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AIR FORCE MAGAZINE

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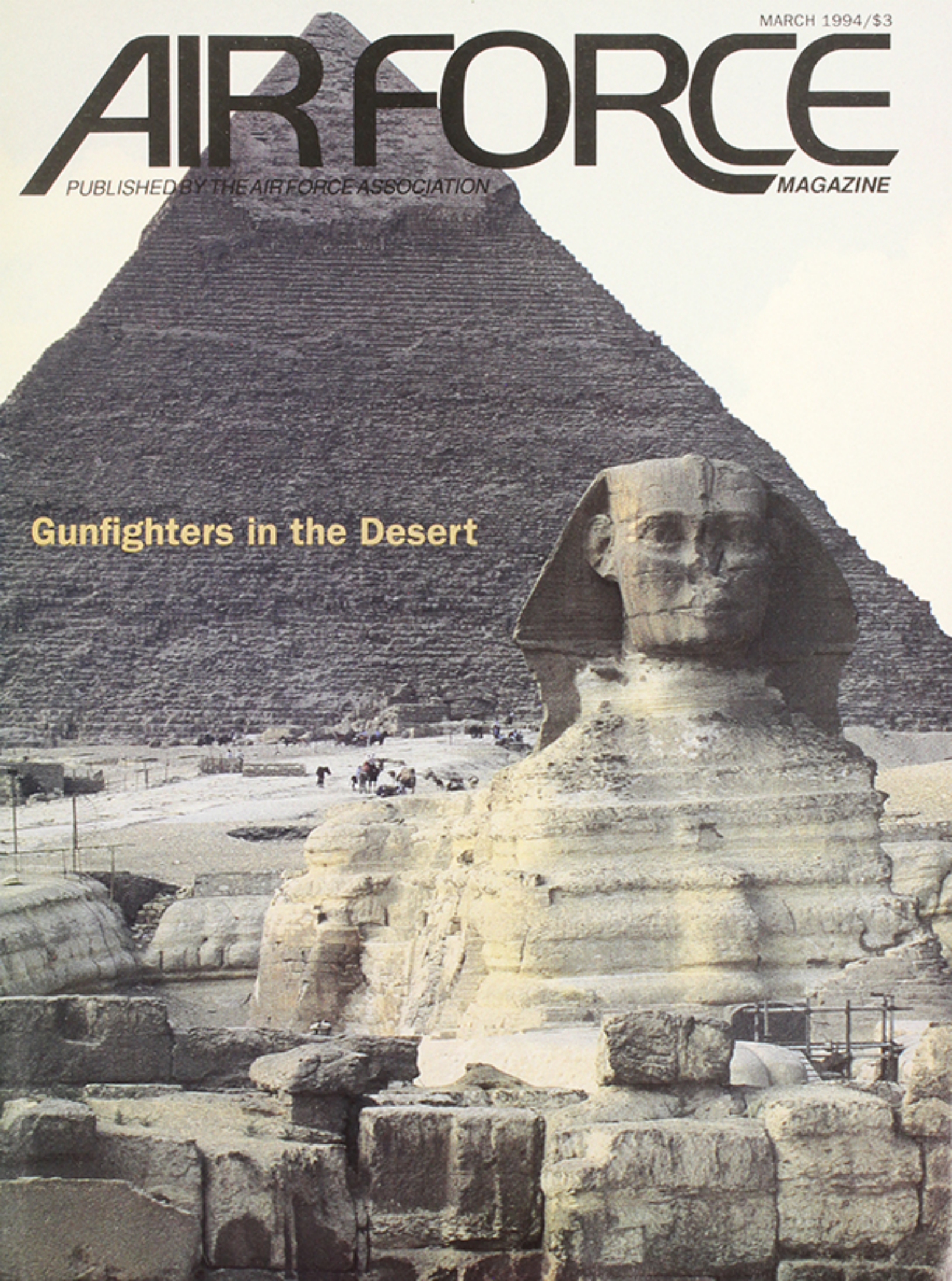

Gunfighters in the Desert

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BRAZIL

NORTHROP

March 1994, Vol. 77, No. 3

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

About the cover: In Egypt for Bright Star '94, the Air Force's air intervention composite wing proved it could deploy to and operate from an austere forward base. USAF photo by A1C Greg Vaughan.

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Editorial

By John T. Correll, Editor in Chief

Shooting Blind

David H. Hackworth is an outspoken infantry officer turned media celebrity and syndicated columnist. For the benefit of those who have not read his 875-page autobiography (*About Face,* Simon and Schuster, 1989), his newspaper columns come with tag lines explaining that he is "the nation's most decorated living military veteran." Colonel Hackworth has a poor opinion of many things, and one of them is a rpower.

"Air power has failed in every modern war we've fought," Colonel Hackworth declared in a January column. "From World War II to the Persian Gulf, only the grunts down on the ground, where it gets nasty and costly, have produced the final victory.

"Contrary to the Air Force's post–Desert Storm hype, air power was not the main event even in the desert, where the Iraqis had no place to hide. . . . Victory came not because of decisive air power, but because of hard-hitting armor attacks against an Iraqi army with no will to fight."

Colonel Hackworth had said pretty much the same thing in a previous column. He now assures us that "with nine wars under my belt," he knows what he's talking about. He does not specify the nine wars, but he is clearly trading on his combat credentials to make assertions that are—not to put too fine a point on it—inaccurate.

The argument that airpower is not decisive is very old and very tired. If Colonel Hackworth can name any recent wars won single-handedly by the other services, we will be amazed to hear about them. As almost everyone except Colonel Hackworth seems to realize, modern warfare is a combined-arms proposition.

Furthermore, he made a strange choice in singling out the Gulf War for his ire. He could not possibly be unaware that airpower destroyed Iraq's command-and-control system before sunrise on the first day of fighting. Then it closed down Iraq's supply routes and put the world's sixth-largest air force out of business for the duration of the war. Before the coalition ground offensive began, the Republican Guard had lost a fourth of its armor to air attacks. Front-line units lost more. Vast numbers of troops had deserted their units because of air attacks. How does Colonel Hackworth suppose the Iraqi army lost its will to fight?

David Hackworth is a distinguished soldier, but his arguments about airpower are old, tired, and wrong.

We have the highest regard for the bravery and achievement of the ground troops in the last 100 hours of the Gulf conflict, but to claim they won the war by themselves is ridiculous. If a "main event" must be designated, it was the air campaign.

Colonel Hackworth has twice made acerbic personal attacks on Gen. Merrill A. McPeak, Air Force Chief of Staff, whom he castigates for being "enthusiastic" about air strikes on Serbian artillery and US involvement in the Balkan conflict. In January, Colonel Hackworth predicted that General McPeak would eat his words if "air power is used as the final solution" in Bosnia.

In fact, General McPeak said nothing like that. In response to a direct question from Sen. Daniel K. Inouye (D-Hawaii), he said he did not know what effect air strikes might have on the political situation in the Balkans, but that, if ordered to do so, the Air Force could find, target, and destroy the Serbian gun positions—and do it without great risk to the aircrews. Does something in Colonel Hackworth's infantry experience qualify him to make a better judgment?

In his 1989 book, Colonel Hackworth said the next war would be one of insurgency and that US troops would not face large armored formations. He did not anticipate the Gulf War, on which he now lectures us. His contempt for airpower is illogical and unrealistic.

Last year's Bottom-Up Review—which was trying to cut forces, not justify them—estimated that the typical adversary in a major regional conflict will have at least 400,000 troops, 2,000 tanks, 500 combat aircraft, and 100 Scud-class ballistic missiles. Most likely, enemy units and armor will already be rolling when US forces deploy.

The first task in the strategy is for airpower to halt the armored advance and stabilize the front until sustaining forces can arrive. Virtually everything going in for the first thirty days will go by airlift. When decisive force is in place, an air-land counteroffensive can begin. Many of the important targets will be in the rear echelons or deep in hostile territory where the only way to hit them is by air.

Gulf War operations departed from the standard air-land concept by delaying the ground offensive and extending the air campaign, which was yielding better-than-expected results. That approach may prove useful again, but wars differ. It's possible that airpower will play a less spectacular role in the next conflict. It is impossible, however, to imagine a modern war in which airpower is not a leading element.

No one who paid attention to the Gulf War can accept Colonel Hackworth's evaluation that airpower was insignificant. No one who thinks more than a few minutes about the order of battle in a major regional conflict will believe it can be fought successfully without airpower.

Colonel Hackworth was a distinguished soldier, but when he talks about airpower, he's shooting blind, and he's wrong. ■

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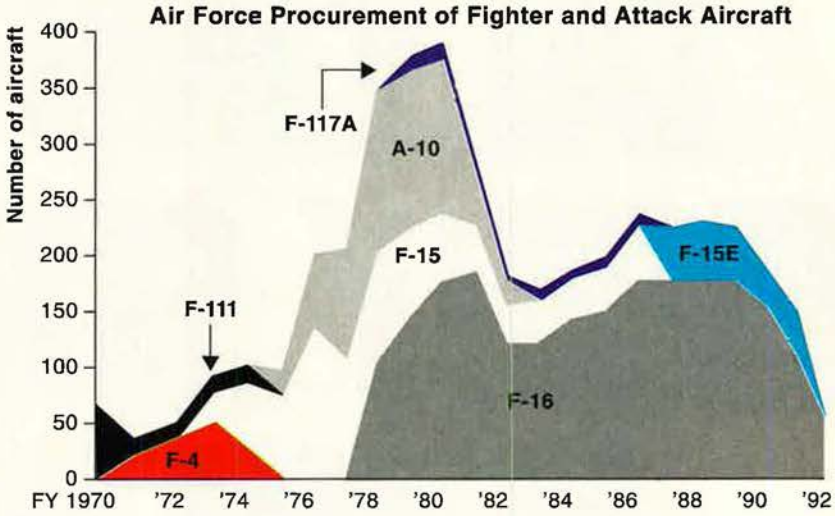
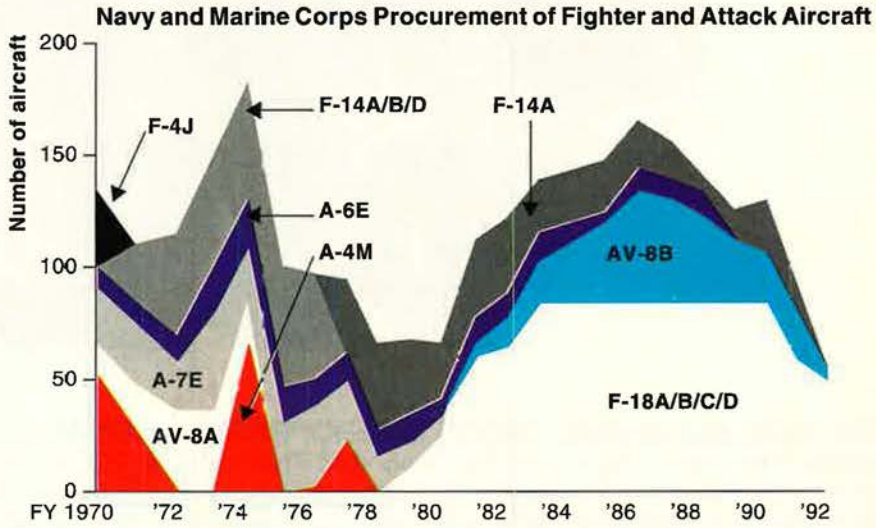
The Chart Page

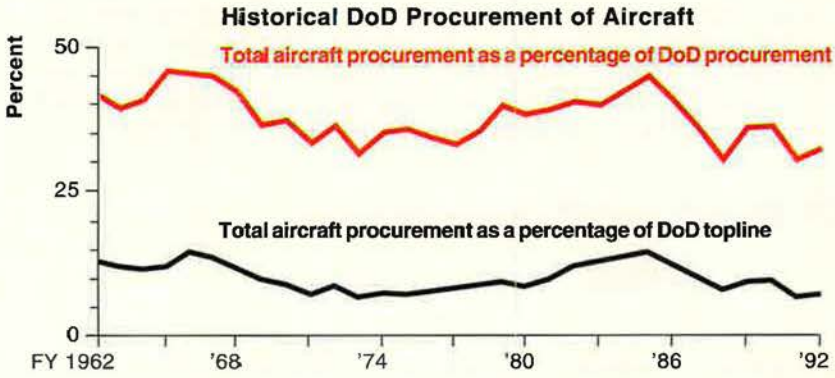
Compiled by **Tamar A. Mehuron,** Associate Editor

Boom and Bust in Fighter Procurement

Defense budgets tend to jump up rapidly in response to a specific stimulus and then erode at a relatively modest rate over an extended period. Procurement can be viewed as the most historically dynamic part of the defense budget. When budgets go up, it is a disproportionate "winner." When they go down, it loses big as well. Procurement of aircraft by the services reflects this boom-and-bust pattern. The pattern is evident in the bottom graph, though it is less pronounced than in the other charts. This is partly because procurement of aircraft as a whole in modern times has been a consistently high DoD budget priority and has consumed a relatively constant percentage of the budget.







Source: Kevin N. Lewis, "Planning Future U.S. Fighter Forces," RAND Corp., Santa Monica, Calif., 1993.

Letters

Applause for Stevens

When I read that Bob Stevens's cartoons *["There I was . . ."]* in the December 1993 issue of AIR FORCE Magazine would be the last, I darn near threw my wings away. Those cartoons were out of this world. I enjoyed looking at them, and laughing like hell, because every one told its little story.

I join hundreds of thousands who thank him for his talent, ability, and willingness to share.

Barry Goldwater
Scottsdale, Ariz.

Say it isn't so!

How can we survive without "There I was . . ." by Bob Stevens?

I didn't experience many of his tales, but I appreciated and understood all of them.

Charles W. McShan
Dixon, Calif.

AIR FORCE Magazine, which I have received for many years, is a good magazine. However, without Bob Stevens's "There I was . . ." it is not the same. At the risk of being presumptuous, I would guess that nearly all of us turned first to the back page to see what treat Bob had for us.

Maj. Elmo H. Cannon, Jr.,
USAF (Ret.)
Keystone Heights, Fla.

I just opened my January issue to my customary first location, and what did I find but a picture of scarves!

"Pieces of History" is a nice try, but . . .

I miss Bob Stevens's "There I was . . ." already!

Maj. Thomas Rolka,
USAF (Ret.)
Peachtree City, Ga.

Credit the Crew

"New Faces at Gunsmoke" *[January 1994, p. 40]* should have been expanded. The B-52 performed outstandingly in the 1993 air-to-ground competition. Another historic chapter of the B-52's distinguished career was written at this event, with all bomber awards won by the BUFF.

The crew concept contributed to superb B-52 results. AIR FORCE Magazine is guilty of inattentiveness in publishing only the aircraft commander's name instead of those of the entire crew. B-52 crew members will agree it is difficult for one crew member to fly, operate bombing systems, navigate, and counter electronic threats in this weapon system. A crew effort is involved.

Thus, you should give credit to the entire crew, not only the crew commander. Capts. Barry Sebring (copilot), Steve Amato (radar navigator), David Conley (navigator), and Vernon Moore (electronic warfare officer) were Captain Stich's award-winning crew. Also, the 93d Bomb Wing, Castle AFB, Calif., won the Top Bomber Operations award, which was not mentioned in the article.

Capt. Steven L. Amato,
USAF
Castle AFB, Calif.

Rules of Competition

Maj. Gen. William P. Hallin's letter *["Success at Warner Robins," January 1994 "Letters," p. 6]* concerning certain achievements at Warner Robins Air Logistics Center, Robins AFB, Ga., while interesting and informative, highlights a troublesome issue: the fairness of competition between government facilities and industry for increasingly scarce defense dollars. Referring to the program for replacing the center wing boxes on 113 C-141s, the General wrote, "We were able to bid more than fifty percent lower than the next most competitive offer and won the repair project bid on the open market." The reason for their success, according to the General's letter, was "the proven skill and ingenuity of our people at Robins AFB."

I do not question the skill and ingenuity of the work force at Warner Robins ALC, but I do wonder if those characteristics alone can account for a bid fifty percent lower than the next most competitive offer. I acknowledge that the Robins ALC bid had no need to include profit, but other factors must have substantially contributed to the government's cut-rate offer to itself. Employee pay and benefits, accounting methods, cost of resources and utilities, and depreciation all must have been major elements that contributed to the final bid. Could it be that the competition rules unfairly favored the government?

Assuming that the true cost of the project can be determined accurately and that the government will want it done, comparing the final cost with the bid cost will reveal either the accuracy of the ALC's estimates or, as many believe, the impropriety of allowing one of the competitors to choose the winner.

Time will tell, I hope.

Ross L. Meyer
Las Vegas, Nev.

Two-Level Uncertainties

I read "Materiel Command Faces Uncertainty" *[November 1993, p. 26]* with great interest. On p. 32, James W. Canan describes AFMC's move into and progress with two-level maintenance (2LM). I would like to challenge five points.

First, 2LM "makes it much easier for combat wings and squadrons to deploy on short notice, travel light, and be self-sufficient—ready to fight—on or soon after arrival." Two-level units are not self-sufficient. They are tied to an umbilical cord of transportation to the source of repair—transportation that is jointly owned, not USAF-owned. This is a link that we must secure because retrograde transportation has not been our strong suit.

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

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John T. Correll

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Robert S. Dudney

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Advertising Director
Patricia Teevan
1501 Lee Highway
Arlington, VA 22209-1198
Tel: 703/247-5800
Telefax: 703/247-5855

Manager, Industry Relations
Elizabeth B. Smith • 703/247-5800

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Letters

Second, "Fortuitously, all of [the 366th Wing's] varied fighters share common, or nearly common, engines and avionics." The 366th is equipped with F-15C, F-15E, and F-16C fighters. Only about five percent of the line replaceable units (LRUs) are common between the F-15 and F-16. About eighty percent of the F-15E's LRUs are common to the F-15C. The F-15C, because of its larger population of LRUs, has only about fifty percent commonality with the F-15E.

Third, "Modern engines and avionics are naturals for two-level maintenance because they are modular, built around [LRUs] . . . that technicians and mechanics can readily remove and replace." This statement does not stand up to serious scrutiny. LRUs were built to be replaced on the line and repaired in base shops under three-level maintenance. Modular engines, such as the F100-PW-220, were designed for 3LM, with modules changed at the base and shipped to the depot.

Going to 2LM takes away the capability to change most modules. For example, in the F100-PW-220, only the fan, augmentor, and gearbox modules can be changed at the 2LM base. In the past, if the core was bad, it would be shipped alone. Under 2LM, a bad core will be accompanied by good modules. In addition, it was not cost-effective to go to 2LM for F101, F110, and TF34 engines. The real decision on 2LM comes down to reliability, number of assets available, and velocity in the pipeline.

Fourth, "The former AFLC made the first move toward two-level avionics maintenance in 1991 with its Coronet Deuce program for F-16s at Hill AFB, Utah." The "Coronet" in "Coronet Deuce" is a nickname formerly assigned to Tactical Air Command and now to Air Combat Command. When Gen. John Michael Loh took command of TAC, he soon asked us to get a wing into 2LM. In April 1991, we did the initial briefing and suggested the name "Coronet Deuce." In July 1991, we took the 388th Fighter Wing into avionics 2LM at Ogden and Warner Robins ALCs, using military technicians from the 388th to run test stations in a depot building. Later, we brought in the 363d Fighter Wing at Shaw AFB, S. C., and subsequently expanded to other squadrons and wings from other commands for follow-on phases of Coronet Deuce. It has been a team effort, as we worked pipeline processes and set standards.

Fifth, "AFMC set up a second two-level avionics maintenance program at Tinker AFB, Okla." The 2LM setup at Tinker was requested by the Oklahoma City ALC but was staffed and funded by ACC in Fiscal Year 1993. The military technicians and most of the equipment came from the intermediate-level maintenance facility closed down at Carswell AFB, Tex. Again, it was a team effort.

While AFMC has made much progress, you have slighted the initiative and contributions of the combat commands.

Col. Dale Fowler,
USAF
Hampton, Va.

Navstar's Future

I found "How Navstar Became Indispensable" *[November 1993, p. 46]* very interesting and potentially informative. However, I found myself questioning quite a few of Michael Rip's statements because he missed the truth with at least one major claim. Not one E-3 AWACS (B or C model) aircraft involved in Operations Desert Shield and Desert Storm was equipped with a GPS receiver. That is because only one E-3C aircraft, Test System 3 (TS-3), has a GPS receiver, and that aircraft belongs to AFMC (then AFSC).

TS-3 is operated as a test-bed by a mixture of Boeing and government flight-crew members. It represents the future configuration of E-3 aircraft as it is modified and tested for many years before those modifications enter the inventory. It was not deployed during the Persian Gulf War.

I have flown on all USAF E-3 aircraft as an E-3 Air Surveillance Officer and as chief of 552d Airborne Warning and Control Wing Surveillance Operations. I also served as an airborne flight test manager supporting the E-3 Joint Test Force (JTF) from the E-3 System Program Office (SPO) at Hanscom AFB, Mass., from July 1991 to the present. Having flown on TS-3 prior to my deployment in August 1990, to Saudi Arabia, I was aware of the capability GPS provided to the command-and-control mission that the E-3 was to assume.

Unfortunately, the other modifications that constitute the Block 30/35 upgrade were not mature enough for the aircraft to be sent to the Gulf. Had TS-3 been the only E-3 in the inventory, I am sure that our leadership would have allowed it to assist. The E-3 JTF was ready to go. I received a call in Saudi Arabia from one JTF Air Force captain who felt that the JTF could contribute immediately. The 552d AWACW's ability to fully ex-

ecute its tasking was probably the deciding factor in not sending TS-3.

Mr. Rip is correct in stating the *future* configuration will be "GPS-assisted INS" because the GPS receiver in TS-3 is not integrated into the navigational computer system (NCS) and, hence, does not provide the mission computer with GPS-quality data. Instead, the navigator "fat-fingers" the GPS data into the off-line INS and then brings it on line to update the NCS. This updates the mission computer and corrects any "drift" caused by the previously on-line INS. Perhaps Congress will provide funding to integrate the GPS in the Block 30/35 upgrade to the USAF E-3 fleet.

Capt. Kirk R. Warburton,
USAF
Hanscom AFB, Mass.

The "Forgiving" C-47

When my copy of AIR FORCE Magazine arrives, the first thing I read is "Valor." It is interesting and inspirational, and I enjoy it very much.

When I read "Night Rescue at Loc Ninh" *[October 1993, p. 79],* I was dismayed to read all the comments about the C-47. I was with the 317th Troop Carrier Group in the Pacific during World War II and had my fill of short strips and crosswinds.

It bothered me very much to read about its being "heavy on the controls, slow to respond," and less than ideal for short-field operations. This aircraft was none of the above. It was the most "forgiving" aircraft I ever flew. It never complained and did whatever it was asked to do.

I wonder what all the intrepid airmen would have done if we who flew the C-47 had not delivered the bombs, ammunition, gas, oil, and the million other things needed to fight an air war. Without this wonderful old plane, things might have been a lot more uncomfortable for a lot of people.

Lt. Col. William P. Shattuck,
USAF (Ret.)
Asheville, N. C.

Giving the Devil His Due

I read "The Loadmasters" *[October 1993, p. 44]* with interest. I was a loadmaster for ten years. I spent four years in the Air Force and six in the Air Force Reserve. Being a loadmaster was the only thing I did.

When I was flying around the world on C-141s out of Charleston AFB, S. C., I thought it was the best job anyone could have. The article points out the many differences and similarities between being a loadmaster now and when I was flying.

In the otherwise excellent article, there is one discrepancy. The caption under the picture of the two loadmasters on p. 49 identifies them as members of the 61st Airlift Squadron. Those look like 50th Airlift Squadron patches to me. I was a proud member of the 50th (then TAS) at Ching Chuan Kang AB, Taiwan, in 1969 and 1970.

Stan Davis
Frederick, Md.

Second-Class Crew Members

I would like to expand on the comments of Susan Young in her letter *["Mall-Bent for Leather," December 1993 "Letters," p. 7].* Another group of combat-ready "back-enders" is not granted the privilege of wearing leather jackets: aeromedical evacuation crews. Despite performing one of the most important but least recognized flying missions and going into harm's way in such places as Panama, the Persian Gulf, and Somalia, we, too, are treated as second-class citizens on the planes we fly.

I believe that the real issue is fairness. Many double standards exist in the military, but surely it is time to stop giving preferential treatment to certain groups of flyers just because they are "flight" crews and the rest of us are just taking up space in back. We wear the same flight suits and (in the case of the enlisted) wear the same wings. We work hard to perform our duties and contribute to the success of the mission. While I in no way wish to downplay the importance of the flight crews, especially pilots, I think it's time to stop dividing flyers into the haves and the have-nots.

Robert C. Mebane
Alexandria, Va.

The Historic Dominator

I would like to reply to SMSgt. Ernest Morgan's letter in the December issue of AIR FORCE Magazine *["B-29 or B-50?," p. 8].*

The B-32 Dominator had reversible props—probably the first ever standard in operational bombers. I remember when Fifth Air Force brass asked to see the new bomber at Clark Field, the Philippines. Colonel Cook and his crew flew from Blanca Airfield, Fla., to Clark Field for the command performance. With all the brass lined up, Colonel Cook said to me, "Let's have some fun," and with that he reversed the props and sent hats flying across the tarmac.

The B-32 was a great airplane and flew the last recorded action of World War II. That action over Tokyo was supposed to be a simple photo mission but turned into a real dogfight. I know. I was there.

John R. Blackburn, Jr.
Bedford, Pa.

Capitol Hill

By Brian Green, Congressional Editor

Skelton Seeks a Balance

Military strength "starts with people," but the nation can't afford to ignore weapon modernization.

REP. IKE SKELTON, chairman of the House Armed Services Committee's Manpower and Personnel Subcommittee, is devoted to a strong national defense and is among the few on Capitol Hill seeking more money for the nation's armed forces. The Missouri Democrat maintains that military strength "starts with quality people," well trained and in sufficient numbers.

In a recent interview with AIR FORCE Magazine, the senior lawmaker expressed deep concern about retaining high-quality personnel and noted that paying a fair wage is critical to any realistic effort to retain them. "If you don't let people know you appreciate them . . . they'll vote with their feet," he said.

Poverty in the enlisted ranks, he believes, is not widespread. He is, however, "very keenly aware that [any such poverty] has a direct impact on morale and keeping good people in."

The Congressman knows that the effort to provide adequate compensation collides with the reality of inadequate and shrinking US defense budgets. "I don't think you have any choice but to [reconsider the pay raise issue] year by year," he said. He argues that this annual uncertainty, as well as the continuing downsizing, contributes to morale problems, particularly in the enlisted ranks.

Mr. Skelton identifies family housing and good health care for service members and dependents as other key elements of a high quality of life in the military. "In my kitchen I have an old wooden sign that reads, 'If mama ain't happy, ain't nobody happy.' . . . You have to keep your family happy to have peace of mind on the job," he argued. That peace of mind, he believes, is also important to retaining quality personnel.

Health-care reform and how it will affect the military is one of Mr. Skelton's main concerns in this regard. He has not signed on to any of the reform plans, and he notes that many have not addressed the military health-care system specifically. He will also focus this session on a medical condition called "Gulf War syndrome," a mysterious illness afflicting some veterans and active-duty members who served in that conflict.

Dealing fairly with these "quality of life" problems not only will enhance retention, said the Congressman, but also is vital to attracting high-quality recruits. "The all-volunteer system works," he said, "[but] it works only if you have quality people standing in line, wanting to get in, and staying as long as they want to," he said. The uncertainty that afflicts the effort to keep good people, he believes, could "have a severe impact" on recruiting, although he doesn't see serious problems yet.

Mr. Skelton is convinced that some inequities are beyond fixing this year because of lack of funds. He notes that low-paid military members stationed overseas are not likely to be eligible for the earned income tax credit—as are their counterparts in the continental US—because too much government revenue would be lost. Likewise, he believes the efforts to provide for concurrent receipt of retirement pay and disability allowances and to make the military retiree cost-of-living allowances consistent with those of civilian federal retirees are not likely to be successful in the foreseeable future.

Although his subcommittee chairmanship leads to a strong focus on personnel issues, Mr. Skelton takes the view that force structure, quality personnel, and pay should not be emphasized to the exclusion of modernization. "You can't have these wonderful, outstanding pilots flying Curtiss-Wright Jennies," he said. "They have to be flying B-2s, F-117s, and F-15s."

High-technology weapons that have served the US military well and the R&D base remain important priorities. Mr. Skelton says that, even if continued B-2 bomber production isn't likely, industrial base issues must be addressed. Neglecting any aspect of the military effort—personnel, modernization, or readiness—"shows up downstream as a hollow military or one that's inadequate to a major task," he argued.

The major task he deems critical is responding to two major regional contingencies (MRCs) nearly simultaneously, as outlined in the Pentagon's latest strategy review. He does not believe that trimming requirements is a viable alternative. "There is great danger," he believes, "in moving to a lesser strategy." The Congressman argued forcefully in a recent speech that the force structure now programmed "can in no way fulfill the national security strategy" of fighting two MRCs.

Mr. Skelton's broad view of military needs—a balanced mix of high-quality troops with a good quality of life and forces sized, trained, equipped, and ready to fight two major conflicts—leads him to push for additional defense funds. He believes that "the defense budget must be leveled out—no more real cuts," a move that would reverse the long-term downward trend that continues in the Administration's five-year spending plan.

Mr. Skelton, along with other conservative Democrats, recently called for the addition of $50 billion over five years to fund the cost of last year's pay raise and inflation in the later years of the multiyear defense program. He also endorsed erecting a "fire wall" around defense spending—*i.e.*, not allowing money cut from defense to be used for domestic initiatives—and controlling "nondefense" spending in the defense budget.

All these views push Mr. Skelton closer to direct conflict with the Administration's spending plan. He anticipates the possibility of "a serious battle on the budget" this year. "The overall budget . . . is a major bind," he said. "I'm deeply concerned." ■

For JPATS Students, It's An Accelerated Learning Program.

Nothing comes close to the Pampa 2000 for helping student pilots to quickly develop their flying skills. It's simple enough for first-time students, yet has the full performance qualities of a jet. This makes it a more realistic, effective JPATS platform than a turbo prop. As a result, it maximizes the total skill level achieved by the beginning pilot and minimizes the transition period between aircraft. The exceptional performance envelope and handling qualities of the Vought Pampa 2000 assures that America's military pilots will benefit from realistic and cost-effective training well into the 21st century.

Pampa 2000

Vought aircraft company

Pampa 2000 JPATS Team: Vought

AlliedSignal • UNC • FMA

For its multi-role function and attack capability, Malaysia has selected the F/A-18D Hornet aircraft equipped with Hughes Aircraft Company's APG-73 radar. This next-generation, state-of-the-art radar is an upgrade of the combat-proven Hughes-built APG-65 system. The APG-73 radar incorporates advanced concepts and components that provide improved performance, reliability and easier maintenance without any increase in size or weight over the APG-65. New F/A-18 aircraft for the U.S. Navy and Marine Corps and for the air forces of Finland and Switzerland will also be equipped with the APG-73 radar, starting with the first scheduled fleet delivery in 1994.

Four major airports in the Ukraine may be completely modernized, with advanced technology and systems built by Hughes. The plan, which would focus on airports at Kiev, Odessa, Lviv, and Symferopol, is designed to automate these airports through electronic data interchange. Its objective is to integrate aircraft operations, passenger handling, air traffic control, security, and administration into one highly efficient unit. Using computer technology can dramatically enhance an airport's efficiency and service, and help it increase revenues and adhere to more stringent regulations.

The U.S. Army's Second Generation Tank Sight (SGTS) reached a major milestone recently by demonstrating advanced infrared imagery using the Army's Standard Advanced Dewar Assembly (SADA). SGTS features a 480 x 4 detector array, high-speed image processing, an eyesafe laser rangefinder, and precision, two-axis stabilization. The SGTS prototype is designed and built by Hughes under contract to the U.S. Army Night Vision and Electronic Sensors Directorate. It will be integrated into the Army's test bed for future combat vehicles.

A new electronics manufacturing process not only saves time and money, but will help save our environment. This process, developed by Hughes, uses a new water-soluble flux called HF1189 in soldering circuit card assemblies. This eliminates the need for ozone-damaging chlorofluorocarbons (CFCs), which are used to clean conventional rosin-based fluxes. With HF1189's rapid and complete deoxidizing action, electronic card assemblies can be soldered and cleaned in about one-half the time needed for rosin-based fluxes. Hughes estimates that by converting its wave soldering machines to this new process, it will save operating costs of several million dollars annually.

A new manufacturing process could save a considerable amount of chemical waste each year. This dry-etch technique, being developed by Hughes, is used to fabricate Mercury Cadmium Telluride (HgCdTe) detector arrays for mid-wave and long-wave infrared imaging. The new dry-etch process would replace a bromine spray etch, eliminating safety hazards and toxic waste disposal problems. Additionally, the dry etch provides superior reproducibility, uniformity, and precision — major advantages in producing today's larger, higher density detector arrays. Development of the new process is being funded by the Advanced Research Projects Agency (ARPA).

For more information write to: P.O. Box 80032, Los Angeles, CA 90080-0032

HUGHES

Aerospace World

By Frank Oliveri, Associate Editor

Perry Follows Aspin, Inman

Dr. William J. Perry was President Clinton's third nominee for the post of Secretary of Defense. Dr. Perry, a highly regarded California defense industrialist, was already serving as Deputy Secretary of Defense when the President tapped him for the top Pentagon post. The Senate confirmed him on February 5.

Dr. Perry's boss, Secretary of Defense Les Aspin, tendered his resignation in December. The President proposed to replace Mr. Aspin with Bobby Ray Inman, but the retired admiral suddenly backed out in mid-January, complaining about criticism in the press.

Dr. Perry previously served as under secretary of Defense in 1977–81, during the Carter Administration. He was responsible for weapon systems procurement and research and development and is considered the father of stealth technologies. He pushed hard for development of the F-117 fighter, B-2 bomber, Advanced Cruise Missile, and other systems yet to be publicized.

Staff photo by Guy Aceto

For heroic actions in the October firefight in Mogadishu, Somalia (the longest sustained firefight involving US forces since the Vietnam War), TSgt. Timothy A. Wilkinson (right) received the Air Force Cross. A Silver Star was awarded to (from left) SSgt. Jeffrey W. Bray and MSgt. Scott C. Fales. All three are with the 24th Special Tactics Squadron, Pope AFB, N. C. An enlisted man last received the Air Force Cross for actions in the rescue of the SS* Mayaguez *crew in 1975.

More Military Jobs Open to Women

In January, former Secretary of Defense Les Aspin rescinded the "risk rule," which barred women from non-combat units where the risk was as great as that in combat units. The move opened the way for women in military specialties once denied them because the jobs were dangerous.

Women will still be barred from jobs that involve direct ground combat. The new policy defines direct ground combat for the services uniformly for the first time. The definition has three parts: "Women may not serve in units that engage an enemy on the ground with weapons, are exposed to hostile fire, and have a high probability of direct physical contact with the personnel of a hostile force."

By May 1, 1994, the services must provide Assistant Secretary of Defense for Personnel and Readiness Edwin Dorn with justification for why billets are being opened or kept closed.

"We've made historic progress in opening up opportunities for women in all of the services," Mr. Aspin said. "Expanding roles for women in the military is right, and it's smart. It allows us to assign the most qualified individual to each military job."

B-1Bs Break Record

Three B-1B bombers launched from the US last November dropped bombs on a range northwest of Cairo, Egypt, as part of the Bright Star exercise, and returned to base, setting a B-1 mission-duration record of thirty-one hours and eighteen minutes.

Two crews from the 9th Bomb Squadron, Dyess AFB, Tex., and one crew from the 28th Bomb Squadron, McConnell AFB, Kan., shattered the existing record of twenty-four hours and thirty minutes set by an aircrew from Ellsworth AFB, S. D.

Four bombers began the mission by teaming up and flying to the East Coast, where it was decided that only three would complete the trip. The three aircraft flew over the North Atlantic, the Straits of Gibraltar, and the Mediterranean Sea and then bombed the Wadi El Natron bombing range. Each aircraft flew more than 13,000 miles round-trip. Together, they consumed over a million pounds of fuel. The most challenging aspects of the mission were sleep, food, and water, the crews said.

USAF Prepares for More Cuts

The Air Force will have to trim an additional 2,300 officers and 17,000 enlisted members above normal attrition to meet FY 1995 end-strength requirements, the service said in January.

The newest plan expands the eligibility criteria for the temporary early retirement, Voluntary Separation Incentive, and Special Separation Benefit programs. The Air Force said it will hold officer Selective Early Retirement Boards and the first-ever senior NCO SERB, if needed, to meet those requirements.

The Air Force will also stop selective continuation of majors twice deferred for promotion. These officers will be offered early retirement in lieu of separation.

"Don't Ask, Don't Tell" Implemented

Former Secretary of Defense Les Aspin released new Pentagon regulations on homosexual conduct in the armed forces that he said were consistent with the Fiscal Year 1994 National Defense Authorization Act.

The new regulations implement the "Don't Ask, Don't Tell" policy established by the Pentagon in July. While ending the fifty-year ban on homosexuals in the military, the new guidelines maintain a strict ban against homosexual conduct.

"We are confident that the new policy will maintain unit cohesion and will maintain the readiness of the best-trained, best-equipped military in the world today," Mr. Aspin said.

Under the policy, no applicant will be asked about sexual orientation because homosexuality is not a bar to service entry or continued service unless revealed through homosexual conduct.

A service member still may be discharged for homosexual acts, actual or attempted same-sex marriage, and statements by the individual that he or she is homosexual or bisexual. An individual can rebut the presumption of homosexual acts by showing he or she does not engage in them and does not have a propensity or intent to do so.

Admiral Owens Nominated

President Clinton nominated Adm. William A. Owens to be vice chairman of the Joint Chiefs of Staff, the Pentagon said in December. Admiral Owens will succeed Adm. David E. Jeremiah, who is retiring.

A native of Bismarck, N. D., Admiral Owens entered the military as a midshipman at the US Naval Academy in 1958. He was commander of the US Navy's Sixth Fleet and Allied Strike Force South from October 1990 to July 1992. Since then, he served as deputy chief of Naval Operations for Resources, Warfare Requirements, and Assessments, where he was the Navy's principal participant in the Pentagon's Bottom-Up Review of defense programs and requirements. He then moved on to command the Navy's Pacific Fleet but served there only a few months before being tapped for the JCS position.

VA to Treat "Mystery Illnesses"

The Department of Veterans Affairs is now allowed to treat Persian Gulf War veterans for diseases that may have resulted from exposure to toxic substances. The veterans' symptoms include fatigue, painful muscles and joints, bleeding gums, skin rashes, short-term memory loss, and hair loss. President Clinton signed the change into law in January.

In December the President said, "Over the past two and a half years, Persian Gulf War veterans have experienced a wide range of health-care problems that have eluded diagnosis and cure. With this legislation, the VA will have the authority to provide to these veterans both inpatient and outpatient care on a priority basis. Thus, we can help make certain that these veterans' health-care needs are met as fully as possible while important research into their problems goes forward."

The legislation also allows the VA to reimburse veterans for any co-payments made to the VA for care that might have been necessary because of exposure to toxic substances in the Persian Gulf region.

C-130 Damaged in Provide Promise

An Air Force C-130 from Rhein-Main AB, Germany, sustained light damage in early January when incoming ordnance exploded near the aircraft parked on the apron at the Sarajevo airport in Bosnia-Hercegovina.

Although no injuries were reported, Provide Promise airlift operations to the area were suspended for about a week. The operation commenced again after the UN protection force gained assurances for aircraft safety from all parties associated with the conflict in the area.

The damaged aircraft was assigned to the 435th Airlift Wing. Damage consisted of a three-inch gash and a one-inch hole in the center of the aircraft's left aileron. Damage assessment was completed at Ancona AB, Italy, and the aircraft then returned to Rhein-Main AB. It was the first US aircraft hit during Provide Promise but the sixth UN aircraft damaged during the operation.

VA Expands PTSD Treatment

The Department of Veterans Affairs is establishing thirty-four new or expanded programs for people suffering from Post-Traumatic Stress Disorder, bringing the number of specialized programs to 110 around the nation.

VA Secretary Jesse Brown said, "VA is a leader in PTSD outreach, treatment, and research. I'm pleased to be able to expand treatment to veterans suffering the psychological effects of trauma from military service. Their invisible scars are no less debilitating than the trauma suffered by their physically injured comrades."

USAF photo by Maj. Joe Mecadon

Gen. Col. Igor Sergeyev, commander in chief of Russia's Strategic Rocket Forces, climbs out of a missile silo after viewing an ICBM inactivation at the 44th Missile Wing, Ellsworth AFB, S. D. In December, USAF began destroying Minuteman II missiles under the terms of the START Treaty.

The VA estimates that as many as 500,000 Vietnam veterans have PTSD, but eighty percent have not contacted the VA for treatment. The disorder typically reveals itself as irritability, anger, recurring thoughts of the traumatic event, and reduced involvement in work.

F-16s to Italy

Two squadrons of F-16C aircraft with the 86th Wing, Ramstein AB, Germany, will be permanently relocated to the 401st Fighter Wing at Aviano AB, Italy, in April, the Air Force said in December.

The aircraft will reestablish a presence in the southern region of Europe in response to NATO tasking. Permanent US fighter presence in the region has been nonexistent since three squadrons of F-16s departed from Torrejon AB, Spain, in early 1992. The relocation will shift 1,300 US military and civilian slots from Ramstein to Aviano. In addition, the 512th and 526th Fighter Squadrons will be inactivated at Ramstein.

Air Force Safety Improves

The Air Force had its second-best year ever for flying safety in 1993, with an overall Class A mishap rate of 1.34 per 100,000 flying hours, a drop from last year's 1.65 rate, the Air Force said in December. Class A mishaps involve the loss of life or an aircraft or at least $1 million in damage.

Last year was the second-safest year ever for ground safety as well, with four fewer private motor vehicle deaths than in Fiscal Year 1992 and thirty-two fewer than in FY 1991. There was also a fifty percent reduction in accidents involving alcohol. There were forty-two flight fatalities, including pilots and crew members, and eighty-eight ground fatalities.

TRW technicians test a Milstar extremely high frequency agile beam antenna at a climate-controlled range. Milstar is a next-generation space communications network designed to relay secure, real-time communications among military users and national command authorities locations worldwide.

USAF to Recruit 33,200 in 1994

The Air Force seeks to recruit 33,200 men and women in Fiscal Year 1994, which ends September 30.

Recruiting Service Commander Brig. Gen. (Maj. Gen. selectee) John M. McBroom said that, as the Air Force gets smaller, the task of recruiting high-quality people must remain a top priority.

However, because of the military drawdown, fewer Americans are considering a military career, said the Air Force. Many believe the services have stopped bringing in new troops altogether. "Nothing could be further from the truth," General McBroom said. "The Air Force is looking to enlist 30,000 people and about 3,200 to commission as officers. There are a great many challenging and rewarding career opportunities for young women and men who can measure up to the high Air Force standards."

Special emphasis is being placed on recruiting for pararescue and combat control duty. Professionals in physical therapy, optometry, occupational therapy, obstetrics and gynecology, and emergency medicine and family practice physicians are also being sought.

In this artist's rendering from Lockheed, a Navy F-22 derivative strike fighter releases a GBU-24 2,000-pound bomb while its wingman launches an AIM-120 AMRAAM. The swingwing, all-weather aircraft developed from the Navy A/F-X program is smaller than the F-14 Tomcat and will weigh less than the F-14D.

AFRES Provides Earthquake Relief

The earthquake that rocked the Los Angeles area in January caused significant damage and suffering, but an Air Force Reserve C-5A aircraft and crew helped the state government deal with the emergency by quickly transporting three urban disaster teams from the California Office of Emergency Services to the area.

The C-5A, from the 433d Airlift Wing at Kelly AFB, Tex., was on a stopover at Travis AFB, Calif., just north

The Air Force will use this Southwest Research Institute equipment to test a heat shield used by the Titan IV Hercules Aerospace Solid Rocket Motor Upgrade program. The test fixture simulates the heat and blast conditions of a rocket launch, from ignition to burnout.

of San Francisco, after returning from a mission to Japan when its crew was tasked to fly the relief mission to Los Alamitos military airfield.

In addition to the 168 disaster relief people, the aircraft carried forty tons of cargo, including first-aid supplies, search-and-rescue equipment, ground penetrating radar, and six search dogs.

New X-31 HMD Tested

The X-31 Enhanced Fighter Maneuverability program aircraft was used to test a unique helmet-mounted display in simulated close air combat with a NASA F/A-18A, DoD said.

The display projects information on the helmet's visor, allowing the pilot to keep his eyes on a maneuvering foe while monitoring his own aircraft performance information. The system uses new symbols specifically designed to show the aircraft's angle of attack. The X-31 program is also experimenting with audible cues to represent angle of attack.

The X-31 and F/A-18A will continue with unrestricted air combat tests to evaluate the helmet-mounted system. Since both aircraft are seen to be equally matched in conventional flight characteristics, engineers can accurately determine how much the X-31's unique vectored thrust, integrated control systems, helmet-mounted display, and other special features contribute to victory in air-to-air engagements.

The X-31 has won the vast majority of engagements flown since tests started in November 1993. The Department of Defense said two types of engagements have been flown by multiple pilots. One is called the neutral start, in which both aircraft are flying at the same altitude and speed, heading in the same direction. The other encounter starts the X-31 in a defensive position with the F/A-18A facing and at a ninety degree angle (head-on) to the X-31, putting the X-31 at a distinct disadvantage. The X-31, in both kinds of engagement, was usually the first to target its adversary successfully.

US Begins Silo Destruction

In December, the Air Force destroyed the first Minuteman II missile silo at Whiteman AFB, Mo. It was eliminated under terms of the Strategic Arms Reduction Talks (START) Treaty between the US and the nuclear states of the old Soviet Union.

The treaty calls for elimination of 500 missile silos. The first silos to go are at Whiteman. All 150 silos there will be destroyed by early 1997. The Missouri base now has become home of the B-2 bomber.

The START Treaty requires the destruction of 450 single-warhead Minuteman II missile silos and fifty Peacekeeper missile silos.

The Peacekeeper, based at F. E. Warren AFB, Wyo., carries ten warheads per missile. The US will begin destroying Peacekeeper silos in 2000 and must finish the job within three years. Missile warheads are being turned over to the Department of Energy for dismantling, and the missiles themselves are being shipped to Hill AFB, Utah, for storage and possible use in space launches, the Air Force said.

Policyholders to Receive Dividends

Those holding Veterans' Life Insurance policies will receive $955

USAF photo by SSgt. Terry Blevins

South Korea's President Kim Young Sam greets a US service member after delivering a speech thanking US troops for their continuing support. "The Korean peninsula remains an island of Cold War today," he told 150 American and South Korean servicemen during a December visit to Osan AB.

million in dividends in 1994 from the Department of Veterans Affairs. The payment affects 2.5 million government life insurance policies issued between 1917 and 1956 to veterans of World War I, World War II, and the Korean War, according to the VA.

The largest group to receive payments will be the 2.1 million veterans of World War II with National Service Life Insurance ("V") policies, who will receive about $392 each. The payments are scheduled to be credited automatically to policyholders on the anniversary dates of their policies. Payments can also be made by check.

AFRES to Provide ATH Personnel

The active-duty Air Force is now being supported by seventeen Air Force Reserve medical units with air-transportable hospital (ATH) personnel, the service said.

At one time, AFRES concentrated on second-echelon duties in time of war, categorizing wounded according to need and providing limited medical care to stabilize patients before transporting them to a third-echelon bedded hospital. That focus changed during the Gulf War, when the Reserve had to supply people with the right training and skills to augment active-duty facilities.

ATHs provide such comprehensive inpatient care as surgery, laboratory work, and radiology.

USAF Rescue Squadron Saves Icelanders

Six citizens of Iceland stranded in January on a tugboat near the eastern city of Neskaupstadur were saved by the 56th Rescue Squadron from NAS Keflavik, Iceland.

Two HH-60G Pave Hawk helicopters flew more than three hours, battling sixty-knot headwinds and poor visibility, to reach the exhausted crewmen, who were clinging to the tugboat's wheelhouse. The 56th is a part of the 35th Wing, a component of the Icelandic Defense Force.

Housing Allowances May Decrease

In January, the Air Force said that up to 13,000 service members may see a decrease in their Variable Housing Allowance (VHA). The decrease offsets the raise in basic pay recently approved.

While this happens to some members in certain areas of the country every year—because local housing costs have not kept pace with national housing costs—the number of people affected in 1994 will be about ten times greater than in 1993.

The current law states that VHA rates cannot be lowered so much in a single year that it cuts a person's total take-home pay.

The Air Force supports legislation that would preclude service members from over-absorbing housing costs out of their basic pay and would reimburse them for excessive non-housing costs common to duty in expensive locations. The reform would put annual adjustments in housing allowances back on track with US housing costs and provide relief for those serving in high-cost areas.

Martin Marietta Buys GD's Space Systems Division

Martin Marietta agreed in December to purchase General Dynamics' Space Systems Division (SSD) for $208.5 million in cash.

The sale, approved by the boards of both firms, is subject to certain conditions and government reviews. The deal is expected to be closed by April 30.

General Dynamics will retain ownership of all associated real estate, including forty acres in the Kearney Mesa section of San Diego, Calif., that has a $50 million book value. Martin Marietta will lease portions of the property.

General Dynamics continues to consolidate its major franchise businesses while building value, GD CEO James R. Mellor said. "This transaction meets that objective by substantially strengthening the Atlas/Centaur's ability to prosper in the highly competitive international space-launch market. By strategically combining Atlas/Centaur with its own space-launch capabilities, Martin Marietta will be able to compete effectively in the intermediate launch vehicle market."

SSD sales in 1992 were approximately $500 million, and current backlog is set at about $2.5 billion.

Guardsmen Die in Crashes, Accidents

Six Wisconsin Air National Guardsmen were killed in December when an explosion rocked their KC-135R tanker, which belonged to the 128th ARG, General Mitchell IAP, during routine ground maintenance on instrumentation, the Air Force said.

The accident is under investigation. The Air Force identified the dead as SSgt. Patrick C. Foran, TSgt. Michael D. Heath, TSgt. James G. Russell, MSgt. James R. Schlicht, TSgt. Russell H. Shurr, and MSgt. Roy A. Starszak.

Capt. Joe Pico of the Virginia ANG ejected safely before his F-16 crashed at Richmond International Airport in December. Captain Pico, assigned to the 192d Fighter Group at Richmond, Va., was returning from a training flight.

ANG lost another pilot at the end of the year. 2d Lt. Stephen L. C. Taylor of the 158th Fighter Group, Burlington, Vt., died in November when his aircraft crashed near the Oregon-California border. Lieutenant Taylor, who was attending F-16 training at Kingsley Field, Ore., was on a routine mission and failed to return to base. His body was later found at the crash site.

Active-Duty Pilots, Maintainers Killed

Air Force U-2 pilot Capt. Richard Schneider, flight commander of the 1st Reconnaissance Squadron, Beale AFB, Calif., was killed in December when his aircraft crashed while taking off on a training mission.

Lt. Col. John M. Steward, an advisor to the Arkansas ANG's 188th Fighter Group at Fort Smith, Ark., was killed off the coast of Brunswick, Ga., when his F-16 collided with an F-15 from the Louisiana ANG. The F-15 pilot ejected safely and was rescued by the Coast Guard, the Air Force said. The accident occurred during an ANG training exercise.

An airman was killed and another injured when the rear seat of an F-4G aircraft accidentally ejected on the ground at Nellis AFB, Nev., in December. The airmen were performing maintenance on the aircraft. SSgt. Roland H. Adams died of head and chest injuries, and SrA. Monty Rhine suffered burns to his face and hands.

Senior Staff Changes

RETIREMENTS: M/G Lester P. **Brown,** Jr., B/G John A. **Browning,** Gen. George L. **Butler,** B/G Gerald E. **Hahn,** B/G Michael A. **McAuliffe,** L/G Gary H. **Mears.**

PROMOTIONS: To be **Major General:** Jerrold P. **Allen,** Allen D. **Bunger,** Stewart E. **Cranston,** Robert S. **Dickman,** William J. **Donahue,** Robert W. **Drewes,** Patrick K. **Gamble,** Francis C. **Gideon,** Jr., Edward F. **Grillo,** Jr., John W. **Handy,** Charles R. **Heflebower,** Henry M. **Hobgood,** Hal M. **Hornburg,** Normand G. **Lezy,** Donald E. **Loranger,** Jr., John M. **McBroom,** George K. **Muellner,** Robert F. **Raggio,** John B. **Sams,** Jr., Michael C. **Short,** Rondal H. **Smith.**

To be **Brigadier General:** James E. **Andrews,** David E. **Baker,** James R. **Beale,** Robert J. **Boots,** William C. **Brooks,** Richard E. **Brown** III, Robert J. **Courter,** Jr., John R. **Dallager,** Curtis H. **Emery** II, Thomas O. **Fleming,** Jr., Robert H. **Foglesong,** Dennis G. **Haines,** Bryan G. **Hawley,** Kenneth W. **Hess,** Paul V. **Hester,** William T. **Hobbins,** John D. **Hopper,** Jr., Silas R. **Johnson,** Jr., Rodney P. **Kelly,** Leslie F. **Kenne,** Ronald E. **Keys,** Timothy A. **Kinnan,** Michael C. **Kostelnik,** Donald A. **Lamontagne,** Robert E. **Larned,** David R. **Love,** Timothy B. **Malishenko,** Robert T. **Newell** III, Robert T. **Osterthaler,** Susan L. **Pamerleau,** Andrew J. **Pelak,** Jr., Steven R. **Polk,** Roger R. **Radcliff,** Antonio J. **Ramos,** Berwyn A. **Reiter,** Pedro N. **Rivera,** Gary M. **Rubus,** John W. **Rutledge,** Dennis R. **Samic,** James E. **Sandstrom,** Terryl J. **Schwalier,** Donald A. **Streater,** Thomas C. **Waskow,** Charles J. **Wax,** George N. **Williams,** Leon A. **Wilson,** Jr., John L. **Woodward,** Jr.

To be **AFRES Major General:** Almon B. **Ballard,** William A. **Cohen,** Walter J. **Giller,** Jr., John M. **Miller,** Frank D. **Watson.**

To be **AFRES Brigadier General:** Boyd L. **Ashcraft,** John J. **Batbie,** Jr., Winfred N. **Carroll,** Dennis M. **Gray,** James E. **Haight,** Jr., Joseph A. **McNeil,** Grant R. **Mulder,** Joseph H. **Penkaul,** David B. **Poythress,** Richard S. **Ritchie,** David S. **Sibley,** Robert B. **Stephens.**

CHANGES: B/G John J. Allen, from USAFE Civil Engineer, Hq. USAFE, Ramstein AB, Germany, to ACC Civil Engineer, Hq. ACC, Langley AFB, Va., replacing retired B/G Michael A. McAuliffe . . . **Col. (B/G selectee) Robert J. Boots,** from Dep. Dir., Plans and Prgms., Hq. AMC, Scott AFB, Ill., to acting Dir., Plans and Prgms., Hq. AMC, Scott AFB, Ill. . . . **M/G Phillip J. Ford,** from Dir., Plans and Prgms., Hq. AMC, Scott AFB, Ill., to Dir., Ops. and Log., J-3/J-4, Hq. USSTRATCOM, Offutt AFB, Neb. . . . **B/G Robert E. Gatliff,** from Cmdr., 12th FTW, AETC, Randolph AFB, Tex., to Dep. Dir., Ops., NMCC, J-3, Joint Staff, Washington, D. C., replacing B/G Thomas A. Twomey . . . **Col. (B/G selectee) Bryan G. Hawley,** from Cmdr., AFLSA, Bolling AFB, D. C., to Staff Judge Advocate, Hq. ACC, Langley AFB, Va., replacing Col. William B. Elliott, Jr. . . . **Maj. Gen. Philip G. Killey,** from Dir., Nat'l Guard Bur., Hq. USAF, Washington, D. C., to Cmdr., 1st AF, ACC, Tyndall AFB, Fla., replacing retired M/G Lester P. Brown, Jr. . . . **Col. (B/G selectee) Timothy P. Malishenko,** from Dep. Dir., Contracting, Hq. AFMC, Wright-Patterson AFB, Ohio, to Dir., Contracting, Hc. AFMC, Wright-Patterson AFB, Ohio, replacing retiring M/G John D. Slinkard . . . **Col. (B/G selectee) Andrew J. Pelak, Jr.,** from Chm., Office of GOM, Hq. USAF, Washington, D. C., to Dir., Mil. Personnel Policy, DCS/Personnel, Hq. USAF, Washington, D. C., replacing M/G William B. Davitte . . . **B/G Charles H. Perez,** from Vice Cmdr., Ogden ALC, AFMC, Hill AFB, Utah, to Cmdr., 377th ABW, AFMC, Kirtland AFB, N. M., replacing B/G James L. Higham. ▪

Larger Glass Cockpit Displays Examined

Scientists are studying a glass cockpit concept with 200 square inches of viewing area, which nearly doubles the viewing area in the front seat of an F-15E, according to officials at Wright Laboratory, Wright-Patterson AFB, Ohio.

The program, the Panoramic Cockpit Control and Display System, is managed by the Cockpit Integration Division of the Flight Dynamics Directorate. The simulator and cockpit display, developed by McDonnell Douglas, enable future fighter pilots to tailor the cockpit configuration to meet mission needs, manage the mission more effectively, and increase situational awareness.

Information is presented on one large screen, eliminating the need for a variety of panels, gauges, and dials. The system presents images of a complete instrument panel on the screen, including switches and knobs. The system responds to voice commands from the pilot to operate functions on the panel. The cockpit can also be reconfigured in flight to suit the combat situation. It will incorporate touch-sensitive screens, the ability to move the cursor on the screen by using a head-mounted tracker, and a head-mounted display.

Such a cockpit could find its way onto a new-development fighter after 2000, according to the Air Force.

AIA Forecasts Further Decline

The Aerospace Industries Association predicted that military aircraft sales in 1994 would drop by one percent, to $32 billion, while space-related sales would rise nearly $700 million, to $29.9 billion. When the space figures are adjusted for inflation, real sales should fall by $141 million.

AIA's year-end forecast predicted that overall industry sales in 1994

USAF photo by Sgt. Eric A. Fike

The name may change, but the mission remains the same. As part of the Air Force's heritage program, the 20th Fighter Wing has replaced the 363d FW as the host wing at Shaw AFB, S. C. Here, SSgt. Chip Dallaine applies new wing crests to Shaw's flagship F-16.

would decrease by $8 billion to $116 billion. Missile sales are expected to decline by seventeen percent.

Overall employment is projected to dip by five percent to 860,000, with most business sectors seeing equal decline. Lower production levels will, as expected, hit production workers the hardest. AIA expects that the work force will decline by six percent to 269,000. The number of scientists and engineers employed in the industry will likely fall 4.6 percent to 146,000.

363d FW Becomes 20th FW

The 20th Fighter Wing replaced the 363d FW as the host wing at Shaw AFB, S. C., the Air Force said in January.

The 20th FW designation was transferred from RAF Upper Heyford, England. The change is a part of the Air Force heritage program, which aims to preserve units with strong historical backgrounds.

The 363d's flag was furled after a tour at Shaw of more than forty years. The redesignation does not change the mission for Shaw's F-16 and A-10 aircraft. "We will be doing the same jobs we did before," Col. David J. Morrow, 20th FW vice commander, said. "Only the names have changed, and change is something to which we are all getting accustomed."

News Notes

■ The Air Force announced in January drastic price reductions resulting from the eighth annual competitive acquisition for the production and support of the Advanced Medium-Range Air-to-Air Missile (AMRAAM). Costs were cut by twenty-three percent to $299,000 per missile in 1994. The reduction allowed the Air Force and Navy to buy 289 more missiles than the original budget estimated. USAF will buy 1,007 missiles and the Navy seventy-five.

■ The Department of Veterans Affairs and DoD will issue, on request, identification badges to World War II veterans who plan to attend US-sponsored events in June commemorating the D-Day invasion of Normandy, France.

■ NASA began full-scale development of the first spacecraft to rendezvous with and orbit an asteroid, NASA said in December. The Near-Earth Asteroid Rendezvous mission is scheduled for launch in February 1996 aboard a Delta II rocket, with estimated arrival at the asteroid Eros in late December 1998. It will orbit the asteroid for a year at altitudes as low as fifteen miles. The mission will offer scientists their first long-term, close-up look at an asteroid.

■ NASA and the Russian State Committee for the Defense Branches of Industry signed a memorandum of understanding in December to cooperate in eight areas of fundamental aeronautic science: transition and turbulence, composite structures and materials, chemical kinetic reaction mechanisms and computational modeling, thermal protection system materials, environmental concerns in

aviation, hypersonic technologies, experimental test facilities, and advanced aerospace materials.

■ Aerospace sales to the Department of Defense fell by seven percent in 1993 to $48 billion, the Aerospace Industries Association said in December. There was also a twenty-five percent decrease in missile sector sales and a four percent decline in military aircraft sector sales.

■ The multinational fleet of F-16 fighters passed the milestone of five million flight hours at the end of 1993, Lockheed said. USAF has accumulated 3.8 million flight hours. More than 3,300 F-16s have been delivered worldwide.

■ The Air Force exercised its fifth option of the T-1A Jayhawk contract, for thirty-five aircraft to be delivered from July 1995 through June 1996. The current contract is worth about $133 million to Beech, which builds the aircraft. The total program to date is worth $628 million for 148 aircraft.

■ NASA's remotely piloted research aircraft *Perseus* made its first flight in December to mark the start of its test program. *Perseus* is the first remotely piloted aircraft especially designed to collect data from the upper atmosphere. The first flight lasted fifty-six minutes, verifying the aircraft's basic characteristics.

Purchases

The Air Force awarded Northrop Corp. a $4.4 billion face-value increase to a fixed-price incentive firm contract for the final five B-2 aircraft. Expected completion: January 1998.

McDonnell Douglas Vice President for Supplier Management and Procurement Bill Stowers (left) presents the preferred supplier award to Vought President and CEO Gordon Williams. Vought was the first C-17 supplier so honored.

The Air Force awarded Lockheed Corp. a $12.4 million face-value increase to a cost plus award fee contract for the F-22 AMRAAM Integration Program. Expected completion: July 2001.

The Air Force awarded Rockwell International an $8.7 million cost plus fixed-fee contract for B-1B Conventional Mission Upgrade Program, Phase I–Conventional Bomb Unit Integration, Engineering and Manufacturing Development. Expected completion: September 1995.

Obituary

Nikolai V. Ogarkov, a retired marshal of the Soviet Union, died in late January after a long illness, said *Krasnaya Zvezda,* the newspaper of the Russian armed forces. He was seventy-six. His obituary was signed by Gen. Pavel S. Grachev, the Defense Minister, and Victor G. Kulikov, the last surviving full marshal of the USSR.

Marshal Ogarkov was most widely known for his public defense of the Soviet armed forces after Soviet Air Defense Forces fighters shot down Korean Air Lines Flight 007, killing all 269 passengers aboard. At a news conference in September 1983, he said that the doomed airliner strayed from its route on a deliberate spy mission.

Marshal Ogarkov had a somewhat different image in Western defense circles, where he was viewed as a shrewd and insightful analyst of military trends. He was one of the first Soviet thinkers to note the revolution in military affairs caused by Western high-technology systems, comparing their destructive potential to that of small nuclear weapons.

He was chief of the General Staff of Soviet armed forces and First Deputy Defense Minister for seven years. He was removed from power in 1984 but surfaced not long afterward in charge of Soviet forces in Europe. Marshal Ogarkov bitterly denounced Boris Yeltsin when the latter attacked the Communist party in 1990. ■

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Superficially, things have seldom looked better. Leading indicators, however, point to trouble on the way.

Behind the High Readiness Rates

By Peter Grier

Photo © Michael Longe

USAF officials worry that the pace of current operations may soon affect the readiness of older airframes, like the AC-130H above, and newer, like the F-15E opposite, in the exercise Bright Star '94.

IN THIS time of squeezed funding for operations and maintenance, the overall materiel readiness of Air Force fighter, bomber, airlift, and support wings remains at historically high levels.

Consider the broad measure of the mission capable rate—the percentage of Air Force aircraft that can carry out at least one of their primary missions. Back in the early 1980s, before President Reagan pumped up Pentagon spending, the mission capable rate of Air Force aircraft hovered around sixty-five percent. An infusion of money for spares and modern aircraft pushed the figure up around eighty-five percent, and it has stayed between the eightieth and ninetieth percentile ever since.

For Fiscal Year 1993, the worldwide mission capable rate for all types of Air Force aircraft was 86.4 percent, according to figures compiled by the service for AIR FORCE Magazine. This means that, despite budget pressures, the situation has improved since 1992, when the rate was 85.9 percent.

However, Air Force officials worry that this broad measure may not tell the whole story. They see hints of a deterioration in readiness in "leading indicators," such as statistics for aircraft cannibalization. These factors feed into overall mission capability. Since the purchase of spares has a three- or four-year lead time, the service's leaders worry that the Air Force may be at the beginning of a period of depleted parts bins.

The future is not necessarily bleak. Improvements in efficiency stemming from such innovations as two-level maintenance and better spares

USAF photo by SSgt. Mark Bucher

handling and transportation may enable the service to keep readiness high, logistics officials claim.

Good Ideas

Says Lt. Gen. John M. Nowak, the Air Force's deputy chief of staff for Logistics, "While there are a lot of difficulties—declining budgets, shrinking force structure, that sort of thing—one of the good things that rolls out of this in the long run is [that] it's causing us to really look hard at how we do our business, and we're generating really good ideas."

At Nellis AFB, Nev., for instance, one maintainer devised a tool to help crews remove the rivets from F-15E canopies. The tool cut average time for canopy removal from twelve days to about two hours and promises an estimated total savings of $4 million annually on F-15E repairs.

Elsewhere, an F-16 maintainer suggested using worn-out nose-wheel tires on ground-equipment carts, helping to keep the latter in good working order. He came up with this change because he felt secure that commanders had given him the authority to improve his job on his own.

Gen. John Michael Loh, commander of Air Combat Command, recounts how, at one bomber base, a maintainer found a way to fix a supposedly "unfixable" $5,200 part on the B-1 bomber for only about $50. At another base, an NCO found a $200 fix for a part on the F-111 that a depot used to fix for $49,000. These innovations have helped USAF stay ready at lower cost.

Of course, the Air Force is not alone in worrying about the overall readiness of its forces to pack up and go to combat. All US military services are closely watching their operations and maintenance statistics as they try to prevent a return of the "hollow forces" of the late 1970s. This has become such an important issue to senior Pentagon officials that former Secretary of Defense Les Aspin created an outside panel headed by former Army Chief of Staff Gen. Edward C. Meyer to monitor the state of US combat readiness.

Pentagon officials worry that their force-structure plans, set forth in the Pentagon's Bottom-Up Review of US defense, call for about $13 billion more during the next five years than current White House budgeting would allow. As a proportion of the total budget, this much-publicized gap is not really that large, claimed Mr. Aspin. But the usual nip-and-tuck way of meeting such a shortfall could have an adverse effect on readiness, in both materiel and personnel.

"You can't nickel and dime it too much without raising the question of supporting the force structure that is there," Mr. Aspin asserted early this year.

When it comes to readiness, the Air Force is probably no better or worse than the Navy or the Army, according to service officials. Yet the overall Air Force budget has shrunk slightly faster than total Pentagon spending. Since the 1985 peak, Air Force funds have fallen about forty percent in real terms, compared to a thirty-four percent drop in total Pentagon spending.

Meanwhile, Air Force flying units are busier than they were during the Cold War, enforcing no-fly zones in far corners of the world and supporting humanitarian operations in Africa and eastern Europe. Air Force officials worry that, if this pace keeps up, it could soon have a significant impact on all aspects of readiness.

Fleet Maintenance Man-Hours Per Flight Hour

	Third Quarter Calendar 1992	Third Quarter Calendar 1993
B-1	48.57	20.70
B-52	31.73	32.67
C-5	25.95	27.27
C-141	15.92	10.08
F-4	17.91	13.24
F-15	20.64	12.81
F-15E	20.41	20.85
F-16	13.74	11.53
F-111	25.67	27.99
KC-10	7.5	8.0
KC-135	8.35	8.0

Fleet Mission Capable Rate

	Fiscal 1992	Fiscal 1993
Worldwide	85.9	86.4
B-1	64.0	60.7
B-52	84.3	88.0
C-5	67.0	65.1
C-141	78.2	82.7
F-4	95.3	94.8
F-15	78.3	81.5
F-15E	85.6	79.6
F-16	80.5	81.8
F-111	75.5	82.6
F-117	86.0	65.4
KC-10	91.3	92.0
KC-135	87.5	88.8

Best and Worst

So far, the top-level signs remain good. With more than eight out of every ten front-line aircraft ready to go on a given day, mission capability is a service strong point. The mission capable rate varies widely by type of aircraft, however. The few F-4s remaining in the fighter inventory have the highest availability, with a 1993 rate of 94.8 percent, according to figures supplied by the Air Force. The B-1 bomber has the lowest mission capable figure—60.7 percent in 1993, down from sixty-four in 1992.

The mission capable rate of most front-line tactical fighters hovers around eighty percent. The exception is the F-117. The Stealth fighter features expensive, delicate parts; its mission capability in Fiscal 1993 was only 65.4 percent, down from eighty-six percent the year before.

Likewise, the C-5 transport, long a difficult aircraft to maintain, had a mission capable rate of 65.1 percent in 1993. The C-141, by contrast, boasted a figure of 82.7.

Another readiness indicator that continues to look good is aircraft break rate, which measures the percentage of aircraft that return from a sortie with system problems. In recent years, a steady stream of modifications aimed specifically at improving aircraft reliability and maintainability has caused break rates to decline gradually. Miniaturization of avionics has especially helped in this area.

In the early 1990s, for example, the F-16 break rate was more than ten percent. By Fiscal 1993, that figure had dropped to 8.45 percent, according to the Air Force. "Our R&M improvements are continuing to build a big payoff," claims an Air Force compilation of statistics.

The retirement of older aircraft has helped improve break rates. Planes built in the 1960s tend to have many more system problems than newer F-16s and F-15s. The break rate of the F-111, for instance, has been rising somewhat in recent years as the system ages. Realignment of the F-111 force from overseas to Cannon AFB, N. M., has not helped in this regard. By the fourth quarter of Fiscal 1993, the F-111 break rate reached 36.2 percent.

Break rate is not the only readiness statistic materially affected by R&M moves. Maintenance Man-Hours per Flight Hour (MMH/FH) have also steadily dropped in recent years as airframe changes allow easier access to subsystems and parts become more reliable.

Back in 1990, F-16s required, on average, some thirty-three hours of maintenance for each hour in the air. That rate has steadily declined, reaching a low of about 11.5 MMH/FH in the third quarter of 1993.

The F-111's MMH/FH, by contrast, has risen somewhat, climbing from 27.1 in 1990 to 27.99 in 1993. According to the Air Force, this change reflects not an increase in daily maintenance but work associated with such major aircraft modifications as Pacer Strike, which is outfitting the plane with a ring-laser gyro and a Global Positioning System receiver.

The most labor-intensive aircraft in the USAF inventory remains the venerable B-52, which required 32.67 man-hours of work for each flying hour in the third quarter of 1993.

Grass-Roots Shortages

The measures above may mask some developing problems. Air Force officials worry that they are already seeing grass-roots shortages that in future months or years may surface in declining mission readiness.

General Nowak divides the figures he studies into "leading and lagging indicators." The lagging measures, such as the mission capable rate, tend to reflect whether the Air Force is ready to fight today. "Those are pretty good," says General Nowak.

Leading indicators, on the other hand, largely reflect what is happening in the parts supply business in depots and on the flight line. Much is happening at that level, he says, and not all of it is good.

Some cannibalization rates have been on the increase, for instance. The F-15 fighter force showed a slowly rising cannibalization rate throughout the first half of the year, followed by a slight decline in the third quarter and a quick jump upward in the last quarter. *[See chart on p. 23.]* This may mean that parts bins for the plane emptied before the new fiscal year brought an infusion of new funds.

Stripping parts from grounded aircraft to keep its stablemates flying is an expensive and manpower-intensive way to carry out maintenance. Instead of simply retrieving a part from supply, crews must first spend time removing it from an airframe. At some point, they also have to put it back.

"There is some deterioration," General Nowak says of cannibalizations. "We are concerned and will watch that in the future." Deterioration is also showing up in a small increase of aircraft rated Not Mission Capable–Supply, says the General.

Behind these troubling signs are budget restrictions, in the view of Air Force officials. Depots have not

been able to buy all the replacement parts needed to meet projected requirements.

Budget cuts do not translate into immediate parts shortages. For one thing, the lead time associated with parts purchases cushions the blow. For another, broken line replaceable units (LRUs) are repaired nine times for every time they must be replaced. This means it takes a while to use up an existing spares backlog.

More than eight out of ten front-line combat aircraft are mission capable on any given day—sometimes because of a little crew ingenuity, such as using an ID card as an ice scraper during Team Spirit '93 (above).

Vanishing Stockpiles

The stockpiles amassed during the Reagan buildup have run out while operations and maintenance funding continues to go down. According to General Nowak, funding for the depot maintenance program for Fiscal 1994 represents only seventy-six percent of the Air Force requirement. Spares program funding is at only thirty-eight percent of the 1994 requirement.

"The downslide in funding and its early impacts in supply availability are important trend indicators," says the General.

The downsizing of the force has helped keep top-level readiness up in the face of the budget shortfall. In recent years, Air Force wings have used some excess aircraft as a parts boneyard, stripping them to obtain spares valued in the hundreds of millions of dollars.

The shrinkage also obviously means that there are fewer aircraft for the strained operations and maintenance budget to support. From 1987 through 1993, the Air Force's primary aircraft authorized declined by twenty-six percent—though the materiel purchased to support them shrank by fifty-two percent during the same period.

On the other hand, continued force shrinkage makes it hard to use supply funds in the most efficient manner. Decisions on what kinds of parts to buy, what kinds of maintenance facilities to build, and so forth must be made years in advance. Yet the force plans on which those decisions are based can disappear with a stroke of the budgeteers' pen.

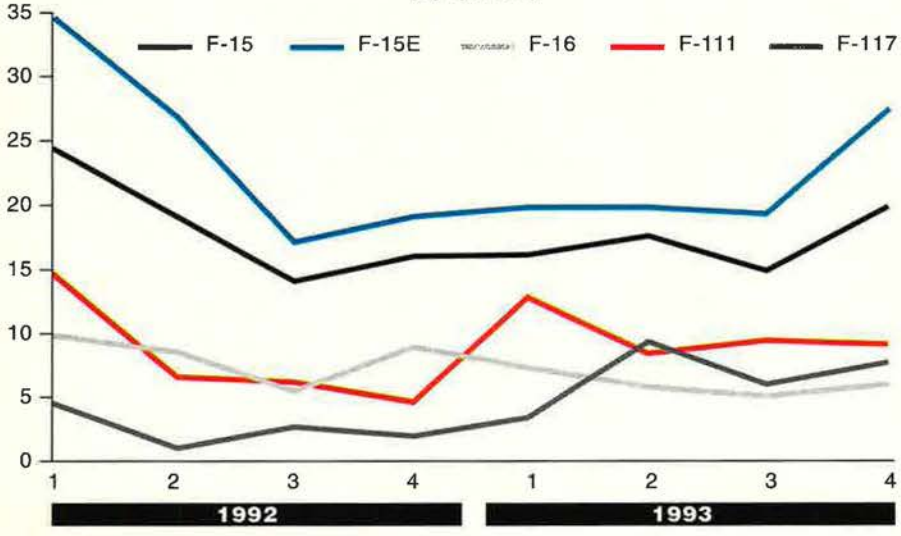
"It seems," says General Nowak, "like each time we get a fix on the target and begin execution, we have another major budget constraint and change the target."

Air Force officials know that budgets will continue to be tight for the foreseeable future. They are counting on a wide range of logistics initiatives to help stretch maintenance dollars and keep top-level indicators of readiness high.

These initiatives will help reshape a logistics system that in many ways remains better suited to the 1940s. Back then, parts and manpower were relatively inexpensive, while transportation was quite expensive and slow. Today the reverse is true: Transportation is quick and relatively cheap while personnel and parts are much costlier.

"What we're doing is looking at the reality of that changing relationship and trying to use more transportation by consolidating repair and minimizing people and parts," says General Nowak.

Cannibalization Rates for USAF Fighter Aircraft
(By quarter)



Fewer Handlers

One of the major efforts in this area is Repair and Return Packaging (R^2P). The concept behind R^2P is simple: If the number of people who must handle a part during shipping can be reduced, then the part's velocity through the logistics pipeline will undoubtedly increase.

Usually, broken parts are removed on the flight line, sent to a transportation facility on base, packed, and

Staff photo by Guy Aceto

Under two-level maintenance, an MH-53 Pave Low helicopter is serviced on the flight line or at a central, specialized depot. Two-level maintenance and better spares handling and transportation should keep readiness levels up.

sent to a depot. At the depot, the receiving department checks in the part, unboxes it, and distributes it to the proper shop for work.

By contrast, parts selected for R²P treatment are sent directly from the flight line to a repair facility in a preformed container with preaddressed labels. Supply personnel never handle the part, though they do receive paperwork to keep track of it

R²P also makes use of such commercial high-speed transportation services as Federal Express and UPS. Their trucks drive right down to the flight line to pick up and drop off R²P packages.

This approach sounds simple, and a three-month test last year showed it might have a big payoff if widely applied. Under R²P, turnaround time for selected F-16 avionics LRUs was cut from fifty-four to 5.7 days.

Currently, R²P cannot handle classified items, though the Air Force is now working with the Defense Logistics Agency to study the feasibility of classified overnight freight express carriers. It will never be able to handle all parts. Items that require a forklift, such as engines, cannot be handled by commercial shippers and need special packaging.

"There are things you can do even with an engine, such as alerting the system that you're about to move one on a trailer so that the transporters are ready with a tow vehicle," says General Nowak. "We really have learned a lot about pipeline management."

Though R²P has promise, the push into two-level maintenance has been perhaps the major logistics overhaul effort. Even in its early stages, the two-level approach promises several hundred million dollars a year in savings on manpower and support expenses, by Air Force estimates.

The traditional Air Force maintenance structure has three levels: organizational, intermediate, and depot. The bottom rung is the organizational level, where immediate repair takes place on the flight line. Intermediate work is also carried out on base but at back shops where parts are taken for somewhat more involved repair. Depot-level work is carried out at a few central specialty repair bases around the country.

Under two-level maintenance, the intermediate level, with its costly back-shop infrastructure, is eliminated. Anything that cannot be fixed on the flight line is shipped off to the depot.

On October 1, 1993, USAF began officially implementing two-level maintenance for selected avionics equipment and engines. According to Air Force plans, eighty-five units will move to the system in 1994. The F-16, B-1, C-130, and F-111 will be affected.

Two-level promises huge improvements in avionics turnaround. Under the Coronet Deuce test program, the base-depot-base cycle for broken F-16 avionics was cut from an average fifty-four days to nine.

Engines are a more difficult challenge. Nevertheless, tests show that two-level maintenance can at least cut base processing times for engine repair from seven days to fewer than four days.

Not all repairs lend themselves to the two-level maintenance approach. If an avionics item, say, has a typical lifetime of only a few hours, it will still be repaired on base rather than go all the way back to the depot. Some back shops, such as sheet metal repair, will probably never be eliminated. "Let's say you had to fix a C-5 flap. That's a huge item. You don't want to be shipping that just because it has a crack in it," says General Nowak.

More can still be done to speed the repair pipeline process. The Air Force would like better in-transit part tracking information systems, for instance. Currently, service logisticians have nothing like the sophisticated data scanning and tracking computers used by commercial overnight shippers.

Logisticians could make do with fewer parts if they had a better idea where everything was at a given time. In the Air Force, as in the commercial world, control of inventory may be the key to survival in the tight-funded 1990s.

"The more we can do to minimize our requirement for inventory, the more we can get out of the budget dollars that are available to us," says General Nowak.

Meanwhile, the Air Force depot structure is likely to get smaller in the future as contractors clamor for a piece of the repair work pie. Air Force logisticians face continued overhaul of their training process in the wake of 1993 Year of Training initiatives.

Concludes General Nowak, "We've got to figure out how we help our Air Force have fewer people and require fewer resources." ■

Peter Grier is the Washington, D. C., defense correspondent for the Christian Science Monitor *and a regular contributor to* Air Force *Magazine. His most recent article, "Deployment," appeared in the November 1993 issue.*

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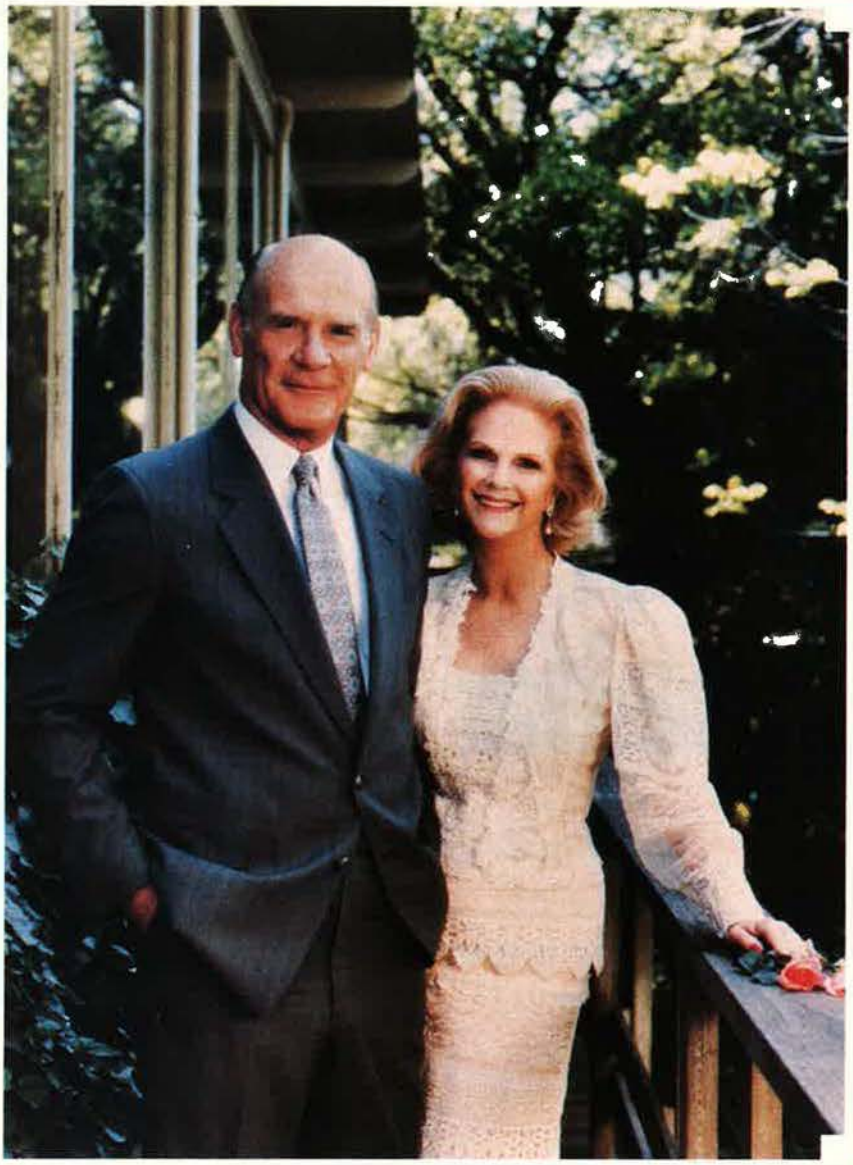

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By design, STRATCOM isn't SAC. The differences go deep.

The New Order in Omaha

By James W. Canan, Senior Editor

ALL THROUGH the Cold War, Strategic Air Command symbolized US strategic deterrence in the eyes of the world and shouldered most of the responsibility for it. Now the Cold War is over, strategic deterrence is much less urgent, and SAC is gone, supplanted by the new, unified US Strategic Command.

STRATCOM inherited SAC's mission and more—but not its heavyweight physical presence. As dyed-in-the-wool Air Force traditionalists might say, "We knew SAC, and STRATCOM is no SAC." But then, it isn't supposed to be.

STRATCOM cannot compare with SAC in size, scope, and everyday operational authority over nuclear weapons and forces. Nor is its mission the essence of national military strategy, as in SAC's heyday. Even so, STRATCOM's champions warn against selling it short. They note that the unified command was created expressly *not* to mirror SAC and that its mission will remain vital so long as there is the slightest chance of an attack on the US with weapons of mass destruction.

In that regard, STRATCOM officials also emphasize these points:

- The number of nuclear nations is on the rise. Nuclear weapons will be stockpiled in the tens of thousands around the globe for many years to come. Warhead delivery systems will spread.
- Four nations of the former Soviet Union, notably Russia, possess some 30,000 nuclear warheads among them, and there is ample cause for concern about the command and control of those weapons in these tumultuous times.
- Nuclear deterrence has broader and subtler significance in the national military strategy now pegged to coping with regional crises. The US relies on its nuclear strength to give would-be aggressors second thoughts, and now nukes are not the only major menaces.
- Chemical and biological weapons, also considered weapons of mass destruction, are on the rise around the globe. STRATCOM's charter extends to deterring or retaliating against their employment, too.

Counterproliferation

STRATCOM is a key player in US "counterproliferation" strategy for keeping weapons of mass destruction out of the hands of so-called "undeterrable" rogue nations, such as North Korea, or for countering their use of such weapons. The strategy is grounded in diplomacy but makes provision for military action should diplomacy fail, STRATCOM officials point out.

A STRATCOM paper notes that the command "possesses 'one-of-a-kind' intelligence, planning, and operational assets to address the threat posed by weapons of mass destruction" and, thus, is "well-postured to support the Department of Defense counterproliferation objectives." STRATCOM counterproliferation plans and actions

"would be coordinated fully with the appropriate regional CINC."

The Defense Department created STRATCOM as a unified command to consolidate and coordinate Air Force and Navy strategic forces far more fully than had been possible. In STRATCOM, for the first time, the planning, targeting, and wartime employment of those forces come under the control of a single commander.

When STRATCOM opened for business at Offutt AFB, Neb., on June 1, 1992, the US Joint Strategic Target Planning Staff, longtime steward of the Single Integrated Operational Plan (SIOP) for nuclear war, became superfluous and went out of existence.

The JSTPS had worked side by side with SAC at Offutt but was never part of SAC. CINCSAC was director of JSTPS, a Navy vice admiral its deputy director.

Once in existence, STRATCOM "greatly strengthened the command and control of strategic deterrent forces, and the number of personnel needed to manage them was significantly reduced," Air Force Gen. George L. Butler, STRATCOM's commander in chief, told a congressional committee late last year.

General Butler was instrumental in the creation of STRATCOM and the phasing out of SAC. He planned the changeover, on assignment from Gen. Colin L. Powell, the Chairman of the Joint Chiefs of Staff, while serving at the Pentagon as the Joint Staff's director of Strategic Plans and Policy. General Butler went from there to Offutt to supervise the transition as the last CINCSAC and then as the first CINCSTRATCOM.

Two years ago, at an AFA symposium, General Butler took note of "a little black humor making the rounds" in the Air Force. "The question," he said, "was, 'Who killed SAC?' The answer was, 'The Butler did it.' "

It was no joke in some Air Force circles, where resentment ran high at the dismantling of SAC in favor of a unified command. SAC diehards did not like the idea of the Air Force losing total control of the planning, acquisition, and operation of its nuclear forces and of putting those forces under "purple-suit" command, with Navy admirals and Air Force generals alternating as CINCSTRATCOM.

Navy partisans felt the same way, in reverse. They resisted the idea of STRATCOM taking wartime control of the Navy ballistic missile submarines (SSBNs) of the Atlantic and Pacific fleets.

The changeover to STRATCOM still rankles many in both services, it seems. Questions persist about STRATCOM's role and its influence in the military command hierarchy. What exactly is STRATCOM, and what does it do? What does it own and operate?

What exactly is STRATCOM, and what does it do? In SAC's day, such questions never came up.

In SAC's day, such questions never came up. SAC, both a JCS specified command and an Air Force major command, had operational hegemony over all Air Force strategic nuclear forces—bombers and intercontinental ballistic missiles (ICBMs)—and their supporting casts at all times and under all circumstances, and no doubt about it. SAC kept bombers, reconnaissance planes, and tankers in the air and on standby alert around the clock in single-purpose support of the SIOP, to which everything else was secondary.

SAC had shrunk but was still plenty substantial. At the end of its days, SAC operated more than a score of air and missile bases and employed more than 100,000 men and women, nearly 6,000 of them at Offutt. It had a $2 billion operations and maintenance budget.

STRATCOM, by contrast, has a skeletal look, with only about 2,500 personnel, nearly all at Offutt, and an O&M budget of less than $100 million a year. STRATCOM does not operate bombers and reconnaissance planes on a daily basis and does not acquire them, train their crews and supporting personnel, or own their bases—not even Offutt, its home base, which is run by USAF's Air Combat Command (ACC).

STRATCOM is no illusion or paper tiger, however. It embodies a sizable command, control, communications, and computers (C^4) establishment at Offutt that would enable CINCSTRATCOM to exert enormous warfighting power in a nuclear emergency. At the President's direction, CINCSTRATCOM would take control of all US nuclear forces—Air Force bombers and ICBMs and Navy SSBNs—and orchestrate their operations.

On an everyday, nonemergency basis, all forces except ICBMs and SSBNs belong to other commands. Bombers and reconnaissance aircraft are the property of the recently remodeled and expanded US Atlantic Command (USACOM, or ACOM) and are operated by ACC, ACOM's air component. Tankers belong to US Transportation Command and are operated by Air Mobility Command (AMC), TRANSCOM's air component, which provides some tankers at any given time to support the daily operations of STRATCOM-owned command-and-control aircraft.

Farewell to the Alert

For bombers and tankers, the nuclear mission is no longer paramount. Most bombers in the shrinking Air Force bomber fleet are now designated "dual-purpose." Some are nuclear-capable, but all are geared to, and equipped for, regional, nonnuclear warfare. Not one bomber stands SIOP alert.

STRATCOM has a more intimate operational connection with ICBMs than with bombers. USAF's 20th Air Force, which operates the ICBMs and trains their crews, is part of Air Force Space Command (AFSPACECOM)—a designated component of both STRATCOM and the unified US Space Command (USSPACECOM).

ACC formerly enfolded 20th Air Force and its ICBM units. They were transferred to AFSPACECOM for operations and training on July 1, 1993.

A year earlier, STRATCOM stood up as the nation's ninth unified command. The others, preceding STRATCOM in chronological order, are five regionally oriented commands—US European Command, US Pacific Command, US Atlantic Command (LANTCOM), US Southern Command, and US Central Command—

and three globally oriented commands—USSPACECOM, US Special Operations Command, and USTRANSCOM.

Under the current US Unified Command Plan, the old specified commands, such as SAC, are no more. Unified, combined-arms commands are the only ones said to "own" forces and to have "combatant command" authority over them.

CINCs of unified commands report to the national command authorities (NCA) via the Chairman of the Joint Chiefs of Staff. Service chiefs are out of the loop.

The Unified Command Plan is an outgrowth of the Goldwater-Nichols Defense Reorganization Act of 1986, which put a premium on joint operations and gave the CINCs and the JCS Chairman more influence over forces, requirements, and operations. Military departments and service chiefs are responsible only for organizing, training, and equipping forces and for providing them to the CINCs of combatant commands.

The remaking of LANTCOM into ACOM last October 1 introduced a variation on this model. ACOM, which comprises nearly all CONUS-based forces of the four services, including the Navy's Atlantic Fleet, now does for other unified commands what the military services also do—train, equip, and provide forces—but with a difference. ACOM organizes and trains forces as "adaptive joint-force packages" and makes them available as such, and as needed, to other regional commands and to global commands, including STRATCOM.

Brig. Gen. Orin L. Godsey, a former SAC officer, who as STRATCOM's deputy director of Operations and Logistics is the command's director of Command and Control, noted that STRATCOM in peacetime is "organized around service components—the Air Force's Air Combat Command and Space Command and the Navy's Atlantic Fleet and Pacific Fleet" but that this would change in wartime.

Task Forces for the War

STRATCOM "would fight a war using task force commanders, not service component commanders," General Godsey explained. "We would deal directly with a bomber task force commander, a tanker task force commander, and [land and sea] missile task force commanders."

STRATCOM would draw its bomber task force from ACOM/ACC's 8th Air Force, its tanker task force from TRANSCOM/AMC's 15th Air Force, its ICBM task force from USSPACECOM/AFSPACECOM's 20th Air Force, and its submarine task forces from Atlantic Command's Atlantic Fleet and Pacific Command's Pacific Fleet.

General Godsey said that, during the remodeling of LANTCOM into ACOM, Strategic Command "agreed that all dual-purpose forces—bombers and reconnaissance airplanes—should come under ACOM, so that ACOM could do the joint training that's required for all possible types of war scenarios [and could] integrate bomber, reconnaissance, and fighter forces [for employment] across the entire [nuclear and nonnuclear] spectrum of warfare."

In nuclear crisis or war, the NCA would give CINCSTRATCOM control of the required bombers and reconnaissance aircraft owned by ACOM.

STRATCOM shares with no other unified command its "combatant command" authority over single-purpose nuclear forces: the Peacekeeper and Minuteman III ICBMs, Poseidon and Trident SSBNs, and command-and-control aircraft—Navy E-6 TACAMO (Take Charge and Move Out) planes in touch with SSBNs, Air Force E-4B National Emergency Airborne Command Post planes for the NCA, and Air Force EC-135 "Looking Glass" planes equipped as STRATCOM airborne headquarters.

Aerial refueling tankers are another story. "We have an agreement with TRANSCOM and AMC that they would give us the tankers we need to support the SIOP in a shooting match," General Godsey said. "If there were other demands on those tankers, the JCS would be the arbitrator, deciding which command would do what with them."

AMC currently operates more than 580 tankers for TRANSCOM. "We would require only about half of that number to fully support the SIOP," General Godsey said.

Bombers and tankers were still on SIOP alert when General Butler arrived to take command of SAC in January 1991, during the Persian Gulf War. He said later that he had, at the time, "questions in my mind about how long [SAC] should endure as an Air Force major command." Why? Because "the signing of the Conventional Forces in Europe agreement in Paris had signaled the end of the Cold War" and because SAC, while still a force to be reckoned with, had become "a shrunken, truncated version of its former self."

General Butler noted that SAC was dwindling to levels of "less than 85,000 people, no more than sixteen bases, 200 bombers max, and none on alert," compared to "240,000 people and growing, about sixty-eight bases, and over 3,000 aircraft" in 1961, the year that he joined the Air Force. He saw no point in "clinging to the past."

The First Try

In a sense, the past was prologue in the creation of STRATCOM. Air Force leaders proposed in 1959 to consolidate Air Force and Navy nuclear forces under a unified command, with CINCSAC at its head. The Navy balked, refusing to relinquish or share command of its new Polaris-missile submarines. So DoD opted for a compromise. In 1960, it established the JSTPS subordinate to the JCS, not to the services, and, against the Navy's wishes, made CINCSAC its director.

The Air Force and Navy components of the JSTPS worked harmoniously through most of the Cold War in coordinating the target plans of the two services. No big interservice problems cropped up. Strategic budgets were ample, the services were satisfied with their shares of the triad of nuclear weapons and with one another's strategic modernization plans, and there were more than enough strategic targets to go around.

The situation began to change as the Cold War wound down. Strategic budgets withered, and arms control bloomed. For the first time, strategic weapons outnumbered targets, and their growth was constrained by treaties. Some weapons were clearly superfluous and would have to go. The times called for major decisions about Air Force and Navy strategic forces.

The JSTPS was in the middle of all this but powerless to participate in decisions. The destiny of strategic forces was not for the JSTPS or

the services to decide. Goldwater-Nichols had given the JCS Chairman and the CINCs more influence than it gave the services with regard to military forces and requirements.

The JSTPS, explained General Godsey, "had always based its target planning on the weapons that the services made available" and "without any real coordination [with them] on an overall nuclear war plan. There had never been an entity for putting all the pieces together, not only operational planning and targeting, but also weapons budgeting, programming, and requirements and force-structure responsibilities. There was no single, unified voice on the kinds and levels of [strategic] weaponry and forces [the US] should have."

STRATCOM officials cite a glaring example in 1991 of the right hand not knowing what the left hand was doing. The Air Force and the Navy decided to speed up the retirement of B-52 bombers and Poseidon submarines without informing the JSTPS. Fortunately, and only by coincidence, the JSTPS also reduced the number of its targets, thus avoiding an awkward and potentially dangerous set of circumstances, STRATCOM officials recall.

General Butler told the AFA symposium audience, "We are finally going to bring to fruition an idea that was impossible to initiate when first raised in the 1940s: standing up a unified command whose commander in chief would have operational authority over all the nation's strategic nuclear offensive forces, whether Air Force or Navy.

"We were in an anomalous position, where [CINCSAC] targeted all the forces but did not have operational control [of all]," a circumstance contrary to the operations and interests of today's "composite-force, unified-action armed forces," he said.

Everything Shrinks

Big changes in the disposition of strategic forces began in September 1991, when the White House ordered SAC to take its bombers off nuclear alert. Now the US has begun dismantling Minuteman II ICBM launchers and retiring short-range attack missiles (SRAM-As). Under the Strategic Arms Reduction Talks (START) II Treaty, the US must also retire its fifty Peacekeeper ICBMs, each with ten warheads, and reconfigure each of its 500 Minuteman III ICBMs to carry one nuclear warhead instead of three. STRATCOM is planning how best to make those adjustments by 2003, as required.

Meanwhile, the US has curtailed the production of stealthy B-2 bombers and stealthy Advanced Cruise Missiles and has canceled programs for Peacekeeper rail-garrison ICBMs, SRAM IIs, and two varieties of so-called small ICBMs.

STRATCOM will have a lot to say about the future of the nuclear triad in defense policy circles.

All types of nuclear warheads, notably the latest model for the multiple-warhead D5, or Trident II, submarine-launched ballistic missile, have gone out of production. Nuclear warheads decreased in number from 11,000 at their Cold War peak to about 7,000 by the end of 1993.

Just since the end of the Cold War, the US bomber force has been cut by almost one-third and the landbased ICBM and missile-launching submarine forces by more than half.

Equally striking are reductions over the longer term. By 1997, there will be only fourteen strategic bases, less than one-fourth the number at the time of the 1962 Cuban missile crisis. The number of bombers and supporting aircraft will have been cut by eighty-four percent (down to 449) from its all-time Cold War high; ICBMs by fifty-six percent (down to 550); SSBNs by fifty-nine percent (down to eighteen); and personnel by sixty-five percent (down to 84,560).

All told, the US will have cut the number of nuclear weapons by two-thirds once the START II Treaty is fully implemented. STRATCOM cites this circumstance in noting that strategic force structures, unlike others, are constrained by arms control measures as well as by budgets.

The need to sustain strong strategic forces while continuing to disengage from the Cold War is justification enough for a unified strategic command, STRATCOM exponents claim. They note that STRATCOM, unlike SAC, can speak with one voice in advising policymakers on such historically divisive issues as the optimum size, makeup, and mix of Air Force and Navy strategic forces.

They also contend that sound advice has never been more important because decisions on cutting, reshaping, and paying for strategic forces are ever more likely to be irreversible as money gets tighter.

The future of the triad is the overriding issue, and STRATCOM will have a lot to say about it in defense policy circles. There is concern in Air Force circles that the bomber fleet will be too small to handle all possible conventional and nuclear missions and that landbased ICBMs have had their day.

As to bombers: With the B-52 getting old, the B-1B out of production, and only twenty B-2s authorized, what lies ahead?

The SSBN force, widely regarded as the most survivable leg of the triad, seems pretty well set. STRATCOM gives the Navy's eighteen-boat Trident program high priority, since thirteen of the SSBNs are in operation and the rest are well along in production and basically paid for.

The Atlantic SSBN force consists of three Poseidon submarines, each with sixteen C4 Trident I missiles, and five Trident submarines, each with twenty-four D4/D5 Trident II missiles. The Pacific submarine force comprises eight Trident submarines, each with twenty-four C4 missiles.

Portions of both forces are continuously on patrol, each SSBN assigned to cover an oceanic area of more than one million square miles.

STRATCOM is mulling a proposal, oriented to START II compliance, to cut in half the number of missiles on Trident submarines and to increase the number of warheads on each. STRATCOM is also studying the pros and cons of switching to a one-ocean SSBN force and to one crew per boat instead of two alternating crews. Such moves, unthinkable during the Cold War, are now practical and would cut personnel and save money, proponents claim. ■

It's sink-or-swim time for the Air Force's top-priority airlift program.

The C-17 on Probation

By David J. Lynch

THE AIR FORCE'S new C-17 airlifter has entered an unusual two-year "probationary" period that may represent USAF's last chance to rescue its top-priority program and that could have a major impact on US military strategy.

The probation stems from an intense, seven-month Defense Department investigation, completed late last year, which found a number of serious problems with the program. Once, the Air Force planned to buy 210 new transports. In 1991, the goal was lowered to 120. Now, the upshot of the new Pentagon review is that the Air Force has permission to buy only forty C-17s, with no assurances of any purchases beyond that.

In a deal finalized in the first days of 1994, the government approved procurement of twelve more lifters—six each in Fiscal Years 1995 and 1996—which will join the twenty-eight in the pipeline. The Pentagon said it will reevaluate the C-17 at the conclusion of Fiscal 1995.

At that time, Washington may approve purchases of up to eighty additional planes, but only if McDonnell Douglas Corp. has fixed what DoD considers severe production and management problems. If the Pentagon judges that the company's performance continues to lag, the C-17 program will be in deep—probably terminal—trouble. DoD is prepared to round out its airlift modernization campaign by buying modified Boeing 747-400 freighters or reviving the long-dormant C-5 assembly line. (Rewinging the aging C-141 was ruled out as too expensive.)

"A C-17 fleet is the most cost-effective solution to our requirements, but a combination of C-17s and C-5Bs, or C-17s and commercial wide-body jets, can get the job done," said Defense Secretary Les Aspin. The Pentagon already has begun a study to determine the best approach to such a mixed airlift fleet.

An omnibus settlement laid to rest all outstanding program issues between the federal government and McDonnell Douglas. As for the extraordinary two-year probation, the company said it was confident the US will make additional purchases beyond the forty planes, the first of which was ordered in 1985. However, the findings of a Defense Science Board (DSB) review, which led to the January 1994 agreement, made

A C-17 airlifter flies over California. The Air Force now has permission to buy only forty of these transports. After Fiscal Year 1995, the Pentagon will reevaluate the program.

it clear the company had a long way to go if the program was to survive. "The current C-17 program is not viable without substantial change," charged Under Secretary of Defense for Acquisition and Technology John M. Deutch.

The Air Force has taken delivery of nine C-17s, split between the test program at Edwards AFB, Calif., and the first operational C-17 squadron at Charleston AFB, S. C. McDonnell Douglas is on contract through aircraft "P-20," with long-lead funding on tap through "P-32." The company is scheduled to deliver seven more C-17s in Fiscal Year 1994 and six in FY 1995. Under terms of the settlement, the Pentagon will decide in November 1995 whether it wants to buy more C-17s starting in FY 1997.

The nineteen-page agreement between Mr. Deutch and John McDonnell, the company's chairman and chief executive, dramatically redraws the aircraft's management, contract, and flight-test effort. In exchange for dropping some $1.7 billion in actual or planned claims, McDonnell won $348 million in new federal outlays for the C-17. The firm will invest an additional $456 million.

The Pentagon also agreed—for the second time—to lower its range and payload demands, lengthen the plane's specified landing distance, and relax three dozen less-significant contract specifications. The flight-test program will be extended from its original eighty aircraft-months to 152 aircraft-months, with the Air Force now expecting completion early in calendar 1995.

On the Factory Floor

For McDonnell Douglas, the next two years represent a time to prove that it can deliver planes on time and within budget. Company officials claim major improvements since the schedule was slipped last year. Though the firm delivered each of the first five production planes late, the last four were either on time or within a month of scheduled delivery date. "We're seeing now delivery dates that are being met or not exceeded by more than thirty days," said Col. Gene Kluter, the defense plant representative at McDonnell Douglas's Long Beach, Calif., facility. Air Force officials at Charleston report that the new transports are performing well.

On-time deliveries are a function of what happens on the factory floor. In the first years of this program, McDonnell Douglas's production system was hopelessly inefficient. Inaccurate or outdated engineering drawings led to thousands of man-hours spent doing work out of position on the assembly line. That added costs and delayed deliveries.

In recent months, McDonnell Douglas has made progress, according to Colonel Kluter. The amount of work performed in the correct position on the assembly line ranged from thirty-one percent to ninety-three percent on the first eight production aircraft. On "P-14," the most recent aircraft for which data are available, the figure was ninety-six percent. Assembly span time was reduced by forty-five percent over the first eight planes, with an additional ten percent improvement by P-14.

Even so, say critics, McDonnell Douglas has frequently claimed in the past that the program was improving, or had "turned the corner," only to encounter new problems. To ensure that this time it stays on track, the Deutch accord commits McDonnell Douglas to implementing "major

Photo © Geoffrey Pearce

The 437th Airlift Wing, Charleston AFB, S. C., boasts the first operational C-17 unit, the 17th Airlift Squadron. The four new transports are said to be performing well, and twelve C-17s are scheduled for IOC at Charleston in early 1995.

management and manufacturing process changes." The first step in that direction occurred in early December when the company named a new executive to manage the program.

The DSB panel, headed by Robert Fuhrman, retired president and chief operating officer of Lockheed Corp., and Lt. Gen. James A. Fain, Jr., commander of Air Force Materiel Command's Aeronautical Systems Center, Wright-Patterson AFB, Ohio, noted that there was an "extremely negative management environment between the contractor and the US government, which has created gridlock and has seriously impeded progress." In December, asked about McDonnell Douglas's management switch, Mr. Deutch said simply, "We welcome the change."

McDonnell Douglas's new man is Don Kozlowski, senior vice president for the C-17. He directed the company's F/A-18C/D program and its YF-23 entry in the Advanced Tactical Fighter competition and worked for two years (1976–77) as USAF's director of offensive air support mission analysis. Insiders said that perhaps the most significant change is that the new man reports directly to John McDonnell. Previously, the C-17 reporting chain led from the program manager to Ken Francis, executive vice president in charge of McDonnell Douglas's western operations, and then to corporate headquarters in St. Louis, Mo.

The change is aimed at providing greater visibility into the program for McDonnell Douglas, as well as allowing the Air Force to hold the company's chief executive responsible for progress or the lack thereof.

Mr. Deutch said McDonnell Douglas's performance on the program had been "unusually poor," and the DSB panel highlighted a slew of management and production weaknesses on the part of the nation's number one defense contractor. Mr. Deutch also leveled stiff criticism at USAF management. "Certainly the Air Force should be indicted for its performance on the program in the past," he said. Late in 1993, the service changed program managers, installing Brig. Gen. Ronald T. Kadish.

New Focus Teams

Acting on another DSB recommendation, the Air Force and McDonnell Douglas established a network of nine integrated product teams that will focus on major program elements. Representatives of the company, the C-17 System Program Office (SPO) at Wright-Patterson, and Defense Contract Management Command will man the new teams, aimed at providing greater focus to problem resolution efforts. The Weapon System Integrated Product Team will oversee eight subordinate teams. Other teams, with as many as seventy participants, will focus on the air vehicle, airframe, aviation flight controls, flight test, and training, aircraft, mission, and support systems.

McDonnell Douglas has agreed to modernize its outdated systems for revising engineering drawings and easing electronic data flow to the Air Force. USAF and McDonnell Douglas will split equally the $40 million cost of a new Computer-Aided Design/Computer-Aided Manufacture system and a $30 million management information system. A new $5 million quality system is intended to convert McDonnell Douglas's Long Beach plant to a design-quality-first approach from the current inspect-it-later stance.

McDonnell Douglas's "business systems are struggling to provide the management visibility and control needed to properly support the C-17 program," the DSB concluded. "These systems are in a state of neglect and badly in need of improvements. [McDonnell Douglas] has been reluctant to fund improvements due to the over-ceiling position of the contracts."

The DSB's recommendations go to the heart of problems that have bedeviled the C-17 program almost from its inception more than a decade ago. The new computer-aided manufacturing system, for example, is aimed at eliminating outdated blueprints that result in too much work being done in the wrong position on the assembly line. The new quality system is a reminder of the firm's botched introduction of a Total Quality Management approach in 1989. Program progress in the subsequent twelve months "came to a virtual standstill," the DSB panel said. "This action was accomplished with the full awareness and tolerance of the government."

Mr. Deutch kicked off the exhaustive C-17 review with a series of May 11 memos. For the Air Force, Maj. Gen. Charles E. Franklin, the Program Executive Officer for Tactical Airlift, took the lead. Through weekly video teleconferences, he kept tabs on the progress of teams of specialists from Air Force headquarters, the SPO, and McDonnell Douglas, who were researching a series of key concerns. Among them were range and payload specifications, unnecessary and costly contract specifications, flight-test delays, late aircraft deliveries, a dispute over McDonnell Douglas's accounting of certain sustaining

engineering costs, and the need to definitize the long-overdue Lot IV production contract. As the summer progressed, General Franklin provided written reports every other week to Air Force Secretary Sheila E. Widnall and Mr. Deutch.

Old Scenarios

The Air Force studies recognized a need to adjust the C-17 performance specifications to take account of international political changes. Originally, the plane was to carry 160,000 pounds for a distance of 2,400 nautical miles. At the center of that weight goal was the perceived need to carry an M1 tank to Europe, a requirement that reflected Cold War scenarios of supply flights from Dover AFB, Del., to Lajes Field, Azores, and from Travis AFB, Calif., to Hickam AFB, Hawaii. Air Force officials say only a tiny percentage of real-world missions ever would have fit that profile.

To meet the regional-conflict scenarios that now dominate Pentagon thinking, Air Mobility Command is focused on a 3,200-nautical-mile specification with a threshold payload of 110,000 pounds and an objective of 130,000 pounds, according to Lt. Col. Greg Lockhart, a mobility specialist assigned to the Air Staff in Washington, D. C.

"If they can't meet the threshold, we'll seriously consider [whether to continue to buy] this airplane. We would like to get to the objective," Colonel Lockhart said. The relaxed range/payload requirement allows McDonnell Douglas to proceed with the aircraft's current commercial engine instead of a more expensive military derivative that would cost $250 million to $275 million.

McDonnell Douglas also has agreed to implement "low-risk weight reduction initiatives" to cut the aircraft's empty weight by a token 1,500 pounds and reduce drag by one percent. The C-17's maximum takeoff gross weight is being boosted 5,000 pounds to a total of 585,000 pounds. McDonnell Douglas is slated to perform trade studies to assess the feasibility of increasing the aircraft's fuel capacity, removing its core thrust reverser, or switching to nacelles made from lightweight composite materials. The latter two proposals previously have been considered and rejected.

Another key change involves the flight-test program, which has lagged well behind what both the Air Force and McDonnell Douglas now label an unrealistically ambitious original schedule. The test program was rebaselined in April 1993 and now calls for developmental tests to be completed in December and initial operational tests to finish in March 1995. Initial operational capability of the first twelve aircraft at Charleston AFB is scheduled for January 1995. USAF and McDonnell Douglas will split equally the cost of lengthening the test program, estimated at a total of $123 million.

Program officials say the aircraft is proceeding smoothly through various test milestones. Test aircraft had completed a total of 2,800 hours as of early January. By year's end, that total should be 3,800 hours, said George Field, McDonnell Douglas's vice president for engineering and testing. In the past three months, the aircraft moved from basic airplane development to demonstrating its unique capabilities, such as steep descent and short-field landings.

An Unabashed Fan

After each capability is demonstrated at Edwards, pilots at Charleston are cleared to execute those maneuvers. By April, the Charleston pilots expect Edwards to formally release forward operating base ground operations, star turns, and combat offload techniques. Low-level flights down to 1,000 feet and formation flight station-keeping also are expected in that period, as are midair refueling operations, according to Col. Ron Ladnier, commander of the 17th Airlift Squadron, the unit flying the first four operational C-17s.

Colonel Ladnier is in charge of training forty-eight C-17 crews—ninety-six pilots and forty-eight loadmasters—by November 1994. An unabashed fan of the new airlifter, he said new pilots can be qualified for copilot duty in two flights, significantly faster than on older aircraft.

A typical training run lasts three or four hours. Pilots begin with a short navigation route at about 2,000 feet, during which cockpit systems and the mission computer are checked out, before practicing a series of approaches.

This spring, as additional capabilities are released to Charleston, the first wave of trainees will have to go back and "recapture" them, said Colonel Ladnier. "Normally, they would have done that in their initial training." He explained that delays in the flight-test program required adjustments in pilot instruction schedules. The final capabilities to be added to the training routine will be airdrop operations and steep approaches, expected this summer, and low-altitude parachute extractions, the heart of the C-17's capability, which won't occur until October, the Colonel said.

Delays in the C-17 flight-test program have required adjustments to the 17th Airlift Squadron's pilot instruction schedule. Airdrop operations and steep approaches will be added to the training routine this summer.

Photo © Ross Harrison Koty

In July 1995, the Air Force will analyze the reliability, maintainability, and availability records of the C-17s operational at Charleston. Four months later, USAF must decide whether it will buy more than its currently alloted forty.

Colonel Ladnier said pilots find the C-17 easy to fly. Its modern systems offer a substantially reduced work load compared to the decades-old C-141, and the plane is easier to load and maintain. "I'm a C-141 guy, and I have that [sentimental] attachment to the -141," Colonel Ladnier said. "But comparing the -141 to the C-17 is like trading in a '63 Ford for a '93 Ford."

Still, while the C-17 represents a vast improvement over its predecessors, the first models at Charleston continue to operate under restrictions. The planes carry only eighty percent of their normal loads because of the failure of the wing on the C-17 static test article. When not carrying cargo, the Charleston C-17s must carry almost 16,000 pounds of ballast to prevent an aft stall. That measure is expected to be lifted next January upon completion of aft stall testing, Colonel Ladnier said. (A C-17 at Edwards almost crashed last year after unexpectedly stalling.)

The settlement required McDonnell Douglas to redesign the flawed C-17 wing to "eliminate the need for supplemental straps to meet design limit load requirements." The straps were an interim fix that followed the first wing failure on October 1, 1992. That failure occurred at 128 percent of the test limit load, below the 150 percent requirement. A second failure on September 10, 1993, was determined to have occurred at 144 percent. A team of experts led by Dr. James Mar of the Massachusetts Institute of Technology reviewed the test data. Based on the team's analysis, the Defense Department and Air Force said the "C-17's wing design is operationally safe and technically sound."

The new design, which replaces the temporary steel straps added to the earlier aircraft with permanent aluminum extrusions, is to be introduced on the production line at "P-29." Eliminating the straps also should remove any danger of corrosion, which an earlier panel of experts feared. The wing redesign is expected to cost $32 million, which McDonnell Douglas will absorb. Separate fixes for the leading-edge slats and flaps will cost the Air Force $292 million and McDonnell Douglas $128 million.

Nagging Problems

There are other nagging problems. The C-17 has fallen short of its reliability goals. The agreement with Mr. Deutch commits McDonnell Douglas to develop a "high-visibility, aggressively managed reliability growth program" and a special reliability performance review board. The DSB found a lack of focus in the program's reliability efforts, but steps are being taken to resolve that problem: At the end of 1993, 100 McDonnell Douglas suppliers were brought together to discuss recommended corrective actions. "We are not currently meeting the growth curves in reliability. We have a clear understanding of the problem, . . . [but] I can't say that all the problems are behind us," said Colonel Kluter.

A key milestone looms in July 1995, when USAF is scheduled to execute a reliability-maintainability-availability evaluation, a thirty-day analysis of a twelve-aircraft squadron in both peacetime and wartime operations. Coming only four months before the scheduled decision on buying more C-17s, the reliability test could be crucial for the program's future.

McDonnell Douglas continues to deal with minor irritants one at a time. Colonel Kluter said problems with the fit of doors on recent aircraft may require a small engineering change. Persistent fuel leaks in the first several aircraft appear to have been resolved, according to company officials and Colonel Kluter. Problems in keeping experienced military aircraft assemblers on the program seem to have eased as McDonnell Douglas's commercial aircraft operations have stabilized. "Rollover has virtually ceased," Colonel Kluter said. "Looking into 1994, we see a stable work force for the first time."

Mr. Deutch will monitor the program during the probation with the help of a panel headed by an Air Force general and a "neutral senior industry official" whom he will name. The panel is to report directly to Mr. Deutch and John McDonnell.

Some outside experts think McDonnell Douglas may have to settle for the forty aircraft already ordered at a total cost of roughly $19 billion. However, McDonnell Douglas says it is confident the Air Force will buy additional planes and has factored that assumption into its strategic planning. "If we assume only forty [aircraft], it's hard to justify a lot of the changes," said McDonnell Douglas's Mr. Field. "Big picture, we have to assume we're going to be successful and get off probation." ■

David J. Lynch covers defense and aerospace for the Orange County Register in California. He is a former editor of Defense Week *Magazine. His most recent article for* Air Force *Magazine was "This Isn't the Bottom Yet," in the February 1994 issue.*

Verbatim

A Trillion From Defense

"This year's defense budget is about $230 billion, in 1990 dollars, [compared to] the $300 billion budget we had at the end of the Cold War before the 1990 budget summit. Over ten years, the savings from that agreement alone—as embodied in the [Bush] Administration's 'Base Force'—were $600 billion. . . . Additional savings from Bottom-Up Review force cuts will be another $350 billion. That is a total defense cut of nearly $1 trillion over the course of the 1990s, compared to the [1990] level . . . which was already far below the level of defense spending at the height of the Cold War."

Sen. Sam Nunn (D-Ga.), chairman of the Senate Armed Services Committee, in a Senate speech delivered on October 21, 1993.

No More Mr. Nice Guy

"I say it quite plainly: When I come to power, there will be a dictatorship. I will beat the Americans in space. I will surround the planet with our space stations so that they'll be scared of our space weapons. I don't care if they call me a Fascist or a Nazi. . . . I may have to shoot 100,000 people, but the other 300 million [living in the territory of the old Soviet Union] will live peacefully."

Vladimir Zhirinovsky, head of Russia's extremist, ultranationalist Liberal Democratic Party, which won nearly a quarter of the seats in the new Russian parliament.

Shameful, Decadent, Ominous

"There have been times in the past when I have disagreed with American foreign policy. This is the first time in my life when I'm ashamed of it. . . . We could have stopped that war [in Bosnia] had we been more decisive. . . . The consequence of [US inaction] politically is the progressive demoralization of western Europe. I don't think we should underestimate the destructive consequence of the Bosnian tragedy. . . . It is undermining movement towards European unity. It is destroying the self-confidence of the Western democracies. It is, I think, revealing a degree of moral decadence [that] is very dismaying and ominous."

Zbigniew Brzezinski, President Carter's National Security Advisor, in January 9, 1994, remarks on CNN's "Late Edition."

Gay Guidelines, Part 1

"Situation: A service member witnesses an act of sodomy by two enlisted men in a barracks room and notifies his superiors. Military law enforcement agents who respond observe in plain view photographs of one of the suspects engaging in sodomy with other service members. Should those other members be investigated?

"Discussion: Service members would not usually be asked about other partners with whom they may have had sex, absent evidence of other criminal activity. In this case, there *is* credible information of additional alleged criminal acts—the photographs."

From training scenarios released by former Defense Secretary Les Aspin on December 22, 1993, to explain new Pentagon regulations concerning homosexual conduct in the armed forces.

Gay Guidelines, Part 2

"Situation: An enlisted man who sees an officer in a well-known homosexual bar and later walking with another man in a park late at night threatens to report him unless he pays $10,000. The officer says nothing but tells the MCIO [Military Criminal Investigative Organization] that he has been blackmailed. What action should the MCIO take?

"Discussion: The MCIO should begin an investigation of the enlisted member's alleged extortion of the officer but should not investigate whether the officer is homosexual."

From the Aspin training scenarios.

Advice for Bear-Tamers

"The Americans would like to tame the bear, but they keep forgetting that they can't do that while it's in the forest. You have to do it in a cage."

Poland's President Lech Walesa in a January 3, 1994, interview with the Washington* Post *describing what he views as excessive US timidity in the face of Russian demands that NATO not extend full alliance membership to Poland and other eastern European nations.

The One-War Force?

"We are drawing down our regular forces from about 2.1 . . . to about 1.6 million . . . by the end of 1995. . . . One-third are deployed, one-third are in training getting ready to go, and one-third are in support roles of some kind or another. In Desert Storm, we deployed close to half a million people. . . . You could sustain something like Desert Storm with . . . 1.3 to 1.5 million. . . . We are beginning to cut to the point where we may be below that, so our ability to sustain a force even the size of Desert Storm is going to be jeopardized."

Sen. John Glenn (D-Ohio), Senate Armed Services Committee, in a November 17, 1993, speech concerning the Clinton Administration's long-term defense budget and force-structure plans.

Home of the Brave

"At one of our bases, a young security specialist asked his supervisor why they spent twenty-five minutes per person at the beginning of every shift checking each individual's gear. It didn't make sense; they trusted these people to guard nuclear weapons, but they didn't trust them to have batteries in their flashlights. The sergeants in the squadron thought this through and took a brave step: They quit making the inspections. They make occasional spot checks now instead. It has been more than a year since they made that decision, and they have had a 100 percent perfect record on the spot inspections."

Gen. John Michael Loh, commander of USAF's Air Combat Command, in an October 5, 1993, speech on ACC organizational change. ■

With programs beyond the F-22 uncertain and undefined, aeronautical developments have gone generic.

Fundamental Features for Future Fighters

By Frank Oliveri, Associate Editor

THE F-22 fighter is in advanced development and soon will enter production. With that exception, however, the Air Force has no new combat aircraft in the works. Program cancellations wiped out the proposed Navy-USAF A/F-X fighter and the Air Force Multirole Fighter, leaving nothing specific or substantial to replace them.

No one believes USAF has withdrawn from the fighter development business. Wright Laboratory, based at Wright-Patterson AFB, Ohio, redirected the main emphasis of its research effort into more generic improvements of fundamental aeronautic features. The improvements, say officials, will be useful for the next fighter—whenever and however it is defined. Of major significance in this regard is Air Force involvement in the Joint Advanced Strike Technology program, as yet undefined, which is supposed to be the seedbed of new Air Force and Navy aircraft.

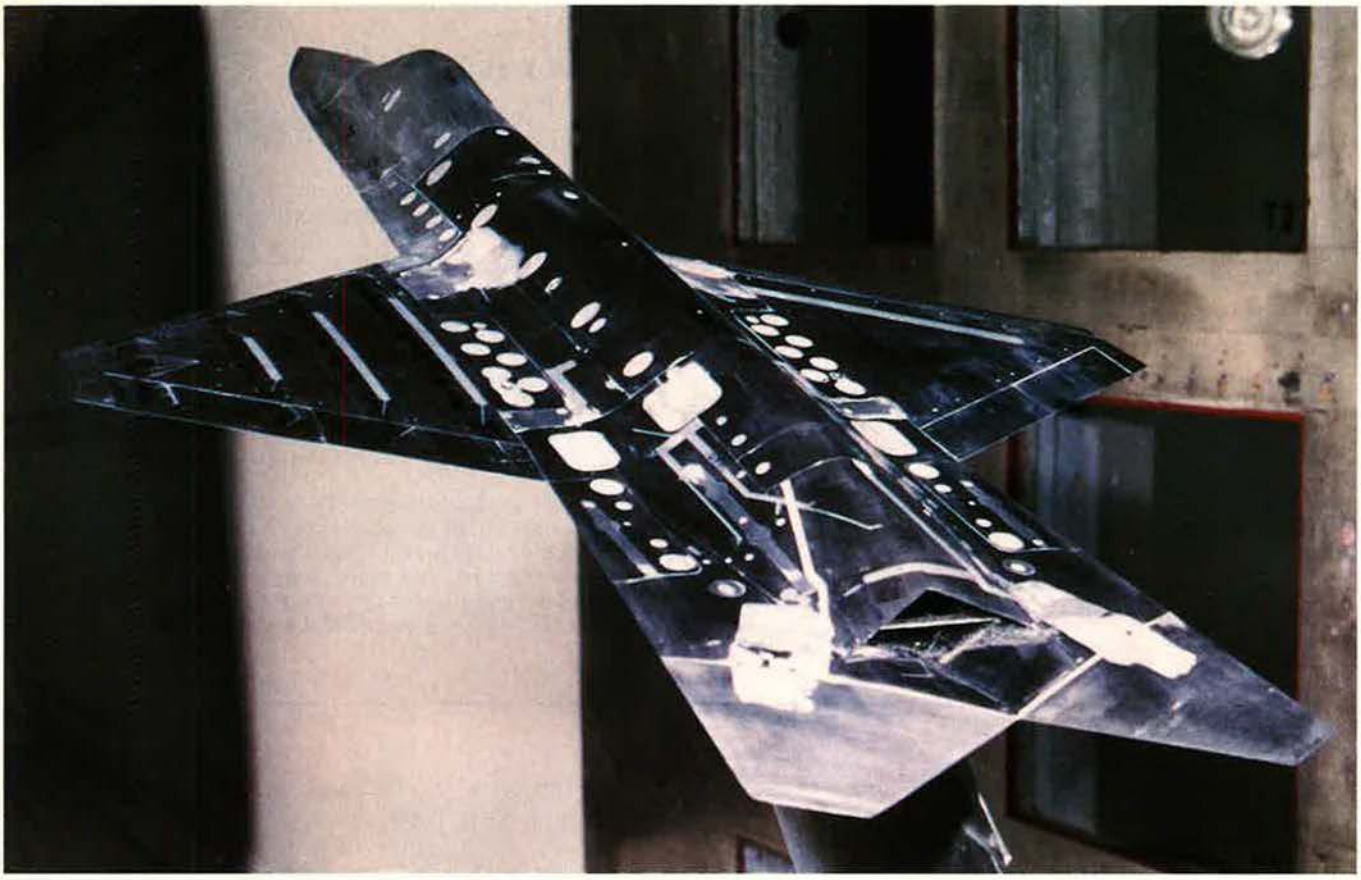
Some of the new work has spun off from current or canceled programs. Some explores new territory. One central fact is clear: Stealth technology overrides all other factors in fighter aircraft design.

Wright Lab is looking for ways to build on the stealth advantage. Several projects seek to eliminate or reduce the size of fighter aircraft tails, which are real radar standouts. Other projects seek to develop and perfect "quiet" control surfaces to improve aerodynamic performance without enhancing radar signatures.

Along with the exotic and the unusual, Wright Laboratory continues to push for improvements in such prosaic but important areas as intake inlets, engine bearings, exhaust nozzles, weapons carriage systems, and landing gear. Even in the age of stealth, those who work with airframes and engines continue to seek breakthroughs in two other traditional areas of concern: weight and structural efficiency. They know that lighter and stronger components and systems will be needed if future fighters are to be fast, nimble, and far-ranging as well as affordable and flexible.

Weight is key. In a sense, USAF buys its aircraft by the pound: The heavier the plane, the greater the cost. Wright Lab studies ways to chop out excess weight, ranging from the radical (removing tails from fight-

Advances in airframes and engines have led designers toward aircraft without tails. Removing the tails improves stealthiness while reducing weight and drag. The Multirole Fighter concept shown opposite would rely on pitch and yaw thrust vectoring and "quiet" control surfaces for flight-control stability.



ers) to the modest (developing and building lighter landing gear and engine bearings). The payoff comes not only in lower cost but also in fighter performance, especially in range and speed.

Improving the strength and efficiency of the airframe produces similar gains. Structural design has a major impact on the sturdiness (and thus the life span) of the aircraft. It can also free internal space for a larger fuel cell (thus increasing range) and more types of weapons (increasing flexibility).

Underlying all the new designs, and most responsible for these advances, is a revolution in materials. *[See box, p. 38.]*

Vanishing Tails

A great challenge for today's airframe researchers is what to do with the vertical stabilizer.

The device is a wonderful tool for aerodynamic control. When it comes to the key areas of stealth and weight, however, it is a nightmare. Modern fighters use very large vertical fins, which not only are heavy and easily seen by radars but also cost a lot, create tremendous drag, and have lifetime fatigue problems. The Air Force would like to get rid of them.

Thrust-vectoring technology, combined with other new control methods, could permit designers to do just that. Les Small, manager of the Multiaxis Thrust-Vectoring program at Wright Lab, said the Air Force is looking at thrust vectoring for propulsion as well as flight-control capabilities. So equipped, a pilot could use propulsion forces to move the aircraft to pitch, yaw, and roll.

"If I can eliminate in the extreme all of those [tail] surfaces, then [the fighter] would be smaller, sleeker, cheaper, faster, and more maneuverable," Mr. Small said. "Because it would have no surfaces out there, you can't see them. They will have a lower [radar cross section] signature."

The Configuration Research Office within the Flight Dynamics Directorate specializes in finding ways to shape and integrate components for optimum aircraft performance and survivability. Recently the office teamed with McDonnell Douglas on a two-year study of Multirole Fighter technologies that seems to have identified some basic trends.

In all four aircraft designs in the MRF technology study, the "paper" airplanes featured small tails or had none at all. The study's recommended airplane was tailless, using thrust vectoring for yaw control and pitch stability. Its takeoff weight was to be just under 30,000 pounds, one reason that it would be able to dash 100 miles at supersonic speeds.

Without a tail, an aircraft would have to rely on additional methods to augment thrust-vectoring control. The Air Force is investigating the use of quiet control surfaces—that is, surfaces that do not increase an aircraft's radar cross section.

Russ Osborn, technical manager of Wright Lab's Aero-Performance Group in the Flight Dynamics Directorate, explained that quiet control is achieved by placing a slightly moving surface where engine exhaust passes over it, thus generating maximum force from minimum mechanical movement. Such quiet control surfaces made their debut in simple form in the F-117 fighter. Additionally, by placing small fences or doors in the forebody, rotation could be produced at high angles of attack.

How to Haul Weapons

The study also focused on another design issue that has drawn intense study in the aerodynamics community: how best to carry weapons.

The study proposed two weapons carriage arrangements. The notional airplane, in the air-to-air configuration, would carry two short-range air-to-air missiles in its internal bay and three Advanced Medium-Range Air-to-Air Missiles in a conformal configuration. Weapons designed to blend well or lie flush with the aircraft are considered conformal.

In the air-to-ground mode, the notional aircraft would carry two short-range air combat missiles internally, plus two conformal advanced ground-attack missiles.

The Airframe Weapons Integration Office, in the Flight Dynamics Directorate, spearheads R&D efforts to bring developers of weapons and aircraft together. In the only effort of its kind under way in the Air Force, AWI studies drag and observables for conformal weapons carriage and aeroacoustics for internal carriage.

AWI weapons specialist Jim Grove said that wind tunnel testing proved drag could be reduced by up to seventy percent simply by moving from conventional pylon carriage to conformal carriage in both advanced and existing weapons and by stacking weapons in a row. "You want to strive for . . . carrying one behind the other because the second one goes along almost for free," said Mr. Grove.

Internal weapons carriage produces a "clean" aircraft, in the aerodynamic sense. However, because a larger aircraft is required for internal carriage, the designer must accept a weight penalty of ten to fifteen percent, perhaps more. Mr. Grove said that, no matter how well weapons are loaded internally, some internal volume is wasted.

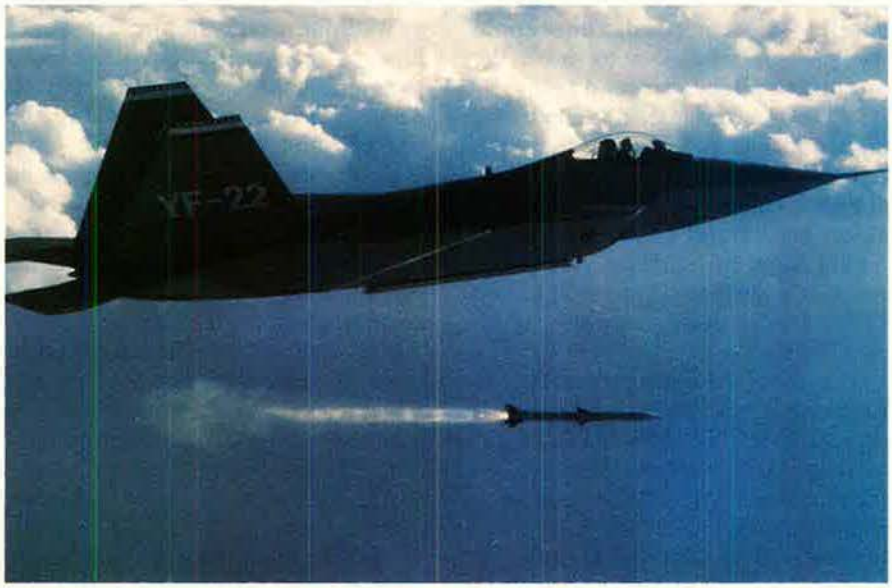
Because it reduces drag, conformal carriage could increase the range of a fully loaded aircraft by up to forty percent while increasing its maximum Mach level to eighty or ninety percent of a clean aircraft's maximum Mach level. A conventionally loaded fighter can barely reach Mach 1.

Because carrying weapons under the wing decreases the aerodynamic qualities of the wing itself, designers prefer that weapons be carried conformally on the fuselage, Mr. Grove said.

"The wing is the most efficient surface, and when you mess with the aerodynamics around the wing, you significantly reduce its efficiency," he noted. "The fuselage is not nearly as clean as the wing. When you put weapons on it, the interference isn't nearly as high."

While internal carriage has obvious drawbacks, Mr. Grove said, future aircraft will probably combine internal and external carriage, with smaller short-range missiles stored internally. Conformal weapons would be mounted nearly flush with the aircraft, posing only a minor technical challenge. Carrying weapons in internal bays, however, requires the use of aeroacoustic suppression devices. When the doors open, the noise is deafening.

One proposed suppression device would rely on small tunnels to chan-



The use of internal weapons carriage, as in the F-22 fighter, allows for a "clean" aircraft, with reduced drag. However, internal carriage also increases the overall weight of the aircraft by ten to fifteen percent.

Composites for 700°

The Air Force is pushing R&D in composites because it believes they will revolutionize structural designs. One major success story is that of AFR-700, a high-temperature organic-matrix resin used in organic-matrix composites.

AFR-700 has been proven to function, with only slight deterioration, at 700° Fahrenheit for 100 hours. The next best organic-matrix composite resin, PMR-15, cannot exceed 550° Fahrenheit.

The Air Force uses lightweight materials in hot sections of aircraft that must be changed out often. Ken Johnson, an engineer in the Materials Directorate of Wright Laboratory, said changes are made too often at great expense. AFR-700 could provide some relief in those areas.

The Air Force has a recurring heat damage problem on the fuselage trailing edges of the F-117 fighter. With AFR-700 increasing the temperature capability of organic-matrix composites by 150° Fahrenheit, the fighter's performance has been increased, while maintaining its low-observable profile. By using the lightweight composite material, the Air Force will save about $5 million in acquisition costs over the life of the F-117.

The Air Force is working with the Navy to see if AFR-700 can replace a graphite epoxy used on the inboard flap of the AV-8B Harrier. When those flaps are exposed to engine exhausts, they quickly break down and need to be replaced. A new resin system was tried, but it had the same problem.

AFR-700 may also be used in certain areas of fighter engines, for example, in the compressor shroud. An AFR-700 compressor shroud will soon be tested in an engine, Mr. Johnson said.

nel pressure away from the bay. Another option calls for specialized shaping of the weapons bay. "Most are rectangular," said Mr. Grove. "If you shape them smoothly, what are the advantages? Or maybe [one could] hook up the weapons conformally inside the bay."

The Air Force plans to conduct tests on the two types of weapons carriage in 1998.

Bending Fast Air

Elsewhere at Wright Laboratory, designers have embarked on a project to find better ways to bend air—not an easy task. The point is to create a better air intake inlet and, in the process, increase the performance of future fighter aircraft.

When a fighter is in flight, air rushes into the intake at such a high velocity that it does not want to bend; it wants to move and stay in a straight line. Such straight-traveling air causes turbulence within the engine, undermining performance.

Technologists have designed special inlets to deal with this problem, but the inlets are highly complex, with many moving parts that require lots of space. For example, the F-15's supersonic inlet contains seven actuators to slow down the rushing air.

Today the average duct's length is about five times its diameter. Engineers in the Airframe Propulsion Integration (API) Office of the Flight Dynamics Directorate want to shorten air intake ducts by removing most of the moving parts.

The goal is to cut the length of the inlet by more than half. Doug Bowers, an engineer at Wright Laboratory, said that if the F-16 inlet's length were cut to twice its diameter, the fighter could shed about 300 pounds of dead weight.

Designers have developed an intake that is offset on two planes, vertically and laterally, and that would use a special grid, said Mr. Bowers. They are using computational fluid dynamics to supplement wind tunnel testing of the intake. CFD uses mathematical equations that describe the motion of fluids around an object, in this case an air vehicle. Using a computer, designs can be modified to make the airflow more efficient. CFD provides designers with the needed data on an inlet's performance.

Thrust-vectoring technology provides an alternative method of flight control while increasing the maneuverability of fighter aircraft. The multiaxis thrust-vectoring test aircraft, a modified F-16, proves the technology.

Lighter Ways to Land

On any flight, the landing gear of an aircraft gets used only twice—during takeoff and landing—and at all other times is dead, parasitic weight. That's the way designers look at landing gear and the reason they are pressing for significant changes.

Landing gear ranges in weight from three to four percent of the maximum gross takeoff weight of an aircraft. Materials have advanced to the point where engineers may be able to produce a basic landing gear that accounts for only two percent of maximum gross weight.

The landing gear consists primarily of steel and aluminum structures, heavy and vulnerable to corrosion. When the paint chips on steel parts, corrosion begins. "Landing gear is the third highest maintenance cost item in Air Force airplanes," said Aivars Petersons, chief of the Aircraft Launch and Recovery Branch of the Flight Dynamics Directorate.

Because landing gear performs such a vital function and because it's a fairly complex structure requiring great strength and reliability, the Air Force has avoided any significant changes in its design. "Traditionally, the landing gear has . . . not received its share of attention from the R&D standpoint," said Mr. Petersons. "We are trying to overcome that."

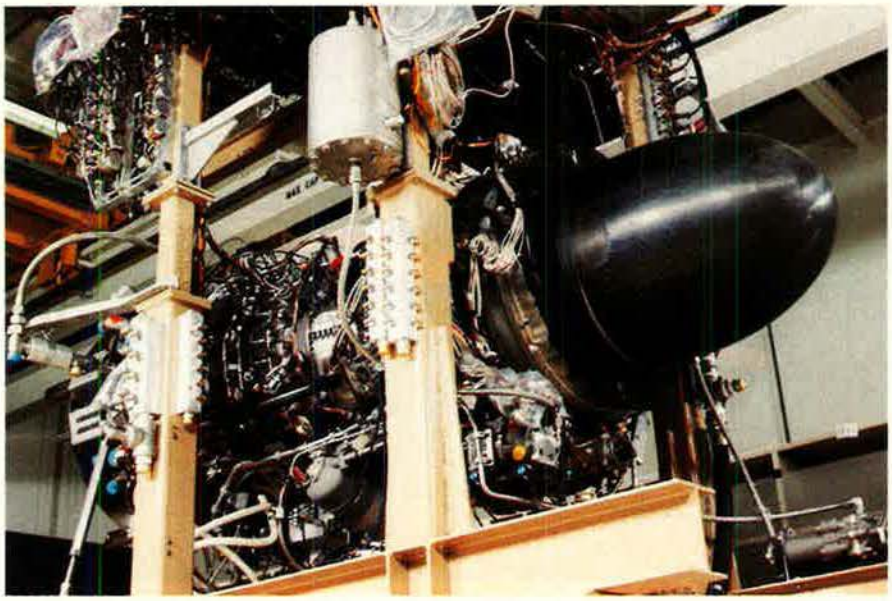
Researchers are looking at the possibility of fabricating landing gear out of a titanium-matrix composite, which would improve corrosion resistance tenfold and would save thirty to forty percent of the weight of high-strength steel parts. The Air Force plans to have a prototype of the new landing gear struts by 1997. These will reduce weight by fifteen to twenty-five percent. This is a joint program with Canada, which is looking to modify the struts of its CF-18s.

API also wrestles with the task of creating better exhaust nozzles. It is focusing on affordability, number of parts, survivability, and performance.

The problem with current thrust-vectoring exhaust nozzles, noted Mr. Bowers, "is that they are heavy. You can't talk about high performance, survivability, and low cost all in the same sentence. It's way too complex."

The exhaust system that API is developing would work for a tailless aircraft in the 30,000-pound weight class. API will achieve pitch and yaw thrust vectoring in a unique manner.

First, designers plan to integrate the nozzle system with an airframe, rather than an engine—an idea first explored under the National Aerospace Plane program. This should significantly reduce weight because the engine would not need to be beefed up to withstand massive directional forces.



The F-22's Pratt & Whitney F119 thrust-vectoring system helps make the aircraft one of the world's most maneuverable fighters. P&W delivered the first production engine core, above, to USAF in August. The prototype is shown below.

The nozzle would be blended into the aft end of the aircraft, with no break between it and the aircraft. Mr. Bowers said that small mechanical parts inside the stationary nozzle would be moved to achieve vectoring control, much in the same manner quiet surfaces are used for aircraft control.

Small composite paddles would act as rudders to direct the jet plume. API plans to build four prototypes for demonstration by 1999.

Building Better Bearings

A fighter's engine and its fuel account for about fifty percent of its gross weight at takeoff. Wright Lab researchers believe that various engine programs will help them produce future fighters half as large as those of today, at less than half the weight.

Air Force scientists and engineers are getting a better handle on metal-, organic-, and ceramic-matrix composites that can be designed for greater strength and temperature resistance while reducing weight.

Work being done under the Integrated High-Performance Turbine Engine Technology (IHPTET) initiative is expected to lead to extreme increases in engine thrust-to-weight ratios, mainly by eliminating weight. One big change could be production and use of magnetic bearings, which would cause the engine compressor and turbine to levitate and permit them to spin in a nearly friction-free environment.

The concept came to light almost by accident. Bill Koop, an IHPTET engineer, said. "As we run our engines hotter and hotter, we have much more power available to us in the core of the engine. We thought, if we could extract some of that power and maybe make a different use of the power—*i.e.*, convert it to electrical capability—we might be able to drive some of the actuation equipment on the engine electrically instead of hydraulically."

The result was magnetic bearings. The compressor and turbine system are surrounded by a magnetic field, which creates equal force all around the compressor and turbine shaft. Because the forces exert equal strength in all directions, the system is self-stabilizing.

Researchers believe the system could be fully demonstrated by the turn of the century, with an actual application by about 2010–15.

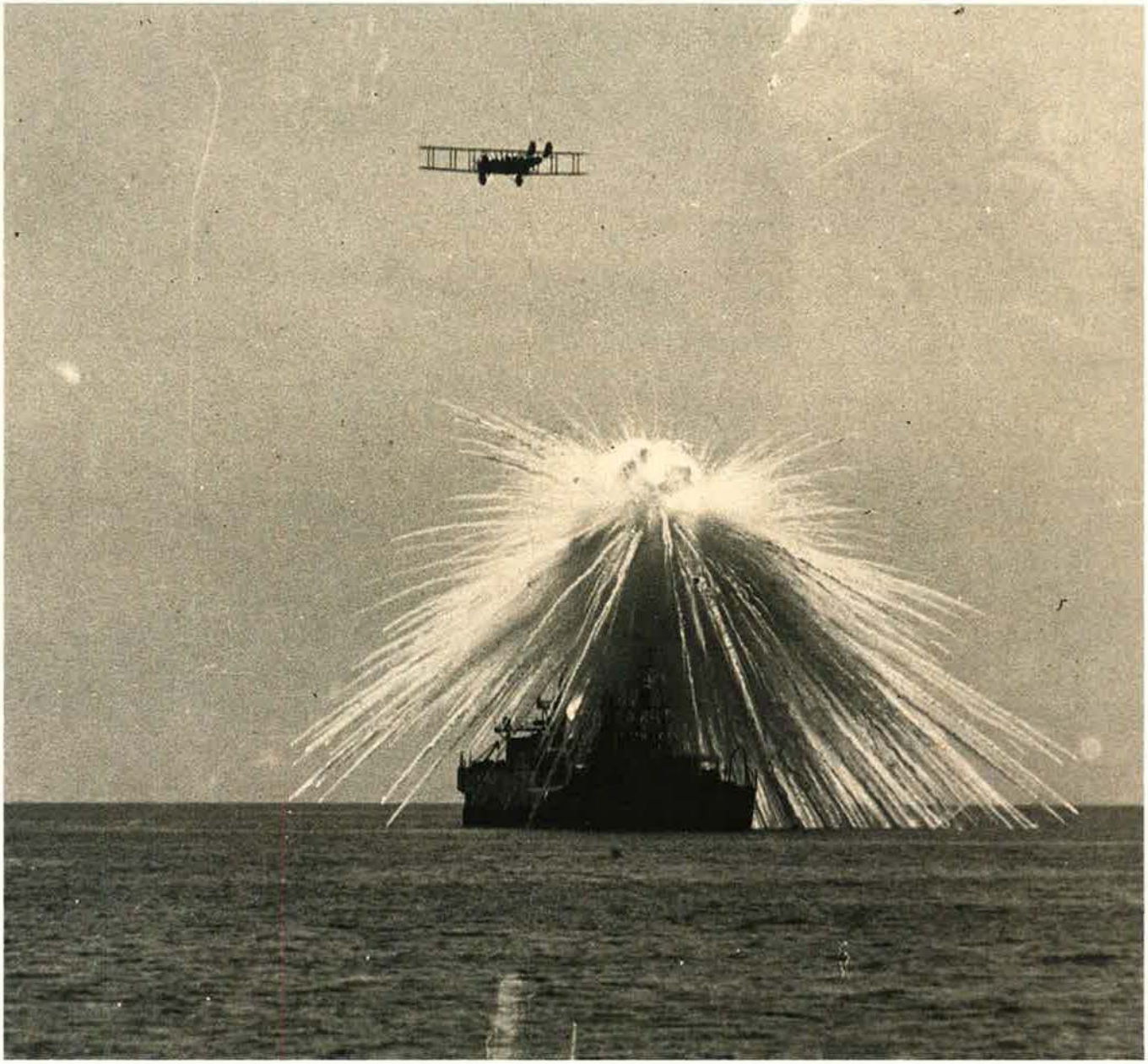
The payoffs of a magnetic-bearing system would be tremendous. Mr. Koop said such heavy liquids as lubricating oils and hydraulic fluids could be eliminated. Electrical systems would replace heavy hydraulic systems, further reducing weight and increasing reliability.

The rotor system could be fine-tuned so that life-cycle fatigue, rotor imbalance, or rotor dynamics problems in classical shaft-bearing-type structures would be eliminated. Clearances in the compressor and turbine could be made tighter, which would also increase efficiency.

Scientists conservatively project that magnetic bearings could reduce engine weight by ten percent while increasing thrust-to-weight ratios by four percent. The efficiencies gained with the magnetic-bearing system would improve fuel consumption, which would pay huge logistics dividends.

The big question is how large the magnets have to be to support the system. The Air Force hopes to learn the answer within the next few years. ■

A Bombing in Chesapeake Bay



In a series of tests that would have far-reaching consequences (intended and unintended), Brig. Gen. Billy Mitchell set out to prove the potential of military aircraft as a weapon against battleships. Here, a Martin MB-2 brackets USS Alabama *with a 100-pound phosphorous bomb. Other bombers followed with 2,000-pound bombs that sent the ship to the bottom. General Mitchell's aircraft sank six capital ships in Atlantic coastal waters between 1921 and 1923, but his superiors and the US Navy never acknowledged the decisiveness of the tests, and he was eventually transferred and court-martialed for zealously championing his views.*


MO
MO
389 FS

In Bright Star '94 it was the 366th Wing's turn to shine.

Gunfighters in the Desert

The capabilities of the Air Force's air intervention composite wing were on display in US Central Command's multiservice exercise Bright Star '94 last November. The 366th Wing deployed from Mountain Home AFB, Idaho, to Cairo West, Egypt, demonstrating the strength and flexibility of the composite wing concept. Streaking across the desert at left are (from bottom) an F-16C from the 389th Fighter Squadron, an F-15E from the 391st FS, and two F-15Cs from the 390th FS.

USAF photo by Amn. Jennifer Pattylohn

USAF photo by A1C Greg Vaughan

USAF photos by SSgt. Mark Bucher

Working closely with their Egyptian counterparts, USAF participants in Bright Star demonstrated their ability to work in bare-base conditions. At top, an Egyptian C-130 taxis past a row of F-15s. Above is one of the KC-135Rs that give the 366th Wing its "go-anywhere" flexibility.

The 366th deployed twenty aircraft and some 800 people in Bright Star, and everybody pitched in on arrival in Egypt (above). The wing has been called "the Air Force's SWAT team"—able to deploy rapidly, as a unit, anywhere in the world during a crisis. Having its own tankers ensures the global reach of the wing.

USAF photo by A1C Greg Vaughan

The most advanced aircraft in the world may be flying overhead, but, on the ground in Egypt, camels remain a common mode of transportation.

USAF photo by Amn. Jennifer Pettyjohn

Cooperation was a must in order to pull off a successful exercise. Prime BEEF (Base Emergency Engineering Force) teams from the 366th Civil Engineering Squadron, augmented by other personnel, built a tent city for nearly 1,500 USAF troops and a sixty-tent work area dubbed "Fighter City."

"When our Prime RIBS [Readiness in Base Services] team got here, there was nothing," said Maj. Timothy Fletcher, commander of the 366th Services Squadron. By the time they were through, there were enough roads, electrical systems, laundry and recreation services, and latrines for a small city.

USAF photo by SSgt. Mark Bucher

USAF photos by SSgt. Mark Bucher

"The great thing about an exercise like this is, it's the closest thing to actual combat," said 366th Operations Group Commander Col. Robin Scott. One realistic element of the exercise was the great variety of aircraft participating, including F-15Cs (above), Egyptian F-4s (left), AWACS E-3s (below), and MC-130s (bottom left).

USAF photo by A1C Greg Vaughan

The 366th was not a one-man band at Bright Star. In addition to B-1s from the 77th Bomb Squadron and E-3 AWACS aircraft from Tinker AFB, Okla., electronic combat aircraft from Cannon AFB, N. M., and Davis-Monthan AFB, Ariz., deployed with the wing. Special Operations deployed separately, and several Stateside B-52 and B-1 units took advantage of the exercise to demonstrate global power with round-trip sorties.

USAF photo by A1C Greg Vaughan

The Air Force worked side-by-side with the US Army at Bright Star. Here, an F-15E pilot from the 366th shows his "office" to US Army visitors. In all, more than 20,000 Air Force, Army, Navy, and Marine personnel took part.

The Air Force Reserve's 914th Airlift Group, Niagara Falls IAP/ ARS, N. Y., brought its C-130H transports to Bright Star in a show of Total Force. No matter what unit you're in or where you go, there is always paperwork to be done (right).

USAF photo by A1C Greg Vaughan

USAF photo by A1C Greg Vaughan

USAF photo by SSgt. Mark Bucher

Maj. Gen. Tad Oelstrom, vice commander of 9th Air Force—Central Command's air component—and deputy commander of the American Joint Task Force, summed up the purpose of the exercise: "If you look at the big picture, our ability to come to a foreign country, coordinate, cooperate, plan, and exercise is very important. . . . We're only as good as our ability to cooperate when it comes time to put a coalition together."

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KEY

ASD	Assistant Secretary of Defense
DASD	Deputy Assistant Secretary of Defense
DUSD	Deputy Under Secretary of Defense
PDASD	Principal Deputy Assistant Secretary of Defense
PDUSD	Principal Deputy Under Secretary of Defense
USD	Under Secretary of Defense

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Edwin Dorn

PDASD for Personnel & Readiness
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DASD for Readiness
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DASD for Military Manpower & Personnel Policy
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DASD for Personnel Support, Families, & Education
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These people know that a problem with your helmet, oxygen mask, or G-suit can ruin your whole day.

Lifeline to the Sky

By Robert F. Dorr

Photo © Michael Longe

SSgt. Bill Godlock of the 16th Special Operations Squadron, Hurlburt Field, Fla., inspects an AC-130 seat-pack survival kit. Opposite, Amn. Ray A. Rice preflights and postflights helmets for the 422d Test and Evaluation Squadron, Nellis AFB, Nev.

A1C SABRINA Kunsman was inspecting torso harness assemblies when she was asked what it meant to be an aircrew life-support specialist. Airman Kunsman belongs to the 27th Fighter Squadron at Langley AFB, Va., which is equipped with F-15C fighters. She gestured around the life-support section found in every Air Force flying squadron—that spotless, you-can-eat-off-this-floor area in Squadron Ops where flying gear is stowed in lockers and oxygen masks dangle from hooks. "If you haven't adjusted the fit of that helmet," she said, "or slapped the proper 'condition tag' on that oxygen mask, the guys who fly don't fly."

TSgt. Jim McKenna of the 756th Airlift Squadron, Air Force Reserve, Andrews AFB, Md., was heating a thermal plastic helmet liner in an oven to shape it. His model, a colonel, sat nearby awaiting the fitting. Aboard their outfit's C-141Bs, the HGU-55/P helmet—standard attire in fighters elsewhere—is worn primarily as chemical defense.

"The aircrew are our customers," Sergeant McKenna said. "We're the last people they see before they go up. We inspect, maintain, issue, fit, and adjust their personal equipment. Like we're doing now, we fit their chem defense gear. We train the flyers in how to use it."

Anyone who has flown in the Air Force knows the importance of having the right gear, having it fit properly, and having it work as expected. An ill-fitting helmet with a painful "hot spot" can wreck your day yanking and banking in a fast jet. A poorly fitted oxygen mask or G-suit can cause discomfort or pain when you're

Photo by Ross Harrison Koty

also coping with high speed, sudden G-forces, and high altitude. Items needed by flight crews in every aircraft, whether chemical defense hoods or twenty-five-person life rafts, won't save a soul if not professionally maintained, stocked, and stowed.

That's the job of Airman Kunsman, Sergeant McKenna, and 3,133 other aircrew life-support specialists. Today, there are 2,000 in the active-duty force, slated to drop to 1,867; 360 in the Air Force Reserve; and 775 in the Air National Guard.

They're a lifeline to the sky for the men and women who fly and fight. Most life supporters have no problem being responsible for flying equipment and survival gear and for continuation training in how to use it. However, many worry that they and their contribution to the flying force are too easy to overlook.

Which is what happens, all too often, when aircrews are "stepping"—jargon for whisking through preparations for takeoff.

Pay Attention

"Pilots like their gear a certain way," said TSgt. Angus V. Johnson of the 27th Fighter Squadron. "They're always one step ahead of themselves. When they come here to suit up, they're already mentally out there preflighting the aircraft. Sometimes it's good to be thinking ahead, but this isn't one of them. My job is to make certain those pilots"—and other aircrew members, in squadrons that have them—"pause for a moment and pay attention to the state of their personal gear. Then I want to make sure there's no 'red ball' [an equipment glitch that can delay takeoff], so they can get on their way expeditiously."

Sergeant McKenna said, "Two of the people to whom I gave follow-on training had to eject during Desert Storm. In our hanging harness training, we taught them to steer away from the fireball. They told me later we saved their lives."

When something goes wrong with the gear, Sergeants Johnson and McKenna and their colleagues suddenly stand out like a bogie at twelve o'clock. The rest of the time, they quietly fulfill the duties of the aircrew life-support specialist. As spelled out in the regulations, their job is to:

- Inspect and maintain aircrew life-support and chemical defense equipment, such as personnel parachutes, torso harness assemblies, life rafts, life preservers, pressure suits, anti-exposure suits, antigravity suits, survival kits, vests, helmets, oxygen masks, and chemical defense ensembles.
- Issue, fit, and adjust this equipment; assist aircrews to don, doff, and preflight pressure suits, anti-exposure suits, and other flying apparel.
- Provide life-support continuation training, including emergency egress, hanging harness, forced landing, ditching, and survival.

The basic school for USAF life supporters is at Sheppard AFB, Tex., where TSgt. John D. Mitchell of the 362d Technical Training Squadron instructs new airmen. Sergeant Mitchell gets to his classroom at 6:00 a.m. to prepare for sessions that begin an hour later.

"It's got to be right," Sergeant Mitchell said. "A lot of the equipment we work with is extremely dangerous." The thirty-one-day course starts with sixty hours of preamble. "We introduce every piece of equipment—helmets, masks, radio testers, strobe lights. We break the news to

them that they're going to be standing up in a room full of officers, giving training."

Next, what Sergeant Mitchell calls the "primary schoolhouse" offers segments on life rafts and preservers, survival kits, and anti-G garments. The final segment covers chemical defense, starting with attire and moving on to aircrew shelters. "We want our student to know how the flyer dons it and doffs it and how to process aircrews through a chemical defense shelter," said Sergeant Mitchell.

"We've got several kinds of shelters. One is an air-lock system with a constant flow of air. Flyers go through it doffing certain items and end up in a shower and a contamination-free area at the end. You have to run the aircrew through this without a mistake—like, you can't touch bare skin because portions of the shelter are going to be contaminated."

Photo © Michael Longe

If something goes wrong with the aircrew's gear, the life-support specialist stands out like a bogie at twelve o'clock. SrA. Les Schneider of the 16th SOS carefully checks out a helmet microphone.

Life as a Spare Tire

In equipping aircrews for chemical warfare, said MSgt. Alexander King at Randolph AFB, Tex., "everything we do is like that spare tire in your trunk. You may not see it, but when it's needed you want it to be right."

Life supporters go from tech school to squadrons, where they continue learning. Younger airmen now focus on honing their skills as apprentices, rather than being rushed into premature boning-up for journeyman tests. As a cradle-to-grave approach is phased in between now and mid-1996, career development courses will be instituted on the job, and today's supervisory course at Sheppard (now the only other off-site training available) will be replaced by a mandatory, advanced curriculum for journeymen and supervisors.

In 1956, life support was established as a separate career field. Its practitioners were renamed personal equipment specialists. The term was changed to protective equipment specialist in 1961 and to aircrew life-support specialist in 1970.

In today's flying squadron, the life-support shop is likely to be a bright, open place of high ceilings and broad spaces—right on the footpath from briefing room to flight line.

It's a big work space, close to the people who fly. The shop may boast half a dozen life supporters (in an Air National Guard F-16 squadron) or as many as twenty-five (in a B-52 outfit). It's often in a renovated location, which means, since Squadron Ops was there already, that it has squeezed out somebody else. "We're finally getting the space we need," said Capt. Michael P. Curphey at Luke AFB, Ariz. "The Air Force is coming to see that what we have here is more than just a locker room."

Lockers are there, all right, some assigned to crew members by name. They hold the personal gear—helmet, mask, G-suit, harness. "But you gotta have elbow room," said Captain Curphey.

Want to restring a G-suit? To alter the waist and hips of those speed jeans, you need a broad work table and room to spread out. You need space, too, for the oven, used to mold five layers of bubble packing into a personalized helmet liner, and a storage bin for the standard "piddle pack," the fighter jock's friend. Most important is bookshelf space for manuals and training materials.

Photo by Ross Harrison Koty

MSgt. James Johnson of the 422d Test and Training Squadron gives harness and parachute instruction to F-4G pilot Capt. Mike Sully. Such training enabled two aircrew members to eject safely and avoid a fireball in Operation Desert Storm.

Before Life Supporters

Life-support specialists have not always existed, but they should have.

"I think the need was evident from the beginning," says CMSgt. Tim Morrow, life-support manager for Air Mobility Command at Scott AFB, Ill. "When Orville and Wilbur found out they could get off the ground, there was a need to say, 'What happens if the system fails?' So parachutes evolved. But we fly for a living, not jump for a living. So we needed expertise on the equipment."

Still, the Air Force's predecessors went through two world wars without life supporters.

On June 8, 1943, Maj. Gen. Ira C. Eaker of Eighth Air Force penned a letter interpreted today as defining the Army Air Forces' need for the life-support technician. "Out of 210 British aircrew members downed at sea, sixty-eight were saved," General Eaker noted of a typical period, "whereas, out of 194 American aircrew members downed, only fourteen were saved, giving relative percentages of 32.4 against 7.2 percent." He was referring to B-17 Flying Fortress crewmen on the way home from punishing missions over Germany. He called for measures to prolong the lives of downed flyers to give them time to be rescued.

After a directive from Gen. H. H. "Hap" Arnold, Commanding General of Army Air Forces, an October 1943 regulation established a Personal Equipment Officer in each AAF unit. This was "preferably a nonflying officer with no duties other than those connected with the use and maintenance of personal, protective, and emergency equipment." The regulation called for "a physical space in which to work [as] storekeeper" for items allotted to flyers. Before V-E Day, more than 600 officers of Eighth, Ninth, Twelfth, and Fifteenth Air Forces received personal equipment training in England. For a few months, some enlisted personnel were designated personal equipment technicians.

In the late 1940s and during the Korean War, officers and enlisted people were given "personal equipment" duties as an added chore. Few were trained in upkeep of flying and survival gear, which was becoming increasingly complex as jet aircraft and chemical and nuclear weapons came on the scene. Prior to 1947, this added portfolio was deemed part of the supply field. Thereafter, the job evolved differently in different major commands. Most airmen who worked on flying and survival garb were considered part of the medical field.

On December 16, 1949, at the initiative of Gen. Curtis E. LeMay, Strategic Air Command set up the Air Force's first survival school, run by SAC's 3904th Training Squadron at Camp Carson, Colo. When this school moved to Stead AFB, Nev., in 1952 to acquire a larger training area, the Air Force established a survival training and personal equipment career field. This interim measure established today's life-support job with its first name and its earliest recognition—but as half of a partnership. Not until 1956 was life support broken off from the separate and equally important world of survival training.

Ellie Handley, a retired chief master sergeant in San Antonio, Tex., joined the Air Force in 1954 "when the life-support field was just opened up. There was no tech school. All of my training was done on the job." In fact, said Chief Handley, when he went to Hanscom AFB, Mass., to help B-25 and B-29 aircrews, "we didn't even have a test to tell us how well we were doing. The Air Force had just separated from the Army, and our equipment was still coming from the supply system for ground-pounders."

Chief Handley found himself hanging equipment on aviators without a guidebook. "We didn't have procedures established for tasks we performed, not even for something as simple as swabbing an oxygen mask. There was no planning for tomorrow." Soon afterward, the first technical school for life supporters opened at Chanute AFB, Ill. It moved to Sheppard in 1991.

Two of Chief Handley's early assignments illustrate the importance of the career field. He went to Eniwetok in the South Pacific for Operation Red Wing, the above-ground detonation of hydrogen bombs; he supported a B-57 crew who wore pressure suits and other specialized gear and flew through the atomic cloud to take samples. A couple of years later, Chief Handley was at Sewart Field, Tenn., in a troop-carrier squadron that took ski-equipped C-130D planes up to isolated radar stations in the Arctic. "We had to ensure the equipment and training that would enable a C-130 crew to do its job at temperatures of –40°." The bomb tests are gone, but LC-130Hs still need life support in the Arctic today.

"An average life-support shop tracks about 15,000 items that require time-change accounting," said CMSgt. Dave Cramer of the 175th Fighter Group, Maryland ANG, in Baltimore. "Take the flares that pilots use. They have an installation date, an expiration date, and a lot number. We need to be able to find them fast." The Air National Guard introduced computers in 1988, replacing a "very tedious manual tracking system," and the active-duty force followed.

The life-support officer (LSO) is in charge of the shop. Typically a captain, the LSO must be rated and current on the squadron's aircraft. Without this pilot or navigator, who can serve as a bridge from the world of pilots, life supporters would find it difficult to muster the clout to demand the right equipment and safe procedures—or even to have their needs understood.

"It's a thankless, difficult job, requiring numerous additional duty hours, and some rated officers view it as a stigma, an unwanted label you're stuck with," said Maj. Dan Baumgartner of the Air Staff. "However, every LSO I've met has said, hands down, that it's not easy to become an LSO or to be a good LSO, and the time spent is extremely rewarding."

Special Training and Wings

The two-week LSO course at Randolph AFB, Tex., offers rigorous exposure to the world of life supporters and training in crash investigation at the Life Support Equipment Laboratory at Kelly AFB, Tex.

In a fast jet squadron, the LSO teaches ejection seat decision-making, said to be both an art and a science—a "good example," said Major Baumgartner, "of where you need both the specialized training and the wings on your chest."

The NCO in charge of the shop typically is a master sergeant with fifteen years' experience in this field. "You need to have credibility with aircrews so you can take their time away from other things," said Sergeant McKenna. "You need to be an innovator, and you need to get yourself accepted as a . . . necessary evil."

In life support, the E-6 or E-7 in charge of the place is really in charge. Leadership credentials, including NCO Academy tickets, count for as much as technical skills.

"In a normal day," said Airman Kunsman, "one of us will install and remove filter elements in chem warfare packs while another is preflighting an aircrew member's gear, laying it out, and checking the schedule to make sure no item due for inspection is flying that day. The crew members who are 'stepping' come in, draw their equipment, check it themselves, and turn to a technician for help if it's needed. While I'm helping them to get aloft, another life supporter may be revising our records, working on an inspection cycle, or carrying inflatable gear

Photo by Ross Harrison Koty

Life-support specialists issue, fit, and adjust equipment. Here, Amn. Shane Heather of the 422d Test and Training Squadron mounts night vision goggles on the helmet of A-10 pilot Capt. Jon Mott of the 57th Test Group at Nellis.

down to the fabrication shop to be tested.

"We remove ejection seat survival kits, which get changed every 120 days. We take components out of an aircraft to test for service life, like radios, flares, and other pyrotechnic devices. Some days, we do an inflation test by pumping up G-suits."

The life supporter's rewards can come from performing a variety of tasks. TSgt. Richard Robichaud of the 756th Airlift Squadron finds a "real challenge" in the intricate process of breaking down and rebuilding a Series 358 mask, the "quick-don" emergency breathing facewear carried on the C-141B. MSgt. Arthur E. Sevigny of the 89th Airlift Wing at Andrews AFB sees a spot for the "action-minded nerd" who likes to graph out trends in equipment deficiencies. Keeping track of patterns in equipment flaws is essential.

Unlikely Disasters

Getting ready for something that probably will never happen—a high-speed bailout, a giant transport ditching at sea—often means prosaic duty for senior airmen and staff sergeants who make up the majority in this career field. Cleaning an oxygen mask is often cited by life supporters as emblematic of the unglamorous and commonplace side of their world. "Swabbing spit," it's called. Not as repulsive as it sounds, the task requires wearing latex gloves and scrubbing the mask with a gauze pad doused in seventy percent alcohol mixed with water.

The good news is, once a piddle pack is used, the aircrew member, not the life supporter, disposes of it. "What we do is mostly pretty clean work," acknowledged Airman Kunsman. "Most of the time, this isn't a physically demanding job." There is more exertion in squadrons that fly heavies, like Sergeant McKenna's with its C-141Bs, which have oxygen prepositioned but need multiplace life rafts and other lifesaving gear.

"It's not easy to tell an officer he's doing something wrong," said Sergeant McKenna. Yet flight crew members by the hundreds risk injury if they wear improperly tested or unauthorized helmet earcups. "It's up to the staff sergeant or airman out there to tell them they can't do it."

Though scheduling varies with each command, every flying squadron holds continuation training. In Air Combat Command and Air Mobility Command, which between them have two-thirds of the active-duty life supporters, aircrews get hands-on life-support equipment training and water egress training every year.

Aircrews get their initial survival training (as well as POW training) at Fairchild AFB, Wash. Those who fly ejection-seat aircraft go to water survival school at Tyndall AFB, Fla., while tanker/transport flyers stay at Fairchild for a two-day, non–ejection seat water survival course. Those assigned to the north get Arctic survival training at Eielson AFB, Alaska. All of these "schoolhouses" are taught by Joint Services SERE (Survival, Evasion, Resistance, and Escape) Agency instructors whose own career field became an offshoot of life support in 1956. Once the aircrew member gets to a squadron, life supporters handle the rest of the job.

Combat survival training is given to all aircrews every three years, sometimes by SERE instructors but more often by life supporters. This

Photo © Michael Longe

Lifesaving equipment can't help a soul if not well maintained, stocked, and stowed. SrA. Fred Smith of the 16th SOS conducts a periodic inspection of a life raft, repacking and securing it before reinstalling it in an aircraft.

puts them outdoors, constructing a lean-to with a parachute canopy as a roof while teaching flyers how to stay alive after being downed.

Fixing the Red Ball

Life supporters typically spend little time on the flight line, perhaps one to three hours a day for several days a month, performing monthly inspections on parachute assemblies, oxygen regulators, and emergency oxygen systems and removing and installing survival kits and parachutes, as well as "running red balls"—that is, fixing equipment problems that keep an aircraft from going aloft.

Life supporters worry that they'll eventually be deprived of even this link to flying—which is what lured them to the job in the first place. "We're here because we want to be 'up close and personal' with the flying experience," said SSgt. Brian K. Livengood of the F-16-equipped 121st Fighter Squadron, District of Columbia ANG, at Andrews. "But the trend is, they're telling us to concentrate on the equipment. They're talking about pulling us off the flight line altogether."

Men and women come into this field for different reasons. Sergeant Livengood joined up because the short-lived 1982 TV series "Call to Glory" showed life supporters helping a U-2 pilot get ready to launch. MSgt. John Mansfield, NCO in charge with the 121st Fighter Squadron, "thought it looked really interesting because you get to deal with both pilots and equipment."

Life support is one area where things are always changing. Suddenly, orange LPU-9/P life preservers are out (too few exist to justify keeping them in stock) and blue ones are in. Only the most nostalgic jet jock could miss the bone-crushingly heavy helmets of the recent past; several versions were replaced by the lightweight HGU-55/P. The MBU-12/P custom-fitted oxygen mask is now replacing MBU-5/P models. In the process of replacing masks, the Air Force discovered that it has too many masks everywhere and that some of the new ones were unusable due to an abnormal shape (lopsided or lack of contour). Old survival radios, for which spare parts are almost impossible to get, are being replaced by the PRC-112 and PRC-125.

Photo by Ross Harrison Koty

When the aircrews are "stepping," life-support specialists must make sure they pause to pay attention to their gear. SSgt. Steve Wolf assists F-16 pilot 1st Lt. Shane Riza of the 57th Test Group in a final preflight check.

The life supporter deploys to world trouble spots on zero notice, but in ordinary times he has too few opportunities for duty assignments away from Squadron Ops. The Air National Guard is the only component that routinely places enlisted life supporters on mishap investigation boards. The active-duty and Air Force Reserve components like the idea and plan to follow suit.

It's not happy work. "A lot of times, if there's no survivor around to tell you what happened," pointed out Chief Cramer, "you can only learn from pilot clothing, or from a broken helmet, or something of that nature. Only a life supporter can do that."

SMSgt. Rob Darter landed a rare assignment that combines mishap investigation with archeology. Sent to Vietnam as part of the Joint Task Force–Full Accounting (JTF-FA) team sifting through POW/MIA crash sites, Sergeant Darter found himself trying to identify aircrews missing in action from what remained, a quarter-century later, of their "kit."

At one juncture, pouring a bucket of sand over a screen to sift out possible remains and aircraft parts, Sergeant Darter came upon four metal teeth from the zipper of a flight suit. This "find," combined with other forensic foraging at the crash site, enabled JTF-FA to confirm that a particular crewman did not bail out—and so could not be a POW.

Still, the vocation offers too few broadening experiences. Only a handful can win assignments to the Life Support Equipment Laboratory at Kelly where new systems are designed and tested.

If funding can keep up with technology—no certainty in the 1990s—the lab at Kelly and the other sources of new equipment will change the life-support environment rapidly. With the F-22, the Air Force will introduce the second generation of fighters that can handle more punishment than their pilots can, and progress will have to be made with new items of equipment like the Combat Edge advanced technology G-ensemble and the Advanced Tactical Anti-G Suit. The Advanced Eye Respiratory Protection System, a new chemical defense ensemble, is on the way.

One thing won't change. "The satisfaction comes when a plane lands," said Sergeant Sevigny, "and you know there've been no red balls, no complaints about hot spots—that everything worked as advertised, and the crew wasn't worrying about equipment when they should have been flying the mission. They step out of that plane, and you feel good that it's been right." ■

Robert F. Dorr, an Air Force veteran, is a free-lance writer in the Washington, D. C., area. His most recent article for Air Force *Magazine, "The Loadmasters," appeared in the October 1993 issue.*

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Rev. Richard Carr
(ex officio)
National Chaplain
Springfield, Va.
Capt. Kathyrn A. Day
(ex officio)
Chairman, Junior Officer
Advisory Council
Ramstein AB, Germany
CMSgt. Gary L. Thomas
(ex officio)
Chairman,
Enlisted Council
USAF Academy, Colo.
Erica Richardson
(ex officio)
National Commander
Arnold Air Society
Champaign, Ill.

Gallery of Russian Aerospace Weapons

By John W. R. Taylor

Attack Aircraft

MiG-27D ("Flogger-J") (Austin J. Brown)

MiG-27 (NATO "Flogger-D and J")

This single-seat, variable-geometry, ground-attack aircraft has many airframe features in common with the MiG-23. It has the same basic power plant as the MiG-23M but with a two-position (on/off) afterburner nozzle and fixed engine air intakes, consistent with the primary requirement of transonic speed at low altitude. MiG-27s serve with both Russian ground-attack air forces and Naval Aviation units. There are two main variants:

MiG-27K (Flogger-D). Forward portion of fuselage completely redesigned by comparison with MiG-23 interceptors. The nose is sharply tapered in side elevation, with a small sloping window at the front, covering a laser rangefinder and marked target tracker. PrNK-23K nav/attack system provides automatic flight control, gun firing, and weapon release. Seat and canopy raised to improve view from cockpit. External armor plate on flat sides of cockpit of early aircraft only. Wider, low-pressure, mainwheel tires. Six-barrel 30-mm GSh-6-30 underbelly gun, with 260 rds, replaces GSh-23 of interceptor. Bomb/JATO (Jet-Assisted Take-off) rack under each side of rear fuselage, in addition to five pylons for 8,820 lb of external stores, including tactical nuclear bombs, R-3S (AA-2 "Atoll") and R-13M AAMs, Kh-23 (AS-7 "Kerry") and Kh-29 (AS-14 "Kedge") ASMs, 240-mm rockets, UB-32A or UB-16 pods of 57-mm rockets, twenty-two 110/220-lb bombs, nine 550-lb or eight 1,100-lb bombs, or napalm containers. Bullet-shaped antenna above each glove pylon, associated with missile guidance. Blister fairing under nose of later aircraft, with windows, providing rearward designation capability for laser weapon delivery. Radar warning receiver (RWR) fairing each side of front fuselage, ahead of nosewheel bay. Other equipment includes SUV fire-control system and an active ECM jammer.

MiG-27D (Flogger-J). Identified in 1981 and delivered subsequently in successively upgraded variants. Improved PrNK-23M nav/attack system. Final model has wider and deeper nose, with lip at top over much larger and less sloping window for the more advanced Klen laser rangefinder. Bullet-shaped antennas above wingroot glove pylons deleted. Wingroot leading-edge extensions on some aircraft. As well as two SPPU-22 pods, each containing a twin-barrel 23-mm gun that can be depressed to fire downward (with 260 rds), this version can carry a photoreconnaissance pod containing three cameras. *(Data for MiG-27K.)*

Power Plant: one Soyuz/Khachaturov R-29B-300 turbojet; 25,335 lb thrust with afterburning.

Dimensions: as for MiG-23M (which see), except length 56 ft 0¼ in.

Weights: gross from unprepared runway 39,920 lb, gross with eight 1,100-lb bombs 45,570 lb.

Performance: max speed at height Mach 1.7, at S/L Mach 1.1, ceiling 45,900 ft, T-O run 3,120 ft, landing run with brake-chute 2,950 ft, combat radius (lo-lo-lo) with two Kh-29 missiles 140 miles, with two Kh-29s and three external tanks 335 miles.

Armament: described above.

Sukhoi Su-17 (NATO "Fitter-C, D, G, H, and K")

Swingwing Fitters continue to serve in diminishing numbers with ground-attack units of the Russian Air Forces. Others are deployed at land bases of the Baltic Fleet and in the Pacific for antiship strikes and amphibious support roles. Variants are as follows:

Su-17M (Fitter-C). Basic single-seat attack aircraft with AL-21F-3 turbojet. Manual wingsweep control, to 30°, 45°, and 63°. Curved dorsal fin. Gun in each wingroot. Equipment includes SRD-5M I-band centerbody ranging radar, ASP-5ND fire-control system, Sirena-3 omnidirectional radar warning system, and SRO-2M IFF. Operational since 1971 in small numbers.

Su-17M-2/M-2D (Fitter-D). Generally similar to Su-17M, but forward fuselage lengthened by 15 inches and drooped 3° to improve pilot's view. Added undernose pod for Doppler navigation radar. Klen laser rangefinder in intake centerbody.

Su-17UM-3 (Fitter-G). Two-seat trainer variant of Su-17M-3, with combat capability. Drooped front fuselage like Su-17M-2. Deepened dorsal spine fairing for additional fuel tankage. Taller vertical tail surfaces. Shallow ventral fin (removable). Starboard gun only. Laser rangefinder standard.

Su-17M-3 (Fitter-H). Improved single-seater with same deepened spine and tail modifications as Su-17UM-3. Doppler navigation radar fitted internally in deepened undersurface of nose. Retains both wingroot guns. Launcher for R-60 (AA-8 "Aphid") AAM between each pair of underwing pylons. About 165 Fitter-H/Ks were equipped for tactical reconnaissance, typically with a centerline sensor pod, an active ECM pod under the port wing glove, and two underwing fuel tanks.

Su-17M-4 (Fitter-K). Single-seat version identified in 1984. Dorsal fin embodies small cooling air intake at front. Chaff/flare and decoy dispensers standard. Weapons include four S-25 tube-launched rockets with 325-mm head. When four SPPU-22 gun pods are fitted, with downward attack capability, the two underfuselage pods can be arranged to fire rearward. *(Data for Su-17M-4.)*

Power Plant: one Saturn/Lyulka AL-21F-3 turbojet; 24,800 lb thrust 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, T-O run 2,955 ft, landing run 3,120 ft, max range at height 1,430 miles, at S/L 870 miles.

Accommodation: pilot only.

Armament: two 30-mm NR-30 guns, each with 80 rds, in wingroots; nine pylons under fuselage and wings for up to 9,370 lb of nuclear weapons, bombs, rocket pods, air-to-surface rockets, 23-mm SPPU-22 gun pods, two R-3 (AA-2 "Atoll"), R-60 (AA-8 "Aphid"), or R-73A (AA-11 "Archer") AAMs, Kh-23 (AS-7 "Kerry") or Kh-25ML (AS-10 "Karen") ASMs, or a reconnaissance pod.

Sukhoi Su-24 (NATO "Fencer")

About one-quarter of the estimated 900 Su-24s delivered from the Komsomolsk factory continue to form primary strike components of the Russian Air Forces. Reassignment of other former Air Army Fencers has increased the capability of MD/GOF and Naval Aviation forces, often replacing Su-17s and deployed for operation alongside MiG-25BMs carrying antiradiation missiles.

Sukhoi Su-24MR ("Fencer-E") (P. R. Foster)

Smaller and lighter than USAF's F-111, with three-position (16°, 45°, 69°) variable-geometry wings, the Su-24 entered first-line service in December 1974. Its ability to deliver a wide range of ASMs provides defense suppression and some hard-target kill potential, with the emphasis on low-level attack. Its already impressive combat radius was increased in the 1980s by the addition of an in-flight refueling probe and provision for carrying buddy refueling equipment. Current operational versions:

Su-24 (Fencer-C). Entered service in 1981, with important equipment changes. Multiple fitting on nose instead of former simple probe. Triangular fairing for RWR forward of each wingroot on side of air intake and on each side of fin near tip.

Su-24M (Fencer-D). Primary version, introduced in 1983. Believed to have terrain-following radar instead of former terrain-avoidance system. Longer nose (approx 2 ft 6 in) for new avionics bay. Added in-flight refueling capability, with centrally mounted retractable probe forward of windshield. Undernose antennas deleted; laser ranger/designator added aft of nosewheel bay; single long noseprobe. Overwing fences integral with extended wingroot glove pylons fitted when carrying Kh-29 (AS-14 "Kedge") ASMs.

Su-24MR (Fencer-E). Reconnaissance variant of Su-24M used by Tactical and Naval Air Forces. Internal equipment includes Shtik side-looking airborne multimission radar in shorter radome, Zima IR reconnaissance system, Aist-M TV reconnaissance system, and panoramic and oblique cameras in ventral fairing. A Shpil-2M laser pod can be carried on the centerline,

with a Tangazh electronic intelligence (elint) pod or Efir-1M radiation detector pod on the starboard underwing swiveling pylon, and two R-60 AAMs under the port wing. Data can be transmitted to the ground by data link. Flight refueling and ASM capabilities are retained.

Su-24MP (Fencer-F). Electronic warfare/jamming/signals intelligence (sigint) version to replace Brewer-E model of Yak-28. Added small fairing under nose. Centerline EW pod. *(Data for Su-24M.)*

Power Plant: two Saturn/Lyulka AL-21F-3A afterburning turbojets; each 24,690 lb thrust.

Dimensions: span 57 ft 10 in spread, 34 ft 0 in swept, length 80 ft 5¾ in, height 20 ft 3¾ in.

Weights: empty, equipped 41,885 lb, gross 87,520 lb.

Performance: max speed at height Mach 1.35, at S/L (clean) Mach 1.08, ceiling 57,400 ft, T-O run 4,265 ft, landing run 3,120 ft, combat radius (lo-lo-lo) more than 200 miles, (hi-lo-hi, with 6,615 lb of weapons and two external tanks) 650 miles.

Accommodation: pilot and weapon systems officer, side by side.

Armament: one GSh-6-23M six-barrel 23-mm Gatling-type gun on starboard side of belly; nine pylons under fuselage, wingroot gloves, and outer wings for 17,635 lb of air-to-surface weapons, including TN-1000 and TN-1200 nuclear weapons, up to four TV- or laser-guided bombs, conventional bombs (typically 38 x 220-lb FAB-100), 57-mm to 370-mm rockets, 23-mm gun pods, and such ASMs as Kh-23 (AS-7 "Kerry"), Kh-25ML (AS-10 "Karen"), Kh-58 (AS-11 "Kilter"), Kh-25MP (AS-12 "Kegler"), Kh-59 (AS-13 "Kingbolt"), Kh-29 (AS-14 "Kedge"), and Kh-31 (AS-17 "Krypton"). Two R-60 (AA-8 "Aphid") AAMs can be carried for self-defense.

Sukhoi Su-25 (NATO "Frogfoot")

First flown February 22, 1975, the Su-25 is a modern counterpart of the World War II Ilyushin Il-2 Shturmovik close-support aircraft, intended to battle through to ground targets at low level with a heavy weapon load. The pilot is protected by an all-welded cockpit of titanium armor. Pushrods rather than cables actuate the control surfaces, main load-bearing members are damage-resistant, the engines are widely separated in stainless steel bays, and the fuel tanks are filled with reticulated foam for explosion protection. A total of 256 flares can be packed into dispensers above the engine nacelles and tailcone for use during eight attack runs. These and other survivability features account for 7.5 percent of the aircraft's normal takeoff weight. The big wings support 10 pylons for a wide range of ordnance, including self-protection AAMs. The engines will run on any fuel likely to be found in a combat area, including MT gasoline and diesel oil. The Su-25 can ferry into a forward operating area, on its underwing pylons, a four-pod servicing kit adequate to keep it operating independently of ground equipment for 12 days.

Production of the basic version for the Russian Air Forces has ended, and some Su-25s delivered earlier from the Tbilisi airframe plant to Air Forces units have been passed to Naval Aviation. The remainder make up more than one-third of the fighter-bomber force. Versions identified to date:

Su-25 (Frogfoot-A). Basic single-seat close-support version.

Su-25UB (Frogfoot-B). Tandem two-seat operational conversion and weapons trainer. Raised rear cockpit. Taller tailfin. Gun and weapons pylons retained.

Su-25UT (Frogfoot-B). As Su-25UB but without weapons. Prototype first flew August 6, 1985. Few only.

Su-25UTG (G for *gak*, "hook") (Frogfoot-B). As Su-25UT, with arrester hook added under tail for deck landing training on dummy flight deck marked out on runway at Saki Naval Airfield, and for use on the carrier *Admiral Kuznetsov*. Ten built; four based at Severomorsk, Kola Peninsula, for service on *Admiral Kuznetsov*.

Su-25UBP. Ten Su-25UBs were to be converted to Su-25UBP (*Palubnyi*, "shipborne") for service on *Admiral Kuznetsov*. Cancellation reported.

Su-25BM. Standard Su-25 with added underwing pylons for rocket-powered targets released for missile training by fighter pilots.

Su-25T. See separate entry. *(Data for Frogfoot-A.)*

Power Plant: two Soyuz/Tumansky R-195 turbojets; each 9,921 lb thrust. To reduce infrared signature, a small pipe in the tailcone of each turbojet on later aircraft expels air to lower exhaust temperature.

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, airbrakes open, 428 mph, ceiling 22,965 ft, T-O run 1,970–3,935 ft, landing run 1,312–1,970 ft, range with combat load at S/L 466 miles, at height 776 miles.

Accommodation: pilot only.

Armament: one twin-barrel 30-mm gun in port side of nose, with 250 rds. Eight underwing pylons for 9,700 lb of air-to-surface weapons, including Kh-23 (AS-7 "Kerry"), Kh-25 (AS-10 "Karen"), and Kh-29 (AS-14 "Kedge") ASMs, SPPU-22 pods for 23-mm guns with twin barrels that pivot downward, 57-mm to 370-mm rockets, laser-guided rocket-boosted bombs, and 1,100-lb incendiary, antipersonnel, and other cluster bombs. Two small outboard pylons for R-3S (AA-2D "Atoll") or R-60 (AA-8 "Aphid") AAMs.

Sukhoi Su-25 ("Frogfoot-A") (P. R. Foster)

Sukhoi Su-27IB (Sebastian Zacharias)

Antonov An-72P ("Coaler") (Piotr Butowski)

Su-25T

The **Su-25T** is a considerably upgraded "Frogfoot" derivative with improved navigation and attack systems and new missiles. The first development aircraft flew in August 1984. Eight were delivered to the Russian Air Forces in 1993. Embodying lessons learned during action in Afghanistan, the original prototype utilized a converted Su-25UB airframe, with the humped rear cockpit faired over and the internal space used to house new avionics and an extra metric ton of fuel. The navigation system, with two digital computers and an inertial platform, permits flights to and from combat areas under largely automatic control. The widened nose houses a TV system, laser rangefinder, and target designator of improved capability. The TV can be activated some six miles from the target, after which target tracking, weapon selection, and release are automatic.

Chaff/flare dispensers are installed in the top of the fuselage tailcone and in a large cylindrical housing at the base of the rudder. This housing also contains an infrared jammer, optimized against Stinger and Redeye frequencies. A radar warning/emitter location system is standard. The Voskhod nav/attack system and Schkval electro-optical system are intended to ensure precision attacks on enemy armor (the T in the aircraft's designation indicates "antitank"). A Khod centerline IR pack enables a main battle tank to be identified at night over a distance of nearly two miles. The gun is transferred to an underbelly position on the starboard side of a farther-offset nosewheel.

Dimensions: span 47 ft 7¾ in, length 50 ft 3½ in, height 17 ft 0¾ in.

Weight: gross 42,990 lb.

Performance: max speed 590 mph, ceiling 32,800 ft, T-O and landing run on unpaved runway 2,300 ft, combat radius with 4,410 lb of weapons at S/L 248 miles, at height 435 miles.

Armament: as Su-25, plus two eight-round underwing clusters of Vikhr (AT-9) tube-launched ASMs able to penetrate 900 mm of reactive armor, KAB-500 laser-guided bombs, and Kh-25ML (AS-10 "Karen"), Kh-58 (AS-11 "Kilter"), Kh-29L (AS-14 "Kedge"), and Kh-31 (AS-17 "Krypton") ASMs. Max external weapon load 9,612 lb.

Sukhoi Su-27IB/Su-34

A side-by-side two-seat development of the Su-27, with foreplanes and twin nosewheels but without folding wings or deck hook, conducted trials with (but not necessarily landing on) the aircraft carrier *Admiral Kuznetsov*. Described as a deck landing trainer, with the designation **Su-27KU**, it had a wider nose, a deep fairing behind the canopy, and wing extensions carried forward as chines to the tip of the nose. The nosewheel leg had been moved forward and retracted rearward. The example seen had no ventral fins, radar, infrared search and track (IRST), or underwing pylons, but the gun was retained.

This or a similar aircraft was exhibited in modified form at Machulishche Airfield, near Minsk, in February 1992, with attack weapons and internal ECM, under the designation **Su-27IB** (*Istrebitel Bombardirovschik*, "fighter-bomber"). It is reported to be in production for the Russian Air Forces as the **Su-34** to replace the MiG-27, Su-17, and some Su-24s.

Power Plant: probably two Saturn/Lyulka AL-35F turbofans; each 29,900 lb thrust with afterburning. Retractable flight refueling probe beneath port windshield.

Armament: prototype at Machulishche had 10 stores pylons (two under intake ducts, two on wingtips, three under each wing), with simulated armament of two Kh-31A/P (AS-17 "Krypton") and two Kh-29 (AS-14 "Kedge") ASMs, two 1,100-lb laser-guided bombs, and two R-73A (AA-11 "Archer") and two R-77 (AA-12) AAMs. Other weapons include those listed for Su-27.

Bombers and Maritime

Antonov An-72P (NATO "Coaler")

This maritime patrol aircraft is based on the standard airframe of the An-72 STOL transport. First seen in 1992, the An-72P is intended for armed surveillance of coastal areas, within 230 miles of shore, in all-weather day/night conditions, carrying a navigator and radio operator in addition to the basic three-person crew. On-board avionics permit automated navigation at all stages of flight and precise fixing of the coordinates, speed, and heading of surface ships. Fixed cameras for photographing targets are supplemented by a TV scanning system, with flares for night use. The TV equipment is carried in the port main landing gear fairing. A 23-mm gun pod can be mounted forward of the starboard fairing, with a UB-32M rocket pack under each wing. The day/night cameras are carried in the fuselage aft of the rear loading hatch; four 220-lb bombs can be carried in the roof of the hold, above the hatch, with the loading ramp slid forward under the cabin to make their release practicable. An initial order for 20 An-72Ps for Russian military use has been announced during the past year. *(Data generally as for An-72.)*

Weights: mission load 1,433 lb, gross 70,545 lb.

Performance: patrol speed at 1,640–3,280 ft 186–217 mph, ceiling 33,135 ft, field requirement 4,600 ft, max endurance 5 hr 18 min.

Accommodation: on secondary missions can carry and air-drop 22 fully equipped paratroops, or transport 40 passengers, 16 litter patients and attendant, or up to 11,020 lb of ammunition, vehicles, or equipment.

Beriev A-40 Albatross and Be-42 (NATO "Mermaid")

The Albatross is the largest amphibian yet built. In its basic **A-40** form, it was designed to replace the Il-38 "May" and M-12 "Mail," though not on a one-for-one basis. Equipped for ASW/surveillance/minelaying duties, it carries weapons and other stores in a 21 ft 4 in bay in the bottom of the hull aft of the step.

The prototype was first observed by a US reconnaissance satellite passing over the Beriev OKB facilities at Taganrog, in the northeast corner of the Sea of Azov, in the spring of 1988. It made its first public appearance in the Aviation Day flyby at Tushino Airport,

Moscow, August 20, 1989, and an initial batch of 20 is now in production for Russian Naval Aviation. Features include flush intakes at the front of the underwing pods to provide cooling air for its extensive avionics, booster turbojets in pods with eyelid nozzles at the rear of the pylon supports for the primary turbofans, a large nose radar, cylindrical containers for ESM above the wingtip floats, and an in-flight refueling probe on the nose. Traditional cockpit instrumentation on the early aircraft is expected to be replaced by color CRTs on production A-40s. As a consequence of recent flight tests, the length of the strakes on the forward portion of the hull has been considerably extended.

Variants of the A-40 include the **Be-42** search-and-rescue amphibian, design of which began in 1988. Its equipment includes extensive radio, radar, electro-optical sensors, and searchlights to detect shipwreck survivors by day or night. A rescue team with power boats, life rafts, and other specialized equipment can be carried, and there is room for up to 54 survivors, who enter the aircraft via hatches in the side of the hull with the aid of mechanized ramps. On-board equipment to combat hypothermia is available, together with resuscitation and surgical equipment and medicines. All ASW equipment, the booster turbojets, and ESM are deleted.

Further versions of the A-40 are projected as the **Be-40P** to carry up to 105 passengers and the **Be-40PT** transport for mixed cargo/passenger payloads. *(Data for basic A-40.)*

Power Plant: two Aviadvigatel D-30KPV turbofans, each 26,455 lb thrust, on pylons above rear of hull (33,070 lb thrust engines to be fitted later). Two RKBM RD-60K booster turbojets, each 5,510 lb thrust.
Dimensions: span 136 ft 6½ in, length 143 ft 10 in, height 36 ft 3¾ in.
Weights: max payload 14,330 lb, gross 189,595 lb.
Performance: max speed at 19,700 ft 472 mph, max cruising speed 447 mph, ceiling 31,825 ft, T-O run 3,280 ft, landing run 2,955 ft, range with max payload 2,547 miles, with max fuel 3,417 miles.
Accommodation: crew of eight.
Armament: not yet specified.

Beriev M-12/Be-12 Tchaika (NATO "Mail")

Of an estimated 100 **M-12** twin-turboprop amphibians, built from 1964, about 75 are in service. Built for overwater surveillance and antisubmarine duties within a 230-mile radius of Naval Aviation shore bases, some have been converted into **Be-12PS** search-and-rescue amphibians. *(Data for M-12.)*

Power Plant: two ZMKB Progress/Ivchenko AI-20M turboprops; each 4,190 ehp.
Dimensions: span 97 ft 5¾ in, length 99 ft 0 in, height 22 ft 11½ in.
Weight: gross 68,345 lb.
Performance: max speed 378 mph, service ceiling 37,000 ft, max range 4,660 miles.
Accommodation: crew of five.
Armament and Operational Equipment: torpedoes, depth charges, mines, and other stores for maritime search and attack carried in internal bay aft of step in bottom of hull and on four pylons under outer wings. Radar in nose "thimble"; MAD (magnetic anomaly detection) tailsting.

Ilyushin Il-38 (NATO "May")

Derived from the Il-18 airliner, this intermediate-range, shore-based, antisubmarine/maritime patrol aircraft serves with Naval Aviation units at coastal bases and on detachments overseas. Standard equipment includes a large radome under the front fuselage and an MAD tailsting, with two internal weapons/stores bays forward and aft of the wing carry-through structure.

Power Plant: four ZMKB Progress/Ivchenko AI-20M turboprops; each 4,190 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 at 21,000 ft 448 mph, patrol speed at 2,000 ft 248 mph, T-O run 4,265 ft, landing run 2,790 ft, max range 4,473 miles, patrol endurance 12 hr.
Accommodation: crew of nine.
Armament and Operational Equipment: variety of attack weapons and sonobuoys in weapons bays.

Sukhoi T-60S

The Sukhoi OKB is developing a new intermediate-range bomber to replace the Tu-16, Tu-22, and Su-24, under the project designation T-60S. No details are available.

Tupolev Tu-16 (NATO "Badger")

After 40 years of stalwart service, the Tu-16 has been largely retired from its attack roles. The Air Forces may retain many of the 20 Tu-16N tankers and 105 reconnaissance/ECM Tu-16s that support their attack units. Similarly, Naval Aviation bases may require for some time their few remaining attack models (mostly Badger-G) and a proportion of the 150 tankers, reconnaissance, and ECM Tu-16s that they had in the 1980s. Versions listed below are, therefore, of varying significance:

Tu-16A (Badger-A). Original strategic bomber version. Glazed nose with small undernose radome. Armed with seven 23-mm guns. Some equipped as in-flight refueling tankers (**Tu-16N**) using a unique wingtip-to-wingtip transfer technique to refuel other Tu-16s or a probe-and-drogue system to refuel Tu-22s.

Tu-16K-10 (Badger-C). Antiship version, with obsolete K-10S (AS-2 "Kipper") winged missile in recess under fuselage from 1958. Wide nose radome in place of glazing and nose gun of Tu-16A. No provision for free-fall bombs.

Tu-16K-10-26 (Badger-C Mod). Modified to carry two KSR-5 (AS-6 "Kingfish") missiles under wings, from 1962. K-10S compatibility retained.

Tu-16R (Badger-D). Maritime/electronic reconnaissance version. Nose like Tu-16K-10. Larger undernose radome. Three elint radomes in tandem under weapons bay, which contains cameras.

Tu-16 (Badger-E). Photographic and electronic reconnaissance version. Similar to Tu-16A but with camera in weapons bay and two additional radomes under fuselage, larger one aft.

Tu-16R (Badger-F). Basically as Badger-E but with elint pod on pylon under each wing. Late versions have small radomes under center-fuselage.

Tu-16K-11/16 (Badger-G). Converted from Badger-B. Generally as Tu-16A but with underwing pylons for two obsolescent KSR-11 or KSR-2 (AS-5 "Kelt") rocket-powered ASMs that can be carried to a range greater than 2,000 miles. Free-fall bombing capability retained. Serves with antiship squadrons of the Naval Air Forces.

Tu-16K-26 (Badger-G Mod). Equipped to carry KSR-5 (AS-6 Kingfish) ASM under each wing. Large radome, presumably associated with missile operation, under center-fuselage, replacing chin radome. Device mounted externally on glazed nose might help to ensure correct attitude of Tu-16 during missile launch.

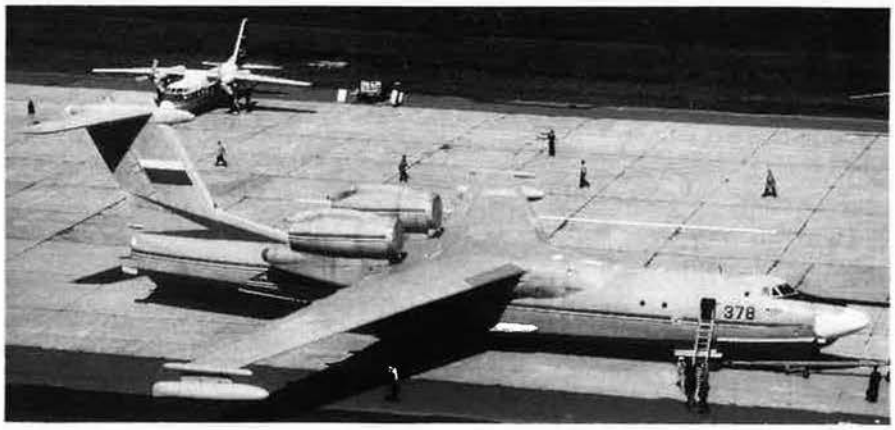
Tu-16PP (Badger-H). Standoff or escort ECM aircraft to protect missile-carrying strike force, with primary function of chaff dispensing. Two teardrop radomes, fore and aft of weapons bay, house passive receivers to identify enemy radar signals and establish length of chaff strips to be dispensed. The dispensers (max capacity 20,000 lb) are in the weapons bay, with three chutes in doors. Hatch aft of weapons bay. Two blade antennas aft of weapons bay. Glazed nose and chin radome.

Tu-16PP (Badger-J). ECM jamming aircraft to protect strike force, with some equipment in a canoe-shaped radome protruding from the weapons bay and surrounded by heat exchangers and exhaust ports. Antiradar noise jammers operate in A to I bands inclusive. Glazed nose as Tu-16A. Some aircraft have large flat-plate antennas at wingtips.

Tu-16R (Badger-K). Electronic reconnaissance variant with nose like Tu-16A. Two teardrop radomes, inside and forward of weapons bay (closer together than on Badger-H); four small pods on centerline in front of rear radome. Chaff dispenser aft of weapons bay.

Tu-16 (Badger-L). Naval electronic warfare variant. Like Badger-G but with equipment of the kind fitted to the Tu-95 "Bear-G," including an ECM nose thimble, pods on center-fuselage forward of engine ducts, and "solid" extended tailcone housing special equipment instead of tailgun position. Sometimes has a pylon-mounted pod under each wing. *(Data for Badger-G.)*

Power Plant: two Mikulin RD-3M-500 turbojets; each 20,920 lb thrust.
Dimensions: span 108 ft 3 in, length 114 ft 2 in, height 34 ft 0 in.



Beriev A-40 Albatross ("Mermaid") (Sebastian Zacharias)

Beriev Be-12PS ("Mail") (Piotr Butowski)

Weights: empty 82,000 lb, normal gross 165,350 lb.
Performance: max speed at 19,700 ft 652 mph, ceiling 49,200 ft, range with 6,600-lb bomb load 3,580 miles.
Accommodation: crew of six (eight to 10 in Tu-16Rs).
Armament: seven 23-mm AM-23 guns; in twin-gun turrets above front fuselage, under rear fuselage, and in tail, with single gun on starboard side of nose. Two Kingfish missiles; or up to 19,800 lb of bombs in internal weapons bay. Normal bomb load 6,600 lb.

Tupolev Tu-22 (NATO "Blinder")

Naval Aviation has about 30 Tu-22 bombers and 20 maritime reconnaissance/ECM Blinders. Most of those in the Air Forces (about 75 total) have been reassigned progressively to such support roles as ECM jamming and reconnaissance. The following versions have been identified:

Tu-22 (Blinder-A). Original bomber version, first seen in 1961, with fuselage weapons bay for 26,450 lb of free-fall nuclear or conventional 550-lb to 19,840-lb bombs. Limited production only.

Tu-22K (Blinder-B). Similar to Blinder-A but equipped to carry a Kh-22 (AS-4 "Kitchen") ASM recessed in weapons bay. Larger radar and partially retractable flight refueling probe on nose. Free-fall bombing capability retained.

Tu-22R (Blinder-C). Daylight reconnaissance version with six windows for pairs of long-focal-length cameras in weapons bay doors. Chaff dispensing chute. Flight refueling probe like Blinder-B. "Solid" extended tailcone, housing ECM equipment, replaces tailgun installation on some aircraft.

Tu-22R (Blinder-C Mod). Capability extended to night reconnaissance by addition of centerline conformal pack, approx 18 ft long and 3 ft wide, possibly housing IR and other sigint systems together with photo-flares.

Tu-22U (Blinder-D). Training version. Cockpit for instructor in raised position aft of standard flight deck, with stepped-up canopy.

Tu-22P (Blinder-E). Electronic warfare/reconnaissance conversion with avionics and cooling systems in weapons bay. Ventral fairing, approx 20 ft long and 1 ft deep, under centerline, with heat exchanger blister

Tupolev Tu-22M-3 ("Backfire-C") (Piotr Butowski)

at rear. Four sweptback jamming antennas at corners of weapons bay doors. Modified nosecone, additional dielectric panels, etc.

Power Plant: two Dobrynin RD-7M-2 turbojets in pods above rear fuselage, on each side of tailfin; each 36,350 lb thrust with afterburning. Provision for four JATO rockets.

Dimensions: span 77 ft 1¼ in, length 139 ft 9 in, height 32 ft 9¾ in.

Weight: gross 202,820 lb (207,230 lb with JATO).

Performance: max speed at 40,000 ft Mach 1.52, ceiling 43,635 ft, T-O run 7,385 ft, landing run 7,120 ft, combat radius 807–1,365 miles.

Accommodation: crew of three, in tandem.

Armament: single 23-mm NR-23 gun in radar-directed tail mounting, except with extended tailcone. Other weapons as described for individual versions.

Tupolev Tu-22M (NATO "Backfire")

Now available for export, the Tu-22M has been produced at the average rate of 30 a year since the late 1970s. Well over 200 have been delivered to the Strategic Air Armies, to attack deep theater targets; Naval Aviation units have more than 160. A high proportion of these forces are equipped with the advanced Tu-22M-3 version, including the majority of Smolensk units and regiments of the Irkutsk Air Army that were upgraded with equipment relocated from the Atlantic-to-the-Urals (ATTU) region prior to signature of the Conventional Forces in Europe (CFE) Treaty. The two versions in service:

Tu-22M-2 (Backfire-B). Initial series production version, with 48,500 lb thrust NK-22 turbofans. Three-position wingsweep (20°, 30°, 65°). Slightly inclined lateral engine air intakes, with large splitter plates. Armament up to three Kh-22 (AS-4 "Kitchen") ASMs or conventional bombs or mines. Two GSh-23 twin-barrel 23-mm guns, with barrels side by side horizontally, in radar-directed tail mounting. Above-nose fairing replaces formerly observed in-flight refueling probe.

Tu-22M-3 (Backfire-C). Advanced production version with more powerful engines and wedge-type air intakes, deployed from 1985. Upturned nosecone. No visible in-flight refueling probe. Can carry Kh-15P (AS-16 "Kickback") SRAMs. Single GSh-23 gun, with barrels one above the other, in aerodynamically improved tail mounting.

Backfire is capable of performing nuclear strike, conventional attack, and antiship missions, its low-level penetration features making it more survivable than earlier Tupolev bombers. Deployment of SRAMs with Backfire-C has improved deliverable warhead potential and increased flexibility for air force strategists. A possible electronic warfare version has been reported. *(Data for Tu-22M-3).*

Power Plant: two KKBM/Kuznetsov NK-25 turbofans; each 55,115 lb thrust with afterburning. Provision for JATO rockets.

Dimensions: span 112 ft 5¾ in spread, 76 ft 5½ in swept; length 139 ft 3¾ in; height 36 ft 3 in.

Weight: gross 273,370 lb (278,660 lb with JATO).

Performance: max speed at high altitude Mach 1.88, at low altitude Mach 0.9, nominal cruising speed 560 mph, ceiling 43,635 ft, T-O run 6,560–6,890 ft, landing run 3,940–4,265 ft, max unrefueled combat radius hi-lo-hi 1,365 miles.

Accommodation: crew of four, in pairs.

Armament: max offensive weapon load comprises three Kh-22 (AS-4 Kitchen) ASMs, with one semi-recessed under the center-fuselage and one under the fixed center-section panel of each wing; or 52,910 lb of conventional bombs or mines, half of them carried internally and half on external racks under the wings and engine air intake trunks. Internal bombs can be replaced by a rotary launcher for six Kh-15P (AS-16 Kickback) SRAMs, with four more underwing as alternative to Kh-22s. Normal weapon load is quoted as a single Kh-22 or 26,455 lb of bombs. Typical loads are two FAB-3000, eight FAB-1500, 42 FAB-500, or 69 FAB-250 or -100 bombs (figures indicate weight in kg), or eight 3,300-lb or 18 x 1,100-lb mines. Single GSh-23 twin-barrel 23-mm gun in radar-directed tail mounting.

Tupolev Tu-142M ("Bear-F" Mod 4) (Piotr Butowski)

Tupolev Tu-95MS ("Bear-H") (Sebastian Zacharias)

Tupolev Tu-95 and Tu-142 (NATO "Bear")

After 38 years of continuous production, ending in 1992, these remarkable propeller-driven aircraft continue to appear in new forms and remain a formidable spearhead of Russian strategic nuclear attack and maritime airpower. The air forces of the CIS have about 151 (89 in Russia), mostly Tu-95K-22 and Tu-95MS missile carriers; Naval Aviation has about 80 maritime reconnaissance/ASW/"TACAMO equivalent" versions. Major current versions:

Tu-95RT (Bear-D). Identified in 1967, this maritime reconnaissance aircraft is equipped with I-band surface search radar in a large blister fairing under the center-fuselage. Glazed nose with undernose radome and superimposed refueling probe. Elint blister fairing on each side of its rear fuselage. Added fairing at each tailplane tip. I-band tail-warning radar in large fairing at base of rudder. Defensive armament of six 23-mm NR-23 guns in pairs in remotely controlled rear dorsal and ventral turrets and manned tail turret. Carries no offensive weapons, but tasks include pinpointing of maritime targets for missile launch crews on board ships and aircraft that are themselves too distant to ensure precise missile aiming and guidance. About 15 operational.

A Bear-D was the first version seen, in 1978, with a faired tailcone housing ECM in place of the normal tail turret and associated radome.

Tu-95MR (Bear-E). Reconnaissance version with rear fuselage elint fairings and refueling probe. Seven camera windows in bomb bay doors. Armament as Tu-95RT. Few only.

Tu-142 (Bear-F). Antisubmarine aircraft. Extensively redesigned, with more highly cambered wings, double-slotted flaps, and longer fuselage forward of the wings. Deployed initially by Naval Aviation in 1970. Reentered production in the mid-1980s. Originally, Bear-F had enlarged and lengthened fairings for 12-wheel main landing gear bogies aft of its inboard engine nacelles and undernose radar. The main underfuselage J-band radar housing is considerably further forward and smaller in size than on Bear-D. There are no large blister fairings under and on the sides of the rear fuselage, and the nosewheel doors bulge prominently, suggesting the use of larger or low-pressure tires. Bear-F has two stores bays for sonobuoys, torpedoes, and nuclear or conventional depth charges in its rear fuselage, one of them replacing the usual rear ventral gun turret and leaving the tail turret as the sole defensive gun position. Later variants of Bear-F are identified as follows:

Mod 1: Reverted to standard-size nacelles and four-wheel main landing gear bogies. Chin-mounted J-band radar deleted. Fewer protrusions.

Mod 2 (**Tu-142M**): Nose lengthened by 9 in and roof of flight deck raised. Angle of refueling probe lowered by 4°. INS standard.

Mod 3 (**Tu-142M**): MAD boom added to fintip. Fairings at tips of tailplane deleted. Rear stores bay lengthened and narrowed.

Mod 4 (**Tu-142M**): Chin radar reinstated. ECM thimble radome on nose, plus other fairings. Observation blister each side of rear fuselage deleted. Entered service 1985; further deliveries 1991.

Most of approx 60 Bear-Fs in service are now to Mod 3 or Mod 4 standard. All versions of the Tu-142M were scheduled to have provision for eight Kh-35 active radar homing antiship missiles in underwing pairs from this year.

Tu-95K-22 (Bear-G). Bomber and elint conversion of early Bear-B/C bombers, able to carry two Kh-22 (AS-4 "Kitchen") ASMs, on a large pylon under each wingroot. Other features include a new undernose radar, an ECM thimble under the in-flight refueling probe, a streamlined ECM pod on each side at the bottom of both the center-fuselage and rear fuselage, and a "solid" tailcone, containing ECM, similar in shape to that on some Bear-Ds. Defensive armament of two 23-mm guns, in ventral turret. More than 45 operational.

Tu-95M-5. Missile carrier, with two KSR-5 (AS-6 "Kingfish").

Tu-95M-55. Carrier for unidentified missile, probably Kh-55 (AS-15 "Kent").

Tu-95MS (Bear-H). New-production bomber based on Tu-142 airframe, but fuselage shortened to length of Tu-95. Initial **Tu-95MS6** version carries six Kh-55 (AS-15A Kent) long-range cruise missiles on an internal rotary launcher. The **Tu-95MS16** carries two more under each wingroot and a cluster of three between each pair of engines, for a total of 16. Bear-H attained IOC in 1984, and more than 80 are deployed, some in the Far East. Features include a larger and deeper radome ("Clam Pipe") built into the nose and a small fintip fairing. There are no elint blister fairings on the sides of the rear fuselage, and the ventral gun turret is deleted. Some aircraft have a single twin-barrel 23-mm gun, instead of the usual pair, in the tail turret. An active electronic jammer, RWR, missile warning receivers, and chaff/flare dispensers are standard.

Tu-142MR (Bear-J). Identified in 1986, this is the Soviet equivalent of the US Navy's E-6A and EC-130Q TACAMO aircraft, with VLF communications avionics to maintain an on-station/all-ocean link between national command authorities and nuclear missile armed

submarines under most operating conditions. Large ventral pod for VLF trailing-wire antenna, several kilometers long, under center-fuselage in weapons bay area. Undernose fairing as on Bear-F Mod 4. Fintip pod with trailing-edge like that on some Bear-Hs. Satcom dome aft of flight deck canopy. Operational in comparatively small numbers with the Northern and Pacific Fleets, it appears to use a modified Tu-142 Bear-F airframe. *(Data for Tu-95MS.)*

Power Plant: four KKBM/Kuznetsov NK-12MV turboprops; each 14,795 ehp. Equipped for in-flight refueling.

Dimensions: span 167 ft 8 in, length 162 ft 5 in, height 39 ft 9 in.

Weights: empty 198,415 lb, gross 407,850 lb.

Performance: max speed at 25,000 ft 506 mph, nominal cruising speed 442 mph, ceiling 39,370 ft, combat radius with 25,000-lb payload 3,975 miles.

Accommodation: crew of seven.

Armament: as described for individual versions.

Tupolev Tu-160 (NATO "Blackjack")

Tu-160 and Tu-95 long-range bombers have been taken off alert status, and their nuclear weapons are being placed in storage at their bases. It was expected that at least 100 Tu-160s would be built at the huge Kazan airframe plant. Instead, only some 20 are in operational service—the same total as USAF's planned B-2 force. In most respects, the two types of strategic bomber could hardly be less similar. The subsonic, flying-wing, two-crew B-2 represents the epitome of stealth technology, to ensure optimum possibility of penetrating densely structured defenses. The supersonic, four-crew Tu-160 is configured like the B-1B, with scant attention to low-observables. It was believed initially to be intended as a high-altitude standoff cruise missile launcher. However, the rotary launcher inside each of its two weapons bays can carry SRAMs, as an alternative or in addition to ALCMs, for defense suppression during low-altitude penetration missions at transonic speed.

Blackjack is about 20 percent longer than the B-1B, with greater unrefueled combat radius and maximum level speed comparable with that of the original B-1 prototypes. It is in no way a simple scale-up of Tupolev's earlier Tu-22M. Common features include low-mounted variable-geometry (20° to 65°, manually selected) wings and a massive dorsal fin, but the Tu-160's horizontal tail surfaces are mounted high, near the intersection of the dorsal fin and all-moving main fin. When the wings are fully swept, the inboard flap-ends hinge upward as large fences. The very long and sharply swept fixed root panel of each wing, and the engine installation, resemble those of the long-retired Tu-144 supersonic transport rather than the Tu-22M.

Power Plant: four Samara/Trud NK-321 turbofans; each 55,115 lb thrust with afterburning. Provision for in-flight refueling.

Dimensions: span 182 ft 9 in spread, 116 ft 9¾ in swept; length 177 ft 6 in; height 43 ft.

Weight: gross 606,260 lb.

Performance: max speed at high altitude Mach 1.88, nominal cruising speed 497 mph, ceiling 60,000 ft, max unrefueled range 7,455 miles.

Accommodation: crew of four, in pairs, on ejection seats.

Armament: no guns; internal stowage for up to 36,000 lb of free-fall bombs, SRAMs, or ALCMs. Each rotary launcher carries 12 Kh-15P (AS-16 "Kickback") SRAMs or six ALCMs, currently Kh-55s (AS-15 "Kents").

MiG-23 (NATO "Flogger-B, C, G, and K")

The MiG-23 is expected to be withdrawn from first-line Russian service by the mid-1990s. Current variants are as follows:

MiG-23M (Flogger-B). Single-seat air combat fighter with 27,540 lb thrust Soyuz/Khachaturov R-29-300 turbojet. Wingsweep variable manually in flight or on the ground at 16°, 45°, or 72°. Equipment includes Sapfir-23D-Sh J-band radar (NATO "High Lark"), Sirena-3 RWR, TP-23 IRST, and Doppler. The first Soviet aircraft with a demonstrated ability to track and engage targets flying below its altitude. Standard version from about 1975.

MiG-23UB (Flogger-C). Tandem two-seater for operational training and combat use, with 22,045 lb thrust Tumansky R-27F2M-300 turbojet. Slightly raised second cockpit to rear, with retractable periscopic sight for occupant, and modified fairing aft of canopy.

MiG-23ML (Flogger-G). Basically similar to MiG-23M but with R-35 engine, rear fuselage fuel tank deleted, much smaller dorsal fin, Sapfir-23ML lighter-weight radar, and TP-23M IRST.

Tupolev Tu-160 ("Blackjack") (Sebastian Zacharias)

MiG-29UB ("Fulcrum-B") (Peter Steinemann)

MiG-23P (Flogger-G). Modified MiG-23ML. Digital navigation computer guides aircraft under automatic ground control and informs pilot when to engage afterburner and to fire missiles and gun.

MiG-23MLD (Flogger-K). Midlife update of MiG-23ML, identified by dogtooth notch at junction of wing glove leading-edge and intake trunk on each side. Leading-edge flaps extended and retracted automatically when wingsweep passes 33°. RWR and chaff/flare dispensers added. New IFF antenna forward of windshield. R-73A (AA-11 "Archer") close-range AAMs on fuselage pylons. Pivoting weapon pylons under outer wings. *(Data for MiG-23ML.)*

Power Plant: one Soyuz/Khachaturov R-35-300 turbojet, rated at 28,660 lb thrust with max afterburning. Variable-geometry air intakes and variable nozzle. Attachment for assisted takeoff rocket each side of rear fuselage.

Dimensions: span 45 ft 10 in spread, 25 ft 6¼ in swept, length incl probe 54 ft 10 in, height 15 ft 9¾ in.

Weights: empty 22,485 lb, max external weapons 6,615 lb, gross 32,405–39,250 lb.

Performance: max speed at height Mach 2.35, at S/L Mach 1.1, ceiling 60,700 ft, T-O run 1,640 ft, landing run 2,460 ft, combat radius with six AAMs 715 miles, with 4,410 lb of bombs 435 miles.

Accommodation: pilot only.

Armament: one twin-barrel 23-mm GSh-23L gun in belly pack, with 200 rds. Two pylons in tandem under center-fuselage, one under each engine air intake duct, and one under each fixed inboard wing panel, for AAMs, bombs, rocket packs, or other stores. Use of twin launchers under air intake ducts permits carriage of four R-60T (AA-8 "Aphid") missiles, in addition to two R-23R or R-23T (AA-7 "Apex") on underwing pylons.

MiG-25 (NATO "Foxbat-A, C, E, and F")

No combat aircraft in first-line service has exceeded the Mach 2.83 limit speed of the MiG-25 interceptor and its reconnaissance counterpart, the MiG-25R. The Ye-155P-1 prototype interceptor flew September 9, 1964. More than 300 of the production variants are in service and are expected to equip the home defense forces through the end of this century. Their airframes are manufactured of 80 percent tempered and welded steel, with eight percent titanium in areas subject to extreme heat, such as the wing and tail unit leading-edges, and 11 percent D19 heat-resistant aluminum alloy. Current versions:

MiG-25R series (Foxbat-B/D). Reconnaissance/bomber versions. Described in Reconnaissance, ECM, and Early Warning Aircraft section.

MiG-25PU and RU (Foxbat-C). Training versions of MiG-25P and R, respectively. Redesigned nose section, containing separate cockpit for instructor, with individual canopy, forward of standard cockpit and at lower level. No radar or reconnaissance sensors in nose and no combat capability. Limited to Mach 2.65.

MiG-25PD (Foxbat-E). Development of original MiG-25P single-seat interceptor produced 1978–82. Uprated R-15BD-300 engines, with life of 1,000 hr instead of former 150 hr. Sapfir-25 radar and IRST, giving look-down/shoot-down capability comparable with MiG-23M. Sirena-3 RWR in wingtip antiflutter bodies and starboard fintip. Basic armament of two R-40R/T (AA-6 "Acrid") and four R-60 (AA-8 "Aphid") AAMs. Provision for 1,400-gallon underbelly fuel tank.

MiG-25PDS (Foxbat-E). As MiG-25PD but converted from MiG-25P from 1979. Nose lengthened by 10 inches to house flight refueling equipment on some aircraft.

MiG-25BM (Foxbat-F). "Wild Weasel"-type of defense-suppression aircraft produced 1982–85. Airframe generally similar to MiG-25RB but with ECM dielectric panel aft of radome on each side of longer nose. Small blister on each side at rear of radome. Dielectric panel on nose of each outboard weapon pylon. Underbelly auxiliary fuel tank as with MiG-25PD. Carries four Kh-58 (AS-11 "Kilter") antiradiation missiles to attack SAM sites over standoff ranges. *(Data for MiG-25PDS.)*

Power Plant: two Soyuz/Tumansky R-15BD-300 turbojets, each 24,700 lb thrust with afterburning.

Dimensions: span 45 ft 11¾ in, length 78 ft 1¾ in, height 20 ft 0¼ in.

Weight: gross with four AAMs and full internal fuel 80,950 lb.

Performance: max speed at height Mach 2.83, at S/L Mach 0.98, ceiling 67,900 ft, T-O run 4,100 ft, landing run 2,625 ft, range on internal fuel at supersonic speed 775 miles, subsonic 1,075 miles.

Armament: no gun; two R-40 and four R-60 AAMs underwing initially. Later, two R-23 (AA-7 "Apex") and four R-73A (AA-11 "Archer") AAMs.

Fighters

1-42

Scraps of information obtained from responsible sources at the Dubai '93 air show suggest that this next-generation Russian fighter program has encountered setbacks. The current defense policy favors upgrades of existing combat aircraft rather than entirely new designs. Prototypes of the 1-42 may have to be flown with Lyulka engines developed for the Sukhoi Su-27/35 family, as their intended new turbofans are not ready.

Like USAF's F-22, the 1-42 will be single-seat, twin-engine, with twin fins, and will offer multirole air-to-air and air-to-surface capability. Unlike the F-22, the 1-42 is said to be a tailless delta, with canards that will improve on the agility of even the Su-27, and possibly thrust-vectoring engine nozzles. A degree of stealth can be assumed. As with other Russian designs, this is likely to result more from careful conventional airframe configuration, use of RAM (radar absorbent materials), and use of countermeasures than from such operationally restrictive features as internal weapons stowage.

MiG-29 (NATO "Fulcrum")

Mikoyan OKB executives have stated that the programs for the much-upgraded MiG-29M and its carrier-based counterpart, the MiG-29K, have now been canceled, though features of these variants may be offered on export models or in upgrade contracts. The basic MiG-29, operational since early 1985, is a twin-engine combat aircraft comparable in size to the US Navy's F/A-18 Hornet. Its N019 Sapfir-29 coherent pulse-Doppler look-down/shoot-down radar (search range 62 miles) is supplemented by a laser rangefinder and infrared search/track sensor forward of the windscreen. Both systems operate in conjunction with the pilot's helmet-mounted target designator. Primary operational role is as a single-seat counterair fighter, but the MiG-29 has dual-role air combat/attack capability. More than 600 are in service with CIS air and naval forces, for which production has ended. Current versions:

MiG-29 (Fulcrum-A). Landbased single-seater. During takeoff and landing, hinged doors shield the engine air intakes against foreign object ingestion; engine air is then taken in through louvers in the upper surface of the wingroot extensions. About 40 percent are equipped to carry an external fuel tank under each wing. Flying controls actuated hydraulically. IRCM flare dispensers in "fences" forward of dorsal tailfins. Airbrakes above and below rear fuselage. Max gross weight 40,785 lb. Some have deeper spine and extra fuel, like MiG-29S, and are identified by NATO as Fulcrum-C.

MiG-29UB (Fulcrum-B). Combat trainer. Second seat forward of the normal cockpit, under a continuous canopy, with periscope for rear occupant. Nose radar replaced by a radar rangefinder. Underwing stores pylons retained.

MiG-29S (Fulcrum-C). As basic Fulcrum-A but with more deeply curved top to fuselage aft of cockpit, containing equipment. Internal fuel increased by 20 gallons. Upgraded radar (N019M) able to engage two targets simultaneously. Able to carry R-77 (AA-12) AMRAAM-class AAMs or up to 8,820 lb of bombs. Approx two squadrons only.

MiG-29M. Greatly redesigned, with quadruplex fly-by-wire controls and a "glass" cockpit with CRTs. First of six prototypes flown in 1986; first flight with definitive 19,400 lb thrust RD-33K engines in late 1989. Movable lower air intake lips to increase mass flow on takeoff. New N01C radar in nose of more tapered profile, new IRST, added TV, and laser designator/marked-target seeker. Nose lengthened by approx 7½ in. Longer canopy. Wider, longer, and less curved dorsal spine, terminating in a "beaver-tail" structure that extends beyond the jet nozzles. Increased-span ailerons; bulged wingtips with fore and aft RWRs. Larger tailplane with dogtooth leading-edge. More rounded wingtip trailing-edge. New aluminum-lithium center-section without engine air louvers, containing additional fuel; eight underwing hardpoints, single large airbrake above rear fuselage. Larger, sharp-edged, repositioned wingroot leading-edge extensions, generating stronger vortices, and modifications to extend aft center of gravity limit for relaxed stability make the MiG-29M more comfortable to fly, with increased permissible angle of attack, better maneuverability, and improved cruise efficiency. Max external stores load increased to 9,920 lb. Armament options include Kh-31P, Kh-29T, Kh-29L, and Kh-25ML ASMs and up to eight R-77 AAMs.

A MiG-29 with fiber optics and another with two-axis thrust-vectoring nozzles have been flight tested. *(Data for MiG-29S.)*

Power Plant: two Klimov/Sarkisov RD-33 turbofans; each 18,300 lb thrust with afterburning.

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

Weights: normal T-O weight 33,730 lb, gross 43,430 lb.

MiG-29M (Sebastian Zacharias)

MiG-31 ("Foxhound-A") (Peter Steinemann)

Sukhoi Su-27K ("Flanker-D") (Richard Malachowski)

Performance: max speed at height Mach 2.3, at S/L Mach 1.06, ceiling 59,055 ft, T-O run 820 ft, landing run 1,970 ft, range on internal fuel 932 miles, with external tanks 1,800 miles.

Accommodation: pilot only.

Armament: six close-range R-60T (AA-8 "Aphid") AAMs, or four R-60T and two medium-range R-27R (AA-10A "Alamo-A"), on three pylons under each wing. Alternative AAMs include R-73A (AA-11 "Archer"). Able to carry bombs, submunitions dispensers, 80-mm, 130-mm, and 240-mm rockets, and other stores (including nuclear weapons) in attack role. One 30-mm GSh-301 gun in port wingroot leading-edge extension, with 150 rds.

MiG-31 (NATO "Foxhound")

Despite having a configuration similar to that of the MiG-25, Foxhound is a very different aircraft. The requirement was for an all-altitude, all-weather interceptor, embodying advanced digital avionics and carrying a crew of two. There was no call for higher speed than that of the MiG-25, but a longer range was specified. Mikoyan decided to reduce the airframe's steel content to 50 percent, with 16 percent titanium, 33 percent aluminum alloy, and negligible composites except for the radome. The first prototype, known as the Ye-155MP (originally MiG-25MP), flew September 16, 1975. Four years later, production of the fully developed **MiG-31** began at the Gorky works. Its Zaslon radar was the first electronically scanned phased-array type to enter service, enabling Foxhound to track 10 targets and engage four simultaneously. Other equipment includes a retractable IRST sensor, RWR, and active infrared and electronic countermeasures. Offset tandem twin-wheel main landing gear units facilitate operation from unprepared ground and gravel. Retractable flight refueling probe on port side of front fuselage. More than 160 in service, with production continuing.

The basic MiG-31 (Foxhound-A) can be guided automatically, and engage targets, under ground control. Developed by means of eight prototypes, since 1984, the **MiG-31M** (Foxhound-B) has a new radar, with a 55-in-diameter antenna, in a 3.5° downward-inclined nose. It is identified by small side windows for the rear cockpit, a wider flat-profile dorsal spine, more rounded wingtips (except when carrying ECM jammer pods), larger curved fin root extensions, modified and extended wingroot leading-edge extensions, a non-retractable IRST, upgraded engines with modified nozzles, and four new-type underwing pylons for R-77 (AA-12) active radar-guided AAMs. It has no gun, but the number of fuselage weapon stations is increased to six, carrying R-37 missiles. The refueling probe is transferred to the starboard side.

Some basic MiG-31s have been converted and others built as **MiG-31Ds**; these are hybrids of the MiG-31 and MiG-31M, compatible with R-37 missiles and with interchangeable wingtips, but retaining basic radar. Two dedicated satellite killers were produced with ballast in the nose instead of radar, a flat belly with no recesses, and underwing antisatellite missiles. *(Data for MiG-31 Foxhound-A.)*

Power Plant: two Aviadvigatel D-30F6 turbofans; each 34,170 lb thrust with afterburning.

Dimensions: span 44 ft 2 in, length 74 ft 5¼ in, height 20 ft 2¼ in.

Weights: empty 48,115 lb, gross 90,390–101,850 lb (MiG-31M 114,640 lb).

Performance: max speed at height Mach 2.83, at S/L Mach 1.23, ceiling 67,600 ft, T-O run 3,940 ft, landing run 2,625 ft, combat radius at Mach 2.35 450 miles, at Mach 0.85 with external tanks 870 miles.

Accommodation: crew of two, in tandem.

Armament: basic armament of four R-33 (AA-9 "Amos") radar-homing, long-range AAMs, in pairs under fuselage; two R-40T (AA-6 "Acrid") medium-range, infrared-homing AAMs on inner underwing pylons; and four R-60 (AA-8 "Aphid") close-range, infrared-homing AAMs on two outer underwing pylons. One 23-mm GSh-6-23 six-barrel Gatling-type gun in fairing on starboard lower fuselage, with 260 rds.

Sukhoi Su-27 (NATO "Flanker")

The prototype of the Su-27 (Flanker-A) first flew May 20, 1977. More than 200 production Su-27s now equip air defense units in states of the CIS; others form primary equipment of fighter units intended to escort Su-24s on deep penetration missions. Fine-grille hinged screens in the engine air intake ducts of these versions guard against foreign-object damage during takeoff and landing. A range of 2,500 miles on internal fuel obviated external tanks. Current variants:

Su-27 (Flanker-B). Basic single-seat production version, first flown April 20, 1981. Square wingtips carrying launchers for AAMs in interceptor role, cylindrical ECM jammer pods in ground-attack configuration. Four-channel analog fly-by-wire flight controls without mechanical backup. Inherently unstable. No ailerons; one-piece differential/collective tailerons operate in conjunction with flaperons and rudders for pitch and roll control. Wing leading-edge flaps and flaperons are controlled manually for takeoff and landing, computer-controlled in flight. No composites, but a considerable quantity of titanium in the airframe. Integrated fire-control system enables the track-while-scan coherent pulse-Doppler radar, IRST, and laser rangefinder to be slaved to the pilot's helmet-mounted target designator and displayed on the wide-angle head-up display (HUD). Radar has search range of 150 miles and tracking range of 115 miles. Provision for reconnaissance pack on centerline pylon. Three banks of chaff/flare dispensers in bottom of long tailcone.

Su-27UB (Flanker-C). Tandem two-seat trainer with full combat capability, based on Flanker-B.

Su-27K (Flanker-D). Version for ramp-assisted operation from naval carriers, first seen on *Admiral Kuznetsov* in 1989. Basically as Flanker-B but with collectively movable foreplanes. Folding outer wings and tailplane, strengthened landing gear with twin-wheel nose unit, and added arrester hook. Long tailcone of landbased version shortened to prevent tail-scrapes during takeoff and landing. Able to refuel in

flight and to carry centerline auxiliary fuel tank or buddy refueling pack. Can carry large antiship ASM, known as Kh-41 (3M80 *Moskit*, "Mosquito"), under fuselage. In production as Su-33 (which see).

Su-27IB. Described in Attack Aircraft section.

Su-27PU. Two prototypes built under this designation. First flown December 30, 1989. In production as Su-30 (which see). *(Data for Flanker-B.)*

Power Plant: two Saturn/Lyulka AL-31F turbofans; each 27,557 lb thrust 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 at height Mach 2.35, at S/L Mach 1.1, ceiling 59,055 ft, T-O run 1,640 ft, landing run 1,970 ft, combat radius 930 miles.

Accommodation: pilot only.

Armament: one 30-mm GSh-301 gun, with 149 rds, in starboard wingroot extension. Up to 10 AAMs, including pairs of R-27 (AA-10 "Alamo-A/B/C/D"), or R-33 (AA-9 "Amos"), and four R-73A (AA-11 "Archer") or R-60 (AA-8 "Aphid"). Able to carry a wide range of air-to-surface weapons, including five-round packs of 130-mm rockets, or larger rockets. Latest weapons include a podded 30-mm gun with downward-deflecting barrel for air-to-ground and air-to-air use.

Sukhoi Su-30

This production development of the Su-27PU is available in two forms:

Su-30. Basic two-seat interceptor for missions of 10 hr or more, including group actions with four Su-27s. Only the Su-30 would operate its radar, so that it could assign targets to the other aircraft by radio data link, while the Su-27s maintained radar silence. New avionics: nav system based on Loran, Omega, and Mars; fire control system able to engage two air-to-air targets simultaneously. Flight refueling probe standard. Without foreplanes, static instability, new engines, and advanced radar of Su-35.

Su-30M. As Su-30 but equipped for multirole operations.

Dimensions: as Su-27, except height 20 ft 10¼ in.

Weights: normal gross 52,910 lb, max 72,750 lb.

Performance: max speed at height Mach 2.0, T-O run 1,805 ft, landing run 2,200 ft, combat range with internal fuel 1,865 miles, with one in-flight refueling 3,230 miles.

Accommodation: two crew in tandem identical cockpits.

Armament: More than 17,635 lb of stores on 12 hardpoints. Conventional bombs, rockets, 30-mm gun, and other munitions as Su-27, plus Kh-59M (AS-18) cruise missiles, antiradiation missiles, TV and laser homing missiles, and bombs.

Sukhoi Su-33

An initial series of about 20 Su-33 single-seat carrier-based fighters is being delivered to a base on the Kola Peninsula for service on board *Admiral Kuznetsov*. They are basically similar to the Su-27K prototype (which see) but have 29,900 lb thrust Saturn/Lyulka AL-35F turbofans and special navaids for maritime operations. Intended primarily for air defense, their armament is basically similar to that of the Su-27, with added capability to carry Kh-31 (AS-17 "Krypton") ASMs underwing and a 9,920-lb Kh-41 *Moskit* antiship missile under the fuselage.

Sukhoi Su-35

This advanced single-seat development of the Su-27, with digital fly-by-wire controls and static instability, was exhibited for the first time at the 1992 Farnborough Air Show. The airframe resembles that of the Su-33, with foreplanes, but without specifically shipboard features, such as folding wings and an arrester hook. It is scheduled to enter Russian Air Forces service within two years. The engines are AL-35F turbofans, uprated by comparison with the AL-31F. Thrust-vectoring nozzles (±15°) are to be offered for later use.

The Su-35's primary radar is of an improved look-down/shoot-down type, with the ability to acquire airborne targets at ranges up to 250 miles and ground targets up to 125 miles. Fifteen targets can be tracked, and six engaged, simultaneously. A rearward-facing radar, in the enlarged tailcone, enables radar-guided AAMs to be fired "over the shoulder" at pursuers. IRST and wingtip ECM jammer pods are standard. All combat flight phases are computerized, with terrain following/avoidance.

Power Plant: two Saturn/Lyulka AL-35F turbofans; each 29,900 lb thrust with afterburning. In-flight refueling probe standard.

Dimensions: span over ECM pods 49 ft 2½ in, length 72 ft 2¼ in, height 19 ft 8 in.

Performance: max speed at height Mach 2.35, at S/L Mach 1.14, ceiling 59,055 ft, runway required 3,940 ft, max range on internal fuel more than 2,485 miles, with one in-flight refueling more than 4,040 miles.

Sukhoi Su-27UB and Su-27 ("Flanker-C and B") (Piotr Butowski)

Sukhoi Su-30M (Brian M. Service)

Sukhoi Su-35 (Brian M. Service)

Helicopters

Kamov Ka-25 (NATO "Hormone")

Fewer than 100 of the 460 Ka-25s built between 1966 and 1975 remain in service with Naval Aviation, in four forms:

Ka-25PL (Hormone-A). Basic ship-based ASW version, with typical Kamov contrarotating three-blade rotors. Undernose search radar; racks for small stores, including sonobuoys, on the starboard side of the fuselage; and cylindrical canisters on each side of the lower fuselage for markers, smoke generators, or beacons. Dipping sonar is housed in a compartment at the rear of the cabin, but the Ka-25 is unable to operate with this at night or in adverse weather, due to lack of automatic hover capability.

Ka-25Ts (Hormone-B). Special electronics variant, to provide over-the-horizon target acquisition for cruise missiles carried by the cruisers and destroyers on which they are based. Larger undernose radome than that of Ka-25PL, with spherical undersurface. When radar is operating, all four wheels of landing gear can be retracted upward to offer minimal interference to emissions. Cylindrical fuel canister on each side of lower fuselage.

Ka-25BShZ. Equipped to tow minesweeping gear.

Ka-25PS (Hormone-C). Search-and-rescue version with hoist and other role equipment. *(Data for Hormone-A.)*

Power Plant: two Mars GTD-3F turboshafts; each 888 shp (later aircraft have 986 shp GTD-3Ms).

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 15,873 lb.

Performance: max speed 130 mph, ceiling 11,000 ft, range 250–405 miles.

Yakovlev Yak-38 (NATO "Forger")

From 1976, the Yak-38 was the standard fixed-wing aircraft in *Kiev*-class carriers. It has been retired from service, with no successor in production.

Yakovlev Yak-141 (NATO "Freestyle")

The two prototypes of this long-range supersonic V/STOL fighter still exist, the second aircraft having been rebuilt (probably in nonflying form) following its accident. However, official funding for the Yak-141 program was withdrawn in 1991. Details can be found in the March 1993 "Gallery of Russian Aerospace Weapons."

Accommodation: crew of two on flight deck; main cabin is large enough to contain 12 folding seats.
Armament: one 18-in ASW torpedo in underfuselage weapons bay.

Kamov Ka-27 and Ka-29 (NATO "Helix")

The prototype Ka-27 flew in December 1974. Retaining the Ka-25's proven contrarotating rotor configuration, it was able to stow in much the same space as the earlier helicopter with the rotors folded, despite its greater power and capability. The basic ASW version was first observed on the stern platform of the guided missile destroyer *Udaloy* in 1981. DoD had already referred to what it called "Hormone variant" helicopters carried in telescoping hangars on *Sovremennyy*-class destroyers. In 1983, at least 16 Ka-27s were seen on board the *Kiev*-class carrier/cruiser *Novorossiysk,* since when the replacement of Ka-25s with Ka-27 variants has continued, in the following forms:

Ka-27PL (Helix-A). Basic ASW helicopter, with crew of three. Described as being effective against submarines cruising at up to 40 knots, at a depth of 1,640 ft, out to 124 miles from its base, by day or night. Equipment includes undernose 360° search radar, ventral weapons bay for torpedoes, depth charges, and other stores, internally stowed sonobuoys, IR jammer above engine bay fairing, chaff/flare dispensers, IFF, RWRs on nose and above tailplane, ESM radomes above rear of power plant pylon fairing and at tailcone tip, flotation gear container on each side of fuselage, dipping sonar compartment in rear of fuselage, MAD, and Doppler box under tailboom. Normally operated in pairs; one aircraft tracks the hostile submarine, the other drops depth charges. More than 100 operational with Naval Aviation.

Ka-29TB (Helix-B). Combat transport version; entered service 1985. Heavy armor on wider flight deck and engine bay. Four-barrel Gatling-type 7.62-mm machine gun behind downward-articulated door on starboard side of nose. Four pylons on outriggers can carry four-round clusters of 9M114 (AT-6 "Spiral") ASMs and 57-mm or 80-mm rocket pods or 23-mm gun pods. Provision for 30-mm gun above port outrigger. Undernose sensor pods for missile guidance and electro-optics. ESM "flower pot" above engine bay fairing, forward of IR jamming pod. Two-part upward/downward-opening cabin door for speedy exit of 16 assault troops from cabin.

Ka-27PS (Helix-D). Search-and-rescue and plane guard version. Basically similar to Ka-27PL but some operational equipment deleted. Winch beside cabin door on port side. External fuel tank above flotation gear on each side of cabin.

Ka-29RLD. Early warning version, first shown on carrier *Admiral Kuznetsov* in August 1990. Shallow pannier extends full length of underfuselage. Added large panniers on sides, fore and aft of main landing gear. APU repositioned above rear of power plant fairing, with air intake at front. No ESM or IR jamming pods above fairing. Longer conical tailcone. No stores pylons, gun door, or armor. *(Data for Ka-29TB.)*
Power Plant: two Klimov TV3-117V turboshafts; each 2,190 shp.
Dimensions: rotor diameter (each) 52 ft 2 in, length of fuselage 37 ft 1 in, height 17 ft 8½ in.
Weights: empty 12,170 lb, gross 27,775 lb.
Performance: max speed at S/L 174 mph, ceiling 14,100 ft, range 285 miles.
Accommodation: flight crew of two, with seat for third person; up to 16 combat-ready troops, or four litters and six seated casualties, as alternative to mission equipment.
Armament: see above.

Kamov Ka-50 Werewolf (NATO "Hokum")

The Ka-50, the first single-seat close-support helicopter, has been flying in prototype form since July 27, 1982, but was not displayed in public, on the ground, until the 1992 Farnborough Air Show. It is in initial production for the Russian Army. Retention of Kamov's familiar coaxial rotor configuration ensures compact dimensions, with no tail rotor to cause problems during nap-of-the-earth operation. Composite materials constitute 35 percent by weight of the structure, including the three-blade rotors. The usual difficulties experienced by standoff attack helicopters as a result of poor battlefield visibility are intended to be avoided by attacking targets fast and low, with great agility, at close range. Ka-50 avionics and missions require four computers to meet navigation, mission control, and display demands. Equipment in the nose includes a laser marked-target seeker, but the intention is to rely on another aircraft or ground personnel to locate and designate targets. Other equipment includes a forward-looking infrared (FLIR) pod, TV, and cockpit CRT. The pilot has a MiG-29-type helmet sight and HUD.

Some 770 lb of armor protect the pilot and critical airframe parts. All canopy and windscreen panels are of heavy bulletproof glass, and the double-wall steel armor surrounding the pilot will resist hits by 20-mm and 23-mm gunfire over ranges as close as 330 ft. In an emergency, at any altitude, the rotor blades and cockpit roof are separated by explosive charges; the pilot is then extracted from the cockpit by a large rocket. Alternatively, he can jettison the cabin doors and stores before rolling out of the cockpit sideways. The Ka-50 can be air-ferried, partially disassembled, in an Il-76 freighter. All systems are configured to permit combat flying from an advanced base for at least two weeks without need for ground maintenance equipment. A tandem two-seat training or combat version has been projected.
Power Plant: two Klimov TV3-117VK turboshafts; each 2,190 shp.
Dimensions: rotor diameter (each) 47 ft 7 in, length (rotors turning) 52 ft 6 in, height 16 ft 2 in.
Weights: normal T-O weight 21,605 lb, max gross 23,810 lb.
Performance: max speed in shallow dive 217 mph, in level flight 193 mph, vertical rate of climb at 8,200 ft 1,970 ft/min, hover ceiling out of ground effect 13,125 ft, endurance 4 hr.
Accommodation: pilot only.
Armament: one flexibly mounted 30-mm 2A42 gun with 500 rds on starboard side of fuselage; four wing pylons for two six-round clusters of Vikhr (AT-12) laser-guided ASMs, up to four packs of 20 x 80-mm S-8 rockets, 23-mm gun pods, Kh-25MP (AS-12 "Kegler") ASMs, AAMs, or dispenser weapons.

Kamov Ka-29TB ("Helix-B") (Linda Jackson)

Kamov Ka-50 Werewolf ("Hokum") (Photo Link)

Mil Mi-14PS ("Haze-C") (Piotr Butowski)

Mil Mi-17 ("Hip-H") (P. R. Foster)

Mil Mi-6 (NATO "Hook")

More than 860 production Mi-6s are believed to have been delivered for commercial and military service. The basic task of these helicopters in military use is to haul guns, armor, vehicles, supplies, freight, or troops in combat areas; but some are equipped for command support roles (see Reconnaissance, ECM, and Early Warning Aircraft section). Replacement with Mi-26 Halos has been under way for some years.
Power Plant: two Aviadvigatel/Soloviev D-25V turboshafts; each 5,425 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 with 17,637-lb payload 385 miles.
Accommodation: crew of five; normally, 70 combat-equipped troops, 26,450 lb of internal freight, or 41 litters and two medical attendants. Max slung cargo (usually with wings removed) 17,637 lb.
Armament: some aircraft have a 12.7-mm gun in the nose.

Mil Mi-8 (NATO "Hip")

About 2,400 Mi-8s and uprated Mi-17s (described separately) were operated by Soviet armies in the field and by the Air Forces. Most of these remain available. Their primary combat task is to put assault troops, equipment, and supplies behind enemy lines, which their crews are trained to do within 15–20 minutes of a nuclear or conventional bombardment/strike. Versions as follows:

Hip-C. Standard equipment of army support forces, carrying 24 troops or freight, loaded via rear clamshell doors and ramp. Twin rack for stores on each side of cabin, able to carry 128 x 57-mm rockets in four packs or other weapons. Some uprated to Mi-17 standard, as **Mi-8MT** and **Mi-8MTV.**

Hip-D. For airborne communications role; see p. 68.

Hip-E. Development of Hip-C, with emphasis on weapons for escort duties. One flexibly mounted 12.7-mm machine gun in nose. Triple stores rack on each side of cabin, able to carry up to 192 rockets in six suspended packs plus four M17P Skorpion (AT-2 "Swatter") antitank missiles on rails above racks. Some uprated to Mi-17 standard, as **Mi-8MTV.**

Hip-G. See Mi-9 entry on p. 68.

Hip-H. See Mi-17 entry on p. 67.

Hip-J and **K.** ECM versions; see p. 68.
Power Plant: two Klimov TV2-117A turboshafts; each 1,677 shp.
Dimensions: rotor diameter 69 ft 10¼ in, length of fuselage 59 ft 7¼ in, height 18 ft 6½ in.
Weights: empty 16,007 lb, gross 26,455 lb.
Performance: max speed at 3,280 ft 161 mph, ceiling 13,125 ft, range as personnel transport 311 miles.
Accommodation: crew of two or three; up to 32 passengers, but normal military configuration is for 24 combat-equipped troops on tip-up seats along cabin side walls; 8,820 lb of freight internally, 6,614 lb externally; or 12 litter patients and attendant.
Armament: see individual model descriptions.

Mil Mi-14 (NATO "Haze")

Overall dimensions, power plant, and dynamic components of this shore-based amphibious helicopter are generally similar to those of the Mi-17. New features to suit the Mi-14 for its maritime roles include a boat hull, a small float attached to the tailskid, and a sponson on each side at the rear, carrying an inflatable flotation bag. The landing gear is fully retractable.

Three versions of the Mi-14 are in service:

Mi-14PL (Haze-A). Basic ASW version, with crew of four. Equipment includes an undernose radome, a retractable sonar housed in the starboard rear of the planing bottom forward of two sonobuoy or signal flare chutes, a towed MAD "bird" stowed against the rear of the fuselage pod, and a Doppler radar box under the tailboom. Weapons include torpedoes, bombs, and depth charges carried in a weapons bay in the bottom of the hull.

Mi-14BT (Haze-B). Mine countermeasures version. Long duct for hydraulic tubing, and air-conditioning pod, on starboard side of cabin. No MAD. Container for searchlight to observe MCM gear during deployment and retrieval under tailboom, forward of Doppler box.

Mi-14PS (Haze-C). Search-and-rescue version. Double-width sliding door at front of cabin on port side, with retractable rescue hoist able to lift three persons in basket. Searchlight on each side of nose and under tailboom. Fuselage duct and air-conditioning pod as Mi-14BT. Room for 10 survivors in cabin; provision for towing many more in 10 x 20-place life rafts carried on board. Normal crew of three.

About half of the 230 Mi-14s built were delivered to Naval Aviation.
Power Plant: two Klimov TV3-117 turboshafts, each 1,923 shp.
Dimensions: rotor diameter 69 ft 10¼ in, length overall incl rotors 83 ft 0 in, height 22 ft 9 in.

Weights: empty 25,900 lb, gross 30,865 lb.
Performance: max speed 143 mph, ceiling 11,500 ft, max range 705 miles.
Accommodation and Armament: as described above.

Mil Mi-17 and Mi-171 (NATO "Hip-H")

The **Mi-17** has an airframe basically identical to that of the Mi-8 but with more powerful TV3 engines in shorter nacelles, with the intakes positioned above the midpoint of the sliding cabin door. The tail rotor is repositioned on the port side of the vertical stabilizer, and the engine air intakes are fitted with deflectors to prevent the ingestion of sand, dust, or foreign particles at unprepared landing sites. Military versions have the same armament options as the Mi-8, supplemented by 23-mm GSh-23 gun packs, and with external armor plate on the cockpit sides.

Details of two special-duty versions can be found in the Reconnaissance, ECM, and Early Warning Aircraft section. Mi-8s can be uprated to Mi-17 standard (see Mi-8 entry). Current versions of the Mi-17 are the **Mi-171,** built in Ulan-Ude, and similar **Mi-17M,** built in Kazan, each with 2,070 shp TV3-117VM engines. Weights and performance are generally unchanged, except for greatly improved rate of climb and ceiling. *(Data for basic Mi-17.)*

Power Plant: two Klimov TV3-117MT turboshafts; each 1,923 shp.
Dimensions: rotor diameter 69 ft 10¼ in, length of fuselage 60 ft 5¼ in, height 15 ft 7¼ in.
Weights: empty 15,653 lb, gross 28,660 lb.
Performance: max speed 155 mph, ceiling 11,800 ft (16,400 ft at normal gross weight), max range 307 miles.
Accommodation and Armament: as for Mi-8 Hip-E.

Mil Mi-24 (NATO "Hind")

Of more than 2,300 Mi-24s (and export Mi-25s and -35s) built in Arsenyev and Rostov, about half are at the disposal of the CIS military, in the following gunship and special-duty variants:

Mi-24D (Hind-D). First observed in 1977. Front fuselage completely redesigned by comparison with original Hind-A, B, and C armed assault transports. Transport capability retained and airframe heavily armored. Tandem stations for weapon operator (in nose) and pilot have individual canopies, with rear seat raised to give pilot an unobstructed forward view. Air data sensor boom forward of top starboard corner of bulletproof windscreen at extreme nose. Under nose is a four-barrel Gatling-type 12.7-mm machine gun in a turret, slaved to adjacent electro-optical sight, and providing air-to-air as well as air-to-surface capability. Four hardpoints under stubwings for 32-rd packs of 57-mm rockets, 20-rd packs of 80-mm rockets, UPK-23 pods each containing a twin-barrel 23-mm gun, GUV pods each containing one four-barrel 12.7-mm gun and two four-barrel 7.62-mm guns or a 30-mm grenade launcher, up to 3,300 lb of bombs, mine dispensers, or other stores; four 9M17P Skorpion (AT-2 "Swatter") antitank missiles on wingtip launchers, with RF guidance pod under nose on port side. Provisions for firing AKMS guns from cabin windows. Many small antennas and blisters, including IFF and RWR. IR jammer in "flower pot" container above forward end of tailboom; decoy flare dispenser initially under tailboom; later triple racks (total of 192 flares) on sides of center-fuselage. Engine exhaust suppressors standard. **Mi-24DU** training version has no gun turret.

Mi-24V (Hind-E). As Mi-24D but with modified wingtip launchers and four underwing pylons for up to 12 x 9M114 (AT-6 "Spiral") radio-guided, tube-launched antitank missiles in pairs, and enlarged undernose guidance pod on port side, with fixed searchlight to rear. R-60 (AA-8 "Aphid") AAMs can be carried on the underwing pylons. HUD replaces former reflector sight.

Mi-24VP. Variant of Mi-24V with twin-barrel 23-mm GSh-23 gun in place of four-barrel 12.7-mm gun in nose.

Mi-24P (Hind-F). Generally similar to Mi-24V, but nose gun turret replaced by a twin-barrel 30-mm GSh-30-2 gun, with 750 rds, on starboard side of front fuselage. Bottom of nose smoothly faired above and forward of sensors.

Mi-24R (Hind-G1). This version lacks the usual undernose electro-optical and RF guidance packs for antitank missiles. Instead of wingtip weapon attachments, it has "clutching hand" mechanisms for soil sampling, associated with NBC (nuclear, biological, and chemical) warfare, on lengthened pylons. Other features include a bubble window on the starboard side and a small rearward-firing marker flare pack on the tailskid. This version is deployed individually throughout ground forces, in small numbers.

Mi-24K (Hind-G2). As Mi-24R but with a large camera in the cabin, with the lens on the starboard side, for reconnaissance and artillery spotting. No target designator pod under nose. *(Data for Mi-24P.)*

Power Plant: two Klimov TV3-117 turboshafts; each 2,190 shp.

Mil Mi-26 ("Halo") (Piotr Butowski)

Mil Mi-28 ("Havoc") (David Stephens)

Antonov An-12 ("Cub-D") (David Stephens)

Beriev A-50 ("Mainstay") (Linda Jackson)

Dimensions: rotor diameter 56 ft 9¼ in, length excl rotors and gun 57 ft 5¼ in, height 21 ft 4 in.
Weights: empty 18,078 lb, gross 26,455 lb.
Performance: max speed 208 mph, ceiling 14,750 ft, range on internal fuel 310 miles, with auxiliary tanks 620 miles.
Accommodation: crew of two; flight mechanic, and provisions for eight troops or four litter patients in main cabin.
Armament: see individual model descriptions. Max external load 5,290 lb.

Mil Mi-26 (NATO "Halo")

Except for the four-engine, twin-rotor Mi-12, which did not progress beyond prototype testing, the **Mi-26** is the heaviest helicopter yet flown anywhere in the world and the first to operate successfully with an eight-blade main rotor. Other features include a payload and cargo hold very similar in size to those of a C-130 Hercules, loading via clamshell doors and ramp at the rear of the cabin pod, and main landing gear legs that are adjustable individually in length to facilitate loading and permit landing on varying surfaces. The Mi-26 flew for the first time December 14, 1977, and was fully operational by 1983. More than 70 have since been built for military and civil use by day and night, in all weather. Infrared jammers, exhaust heat suppressors, and decoy dispensers can be fitted to production aircraft. Under development is the uprated **Mi-26M** with more powerful ZMKB Progress D-127 engines, all-composites rotor blades, and max payload of 48,500 lb. An **Mi-26TM** flying crane, with belly gondola, is under development, and an **Mi-26TZ** tanker version is projected. Other new variants are expected to replace Mi-6s specialized for command support.

Power Plant: two ZMKB Progress D-136 turboshafts; each 10,000 shp.
Dimensions: rotor diameter 105 ft 0 in, length of fuselage 110 ft 8 in, height to top of main rotor head 26 ft 8¾ in.
Weights: empty 62,170 lb, gross 123,450 lb.
Performance: max speed 183 mph, ceiling 15,100 ft, range with standard fuel 497 miles, with auxiliary tanks 1,190 miles.
Accommodation: crew of five; about 40 tip-up seats along side walls of hold; seats can be installed for 80 combat-equipped troops, plus four more passengers in compartment aft of flight deck, or litters for 60 casualties plus up to five attendants. Other loads include two airborne infantry combat vehicles or a standard 44,100-lb ISO container.
Armament: none.

Mil Mi-28 (NATO "Havoc")

Production of the Mi-28 attack helicopter was scheduled to begin this year. Its general configuration is similar to that of the slightly smaller US Army AH-64A Apache, and it has broadly similar applications. The original prototype flew for the first time November 10, 1982.

The Mi-28's IFR instrumentation is conventional, with autostabilization, autohover, and hover/heading hold lock in the attack mode. The fuel tanks are protected by a thick second skin of composites. All vital units and parts are redundant and widely separated. The cockpits have armored glass transparencies and are protected by titanium and ceramic armor. Energy-absorbing seats and landing gear are designed to protect the crew in a 40 ft/sec vertical crash landing. Escape by parachute would be facilitated by a system that blasts away the doors and stubwings in an emergency, although there is no provision for main rotor separation. A door aft of the port stubwing gives access to a compartment large enough to enable the crew to land and pick up two or three persons in a combat rescue situation.

The 30-mm NPPU-28 turret-mounted gun is identical to that on many CIS army ground vehicles and uses the same ammunition. It is fired by the navigator/gunner in the front cockpit, together with the aircraft's guided and unguided weapons. The pilot normally fires only unguided weapons but can also fire the gun if it is fixed. Operational equipment includes a swiveling undernose turret for a daylight optical sight and laser ranger-designator, with a housing on each side for low-light-level TV and FLIR night combat systems. It has been seen with a pod on each wingtip, housing chaff/flare dispensers and sensors, probably RWR. The Mil OKB has said that versions are under development for naval amphibious assault support, night attack, and air-to-air missions.

Power Plant: two Klimov TV3-117VM turboshafts; each 2,070 shp.
Dimensions: rotor diameter 56 ft 5 in, length excl rotors 55 ft 9¾ in, height overall 15 ft 5 in.
Weights: empty 17,850 lb, gross 25,353 lb.
Performance: max speed 186 mph, ceiling 19,025 ft, max range 285 miles.
Accommodation: crew of two, in tandem.
Armament: one 30-mm NPPU-28 gun in undernose turret. Four underwing pylons for 4,230 lb of stores, typically two UB-20 pods of 20 x 80-mm or 130-mm rockets and total of 16 9M114 (AT-6 "Spiral") antitank missiles. Missile guidance equipment in thimble radome on nose.

Reconnaissance, ECM, and Early Warning Aircraft

Antonov An-12 (NATO "Cub-A, B, C, and D")

The large hold of this four-turboprop transport can accommodate a wide variety of equipment for special duties. Variants are:

Cub-A. Elint version. Generally similar to basic An-12BP transport but with blade antennas on front fuselage, aft of flight deck, and other changes.

Cub-B. Conversion of Cub transport for elint missions. Two additional radomes under the forward- and center-fuselage, plus other antennas. About 10 produced for Naval Aviation.

Cub-C. ECM variant carrying several tons of electrical generation, distribution, and control gear in the cabin, and palletized jammers for at least five wavebands faired into the belly, plus chaff/flare dispensers. Glazed nose and undernose radar of transport retained. An ogival "solid" fuselage tailcone, housing electronic equipment, is fitted in place of the usual gun position.

Cub-D. Further ECM variant for active countermeasures, with pods on each side of front fuselage and tailfin. Naval Aviation has about 20 Cub-Cs and Ds.

Antonov An-26 (NATO "Curl-B")

This sigint version of the An-26 transport can be identified by many short blade antennas above and below the fuselage.

Beriev A-50 (NATO "Mainstay")

The Beriev OKB is responsible for this AEW&C version of the Il-76 "Candid" transport. About 25 A-50s currently operate with MiG-29, MiG-31, and Su-27 counterair fighters of the home defense force and tactical air forces, mainly in the northwestern TVD centered on the Kola Peninsula. Mainstay's configuration is conventional, with a 29 ft 6 in diameter pylon-mounted rotating "saucer" radome, lengthened fuselage forward of the wings, satellite nav/com, a new IFF system, RWR, comprehensive ECM, and flight refueling probe. A crew of 15 is normally carried. The Il-76's nose glazing around the navigator's station is replaced by nontransparent fairings, and there is no rear gun turret. Color CRT flight deck displays are standard.

The A-50 can detect and track aircraft and cruise missiles flying at high or low altitude over land and water. It could be used to help direct fighter operations over battlefields as well as to enhance air surveillance and defense. Production has averaged two to five A-50s each year since the early 1980s.

Ilyushin Il-20 (NATO "Coot-A")

The Il-20 elint/reconnaissance aircraft is a conversion of the Il-18 four-turboprop transport. An underfuselage container, about 33 ft 7½ in long and 3 ft 9 in deep, is assumed to house side-looking radar. Smaller containers on each side of the forward fuselage each contain a door over a camera or other sensor. About eight antennas and blisters can be counted on the undersurface of the center- and rear-fuselage, plus two large plates projecting above the forward fuselage.

Ilyushin Il-22 (NATO "Coot-B")

In its best-known form, this airborne command post conversion of the Il-18 airframe has a bullet-shaped pod on the fintip, a long and shallow container under the front fuselage, and many small blade antennas above and below the fuselage. The electronics and their fairings vary considerably from one aircraft to another.

MiG-25R (NATO "Foxbat-B and D")

The Ye-155R-1 prototype of this single-seat, high-altitude, reconnaissance aircraft flew March 6, 1964. Production of the basic MiG-25R began in 1969, but in the following year it was decided to add a bombing capability, and a modified version, the MiG-25RB, became standard. Its automatic bombing system made possible all-weather, day and night precision attacks at supersonic speed and from heights above 65,600 ft, against targets whose geographic coordinates were known. No gun or AAMs for self-defense were considered necessary because of the aircraft's high speed and ceiling, maneuverability, and ECM. Its navigation system was an inertial type, updated by Doppler, for the first time in the Soviet Union. The following variants were produced:

MiG-25RB series (Foxbat-B). Able to carry any one of three interchangeable reconnaissance/elint packs in its nose, offering various combinations of cameras and side-looking airborne radar (SLAR). Later subtypes were the **MiG-25RBV** and **MiG-25RBT**, with different SLAR or navigation equipment. Foxbat-B can be identified by its five camera windows. All reconnaissance Foxbats also have large dielectric panels for the SLAR on the sides of the nose.

MiG-25RBK series (Foxbat-D). Produced simultaneously with RB series in 1971–82. Modules contain different elint systems and no cameras, requiring no camera windows. **MiG-25RBS** followed the RBK into production, with different sensors, and all RBSs were upgraded to **MiG-25RBSh** standard, with more sophisticated equipment, from 1981. Further changes were embodied in the **MiG-25RBF.**

More than 50 MiG-25R reconnaissance/bombers remain in service. All have a generally similar specification, two R-15BD-300 engines as fitted to MiG-25 interceptors, 4,850 gallons of internal fuel, and provision for the same 1,400-gallon underbelly tank.

Dimensions: as MiG-25P, except span 44 ft 0¼ in.
Weights: gross 81,570–90,830 lb.

Ilyushin Il-20 ("Coot-A") (P. R. Foster)

Ilyushin Il-22 ("Coot-B") (Piotr Butowski)

Mil Mi-6 ("Hook-B") (P. R. Foster)

Myasishchev M-17R ("Mystic-B") (David Stephens)

Antonov An-12BP ("Cub") (P. R. Foster)

Performance: max speed at height Mach 2.83, at S/L Mach 0.98, ceiling 68,900 ft, range at supersonic speed on internal fuel 1,015 miles, subsonic with underbelly tank 1,490 miles.
Armament: provision for four 1,100-lb bombs under wings and two under fuselage.

Mil Mi-6 and Mi-22 (NATO "Hook-B and C")

In addition to the standard Mi-6 heavy transport helicopter, there are two special-duty versions:

Mi-6 (Hook-B). Command support helicopter, with flat-bottom, U-shaped antenna under tailboom, X configuration blade antennas forward of horizontal stabilizers, large heat exchanger on starboard side of cabin, and small cylindrical container aft of starboard rear cabin door.

Mi-22 (Hook-C). Developed command support version with large sweptback plate antenna above forward part of tailboom in place of Hook-B's U-shaped antenna. Small antennas under fuselage. Pole antenna attached to starboard main landing gear of some aircraft.

These helicopters are expected to be replaced by specially equipped versions of the Mi-26.

Mil Mi-8 (NATO "Hip-D, J, and K")

Special-mission versions of this helicopter have the following NATO reporting names:

Hip-D. For airborne communications role. Generally similar to Hip-C transport but with canisters of rectangular section on outer stores racks and added antennas above and below forward part of tailboom.

Hip-J. Additional small boxes on sides of fuselage, fore and aft of main landing gear legs, identify this ECM version.

Hip-K (Mi-8PP). Communications-jamming ECM version with a rectangular container and array of six cruciform dipole antennas on each side of cabin. No Doppler radar box under tailboom. Some uprated to Mi-17 standard, with port-side tail rotor.

Mil Mi-9 (NATO "Hip-G")

The designation Mi-9 applies to the airborne command post variant of the Mi-8 known to NATO as Hip-G. Rearward-inclined "hockey stick" antennas project from rear of cabin and from undersurface of tailboom, aft of box for Doppler radar. Strakes on fuselage undersurface.

Mil Mi-17 (NATO "Hip-K derivative")

The Mi-17P ECM communications jamming helicopter, first seen in Hungarian service in 1990 and designated Hip-K derivative by NATO, has an airframe and power plant of Mi-17 standard and a much-enhanced antenna array. Behind the main landing gear on each side is a large, panel-like, 32-element array, with a separate four-element array to the rear, on the tailboom. A large radome is mounted on each side of the cabin, below the jet exhaust, with a further triangular container in place of the rear cabin window each side. Six heat exchangers can be seen under the front fuselage.

A further military variant of the Mi-17 was first seen in Czech and Slovak Air Force service at Dobrany-Line Air Base, near Plzen, in 1991. Each of the two examples seen had a tandem pair of very large cylindrical containers mounted on each side of the cabin. It is assumed that the containers are made of dielectric material and contain receivers able to locate and analyze hostile electronic emissions. Each of two operator's stations in the main cabin has large screens, computer-type keyboards, and an oscilloscope. Several blade antennas project from the tailboom.

Mil Mi-24 (NATO "Hind-G1 and G2")

See main Mi-24 entry for details of these special-duty versions of the helicopter known to NATO as Hind.

Mil Mi-26 (NATO "Halo")

DoD stated in 1990, "New variants of 'Halo' are likely in the early 1990s to begin to replace 'Hooks' specialized for command support." No further information has become available.

Myasishchev M-17 (NATO "Mystic")

The M-17 is a single-seat high-altitude reconnaissance and research aircraft similar in concept to USAF's U-2. The first of two **M-17** (Mystic-A) prototypes, each with a single 15,430 lb thrust RKBM Rybinsk RD-36-51V turbojet, was observed in 1982. The **M-55** (Mystic-B) twin-engine version has the military designation **M-17R** and is assumed to represent the intended production aircraft, although two prototype and two preseries examples have been seen so far only in civil-registered research form. Cameras and other sensors are housed in a large compartment in the lower fuselage, with underbelly dome-shaped fairing. Performance includes the ability to loiter for 4 hr 12 min at 65,600 ft with 3,305 lb of sensors or for 5 hr at 55,775 ft. *(Data for M-17R.)*
Power Plant: two Aviadvigatel PS-30-V12 turbojets; each 11,025 lb thrust.
Dimensions: span 123 ft 0½ in, length 78 ft 9 in, height 15 ft 9 in.
Performance: max speed at height 435–466 mph, ceiling 65,600 ft, max endurance 6 hr 30 min.
Accommodation: pilot only.
Armament: none.

Sukhoi Su-17 (NATO "Fitter-H and K")

Some Su-17 (Fitter-H/K) fighters serving with Air Force units are equipped for reconnaissance. See main entry for this aircraft in the Attack Aircraft section.

Sukhoi Su-24 (NATO "Fencer-E and F")
Reconnaissance and electronic warfare versions of the Su-24 are listed under the main entry for this aircraft in the Attack Aircraft section.

Tupolev Tu-16 (NATO "Badger-D, E, F, H, J, K, and L")
Details of these maritime, photographic, and electronic reconnaissance versions of the Tu-16, and ECM chaff-dispensing and jamming versions, can be found under the main Tu-16 entry in the Bombers and Maritime section.

Tupolev Tu-22 (NATO "Blinder")
See main Tu-22 entry in the Bombers and Maritime section.

Tupolev Tu-95 (NATO "Bear")
See main Tu-95 entry in the Bombers and Maritime section.

Transports and Tankers

Antonov An-12BP (NATO "Cub")
This veteran aircraft continues to fly in small numbers with the Military Transport Aviation force (VTA) and other units, but its usefulness is limited by lack of an integral rear-loading ramp/door. Instead, the bottom of the rear fuselage is made up of two longitudinal doors that hinge upward inside the cabin to permit direct loading from trucks on the ground or air-dropping supplies and equipment. A full complement of 60 paratroops can be dispatched via this exit in less than one minute.
The Cub-A, B, C, and D elint and ECM versions are described separately on p. 67–68.
Power Plant: four ZMKB Progress/Ivchenko AI-20K turboprops; each 3,945 ehp.
Dimensions: span 124 ft 8 in, length 108 ft 7¼ in, height 34 ft 6½ in.
Weights: empty 61,730 lb, gross 134,480 lb.
Performance: max speed 482 mph, ceiling 33,500 ft, range 2,236 miles with max payload.
Accommodation: crew of six; 44,090 lb of freight, 90 troops or 60 parachute troops. Built-in freight-handling gantry with capacity of 5,070 lb.
Armament: two 23-mm NR-23 guns in manned tail turret.

Antonov An-22 (NATO "Cock")
Until the An-124 became available, the An-22 was the only Soviet transport aircraft capable of lifting the Soviet Army's main battle tanks and theater missile systems. Production was terminated sooner than expected, in 1974, and about 45 An-22s are now available to VTA, often operating in civil markings. Each has a max payload of 176,350 lb, loaded via a rear ramp.
Power Plant: four KKBM/Kuznetsov NK-12MA turboprops; each 14,795 shp.
Dimensions: span 211 ft 4 in, length 190 ft 0 in, height 41 ft 1½ in.
Weights: empty 251,325 lb, gross 551,160 lb.
Performance: max speed 460 mph, range with 99,200 lb payload 6,800 miles.
Accommodation: crew of five or six, 28–29 passengers in cabin forward of main freight hold. Four traveling gantries and two winches to speed freight handling.
Armament: none.

Antonov An-26 (NATO "Curl")
The An-26 freighter (**Curl-A**) was the first aircraft to embody Oleg Antonov's unique rear-loading ramp. This forms the underside of the rear fuselage when retracted but can be slid forward under the rear of the cabin to facilitate direct loading onto the floor of the hold or when the cargo is to be air-dropped. Max payload is 12,125 lb; conversion of the standard freighter to carry troops or litters takes 20 to 30 minutes in the field. The **Curl-B** sigint version is described in the Reconnaissance, ECM, and Early Warning Aircraft section.
Power Plant: two ZMKB Progress AI-24VT turboprops; each 2,780 ehp. One 1,765 lb thrust RU 19A-300 auxiliary turbojet in starboard nacelle for turboprop starting and to provide additional power for takeoff, climb, and cruising flight, as required.
Dimensions: span 95 ft 9½ in, length 78 ft 1 in, height 28 ft 1½ in.
Weights: empty 32,518 lb, gross 52,911 lb.

Antonov An-26 ("Curl-A") (Press-Office Sturzenegger)

Antonov An-32 ("Cline") (Alex Hay Porteous)

Model of Antonov An-70T (Brian M. Service)

Performance: cruising speed at 19,675 ft 270 mph, ceiling 24,600 ft, T-O run 2,855 ft, landing run 2,135 ft, range with max payload 770 miles, with max fuel 1,652 miles.
Accommodation: crew of five, plus station for load supervisor or dispatcher. Electrically powered mobile hoist, capacity 4,409 lb, and conveyor to facilitate loading and air-dropping. Provision for carrying 40 paratroops or 24 litters. Improved An-26B (Curl-A) version has roll-gangs and mechanical handling system, enabling two men to load and unload three 8-ft-long standard freight pallets in 30 minutes.
Armament: none.

Antonov An-32 (NATO "Cline")
The basic airframe of the **An-32** specialized "hot and high" short/medium-range transport is similar to that of the An-26, except for having triple-slotted trailing-edge flaps, automatic leading-edge slats, much-enlarged ventral fins, a full-span slotted tailplane, and improved systems. It is able to operate from airfields 13,000 to 14,750 ft above sea level in an ambient temperature of ISA + 25°C. Turboprop uprating, to give an extra 200 shp from each engine, gives the **An-32B** a 1,100-lb increase in payload. Production has been maintained at the rate of around 40 a year through the 1980s to the present, largely for CIS military use.
Power Plant: two ZMKB Progress AI-20D Series 5 turboprops; each 5,042 ehp.
Dimensions: span 95 ft 9½ in, length 78 ft 0¼ in, height 28 ft 8½ in.
Weights: empty, equipped 38,158 lb, max payload 14,770 lb, gross 59,525 lb.
Performance: max cruising speed 329 mph, ceiling 30,840 ft, T-O run 2,495 ft, landing run 1,542 ft, range with max payload 745 miles, with max fuel 1,565 miles.
Accommodation: crew of three or four; freight, or 42 paratroops and a jumpmaster, or 24 litter patients and up to three medical attendants.
Armament: none.

Antonov An-70T
With its first flight imminent, the **An-70T** is a medium-size wide-body freighter intended primarily for service with CIS military and commercial operators. A version designated **An-77** is offered to Britain's RAF and other air forces as a C-130 replacement. Approx 28 percent of the airframe, by weight, is made of composites. The pressurized freight hold is 61 ft long (73 ft 6 in with ramp, which can be loaded), 13 ft 1½ in wide, and 13 ft 5½ in high. Loading is via rear fuselage ramp/doors, with adjustable sill height and built-in cargo-handling system. Max payload is 66,135 lb. Design life is 20,000 cycles and 45,000 flying hours in 25 years. Seven to eight man-hours of maintenance per flying hour is estimated, and the An-70T is expected to be cost-effective with a minimum 200 flying hours per month.
Power Plant: four ZMKB Progress D-27 propfans; each 13,800 shp.
Dimensions: span 144 ft 6¾ in, length 132 ft 0¾ in, height 52 ft 10 in.
Weight: gross 271,165 lb.
Performance (estimated): nominal cruising speed at 30,000 ft 466 mph, T-O run 4,920–5,905 ft, landing run 6,235 ft, range with max payload 3,435 miles.
Accommodation: crew of two or three, plus loadmaster; freight in containers, on pallets, or unpackaged, including perishables or vehicles.
Armament: none specified.

Antonov An-72 and An-74 (NATO "Coaler")
The An-72 is intended as a STOL replacement for the An-26 that can operate from unprepared airfields or from surfaces covered with ice or snow. The high location of the engines was adopted primarily to avoid foreign object ingestion. Their efflux is ejected over the wing upper surface and then down over large multislotted flaps to provide a considerable increase in lift for short-field operation. The first of two prototypes (NATO Coaler-A) flew December 22, 1977. Features included a Doppler-based automatic navigation system. The second prototype introduced a "slide-forward" loading ramp of the kind fitted to the An-26. Production versions are being built at the rate of 20 aircraft a year, in the following forms:
An-72A (Coaler-C). Light STOL transport. Conventional landing gear, with twin-wheel nose unit and two wheels in tandem on each main unit.
An-72AT (Coaler-C). Cargo-carrying version of An-72A, equipped to accommodate international standard containers.
An-72S (Coaler-C). Executive transport version, with cabin divided by bulkheads into three separate compartments. Can be adapted to carry a light vehicle, freight, 38 passengers, or eight litters.
An-72P. See the Bombers and Maritime section.
An-74 (Coaler-B). Specialized version for operation in the Arctic and Antarctic, with flight crew of five. Available in same forms as An-72. More advanced navigation aids include inertial navigation system; provision for wheel/ski landing gear and greatly increased fuel capacity. Airframe identical with that of An-72A but with larger nose radome.
About 175 An-72/74s have been built to date, for military use. *(Data for An-72A.)*
Power Plant: two ZMKB Progress D-36 turbofans; each 14,330 lb thrust.
Dimensions: span 104 ft 7½ in, length 92 ft 1¼ in, height 28 ft 4½ in.
Weights: empty 42,000 lb, max payload 22,045 lb, gross 60,625–76,060 lb.
Performance (at T-O weight of 72,750 lb): max speed 438 mph, normal cruising speed at 32,800 ft 342–373 mph, ceiling 35,100 ft, T-O run 3,050 ft, landing run 1,525 ft, range with max payload 497 miles, with max fuel 2,980 miles.
Accommodation: crew of three or four; main cabin designed primarily for freight but with provision for 68 passengers or 57 paratroops on folding seats along side walls and removable central seats; or for 24 litter patients, 12 seated casualties, and attendant.
Armament: none.

Antonov An-124 (NATO "Condor")
Antonov's counterpart to USAF's C-5 Galaxy has a slightly larger wingspan and higher gross weight. An upward-hinged, visor-type nose and rear fuselage ramp/door allow simultaneous front and rear loading/unloading. Advanced features include a fly-by-wire control system, "mobilely attached" titanium floor throughout the main hold, and 12,125 lb of composites, making up 16,150 sq ft of the airframe surface area. The 24-wheel landing gear enables the An-124 to operate from unprepared fields, hard-packed snow, and ice-covered swampland. The oleos can be deflated so that the aircraft "kneels" to facilitate front loading. Payloads range from the largest battle tanks to complete missile systems, Siberian oil well equipment, and earth movers.
The first of two prototypes flew December 26,1982. On July 26, 1985, an An-124 set 21 official records by lifting a payload of 377,473 lb to a height of 35,269 ft.

On May 6–7, 1987, it set a closed-circuit distance record by flying 12,521.2 miles nonstop around the northern periphery of the former Soviet Union. Deliveries to VTA to replace An-22s began in the same year. More than 30 have been built.

Power Plant: four ZMKB Progress D-18T turbofans; each 51,590 lb thrust.
Dimensions: span 240 ft 5¾ in, length 226 ft 8½ in, height 68 ft 2¼ in.
Weights: empty 385,800 lb, max payload 330,693 lb, gross 892,872 lb.
Performance: max cruising speed 537 mph, T-O balanced field length 9,850 ft, landing run 2,955 ft, range with max payload 2,795 miles, with max fuel 10,250 miles.
Accommodation: crew of six, plus loadmaster and reserve crew; up to 88 passengers on fully pressurized upper deck; freight on lightly pressurized lower deck, positioned by two electric traveling cranes with total lifting capability of 44,100 lb.
Armament: none on aircraft seen to date.

Ilyushin Il-76 (NATO "Candid-B")

More than 500 Il-76s are the workhorses of CIS air forces, with manufacture continuing. Delivery of military **Il-76M**s (Candid-B), with rear guns and small ECM fairings, has been ongoing since 1974. When operating into combat areas, they can be fitted with packs of 96 x 50-mm infrared countermeasures flares, in the landing gear fairings and/or on the sides of the rear fuselage.

The Il-76 is comparable to USAF's C-141 StarLifters. Its basic design features include rear-loading ramp/doors, full-span leading-edge slats and triple-slotted flaps for good field performance, a navigator's station in the glazed nose, ground-mapping radar in a large undernose fairing, and a unique and complex 20-wheel landing gear. The entire accommodation is pressurized, making it possible to carry 140 troops or 125 paratroops as an alternative to freight. Advanced mechanical handling systems are fitted for containerized and other freight. Equipment for all-weather operation includes a computer for automatic flight control and automatic landing approach.

Also in service is an improved version, designated **Il-76MD,** with an increased gross weight of 418,875 lb, max payload of 110,230 lb, and additional fuel to extend max range by 745 miles. A stretched version, with the freight hold lengthened by 21 ft 8 in and payload increased to 114,640 lb, is under development. Designated **Il-76MF,** it has 35,275 lb thrust Aviadvigatel PS-90AN turbofans. *(Data for basic Il-76M.)*

Power Plant: four Aviadvigatel D-30KP turbofans; each 26,455 lb thrust.
Dimensions: span 165 ft 8 in, length 152 ft 10¼ in, height 48 ft 5 in.
Weights: max payload 88,185 lb, gross 374,785 lb.
Performance: cruising speed at 29,500–39,350 ft 466–497 mph, T-O run 2,790 ft, landing run 1,475 ft, nominal range with 88,185 lb payload 3,100 miles, max range 4,163 miles.
Accommodation: crew of seven, incl two freight handlers.
Armament: two 23-mm twin-barrel GSh-23L guns in tail turret.

Ilyushin Il-76 Command Post

Two examples of what appears to be an airborne command post version of the Il-76MD were seen at Zhukovsky Flight Test Center in 1992. Each has a large canoe-shaped fairing above the fuselage forward of the wing; five small antennas above the center-section; other small antennas and air intake scoops under the front fuselage and at the rear of the main landing gear fairings; a long, shallow fairing forward of the dorsal fin each side at the top of the fuselage; a large, downward-inclined, flat-plate antenna on each side of the tailcone; and a long, pod-mounted probe on a pylon under each outer wing. The usual nose glazing around the navigator's compartment has been deleted, and the flight deck rear side windows are covered. The basket-drogue of what appears to be a VLF trailing-wire antenna can be seen under the rear fuselage.

Ilyushin Il-78 (NATO "Midas")

The basic **Il-78** in-flight refueling tanker derivative of the Il-76MD entered service during 1987, in support of both strategic and tactical aircraft. Using the probe-and-drogue technique, it is able to refuel up to three aircraft simultaneously. Two refueling pods are mounted conventionally under the outer wings. The third drogue is streamed from a similar pod on the port side of the rear fuselage. Fuel can be transferred from the standard tanks in the wing torsion box as well as from two cylindrical tanks, containing 61,728 lb of fuel, in the hold. These two tanks are removable, enabling the aircraft to be used as a transport. The rear turret is retained as a flight refueling observation station, without guns. Special navigation systems allow all-weather day/night mutual detection and approach by receiver aircraft from distances up to 185 miles. Convergence is controlled automatically, but refueling is permitted only in direct visibility.

The current-standard **Il-78M** has three fixed tanks in the hold, containing an additional 44,090 lb of fuel, and is not convertible. Twelve are operational.

Power Plant: four Aviadvigatel D-30KP-2 turbofans; each 26,455 lb thrust.
Weights (Il-78): empty 216,050 lb, gross 346,120–418,875 lb (Il-78M 462,965 lb).

Ilyushin Il-76 Command Post (Sebastian Zacharias)

Ilyushin Il-86 Command Post ("Maxdome") (Sebastian Zacharias)

AS-? (Kh-65SE) (Richard Malachowski)

AS-10 (Kh-25ML "Karen") (Denis Hughes)

AS-11 (Kh-58 "Kilter") and, at rear, AS-? (Kh-41 Moskit) (Piotr Butowski)

Performance (Il-78): nominal cruising speed 466 mph, refueling speed at 6,500–29,500 ft 267–366 mph, refueling radius with 143,300 lb transfer fuel 620 miles, with 79,365 lb transfer fuel 1,553 miles.
Accommodation: crew of seven.

Ilyushin Il-86 Command Post (NATO "Maxdome")

Four Il-86 transports were first observed at Zhukovsky Flight Test Center in 1992 with modifications similar to those seen on the Il-76s described earlier as probable airborne command posts. Each has a large fairing above the front fuselage, as well as a shallow dished fairing forward of the fin root, large blade antennas above and below the fuselage, and large pods under the wings inboard of the inner engines. A drogue for a VLF trailing-wire antenna is mounted on the lower fuselage on the port side.

Power Plant: four KKBM NK-86 turbofans; each 28,660 lb thrust.
Dimensions: span 157 ft 8¼ in, length 195 ft 4 in, height 51 ft 10½ in.
Performance (as transport): normal cruising speed at 30,000–36,000 ft 559–590 mph, nominal range with max fuel 2,858 miles.

Airborne Nuclear Attack and Cruise Missiles

AS-4 (Kh-22 Burya; NATO "Kitchen")

Thirty-three years after it was first seen on a Tu-22, this large ASM remains the primary armament of two of the three major types of Russian strategic bomber. The original version had inertial guidance and a 350-kiloton nuclear warhead, needing no terminal homing. When an alternative version, with a 2,200-lb high-explosive warhead for antiship use, was developed in the early 1970s, active radar terminal homing was added. A defense-suppression version, with passive radar homing and either type of warhead, is also in service.

Type: short-range ASM.
Power Plant: liquid-propellant rocket.
Guidance: inertial, or inertial plus active radar homing, or inertial plus passive radar homing.
Warhead: alternative nuclear (350 kilotons) or high-explosive (2,200 lb).
Dimensions: span 9 ft 10 in, length 37 ft 1 in, body diameter 3 ft 3½ in.
Launch Weight: 13,000 lb.
Performance: max speed Mach 4.6, range 185 miles at low altitude, 285 miles at 50,000 ft.
Carried by: Tu-22 "Blinder-B" (one), Tu-22M "Backfire" (up to three), Tu-95 "Bear-G" (two).

AS-6 (KSR-5; NATO "Kingfish")

The AS-6 Kingfish has an airplane configuration similar to that of the AS-4 "Kitchen" but is powered by a solid-propellant rocket motor. It was first seen under the port wing of a Tu-16K, replacing the bomber's underbelly 1961-vintage K-10 (AS-2 "Kipper") antiship missile. In first-line service, the "Badger-C Mod" version of the Tu-16K carried a Kingfish under each wing, as do Badger-G Mod conversions.

The AS-6 began, like Kitchen, with a 350-kiloton nuclear warhead and inertial guidance, requiring no terminal homing. To optimize its accuracy in an antiship role, a second version was developed with an active radar terminal seeker and alternative nuclear or high-explosive warhead. The third variant has a defense-suppression role, with a passive radar seeker that homes on ship- or landbased radars. Deployment is believed to have started in 1973, with about 100 missiles now operationally available.

Type: medium-range ASM.
Power Plant: solid-propellant rocket.
Guidance: inertial, or inertial plus active or passive radar homing.
Warhead: alternative nuclear (350 kilotons) or high-explosive (2,200 lb).
Dimensions: span 8 ft 2½ in, length 34 ft 8 in, body diameter 3 ft 0¼ in.
Launch Weight: 9,920 lb.
Performance: max speed Mach 3, range 185 miles.
Carried by: Tu-16K Badger-G Mod.

AS-15 (Kh-55; NATO "Kent")

When the START I Treaty becomes fully effective, some three-fourths of the CIS strategic bomber force will consist of Tu-95MS "Bear-Hs" and Tu-160 "Black-

jacks" armed with AS-15 ALCMs unless stated intentions change. AS-15 appears to be similar in configuration and size to the US BGM-109 Tomahawk. Both missiles are turbofan-powered, and the AS-15 has a terrain-comparison/inertial guidance system like Tomahawk's Tercom.

Deployment on the Tu-95MS6 began in 1984, with six **AS-15A**s on an internal rotary launcher in each aircraft. The Tu-95MS16 has, in addition, pylons for up to 10 more in four underwing clusters. The Tu-160 has two rotary launchers for a total of 12 **AS-15B**s. The two current versions differ in body diameter. *(Data for AS-15A.)*

Type: long-range ASM.
Power Plant: turbofan.
Guidance: inertial with terrain comparison.
Warhead: nuclear (200 kilotons).
Dimensions: span 10 ft 2 in, length 23 ft 3½ in, body diameter 1 ft 8 in (AS-15B 2 ft 6¼ in).
Launch Weight: 3,307 lb.
Performance: speed subsonic, range 1,865 miles. CEP 500 ft.
Carried by: Tu-95MS Bear-H, Tu-160 Blackjack.

AS-16 (Kh-15; NATO "Kickback")

In addition to two underwing AS-4 "Kitchens," a Tu-22M-3 "Backfire-C" bomber exhibited at Machulishche Airfield, near Minsk, in February 1992 had a rotary launcher carrying six **AS-16** Kickbacks in its weapons bay. DoD believes that the Backfire-C can carry four more AS-16s underwing, instead of the AS-4s. Designated Kh-15 in Russia, the AS-16 is a SRAM in the same class as USAF's AGM-69. An alternative nuclear or conventional warhead can be fitted, plus an active radar seeker in the **Kh-15A** antiship version and a passive radar seeker in the antiradiation **Kh-15P**. Development is assumed to have begun in the 1980s, with IOC in about 1988. Twelve can be carried as an alternative to six AS-15B ALCMs on each of the Tu-160 "Blackjack's" rotary launchers.

Type: short-range ASM.
Power Plant: solid-propellant rocket.
Guidance: inertial, or inertial plus active or passive radar homing.
Warhead: nuclear (350 kilotons), or high-explosive (330 lb).
Dimensions: span 3 ft 0¼ in, length 15 ft 8 in, body diameter 1 ft 5¾ in.
Launch Weight: 2,650 lb.
Performance: max speed Mach 3, range 95 miles.
Carried by: Tu-22M-3 Backfire-C, Tu-160 Blackjack.

AS-? (Kh-65SE)

As shown in the illustration on p. 70, this ASM has a basically cylindrical body, changing to a flat-bottom triangular section with rounded corners forward of the wings to reduce radar signature. The wings and three tail control surfaces fold for stowage on the missile launcher. After launch, these surfaces deploy and the power plant pod extends through hinged doors in the weapon's undersurface. No further details are available.

Airborne Tactical Missiles

AS-7 (Kh-23 and Kh-66; NATO "Kerry")

This first-generation tactical ASM has a solid-propellant rocket motor, radio command guidance by joystick control from the launch aircraft, and a 242-lb, hollow-charge, high-explosive warhead. It is carried by the MiG-27, Su-17, and Su-24. The latest version is designated Kh-66.

Dimensions: span 2 ft 7¼ in, length 11 ft 7 in, body diameter 10⅞ in.
Weight: 633 lb.
Performance: max speed transonic, range 3 miles.

AS-9 (Kh-28; NATO "Kyle")

The liquid-propellant AS-9 antiradiation missile has a configuration similar to that of the much larger Kh-22 (AS-4 "Kitchen"). In service since the early 1970s, it has a passive radar homing system and 330-lb warhead with which to attack landbased and shipborne radars. Launch aircraft are reported to be the MiG-25, MiG-27, Su-17, Su-24, Tu-16, and Tu-22M, but not all of these applications have been confirmed. Like the AS-4, it is said to cruise to the target at high altitude and to complete its terminal homing in a steep dive.

Dimensions: span 4 ft 7¼ in, length 19 ft 8¼ in, body diameter 1 ft 5 in.
Weight: 1,576 lb.
Performance: max speed supersonic, range 56 miles.

AS-14 (Kh-29L "Kedge") (Brian M. Service)

AS-17 (Kh-31A/P "Krypton") (Denis Hughes)

AS-18 (Kh-59M) (Brian M. Service)

AS-? (Kh-35 "Harpoonski") (Linda Jackson)

AS-10 (Kh-25ML/MR; NATO "Karen")

There are two basic operational versions of Karen, each with a solid-propellant motor and 198-lb warhead. The **Kh-25MR** uses the same kind of radio command guidance system as the Kh-23 (AS-7 "Kerry"), to which it is very similar. The **Kh-25ML** is laser-guided, with target designation by the launch aircraft. These include the MiG-27, Su-17, Su-24, and Su-25.

Dimensions: span 2 ft 7½ in, length 13 ft 3 in, body diameter 10⅞ in.
Weight: 660 lb.
Performance: launch height 330–33,000 ft, max speed Mach 2.35, range 1.25–12.5 miles.

AS-11 (Kh-58; NATO "Kilter")

The Kh-58 is an antiradiation missile of cruciform clipped-delta wing/tailfin configuration, with passive radar homing head and a dual-thrust solid-propellant rocket motor. A nuclear warhead is reported to be optional in place of the usual 330-lb or 440-lb blast fragmentation type. Intended primarily for antiship use, Kilter forms the primary armament of the MiG-25BM and is compatible with the MiG-27, Su-17, Su-24, and Su-25.

Dimensions: span 3 ft 10 in, length 16 ft 4⅞ in, body diameter 1 ft 3 in.
Weight: 1,433 lb.
Performance: max speed Mach 4, range at low altitude 37–43 miles.

AS-12 (Kh-25MP; NATO "Kegler")

Kegler differs from the AS-10 "Karen" ASM only in having a passive radar homing head. Much smaller and lighter than the AS-9, it can be carried by the MiG-27, Su-17, Su-24, Su-25, and Tu-22M. It has a 198-lb warhead.

Dimensions: as AS-10, except length 14 ft 3½ in.
Weight: 685 lb.
Performance: launch height 330–49,200 ft, max speed Mach 2.5, range 1.5–37 miles.

AS-13 (Kh-59; NATO "Kingbolt")

The medium-range, TV-guided AS-13 has a two-stage solid-propellant power plant. Although it was first displayed in 1991, it was probably developed in the 1970s to supplement the short-range AS-10. It is thought to have a 330-lb warhead and is carried by the MiG-27, Su-17, Su-24, and Su-25, together with an ARK-9 data link pod.

Dimensions: span 4 ft 1¼ in, length 17 ft 8½ in, body diameter 1 ft 3 in.
Weight: approx 1,765 lb.
Performance: range 37 miles.

AS-14 (Kh-29; NATO "Kedge")

The two basic versions of this tactical ASM are the TV-guided **Kh-29T** and the semiactive, laser-guided **Kh-29L**. Except for the interchangeable seeker heads, they are identical. In the class of USAF's Maverick, they are carried on the extended wingroot glove pylons of the Su-24M and by the MiG-29 and Su-25. The Kh-29L has been seen on a MiG-27, accompanied by an underfuselage laser designator pod. Each version has a 705-lb high-explosive warhead. A **Kh-29MP** version, with passive antiradiation seeker, has been reported on an Su-17. *(Data for Kh-29T.)*

Dimensions: span 3 ft 7¼ in, length 12 ft 8½ in, body diameter 1 ft 3¾ in.
Weight: 1,500 lb. (Kh-29L 1,455 lb.)
Performance: launch height 650–16,400 ft, range 1.85–18.5 miles.

AS-17 (Kh-31A/P; NATO "Krypton")

Seen for the first time at Dubai '91, this impressive medium-range inertially guided ASM is powered by an integral rocket/ramjet, with four intakes for the ramjet disposed around the body, each carrying a wing and a control surface. Blast fragmentation warhead weight is 198 lb. Four versions of the AS-17 have been identified:

Kh-31A Mod 1. Antiship missile with active radar seeker. Length 15 ft 5 in, range 3–31 miles.

Kh-31A Mod 2. As Mod 1 but length 17 ft 2 in, range 3–43 miles.

Kh-31P Mod 1. Antiradiation missile with passive radar seeker. Length 15 ft 5 in, range 6–93 miles.

Kh-31P Mod 2. As Mod 1 but length 17 ft 2 in, range 6–125 miles.

An air-to-air version also exists. The Kh-31 has been seen mounted in inert form, or has been reported, on Su-17, Su-24, Su-25T, Su-27IB, and Su-35 aircraft.

Dimensions: span 3 ft 9¼ in, length see above, body diameter 1 ft 2¼ in.
Weight: 1,323 lb.
Performance: launch height 165–49,200 ft, max speed Mach 3, range see above.

AS-18 (Kh-59M)

First seen under the wing of an Su-30 demonstrator at the 1993 Paris Air Show, this short-range cruise missile has a cylindrical body with sweptback cruciform nose surfaces and a cruciform tail unit carrying inset control surfaces. Guidance is by a Granit 7TM1 TV camera behind a glass nose, and the AS-18 is powered by a podded turbofan pylon-mounted under the rear of the body. The Russian designation Kh-59M suggests that it may be intended to supersede or supplement the Kh-59 "Kingbolt."

Weight: 2,028 lb.
Performance: range more than 75 miles.

AS-? (Kh-35)

Dubbed "Harpoonski" because of its similarity to the US AGM-84 Harpoon, the Kh-35 is intended as an active radar homing antiship ASM to arm combat aircraft and helicopters, as surface-to-surface armament for ships and shore-based combat vehicles, and as a target vehicle for troops and antiaircraft defenses training to intercept hostile weapons of the Harpoon type. Delivery is scheduled to begin this year to arm the Tu-142M, with the Su-33 as another potential early carrier. Warhead weight is 320 lb.

Dimensions: length 12 ft 3½ in, body diameter 1 ft 4½ in.
Weight: 1,060 lb.
Performance: launch height 650–16,400 ft, max speed 670 mph, range 3–80 miles.

AS-? (Kh-41 Moskit)

This large antiship missile was first displayed in inert form as underbelly armament of an Su-27K at Machulish-

che Airfield, near Minsk, in February 1992. It has been identified as an air-launched development of the SS-N-22 "Sunburn" carried in launchtubes by Russian naval craft. The configuration resembles that of the much smaller Kh-31 but with the cruciform wings located toward the front of the wraparound ramjet air intakes. The wing and tail surfaces all fold to fit between the engine ducts of the Su-33 that the Kh-41 will arm. It has a 705-lb high-explosive warhead and makes an inertially guided sea-skimming approach to its target.
Dimensions: length 32 ft 0 in, body diameter 2 ft 6 in.
Weight: 9,920 lb.
Performance: max speed Mach 3, range 93–155 miles.

AFM-L

A mockup of this new antiship ASM was exhibited at the 1993 Moscow Air Show near an Su-27K. No details were given, but the AFM-L has a very long cylindrical body, with slightly reduced diameter on a short section behind the ogival nosecone. The only visible aerodynamic surfaces comprised small cruciform fins at the extreme tail, but there are long slots for retracted wings in the upper part of the center-body.

AT-2 (9M17 Skorpion; NATO "Swatter")

Designed originally for launch from land vehicles, this solid-propellant antitank weapon forms the missile armament of the Mi-24D helicopter gunship and is carried by the Hip-E version of the Mi-8. The **Swatter-A/B** employs radio command guidance and requires the helicopter's weapons operator to keep crosswires on his sight centered on the target. **Swatter-C** is similar but has semiautomatic command to line-of-sight and a range of 2.5 miles. *(Data for Swatter-A/B.)*
Dimensions: span 2 ft 2 in, length 3 ft 9¾ in, body diameter 5¼ in.
Weight: 65 lb.
Performance: cruising speed 335 mph, range 1.85 miles.

AT-6 (9M114 Kokon; NATO "Spiral")

Spiral is a solid-propellant, tube-launched missile, with a radio command guidance system. The 22-lb high-explosive warhead fitted to the basic antitank version can penetrate 11-inch armor plate at an angle of 60°. A variant with a fragmentation warhead for attacking other battlefield targets has been reported. The antitank version is standard armament on the Hind-E and F versions of the Mi-24, the Mi-28, and the Ka-29TB.
Dimensions: span 1 ft 0 in, length 6 ft 0 in, body diameter 5¼ in.
Weight: 77 lb.
Performance: cruising speed 895 mph, range 3 miles.

AT-9 (9M120 Vikhr)

The Vikhr tube-launched, solid-propellant, antitank missile was seen for the first time in the form of two eight-round clusters under the wings of the Su-25T attack aircraft. Guidance is by laser beam riding. The warhead weight is estimated at 6.6 lb.
Dimensions: length 3 ft 11¼ in, body diameter 5 in.
Weight: 37 lb.
Performance: range 2.5 miles.

AT-12 (Vikhr)

The AT-12 appears to be a lengthened and improved version of the AT-9. Its launchtube is 9 ft 8 in long, suggesting the estimated missile data that follow. The AT-12 was first seen on the Ka-50 combat helicopter, in the form of six-round underwing clusters. Other possible carriers include the Mi-24, Mi-28, and Su-25T. The motor is believed to be two-stage solid-propellant. Semiactive laser guidance is standard, with a 17-lb shaped-charge warhead.
Dimensions: length 9 ft 6 in, body diameter 5¼ in.
Weight: 132 lb.
Performance: cruising speed supersonic, range 5 miles.

AA-6 (R-40; NATO "Acrid")

This two-stage solid-propellant AAM, with a 110-lb warhead, is one of the weapons carried by MiG-25 and MiG-31 interceptors. The **R-40T** has an infrared homing head. The **R-40R** is a radar homing version. A 110-lb fragmentation warhead is standard.
Dimensions: length 20 ft 4 in, body diameter 1 ft 2¼ in, wingspan 5 ft 11 in.
Weight: 1,015 lb.
Performance: cruising speed Mach 2.2, range 18.5 miles.

AA-7 (R-23; NATO "Apex")

This AAM is one of the two types carried as standard armament by interceptor versions of the MiG-23 and is reported to be an alternative weapon for the MiG-25 and MiG-29. Apex has a solid-propellant rocket motor and exists in infrared and semiactive radar homing versions (Russian designations **R-23T** and **R-23R**, respectively). Warhead weight is 66 lb. *(Data for R-23R.)*

AFM-L antiship ASM (Piotr Butowski)

AA-8 (R-60T "Aphid") (Linda Jackson)

AA-9 (R-33 "Amos") (Piotr Butowski)

AA-10 (R-27R "Alamo-A") (Denis Hughes)

Dimensions: length 14 ft 11 in, body diameter 8 in, wingspan 3 ft 5 in.
Weight: 518 lb.
Performance: range 12.5 miles.

AA-8 (R-60; NATO "Aphid")

Successor to the AA-2 "Atoll" (see March 1993 "Gallery of Russian Aerospace Weapons") as standard close-range AAM of CIS air forces, Aphid can be carried by most Russian fighters and attack aircraft. It is intended for both interception and self-defense and has been reported in the latter role on Mi-24D/24V helicopters. It is a highly maneuverable, solid-propellant weapon with infrared homing guidance. In addition to the basic **R-60T** with active radar fuze, there is an **R-60M** version with new electro-optical fuze to match all-aspect engagement capability, and range of three miles. A 13.2-lb fragmentation warhead is fitted. *(Data for R-60T.)*
Dimensions: length 6 ft 10 in, body diameter 5⅛ in, wingspan 1 ft 5 in.
Weight: 143 lb.
Performance: range under 1,650 ft min, 1.85 miles max.

AA-9 (R-33; NATO "Amos")

The AA-9 is standard armament on the MiG-31 and is claimed to be capable of destroying targets flying at up to Mach 3.5 at all altitudes from 80 ft to 92,000 ft, in all weather. It has folding upper tailfins to facilitate stowage on the MiG's recessed launchers, a solid-propellant motor, and a 104-lb warhead, and combines inertial autopilot guidance with semiactive radar terminal homing. The AA-9 is an alternative weapon for the Su-27. The basic **R-33** version has been followed by the **R-33S** with small cruciform front fins.
Dimensions: length 13 ft 7½ in, body diameter 1 ft 3 in, finspan 3 ft 10½ in.
Weight: 1,080 lb.
Performance: range 75 miles.

AA-10 (R-27; NATO "Alamo")

The AA-10 has generally similar capabilities to those of the AA-9. It has a complex configuration, with long-span, reverse-tapered, cruciform control surfaces to the rear of small foreplanes. An 86-lb expanding-rod warhead is standard. Six versions have been identified:

R-27R (Alamo-A). Short-burn version, with radio-corrected inertial guidance and semiactive radar terminal homing. Standard medium-range armament of MiG-29 and Su-27.

R-27T (Alamo-B). Short-burn, all-aspect, infrared homing version with fire-and-forget capability. Carried by MiG-29 and Su-27.

R-27RE (Alamo-C). Long-burn version for longer ranges. Guidance as R-27R. Carried by MiG-31 and Su-27.

R-27AE (Alamo-C). As R-27RE but better able to deal with active maneuvering counterattacks and countermeasures. Length 15 ft 8¼ in.

R-27EM (Alamo-C). As R-27AE, with added capability against sea-skimming ASMs down to 10 ft above water.

R-27TE (Alamo-D). Long-burn, all-aspect, infrared counterpart of R-27RE, with fire-and-forget capability. Carried by Su-27.

Dimensions: length 13 ft 1½ in (27R), 12 ft 1¾ in (27T), 15 ft 5 in (27RE), 15 ft 8 in (27AE/EM), 14 ft 9 in (27TE), body diameter 9 in (27R/T), 10¼ in (all others), finspan 3 ft 2¼ in.
Weights: 558 lb (27R), 560 lb (27T), 772 lb (27RE/AE/EM), 756 lb (27TE).
Performance: max launching range (head-on) 50 miles (27R), 45 miles (27T), 80 miles (27RE/AE), 105 miles (27EM), 74 miles (27TE), min launching range (tail-chase) 1,640 ft.

AA-11 (R-73; NATO "Archer")

This close-range missile is standard armament on the MiG-29 and Su-27. Its controls are complex, with movable sets of vanes and fins fore and aft of fixed cruciform surfaces at the nose, control surfaces at the trailing-edge of each of the cruciform tailfins, and four thrust-vectoring control vanes in the rocket efflux. They ensure great maneuverability, particularly when the missile is launched at large off-boresight target angles. Guidance is inertial, with terminal all-aspect infrared; a 16-lb fragmentation warhead is fitted. Two versions (R-73M1 and 2) differ in launch weight and max range.
Dimensions: length 9 ft 6¼ in, body diameter 6¾ in, finspan 1 ft 8 in.
Weights: R-73M1 232 lb, R-73M2 243 lb.
Performance: max launching range (head-on) 18.6 miles (R-73M1), 24.8 miles (R-73M2), min launching range (tail-chase) 985 ft.

AA-12 (R-77)

The capability of this solid-propellant, multimission AAM has earned it the Western nickname "AMRAAM-ski." First seen at Machulishche Airfield in February 1992, it is described as capable of destroying highly maneuverable (12*g*) aircraft, helicopters, cruise missiles, SAMs, and AAMs at all aspects, by day and night, in all weather and intense ECM, over ground and sea, in fire-and-forget mode. It has autopilot control, with midcourse radar updates and active radar terminal lock-on, and planned future versions will be able to attack AWACS aircraft at a range of 100 miles or more. From this year, the basic R-77 will gradually become standard armament on late-model Russian aircraft. It is easily distinguished by its unique lattice tailfins, which fold for possible future internal stowage. Warhead weight is 66 lb.
Dimensions: length 11 ft 9¾ in, body diameter 7⅞ in, wingspan 1 ft 1¾ in.
Weight: 385 lb.

AA-? (Kh-31 derivative)

The AAM that is being derived from the Kh-31A/P (AS-17 "Krypton") is identical to the ASM in dimensions, weight, warhead, and max speed. It is intended to be launched at all altitudes from 330 to 49,200 ft, to attack targets over a range of 6.2 to 125 miles, and will have a combined active/passive radar seeker for the specific task of destroying AWACS and other nonagile aircraft.

AA-? (R-37)
A MiG-31M has been depicted with four R-37 AAMs on the fuselage-side conformal weapon attachments and with two R-33S versions of the AA-9 "Amos" on centerline mounts. The R-37 is a greatly enhanced derivative of the R-33, with a much slimmer body and with all four tailfins able to fold for internal stowage on future stealthy aircraft. Its cruciform wings are positioned further forward than those of the R-33, and it has active radar terminal homing.
Dimensions (approx): length 13 ft 7½ in, body diameter 1 ft 0 in.
Performance: range currently more than 62 miles; with first-stage booster 250 miles.

AA-? (AAM-L; KS-172)
This AAM was shown in mockup form at the 1993 Moscow Air Show. Possibly designed in competition with the R-37, it is a slim cylindrical missile with small cruciform tail control surfaces. Propulsion is by two-stage solid rocket. Guidance is inertial with active radar terminal homing. A range of 250 miles is claimed, against targets flying up to Mach 3.75 at heights from 10 ft to 98,000 ft.
Dimensions: length 18 ft 6 in, body diameter 1 ft 7¾ in, finspan 2 ft 11½ in.
Weight: 1,650 lb.

AA-11 (R-73 "Archer") (left) and AA-12 (R-77 "AMRAAMski") (Brian M. Service)

AAM-L (KS-172) (Piotr Butowski)

Intercontinental Ballistic Missiles

SS-11 (RS-10; NATO "Sego")
In 1991, when information was exchanged between East and West under the START I Treaty, there were 296 of these "light" ICBMs at six sites in Russia, directed at softer area targets in China, Europe, and the Middle East. Since 1973, the primary version has been known to NATO as the SS-11 Mod 2, carrying a single one-megaton reentry vehicle plus penetration aids. Mod 3, with three 200-kiloton multiple reentry vehicles (MRVs), was deployed from 1975 but was withdrawn subsequently. All SS-11s are expected to be deactivated by the mid-1990s.
Launch Mode: silo-based (not upgraded in hardness); hot-launched.
Power Plant: two-stage storable liquid-propellant.
Guidance: inertial.
Warhead: single nuclear (Mod 2); three MRVs (Mod 3).
Dimensions: length 62 ft 4 in, body diameter 6 ft 6¾ in.
Launch Weight: 110,450 lb.
Performance: max range 8,075 miles (Mod 2), 6,585 miles (Mod 3). CEP 1.1 km (0.7 miles).

SS-13 (RS-12; NATO "Savage")
When development of the SS-13 began in 1957, the choice of solid propulsion was unique among the larger Soviet missiles. Only 60 were deployed, in Mod 2 configuration from 1971. Of these, 40 remain in silos in Russia. Each is in approximately the same category as the US Minuteman.
Launch Mode: silo-based; hot-launched.
Power Plant: three-stage solid-propellant, each with four nozzles and separated by truss structures.
Guidance: inertial.
Warhead: single nuclear (750 kilotons).
Dimensions: length 71 ft 2½ in, body diameter 6 ft 0½ in (first stage).
Launch Weight: 112,435 lb.
Performance: range 5,840 miles. CEP 1.8 km (1.1 miles).

SS-17 (RS-16; NATO "Spanker")
In 1991, only 44 SS-17 "light" ICBMs remained operational, of 150 originally emplaced. In their time, they had introduced innovative features, as well as much-improved accuracy. They were loaded in modified SS-11 silos inside their transportation canister. A cold launch technique enabled them to be "popped" out of the launchers by a gas generator before the main booster motors were fired. As a result, the silos would not have been heavily damaged in operational use and could have been reloaded, although this would have been a slow process. The SS-17 Mod 1 had multiple independently targetable reentry vehicles, like the other fourth-generation Russian ICBMs, the SS-18 and SS-19. All three missile types were test-fired with a single reentry vehicle for a multimegaton warhead, in case it might be needed for use against future very hard targets; but all SS-17s were eventually upgraded to Mod 3 standard with four MIRVs, as described below.
Launch Mode: silo-based; cold-launched.
Power Plant: two-stage storable liquid-propellant.
Guidance: inertial.
Warhead: four MIRVs (each 200 kilotons).
Dimensions: length 78 ft 5 in, body diameter 7 ft 4½ in (first stage).
Launch Weight: 156,750 lb.
Performance: max range 6,200 miles. CEP 1,300 ft.

SS-18 (RS-20; NATO "Satan")
The SS-18 is the only Russian missile classified as a "heavy" ICBM in START terms. Under START I, the total of 308 deployed in converted SS-9 silos must be reduced to 154 by 1998. This is expected to be achieved by removing the 104 SS-18s that constitute Kazakhstan's entire ICBM force, plus 50 of those based in Russian Siberia. There are four basic versions, two with single warhead and two with MIRV payloads of 10 reentry vehicles each. DoD stated in 1991 that "silo conversion is under way to replace older variants of the SS-18 . . . with substantially more capable versions (the SS-18 Mod 5, equipped with 10 MIRVs, and the single-warhead Mod 6)." This development effort may have been delayed or canceled. In any case, all SS-18s will be eliminated under START II.
Launch Mode: silo-based; cold-launched.
Power Plant: two-stage liquid-propellant.
Guidance: inertial.
Warhead: single nuclear (25 megatons in Mod 1, 20 megatons in Mod 3 and 6). Ten MIRVs (each 500 kilotons in Mod 2 and 4,750 kilotons in Mod 5).
Dimensions: length 119 ft 9 in, body diameter 9 ft 10 in.
Launch Weight: 465,390 lb.
Performance: max range 6,200 miles (Mod 1), 6,835 miles (Mod 2 and 4), 8,075 miles (Mod 3). CEP 820 ft.

SS-19 (RS-18; NATO "Stiletto")
The hot-launched SS-19 Mod 3 is a light ICBM, comparable in size to USAF's Peacekeeper, with the flexibility to attack targets in Eurasia as well as in the US. Although less accurate than the SS-18, it is reckoned to have significant capability against all but hardened silos. The total of 170 currently emplaced was expected to be deactivated under START II, but 105 of the missiles may be kept if converted to single warheads.
Launch Mode: silo-based; hot-launched.
Power Plant: two-stage liquid-propellant.
Guidance: inertial.
Warhead: six MIRVs (each 500 kilotons).
Dimensions: length 88 ft 7 in, max diameter 8 ft 2½ in.
Launch Weight: 232,805 lb.
Performance: range 6,200 miles. CEP 985 ft.

SS-24 (RS-22; NATO "Scalpel")
Operational since 1987, the SS-24 is a highly accurate, Peacekeeper-sized, solid-propellant system intended for use against soft or semihardened targets. The Mod 1 version, regarded in the US as the first Russian fifth-generation ICBM, reflects the 1970s emphasis on survivability through weapon system mobility. DoD has stated that "deployment of the rail-mobile SS-24 Mod 1 is complete. The [Russians] currently have three garrisons for this system that has the capability to roam over 145,000 km [90,100 miles] of track."
Only 33 SS-24 Mod 1s were operational in September 1991, and production had ended. The other 56 SS-24s are Mod 2s; 10 of these are in Russia at Tatishchevo, the remainder in Ukraine, all in converted SS-17 silos.
Launch Mode: rail-mobile (Mod 1) or silo-based (Mod 2); cold-launched.
Power Plant: three-stage solid-propellant.
Guidance: inertial.
Warhead: up to 10 MIRVs (each 300–500 kilotons).
Dimensions: length 78 ft 1 in, body diameter 7 ft 10½ in.
Launch Weight: 230,380 lb.
Performance: max range 6,200 miles. CEP 660 ft.

SS-25 (RS-12M; NATO "Sickle")
A total of 288 road-mobile SS-25s were operational in 1991, with production continuing at the rate of 60 missiles a year. All but 54 were based in seven regions of Russia, each with 27 to 45 missiles: Irkutsk, Kansk, Nizhniy Tagil, Novosibirsk, Teykovo, Yoshkar-Ola, and Yuryu. Ninety redundant SS-18 silos are to be made available for nonmobile SS-25s under START II.
As the designation RS-12M implies, Moscow regards this Minuteman-sized ICBM as a direct modernization of the SS-13 (RS-12). This enables it to conform with restraints embodied in the SALT Treaty terms. Most operational SS-25 deployments are to former SS-20 IRBM bases eliminated under the INF Treaty. At each base, a number of garages with sliding roofs house the system's massive off-road, wheeled transporter-erector-launchers (TELs); other buildings shelter the mobile support equipment. Advances claimed for the SS-25 include a greater throw-weight and nine times the accuracy of the SS-13, as well as greater survivability (because it is mobile in its basic form) and an inherent refire capability.
Launch Mode: basically road-mobile, with operational launch from inside garage, or from silo; cold-launched.
Power Plant: three-stage solid-propellant.
Guidance: inertial.
Warhead: single RV (550 kilotons).
Dimensions: length 70 ft 6½ in, body diameter 5 ft 11 in.
Launch Weight: 99,425 lb.
Performance: range 6,525 miles. CEP 660 ft.

Submarine-Launched Ballistic Missiles

SS-N-6 (RSM-25; NATO "Serb")
The oldest class of Russian SSBN still operational is known to NATO as "Yankee I." Thirty-four were built in 1963–74, each with two rows of launchtubes in its hull for 16 SS-N-6 ballistic missiles. Six may remain in service with the Pacific and Northern Fleets. The missiles are of the type known to NATO as SS-N-6. *(Data for Mod 3.)*
Launch Mode: submarine-launched; intermediate range.
Power Plant: single-stage liquid-propellant.
Guidance: inertial.
Warhead: two MIRVs (each 500 kilotons).
Dimensions: length 31 ft 8 in, body diameter 4 ft 11 in.
Launch Weight: 31,305 lb.
Performance: max range 1,865 miles. CEP 4,265 ft.

SS-N-8 (RSM-40; NATO "Sawfly")
Increased size and the addition of stellar sensing techniques to the guidance system gave this SLBM intercontinental range and greatly improved accuracy compared with the SS-N-6. It was deployed from 1971 on 18 (now 17) "Delta I" submarines, developed from the "Yankee," with a deeper housing for the longer SS-N-8s above the rear casing. To compensate for added top-weight, the number of missiles was restricted to 12. This was restored to 16 in the four Delta IIs, which have a lengthened hull at the expense of a small speed reduction to 24 knots. *(Data for Mod 1.)*
Launch Mode: submarine-launched; intercontinental range.
Power Plant: two-stage liquid-propellant.
Guidance: inertial, with stellar reference update.
Warhead: one RV (1.2 megatons).
Dimensions: length 46 ft 7 in, body diameter 5 ft 10⅞ in.
Launch Weight: 73,410 lb.
Performance: max range 4,850 miles. CEP 1,315 ft.

SS-N-18 (RSM-50; NATO "Stingray")

Although similar in many respects to the SS-N-8, the SS-N-18 introduced the first MIRVed warheads on a Russian SLBM. Increased length required an even higher housing above the ship's casing when it was deployed on 14 "Delta III" SSBNs in 1976–82. Each ship carries 16 missiles, in two rows, making a total of 224 currently deployed with the Pacific and Northern Fleets. It is expected that some will be replaced with SS-N-23 "Skiffs." *(Data for Mod 1.)*

Launch Mode: submarine-launched; intercontinental range.
Power Plant: two-stage liquid-propellant.
Guidance: inertial, with stellar reference update.
Warhead: three MIRVs (each 200 kilotons).
Dimensions: length 51 ft 2¼ in, body diameter 5 ft 10⅞ in.
Launch Weight: 77,820 lb.
Performance: max range 4,040 miles. CEP 2,950 ft.

SS-N-20 (RSM-52; NATO "Sturgeon")

Largest and heaviest of Russian SLBMs, the SS-N-20 is carried by the formidable "Typhoon" SSBNs. The ships of this class are by far the biggest submarines ever put into service, with a length of 562 ft and displacement of 21,500 tons surfaced, 26,500 tons submerged. Six entered service in 1982–89; they are based in the Kola Peninsula and are intended to launch their missiles from protected waters near Russia.

The SS-N-20 was the first Russian series-production, solid-propellant SLBM. Twenty are loaded in each Typhoon in a unique configuration with the launchtubes forward of the sail. An improved SS-N-24/26 version is under development.

Launch Mode: submarine-launched; intercontinental range.
Power Plant: three-stage solid-propellant.
Guidance: inertial, with stellar reference update.
Warhead: six to nine MIRVs (each 100 kilotons).
Dimensions: length 59 ft 0½ in, body diameter 7 ft 10½ in.
Launch Weight: 185,185 lb.
Performance: max range 5,150 miles. CEP 1,640 ft.

SS-N-23 (RSM-54; NATO "Skiff")

First tested in 1983, the SS-N-23 has liquid propulsion, suggesting that this is still preferred by Russia's submariners. To carry it, seven new *Delphin*-class (NATO "Delta IV") submarines have been constructed at Severodvinsk, at the rate of about one a year, with another five planned. Each carries 16 SS-N-23s inside the conventional type of raised housing aft of the sail. They are based with the other newer ("Typhoon") class in the Kola Peninsula as part of the Northern Fleet.

Launch Mode: submarine-launched; intercontinental range.
Power Plant: three-stage liquid-propellant.
Guidance: inertial, with stellar reference update.
Warhead: ten MIRVs (each 100 kilotons).
Dimensions: length 55 ft 1½ in, body diameter 6 ft 2¾ in.
Launch Weight: 88,845 lb.
Performance: max range 5,160 miles. CEP 1,640 ft.

Surface-to-Air Missiles

SH-11 (UR-96; NATO "Gorgon")

The world's only operational ABM (antiballistic missile) system is emplaced at eight sites around Moscow. Comprising the full 100 launchers permitted by the 1972 ABM Treaty, it is considered capable of engaging small numbers of reentry vehicles approaching from any direction during an accidental or unauthorized launch against the city. In its current ABM-3 form, it offers a dual-layered defense against ballistic missiles and some use against satellites in low-Earth orbit. A multifunctional "Pill Box" radar located at Pushkino, north of Moscow, has the task of identifying and tracking incoming reentry vehicles. These would then be intercepted at high altitude and over long ranges by Gorgon ABMs. Any that penetrated this layer of defense would be engaged by "Gazelle" ABMs within the atmosphere.

It is believed that 36 silo-based Gorgons have replaced the original SH-01 "Galosh" exoatmospheric intercept missiles, which were launched from above ground. Little is known about them, but they were identified initially as Modified Galosh, and the following details of the original SH-01 provide an indication of their likely characteristics:

Type: silo-launched, exoatmospheric, antiballistic missile.
Power Plant: three-stage liquid-propellant.
Guidance: command.
Warhead: nuclear (one megaton).
Dimensions: length 65 ft, base diameter 8 ft 5 in.
Launch Weight: 72,750 lb.
Performance: range more than 200 miles.

SH-08 (NATO "Gazelle")

This quick-reaction, high-acceleration interceptor missile is designed to destroy in the atmosphere reentry vehicles that penetrate the outer layer of ABM defense. Up to 64 are thought to be silo-based around Moscow, as the second stage of the capital's antiballistic missile defenses. Gazelle is described as being similar in general configuration to the long-abandoned US Sprint, with a low-yield nuclear warhead. Like the exoatmospheric "Gorgons," it is command-guided from the ground via the "Pill Box" phased-array radar. The following data are estimated:

Type: silo-launched, endoatmospheric, antiballistic missile.
Power Plant: solid-propellant.
Guidance: command.
Warhead: nuclear (10 kilotons or less).
Dimensions: length 32 ft 10 in, max diameter 3 ft 3 in.
Launch Weight: 22,300 lb.
Performance: range 50 miles.

SA-2 (V-75 Dvina; NATO "Guideline")

This veteran SAM is land-transportable on a semitrailer and can be transferred to the standard single-round launcher in 12 minutes. Of six versions (**SA-2A** to **F**), only the **SA-2E** has alternative high-explosive (650 lb) or command-detonated nuclear (15 kiloton) warheads, in a more bulbous nose. Improved guidance on the **SA-2F** offers a home-on-jam capability. Up to 2,000 SA-2s are currently in service in the CIS.

The SA-2's effectiveness has been reduced dramatically by modern airborne countermeasures. Its "Fan Song" radar, with a crew of four to six, operates in target acquisition and automatic tracking modes. It can track up to six targets simultaneously before switching to automatic tracking and missile guidance against the selected target. Unless the SA-2 picks up its narrow UHF line-of-sight guidance beam within six seconds of launch, it will go ballistic. It reaches its maximum velocity at 25,000 ft and has only limited maneuverability against modern tactical aircraft.

Type: medium-altitude, transportable, SAM.
Power Plant: liquid-propellant sustainer, burning nitric acid–kerosene mix; solid-propellant booster.
Guidance: radio command.
Warhead: high-explosive fragmentation (430 lb, except on SA-2E), with proximity and/or command fuzing.
Dimensions (SA-2F): length 35 ft 5¼ in, body diameter (second stage) 1 ft 8 in, wingspan (second stage) 5 ft 7 in.
Launch Weight (SA-2F): 5,040 lb.
Performance (SA-2F): max speed Mach 3.5, slant range 3.75–18.65 miles, effective ceiling 300–82,000 ft.

SA-3 (S-125 Neva; NATO "Goa")

More than 300 battalion sites with SA-3 missiles were operational in the CIS when information was last available, each with four semimobile twin or fixed quadruple rail launchers. Current versions are the **SA-3A** and **SA-3B**, the latter with improved command guidance. Reload time on four rails is 50 minutes.

The system's P-15M "Squat Eye" early warning and target acquisition racar has a range of 125 miles; the "Low Blow" radar used for target monitoring and missile control has an acquisition range of 68 miles and a tracking range of 25–52 miles. Six targets can be tracked simultaneously and one or two missiles guided. During operations in a dense ECM environment, 15-mile-range TV cameras on the latest Low Blow systems provide the fire-control team with the same information as that from the radar without affecting the command guidance function. *(Data for SA-3B.)*

Type: low/medium-altitude, transportable SAM.
Power Plant: two-stage solid-propellant.
Guidance: radio command.
Warhead: high-explosive fragmentation (132 lb), with Doppler radar proximity and contact fuzing. Lethal burst radius 41 ft.
Dimensions: length 20 ft 0 in, body diameter (second stage, max) 1 ft 2½ in, wingspan (second stage) 4 ft 0 in.
Launch Weight: 2,095 lb.
Performance: max speed Mach 3.5, slant range 1.5–12.4 miles, effective ceiling 150–39,375 ft.

SA-4 (9M8 Krug; NATO "Ganef")

There were 1,375 twin-round SA-4 launchers in armies of the former USSR in the 1980s, in spite of progressive replacement with SA-11s and SA-12As. They are deployed normally six to 15 miles behind the FEBA as elements of an integrated defense system embodying every type of SAM and antiaircraft gun. Each battery has three 2P24 SPU tracked mobile launchers, four Ural 375 TZM transport/reload vehicles each carrying one missile, and one SSNR "Pat Hand" mobile missile guidance radar. Acquisition range of Pat Hand is 75–80 miles, and tracking range, at which a single missile can be launched, is 50–56 miles. The radar can guide two missiles to a single target, if required. Reload time for the SPU is 10–15 minutes.

All elements of the SA-4 system are air-transportable in An-22 and An-124 military freighters. Major current versions, often mixed in a battery:

9M8M1 (SA-4A). 1967 version, with overall length of 28 ft 10½ in; slant range 5–34 miles; effective ceiling 330–82,000 ft.

9M8M2 (SA-4B). 1973 version, with shorter nose; improved close-range performance at expense of max range and effective ceiling. *(Data for SA-4B.)*

Type: medium-altitude, air-transportable SAM.
Power Plant: ramjet sustainer, burning kerosene; four wraparound solid-propellant boosters.
Guidance: radio command, with semiactive radar terminal homing.
Warhead: high-explosive fragmentation (300 lb), with proximity fuzing.
Dimensions: length 27 ft 7 in, body diameter 2 ft 10 in, wingspan 7 ft 6½ in.
Launch Weight: approx 5,500 lb.
Performance: max speed Mach 2.5, slant range 0.7–31 miles; effective ceiling 330–78,750 ft.

SA-5 (S-200 Volga; NATO "Gammon")

About 1,930 SA-5s are believed to be operational in the CIS, at 130 sites. They are the last known SAMs developed in the former USSR for deployment from static launchers and exist in three versions:

SA-5A. Initial production version with high-explosive warhead, operational from 1966.

SA-5B. As SA-5A but with nuclear warhead. Entered service 1969–70.

SA-5C. As SA-5A but with improved maneuverability and terminal guidance. Standard version from 1975.

The Russian missiles are deployed in Air Defense Rocket Brigades, made up of battalions of SA-3 and SA-5 launchers, plus 23-mm or 57-mm antiaircraft guns. Each SA-5 battalion has a 240-mile-range P-50 "Bar Lock B" target search and acquisition radar, a 100-mile-range "Square Pair" missile guidance radar, and six single-rail missile launchers.

Type: medium/high-altitude SAM.
Power Plant: initially liquid-propellant, later solid-propellant sustainer; four wraparound solid-propellant boosters.
Guidance: radio command, with semiactive radar terminal homing.
Warhead: high-explosive or (SA-5B only) nuclear (25 kilotons), with proximity and command fuzing.
Dimensions: length 34 ft 9 in, body diameter 2 ft 9½ in, wingspan 9 ft 4 in.
Launch Weight: 6,175 lb.
Performance: max speed above Mach 4, slant range 93 miles, effective ceiling 1,000–65,000 ft.

SA-6 (9M9 Kub; NATO "Gainful")

The SA-6 is a self-propelled tactical weapon system, consisting of three missiles, with unique integral solid rocket/ramjet propulsion, on a tracked TEL. The armies of the CIS have about 850 SA-6 TELs, deployed in antiaircraft regiments at divisional level. Each regiment consists of a Hq. with EW, IFF, and height-finding radars, and five SA-6 batteries. Each battery has an IS-91 "Straight Flush" fire-control radar, mounted on the same kind of tracked chassis as the TEL; four SA-6 TELs; and four ZIL 131 TZM reload vehicles, each carrying three missiles. Straight Flush has a surveillance range of 34 miles and engagement range of 18 miles. It performs IFF interrogation, target tracking and illumination, and missile radar command guidance functions. Up to three missiles can be guided toward the same target, with a TV tracker available to assist operation in a dense ECM environment. Reloading of the TEL takes 10 minutes. All elements of the SA-6 system are air-transportable in An-22, An-124, and Il-76 freighters.

Pending availability of the SA-11 "Gadfly" weapon system, one of the original **SA-6A** TELs in some batteries was replaced with a TELAR (transporter-erector-launcher and radar) with added SA-11 "Fire Dome" engagement radar. The TELAR carries modified **SA-6B** missiles.

Type: low/medium-altitude, mobile SAM.
Power Plant: solid-propellant booster; after burnout, its empty casing becomes a ramjet combustion chamber for ram air mixed with the exhaust from a solid-propellant gas generator.
Guidance: radar command; semiactive radar terminal homing.
Warhead: high-explosive fragmentation (130 lb), with proximity and contact fuzing. Lethal burst radius 16 ft.
Dimensions: length 19 ft 0¼ in, body diameter 1 ft 1⅜ in, wingspan 4 ft 1 in.

Launch Weight: 1,320 lb.
Performance: max speed Mach 2.8, slant range 1.8–15 miles, effective ceiling 100–49,000 ft.

SA-7 (9M32 Strela-2; NATO "Grail")

The initial **SA-7A** version of the shoulder-fired, tube-launched, passive IR homing Grail could be fired only from behind a target at a very hot exhaust area, over a narrow field of fire, and tended to home on the sun if pointed within 20° of that heat source. Solar reflection from clouds or heat from sun-exposed rocks could guide it astray, limiting its usefulness against low-flying aircraft. In 1971, the improved **SA-7B** Grail Mod 1 (Russian **9M32M Strela-2M**) entered service, with an extended field of fire of 30° each side of the target's tail, a seeker able to filter out spurious heat sources, including early IR decoys and flares, and an improved warhead. The operator could also have a small passive RF antenna fixed to his helmet, to provide audible warning of an approaching aircraft by picking up emissions from its radar and radar altimeter. Major version from the mid-1970s has been the **SA-7C** Grail Mod 2, with improved launcher and more effective RF detector mounted forward of the gripstock. The second member of an SA-7 team carries a reload missile. Reload time is six seconds.

The SA-7 is also carried by vehicles, including ships, in batteries of four, six, and eight, for both offensive and defensive employment.
Type: low-altitude, man-portable SAM.
Power Plant: solid-propellant booster/sustainer.
Guidance: infrared passive homing.
Warhead: high-explosive fragmentation (2.5 lb) with contact and graze fuzing.
Dimensions: length 4 ft 8¾ in, body diameter 2⅞ in.
Launch Weight: 21.7 lb. Launcher: 10.9 lb.
Performance: max speed Mach 1.55, slant range 0.5–2.6 miles, effective ceiling 165–7,550 ft.

SA-8 (9M33 Romb; NATO "Gecko")

First seen in 1975, this all-weather, low-altitude SAM was developed to fill the gap between the SA-7/SA-9 and the SA-6. It is able to self-deploy over medium ranges and was the first tactical air defense weapon system of the former USSR in which all components necessary to conduct a target engagement are carried by a single vehicle. In the original **SA-8A** Gecko Mod 0 (**9M33**), two pairs of exposed single-stage missiles were carried, ready to fire. The **SA-8B** Gecko Mod 1 (typically **9M33M3**) system has six dual-thrust, increased-performance missiles in launcher/containers. Fire-control equipment and launcher are mounted on a rotating turret, carried by a BAZ-5937 six-wheel, fully amphibious, all-terrain vehicle. The "Land Role" fire-control radar, to the rear of the one-man gunner/radar operator's position, has a 360° scan over a 22-mile range. It folds down behind the launcher, enabling the weapon system to be airlifted in An-22, An-124, and Il-76 transport aircraft. Range of the monopulse tracking radar is 15.5 miles. An LLLTV/optical system assists target tracking in low visibility and dense ECM. Reload time is five minutes.

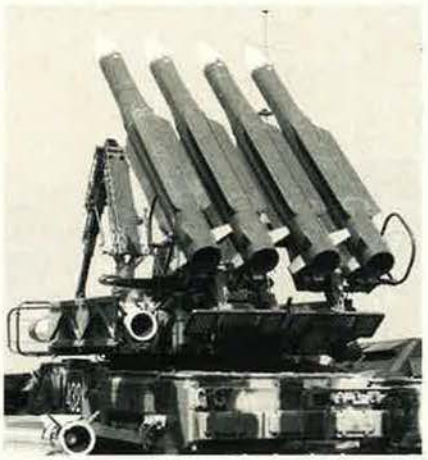
Together with the SA-6, the SA-8A largely replaced S-60 57-mm towed antiaircraft guns in CIS service and has itself replaced some SA-6s. More than 1,000 systems are operational in the CIS. In Iraqi service, they destroyed a number of Tomahawk cruise missiles during the Persian Gulf War. *(Data for SA-8A.)*
Type: low-altitude, self-contained, mobile SAM.
Power Plant: single-stage solid-propellant.
Guidance: radar command, permitting two missiles to be guided simultaneously against a single target, on different frequencies to complicate ECM.
Warhead: high-explosive fragmentation (42 lb), with proximity and contact fuzing. Lethal burst radius 16 ft.
Dimensions: length 10 ft 4 in, body diameter 8¼ in, finspan 2 ft 1¼ in.
Launch Weight: 286 lb.
Performance: max speed Mach 2.4, slant range SA-8A 0.9–7.5 miles, SA-8B 0.9–9.3 miles, effective ceiling 82–16,400 ft.

SA-9 (9M31 Strela-1; NATO "Gaskin")

The SA-9 mobile amphibious weapon system has been largely replaced in CIS armies with the SA-13. It comprises a BRDM-2 four-wheel vehicle carrying a box launcher for two pairs of infrared homing solid-propellant missiles in place of the normal turret. The launcher rests flat on the rear of the vehicle when not required to be ready for action. Early **SA-9A** Gaskin Mod 0 (**9M31**) missiles were followed by **SA-9B** Gaskin Mod 1s (**9M31M**) with improved cooled seeker and longer range. *(Data for SA-9B.)*
Type: low-altitude, mobile SAM.
Power Plant: dual-thrust solid-propellant.
Guidance: infrared passive homing.
Warhead: high-explosive fragmentation (5.75 lb), with proximity fuzing. Lethal burst radius 16 ft.
Dimensions: length 5 ft 11 in, body diameter 4¾ in, wingspan 1 ft 2¾ in.

SA-8B (9M33M3 "Gecko" Mod 1) (Robert Hewson)

SA-10B (S-300PMU "Grumble" Mod 1) (Robert Hewson)



SA-11 (9M38 Gang; "Gadfly")

Launch Weight: 66 lb.
Performance: max speed Mach 1.5, slant range 0.35–5 miles, effective ceiling 32–20,000 ft. Range is reduced considerably in head-on engagement and extended to a possible 6.8 miles in tail-chase.

SA-10 (S-300PMU; NATO "Grumble")

Russia's counterpart to the US Army's MIM-104 Patriot, the all-altitude SA-10 replaces SA-2s, SA-3s, and SA-5s. It is effective against targets at heights up to 88,500 ft, including low-flying aircraft, cruise missiles, and reentry vehicles from ballistic missiles in the class of the Scuds used by Iraq in the Persian Gulf War. Deployment of the initial fixed-base **SA-10A** (Grumble Mod 0) began in 1980. An SA-10A regiment is reported to comprise three batteries and an F-band 3-D surveillance and tracking radar ("Big Bird") at the command post for long-range target detection. Each battery has an engagement control center, a 3-D CW pulse-Doppler target acquisition radar ("Clam Shell"), an I-band phased-array engagement radar ("Flap Lid A"), and up to 12 four-rail container erector/launchers on semitrailers. These are positioned on concrete pads, and the missiles are launched vertically by compressed air, with ignition after launch. The track-via-missile (TVM) system guidance, like that of Patriot, enables up to six targets to be engaged simultaneously, with one or two missiles per target. A battery can fire three missiles per second, against targets traveling at up to 2,610 mph. Max range is 28, 47, or 56 miles, according to model.

For improved mobility, the land-mobile **SA-10B** (Grumble Mod 1) version was developed in the mid-1980s, with four-axle, four-round TELs based on the MAZ-7910 vehicle. Reload missiles and a "Flap Lid B" planar array target-tracking and fire-control radar are carried on similar trucks. Readiness to fire is five minutes after the vehicles come to a halt. At least 10,000 SA-10s are believed to be in service, including exports, with production continuing.
Type: all-altitude, fixed-site and mobile SAM.
Power Plant: single-stage solid-propellant.
Guidance: radar command and midcourse inertial, with semiactive radar terminal homing and proximity fuzing.
Warhead: high-explosive (285 lb) or low-yield nuclear.
Dimensions: length 23 ft 4 in, body diameter 1 ft 5¾ in, wingspan 3 ft 3½ in.
Launch Weight: 3,300 lb.
Performance: max speed Mach 6, range 3–56 miles, effective ceiling 80–88,500 ft.

SA-11 (9M38 Gang; NATO "Gadfly")

Since 1980, this weapon system has progressively replaced SA-4s in army-level missile brigades, and some SA-6As at divisional level, for defense against high-performance aircraft and cruise missiles at low to medium altitudes. The SA-11 system is self-contained on a GM-569 tracked vehicle, which carries a 360° traversing four-rail launcher and "Fire Dome" monopulse guidance and tracking radar. The missile resembles the US Navy's Standard MR1 RIM-66 in general appearance and can sustain 23*g* maneuvers.

An SA-11 regiment is made up of five batteries, each with four TELs, and similar GM-569 vehicles carrying early warning and acquisition radars and reload missiles. The same chassis is also used to carry the regiment's long-range early warning radar. If this is not available, the SA-11 TELs can be integrated into an SA-6 battery, using the latter's "Straight Flush" fire-control radar.
Type: low/medium-altitude, mobile SAM.
Power Plant: solid-propellant.
Guidance: semiactive monopulse radar command.
Warhead: high-explosive fragmentation (154 lb).
Dimensions: length 18 ft 2½ in, body diameter 1 ft 3¾ in, wingspan 3 ft 11¼ in.
Launch Weight: 1,520 lb.
Performance: max speed Mach 2.5, slant range 1.85–21.75 miles, effective ceiling 50–72,000 ft.

SA-12A (S-300V/9M83; NATO "Gladiator")

Deployment of the land-mobile tactical SA-12A began in 1986, primarily for use against aircraft and ASMs. All components of the system are based on the tracked MT-T chassis, a derivative of the T-64 main battle tank. The three batteries of an SA-12A battalion each have three TELs, a "Grill Pan" fire-control vehicle, and a reload transporter. The main "Bill Board" long-range target search and acquisition radar vehicle and additional reload transporters are held at battalion Hq. level. Each TEL carries four missile container/launchers that can be raised independently to a vertical position for launch and a telescopic missile guidance radar. The latter is believed to control the missile in flight after its target has been tracked and handed on by Grill Pan.
Type: all-altitude, mobile SAM.
Power Plant: two-stage solid-propellant.
Guidance: radar command and midcourse inertial, with semiactive radar terminal homing.
Warhead: high-explosive fragmentation (330 lb) with possible low-yield nuclear option.
Dimensions: length 26 ft 11 in, body diameter 2 ft 3½ in.
Launch Weight: 2,800 lb.
Performance: max speed Mach 3, slant range 47 miles, effective ceiling 2,950–98,400 ft.

SA-12B (S-300V/9M82; NATO "Giant")

This derivative of the SA-12A appears to have the same 21-ft-long, 1,800-lb second stage mated to a much longer first stage. It was intended to be deployed to defend road-mobile SS-25s and as part of the rail-mobile SS-24 Mod 1 ICBM system with its MT-T two-round tracked TELs carried on low-loader railcars. After an SS-24 train emerged from its tunnel concealment to move to its launch area, the SA-12Bs were to disperse into the surrounding area to defend the Scalpel launchers from attacking enemy aircraft, short-range ballistic missiles, and possibly strategic missile reentry vehicles.

Type: all-altitude, mobile SAM.
Power Plant: two-stage solid-propellant.
Guidance: as SA-12A, with possible active homing under development.
Warhead: as SA-12A.
Dimensions: length 34 ft 5½ in, body diameter 3 ft 3½ in.
Launch Weight: 4,250 lb.
Performance: max slant range 62 miles.

SA-13 (9M37 Strela-10; NATO "Gopher")

About 900 SA-13 four-missile tracked launchers were operational with Russian Army and Naval Infantry units by 1987, when production of the missiles was at the rate of around 2,800 a year. Replacing the SA-9, the basic **9M37** missile was followed by the **9M37M Strela-10M2,** offering choice of an uncooled lead sulphide, near-IR homing seeker, or cooled indium altimonide mid-IR homing type, in each case with all-aspect and IRCCM capabilities. The missiles are carried in two twin-box launchers on TELAR vehicles, some with four "Flat Box B" passive radar detection antennas on their upper surface. Eight reload missiles are normally carried by each of the vehicles, which are fully amphibious. The associated "Dog Ear" acquisition/tracking radar vehicle of the SA-9 is retained, with range-only radar on each TELAR.

The latest known version of the missile is the **9M333 Strela-10M3,** intended for use in the mobile battle and to defend troops in movement from attack by low-level aircraft, helicopters, and precision guided weapons, as well as from observation by UAVs. It has a dual-mode optical photocontrast/infrared seeker to improve adverse weather operation. *(Data for 9M37M; 9M333 in parentheses.)*

Type: low-altitude, mobile SAM.
Power Plant: solid-propellant.
Guidance: infrared passive homing in two frequency bands (optical photocontrast/IR).
Warhead: high-explosive fragmentation rod; 6 lb and 100 rods. Lethal burst radius 16 ft. Contact and active xenon lamp proximity fuzing (contact and active laser proximity fuzing).
Dimensions: length 7 ft 2½ in, body diameter 4¾ in, wingspan 1 ft 3¾ in.
Launch Weight: 87 lb (93 lb).
Performance: max speed Mach 2, slant range 0.3–6.2 miles, effective ceiling 33–16,400 ft.

SA-14 (Strela-3; NATO "Gremlin")

This development of the SA-7 shoulder-fired SAM, with much-improved effective altitude capability, began to replace the earlier weapon one for one in 1978. Compared with the SA-7, it has an uprated rocket motor, a more powerful warhead, and a cryogenically cooled IR seeker with proportional guidance that is effective in head-on as well as tail-chase firings and against targets maneuvering at up to 8*g*. Effectiveness against targets equipped with flare dispensers and IR jammers is claimed to be much enhanced. A passive RF direction-finder antenna system is optional.

Type: low-altitude, man-portable SAM.
Power Plant: solid-propellant booster/sustainer.
Guidance: infrared passive homing.
Warhead: high-explosive fragmentation (4.4 lb), with contact and graze fuzing.
Dimensions: length 4 ft 7¼ in, body diameter 3 in.
Launch Weight: 21.8 lb. Launcher: 13.4 lb.
Performance: max speed Mach 1.76, slant range 0.37–3.7 miles, effective ceiling 33–18,000 ft.

SA-15 (9M330 Tor; NATO "Gauntlet")

In service since 1988, this large, highly automated, mobile SAM system is immensely more formidable than the SA-8 it was designed to replace. Its modified GM-569 tracked vehicle is air-transportable but not amphibious. A box-like turret on top of the hull houses eight vertically mounted missiles in two rows and carries the engagement radars. Above the rear of the box is a 3-D pulse-Doppler G-band surveillance radar able to detect up to 48 targets over a range of 15 miles. It then assesses in order of priority, and tracks, the 10 most threatening targets. The pulse-Doppler phased-array K-band target tracking and missile guidance radar at the front can simultaneously track and engage two targets traveling at 22–1,565 mph, by day or night, in all weather, and in dense ECM environments. It is supplemented by an autonomous automatic TV tracking system that enhances the SA-15's capability in battlefield clutter and dense ECM. Reaction time is five to eight seconds from target detection. The missiles are cold-launched, at minimum three-second intervals, and able to maneuver at 23*g* to 30*g* against fixed-wing aircraft, helicopters, UAVs, precision guided weapons, and some types of guided missiles. Long-range surveillance for the SA-15 is provided by the "Dog Ear" type of radar vehicle. The SA-15 vehicle carries a crew of three and is equipped with IFF.

Type: low/medium-altitude, mobile SAM.
Power Plant: two-stage solid-propellant.

SA-12B (S-300V/9M82 "Giant") (top) and SA-12A (S-300V/9M83 "Gladiator")

SA-13 (9M37 Strela-10; "Gopher") (Robert Hewson)

SA-15 (9M330 Tor; "Gauntlet")

2S6 Tunguska with SA-19 (9M311; "Grissom") launchtubes

Guidance: radar command and active radar terminal homing, supplemented by TV/IR trackers.
Warhead: high-explosive fragmentation (33 lb), with proximity fuzing.
Dimensions: length 9 ft 4¼ in, body diameter 1 ft 1¾ in, wingspan 2 ft 0 in.
Launch Weight: 368 lb.
Performance: max speed Mach 2.5, slant range 1–7.5 miles, effective ceiling 33–19,700 ft.

SA-16 (9M313 Igla-1; NATO "Gimlet")

Together with the self-propelled 2S6 antiaircraft weapon system (see SA-19), the third-generation SA-16 has been replacing the SA-7, SA-14, and ZSU-23-4 gun system for the past decade. Its configuration is similar to that of the SA-7 and SA-14, but it is an entirely new weapon, with a conical nose. Deployment time is 13 seconds, and launch time from target acquisition is five seconds. Guidance is by proportional navigation, and the cooled IR seeker improves resistance to countermeasures. Maximum target-bearing angle for launch is ±40°.

Type: low-altitude, man-portable SAM.
Power Plant: dual-thrust solid-propellant.
Guidance: infrared passive homing.
Warhead: high-explosive fragmentation (4.4 lb), with contact and graze fuzing.
Dimensions: length 5 ft 1 in, body diameter 3⅛ in.
Launch Weight: 23.8 lb. Launcher: 9.25 lb.
Performance: average speed Mach 1.68, slant range 0.37–3.1 miles, effective ceiling 33–11,500 ft.

SA-17 (NATO "Grizzly")

Intended to supersede the SA-11 "Gadfly," this new low/medium-altitude SAM was identified by NATO in 1986–87 and is now almost ready for production. It has a similar configuration to the SA-11 and is based on the same GM-569 tracked vehicle. A major innovation is a new engagement radar known to NATO as "Chair Back," which replaces the SA-11's "Fire Dome," and enables two to four targets to be engaged simultaneously. Data generally as for SA-11, except:

Dimensions: length 18 ft 0½ in.
Weight: 1,587 lb.
Performance: max speed Mach 3.5, slant range 1.85–31 miles, effective ceiling 33–78,750 ft.

SA-18

First mentioned in the 1990 edition of DoD's *Soviet Military Power,* this fourth-generation, shoulder-fired SAM is described as "highly capable." It is said to be in service in small quantities for field testing.

SA-19 (9M311; NATO "Grissom")

This tube-launched hypersonic missile was developed as one element of the 2S6 Tunguska gun/missile tracked regimental air defense vehicle, which entered service in 1986 as an SA-13 replacement, for use against low-flying aircraft and ASMs. Eight SA-19s are mounted in clusters of four on each side of a turret that also carries four 30-mm guns, and fire-control and "Hot Shot" surveillance and target acquisition radars.

Type: tube-launched, low/medium-altitude SAM.
Power Plant: two-stage solid-propellant.
Guidance: semiautomatic command to line-of-sight (SACLOS), supplemented by thermal imaging sight, TV, and laser rangefinder/designator.
Warhead: high-explosive fragmentation (19.8 lb).
Dimensions: length 8 ft 2½ in, body diameter 5⅞ in.
Launch Weight: 93 lb.
Performance: speed hypersonic, max range 1.5–5 miles. ■

AEF expands its tuition assistance program for USAF enlisted personnel.

The Eagle Plan

By Arthur C. Hyland

THE AIR FORCE Association's Aerospace Education Foundation has expanded the Eagle Plan, its popular tuition assistance program for active-duty Air Force enlisted personnel.

Under the plan, the foundation has awarded unconditional $250 grants to selected active-duty graduates of the Community College of the Air Force (CCAF). AEF will increase the number of Eagle Grants (up to four) at bases with larger graduating classes. Moreover, AEF now offers the grants to selected Air Force Reserve and Air National Guard enlisted CCAF graduates. To date, almost 500 Eagle Grants have been awarded.

Enlisted personnel in grades E-4 through E-7 are eligible for Eagle Grants. To qualify, a candidate must be among the top CCAF graduates at his or her base and must be planning to seek a bachelor's degree from an accredited college.

Grant money is presented during biannual graduation ceremonies held each April and October. The grants acknowledge job performance, scholastic ability, educational goals, and leadership qualities.

Winners are chosen by a committee composed of the base Senior Enlisted Advisor, the base education officer, and a local AFA representative. AFA chapters also participate in the awarding of the grants at graduation ceremonies, and many chapters augment the grants with a chapter-funded grant. Details are available from each base education officer or by calling the Aerospace Education Foundation. ■

Fall 1993 Eagle Grant Recipients

Sgt. Michelle C. Alombro, Altus AFB, Okla.
SSgt. Jacqueline G. Alston, Tinker AFB, Okla.
SrA. Kayleen Amerson, Offutt AFB, Neb.
MSgt. Robert R. Ashley, Edwards AFB, Calif.
MSgt. Susan Bailey, Sheppard AFB, Tex.
SSgt. Jonathan D. Bey, Dyess AFB, Tex.
MSgt. Lanny S. Bowman, Langley AFB, Va.
MSgt. Eric C. Brown, USAF Academy, Colo.
MSgt. William F. Bukowski, Ellsworth AFB, S. D.
MSgt. William C. Chinault, McConnell AFB, Kan.
Sgt. Philip A. Conn, Sheppard AFB, Tex.
TSgt. Ronald J. Coyne, Birmingham Airport, Ala.
TSgt. Martha J. Curtis, Peterson AFB, Colo.
MSgt. Richard J. Dansizen, Grissom AFB, Ind.
MSgt. Dennis A. Davenport, Mountain Home AFB, Idaho
SSgt. Donovan S. Davis, Osan AB, South Korea
MSgt. Tony R. DeMarini, Beale AFB, Calif.
TSgt. Dennis A. Desilet, Plattsburgh AFB, N. Y.
SrA. Charles V. DiBello, Wright-Patterson AFB, Ohio
SSgt. Erin K. Dunn, Lowry AFB, Colo.
TSgt. Patsie E. DuPar, Howard AFB, Panama
MSgt. Douglas W. Edmonds, Griffiss AFB, N. Y.
SSgt. Daniel L. Edwards, RAF Alconbury, UK
MSgt. John D. Edwards, F. E. Warren AFB, Wyo.
Sgt. Jesse A. Eutsay, Minot AFB, N. D.
SSgt. James S. Evridge, Peterson AFB, Colo.
SSgt. James R. Freeman, Lajes Field, Azores
SSgt. Peter A. Fronczak, Ramstein AB, Germany
SSgt. Joseph K. Gallahan, Jr., Ramstein AB, Germany
SSgt. Michael J. Garcia, Travis AFB, Calif.
SrA. Toni J. Gibson, RAF Mildenhall, UK
Sgt. Annie Gorum, Bitburg AB, Germany
SrA. John L. Hall, Nellis AFB, Nev.
MSgt. Casey L. Harthorn, Cannon AFB, N. M.
MSgt. Michael Hazy, Loring AFB, Me.
SSgt. Julie D. Hebert, Travis AFB, Calif.
SrA. Alan R. Helper, Jr., Vance AFB, Okla.
MSgt. Stephen H. Hennessy, Langley AFB, Va.
TSgt. Daniel J. Hogan, Tyndall AFB, Fla.
SSgt. Jeffrey E. Holland, McChord AFB, Wash.
SSgt. Timothy B. Horn, Patrick AFB, Fla.
SSgt. Edmond Hrivnak, McChord AFB, Wash. (AFRES)
SrA. Corina M. Hyer, Sheppard AFB, Tex.
TSgt. James Jezek, Offutt AFB, Neb.
TSgt. Tracy Johnson, Travis AFB, Calif. (AFRES)
SSgt. Lisa A. Kennedy, Los Angeles AFB, Calif.
TSgt. Donna J. Killebrew, Barksdale AFB, La.
TSgt. Brian K. Knott, Maxwell AFB, Gunter Annex, Ala.
TSgt. Ronald E. Knowles, RAF Upper Heyford, UK
SSgt. Kristin A. Koski, Lackland AFB, Tex.
SSgt. James K. Langley, Brooks AFB, Tex.
MSgt. Michael J. LeBlanc, Eielson AFB, Alaska
TSgt. Mark L. Lewis, Sheppard AFB, Tex.
SSgt. John R. Liddell, RAF Chicksands, UK
Sgt. Timothy J. Lindenberger, Hanscom AFB, Mass.
Sgt. William M. Lucas, Vandenberg AFB, Calif.
MSgt. Steven A. Marley, Whiteman AFB, Mo.
TSgt. James A. Martin, Columbus AFB, Miss.
MSgt. George P. Martinez, Aviano AB, Italy
SSgt. Angela L. May, Travis AFB, Calif.
SSgt. Mark R. McLouth, Keesler AFB, Miss.
MSgt. Patrick R. Michl, Lowry AFB, Colo.
SSgt. John W. Miller, Moody AFB, Ga.
SSgt. Kathy-Ann R. Mitchell, Kelly AFB, Tex.
SSgt. John W. Moak, Keesler AFB, Miss.
MSgt. Stephen A. Muller, Griffiss AFB, N. Y.
SSgt. Roberto Navarrete, Luke AFB, Ariz.
SSgt. Jesse A. Nelson, Reese AFB, Tex.
TSgt. Mark J. Peacock, Laughlin AFB, Tex.
MSgt. Wesley T. Peel, Vandenberg AFB, Calif.
MSgt. Efrain Perez, Holloman AFB, N. M.
Sgt. Deborah F. Potts, Shaw AFB, S. C.
Sgt. Terence R. Powell, Misawa AB, Japan
MSgt. Roger L. Pugh, Pope AFB, N. C.
Sgt. Luis E. Quinonez, Grand Forks AFB, N. D.
SSgt. Daniel C. Radick, Scott AFB, Ill.
Sgt. Randall A. Reif, Keesler AFB, Miss.
TSgt. Mary S. Russell, Kelly AFB, Tex.
Sgt. Michael E. Sanders, Lowry AFB, Colo.
MSgt. Wade J. Schaber, Ellsworth AFB, S. D.
SSgt. Sharon L. Schaper, Hickam AFB, Hawaii
SSgt. Michael C. Schoenbein, Hill AFB, Utah
Sgt. David S. Singer, Langley AFB, Va.
TSgt. Dan W. Smith, Ramstein AB, Germany
MSgt. Robert C. Smith, McClellan AFB, Calif.
MSgt. Dale H. Spencer, Luke AFB, Ariz.
TSgt. Rosmarie C. Stange, Cannon AFB, N. M.
SSgt. Donald L. Steckman III, K. I. Sawyer AFB, Mich.
SSgt. Marcia E. Steiner, Charleston AFB, S. C.
SSgt. David L. Swanson, Keesler AFB, Miss.
MSgt. John M. Temple, Little Rock AFB, Ark.
Sgt. Charles A. Tomasello, Castle AFB, Calif.
SSgt. James E. Tulio, Maxwell AFB, Ala.
SrA. Arnat J. Vale, McGuire AFB, N. J.
SSgt. David A. Veenstra, Osan AB, South Korea
MSgt. Joey S. Walker, Bolling AFB, D. C.
Sgt. Horatio Watson, Nellis AFB, Nev.
Sgt. Phillip S. Weatherford, Hurlburt Field, Fla.
MSgt. Donald L. Weeks, Kunsan AB, South Korea
MSgt. Larry R. Weimer, Malmstrom AFB, Mont.
TSgt. Fred I. Williams, Bolling AFB, D. C.
SSgt. Kathy M. Williams, Peterson AFB, Colo.
Sgt. Michael L. Williams, Randolph AFB, Tex.
SSgt. Anthony C. Wilson, Hickam AFB, Hawaii
SSgt. Stacy E. L. Wingard, Goodfellow AFB, Tex.
TSgt. Leighton A. Wright, MacDill AFB, Fla.
SSgt. Ricky E. Wright, Fairchild AFB, Wash.
SSgt. Jeffrey J. Zettle, Rhein-Main AB, Germany

Books

Compiled by Frank Oliveri, Associate Editor

Arnett, Peter. *Live From the Battlefield: From Vietnam to Baghdad.* Simon & Schuster, 1230 Avenue of the Americas, New York, NY 10020. 1994. Including photos and index, 463 pages. $23.00.

Bird, Annette, and Prouty, Tim. *So Proudly He Served: The Sam Bird Story.* Okarche Books, P. O. Box 782076, Wichita, KS 67278-2076. 1993. Including photos and index, 412 pages. $24.95.

Blackwill, Robert D., and Carnesale, Albert, eds. *New Nuclear Nations: Consequences for US Policy.* Council of Foreign Relations Press, 58 E. 68th St., New York, NY 10021. 1993. Including notes and index, 272 pages. $17.95.

Blank, Stephan J., and Kipp, Jacob W., eds. *The Soviet Military and the Future.* Greenwood Press, Inc., 88 Post Rd. W., Box 5007, Westport, CT 06881. 1993. Including bibliography and index, 316 pages. $49.95.

Bloch, Michael. *Ribbentrop: A Biography.* Crown Publishers, Inc , 201 E. 50th St., New York, NY 10022. 1993. Including photos, notes, bibliography, and index, 528 pages. $25.00.

Brown, Malcolm. *The Imperial War Museum Book of the First World War: A Great Conflict Recalled in Previously Unpublished Letters, Diaries, and Memoirs.* The University of Oklahoma Press, 1005 Asp Ave., Norman, OK 73019-0445. 1993. Including photos and index, 288 pages. $27.95.

Cordesman, Anthony H. *After the Storm: The Changing Military Balance in the Middle East.* Westview Press, 5500 Central Ave., Boulder, CO 80301-2847. 1993. Including notes, bibliography, and index, 811 pages. $65.00.

Crevald, Martin van. *Nuclear Proliferation and the Future of Conflict.* The Free Press, 866 Third Ave., New York, NY 10022. 1993. Including bibliography and index, 180 pages. $22.95.

Duke, Neville. *Test Pilot.* Seven Hills Book Distributors, 49 Central Ave., Cincinnati, OH 45202. 1993. Including photos and index, 195 pages. $29.95.

Dunn, Lewis A., and Squassoni, Sharon A., eds. *Arms Control: What Next?* Westview Press, Inc., 5500 Central Ave., Boulder, CO 80301-2877. 1993. Including notes and index, 169 pages. $38.50.

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Ebbert, Jean, and Hall, Marie-Beth. *Crossed Currents: Navy Women From WWI to Tailhook.* Brassey's (US), 8000 Westpark Dr., First Floor, McLean, VA 22102. 1993. Including photos, references, and index, 321 pages $25.00.

Franks, Norman, and Richey, Paul. *Fighter Pilot's Summer.* Grub Street. Distributed by Seven Hills Book Distributors, 49 Central Ave., Cincinnati, OH 45202. 1993. Including photos, appendix, and index, 248 pages. $29.95.

Hershberg, James. *James B. Conant: Harvard to Hiroshima and the Making of the Nuclear Age.* Alfred A. Knopf, Inc., 201 E. 50th St., New York, NY 10022. 1993. Including notes and index, 948 pages. $35.00.

Kaplan, Philip, and Currie, Jack. *Round the Clock: The Experience of the Allied Bomber Crews Who Flew by Day and by Night From England in the Second World War.* 1993. Random House, Inc., 201 East 50th St., New York, NY. 10022. Including photos and index, 234 pages $50.00.

Katz, Samuel M. *Israel Versus Jibril: The Thirty-Year War Against a Master Terrorist.* Paragon House, 90 Fifth Ave., New York, NY 10011. 1993. Including photos, notes, glossary, and index, 285 pages. $24.95.

Kennedy, William V. *The Military and the Media: Why the Press Cannot Be Trusted to Cover a War.* Praeger Publishers, 88 Post Rd. W., Westport, CT 06881. 1993. Including notes, bibliography, and index, 167 pages. $45.00.

Kern, Ernst. *War Diary, 1941–45: A Report.* Vantage Press, Inc., 516 W. 34th St., New York, NY 10001. 1993 Including photos, 152 pages. $16.95.

Kuhl, George C. *Wrong Place! Wrong Time! The 305th Bomb Group & the 2nd Schweinfurt Raid, October 14, 1943.* Schiffer Publishing Ltd., 77 Lower Valley Rd., Atglen, PA 19310. 1993. Including photos, appendix, and notes, 304 pages. $24.95.

MacDonald, Callum. *The Lost Battle: Crete 1941.* The Free Press, 866 Third Ave., New York, NY 10022. 1993. Including photos and index, 350 pages. $24.95.

Mackin, Elton E. *Suddenly We Didn't Want To Die: Memoirs of a World War I Marine.* Presidio Press, 505 B San Marin Dr., Suite 300, Novato, CA 94945-1340. 1993. 264 pages. $19.95.

McClean, Andrew, compiled by. *Security, Arms Control, and Conflict Reduction in East Asia and the Pacific: A Bibliography, 1980–1991.* Greenwood Press, 88 Post Rd. W., Westport, CT 06881. 1993. 551 pages. $95.00.

Mikesh, Robert C. *Broken Wings of the Samurai: The Destruction of the Japanese Airforce.* Naval Institute Press, 118 Maryland Ave., Annapolis, MD 21402-5035. 1993. Including photos, bibliography, and index, 199 pages. $34.95.

Moore, Molly. *A Woman at War: Storming Kuwait with the U.S. Marines.* Charles Scribner's Sons, 866 Third Ave., New York, NY 10022. 1993. Including photos, notes, and index, 336 pages. $22.50.

Pappas, George S. *To the Point: The United States Military Academy, 1802–1902.* Praeger Publishers, 88 Post Rd. W., Westport, CT 06881. 1993. Including photos, appendix, index, and bibliography, 474 pages. $55.00.

Perret, Geoffrey. *Winged Victory: The Army Air Forces in World War II.* Random House, 201 E. 50th St., New York, NY 10022. 1993. Including notes and index, 549 pages. $30.00.

Sedeen, Margaret. *Star-Spangled Banner: Our Nation and Its Flag.* National Geographic Society, Washington, DC 20036. 1993. Including photos and index, 232 pages. $37.50.

Semelin, Jacques. *Unarmed Against Hitler: Civilian Resistance in Europe, 1939–1943.* Praeger Publishers, 88 Post Rd. W., Westport, CT 06881. 1993. Including notes and index, 198 pages. $18.95.

Shores, Christopher, and Cull, Brian, with Izawa, Yasuho. *Bloody Shambles: The First Comprehensive Account of Air Operations Over South-East Asia, December 1941–May 1942.* Seven Hills Book Distributors, 49 Central Ave., Cincinnati, OH 45202. 1993. Including photos, maps, and index, 494 pages. $49.95.

Smith, Maj. Gen. Perry M., USAF (Ret.). *Assignment Pentagon: The Insider's Guide to the Potomac Puzzle Palace.* Second Edition, Revised. Brassey's (US), 8000 Westpark Dr., First Floor, McLean, VA 22102. 1993. Including appendix and index, 272 pages. $30.00.

Stevenson, James P. *The Pentagon Paradox: The Development of the F-18 Hornet.* Naval Institute Press, Annapolis, MD 21402. 1993. Including photos, bibliography, and index, 445 pages. $24.95.

Sweetman, Bill. *Aurora: The Pentagon's Secret Hypersonic Spyplane.* Motorbooks International, P. O. Box 2, 729 Prospect Ave., Osceola, WI 54020. 1993. Including photos and index, 96 pages. $9.95.

Wamsley, George. *American Fly-Boy.* Vantage Press, Inc., 516 W. 34th St., New York, NY 10001. 1993. Including photos, 199 pages. $16.95.

Winnefeld, James A., and Johnson, Dana J. *Joint Air Operations: Pursuit of Unity in Command and Control, 1942–1991.* Naval Institute Press, Annapolis, MD 21402. 1993. Including photos, glossary, notes, bibliography, and index, 219 pages. $29.95. ■

Valor

By John L. Frisbee, Contributing Editor

Working on the Railroad

In the spring of 1944, eight fighter pilots conducted a unique, month-long campaign in northern China.

"BUT FOR the Fourteenth Air Force, we could have gone anywhere we wished in China." Those are the words of Lieutenant General Takahashi, who had been chief of staff of Japanese armies in northern China. It was a remarkable admission. At no time did Maj. Gen. Claire L. Chennault's Flying Tigers have more than 600 fighters and bombers to cover an area as large as the US east of the Mississippi.

Some readers may think of Fourteenth Air Force in terms of its ten-to-one kill ratio over the Japanese. Less has been written about the interdiction and close-support operations that denied Japanese armies the freedom of movement regretted by General Takahashi. Both aspects of that air war as seen from a fighter cockpit are etched in graphic detail by William F. X. Band in his book *Warriors Who Ride the Wind.* He recounts with power and sensitivity the perils and exhilaration of combat, the poignancy of loss, and hilarious escapades that tempered the austerity with which the Flying Tigers lived and fought.

Bill Band, who flew more than 100 combat missions in China, was a major participant in a unique interdiction campaign. In early 1944, when Band was a first lieutenant, the Japanese were building up forces north of the Yellow River for a drive south that would give them control of eastern China.

In late May, General Chennault sent eight pilots with recently arrived P-51Bs and a small maintenance team to a secret landing strip at Liangshan. They were designated the 26th Fighter Detachment, now all but forgotten to history.

From Liangshan, they would stage forward to another bare strip at Sian, some 800 miles north of Kunming. Their mission was to stop all traffic on the Peking-Hankow Railroad north of the Yellow River as far east as Peking, some 600 miles from Sian.

The assignment had some aspects of a suicide mission. The pilots would be operating on their own, beyond the range of friendly support, strafing at low altitude, where the P-51s' liquid-cooled engines were extremely vulnerable to ground fire. If they were attacked near Peking and had to drop wing tanks, there could be no return to friendly territory. Add to that the customarily bad spring and summer weather in northern China and the absence of navigational aids, and prospects for survival or, at best, avoiding an unpleasant POW experience were marginal.

On May 30, the detachment flew its first mission in four flights of two aircraft each. Bill Band flew with Capt. Roderick P. "Red" MacKinnon. Together they blew up seven locomotives, strafed several troop trains, set fire to storage areas, and generally created havoc for several hundred miles along the river.

It wasn't a cheap day, though. Band and Captain MacKinnon took many small-caliber hits, and one pilot, 1st Lt. Leland W. Dawson, was shot down and captured. He spent the next fifteen months as a POW, emerging on V-J Day weighing only ninety-five pounds. One P-51 was so badly shot up it would not fly again for many days, but on that first mission the detachment had accounted for twenty-three locomotives, many trucks, several storage areas, and untold numbers of enemy troops.

On another mission, 1st Lt. Joseph P. Baglio was shot down by ground fire near Peking and rescued by Chinese Communist guerrillas, who had fled to the mountains much earlier to escape Chiang Kai-shek's Nationalist armies. Baglio was led 900 miles on foot and horseback to safety. One of the rest stops was at Communist headquarters, where he spent hours discussing political philosophy with Mao Tse-tung and Chou En-lai, the Communist leaders.

Bill Band's longest mission—seven and a half hours—took him to the Great Wall near Peking. On the return flight, after being separated from his wingman, he attacked a large airfield not on his map, destroying enemy planes on the ground and in the air. This, like every other mission north of the Yellow River, was a flirtation with disaster.

When weather permitted, missions continued until June 25, when the detachment was ordered to return the four remaining, patched-up P-51s to Kunming. In a month of combat, eight fighter pilots had destroyed more than sixty locomotives and hundreds of other targets. Later it was learned that Japanese headquarters in Tokyo turned down the request of their commanders in China to drive into the western provinces. Air attacks on railroads in northern China by the 26th Fighter Detachment, and further south by other Fourteenth Air Force fighters and bombers, had reduced rail capacity by more than forty percent and the number of locomotives to the minimum needed for moving raw materials bound for Japan.

In a theater where decorations were not bestowed lavishly, the pilots of the 26th Fighter Detachment were awarded the Distinguished Flying Cross for one of the most unusual and courageous actions of World War II. After the war, Bill Band graduated from law school, was recalled as a fighter pilot for the Korean War, then served as a senior official in the Departments of Defense and State. For him, those later experiences will never equal the high adventure shared with good friends who fought an extraordinary war in a remote theater of World War II. ■

AFA NATIONAL REPORT

AFA fights in unified coalition

When over 3 million people speak, Congress tends to listen.

There are clearly times when AFA's concerns overlap with those of other military and veterans' associations. When they do, AFA represents its members' interests as part of a 3.5 million-strong Military Coalition.

AFA has been a member of the Coalition since its founding. The group represents 25 military-oriented organizations in the Washington, D.C., area. Each organization, of course, has its own unique purpose and mission. All of the organizations, however, find common ground when military benefits come under attack or when military readiness is threatened. The Coalition weighs in on Capitol Hill and makes its views known to key policy-makers within the Department of Defense (DoD) and the Department of Veterans Affairs (VA).

When over 3 million people speak, Congress tends to listen.

The Coalition's birth can be traced to an assault on the military's cost of living increases back in 1985. For AFA, and its allies, the rallying cry was unfairness. Once again, military and civilian retirees were the target of COLA cuts while other Federal annuitants went untouched. In short order, the emerging Military Coalition energized its various grass-roots organizations and, within a year, defeated Congress's attempt to penalize military and civilian retirees.

Over the years, the Coalition has continued to voice its concerns and to maintain a strong Washington presence. As military personnel- and benefit-related issues have become more and more complex, no single organization has been able to devote the staff and financial resources to study, track and monitor all of the issues. By dividing up these responsibilities and forming task forces for key issues, every Coalition organization has access to the latest information.

Moreover, because of its past successes, the Coalition's opinion on initiatives is sought frequently by the Pentagon and members of Congress. Key issues on the Coalition agenda include:

- Getting active duty service members a full pay raise;
- Preventing commissary benefits from being eroded for retirees;
- Trying to move the 1995 COLA effective date from October, 1995, to January, 1995;
- And ensuring that the needs of military families and retirees are addressed in national health care reform.

Throughout the year, AFA will continue to work for a strong Air Force and a strong national defense. Working with the Coalition is one part of achieving those goals – and of making the best use of the resources entrusted to AFA by its members.

Lights, Camera, Action

AFA moves into television

The Air Force Association is developing a pilot television news magazine program called *The Air/Space Report*. The pilot is being funded with the generous support of the Aerospace Education Foundation. Once the pilot is completed, AFA and AEF will seek funding from potential underwriters and explore broadcast and cable outlets that might be interested in airing a regular run of the program.

The Air/Space Report television news magazine will treat several topics on each program in a lively format that shifts from moderator to background reports, to round table discussions with the experts. An Emmy-award winning group of broadcast journalists will be producing and directing the pilot. Tim White, formerly of *Fox Morning News* and currently of PBS' *Technopolitics* news magazine, will serve as host and co-executive producer. He will be teamed with co-executive producer Russ Hodge, who produced Fox's "Off the Record" talk show and CNBC's "McLaughlin" show, and Dan Perez, the program's director, who has directed everything from "America's Most Wanted" to "Comic Strip Live" to football for CBS Sports.

The Air/Space Report is being designed to educate and inform general audiences about issues that cut across the dimensions of air and space. It will explore topical issues related to airpower and aerospace, alongside broader issues related to the nation's defense.

The Air/Space Report will also raise issues related to the welfare of military people, with a focus on Air Force people. It will highlight developments that affect military people and aspects of military life that are largely unknown to many Americans, including the untold stories about how these people bring technology to life.

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

Great Plains Publicity

The **General David C. Jones (N. D.) Chapter** has launched a program of luncheon speakers in an effort to get AFA's message before the public. The program began cn a high note in December when Col. Michael Haugen, commander of ANG's 119th Fighter Group, Hector IAP, Fargo, addressed a meeting, garnering extensive media coverage for the chapter.

Colonel Haugen described the effects of the drawdown on the Air National Guard and on the 119th FG in particular. The unit is slated to lose 155 of its 1,200 positions by 1996, he said. He also detailed ANG's role in drug interdiction along US borders and humanitarian relief operations in Bosnia. Chapter President Charlotte M. Robertson praised Colonel Haugen as an "effective spokesman for the Air National Guard and its mission."

A strong turnout of civic leaders from Minot, N. D., attended the meeting—another instance of the remarkable support the city has always shown for the Air Force. (The citizens of Minot contributed $50,000 toward the purchase of land for Minot AFB in the 1950s.) The Minot *Daily News* devoted two stories to the Colonel's speech, which was also covered by media outlets in Fargo, thanks in large part to the efforts of acting Chapter Secretary Eloise Ogden.

The chapter's luncheon speakers program is slated to continue through 1994.

The Tennessee Ernie Ford (Calif.) Chapter presented to AMC Commander Gen. Ronald R. Fogleman its Distinguished Achievement Award. Making the presentation are Mrs. Beverly Ford and Brig. Gen. John W. Pauly, USAF (Ret.).

From left, National Board Chairman O. R. Crawford, Maj. Gen. Charlie Bond, USAF (Ret.), Air Force Memorial Foundation Executive Director Lt. Gen. Bob Springer, USAF (Ret.), and Harry S. Truman Chapter President Jim Snyder take time out during the Kansas City Air Races to pose before Chairman Crawford's P-40.

Chapter News

Lt. Gen. Bradley C. Hosmer, the first graduate of the US Air Force Academy to become its superintendent, addressed a meeting of the **Greater Seattle (Wash.) Chapter** in Bellevue, Wash. After his thirty-minute talk, General Hosmer fielded questions from the audience for an additional thirty minutes and won high marks from outgoing Chapter President Bill Dunne, a fellow Academy alumnus, for his candcr. Incoming Chapter President Fred Rosenfelder joined Mr. Dunne in presenting a commemorative plaque to General Hosmer as a token of appreciation for his speech. Mr. Rosenfelder also presented a plaque to Mr. Dunne in honor of his effective tenure as chapter president.

A group of fourth graders in the Phoenix, Ariz., area has entered the computer age thanks to the good work of the **Frank Luke Chapter.** As part

Industrial Associates

Listed below are the Industrial Associates of the Air Force Association. Through this affiliation, these companies support the objectives of AFA as they relate to the responsible use of aerospace technology for the betterment of society and the maintenance of adequate aerospace power as a requisite of national security and international amity.

AAI Corp.
AEL Defense Corp.
Aermacchi S.p.A.
Aerojet
Aerojet Electronic Systems Div.
Aerojet Propulsion Div.
Aerospace Corp.
Aerospatiale, Inc.
AIL Systems Inc., a subsidiary of Eaton Corp.
Alliant Techsystems Inc.
Allied-Signal Aerospace Co.
American-Amicable Life Insurance Co. of Texas
Analytic Services Inc. (ANSER)
Anheuser-Busch, Inc.
ARINC Research Corp.
Army Times Publishing Co.
Arrowsmith Shelburne
ASTECH/MCI Manufacturing Inc.
Astra Holdings Corp.
Astronautics Corp. of America/ Kearfott Guidance & Navigation
AT&T Federal Systems
Atlantic Research Corp.
Atlantic Research Corp., Professional Services Group
Atlantis Aerospace Corp.
Autometric, Inc.
Battelle Memorial Institute
BDM International, Inc.
Beech Aircraft Corp.
Bell Helicopter Textron
Boeing Defense & Space Group
Bose Corp.
British Aerospace, Inc.
Brunswick Corp., Defense Div.
Burdeshaw Associates, Ltd.
CAE-Link Corp.
Canadian Marconi Co.
Carter Chevrolet Agency, Inc.
Cessna Aircraft Co.
Charles Stark Draper Laboratory, Inc., The
Coltec Industries, Inc.
Computer Sciences Corp.
Computing Devices International
COMSAT Aeronautical Services
Cubic Corp.
Cypress International, Inc.
Datatape Inc.
Deutsche Aerospace Washington, Inc.
Dowty Aerospace Marketing
DynCorp
Eastman Kodak Co., FSD
ECC International Corp.
EDO Corp., Government Systems Div.
EDS
EG&G Defense Systems Group
E. I. du Pont de Nemours & Co.
ESCO Electronics Corp.
E-Systems, Inc.
Evans & Sutherland
Fairchild Space & Defense Corp.
FCD Corp., Mark IV Industries, Inc.
Firearms Training Systems, Inc.
Garber International Associates, Inc.
GDE Systems, Inc.
GE Aircraft Engines
GEC Avionics, Inc.
GEC-Marconi Electronic Systems Corp.
General Atomics
General Dynamics, Space Systems Div.
General Motors Corp.
Gentry & Associates, Inc.
Geodynamics Corp.
Government Employees Insurance Co. (GEICO)
Grumman Corp.
Grumman Data Systems Corp.
Grumman Melbourne Systems Div.
GTE Government Systems Corp.
GTE Government Systems Corp., C^3 Systems Sector
GTE Government Systems Corp., Electronic Defense Systems Div.
Gulfstream Aerospace Corp.
Harley-Davidson Inc.
Harris Electronic Systems Sector
Harris Government Communications Systems Div.
Harris Government Support Systems Div.
Hercules Missiles, Ordnance and Space Group
Honeywell Inc.
Howell Instruments, Inc.
Hughes Aircraft Co.
Hughes Danbury Optical Systems, Inc.
IBM Federal Systems Co.
IMO Industries Inc.
Ingersoll-Rand Co.
Innovative Technologies Corp.
Iowa Concepts Inc.–American Matrix Technologies
Israel Aircraft Industries Int'l, Inc.
Itek Optical Systems, a Division of Litton Industries
ITT Aerospace Communications Div.
ITT Defense
ITT Gilfillan
Jane's Information Group
Johnson Controls World Services Inc.
Judd's, Inc.
Kaiser Electronics
Kollsman
Lear Astronics Corp.
Learjet Inc.
Litton-Amecom
Litton Applied Technology
Litton Data Systems
Litton Guidance & Control Systems
Litton Industries
Lockheed Advanced Development Co.
Lockheed Aeronautical Systems Co.
Lockheed Aircraft Service Co.
Lockheed Corp.
Lockheed Engineering & Sciences Co.
Lockheed Fort Worth Co.
Lockheed Missiles & Space Systems Group
Lockheed Sanders Inc.
Lockheed Space Operations Co.
Logicon, Inc.
Logistics Management Institute
Loral Corp.
Loral Vought Systems
Lucas Aerospace Inc.
Magnavox Electronic Systems Co.
Martin Marietta Astronautics Group
Martin Marietta Corp.
Martin Marietta Electronics, Information & Missiles Group
Matra Aerospace Inc.
McDonnell Douglas Aerospace–East
McDonnell Douglas Aerospace–West
McDonnell Douglas Corp.
MITRE Corp., The
Motorola Inc., GSTG
Munters Corporation, Cargocaire Defense Div.
NavCom Defense Electronics, Inc.
Northrop Corp.
Northrop Corp., Aircraft Div.
Northrop Corp., B-2 Div.
Northrop Corp., Electronics Systems Div.
OEA, Inc.
Olin Ordnance
Orbital Sciences Corp.
Oshkosh Truck Corp.
Pilatus Aircraft, Ltd.
PRC
Racal Communications, Inc.
RAND
Raytheon Co.
RBI, Inc.
RECON/OPTICAL, Inc.
Reflectone, Inc.
Rockwell Int'l Aerospace Operations
Rockwell Int'l Collins Avionics & Communications Div.
Rockwell Int'l Corp.
Rockwell Int'l Electronics Operations
Rolls-Royce Inc.
Rosemount Inc.
Sabreliner Corp.
Scheduled Airlines Traffic Offices, Inc. (SatoTravel)
Science Applications Int'l Corp.
SIMCO Electronics
Smiths Industries, Aerospace & Defence Systems Co.
Snap-On Tools Corp.
SNECMA, Inc.
SofTech, Inc.
Software Productivity Consortium
Southwest Mobile Systems Corp.
Space Applications Corp.
SPARTA, Inc.
Steward-Davis International, Inc.
Sundstrand Aerospace
Sun Microsystems Federal, Inc.
Sverdrup Aerospace
Systems Control Technology, Inc.
Systems Research Laboratories/ Defense Electronic Systems
Systron Donner, Safety Systems Div.
Talley Defense Systems
TASC
Teledyne Brown Engineering
Teledyne Power Systems Group
Teledyne Ryan Aeronautical
Telephonics Corp.
Texas Instruments, Defense Systems & Electronics Group
Texstar, Inc.
Textron
Textron Defense Systems
Thiokol Corp.
Thomson-CSF, Inc.
Tracor, Inc.
Trident Data Systems
TRW Inc., Avionics and Surveillance Group
TRW Space & Electronics Group
TRW Systems Integration Group
UNC Aviation Services
Unisys Corp.
United Technologies Corp.
Universal Propulsion Co., Inc.
UTC, Hamilton Standard
UTC, Norden Systems, Inc.
UTC, Pratt & Whitney
UTC, Research Center
UTC, Sikorsky Aircraft
Vitro Corp.
Vought Aircraft Co.
Walter Kidde Aerospace Inc.
Watkins-Johnson Co.
Westinghouse Electric Corp.
Williams International

Coming Events

March 18–19, **Louisiana State Convention,** Bossier City, La.; April 21–24, **Mississippi State Convention,** Biloxi, Miss.; May 6–7, **North Carolina State Convention,** Fayetteville, N. C.; May 7, **Massachusetts State Convention,** Boston, Mass.; May 13–14, **South Carolina State Convention,** Sumter, S. C.; May 13–14, **Tennessee State Convention,** Knoxville, Tenn.; June 10–12, **Arizona/Nevada State Convention,** Las Vegas, Nev.; June 10–12, **New York State Convention,** Cheektowaga, N. Y.; June 17–19, **Missouri State Convention,** Whiteman AFB, Mo.; June 24–26, **Alabama State Convention,** Huntsville, Ala.; July 8–9, **Virginia State Convention,** McLean, Va.; July 15–18, **Pennsylvania State Convention,** Pittsburgh, Pa.; July 22–24, **Texas State Convention,** Fort Worth, Tex.; August 5–6, **New Mexico State Convention,** Albuquerque, N. M.; August 6, **Montana State Convention,** Three Forks, Mont.; August 6–7, **Iowa State Convention,** Des Moines, Iowa; August 12–13, **Arkansas State Convention,** Hot Springs, Ark.; August 12–14, **California State Convention,** Vandenberg AFB, Calif.; August 19–21, **Kansas State Convention,** McConnell AFB, Kan.; September 12–14, **AFA National Convention and Aerospace Technology Exhibition,** Washington, D. C.

Through the generosity of National Director Jack B. Gross, AFA honored its second annual Employee of the Year Jancy Bell (center). Ms. Bell is flanked by her fellow Employees of the Quarter for 1993 (from left), Kelly Jarvis, Ed Walker, and Cindy Mercer, and Executive Director Monroe W. Hatch, Jr.

of their endeavor to cement good community relations, Chapter President SMSgt. Jerry Palmer and First Vice President Rulon Booth presented a computer to teacher Joyce Deas at Luke Elementary School. The computer was donated by chapter member Gerry Berger.

The **Brandywine (Pa.) Chapter** celebrated the ninetieth anniversary of the Wright brothers' first flight in style with an anniversary dinner last December. Chapter President Joe Dougherty welcomed special guest J. Bradley McManus, who as a lieutenant during World War II became part of the famed "Lost Squadron." Lieutenant McManus was flying as part of a detachment of two 97th Bomb Group B-17s and six P-38s when foul weather forced his P-38 and the other seven airplanes to crash-land in Greenland. All of the aircrews were eventually rescued, but the aircraft were abandoned to the elements. Work has been under way for two decades to attempt to recover some of the squadron's aircraft. *[See "Squadron in the Ice," June 1990, p. 88.]*

New Checklist Available

AFA member H. K. O'Leary has developed a "Retirees Casualty Assistance Checklist" for use by next of kin and other survivors of retirees from all services. The checklist will assist in preparing the obituary, the death certificate, and the paperwork for claiming death benefits. By filling out the simple form, the retiree can keep all pertinent information up-to-date in a single place. This can make life much less complicated for his or her survivors.

AFA's Veterans/Retirees Council has reviewed the checklist and highly recommends it. Copies may be obtained by contacting any AFA chapter's vice president for veterans affairs.

Have AFA/AEF News?

Contributions to "AFA/AEF Report" should be sent to Dave Noerr, AFA National Headquarters, 1501 Lee Highway, Arlington, VA 22209-1198. ■

Unit Reunions

Air Force Missileers
The Association of Air Force Missileers and other former and current USAF missileers are planning to hold their first reunion May 23–26, 1994, in Colorado Springs, Colo. **Contact:** Col. Charles G. Simpson, USAF (Ret.), P. O. Box 5693, Breckenridge, CO 80424. Phone: (303) 453-0500.

Berlin Airlift Veterans Ass'n
Veterans of the Berlin Airlift will hold a forty-fifth-anniversary reunion in September 1994 in Germany. **Contact:** Lt. Col. Joseph W. Studak, USAF (Ret.), 3204 Benbrook Dr., Austin, TX 78757-6804. Phone: (512) 452-0903.

Freeman Field
A reunion will be held October 7–9, 1994, for cadets, officers, enlisted personnel, WACs, and WASPs who were assigned to Freeman Field (Seymour, Ind.) between 1942 and 1946. **Contact:** Louis Osterman, Mayor's Office, City Hall, 220 N. Chestnut St., Seymour, IN 47274. Phone: (317) 888-8661.

Glider Pilots Ass'n
The World War II Glider Pilots Association will hold a reunion September 28–October 1, 1994, in King of Prussia, Pa. **Contact:** Maj. Kenneth K. Slade, USAF (Ret.), 1323 West Ave., H-9, Lancaster, CA 93534. Phone: (805) 723-9928.

Hawthorne Field Pilots
Aviation cadets who received primary flight training at Hawthorne Field between 1941 and 1945 will hold a reunion April 7–9, 1994, in Orangeburg, S. C. **Contact:** Robert N. Stanley, 3411 Fox Hall

Unit Reunions

Rd., Columbia, SC 29204. Phone (803) 787-0845.

Jolly Green Ass'n
USAF Jolly Green helicopter members will hold a reunion April 29–30, 1994, at the Ramada Beach Resort Hotel in Fort Walton Beach, Fla. **Contact:** Jolly Green Association, P. O. Box 965, O'Fallon, IL 62269-0965.

Night Fighters
World War II night fighters will hold a reunion June 29–July 3, 1994, at the Omni Hotel in Norfolk, Va. **Contact:** Alvin E. Anderson, 8885 Plumas Cir., D-1116, Huntington Beach, CA 92646. Phone: (714) 960-9058.

RAF Welford
Veterans who served at RAF Welford, England, will hold a reunion commemorating the fiftieth anniversary of D-Day May 7–8, 1994, at RAF Welford. **Contact:** John L. Stephens, Woodside, Wantage Rd., Leckhampstead, Newbury, Berkshire RG16 8QT, England.

Rhein-Main AB Personnel
Enlisted personnel who served at Rhein-Main AB, Germany, between 1968 and 1975 will hold a reunion August 4–7, 1994, at the Embassy Suites in St. Louis, Mo. **Contact:** Earl C. Spohr, RR1, Box 25, Woodlawn, IL 62898. Phone: (618) 735-2616.

USAF Academy
The US Air Force Academy Class of 1959 will hold its thirty-fifth-anniversary reunion June 9–12, 1994, at the Air Force Academy in Colorado Springs, Colo. **Contacts:** Lt. Col. Charles J. Ferrari, USAF (Ret.), 5911 S. Lima St., Englewood, CO 80111. Phone: (303) 780-5970 or (719) 472-0300 (Jock Schwank).

1st Air Commando Ass'n
The 1st Air Commandos (CBI) who served in World War II will hold a reunion October 5–9, 1994, at the Ramada Beach Hotel in Fort Walton Beach, Fla. **Contact:** Rodney E. Petty, 2106 Godfrey Dr., Baton Rouge, LA 70816. Phone: (504) 752-3831.

3d Bomb Group
Veterans of the 13th Bomb Squadron "Grim Reapers," 3d Bomb Group (Korea), will hold a reunion July 27–30, 1994, in Burlington, Vt. Former members of the 8th and 90th Bomb Squadrons are invited. **Contact:** Al Adams, 3398 N. Studebaker Ct., Terre Haute, IN 47803-9403. Phone: (812) 877-6042.

11th Air Force Ass'n
Veterans of the 11th Air Force/Americans Home from Siberia (World War II) will hold a reunion October 6–9, 1994, in Dayton, Ohio. **Contact:** Ralph W. Hammond, 4952 Pepperwood Dr., Dayton, OH 45424-4810. Phone: (513) 236-9845.

13th Air Force Veterans Ass'n
Veterans of the 13th Air Force "Jungle Air Force" will hold a reunion September 22–24, 1994, at the Holiday Inn in Englewood, Ohio. **Contact:** Philip Dyer, 7049 W. Illinois St., Ludington, MI 49431. Phone: (616) 843-9597.

27th Air Transport Group
Veterans of the 27th Air Transport Group, which included the 310th, 311th, 312th, and 325th Ferrying Squadrons; 86th, 87th, 320th, and 321st Transport Squadrons; and 519th and 520th Service Squadrons, will hold a reunion August 25–27, 1994, in Denver, Colo. **Contact:** Richard Seebers, 707 Baxter Ave., Orlando, FL 32806. Phone: (407) 851-6368.

47th Bomb Group Ass'n
The 47th Bomb Group, 12th Air Force, will hold a reunion September 15–18, 1994, in Falls Church, Va. **Contact:** Costa Chalas, Rainbow Travel, 64 Trapelo Rd., Belmont, MA 02178. Phone: (617) 484-5620.

47th/479th Service Squadrons
Veterans of the 47th and 479th Service Squadrons will hold a reunion May 17–19, 1994, in San Antonio, Tex. **Contact:** Tom Webb, 2705 James St., San Marcos, TX 78666-5013. Phone: (512) 392-8787.

Class 51-D
Members of Pilot Class 51-D will hold a reunion October 14–16, 1994, at the Imperial Palace in Las Vegas, Nev. **Contacts:** Lt. Col. Russell A. Bunn, USAF (Ret.), 13811 Bluffcircle, San Antonio, TX 78216. Phone: (210) 496-1580. Lt. Col. Gene Rogge, USAF (Ret.) 15713 E. Sunflower Dr., Fountain Hills, AZ 85268. Phone: (602) 837-6054.

53d Fighter Group
Veterans of the 53d Fighter Group will hold a reunion April 21–24, 1994, at the Radisson Inn Prince Charles in Fayetteville, N. C. **Contact:** Elmer E. Johnson, 1815 S. E. 6th Terr., Cape Coral, FL 33990. Phone: (813) 574-4044.

Class 54-E
Members of Class 54-E are planning to hold a fortieth-anniversary reunion March 11–13, 1994, in Tucson, Ariz. **Contacts:** Maj. Gen. Neil Eddins, USAF (Ret.), 3753 Howard Hughes Pkwy., Suite 200, Las Vegas, NV 89109. Phone: (702) 892-3775 or (602) 797-4851 (Leo Kimminau).

58th Fighter Ass'n
Veterans and present members of the 58th Fighter Association, which includes the 69th, 201st, 310th, and 311th Fighter Squadrons, who served in World War II, Korea, or at Luke AFB, Ariz., will hold a reunion June 9–12, 1994, in Phoenix, Ariz. **Contact:** Anthony J. Kupferer, 2025 Bono Rd., New Albany, IN 47150. Phone: (812) 945-7649.

69th Fighter Squadron
The 69th Fighter Squadron "Werewolves" will hold a reunion May 19–23, 1994, in Norfolk, Va. **Contact:** George E. Mayer, 7445 Thomas Ave. S., Richfield, MN 55423. Phone: (612) 866-6073.

74th Tactical Recon Group
The 74th Tactical Reconnaissance Group will hold a reunion September 25–29, 1994, in Las Vegas, Nev. **Contact:** Lt. Col. John H. Meierdierck, USAF (Ret.), 2900 Valley View Blvd. S., #287, Las Vegas, NV 89102. Phone: (702) 876-5720.

81st Troop Carrier Squadron
Veterans of the 81st Troop Carrier Squadron, 436th Troop Carrier Group (World War II), will hold a reunion October 12–16, 1994, at the Omni Hotel, Newport News, Va. **Contact:** Gale R. Ammerman, 210 Quail Trail, Aliceville, AL 35442. Phone: (205) 373-6820.

99th Bomb Group
Veterans of the 99th Bomb Group (World War II) who served in North Africa and Italy will hold a reunion September 5–10, 1994, in Hampton, Va. **Contact:** Bob Bacher, 692 N. Abbe Rd., Elyria, OH 44035. Phone: (216) 365-3023.

303d Air Rescue Squadron
Veterans of the 303d Air Rescue Squadron (March AFB, Calif.) will hold a reunion September 16–18, 1994, at the Harrah's Hotel in Laughlin, Nev. **Contact:** Duane A. Sands, 255 N. El Cielo Dr., Suite 396, Palm Springs, CA 92262-6974. Phone: (619) 322-7200.

306th/312th/316th FCS
Veterans of the 306th, 312th, and 316th Fighter Control Squadrons will hold a reunion October

7–9, 1994, in St. Louis, Mo. **Contact:** Col. Harold J. Salfen, USAF (Ret.), 3841 Whitehall Dr., Dallas, TX 75229-2757. Phone: (214) 579-1261.

314th Composite Wing
Veterans of the 314th Composite Wing, 5th Air Force, which included headquarters/headquarters squadrons and the 5th Station Hospital (formerly VBC, 5th Air Division), will hold a reunion June 22–26, 1994, in Minneapolis, Minn. **Contact:** Louis J. Buddo, P. O. Box 270362, St. Louis, MO 63127.

333d Fighter Squadron
Veterans of the 333d Fighter Squadron will hold a dining-in March 12, 1994, at the NCO Club at Davis-Monthan AFB, Ariz. **Contact:** Lieutenant Wildung, 4190 S. Phoenix St., Davis-Monthan AFB, AZ 85707-4633. Phone: (602) 750-3275.

339th Fighter Group Ass'n
The 339th Fighter Group, 8th Air Force (World War II), will hold a fiftieth-anniversary reunion April 27–May 6, 1994, in England. **Contact:** Chet Malarz, 2405 Kings Point Dr., Atlanta, GA 30338.

359th Fighter Group
Veterans of the 359th Fighter Group, 368th, 369th, and 370th Fighter Squadrons and support units (World War II), will hold a reunion September 8–11, 1994, in Williamsburg, Va. **Contacts:** Maj. Charles W. Staley, USAF (Ret.), 2546 Austin Pl., Beloit, WI 53511. Anthony Chardella, 511 Cresthaven Dr., Pittsburgh, PA 15239. Phone: (412) 793-7619.

456th Bomb Group Ass'n
Veterans of the 456th Bomb Group will hold reunions June 15–19, 1994, in Omaha, Neb., and June 19–July 3, 1994, in Europe. **Contact:** James Watkins, 504 Hedgerow Cir., Kearney, MO 64060. Phone: (816) 635-5566.

459th Bomb Group Ass'n
Veterans of the 459th Bomb Group, 15th Air Force (World War II), will hold a reunion September 15–18, 1994, at the Holiday Inn–Central in Omaha, Neb. **Contacts:** Al Dhaenens, 3048 Vane St., Omaha, NE 68112-3146. Phone: (402) 455-7325. John Devney, 90 Kimbark Rd., Rochester, NY 14610. Phone: (716) 381-6174.

485th Bomb Group
Veterans of the 485th Bomb Group, 15th Air Force, will hold a reunion September 14–18, 1994, at the Hilton Hotel in Memphis, Tenn. **Contact:** Earl L. Bundy, 5773 Middlefield Dr., Columbus, OH 43235.

507th Fighter Group
Veterans of the 507th Fighter Group, which included the 463d, 464th, and 465th Fighter Squadrons, will hold a reunion September 2–5, 1994, at the Hyatt Regency in Louisville, Ky. **Contacts:** J. T. Layne, P. O. Box 1174, Copperhill, TN 37317. Phone: (615) 496-7247. Bobby Cox, 603 North D St., Cleveland, OK 74020. Phone: (918) 358-2615.

751st AC&W Squadron
Veterans of the 751st Aircraft Control and Warning Squadron (Mount Laguna AFS, Calif.) will hold a reunion April 28–30, 1994, in San Diego, Calif. **Contact:** Lt. Col. Roger D. Scow, USAF (Ret.), 865 W. Coll St., New Braunfels, TX 78130. Phone: (210) 606-0084.

839th Engineer Aviation Battalion
839th Engineer Aviation Battalion personnel who served at Osan AB, Korea, will hold a reunion June 17–19, 1994, in Oklahoma City, Okla. **Contact:** Don K. Tomajan, P. O. Box 90457, Los Angeles, CA 90009-0457. Phone: (310) 641-7501.

3083d ADG/3096th ADS
Veterans of the 3083d Aviation Depot Group, 3096th Aviation Depot Squadron, will hold a reunion May 12–15, 1994, in Fort Walton Beach, Fla. **Contacts:** Reunion Committee, #501, 200 W. Miracle Strip Pkwy., Fort Walton Beach, FL 32548. John Boegeman, 24601 Chrisanta Dr., Mission Viejo, CA 92691. Phone: (714) 586-7761.

Class 75-05
For the purpose of planning a reunion, I am seeking contact with members of Class 75-05 who attended Undergraduate Pilot Training at Webb AFB, Tex. **Contact:** Lt. Col. Arthur Fournier, USAF (Ret.), 4729 Willows Rd., Chesapeake Beach, MD 20732. Phone: (410) 535-0690.

97th Fighter-Interceptor Squadron
For the purpose of planning a reunion, I am seeking contact with members of the 97th Fighter-Interceptor Squadron who served between 1950 and 1957 at Wright-Patterson AFB, Ohio. **Contact:** Lt. Col. James D. Smith, USAF (Ret.), 2408 N. W. 112th Terr., Oklahoma City, OK 73120. ■

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.

Bulletin Board

Editor and photographer wishes to trade **35-mm slides** of modern military aircraft (1980 to present). Also interested in trading **military patches** and **decals. Contact:** Renato E. F. Jones, P. O. Box 73403, Puyallup, WA 98373.

Seeking contact with graduates of the **USAFE NCO Academy** in Freising, Germany, especially Class 57-D. Also interested in information about or photos of the **XB-36 (XBN-36).** Photos will be returned. **Contact:** MSgt. Thomas W. Young, Sr., USAF (Ret.), 830 W. Amsden St., Denison, TX 75020-7929.

Kalamazoo Aviation History Museum seeks clear photos of the tail and tip markings of a black **B-57B** from the **499th Bomb Squadron,** recollections of B-57 operations with the **345th Bomb Wing,** and information about **B-57B #52-1584,** including markings. **Contact:** Maj. Richard Bauer, AFRES, 130 Brewer Dr., #31A, Battle Creek, MI 49015.

Researcher seeks contact with members of the **310th** or **321st Bomb Groups** who flew missions against Sardinia in 1943. Recollections, extracts from diaries and logbooks, and photos would be appreciated. **Contact:** Alessandro Ragatzu, Via Sulcitana 134, 09034 Elmas Ca., Sardegna, Italy.

Historian seeks contact with anyone familiar with the **conversion of C-124As to C-124Cs** in 1963–64, especially the change from the R4360-20WA engine to the R4360-63. **Contact:** Steven B. Brown, 1209 23d Ave. Ct., Greeley, CO 80631.

Seeking contact with primary students of **Ralph Hullender** at Souther Field, Ga., in 1942–44. **Contact:** Clarke Harper, 4501 Murano Rd., New Orleans, LA 70129.

Historian seeks contact with aircrews who ejected from **F-105 Thunderchiefs.** Desire the following information on noncombat losses of F-105s from 1958 to 1983: serial number; owning organization; crash date, cause, and location; and names of aircrew members. **Contact:** Lt. Col. Howard Plunkett, USAF (Ret.), 5042 Justin Dr. N. W., Albuquerque, NM 87114.

Seeking information on **2d Lt. Franklin R. Gowing** of the 357th Fighter Squadron, 355th Fighter Group, who was shot down August 2, 1944. **Contact:** Alan Carey, 1 Broken Hill Rd., Pittsford, NY 14534.

Seeking the whereabouts of **Randy Otte,** who was stationed at England AFB, La., in the late 1980s. **Contact:** MSgt. Douglas Voelker, 6014 S. Switzer Ave., Tampa, FL 33611.

Seeking contact with the following individuals stationed in Canada during the Lend-Lease flights of 1942–45: **Lieutenant Love,** stationed at Whitehorse and Watson Lake in 1942–43; **Lieutenant Lucey,** Watson Lake, 1943; **George Mattich,** Norman Wells, 1943; and **Lieutenant Kirmil** and **1st Lt. Russell Yarnall,** who crash-landed a P-63 on the ice at Watson Lake in 1945. **Contact:** Everett A. Long, P. O. Box 60961, Fairbanks, AK 99706.

Seeking information about **Lt. Robert Anspach,** USAAF, of "Watson's Whizzers," who landed an Me-262 in the Channel Islands, UK, in May 1945 and later flew the plane to France. **Contact:** L. J. Le Moignan, Temple Villa, St. John, Jersey JE3 4BH, Channel Islands.

Seeking contact with personnel stationed at **Chambley AB,** France, during 1953–67 for reminiscences of life at the base. **Contact:** Caroline Brustad, Pôle Aérostatique Pilâtre de Rozier, B. P. 18, 57530 Courcelles-Chaussy, France.

AAF insignia collector seeks original **15th Air Force World War II patch** (shield type with Roman numerals XV). **Contact:** Martin Reynolds, 10548 Catawba Way, Rancho Cordova, CA 95670.

Writer seeks contact with **B-29 crew members** of 20th Air Force who experienced inadequate air/sea rescue backup from the Naval Air/Sea Rescue Task Group in the **Marianas Islands** in 1944–45. **Contact:** George R. Delgado, 1820 Delki St. N. W., Palm Bay, FL 32907.

Seeking information about **Lt. William C. Mackey,** a pilot with the 8th Bomb Group who was killed November 3, 1943, at Rabaul, New Britain. He was awarded the Silver Star with one oak leaf cluster and the Purple Heart with one oak leaf cluster. **Contact:** A. Gerard Mack, 1918 Huntington Tpke., Trumbull, CT 06611.

Researcher seeks information about **B-17 pilot training,** from basic to advanced. Training manuals, where the pilots trained, and personal stories about training missions would be appreciated. Also seeking history and photo of **Lt. Kenneth**

Bulletin Board

Williams, who was mentioned on p. 62 of the September 1993 AIR FORCE Magazine. **Contact:** H. Williams, 1305 Denise, Deer Park, TX 77536.

Seeking information about **Troy F. Henline,** who was stationed at Hahn AB, West Germany, in 1963; Shaw AFB, S. C., 1966; Udorn RTAFB, Thailand, 1967; Keesler AFB, Miss., 1968; and Tuy Hoa, Vietnam, 1969. **Contact:** D. Parker, 357 Sandusky Rd., Shelbyville, TN 37160.

Collector seeks **patches, scarves,** and **Vietnam-era party suits. Contact:** SSgt. Herb Weaver, USAF, 2333 Grant Dr., Tyndall AFB, FL 32403.

Seeking the whereabouts of **TSgt. Warren G. Lawton, SSgt. John F. Carr,** and **SSgt. William C. Crowell,** who were members of **W. W. Head's** aircrew with 11th Air Force in World War II. **Contact:** Ralph W. Hammond, 4952 Pepperwood Dr., Dayton, OH 45424-4810.

Collector seeking the "real story" behind the **"PACAF FB-111A Mach 2+"** and **"FB-111A Number 1 Team"** patches. Also interested in the 388th Electronic Combat Squadron patch, the FB-111A Swing Wing Crow Defender patch, and any other F-111-related patches. **Contact:** Robert E. Styger, 15 Genesee Ln., Willingboro, NJ 08046-3319.

Seeking contact with veterans of the **78th Fighter Squadron "Bushmasters"** to obtain information about the squadron's history. **Contact:** 78th Fighter Squadron, 716 Fighting Falcon St., Shaw AFB, SC 29152-5045.

Writer seeks information on **dice games** or **bar games** played in officers or NCO clubs, especially those played during the Korean and Vietnam Wars. **Contact:** Capt. Terry Hunter, 2713 Selman Dr., San Angelo, TX 76905.

Son of World War II B-24 navigator seeks patch from the **787th Bomb Squadron,** 466th Bomb Group; **B-24 aircrew training manuals;** and photos of Attlebridge Airfield, UK, from the 1940s. **Contact:** Richard B. Dondes, 21 Firethorn Ct., East Brunswick, NJ 08816-2778.

Historian seeks names and addresses of cadets in **Class 43-B,** Maxwell Field, Ala. **Contact:** Hoyt M. Warren, 884 Terrace Acres, Auburn, AL 36830.

Seeking the whereabouts of **Lt. Gen. Laurence C. "Bill" Craigie, Mark Ridley, Col. Paul W. Tibbets, Jr., Reeve Lindbergh Trip,** and any **SR-71 pilots. Contact:** John A. Moore, 13914 Tree Crossing, San Antonio, TX 78247.

Seeking contact with members of the **65th Bomb Squadron "Eager Beavers,"** 43d Bomb Group, 5th Air Force, stationed at Dobodura, New Guinea, in 1942–43. Interested in information on **Maj. Jay Zeamer, Jr.,** and the reconnaissance mission of June 16, 1943. **Contact:** Clint Hayes, 1500 N. Preston Rd., #512, Plano, TX 75093.

Seeking the whereabouts of **Joe Doyle,** who was stationed at Drew Field, Fla., in 1944. His last known address was in Pennsylvania. **Contact:** Wesley C. Chapman, 323 E. 35th St., Erie, PA 16504.

Seeking information on **Majs. Joe Elliot and Charles Lowe.** Both belonged to the 31st Air Transport Group, Berkshire, England, and the 302d Air Transport Wing, Le Bourget Field, France, during 1943–45, and both were close friends of Bill Curtis. **Contact:** John Oberg, 1924 N. W. 43d Terr., Gainesville, FL 32605.

Seeking contact with **Lt. Blair Hale** or any member of the 410th Bomb Squadron, 94th Bomb Group, who knew **Sgt. Robert Thomas.** Sergeant Thomas was shot down during a June 13, 1943, mission to Kiel, Germany. The pilot was 1st Lt. Harold A. Johnson. **Contact:** Ted Thomas, 500 N. E. 7th Ave., Fort Lauderdale, FL 33301-1210.

Seeking contact with relatives or friends of **Lt. Robert Carl Holtham** of the 362d Fighter Group, who was killed July 29, 1944, near Reffuville, France. **Contact:** Col. Frank Wood, USAF (Ret.), 2296 N. Mariners Beach Dr., Oak Harbor, WA 98277.

Seeking contact with **James R. Richards, Elisha V. Z. Sessums, Woodrow W. Smith,** or anyone else who served with **Joseph R. Weyn** in the 4238th Combat Support Group, Barksdale AFB, La., in 1961–62. **Contact:** J. Weyn, 160 Hershey, Waterford, MI 48327.

Author seeks information about the **USAF Air Rescue Service** for a history of the service. Also researching the Grumman HU-16 Albatross, the Kaman HH-43, and Air Force pararescue technicians. Contributors will receive a copy of the book upon publication. **Contact:** Wayne Mutza, 2400 W. Henry Ave., Milwaukee, WI 53221.

Cassette available containing **"The Wonder of Flight,"** a program written in 1962 to commemorate USAF's fifteenth anniversary and updated in 1969 to include a tribute to the Apollo 11 mission. The tape contains both versions. Anyone wanting a free copy should send a nonmetal cassette and a stamped, self-addressed, insulated envelope. **Contact:** Lt. Col. Jim Roland, USAF (Ret.), 914 Duane, El Reno, OK 73036.

Seeking contact with **Ed Esbaugh** and **Greg Howard** (Their last known base was Camp Darby, Italy, in 1990); **Dan Mumma** (last known base: Morbach AB, Germany, 1992); **Jeff Nelson** (last known base: Misawa AB, Japan, 1988); and **Donald Panek** (last known base: Bitburg AB, Germany, 1992). **Contact:** SSgt. Michael G. Holmes, Det. 1, 100th RSG, PSC 43, Box 4783, APO AE 09466.

Seeking contact with veterans of the **8th Tactical Fighter Squadron** "Black Sheep" who deployed to Takhli RTAFB, Thailand, in 1972. **Contact:** Paul E. Raudenbush, 1725 Weston Brent Ln., El Paso, TX 79935.

Seeking anyone who would like information, or can supply missing data, about the **36th Bomb Squadron,** 8th Air Force, RAF Alconbury, England, during World War II. **Contact:** Stephen M. Hutton, 4016 Old Sturbridge Dr., Apex, NC 27502.

Historian seeks information on the **Nike antiaircraft defense system** deployed in the US in the

If you need information on an individual, unit, or aircraft, or if you want to collect, donate, or trade USAF-related items, write to "Bulletin Board," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Letters should be brief and typewritten; we reserve the right to condense them as necessary. We cannot acknowledge receipt of letters. Unsigned letters, items or services for sale or otherwise intended to bring in money, and photographs will not be used or returned.—THE EDITORS

1950s. **Contact:** Dean W. Smeaton, P. O. Box 16355, Irvine, CA 92713.

Seeking the whereabouts of **Lt. Sam Holland,** who survived a crash in Magdeburg, West Germany, in 1965. **Contact:** Capt. Donald F. Henry, USAF, 4880 E. 29th St., #9203, Tucson, AZ 85711.

Collector seeks original **North American Air Defense Command** patch of the type worn from the 1960s to the end of the Cold War. **Contact:** TSgt. William M. Kyzer, 103 Juanita Dr., Lafayette, LA 70506.

Seeking the whereabouts of **Capt. Robert E. Smith** of Swissvale, Pa., who flew B-24s with the 725th Bomb Squadron, 451st Bomb Group, 15th Air Force, during World War II. **Contact:** Lt. Col. Louis S. Sagi, USAF (Ret.), P. O. Box 367, Fallston, MD 21047.

Seeking contact with anyone who served with **CMSgt. George J. Cooper** in Iceland, Morocco, Okinawa, Vietnam, or various locations in the US. His last station was Otis AFB, Mass., and he retired in January 1971. **Contact:** CMSgt. George J. Cooper, USAF (Ret.), 348 Briar Dr., Millville, NJ 08332.

Seeking the whereabouts of **Stephen Albert Nyardy (or Nyarady),** a World War II US naval aviator. **Contact:** Henry Sakaida, 9555 La Rosa Dr., Temple City, CA 91780.

Author seeks information about **2nd Lts. Erwin R. Bleckley and Harold E. Goettler,** Medal of Honor recipients during World War I. Both served with the 50th Aero Squadron in France. **Contact:** Joseph P. Bowman, P. O. Box 172, Burlington, ND 58722.

Writer seeks personal stories of **1943 aerial battles** involving 8th Air Force, particularly those that occurred between the August 17 Regensburg/Schweinfurt raid and the October 14 raid on Schweinfurt. **Contact:** David M. Brown, 4752 Steele St., Torrance, CA 90503.

Writer seeks information on the **first KC-135A,** #55-3118, which was upgraded to EC-135K for the 8th Tactical Deployment Control Squadron. **Contact:** Ron Strong, 7543 Bonniewood Ln., Dublin, CA 94568.

Researcher seeks contact with **Warrant Officer O'Brien,** who, as a member of an APG Command test project at Eglin AFB, Fla., was sent to Korea in 1953 for four months. Also seeking the whereabouts of **Capt. Murray Winslow,** who flew F-86s with the 335th Fighter-Interceptor Squadron, 4th Fighter-Interceptor Wing, at Kimpo AB, South Korea, in 1953. **Contact:** John Henderson, 1015 Horizon Dr., Ventura, CA 93003.

Seeking contact with anyone familiar with the **16th Bomb Squadron** around the time of the fall of Bataan and Corregidor. **Contact:** Lt. Col. Harry C. Bradshaw, USAF (Ret.), 200 Wadleigh Falls Rd., Lee, NH 03824-6222.

Seeking contact with **C-119 crew members** who served in the combat cargo operation at Ashia, Japan, during the Korean War. **Contact:** A. David Dean, Jr., 1031 Forrest Hills Pointe, Bogart, GA 30622.

Seeking the addresses of **William Askins, Elton K. Casler, Edward Foley, Thomas Grissom, Clyde H. Partlo,** and **Dennis Savor.** All served with the 95th Bomb Wing at Biggs AFB, Tex., during 1953–56. **Contact:** Donald J. Debelak, W11463 Wisconsin Ave., Dunbar, WI 54119-9238.

Seeking a **used** or **scrapped autogyro** to popularize autogyros in Poland. **Contact:** Maciej Maleszko, Al. Niepodleglosci 31 m. 15, 02-653 Warszawa, Poland. ■

Pieces of History

Photography by Paul Kennedy

Hollywood Help

Memorabilia courtesy George Petersen

In 1942 Gen. H. H. "Hap" Arnold established the First Motion Picture Unit (FMPU), bringing together professional directors, cameramen, actors, and others (among them, Capt. Ronald W. Reagan) to quickly produce training films for the ever-larger numbers of recruits jamming the doors of recruiting offices in the days following the attack on Pearl Harbor. From its headquarters at Hal Roach Studios in Culver City, Calif., the FMPU also trained combat cameramen and produced documentaries and industrial short films. In late summer 1944, General Arnold ordered the FMPU to shift its focus from training films to an AAF history.

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