'

"There I was..."



"Tiger 1.
Fulcrum.
010, 10 high.
40 miles,
1500 closing.
No missile
threat."



Lockheed leads.

Today's pilots face a staggering array of deadly missiles—RF, IR or EO.

For forty years, Sanders has been building the systems that neutralize these threats. We've produced and delivered more electronic warfare systems than any other company in the world. Moreover, we continue to advance the state of the art, integrating the latest gallium arsenide circuitry into new expendables as well as proven jammers like the AN/ALQ-126B.

Twenty-first century fighter aircraft will require even more capable, fully integrated EW systems. Sanders has already made that technological leap with INEWS—the most sophisticated EW system ever built.

Our aircrews—Army, Navy, Air Force and Marines—must have the best possible protection. With Sanders EW systems, that's just what they get.

ALQ-126, 156 AND 144
COUNTERMEASURE SYSTEMS.

FAMILY OF EXPENDABLE DECOYS.

Lockheed
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MDMSC: Smart choices for tough decisions.

THE ADVANCED CRUISE MISSILE: IT PUTS THE ENEMY ON EDGE–AND YOU AT EASE.

No other missile is equipped to deliver its punch deeper into hostile territory with greater precision or with less warning. The Air Force's new Advanced Cruise Missile (ACM) was designed to provide America with sustained and credible strategic deterrence. And it does. Currently produced by the McDonnell Douglas Missile Systems Company (MDMSC), ACM has the experience of successful programs like Tomahawk, SLAM and Harpoon behind it. Experience that will ensure high quality and productivity for the program.

ACM is coming on line now. An unsettling thought for America's enemies, a comforting thought for those responsible for our nation's defense.

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A company of leaders.