OCTOBER 1990/$2

AIR FORCE MAGAZINE

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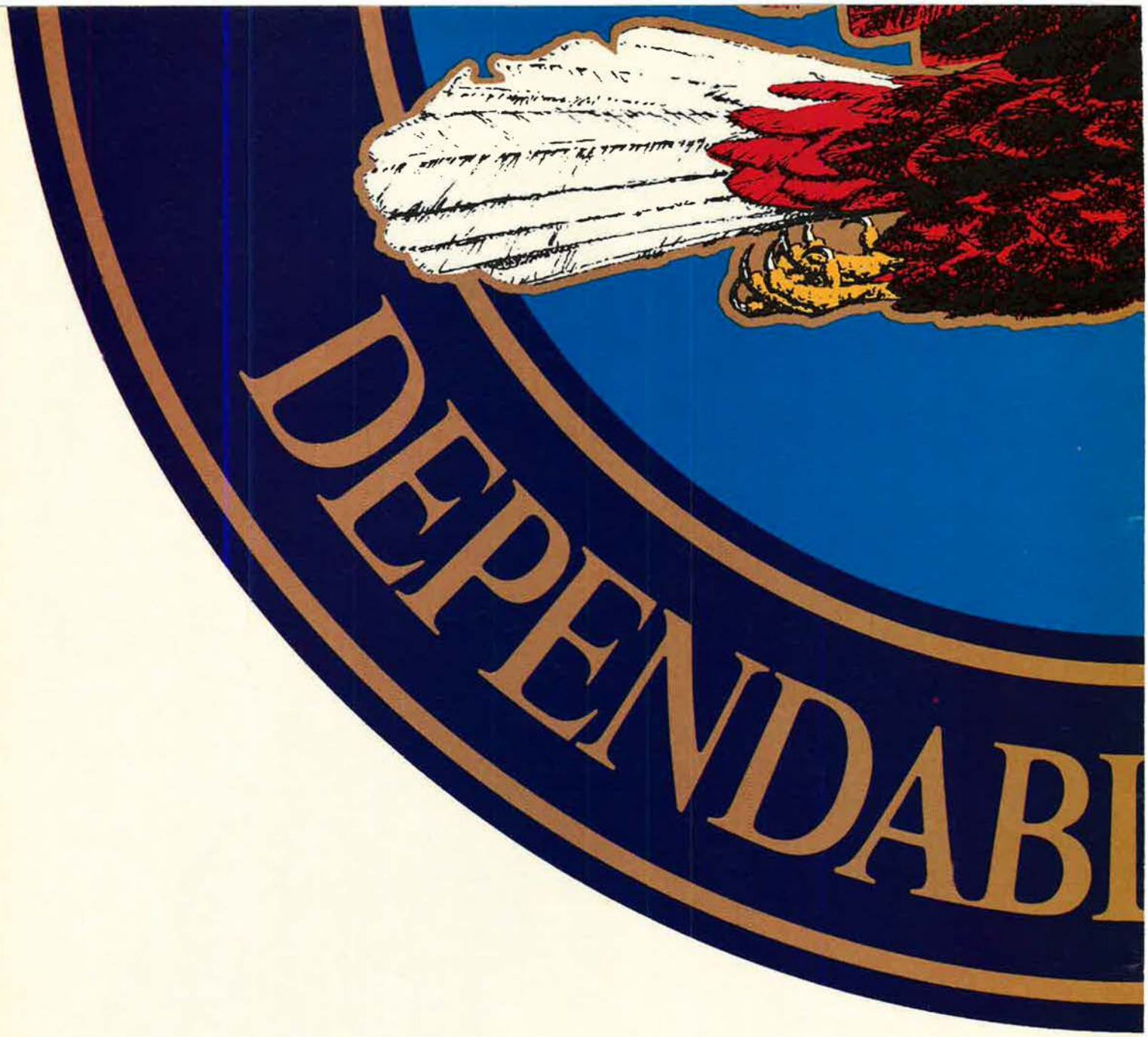
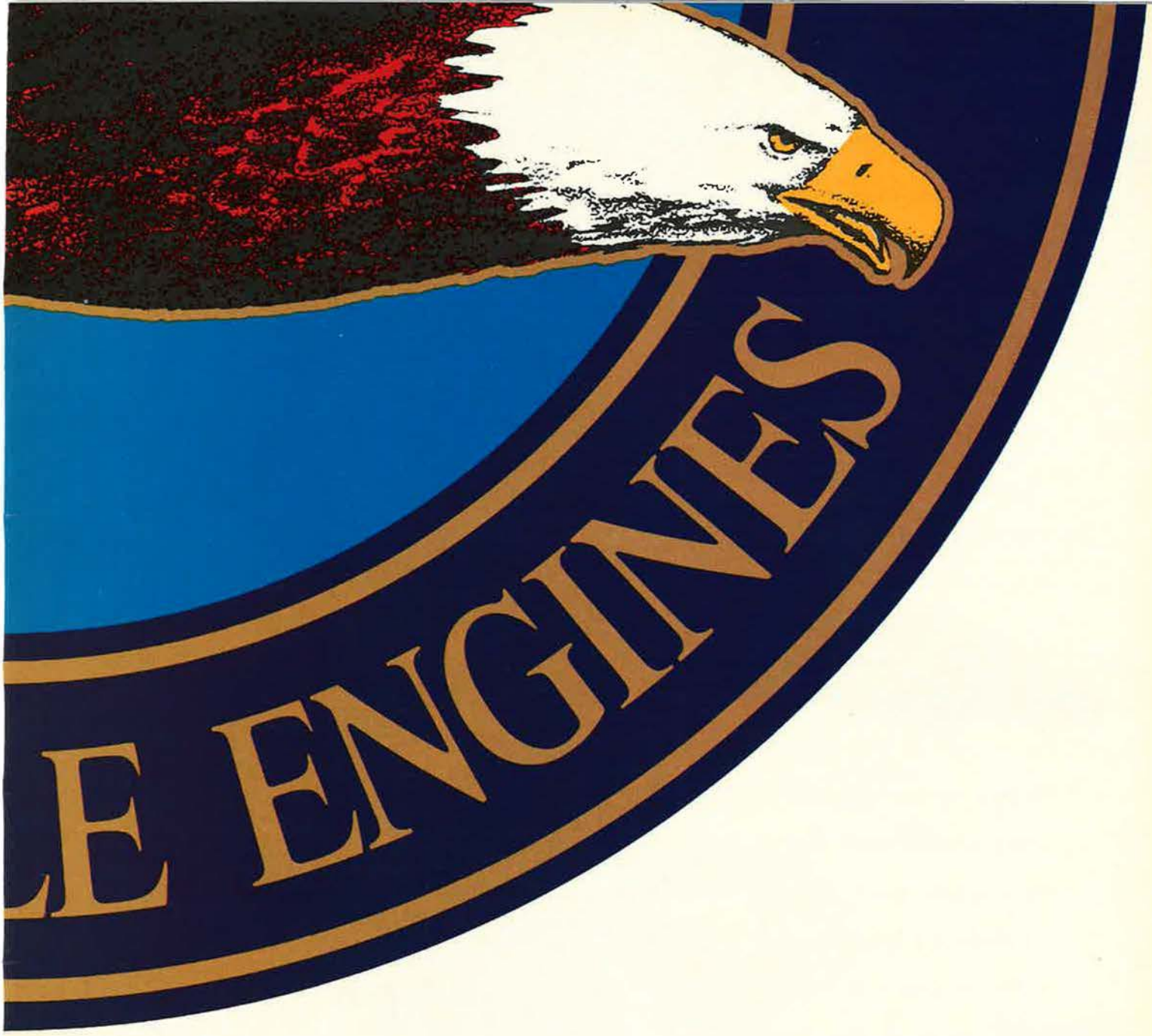


WHAT KIND SHOULD GO



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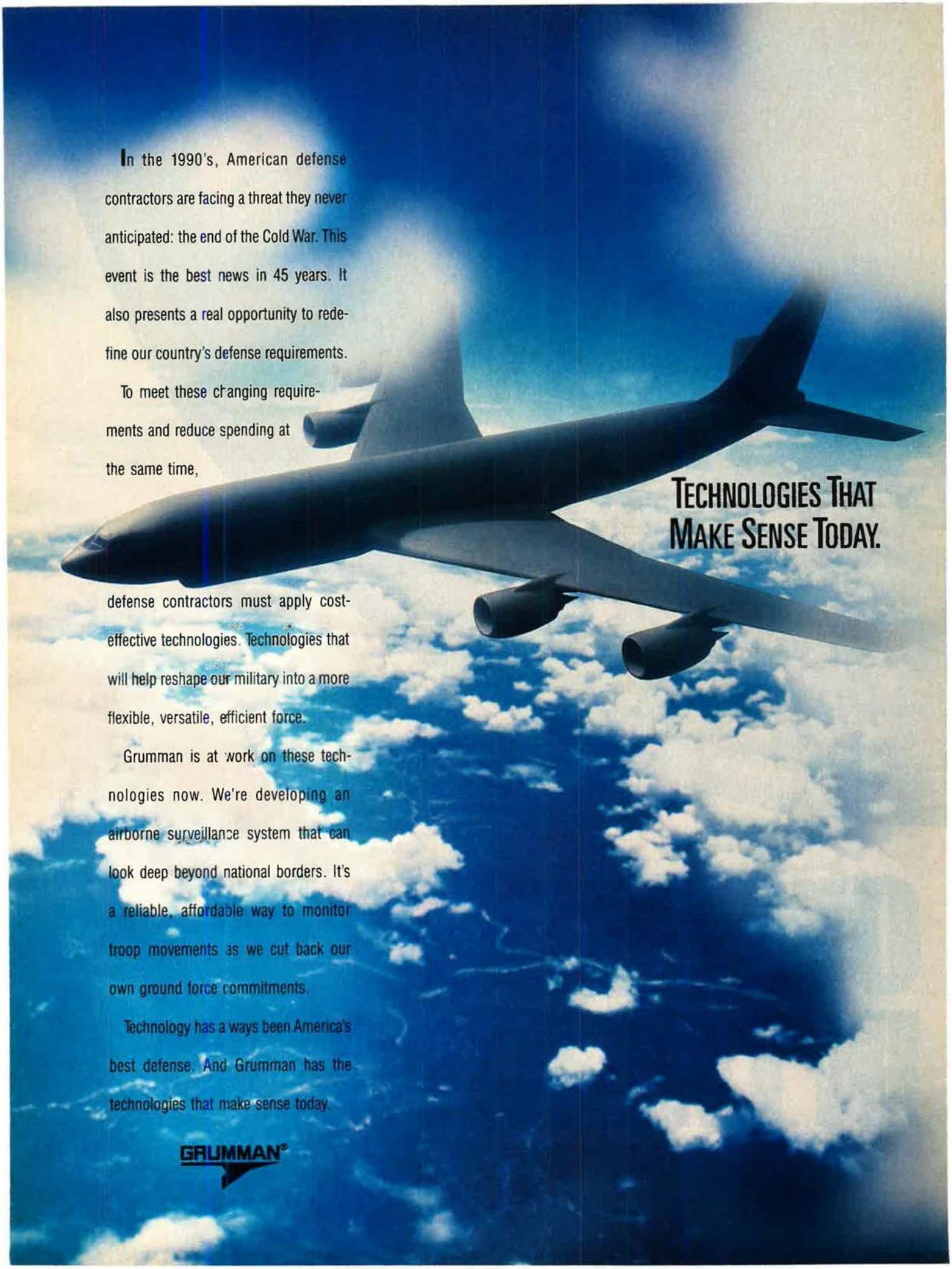
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October 1990, Vol. 73, No. 10

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Departments

About the cover: This Dru Blair illustration suggests "Global Reach, Global Power," the Air Force's theme for the future.

The Future of the Force

AIR FORCE Magazine (ISSN 0730-6784) October 1990 (Vol. 73, No. 10) is published monthly by the Air Force Association, 1501 Lee Highway, Arlington, Va. 22209-1198. **Phone** (703) 247-5800. Second-class postage paid at Arlington, Va., and additional mailing offices. **Membership Rate:** $21 per year; $48 for three-year membership. **Life Membership:** $300. **Subscription rate:** $21 per year; $25 per year additional for postage to foreign addresses (except Canada and Mexico, which are $8 per year additional). Regular issues $2 each. Special issues (Soviet Aerospace Almanac, USAF Almanac issue, and Anniversary issue) $5 each. **Change of address** requires four weeks' notice. Please include mailing label. **POSTMASTER:** Send change of address to Air Force Association, 1501 Lee Highway, Arlington, Va. 22209-1198. Publisher assumes no responsibility for unsolicited material. Trademark registered by Air Force Association. Copyright 1990 by Air Force Association. All rights reserved. Pan-American Copyright Convention.

Editorial

By John T. Correll, Editor in Chief

The First Thirty Days

In August, just as the nation was turning out the lights on the defense program, crisis struck in the Middle East. Six days after Iraq invaded Kuwait, US Air Force fighters were on location in Saudi Arabia, ready to fight, and a massive airlift had been assembled to deliver ground forces, equipment, and supplies.

At this writing in early September, it is unknown whether the culmination is to be war, stalemate, or some sort of negotiated settlement. Whatever happens, the first thirty days of the crisis should have been instructive.

As David Broder put it in a Washington *Post* column, the crisis shattered a "dangerous myth" that the US no longer needs military strength. It further demonstrated, Mr. Broder said, that "we bought a lot more in the military buildup of the 1980s than the overpriced toilet seats Pentagon critics held up to constant ridicule."

As Mr. Broder points out, the United States is fortunate to have airlift and sealift capacity "that made this deployment a logistic miracle" and weapons that "would be the telling difference if war comes."

Slow learners, however, remain among us. They say the Iraqi despot, Saddam Hussein, is a unique threat, that his military power is overrated, that he can be defeated with relative ease, and that it would be easier yet if our forces had simple, sturdy equipment rather than the esoteric weapons on which we spent our money.

That is hogwash. Of course this threat is unique. Most threats are. Before August 2, the instant experts who now perceive no other threats were not worried about Iraq either.

Of course the United States can defeat Iraq in battle, but we should not expect a pushover. Many of Saddam's weapons are below par, but even the older arms have some military value, and an appreciable part of his equipment—MiG-29 fighters and Su-25 attack aircraft, for example—is modern.

Some of his troops are ragged, but he still has a million of them. The quality of his chemical weapons may be questionable, but it's good enough to put our own forces into hot, bulky, protective gear.

The United States owes its advantage to advanced capabilities. Our aircraft and tanks are better than Saddam's. We can fight at night. We can operate against lethal defenses. Our well-trained forces have the benefit of timely information from airborne and battlefield sensors. We can place power where it's needed.

Why did deterrence fail in the Middle East? Where might it fail next?

Analyst Jeffrey Record, who created a furor last spring by suggesting the Air Force had outlived its usefulness, now writes that "we would be stupid to try to slug it out with Iraq on the ground" and that "US airpower could prove the decisive instrument of Iraq's defeat."

It was not necessary to develop the American military presence from scratch. US ships and capable carrier-based fighters were already in the area. Nevertheless, everyone breathed a bit easier once the Air Force and some ground divisions arrived to put more muscle in the order of battle.

The prompt positioning of superior forces stopped Iraq short of uncontested domination of forty percent of the world's oil. The United States says there won't be a war unless Saddam starts it, but that leaves some problems hanging.

Rep. Les Aspin (D-Wis.)—whose House Armed Services Committee voted, two days before the invasion of Kuwait, to cut defense by $24 billion next year—says, "Our bottom line boils down to ridding the world of Saddam Hussein or his army." In Mr. Aspin's view, if Saddam merely pulls out of Kuwait with his forces intact, he can still intimidate his neighbors with raw power that he has demonstrated his willingness to use.

"It would not be long—two to five years, say—before he made his next land grab," observed *The Economist*. "By the mid-1990s, the West is likely to depend rather more than now on oil from the Gulf, and the Soviet Union may depend rather less on the goodwill of the West. Beating Mr. Hussein then, when Iraq could be nuclear-armed and economically strong, would be much harder."

The crisis caught radical reductions to US defense in the planning stage and the defense industrial base beginning to disintegrate. Neither the defense program nor the industrial base is yet beyond recovery. A wise nation might now reconsider their importance in light of recent experience.

Furthermore, the US should look again at the signals it is sending, especially to those who do not mean us well.

The sobering fact is that deterrence failed in the Middle East.

Perhaps Saddam is a megalomaniac, and no logic would have forestalled him. The more likely assessment, though, is that he "miscalculated" when he invaded Kuwait and threatened Saudi Arabia.

If the second view is correct, what led him to miscalculate and figure he could get by with aggression? Who else, in what situations, threatening which US interests, might also miscalculate—and why? ■

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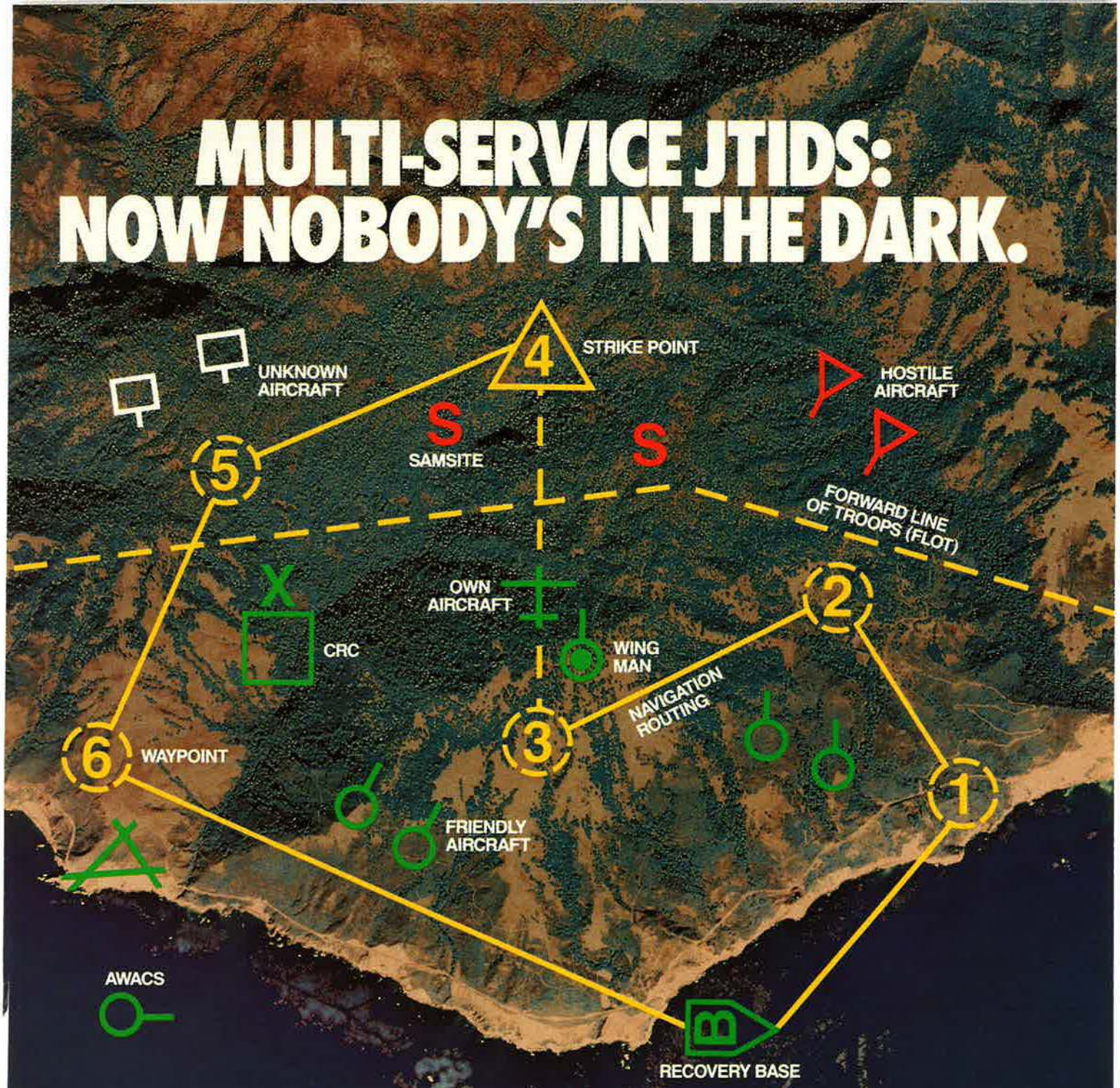

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Letters

Transition Woes

The "Employment Supplement" in your August 1990 issue *[see "Veterans in Transition," by Amy D. Griswold, p. 70]* causes me some concern. I certainly agree that our military force is well-educated, dedicated, and competent. However, this is only part of the story. The single most telling sentence in the entire supplement is found on p. 71 and reads, "Many industries stand to benefit . . . if they can overcome the 'language barriers' that make it difficult to translate military experience into civilian terms." Because many industries can't—or won't—attempt such a translation, we are doing our service members a monumental injustice by perpetuating the myth that the civilian job market is awaiting them with open arms.

You mention the excellent management skills and the ability to work under pressure that veterans bring to the civilian marketplace. It has taken me almost five years to overcome these "advantages." I have been told by corporate human resource personnel and representatives of executive search firms that military managerial experience is totally discounted by the civilian marketplace. . . . I have been told that management skills developed in the military are inappropriate for the nonmilitary work place because "the civilian world is not the regimented, blind-obedience, master-servant society of the military." This view of the military is, of course, ridiculous—but pervasive.

The "easy, seamless transition to the civilian market" offered by the defense industries and further government service will be available to fewer former military personnel than in the past. Many more will have to compete in the purely civilian job market. Your article painted the bright picture of 18,000,000 new jobs being added to the economy by the year 2000, with half of these jobs being in the fields of retail trade, health services, and business services. You stopped short of divulging what proportion of these 18,000,000 new jobs will be for minimum wage with no employee benefits and little opportunity for advancement. The economic sector you mentioned, the service sector, is a veritable bastion of such jobs. This, to me, is not an encouraging employment outlook.

What suggestions would I offer to members separating from the service? Be aware that your greatest asset to a civilian employer could be your education, not your experience. The perception is widespread that military experience, particularly management experience, is not transferable, so the veteran must be prepared to deal with it. Consider continuing your education, even if only part-time. Not only will your talents become more marketable, but you will also be afforded the time to shift gears from the military to the civilian world and to establish your network of work place contacts.

The "Employment Supplement" is absolutely true—as far as it goes. But the environment many colleagues and I have experienced in our search for meaningful civilian employment is somewhat different from the environment you portray. . . . I am not saying that the services or departing service members will be able to modify societal perceptions in the near term. I am suggesting that we prepare our service members to deal with these perceptions, to play the hand that most certainly will be dealt many of them.

Maj. Walt Dunlavey,
USAF (Ret.)
Pittsburgh, Pa.

"Medevac" Attack

As a member of an Air Force Reserve Aeromedical Evacuation Squadron, I was quite pleased and interested to read the article in the July issue on the MAC medevac system *[see "Medevac," by Jeffrey P. Rhodes, p. 84]*. I have also been pleased to see more pictures of medevac crews in the recent May Almanac issues, because the Aeromedical Airlift system is a part of the Air Force mission that rarely gets the attention it deserves.

However, there were some shortcomings in the article that need to be pointed out. It is a great disservice to give no more than a passing mention to the role played by the Reserve crews flying intertheater missions on the C-141 (certainly more than the seventy percent contribution you claim). Some of the pictures in the article should have been devoted to C-141 missions, and more should have been said about the C-141's role in flying all the missions out of Panama. Flying live missions on the C-141 is probably harder work than flying C-9s, because of the larger patient loads and the longer routes.

Taking care of a planeload of patients on a ten-hour flight from Rhein-Main AB, West Germany, to Andrews AFB, Md., is definitely no joyride. Also, your mention of the C-141 routes failed to include the weekly mission to Roosevelt Roads, Puerto Rico, and Guantanamo Bay, Cuba, flown by all-Reserve crews from Andrews and McGuire AFB, N. J.

By describing the job of the aeromedical technicians as primarily "keeping track of baggage, serving meals, and giving safety briefings," you make them seem like nothing more than glorified flight attendants or baggage clerks. I can tell you from personal experience that besides doing that and a whole lot more, aeromeds also perform the lion's share of the patient care. The aeromeds in my squadron are highly qualified and experienced medical professionals, including numerous civilian paramedics, operating-room and emergency-room technicians, LPNs, and nursing students.

According to the caption at the top of p. 87, "it is not unusual to see mem-

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bers of the flight crew lift a litter." Trust me, folks, in my unit no one *but* crew members lifts litters! After all, it's part of our job. . . .

A1C Robert C. Mebane,
AFRES
Andrews AFB, Md.

Illinois's Pride

Thank you very much for the excellent article about the 375th Military Airlift Wing at Scott AFB, Ill.

Illinois is proud to have this MAC unit. I have toured Scott AFB and its C-9A Nightingales. I especially remember ship #88934 of the 375th AAW. It was on static display at Scott on June 18, 1988. The cabin was filled with aeromedical equipment, which was efficiently unloaded using the plane's special ramp. A bit of trivia: At that time, this C-9 had 30,372.3 hours, 34,601 landings, and 22,297 cycles.

Your in-depth, behind-the-scenes coverage of Scott AFB has increased my appreciation for the 375th MAW.

Margaret Nowacki
Rolling Meadows, Ill.

Forgotten Flight Surgeons

I read with great interest your article on the medevac system, as I have been closely involved with the aeromedical evacuation of countless patients. The article is thorough, with one glaring exception: It makes no mention of the crucial role of flight surgeons in aeromedical evacuation. Once a patient has been identified by his physician as a candidate for aeromedical evacuation, he must be evaluated by a flight surgeon to determine whether his medical status allows air transport, what restrictions should be placed on the flight, and what special medicines, equipment, or procedures should be performed, and to clarify any other medical concerns before clearing the patient into the system.

The environment in an aircraft at altitude is more hostile than it is in a hospital bed on the ground. Such things as hypoxia, humidity, pressure changes, and procedural difficulties in flight must be considered. This is a key duty in the practice of flight medicine. While the patient is en route or remaining overnight in transit, his medical care is the responsibility of the flight surgeons. Often a flight surgeon will accompany the patient on the flight if he needs monitoring for a potentially unstable condition.

Another point, though somewhat less important, is that here in Alaska we often use the C-130 in medevac missions to and from the many remote sites across the state, usually on very short notice. This is not necessarily only a wartime role.

This letter is not meant to belittle the efforts of the pilots, nurses, technicians, and administrators—all are part of the medevac system. To leave out the flight surgeons is an oversight in need of correction.

Capt. Richard E. Bachmann, Jr.,
USAF
Chief, Flight Medicine
Elmendorf AFB, Alaska

Phantom Data

Thank you for the "Gallery of US Navy, Marine Corps, and Army Aircraft" *[by Kenneth Munson, Paul Jackson, and Bill Gunston, July 1990 issue, p. 90]*, which is gratifyingly comprehensive—but not entirely accurate.

Leaving aside such oversights as the four-engined *[sic]* C-9 (p. 95), I was particularly puzzled by the "Armament" ascribed to Navy/Marine Corps F-4s—*e.g.*, M61A1 gun (p. 91) and F-4Bs' gun "in the nose and fuselage" (p. 94).

I will not undertake to speak of experiments that might have been pro-

AIR FORCE MAGAZINE
PUBLISHED BY THE AIR FORCE ASSOCIATION

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posed (or even tried) at such places as St. Louis, Patuxent River, China Lake, or Point Mugu. But I *can* tell you that in 1967 I deployed fifteen F-4B airplanes and the COSAL fifteen guns. In the period from September 1967 to February 1968, the Reporting Unit (VMFA-122) fired four times as much 20-mm ammunition as the rest of the First Marine Aircraft Wing combined (eleven other airplane squadrons). Not one of those 20-mm rounds came out of the M61, and not one of those 20-mm rounds came out of the nose of an F-4.

Our COSAL gun was the Mk. 11. The Mk. 11 gun lived in the Mk. 4 gun pod, suspended on station 5 (centerline, underfuselage).

No F-4B (later F-4N) or F-4J (later F-4S) was delivered to the Fleet or Fleet Marine Force with an internal gun. What is puzzling (to me) is that your three well-known contributors were presumably aware of USAF's F-4 history, which began with F-4Cs and F-4Ds—also delivered without internal guns. For these, the gun was likewise suspended on station 5.

The big difference was that the Mk. 11 is a self-driven gun—half the recoil energy is used to drive the gun. At 4,000 rpm (vs. 6,000 for M61), this means that the mechanically driven M61 pumps about three times as much recoil energy into the aircraft structure—with resultant structural damage for the depots to repair.

A related difference is that from a self-driven gun you get instant bullets—there is no spinup delay. Anybody who maintains that this is not significant has not thought out the mathematics of "V-sub-c" (closing velocity).

The German *Schnellboote* sailors said it fifty years ago: "The idea is to throw the maximum iron at the enemy in the shortest possible time." Nothing does this quite so well as a large-caliber automatic gun. More than one, if you can manage it. We also suspended the Mk. 11 on stations 1 and 9 when the mission required it. Three guns did a wonderfully satisfying number on enemy flak.

Col. John M. Verdi,
USMCR (Ret.)
Northport, Ala.

In the "Jet War"

The Radar Observers in the F-82s or F-94s *[see "Jet War," by Philip Farris, June 1990 issue, p. 92]* were along for far more than the ride. For the record, 1st Lt. William Hudson's RO was Lt. Carl Frazer. The identity of Maj. James Little's RO has never been determined; it could have been any one of five who flew missions on June 27, 1950, whose names were not matched with a pilot in the 339th's records. Many believe that it was Capt. Phillip Porter, the only RO to receive ace acclaim during World War II. Lt. Charles Moran's RO was Lt. Frederick Larkins.

There never was a 68th Fighter-Bomber Wing [in the Korean War]. The author presumably meant the 68th Fighter (All-Weather) Squadron. . . .

The Royal Australian Air Force, 77 Squadron, . . . did not become operational with Meteors until 1951. The 2d Squadron, Republic of South Africa, flew its first combat mission in support of United Nations Forces on November 19, 1950; the Greek and Thai governments were not solicited for support until October 1950.

The Ilyushins shot down [on] June 27 were Il-10s, not Il-1s. The Il-10 [was] known as the Stormovik.

David R. McLaren
Springfield, Ill.

• *Mr. McLaren is correct. In the editing of the section on forces of Australia, South Africa, Greece, and Thailand, the word "eventually" was deleted, a change that made the contribution of these nations seem more immediate than was the case. The designation "Il-1" came directly from the official report "Aerial Victory Credits," compiled by the Air Force Historical Research Center, Maxwell AFB, Ala. However, spokesmen at the Center say that its use of the term was an error.*—THE EDITORS

Keith Tribute

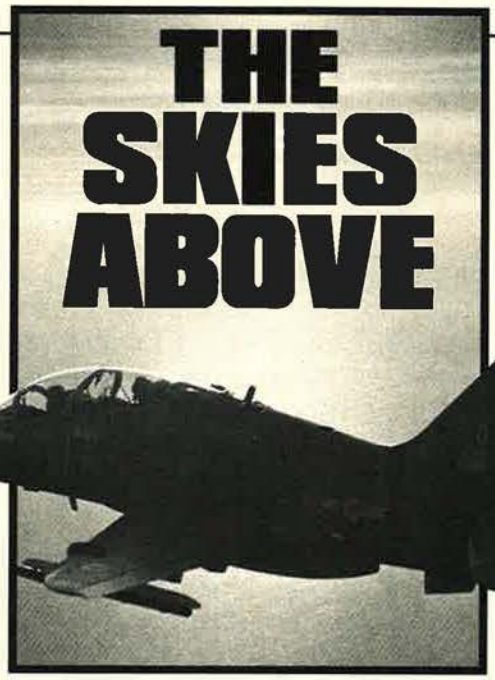
The men and women of the US Air Force have lost a great friend and supporter upon the death of Mr. Sam Keith, AFA Board Chairman. Mr. Sam had the uncanny ability to deal effectively with everyone from US Presidents to the newest airman and all those in between. He was always willing to go to bat for Air Force people and speak out on vital issues that needed his wise and compassionate judgment and support.

I am sure everyone who knew him feels the same sense of personal loss but at the same time remembers fondly the warmth of Mr. Sam and what a genuine person he was.

The word "great" is used too often these days, but he was truly a great supporter, great friend, and great human being. We'll miss you but always remember you, Mr. Sam.

CMSgt. Donald B. Hines,
USAF
Gunter AFB, Ala.

THE SKIES ABOVE



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A new fiber optic cable may open the door to interference-free, high speed communications. The metal-coated optical fiber was created by Hughes from long glass strands covered with an aluminum coating. These optical fibers withstand temperatures up to 400 degrees centigrade, can be soldered to eliminate the need for organic materials that could cause contamination, and exhibit long life and high reliability characteristics. Besides being used for point-to-point data communication, the new technology can also be incorporated in fiber optic sensors and optoelectronic hybrid circuits for use in space satellites, advanced fighter aircraft instrumentation, and automobile, aircraft and spacecraft engine monitoring.

Lower cost infrared detectors may be one result of research under way at Hughes. The U.S. Army is planning to use detectors made of platinum silicide on an infrared version of the Non-Line-of-Sight Missile. The detectors are made from silicon chips containing an electrode made of a compound of platinum and silicon. Staring arrays made from these detectors, and using fixed optics, perform better than more expensive scanning systems, and the staring arrays are inherently more reliable. Platinum silicide detectors may also be used to gather radiometric data on missile launches and in aerial reconnaissance.

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Washington Watch

By James W. Canan, Senior Editor

The Streamlined Six

Doubters and detractors see trouble ahead for the PEO acquisition approach, but the Air Force believes the new process will work.

Program Executive Officers, upper-level newcomers to the acquisition hierarchy, are in position to make a huge difference in how the Air Force oversees and executes its major programs. The PEOs are a small, select group. They have high rank and heavy clout and have been around.

They have their work cut out for them, though. As they stake out their turf inside the Air Force, no mean feat in itself, they must also break new ground in dealing with the captains of the defense industry.

Their charter extends far beyond the Air Force. They are being counted on to make a big difference in how the Air Force's contractors carry out their blue-chip programs.

The PEOs report directly to John J. Welch, Assistant Secretary of the Air Force for Acquisition, whose expectations are high. Mr. Welch says the Defense Department's creation of PEO slots last year "provided us with an opportunity to focus the experience and knowledge of our top acquisition managers on our major programs, to see where the programs stand at all times—whether they're on track to produce the systems that the users need from them."

Through their careers, all six Air Force Program Executive Officers have served as directors of major acquisition programs and have held higher-level supervisory jobs. The PEOs are:

- Maj. Gen. Edward P. Barry, Jr., tactical and airlift systems.
- Maj. Gen. Eric B. Nelson, C^3 systems (except Joint STARS).
- Brig. Gen. Joseph K. Glenn, strategic systems (except the B-2).
- Maj. Gen. Stephen M. McElroy, tactical strike systems (including Joint STARS).
- Brig. Gen. Garry Schnelzer, space systems.
- Robert C. Majors, information systems.

The B-2 program is a special case. It is directed by Maj. Gen. Richard Scofield, who is not a PEO but who reports directly to Mr. Welch.

The Program Executive Officers are being counted on to make a big difference in how the Air Force's contractors carry out their blue-chip programs.

Mr. Welch expects all PEOs to have set up shop at the Pentagon by the first of the year. General Glenn was the only one already there at the time of their selection. The other general officers were occupying top positions at Air Force Systems Command product divisions around the country. Mr. Majors worked for Air Force Communications Command.

Some PEOs privately expressed misgivings about having been summoned to work at the Pentagon. For the most part, they were already stationed in places where the programs assigned to them were being carried out, and they felt they would do a better job of overseeing those programs if they simply stayed put.

Mr. Welch ruled against them. He saw their point but believed it was outweighed by others. He sees an advantage in having all the PEOs on hand "to improve communications" and "to understand this [acquisition management] environment better by living in it."

Working under the same roof at relatively close quarters will make it easier for the PEOs to "learn from each other and be mutually supporting," he says. "They face the same kinds of challenges, their programs interface in many cases, and they are dealing with the same companies."

Mr. Welch also notes that those programs and companies "are spread all around the country, so the PEOs will be on the road a lot no matter where they live. They won't be here much, but they will be at critical times."

Mr. Welch clearly has high hopes for the PEOs, but not everyone does, by a long shot. Detractors and doubters in government and industry are concerned that the PEO setup will bring marginal improvements to the acquisition process, at best, and may even impede it. They claim it only pads an already overstuffed acquisition bureaucracy and drains too much power from Air Force Systems Command, which formerly had the acquisition arena all to itself but now has been dealt out of managing all programs categorized as "major."

The corporate Air Force disagrees. Its leaders had a hand in—and hailed—last year's Defense Department decision to establish PEO slots in all the services. That decision was an outgrowth of the department-wide Defense Management Review, the seedbed of many changes in the Pentagon's ways of doing business and of more changes to come.

Secretary of the Air Force Donald B. Rice explained that DoD had created the PEO position "to put into place a clean, clear, short line of management responsibility and accountability" for the major acquisition programs of all the services.

Where the Air Force is concerned, that line starts at the top with the Under Secretary of Defense for Acquisition, then runs to the Assistant Secretary of the Air Force for Acquisition, to the PEOs, and, finally, to the individual program directors. Dr. Rice described the PEOs as "general managers for clusters of major programs."

Some reservations about the PEO setup may stem from an imperfect understanding of the duties and responsibilities of these new acquisition executives.

The influence of the PEOs, while considerable, is narrower than may

be generally recognized. They have lofty positions, but there are clear limits on what they can do. They are not free to throw their weight around in all arenas having anything whatsoever to do with acquisition. They are supposed to concentrate on running their programs and on steering clear of everything else.

In this regard, questions persist about the working relationships of the PEOs with other Air Force acquisition officials at the Pentagon, especially the eight "mission-area directors"—general officers for the most part—who also report directly to the Assistant Secretary of the Air Force for Acquisition. They run acquisition directorates that cover the whole range of Air Force programs—space, strategic aircraft, strategic missiles, tactical, electronic combat, airlift, special operations, and others.

These directorates devise acquisition programs to satisfy the stated requirements of the operational commands. Then they go to bat for those programs all over town.

"The jobs of the mission-area directors are completely different from the jobs of the PEOs," Mr. Welch asserts. "The directors are part of the PPBS [planning, programming, and budgeting system]. They look at budgeting and at everything else involved in structuring acquisition programs at the front end—funding them, advocating them appropriately in this building and on the [Capitol] Hill."

Their titles are germane to their responsibilities because, explains their boss, "their job is to represent the mission-area needs of the major commands, the operating commands, in the acquisition process."

The PEOs also represent those needs, but not in the same way. They deal in hardware. Their job is to see to it that the acquisition process comes up with the aircraft, missiles, and other systems specified as requirements by the operational commands.

Programs qualify for PEO stewardship once the time has come to begin putting big money on them. On taking charge of such programs, PEOs are responsible for making sure that they have been intelligently conceived and are solidly grounded, that their acquisition strategy is sound, and that they are properly executed.

PEOs set the tempo and the tone for programs in their purview. They decide such questions as whether a system should be built by one contractor or two, whether a flyoff will be in order for competing aircraft, and whether a program should be stepped up or slowed down, modified or set aside. One of their most important responsibilities is to devise developmental testing regimens for the systems under their supervision.

All things considered, the main job of the PEOs is to come up with the real goods at fair prices for the operational Air Force.

Mr. Welch sees the PEOs as "extensions of the program offices, accountable to get the programs done and the products delivered in supportable fashion to the users. PEOs are not actually a part of the Air Force's basic AQ [acquisition] organization. They're collocated with me and report to me in my capacity as SAE [service acquisition executive]."

He continues, "We decided that each PEO should have no more than five staff people. A PEO is not a staff agency, not an organization unto himself, so there is no reason for him to build up a big staff. He is supposed to provide leadership and direction to his program directors, and they're the ones who have the organizations and the staffs.

"PEOs won't sit here at the Pentagon and call a lot of meetings or go to a lot of them. Their business is out there on the road with their program directors and the industry. They can easily communicate with me and their people back here, through teleconferencing and other means."

The PEOs will have to be present at the Pentagon "to explain things to us [Air Force and DoD leaders] when we look at their programs from the standpoint of execution, to make sure we understand the situations," Mr. Welch declares.

The Assistant Secretary for Acquisition would like his PEOs to be spared the time-consuming job of testifying before congressional committees, a job that he and his mission-area directors usually handle. "Hopefully, the PEOs won't have to go to the Hill," he says.

Refining USAF-contractor relationships right at the top is "an absolutely major goal" of the PEOs, Mr. Welch asserts.

The PEOs have the leverage to pull it off. Given their select status in the Air Force acquisition community, they should be able to deal with top-rung defense-industry executives on a more or less equal footing and compel them to heed problems that bedevil their performance on Air Force contracts.

The way things usually work, such problems may not come to the attention of upper-echelon corporate officials, or may be seen by them as not worth their time and trouble. Persuading those executives to focus on and fix the problems should be much easier for PEOs than it has been for lower-ranking uniformed and civilian officials at program levels.

"The companies have got to perform," Mr. Welch asserts. "We expect it of them. But their CEOs and other top officers are faced with many other challenges, such as searching for financing in this [tight budget] environment, that make heavy demands on their time and attention.

"But the CEOs also have a commitment to us, and we believe our PEO arrangement will improve our communication with them and help them focus on the execution part of that commitment."

The PEOs have the power that comes with filling out report cards. They take the lead for the Air Force in rating the performances of contractors, a practice that has come into full flower in the procurement-reform climate of recent years. It requires "close communication with the companies so we can let them know how they're doing and what we need from them," says Mr. Welch.

He continues: "Maybe the toughest problem we [Air Force and industry managers] have is visibility—being able to see problems that are developing deep down in the programs. We have to see them before we can pull them up and fix them."

The PEOs keep their eyes open for such problems and are not shy about calling them to the attention of CEOs and other top managers of the companies involved. Some top-level armtwisting may be in order from time to time.

The PEOs are also expected to be potent forces for keeping blue-chip Air Force programs from going off in all directions, a tendency that has characterized all too many.

"One problem our contractors seem to have in common is that they try to do too many things at the same time, sometimes because we've asked them to," Mr. Welch declares. "It's as if their marketing people come in and say, 'We'll give you everything you want for a buck,' and our [Air Force] program directors say, 'Great, I'll take two bucks worth.'"

By all accounts, the PEOs have made good use of their time out and around. Says Mr. Welch, "On several occasions, where there have been problems with companies, our PEOs have been able to sit down with the senior company leadership—above

program level—and tell them how we see things and explore with them what might be done, what new approaches might be taken."

Some such sessions have been eye-openers for corporate executives who came away acknowledging that "they had some work to do," says Mr. Welch. "We're getting them [the company executives] to see how we see them and then to do something about it. Better communications is the key. Just beating on them doesn't do any good."

He names no names, but says, "You can safely conclude that we have gone through this with all our major-program companies and that we'll be doing it on a continuing basis."

All is not bad. Some companies have done themselves proud on certain programs and have been willing to "share with others how they got to be so good," says Mr. Welch. "Some got to be really good because they'd been really bad, to the point that they were being challenged as to whether they would be able to stay in business."

Mr. Welch points out another natural advantage that the PEOs bring to improving communications with companies: They have a much better, top-down view of total Air Force science and technology resources than directors of individual programs can possibly have.

"The PEOs can look all across those resources, throughout the [AFSC] product divisions, and keep the companies abreast of them," he explains.

The general officers in command of those product divisions had doubled as PEOs of major programs. The Air Force's establishment of PEOs outside the AFSC organization to take over those programs was widely regarded as a comedown for the product divisions and their commanding officers.

Not so and to the contrary, says Mr. Welch.

He declares, "That's another myth that has sprung up—that now, because of the PEOs, we don't need Systems Command or its product divisions. Our program managers still get all their functional resources from the product divisions and draw on them for their functional expertise. Systems Command is still in charge of our [Air Force] science and technology base—the laboratories and everything else about S&T. Systems Command manages our test and evaluation facilities. It's in charge of career planning—recruiting and retaining top-flight engineers and other vital military and civilian personnel."

Mr. Welch notes that AFSC's top officers, rid of the responsibility for riding herd on major programs, "now have more time to focus on all those other important matters." He also calls attention to something else they do that determines whether a program ultimately succeeds or fails.

"They still have the responsibility for seeing to it that programs get off to a good start" on course to becoming major programs, he declares.

The PEOs must devise test programs that will determine whether or not the major systems emerging from their programs meet operational requirements.

Moreover, the generals in command of AFSC and of its product divisions continue to be the prime points of contact for Mr. Welch and other Air Force acquisition officials at the Pentagon. Those commanders will still be first to answer the phone when the Pentagon calls.

Thus, as one Air Force acquisition official outside the Pentagon points out, "the three-stars [product division commanders] still have some responsibility for major programs, *de facto,* simply because they are still the senior officers in their divisions and their divisions are still working the major programs, PEOs or no PEOs."

Mr. Welch bristles at any suggestion that the PEOs represent a putdown of AFSC. He commends "the way Systems Command does business" and "the excellence of its people."

"We drew most of our PEOs from it, after all, and we drew the very best," he asserts.

PEOs work closely with Systems Command from the very start of their programs. They do not get involved with the operational commands until the programs are fairly far along. They have no part in setting requirements for systems or in conceiving systems to meet those requirements.

There is one area, though, in which the PEOs and the operational commands find common ground: testing, which is often full of pitfalls for costly, controversial, attention-getting weapon systems. It falls to the PEOs to devise test programs that will determine whether or not the major systems emerging from their programs meet operational requirements.

They will find this easier to do if the requirements do not impose unrealistic demands on the testing, Mr. Welch emphasizes. He uses the Advanced Medium Range Air-to-Air Missile testing program to make his point.

AMRAAM testing had its problems in recent years. Not long ago, however, the program passed its toughest test with flying colors. Four AMRAAMs launched by an F-15 scored kills against four separate targets, thus demonstrating launch-and-leave, multiple-kill capability as advertised—and as required.

There had been discussion in the Air Force of raising the ante on AMRAAM requirements, making it necessary to prove, through testing, a much greater capability—two F-15s launching four AMRAAMs apiece at eight targets and destroying all of them.

"We didn't know how to test to that," Mr. Welch says, "and if we don't know how to test to a requirement, we shouldn't make it a requirement in the first place, because if we do, everybody and his brother will hold us hostage to it."

In setting goals and requirements for systems and their testing, the Air Force "must ask ourselves, 'Are they truly representative of what we'll be doing with the systems after they go into operation, or are they so far out on the margin that we're going to spend all our time and energy trying to make them perform out there and trying to test them out there?'"

The way Mr. Welch sees it, setting realistic operational requirements and not asking the impossible of testing programs are fundamental steps in earning and keeping the public's trust in the defense acquisition process.

But more than that is involved. "We believe," he says, "that the defense business is, and rightfully should be, held to a high standard. We have no quarrel with that. We're executing a mission that's critical to the future of the United States.

"But there are so many standards, some of which are in conflict with one another, that they create a whole conglomerate of oversight, too many overseers. The result is confusion and concern about trust, integrity, and performance. This concern leads to instability of financing, scheduling, and performance of our programs.

"We have to have stability so that our people are free to perform. We have to perform our way out of this climate of distrust. That's why we have the PEOs. That's what the [acquisition] reorganization is all about. It's focused on performing our way into the world of trust." ■

The Chart Page

By **Colleen A. Nash,** Associate Editor

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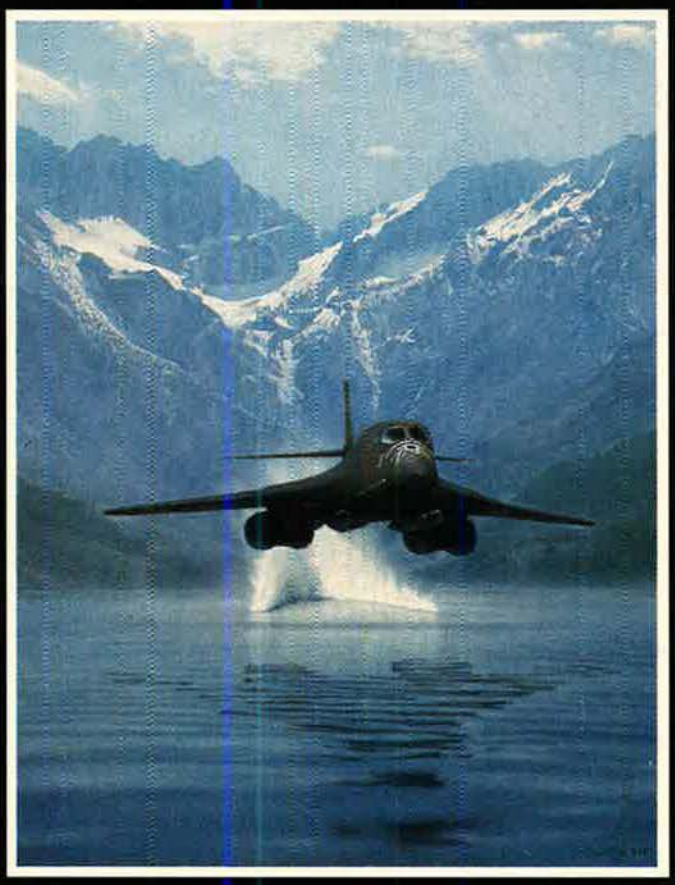

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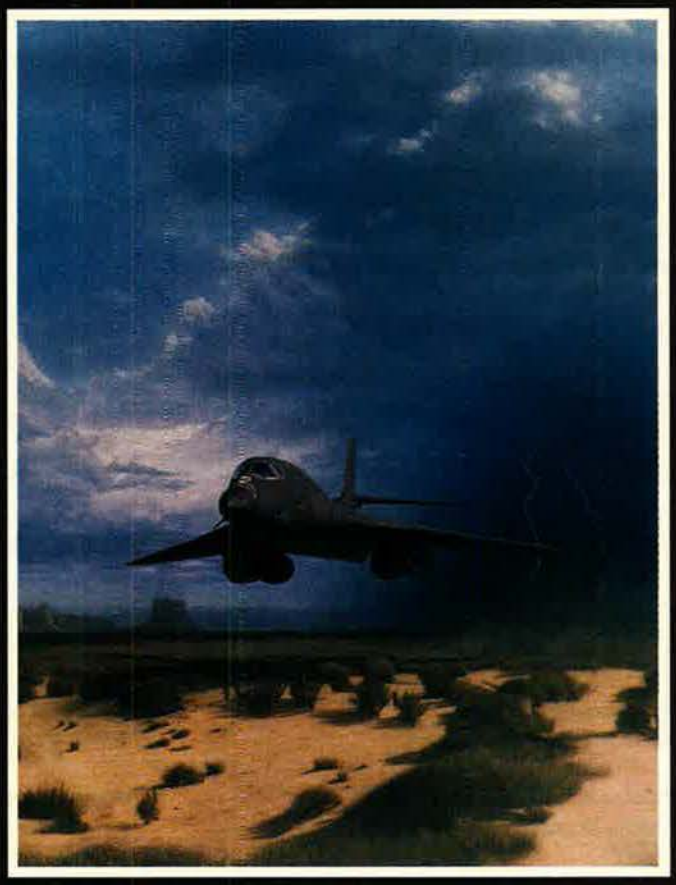

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Capitol Hill

By Brian Green, Congressional Editor

The Gramm-Rudman Snapshot

The deficit projections are getting worse. The latest—and official—one sets up a sequester of $105.7 billion from 1991 outlays if the budget process fails.

The Office of Management and Budget (OMB) produced an August "snapshot" of what it thinks the budget deficit will look like this month, the first of Fiscal 1991. The figure was shocking: $169.7 billion. OMB's official adoption of this gargantuan number sets the stage for defense spending cuts of unprecedented magnitude. Should these cuts be imposed, they would shatter existing defense capabilities.

This danger stems from requirements of the Gramm-Rudman-Hollings (GRH) balanced budget law. GRH provides that OMB's projected deficit for a given fiscal year may not exceed a predetermined limit by more than $10 billion. If it does, Washington must impose across-the-board spending cuts, a process known as sequestration, in order to reach the target figure. For FY 1991, GRH sets a deficit goal of $64 billion. Thus, the OMB "snapshot" deficit overshoots the target by a whopping $105.7 billion.

The sequester would have to be sufficiently large to reduce the projected 1991 budget deficit by that amount. The danger for the military services is that half of that amount—$52.9 billion in outlays—would come out of the hide of defense programs.

The Congressional Budget Office, often at odds with OMB in the past, provided a nearly identical set of budgetary projections. CBO estimates the 1991 deficit at $165.2 billion, the amount to be sequestered at $101.2 billion, and the Pentagon's share of this sequestration at $50.6 billion.

The GRH sequester does not directly reduce outlays but rather cancels budget authority (BA) that is needed in order to spend federal funds. In its estimate, the OMB maintains that it would have to cancel $101.6 billion in FY 1991 Pentagon BA for future spending in order to reduce this year's defense "outlays"—actual spending—by $52.9 billion. That would reduce defense spending BA from its current baseline of $314.2 billion to $212.6 billion, a reduction the like of which the US has never seen.

President Bush, at the recommendation of Defense Secretary Dick Cheney, exempted military personnel from the 1991 sequester. Based on a deficit estimate consistent with OMB figures, Secretary Cheney told OMB Director Richard Darman that "our existing defense capabilities would be shattered by the implied large sequester, with or without a military personnel exemption." The Defense Secretary added that, under either option, "there is no way to run the Department."

If sequestration is imposed, the exemption will cause a disproportionately large bite to be taken out of every other military program, project, or activity. OMB estimates that those portions of the Pentagon budget subject to the GRH sequestration would be slashed by a whopping 43.6 percent. Another reason the percentage outlay reduction for affected programs is so devastating is that vast portions of the budget are off-limits. Congress has fenced off all but twelve percent of nondefense outlays. Only forty percent of defense outlays are subject to the sequester.

Vulnerable Air Force programs include Operations and Maintenance (with a 1991 "baseline" of $23.1 billion in budget authority, $10.1 billion to be sequestered), Aircraft Procurement ($16.0 billion and $7.0 billion, respectively), Missile Procurement ($6.6 billion and $2.9 billion, respectively), and Research and Development ($14.0 billion and $6.1 billion, respectively). Reductions on this scale would cripple the Air Force.

Defense officials worried that by October 15, the date of the final sequester order, the situation would be worse. The OMB deficit projection is required to reflect current law. At the time of the OMB "snapshot," however, Congress had not yet passed legislation authorizing the expenditure of billions to bail out failing US thrift institutions. When such outlays are factored in, the federal deficit could rise to $232.3 billion.

Fearsome as sequestration looks, the Bush Administration has hinted that it might be more acceptable than certain budget plans proposed by congressional Democrats. Bills passed by Congress impose deep cuts on defense but inflate the Bush Administration's domestic appropriation requests by billions of dollars.

Iraq and a Hard Place

At the outset of the Persian Gulf crisis, House Armed Services Committee Chairman Les Aspin argued forcefully that the US face-off with Iraq must end with either the fall from power of Saddam Hussein or the destruction of his armed forces.

Representative Aspin noted that President Bush declared his intent to maintain US military forces in the Gulf area until Iraq ended its military occupation of Kuwait, permitted the return to power of the Kuwaiti royal family, and freed US hostages in Kuwait and Iraq. But, Representative Aspin countered, "that's [not] what we should be saying, because I don't think that's what we're there for."

Representative Aspin argued that the real US goal was to "prevent an oil monopoly under Saddam Hussein. And that, I think, is something that can be done, but I'm not sure that restoring the *status quo* . . . gets you there. . . . The best way to accomplish that is one of two things: Either Saddam Hussein goes, or his army goes." Without one or both of these results, he said, the Iraqi dictator would control the oil-producing nations of the Arabian peninsula through threats and intimidation.

Representative Aspin suggested that some weapons programs, the C-17 airlifter being a notable case, would be reevaluated in the wake of the Gulf crisis. He conceded that defense budget cuts might be smaller than anticipated as a result of the Gulf action but contended that pressures to cut defense spending remain. ■

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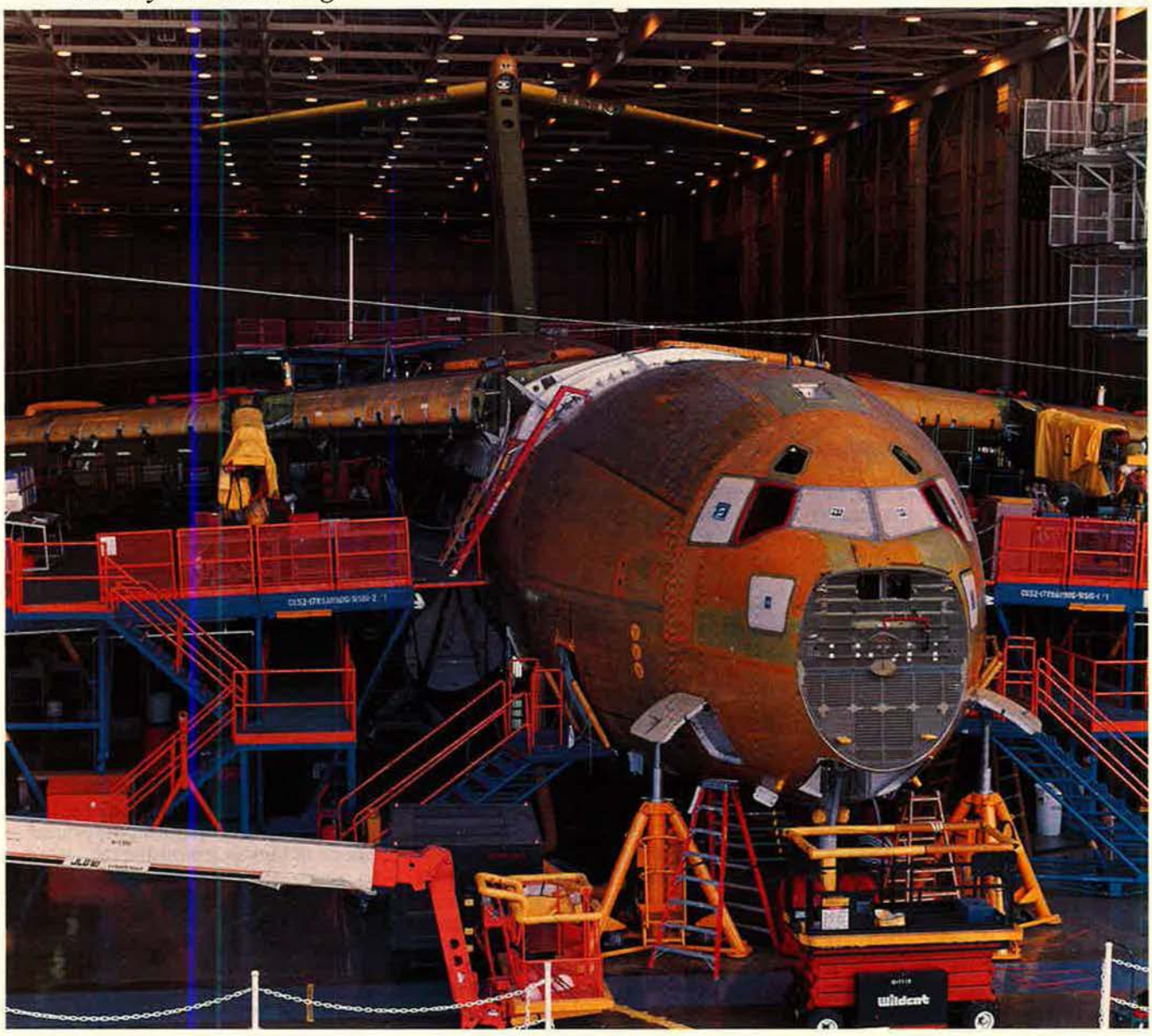

LTV horizontal joined to C-17 on August 12.

A milestone in the future of mass transit.

The C-17 airlifter has reached yet another major milestone as it moves toward completion and first flight by June 1991. August 12 marked the joining of the horizontal stabilizer built by LTV to the C-17's vertical stabilizer.

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LTV Aircraft Products Group is building major substructures for the C-17, including the vertical and horizontal stabilizers, as well as the engine nacelles.

LTV, together with the experienced team at McDonnell Douglas, is making this important program fly.

LTV Aircraft Products Group

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

Aerospace World

By Jeffrey P. Rhodes, Aeronautics Editor

★ The Air Force, particularly Military Airlift Command, played a crucial role in the early stages of Operation Desert Shield, the large-scale movement of US forces to the Middle East in response to Iraq's August 2 invasion of Kuwait.

On August 7, President George Bush ordered elements of the Army's 82d Airborne Division and several Air Force units to deploy to Saudi Arabia to bolster that country's defense.

In a Pentagon press conference on August 21, Gen. H. T. Johnson, commander in chief of US Transportation Command and MAC, said that, in the first two weeks of the operation, one billion pounds of materiel had arrived or were en route to Saudi Arabia. He added that this operation was more complex than the airlift to southeast Asia during the Vietnam era and was, in fact, "the largest sustained airlift ever over a short period of time."

Normally, seventy percent of the C-141B fleet of 266 aircraft fly every day. General Johnson said that eighty-nine percent of the available C-141s were being used in the Desert Shield airlift. He noted that ninety-four percent of the available C-5A/B fleet were involved in the airlift. Eighty-nine C-5 and 195 C-141 sorties were being flown to or from Saudi Arabia daily.

The load was so large, in fact, that the Civil Reserve Air Fleet (CRAF) was activated for the first time since its creation in 1951. In Stage I activation, seventeen commercial airliners were called up to carry passengers and twenty-one civilian cargo aircraft (three percent of US long-range civil aviation) were tapped for service. Stage I of the CRAF can be called up at the direction of CINCMAC. Twenty CRAF flights were made daily.

Stage II of the CRAF call-up brings into play a total of seventy-nine passenger and 108 civilian cargo aircraft. Stage II can only be activated on order of the Secretary of Defense. CRAF Stage III, which can only be activated in time of national emergency, calls up for military use a total of 258 passenger aircraft, 217 cargo aircraft, and thirty-one Boeing 767s for aeromedical airlift.

Air Force combat units that deployed to Saudi Arabia include the 1st Tactical Fighter Wing, Langley AFB, Va. (F-15C/D); 354th TFW, Myrtle Beach, S. C. (A-10); 363d TFW, Shaw AFB, S. C. (F-16C/D); 4th TFW, Seymour Johnson AFB, N. C. (F-15E); 35th TFW, George AFB, Calif. (F-4G); 37th TFW, Tonopah Test Range, Nev. (F-117A); 552d Airborne Warning and Control Wing, Tinker AFB, Okla. (E-3B/C); and elements of the 317th Tactical Airlift Wing, Pope AFB, N. C. (C-130). Strategic Air Command KC-10 and KC-135 crews played a crucial role in the deployments. Some tankers and RC-135 reconnaissance aircraft were later stationed in Saudi Arabia.

The contributions of the Air National Guard and Air Force Reserve were indispensable; almost 4,200 citizen-soldiers volunteered for the airlift part of the operation alone. In late August, President Bush called up more than 40,000 Reservists of all services.

Air Force Lt. Gen. Charles A. Horner, commander of Ninth Air Force and US Central Command Air Forces, is the Desert Shield Air Force commander. Air Force SSgt. John Campisi, a native of Covina, Calif., assigned to Offutt AFB, Neb., was the first casualty of the operation. He was killed August 12 as the result of a ground accident at a Saudi airfield. On August 29, thirteen crew members were killed when a C-5A bound for the Middle East crashed on takeoff at Ramstein AB, West Germany. There were four survivors.

The Navy has released this artist's concept of the General Dynamics/McDonnell Douglas A-12A Avenger (not Avenger II) attack aircraft. Designed to replace the Navy's A-6Es and, later, the Air Force's F-111s, the Avenger should roll out in late 1991.

★ The Navy released an artist's concept and provided the first official details about the previously classified, stealthy, General Dynamics/McDonnell Douglas A-12A Avenger attack aircraft in a Pentagon press conference on August 17. The A-12 is designed to replace the Navy's A-6Es and, later, the Air Force's F-111s.

The artist's concept shows a delta-shaped flying wing with what appears to be a slight protrusion in the area of the engine exhausts, although the exhaust configuration is not shown. The concept also fails to reveal whether the plane has any vertical surfaces. Unconfirmed reports indicate that it does not.

A pair of trapezoidal intakes are shown flush with the leading edge of the wing on the "point" of the delta. The drawing also shows a bubble canopy with tandem seating for the

pilot and bombardier/navigator. No details of the bomb bay were revealed, nor were any other bumps or panel lines.

The aircraft is said to be roughly the size of the 1960s-era Douglas A-3 Skywarrior (about seventy-six feet long, with a wingspan of seventy-two feet). The A-12 will have folding wings. The Navy says the plane "will fly faster and farther than the A-6E with a greater weapons payload." The A-6E can carry 18,000 pounds of ordnance 1,011 miles at a speed greater than 500 mph. The A-12 will also have a "significant offensive and defensive air-to-air capability" and a missile-warning capability.

A $4.78 billion fixed-price incentive contract for full-scale development of the A-12 was let in late 1987. The Navy also spent an additional $800 million on the demonstration/validation effort. Congress has appropriated $5.1 billion on the program so far for development and procurement. The first lot of six aircraft was funded in FY 1990, and these will support the operational test and evaluation and fleet introduction of the A-12.

A number of program deficiencies were recently uncovered, and the plane is reportedly very much over design weight. Correction of these problems (and other factors) will push the rollout of the Avenger (not Avenger II, as tradition would dictate) to late 1991.

★ The Magellan interplanetary probe entered orbit around Venus on schedule on August 10, but controllers at NASA's Jet Propulsion Laboratory in Pasadena, Calif., twice lost contact with the spacecraft during its first two weeks of operation.

A Hughes AGM-65F Maverick missile is fired from a Navy P-3C Orion from the Naval Air Test Center, NAS Patuxent River, Md., in the first of a series of tests. The Navy's "F" version of the Maverick has a tracker fine-tuned to increase its effectiveness at sea.

The Martin Marietta–built probe fired its thrusters for eighty-three seconds to slow from more than 24,000 mph to 18,675 mph to enter a near-polar orbit. It entered orbit on the far side of Venus, so ground controllers weren't sure of success until Magellan came around the planet the first time. The only glitch was that the probe unexpectedly switched from its main gyroscopes to a backup during orbital insertion.

After collecting the first set of engineering images, ground controllers lost contact with the probe for more than fourteen hours on August 16. The spacecraft, not hearing from Earth because its antenna was pointed incorrectly, had put itself in a "safe" mode, and reestablishing contact with it was difficult. Solid contact was made on August 17. The pictures, released August 21, showed craters on Venus's surface as well as ridges and valley floors where volcanic flows have hardened.

Later on the night of August 17, contact with Magellan was again lost. It took controllers more than twenty-one hours to regain solid contact. Although this turn of events was puzzling, the spacecraft showed it was able to take care of itself: It had once again gone into the "safe" mode. Engineers then had the probe send a copy of its complete computer memory to Earth so they could find any programming flaws.

Magellan was launched from the space shuttle *Atlantis* during the STS-30 mission in May 1989. The $530 million probe is to make 1,852 mapping passes of the planet's surface with its Hughes-built synthetic aperture radar. The probe's mission is to spend 243 Earth days (one Venus day) mapping up to ninety percent of the cloud-shrouded planet. However, NASA has never turned off a working probe, so mapping could continue until 1995.

B-2 bomber sections, including the area around the engines and the landing gear, are manufactured at LTV Aircraft Products Group's Dallas facilities and then shipped via an Air Force C-5 (above) to Northrop's Palmdale, Calif., facility for final assembly.

★ **VCR ALERT**—A series of televised specials, entitled **"Medal of Honor: True Stories of America's Greatest War Heroes,"** will air on or near patriotic federal holidays (and Pear Harbor Day 1990) through next July 4. Each program profiles several Medal of Honor recipients from all services, using eyewitness accounts, historical film footage, and interviews with the living recipients. The series, sponsored by *U.S. News & World Report*,

October Anniversaries

• *October 12, 1905:* The Fédération Aéronautique Internationale, the recognized authority for certifying air records, is formed in Paris, France. The Aero Club of America (which changed its name to the National Aeronautic Association in 1922) is formed the next day.

• *October 11, 1910:* Former President Theodore Roosevelt becomes the first Chief Executive to fly. He goes aloft as a passenger in a Wright biplane over St. Louis, Mo.

• *October 26, 1925:* Lt. Jimmy Doolittle, flying the Curtiss R3C-2 floatplane racer, wins the Schneider Cup race in Baltimore, Md., with an average speed of 232.57 mph. The next day, Lieutenant Doolittle sets a world seaplane record of 245.713 mph over a three-kilometer course.

• *October 8, 1940:* The Royal Air Force announces the formation of the Eagle Squadron, a Fighter Command unit to consist of volunteer pilots from the US. The unit later becomes the nucleus of the US 4th Fighter Group.

• *October 14, 1940:* Near the Virginia coast, Maj. Reuben Moffat, commander of the 33d Pursuit Squadron, becomes the first pilot to fly an Army Air Corps plane from a carrier as he flies his Curtiss P-40 off the deck of USS *Wasp* (CV-7). In all, twenty-four P-40s and nine North American O-47s would be flown off the *Wasp* to Langley Field, Va., as a test of deployment methods.

• *October 26, 1940:* Company pilot Vance Breese takes the North American NA-73, prototype of the legendary P-51 Mustang, aloft for the first time at Mines Field near Los Angeles, Calif. The plane, built to British specifications, was designed and fabricated in 117 days.

• *October 12, 1945:* The Air Force Association, Inc., a predecessor to the current Air Force Association, is incorporated in Norfolk, Va., at the urging of Gen. Henry H. Arnold.

• *October 17, 1955:* Flying a Douglas A4D Skyhawk, Navy Lt. Gordon Gray sets a world speed record of 695.163 mph on a 500-kilometer closed course over Edwards AFB, Calif.

• *October 13, 1960:* After a 5,000-mile flight in the nosecone of an HGM-16 Atlas booster, three black mice (named Sally, Amy, and Moe) are recovered near Ascension Island in the Atlantic in good condition, despite having been weightless for twenty minutes. Launched from Cape Canaveral AFS, Fla., the rocket reached an altitude of 650 miles and a speed of 17,000 mph.

• *October 14, 1965:* The North American XB-70 Valkyrie research aircraft lives up to its "triple-sonic" description as it passes Mach 3 for the first time. Company pilot Al White and Air Force Col. Joseph Cotton reach a speed of nearly 2,025 mph (Mach 3.02) during the one-hour, forty-seven-minute flight over Edwards AFB, Calif.

• *October 22, 1970:* The first salvo (simultaneous) launch of two unarmed Boeing LGM-30F Minuteman II intercontinental ballistic missiles is successfully carried out from Vandenberg AFB, Calif.

• *October 3–7, 1985:* The twenty-first space shuttle mission (51-J) is the second dedicated Department of Defense flight. The crew, Col. Karol Bobko, Lt. Col. Ron Grabe, and Maj. William Pailes (all Air Force officers), Marine Maj. David Hilmers, and Army Lt. Col. Robert Stewart, deploys two Defense Satellite Communications System satellites during the first trip into space for the orbiter *Atlantis*.

highlights the heroism of recipients from World War II, Korea, and Vietnam. Several airmen, including Maj. Richard Bong, SSgt. Henry Erwin, and Lt. j.g. Thomas Hudner, are among those profiled. Check local listings for dates and times.

★ **APPOINTED—Michael P. Higgins,** a civilian at Air Force Communications Command (AFCC) headquarters, has been named **director of National Airspace Systems** for the Air Force. He is responsible for managing, supervising, and planning the integration of Air Force air traffic control equipment, procedures, and guidelines into the Federal Aviation Administration's National Airspace System Plan (NASP). The FAA will modernize airports, control towers, navigational aids, communications, weather equipment, and radar approach systems under NASP. The entire US military air traffic control system is scheduled to be upgraded within the NASP program guidelines. AFCC is the service's executive agent for air traffic control.

★ **HONORS—1st Lt. Gregory Smith,** a B-52 pilot with the 644th Bomb Squadron at K. I. Sawyer AFB, Mich., was presented the **1989 Cheney Award** in Pentagon ceremonies on July 19. On December 6, 1988, Lieutenant Smith's B-52H exploded fifty feet above the runway after a touch-and-go landing. The crew compartment skidded 3,200 feet down the runway before coming to rest. Injured, but the only crew member who could move, he remained in the smoke-filled cockpit to extinguish flames that were burning the gunner. After fire fighters arrived, Lieutenant Smith disarmed the ejection seats, pulled both navigators upstairs, and removed an equipment rack that had fallen on the electronic warfare officer, then climbed through a fuselage hole to safety. Presented annually since 1927, the Cheney Award is given for an act of valor, extreme fortitude, or self-sacrifice in a humanitarian interest performed in connection with an aircraft. It is named in honor of 1st Lt. William Cheney, an Air Service pilot killed in a crash in 1918.

The **Pegasus launch vehicle development team and Kelly Johnson and the Lockheed SR-71 design team** will receive the **National Air and Space Museum Trophy** in ceremonies later this month in Washington, D. C. The air-launched Pegasus, a private venture between Orbital Sciences and Hercules, is the first all-new space launch booster to be developed in the past twenty years. It was first successfully launched on April 5. Mr. Johnson and the SR-71 team are being cited for their creation of an aircraft that operated on the fringes of space and provided outstanding service to US decision-makers for twenty-five years. Two awards are presented annually: one for current achievement and one for a past achievement that contributed significantly to the advancement of aerospace activities. The awards have been presented since 1985.

The winners of the **first Air Force Public Affairs Achievement Awards** were announced on July 13. Director's Excellence Awards go to US Air Forces in Europe (major command); the 434th Air Refueling Wing (AFRES), Grissom AFB, Ind. (wing or equivalent); and *Airman* Magazine and the 24th Composite Wing, Howard AFB, Panama (special achievement). Individual awards go to Lt. Col. Valerie Elbow (field grade officer), Capt. Harry Edwards (company grade officer), Maj. Alan Matecko (individual mobilization augmentee), Ceferina Yepez (civilian), MSgt. Larry Clavette (senior NCO), and TSgt. David Bryan (NCO).

★ **PURCHASES—CFM International** received a $318 million Air Force Logistics Command contract on August 9 for **108 F108-CF-100 turbofan engines** for the continued reengining of KC-135 tankers. With this FY 1990 order, CFM International, a joint venture between General Electric and SNECMA of France, has delivered or received firm orders for 1,361 F108 engines for the KC-135R modification effort. To date, 201 KC-135s have been brought up to the R model standard, and engines are on order to refit an additional 125 aircraft.

A modified Boeing 747-200B becomes the new Air Force One (VC-25A), replacing the 707-320Bs that have provided presidential transport for 30 years. The first of two identical new aircraft was delivered in August.

Honeywell exercised a $5.9 million subcontract option with **AEL Defense** on August 1 for **converting an additional forty-eight F-106 aircraft into remotely controlled drones.** Delivery of the QF-106s, to be used as targets in Air Force missile tests, is expected to be completed in late 1991. This is the second of three contract options that call for a total of 188 F-106s to be converted into drones.

Rockwell received a $2.6 million Air Force Systems Command Aeronautical Systems Division contract in late July **to certify the AGM-130A** rocket-propelled glide bomb **on the McDonnell Douglas F-15E.** The certification process should be completed by mid-1992. A series of eight flight-separation trials will test the AGM-130's jettison and launch envelopes from the F-15E. A derivative of the GBU-15 glide bomb, the AGM-130 has nearly three times the range of its predecessor. The weapon is already certified on F-4E and F-111 aircraft.

Texas Instruments received a $58.8 million modification to a Naval Air Systems Command contract on July 27 for the FY 1990 buy of AGM-88 high-speed antiradiation missiles **(HARMs).** The 350 additional missiles called for in the contract revision will be split between the Air Force (250 missiles) and the Navy (100 missiles plus twenty-two spare guidance sections and sixteen spare wing/fin sets). The total FY 1990 buy now stands at 1,988 missiles. This contract modification comes from a congressional initiative to provide a more orderly production rate decline from the FY 1988 peak of 2,614 HARMs to the expected FY 1991 level of approximately 1,400 missiles.

Lockheed Sanders received a $12 million San Antonio Air Logistics Center contract on August 12 **to produce** Malfunction Detection, Analysis, and Recording **(MADAR) II hardware for the C-5A fleet.** The equipment will be part of a retrofit program that will upgrade seventy-six C-5As with the improved avionics subsystems developed for the C-5B. Sanders will produce fifty sets of MADAR II hardware (fifty controllers and 1,150 signal acquisition remote board and cable assemblies), and deliveries are expected to be completed in 1992.

TRW received a $1.3 million Air Force Logistics Command contract on July 18 to **provide maintenance and support to AFLC's local area network computer systems.** The company will provide site management, maintenance, engineering, and operations support for LAN systems at AFLC Headquarters, the command's five air logistics centers, and other AFLC activities. Total value of the five-year contract could reach $50.5 million if all options are exercised.

Senior Staff Changes

RETIREMENTS: B/G John R. **Allen,** Jr.; B/G Orthus K. **Lewis,** Jr.

PROMOTION: To be **Lieutenant General:** James T. **Callaghan.**

CHANGES: B/G Ralph T. Browning, from Cmdr., 313th AD, PACAF, Kadena AB, Japan, to Cmdr., 832d AD, TAC, Luke AFB, Ariz., replacing retiring B/G Daniel J. Sherlock . . . **M/G (L/G selectee) James T. Callaghan,** from Director, Plans & Policy, J-5, Hq. USEUCOM, Vaihingen AB, West Germany, to Cmdr., Allied Air Forces Southern Europe, and Dep. CINC for the Southern Area, USAFE, Naples, Italy, replacing retiring L/G Harry A. Goodall . . . **Col. (B/G selectee) Ralph E. Eberhart,** from Cmdr., 363d TFW, TAC, Shaw AFB, S. C., to IG, Hq. TAC, Langley AFB, Va., replacing B/G Larry L. Henry . . . **B/G Larry L. Henry,** from IG, Hq. TAC, Langley AFB, Va., to DCS/Plans & Req., Hq. ATC, Randolph AFB, Tex., replacing B/G Michael D. McGinty.

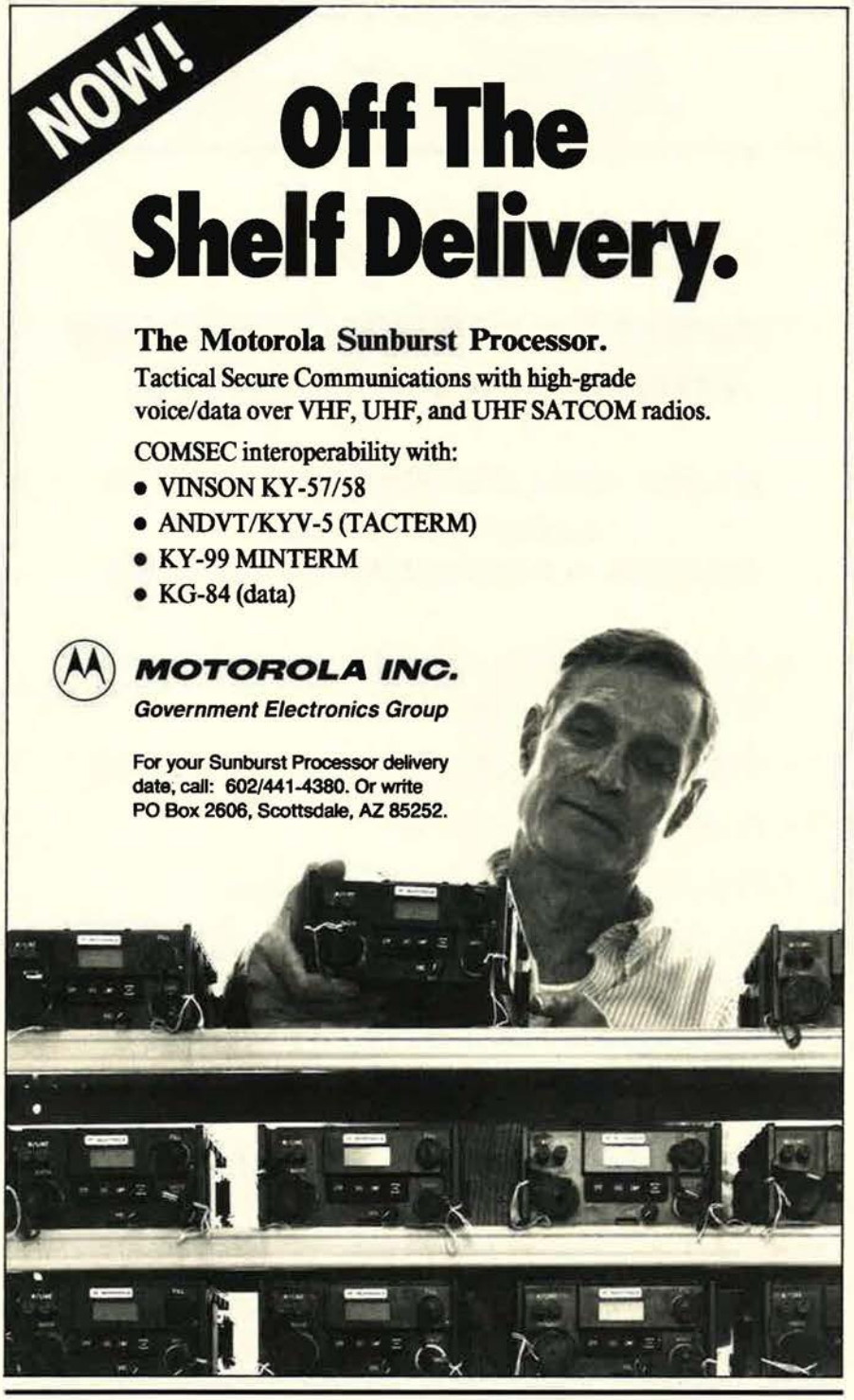
B/G Joseph E. Hurd, from Cmdr., 432d TFW, PACAF, Misawa AB, Japan, to Cmdr., 313th AD, PACAF, Kadena AB, Japan, replacing B/G Ralph T. Browning . . . **B/G Michael D. McGinty,** from DCS/Plans & Req., Hq. ATC, Randolph AFB, Tex., to Vice Cmdr., AFMPC, & Dep. Ass't DCS/Pers. for Military Personnel, Randolph AFB, Tex., replacing B/G (M/G selectee) Ronald W. Iverson . . . **Col. (B/G selectee) Jimmey R. Morrell,** from Cmdr., 2d Space Wg., AFSPACECOM, Falcon AFB, Colo., to Cmdr., 9th Space Div., AFSPACECOM, Patrick AFB, Fla. . . . **Col. (B/G selectee) F. Keith Tedrow,** from IG, Hq. MAC, Scott AFB, Ill., to DCS/Tech. Training, Hq. ATC, Randolph AFB, Tex., replacing retired B/G Orthus K. Lewis, Jr.

SCIENTIFIC AND TECHNICAL (ST) CHANGE: Robert R. Blandford, from Program Manager, DARPA, Arlington, Va., to Senior Scientific Advisor (Geophysics), Directorate of Nuclear Treaty Monitoring, AFTAC, Washington, D. C. ■

★ **DELIVERIES**—The **first Boeing VC-25A presidential transport was delivered** to the 89th Military Airlift Wing at Andrews AFB, Md., on August 23. The new "Air Force One" aircraft, a modified 747-200B commercial transport, is the first of two VC-25s. The second aircraft will be delivered early next year. The aircraft is practically self-sufficient, with two self-contained airstairs, a baggage loader, and a second auxiliary power unit that will reduce the need for ground support equipment. The VC-25 has a 7,140-mile range, but it has been modified for air-to-air refueling. First flight of the aircraft came in January; approximately forty Air Force and Federal Aviation Administration test flights, as well as several operational evaluation flights, were made prior to delivery. The planes can carry seventy-seven passengers and will have a crew of twenty-three. The Boeing C-137Cs currently used for presidential transport are scheduled to be retired in the next few years.

The **first upgraded Lockheed AC-130H gunship was delivered** to the Air Force on July 31. In 1985, Lockheed Aircraft Service Co. received a contract to replace the AC-130H's core avionics with the same systems being developed for the MC-130E Combat Talon I upgrade. In 1987, the Air Force decided to include a new head-up display, new forward-looking infrared radar, a new secure communications system, and improved gun mounts in the gunship modification. Electronic warfare systems and Global Positioning System terminals were also added. All system software was rewritten and integrated with a 1553B data bus. Flight tests began last year, and more than seventy test missions were flown. Overall mission availability of the new systems was consistently above ninety percent, and gunfire accuracy also improved.

Contel delivered the **first Automated Weather Distribution System** (AWDS) to Air Weather Service for use at McGuire AFB, N. J., on July 13. AWDS is a weather data management system that will allow meteorologists to display forecasts and maps at computerized work stations, rather than using paper maps and posted teletype messages. The system gives AWDS a worldwide capability to receive, store, process, disseminate, and display weather information for pilots at Army and Air Force bases. A total of 186 AWDS sets will be installed at bases in the continental US (114), Alaska (six), Europe (forty-five), the Pacific (twenty), and Panama (one). Twenty transportable AWDS sets will be delivered for supporting field exercises or contingencies. Deliveries are to be completed in late 1993.



The Army Corps of Engineers transferred the **Test Operations Control Center** (TOCC) at Cape Canaveral AFS, Fla., **to the Air Force** on August 8. The $19.5 million, 127,000-square-foot structure and its advanced instrumentation will support prelaunch checkout, launch, and flight test of ballistic missiles as well as NASA, Department of Defense, and commercial space booster programs. It will serve as the Eastern Space and Missile Center's range control facility and computer control center and as a portion of ESMC's communications center. Once fully operational next December, the TOCC will be able to support two launch operations at the same time and shorten turnaround time between launches from several days to about an hour. Harris is working under a $58 million contract for design,

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installation, and certification of the TOCC's instrumentation.

McDonnell Douglas officially delivered the **600th AH-64A Apache attack helicopter** to the Army in ceremonies at the company's plant in Mesa, Ariz., on August 14. The company is producing Apaches at a rate of six per month and expects to complete the 807-aircraft AH-64 line in the winter of 1993.

★ **MILESTONES**—The **first Hughes AIM-54C (Plus) Phoenix** long-range missile **to incorporate all three major improvements scored a direct hit** in an early August test at the Pacific Missile Test Center range near Point Mugu, Calif. The missile was launched head-on at a QF-4 drone flying at long (although unspecified) range from a Navy F-14A Tomcat. The 985-pound missile was unarmed, but its impact destroyed the target. The improvements in the AIM-54C (Plus) are a reprogrammable memory (RPM), a high-power traveling-wave tube radar transmitter (which gives the Phoenix radar roughly ten times the power of its original solid-state transmitter), and a low-sidelobe antenna that provides the missile more capability in an electronic countermeasures environment. The improvements will be included in every new-build AIM-54 and will be retrofitted to others.

The **Rockwell-built, radiation-hardened, integrated circuits** in the guidance systems of the fifty deployed LGM-118A Peacekeeper intercontinental ballistic missiles **have compiled a total of more than 4.2 billion operational hours.** This record equates to one failure every 476,000 years. There are more than 4,500 integrated circuits in each missile's electronics and computer assembly and its inertial measurement unit. Peacekeeper reached full operational capability at F. E. Warren AFB, Wyo., in December, 1988.

The **first test launch of the joint US-Israeli Arrow antitactical ballistic missile** on August 9 **was a success.** The hypervelocity missile was launched from an undisclosed location in Israel, flew for approximately one minute, and then plunged into the Mediterranean Sea. Speed, range, and other details of the flight were not released. Future tests will include actual intercepts against target missiles designed to imitate tactical missiles. Arrow is being developed by Israel Aircraft Industries under a $158 million US Strategic Defense Initiative Organization contract. Wind-tunnel testing of Arrow was performed at Arnold AFB, Tenn. Approval to start the $200 million second phase of development was given on July 26.

★ **NEWS NOTES—Lockheed completed** the first **in-flight test of the Radar Test Instrumentation System** (RTIS) aboard a highly modified C-141A StarLifter transport on July 30. The RTIS will be used to investigate in-flight electronic counter-countermeasures techniques. The modified C-141, called the Advanced Radar Test-Bed (ARTB), is an airborne laboratory platform designed to test a wide range of sensors in a dynamic electronic countermeasures environment. Lockheed modified the aircraft to operate a fighter-type airborne radar (in a Pinocchio-like nosecone) and integrated this radar with the RTIS. Other modifications to the C-141 include changing the electrical and cooling systems to accommodate the required radars and instrumentation for the RTIS. After a series of test flights, the ARTB will be turned over to the Air Force later this year.

The **US Air Force** recently gave formal notice to the Canadian government that it **intends to withdraw its personnel and aircraft from CFB Goose Bay, Labrador,** by July of next year. The Air Force uses Goose Bay as a staging base for aircraft flying troops and materiel to Europe. Permanent facilities to support transport operations in peacetime are no lon-

ger required, and withdrawal from the base provides an opportunity to cut expenditures. The Air Force will still use Goose Bay for exercises and during contingencies.

The **eighth operational Navstar Global Positioning System satellite was successfully launched** from Launch Complex 17 at Cape Canaveral AFS, Fla., on August 2. The Rockwell Block II GPS satellite was carried aloft by a McDonnell Douglas Delta II booster. (All Block II GPS satellites are now designated NS-7B, and all Delta II boosters are designated SB-3A.) The satellite was moved to its final orbital position two days after launch. It then underwent de-spin maneuvers prior to final on-orbit checkout. GPS is a space-based radio navigation system designed to provide US and Allied forces with worldwide, three-dimensional position and velocity information. When completed in 1992, the Navstar constellation will consist of twenty-one operational satellites and three on-orbit spares. The current schedule calls for Navstar launches at roughly two-month intervals.

The Air Force's Tactical Air Warfare Center's Combat Support Deputate completed **initial operational test and evaluation of the folded fiberglass mat system for rapid runway repair** at Wendover, Utah, earlier this summer. The test was part of an effort to improve the Air Force's ability to repair runways damaged in combat. Three bomb craters were created by the 820th Civil Engineering Squadron RED HORSE team from Nellis AFB, Nev., to start the test. The matting, developed by the Air Force Engineering and Services Center at Tyndall AFB, Fla., was then put into place by members of the 2849th CES Prime BEEF team from Hill AFB, Utah. Two F-4s, two F-16s, and one RF-4 were flown from Eglin AFB, Fla., and the aircraft crews made 500 passes (a mixture of takeoffs, full-stop landings, and touch-and-goes) on the matting. The only repairs needed to the rapid runway repairs included leveling ruts in the crushed stone (used to fill craters) underneath the mats and periodic retightening of ten bolts used to hold the mat sections together. Testing of a new minimum strip marking system was also conducted during this exercise. Permanent repairs to the runway were completed at the conclusion of the exercise.

The Department of Defense announced in early July that the **Humanitarian Service Medal** will be awarded to those members of the armed forces who **directly participated in three recent actions.** Military members who took part in the search-and-rescue operation for the late Rep. Mickey Leland (D-Tex.) in Ethiopia, the Hurricane Hugo relief effort, and the California earthquake relief operation are eligible for the award.

The **38th Tactical Missile Wing,** the BGM-109G Gryphon ground-launched cruise missile unit at Wueschheim AB, West Germany, **was deactivated** on August 22. The 38th TMW is the fourth GLCM wing to be deactivated under the terms of the 1987 Intermediate-range Nuclear Forces Treaty with the Soviet Union. The 486th TMW at Woensdrecht AB, the Netherlands (which never reached full operational status), the 303d TMW at RAF Molesworth, UK, and the 485th TMW at Florennes AB, Belgium, are the other deactivated wings. The 487th TMW at Comiso AB, Italy, and the 501st TMW at RAF Greenham Common, UK, will be deactivated by next spring. All missiles covered by the INF Treaty must be destroyed by May 31, 1991.

The **US Military Academy Association of Graduates** has begun a fund-raising drive **to recognize West Point**

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Maj. Gen. James E. Chambers, commander of 17th Air Force, congratulates the Vehicle Maintenance Division of the 38th Tactical Missile Wing, Wueschheim AB, West Germany, on being named 1990's best motor vehicle maintenance unit in 17th Air Force, which includes eleven major USAF installations in West Germany, Belgium, and Holland. Wueschheim's vehicle maintainers ensured a 96.2 percent in-commission rate this year for their fleet of Ground-Launched Cruise Missile support vehicles.

alumni who have made contributions to aviation. The $800,000 the graduates hope to raise will go toward constructing exhibits in the foyer of Arnold Auditorium in Mahan Hall, redecorating the auditorium itself, erecting a statue to honor the USMA graduates who have died while flying, and adding displays to the new West Point Museum in Olmstead Hall.

Escorting Soviet aircraft outside US airspace is a fairly common occurrence for interceptor pilots, but **four 177th Fighter Interceptor Group pilots** had the unusual experience of **escorting Soviet aircraft while *in* US airspace** on July 11. The Air National Guard F-16 pilots, Col. Bobby Ockerhausen, Lt. Col. Maurice Eldredge, Lt. Col. Michael Judge, and Capt. Lawrence Thomas, escorted two MiG-29 fighters and an Il-76 transport from Kalamazoo, Mich., to Rockford, Ill., as part of the Soviet Union's first US air show tour. Pilots from the 177th FIG, based at Atlantic City IAP, N. J., later escorted the Soviet entourage to air shows in Dayton, Ohio, and at CFB Winnipeg, Manitoba. Canadian Forces CF-18 pilots escorted the Soviets to Kalamazoo and from Winnipeg.

★ **DIED—George Seabrook Wing,** the North American Aviation engineer who devised the Hi-Shear Rivet, of cancer August 14 in a hospital in Torrance, Calif. He was seventy-four. The Hi-Shear Rivet, first used in the P-51, cut the weight of the standard rivet by one-third and became one of the most important fasteners in aerospace. Mr. Wing started his own firm in 1943, producing rivet-making tools, fasteners, explosive separation devices, and other aerospace-related items. ■

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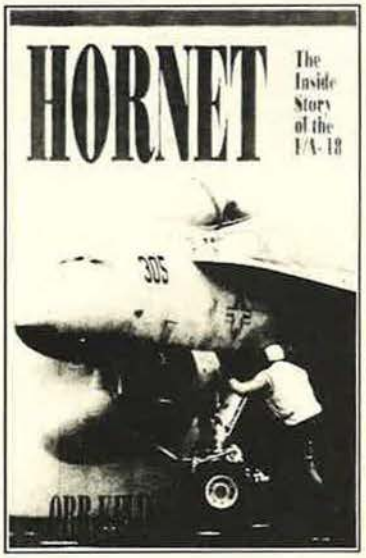

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As senior Air Force leaders describe it, "Global Reach, Global Power" is a forward-looking mix of tradition and change.

Back to the Future

By James W. Canan, Senior Editor

OPERATION Desert Shield raised the curtain on tomorrow's Air Force. USAF units that deployed to Persian Gulf environs in that vast US military operation last August had the look, taken altogether, of the force structure of the future.

That structure may well be centered on "composite forces"—units and combinations of units made up of different kinds of aircraft capable of applying airpower over all distances, long and short.

The magic words are "global reach" and "flexible forces."

The Air Force convincingly demonstrated its global reach last August in responding to the Iraqi takeover of Kuwait and threat to Saudi Arabia. It dispatched F-15C/D counterair fighters, F-15E dual-role fighters, F-16C/D attack aircraft, A-10 close air support planes, and E-3 Airborne Warning and Control System planes to the oil-rich kingdom.

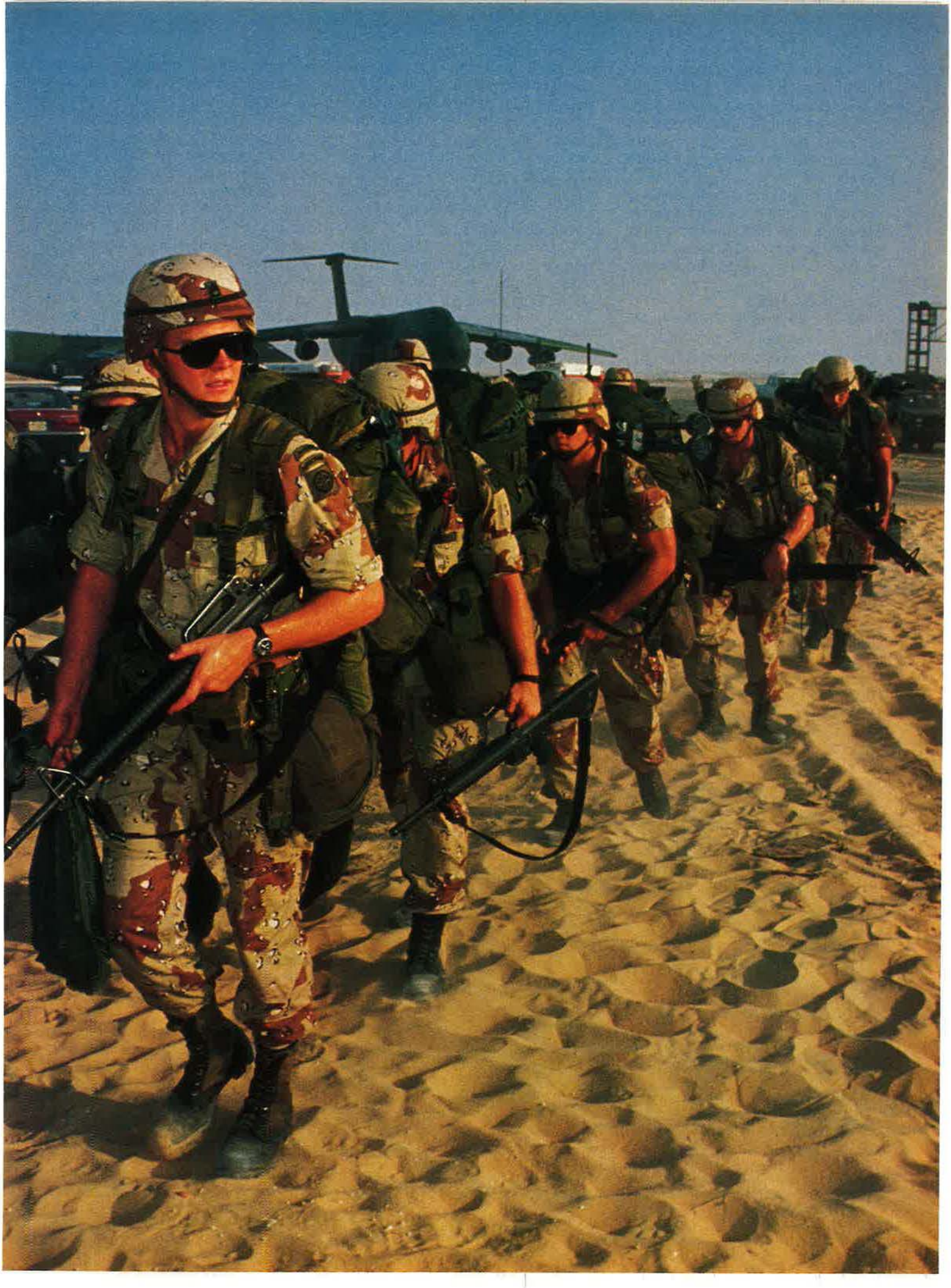
That wasn't all by a long shot. F-111s had already been deployed from England to Incirlik AB, Turkey, for regularly scheduled exercises. B-52s were sent from the US to the British-owned Indian Ocean island of Diego Garcia. All kinds of tankers and airlifters were put into play, along with the F-117, the F-4G Wild Weasel, and the EF-111 for suppressing air defenses and engaging in electronic warfare.

Only nine days after Desert Shield got under way, USAF's then-Chief of Staff Gen. Michael J. Dugan noted, in an interview with AIR FORCE Magazine, that the Air Force had moved 150 combat aircraft and 100 support planes into the region, along with roughly 12,000 troops and many millions of pounds of combat cargo.

General Dugan, who was abruptly relieved of command on September 17, saw the Iraqi incursion as much more than a unique, one-time threat. He called it "a classic demonstration of the kinds of contingencies we can expect in the future." He affirmed that the Air Force is looking to restructure some of its forces in the fashion of those that it brought together in the Middle East. General Dugan is gone, but his successor, Gen. Merrill McPeak, is certain to feel some of the same pressures to reconsider the shape of USAF forces.

US troops get their bearings on Saudi Arabian sands in Operation Desert Shield, the combined-arms operation to countervail Iraq's invasion of Kuwait. Demonstrating its global reach, the Air Force airlifted the troops and swiftly deployed a composite force of richly diverse combat aircraft to support them.

—Photo by Dennis Brack/*Time* Magazine



Such amalgamated forces, blending different types of aircraft and units, capable of conventional attack over long distances against strategic and tactical targets, are shaping up as the wave of the future for the Air Force.

"We are looking at new concepts for different organizational arrangements, at new relationships among aircraft occupying the same battle space," General Dugan declared.

Composite Force

To describe one such concept, the term "composite force" is now being used in Air Force planning circles. It would be just what it sounds like—a combination of various aircraft, such as fighters, bombers, tankers, defense-suppression planes, and reconnaissance and electronic warfare planes.

Before the Middle East erupted, the Air Force had laid plans for a composite force to converge in USAF's vast, instrumented Alaskan practice range for an exercise in long-range airpower. General Dugan characterized the exercise as "doing something we haven't done much of since the southeast Asia time frame—the long-range integration of fighter and bomber assets to exploit the capabilities that each brings to the battle space."

The Alaskan airpower extravaganza was set up to marshal all manner of Air Force combat aircraft in the same airspace on "a strategic mission, but with a mix of tactical targets [to be destroyed] to protect our strategic forces coming in," General Dugan said. The exercise was postponed in the face of the Middle East crisis. "We'll still do it, because the reasons for it remain valid, but we don't know when," the General said later.

The "composite" designation rings a bell from the past. In the 1950s, Tactical Air Command created the Composite Air Strike Force. It was designed to enfold all elements of a modern tactical air force —counterair fighters, ground-attack aircraft, tankers, transports—and to deploy quickly, on short notice, to any part of the world.

The CASF concept was successfully put to the test when a unit called Composite Air Strike Force Bravo deployed to the Middle East in 1958. It was on the scene in Lebanon within twelve hours after that nation asked for US military assistance in the threatening aftermath of a leftist military coup in Iraq.

There were no composite forces as such among the units that the Air Force recently dispatched to the Middle East, because none exist. But those units had the look of such a force when viewed in the aggregate, once in place.

—USAF photo by MSgt. Patrick Nugent

—Photo by Dennis Brack/*Time* Magazine

Tomorrow's Air Force likely will feature composite forces made up of dissimilar aircraft for different missions, such as the USAFE F-15, F-16, and A-10 (top, in formation over Europe). Above, a Royal Saudi Air Force F-15 is prepared for combat. Having F-15s in common with the RSAF took a load off USAF's logistics.

According to General Dugan, top US Army commanders in Desert Shield would have preferred, at the outset, the support of something a little different—Air Force composite units with built-in versatility, each capable of carrying out such missions as close air support, defensive counterair, and battle-area interdiction, among others, as necessary.

"The Army commanders saw great value in having a composite force from day one, one that could have done all the necessary jobs," General Dugan reported during the height of the buildup in August.

Even though the Air Force wound up fielding a composite force in the region, from the standpoint of the force's collective capabilities,

its individual units were not integrated under a single commander, as they might have been.

Tied to the Past

"We had to build up a composite force. We had to use a building-block approach" with special-purpose units under separate commanders, General Dugan explained. It had to be done that way because "we're still tied to our old logistics system," geared to supporting wings and squadrons of specialized, homogeneous aircraft, not wings composed of heterogeneous aircraft for a variety of purposes.

In the future, "more of the punch that goes with our commitments to our allies and to our cooperative security arrangements will be based on US soil," General Dugan said. As a result, "we need to train ourselves to go out on those kinds of missions that we discuss in 'Global Reach, Global Power.'"

His reference was to an Air Force white paper, issued earlier this year, in which the service staked its claim as a prime instrument of national security policy and strategy. In this context, Secretary of the Air Force Donald B. Rice told Congress that USAF is intent on "designing and fielding forces that are highly mobile and quite flexible, forces that can hit hard and be used in alternative scenarios . . . across the spectrum of conflict."

Interviewed prior to the Middle East crisis, General Dugan postulated a call-to-arms scenario that shortly came true—"some nation at a good distance from the United States picking on its neighbors in an area where the US has vital interests."

In such an event, "the US might prefer not to introduce major land elements, because of the potential for becoming bogged down and taking heavy losses, and because of the difficulties of providing logistics support, depending on the range," he said.

"Nevertheless," the former Chief of Staff continued, "we want to make a major statement, an important one, as a nation. How do we do that? One way is with maritime power. Another is with airpower. Or both."

Under some conditions, naval forces, including their air arms, might be the answer if they have enough reach—if the action is taking place in "a littoral environment"—and if they can get to the scene and apply their power in a timely manner, General Dugan said.

Under other conditions, notably those requiring faster response and longer reach, the likelier recourse for the US would be to "project long-range power from air bases," General Dugan asserted, provided that staying power is not a prime requisite.

He explained, "Armies bring persistence to the battle space. Naval forces bring less persistence but more mobility. Air forces don't have much persistence at all. . . . But if you just want to go out and deliver a big punch between the eyes and then come home, you can't beat long-range airpower. . . . We can fly it out of Barksdale or Loring or wherever."

Is the Air Force properly set up to employ airpower around the world?

"We're marvelously structured to do that," General Dugan replied. "If we're told to put aircraft over the Persian Gulf, for example, we can do it in hours." Events around the Gulf quickly bore him out.

So why bother changing the Air Force's structure? General Dugan's reply, in summary: to make it even better and because the increasing quality, reliability, and standardization of modern Air Force aircraft open the way to new force structures that were formerly impractical.

Opportunity Knocks

The Air Force is now ready for different organizational schemes, and it is "busily looking at them," General Dugan declared. "At a time of great turbulence, there is an opportunity and a need for us to look again at the way the Air Force is—at all the things we came to accept about the Air Force as lieutenants or captains or colonels."

One of those things, he said, is "our wing-based structure," which was devised in the past "to optimize our warfighting according to our logistics needs." Nowadays, those needs are much easier to fulfill, he continued, because contemporary combat aircraft have more hardware in common, hold up longer and better, and are easier to maintain.

"Reliability and maintainability—particularly reliability—have become such important elements of the design and production of our modern airplanes that we don't have to take nearly as much stuff along [on deployments] to keep them operating," General Dugan asserted.

He referred to fighter engines as prime examples of modern-day commonality. Because F-16s and F-15s are powered by the same Pratt & Whitney and General Electric engines, "it won't be nearly so important to us in the future to have all F-15s at one base and all F-16s at another," General Dugan explained.

As cases in point, General Dugan, fresh from his tour as Commander in Chief of US Air Forces in Europe, cited Bitburg AB, West Germany, home of F-15s, and Hahn AB, West Germany, home of F-16s. Each base may someday house both kinds of fighters.

"I don't know whether [the Air Force] will come to that conclusion," General Dugan continued, "but the basis for making such alternative organizational arrangements—as we look ahead at the costs of running air forces—has been laid by the refinement of our logistics process and, indeed, by the success of our acquisition process."

According to some sources, Kadena AB, Okinawa, Japan, is also being eyed by Pacific Air Forces as a likely base for both F-15s, which it now has, and F-16s, which it does not. PACAF reportedly commissioned RAND Corp. to analyze costs and other considerations of making Kadena common ground for the two fighters. RAND's conclusions are said to have been encouraging.

Kadena Kaleidoscope

General Dugan called Kadena "an interesting base to watch," because "it's a kind of a microcosm of a composite wing."

Over the years, Kadena has been home base for a richly varied assortment of combat aircraft—fighters, bombers, tactical and strategic reconnaissance aircraft, gunships, tankers, and airborne warning and control planes. They have belonged to different major commands—Strategic Air Command, Pacific Air Forces, and Military Airlift Command, for example—but have "al-

An F-111F of the 48th TFW over RAF Lakenheath, above, symbolizes the US Air Force's long-range airpower. Some Air Force F-111s were deployed to forward locations in support of Desert Shield. Below, an E-3 AWACS plane takes off while an F-15 fighter waits on the ramp at Kadena AB, Okinawa, Japan, home of assorted USAF aircraft.

ways worked together very efficiently, very well," General Dugan said.

The disparate units operating all those aircraft could be made into a composite wing, or the beginnings of one, by putting them under a single commander and having them train together as well as live together. The same goes for other USAF units elsewhere in the world.

Some Air Force planners conceive of composite wings as blends of air-superiority fighters, long-range bombers, shorter-range attack aircraft, tactical reconnaissance planes, Wild Weasels, and even gunships. The increasing versatility of today's multirole fighters, exemplified by the F-16, late models of the F-15, and likely the Advanced Tactical Fighter, makes possible the formation of "general-purpose squadrons" of such planes within each composite wing.

Another sort of notional composite wing, one tailored more to logistics and combat support, might contain some of the same kinds of aircraft, but would be heavier on airlifters, tankers, command-and-control aircraft, surveillance planes, and search-and-rescue planes.

The main prerequisite for any such unit would be its mobility, which would take different forms. Its long-range bombers could fly to targets anywhere in the world from the continental US or from selected overseas bases, such as Guam or Diego Garcia. Its fighters and other shorter-range warplanes could do that too, if refueled in flight.

Preferably, though, units operating those shorter-range aircraft would set up shop at air bases in host nations, as they did in Saudi Arabia last August, or stop here and there at more austere intermediate airstrips around the globe. When the time came, they would join up with the long-range heavies in the battle space, a maneuver that will be practiced in the Alaskan exercise.

Mobility is the key. This is why logistical considerations are of paramount importance in Air Force planning for leaner, more flexible forces, whatever they may be called. The Air Force is bent on "going lighter" in overseas deployments—cutting back on creature comforts and carrying the bare minimum of spares, stores, and the stuff of everyday living.

Easier said than done. The Air Force will find it impossible to travel light, according to a recent USAF study, without "fundamental restructuring of selected Air Force units to make us more nimble."

—USAF photo by TSgt. Daniel Perez

Battle Force

Some Air Force planners see as the linchpin of such restructuring a wholly unprecedented unit called an "air battle force"—a "cohesive warfighting structure" made up of two composite wings with a grand total of 140 to 150 aircraft.

Asked about this, General Dugan said it is too early in the game to anticipate the eventual makeups and official designations of any such units. "You won't hear me calling them that [air battle forces]," he said good-humoredly. "I don't want to sound like Captain Kirk [of "Star Trek" fame] telling Scotty to beam me up."

Before becoming Commander in Chief of USAFE in the spring of 1989, General Dugan was Air Force Deputy Chief of Staff for Plans and Operations (XO) at the Pentagon. As such, he is said to have advocated taking fresh approaches to formulating future force structures.

As Chief of Staff, he was clearly in position to bring to the finish line

the plans that he once set in motion. He made it clear, though, that he intended to weigh proposed innovations carefully.

"There is potential for gain and potential for loss in tinkering with our organizational structures. It's unplowed ground."

He continued, "What sounds like a good idea could turn out to be a disaster if we pursued it. But there's another side to that coin. It might be a disaster just to live with what we've got. There may be as many errors of omission available to us as there are errors of commission."

What it comes down to, he said, is this: "To the extent that we find we can do things to make us more flexible, we'll pursue those. To the extent that we find things that make us less flexible—organizational schemes that make people and commanders worry more about turf than about trust or targets—we'll do away with those."

—Photo by Dennis Brack/*Time* Magazine

Backdropped by the C-5 that flew them to Saudi Arabia, US soldiers move out to help defend a military airfield. Former Air Force Chief of Staff Gen. Michael J. Dugan called the Iraqi incursion and the consequent call to arms "a classic demonstration of the kinds of contingencies we can expect in the future."

Less With Less

General Dugan made it clear that the Air Force should have no pretensions about becoming more powerful even though it would become a smaller force.

"You just don't do more things with fewer forces," he declared. "You don't do more with less, or do the same with less. You do less with less. That's the way it is.

"So I don't think our military responsibilities are going to widen. The United States is going to have to agree that, with smaller forces in each of the services, there are certain things out there that we're not going to be able to do.

"I don't know that anyone wants to pick out those things—for example, to say that we're not going to defend Korea again, that we're not going to draw another line like we did in 1950."

US force cuts and military pullbacks may also be invitations to trouble. "There will be areas in the world where US military men and women will no longer be on duty. They are not going to send the same kind of message to foreign powers," General Dugan said.

Nor will the Soviets be as influential in areas from which they too withdraw or deplete forces, he said.

Thus the world is changing from bipolar to multipolar, and "a multipolar world is much more difficult for us to keep track of," said the former Chief of Staff.

"We have to find ways to transmit not only our military capability, but our political will to use that capability if, in fact, the matter is serious," General Dugan asserted.

He went on, "I don't think our interests around the world are going to change much. We are still going to be—as we have been throughout our history—interested in free trade, open access across airways, seaways. We will still be interested in not having our people abused when they take cruises in the Mediterranean, in our people freely traveling and exchanging products and ideas any place they choose to in the world.

"But there are those out there whose ideologies and philosophies don't agree with that and who have stepped on US interests in the past and will again."

General Dugan said he cannot assess the eventual size of the shrinking Air Force, because "I don't know what the details of our emerging national strategy are going to be."

Come what may, General Dugan expected the Air Force to "make a credible and important contribution to national security." Getting the B-2 bomber would be a big help, he said, because without it—and given the completion of B-1B production and the phasing out of the B-52—"we will have a bomber force structure of about 100 [aircraft] at the end of the century.

"I'm not sure that number will gain us the respect internationally that the American public has demanded of its Air Force in the past."

The big question, he said, is not so much "whether we'll have the B-2, but whether or not penetrating bombers have provided great utility for the American public in the past, and whether the public will say, yes, we understand what bombers have, but we [still] can't afford the cost of the B-2."

General Dugan said the B-2 and the Advanced Tactical Fighter have something fundamental in common—they are the only conceivable bomber and fighter that will be capable of winning the day in their respective arenas in the years ahead.

Proposals from outside the Air Force for F-15 and F-16 follow-on air-superiority fighters have not caught the service's fancy.

"No concept on the street that includes any derivative of currently available fighters will [result in an airplane] able to operate with impunity in a modern battlefield, beginning at the middle or the end of this decade," he declared.

How would he define a modern battlefield? "Any place where somebody has modern surface-to-air missiles and modern air-to-air missiles." ■

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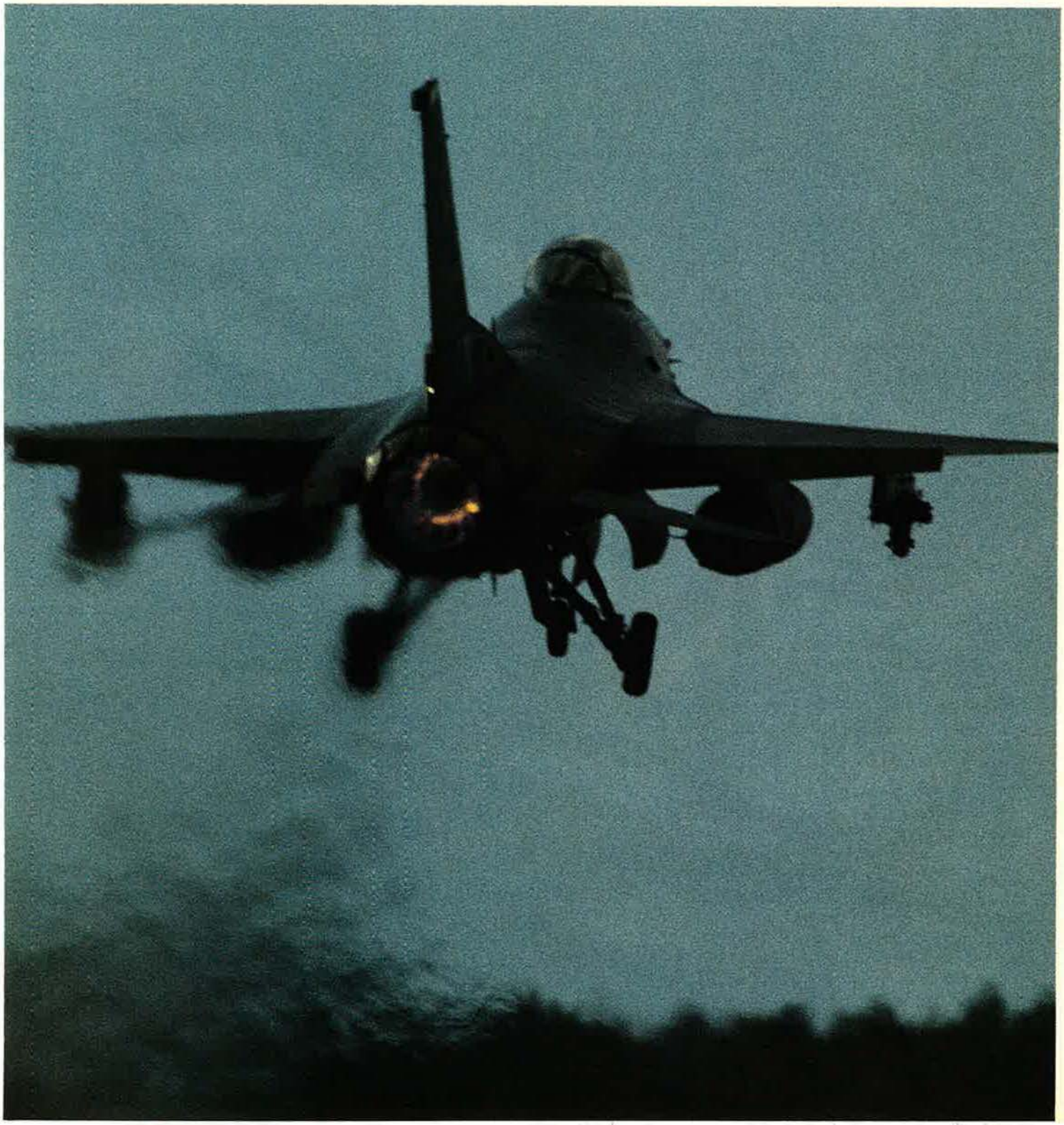


The reduction may be twenty-five percent or more. That would cut force levels by about 500,000.

How Far Is Down?

By John T. Correll, Editor in Chief

WHOPPING cuts are on the way for US armed forces. That much is certain. The big questions are how deep the reductions will go and how rapidly they must be made.

The most popular prediction is a twenty-five percent cut in force structure—meaning about 500,000 fewer troops—over a five-year period. In close step with that estimate, the Senate Armed Services Committee in July projected military strength to drop from 2,076,405 in 1990 to 1,602,000 in 1995.

Some Washington insiders regard the twenty-five percent forecast as conservative. They think a fifty percent reduction, spaced out ten years, may prove nearer the eventual mark.

The scope and pace of cuts, however, are merely the beginning of the questions to be answered.

How would cuts be distributed among the services? Most scenarios see the Army and Air Force bearing the brunt, at least in the beginning, by drawdown of their units in Europe.

How much can be absorbed by curtailed recruiting? The services are understandably reluctant to re-

lease veterans in midcareer, but failure to spread the impact across the ranks could mean "too few Indians in the short term and too few chiefs later on," the Congressional Budget Office (CBO) warns.

What kind of financial safety net would be provided for the troops? At present, regular enlisted members are not eligible for severance pay. If they leave—voluntarily or otherwise—short of twenty years of service, they lose all equity in the retirement program. Their unemployment compensation runs only half as long as that for workers who lose their jobs in the private sector.

What happens to the capability, readiness, and morale of the force that remains? As CBO observes, "even the morale of those not directly affected could suffer because of uncertainty about their futures."

How much money could the nation save? According to CBO, whose numbers tend to be fairly sound in such matters, the direct savings from a twenty-five percent troop cut over five years might reach $34.2 billion.

The most immediate question is how much of the reduction must be achieved in 1991. The Senate Armed Services Committee prescribes a 100,000 troop cut for next year. The House Armed Services Committee pegs the 1991 reduction at 129,500.

Seized by a Notion

Official Washington locked on to the twenty-five percent force cut as its working target after a curious sequence of events in June and July.

Earlier this year, Congress directed Defense Secretary Dick Cheney to examine the consequences and potential savings from varying levels of force reduction. Careful to label his numbers as "notional" and "illustrative," Mr. Cheney reported in June that he could save $128 billion in budget authority by cutting force structure twenty-five percent over five years.

Achieving that, he said, would require the services to eliminate all manner of units and programs and make huge manpower reductions—cutting military personnel by twenty-one percent (442,000 in the active forces, 260,000 in the Guard and Reserve) and reducing the civilian work force by 145,000.

Despite Mr. Cheney's disclaimers, his "notional" report was interpreted as a proposal or, at minimum, as the Pentagon's new bargaining position. "By presenting such material, Dick Cheney has legitimized the notion of a twenty-five percent cut in force structure," declared Rep. Les Aspin (D-Wis.), chairman of the House Armed Services Committee. He said that Mr. Cheney could get far more than $128 billion in savings out of such an exercise.

Almost overnight, twenty-five percent was established as the bridgehead, and Congress marched onward from there. "A twenty-five percent cut in five years is the first half of a ten-year, fifty-percent cut," Mr. Aspin said.

The Fiscal Year 1991 defense authorization bill, which was adopted unanimously by the Senate Armed Services Committee in July, called for a 22.8 percent troop cut by 1995.

The Committee mark, however, does not distribute the reductions evenly among the services. The Army is hit hardest, cut by 31.4 percent over five years. The Air Force would take a 23.8 percent reduction. The impact is much less severe for the Navy (down 15.3 percent) and the Marine Corps (down ten percent).

In part, the rationale is that the heaviest cutting will be from US troops in Europe. Most of them belong to the Army and the Air Force. Sen. Sam Nunn (D-Ga.), chairman of the Senate Armed Services Committee, believes that American troop strength in Europe will eventually level out at around 75,000.

Another factor probably influencing the allocation of cuts is that the sea services have done well in selling the appeal of a "maritime strategy," in which the Navy and the Marine Corps figure most prominently.

Two Ways to Do It

US forces have been through demobilizations before, the biggest one coming at the end of World War II. These drawdowns, however—even as recently as the post-Vietnam demobilization—involved mainly draftees, draft-induced volunteers, and troops who had no real desire to stay in service.

In today's all-volunteer force, more of the troops do want to stay. Some voluntary separations are possible, but not nearly enough to meet the requirement. Furthermore, the dynamics of force-structure management work against achieving so large a reduction by attrition alone.

The Department of Defense has asked Congress for broader authority to involuntarily discharge or retire regular officers, who are currently protected by law from most reductions. The request was mainly

The defense authorization bill, as drafted in July by the Senate Armed Services Committee, projects a 22.8 percent reduction in force levels over five years. The brunt of the cuts would fall on the Air Force and the Army. As recently as 1986, the Air Force stood at a strength of 608,000.

The Senate's Forecast

	Troop strength		
	FY 1990	FY 1991	FY 1995
Army	744,169	704,170	510,000
Navy	590,501	568,500	500,000
Marine Corps	196,735	193,735	177,000
Air Force	545,000	510,000	415,000
Total	**2,076,405**	**1,976,405**	**1,602,000**

on behalf of the Army, although Christopher Jehn, Assistant Secretary of Defense for Force Management and Personnel, says the other services may need similar authority later on.

The Congressional Budget Office sees two basic approaches—called "accession-heavy" and "across-the-board"—that the services might take in reducing their enlisted ranks. (CBO's analysis does not deal with the officer corps, which it has not modeled in detail.)

Accession-heavy. By normal attrition, the Air Force will lose 60,000 enlisted members this year, the Army 120,000. If the services absorbed the whole 1991 reduction by curtailment of recruiting, the Air Force would not replace fifty percent of its losses. The Army would not replace sixty percent.

Cranking accessions back to zero is an extreme and unrealistic example, but the services will soak up as much of the impact as possible by reduced recruiting. The accession-heavy strategy can work for a year or two, but it isn't feasible to close off new entries at the bottom of the force structure indefinitely.

Following an accession-heavy approach, the Air Force by 1995 would have nearly eighty percent of its enlisted force in the career ranks—a much older, top-heavy force with lowered promotion opportunities and with seasoned NCOs relegated to jobs once held by junior personnel.

In time, gaps would develop in the NCO ranks because too few airmen had been recruited five or ten years previously.

CBO says that if the Air Force's share of the 1991 enlisted cut is 25,000, about 8,000 of reductions can come from accessions without harm to the "long-term sustaining level" of recruiting.

Across-the-board. In the long run, CBO believes, the services must take most of their cuts by allowing fewer first-term people to reenlist, encouraging voluntary separations, inducing members to retire sooner than they had planned, and—unfortunately—forcing out people in midcareer.

Over the five-year run of a twenty-five percent reduction, CBO calculates, the Air Force each year would involuntarily separate 8,500 career airmen short of retirement and would deny reenlistment to about ten percent of the first-term airmen who would otherwise be eligible. The Army would force out 9,000 career troops a year and would deny reenlistment to a fourth of its first-termers.

The outlook for 1991, with reductions concentrated in only two services, is worse. CBO estimates that the Air Force might involuntarily separate 11,000 career personnel, the Army 18,000.

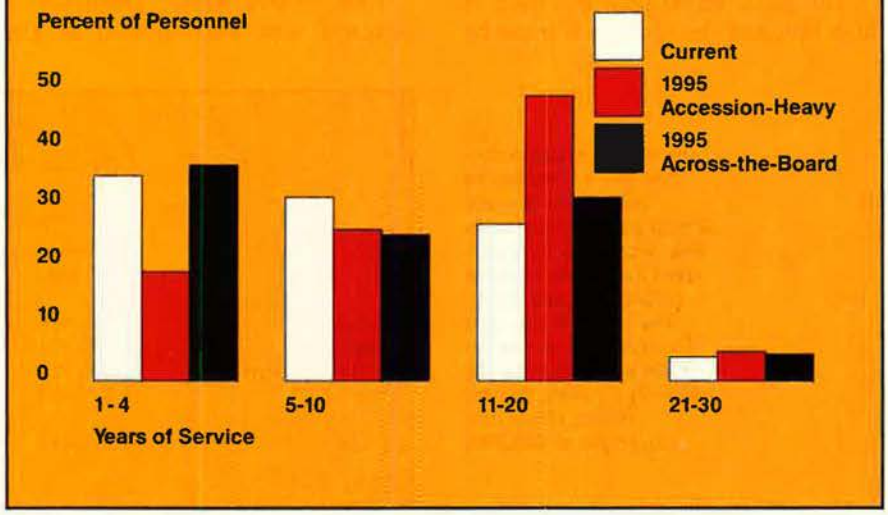
CBO is at pains to present its data as *analysis*, not a recommendation or a plan. Indeed, protracted arguments can be expected before the ultimate decisions are made.

The House Armed Services Committee—in the same bill that calls for a troop cut of 129,500 next year—stipulated that the 1991 cuts

In July, the Congressional Budget Office examined how enlisted troop strength might look after the force cut. In the breakout at right, the Air Force keeps only 327,000 enlisted members. CBO believes the Army and the Air Force might fare still less favorably in the actual reductions. The bar chart compares Air Force structure as it is today with two post-reduction options: one achieved mainly by curtailed recruiting, the other by spreading cuts through all grades and year groups.

Revamping the Enlisted Force

	Troop strength	
	FY 1991	FY 1995
Army	635,000	402,000
Navy	513,000	403,000
Marine Corps	177,000	126,000
Air Force	440,000	327,000
Total	**1,766,000**	**1,258,000**



should not come from the career force. The Committee, however, confined its explicit protection to those with sixteen years of service or more and hedged its preferences about how to handle the reductions in subsequent years.

Where's the Safety Net?

No one seriously believes force reductions of the size under discussion will be possible without causing hardship to individuals. Present entitlements and laws do not provide much help for the troops who would be forced out of service. Both Congress and the Department of Defense are working to create an improved financial safety net.

The "biggest single item on the list" is separation pay for enlisted members, according to Mr. Jehn, the Pentagon's top official for personnel matters. Officers and Reserve enlisted personnel forced off active duty after five years receive a payment—capped at $30,000—equal to ten percent of their annual pay, multiplied by years of service. There is no such entitlement for regular enlisted personnel, because the need for it had not been envisioned. Up to now, troops qualified to reenlist were welcome to do so. In June, the Pentagon asked Congress to extend the current separation pay entitlement to enlisted members and also, since many of the individuals affected will have long service, to lift the $30,000 cap.

Mr. Jehn says that he does not expect the Defense Department to propose basic change to the current military retirement system to allow early or partial vesting of benefits for members who serve less than twenty years.

A bill proposed by Sen. John McCain (R-Ariz.) would allow former military personnel to draw up to twenty-six weeks of unemployment compensation and permit them to apply for benefits after one week of unemployment. This is the coverage that displaced workers in the civilian sector have already. Veterans, however, are currently eligible for only thirteen weeks of unemployment compensation, and they must wait a month before applying.

Senator McCain's bill would also confirm separation pay, with no dollar cap on the total, for enlisted people who have served for five years. It would extend health care a year beyond separation for existing ailments and for ninety days for new problems. It would also provide relocation and outplacement service and give departing service members another chance to enroll under the GI Bill for education assistance.

Other changes being considered, according to Mr. Jehn, include allowing former service members to use commissaries and exchanges and to occupy government housing for ninety days after separation. They might also be granted free leave time for job-hunting and house-hunting trips.

The Financial Return

Those expecting a quick windfall of money from the reductions will be disappointed. For months, defense officials and some members of Congress, notably Senator Nunn, have been cautioning the public that deep cuts in military programs will not yield a huge peace dividend in 1991.

As Defense Secretary Cheney's $128 billion estimate indicates, the savings would not be confined to lower personnel costs in a five-year, twenty-five percent force reduction. That aside, the savings from the troop cut will be far less than generally imagined.

Counting both officer and enlisted reductions, CBO estimates, the 1991 savings from an across-the-board cut would be only $900,000,000, and only $1.4 billion would be saved by an accession-heavy approach.

Over the five-year period, the direct yield from personnel reductions would total between $32.8 billion (accession-heavy) and $34.2 billion (across-the-board). The all-ranks reduction saves more money in the long haul, CBO says, primarily because of the higher average pay of those being separated.

Even at that, the savings estimate may be too high. CBO reports that its assumption about the cost of severance payments is speculative. If it turns out to be wrong, the actual return to the taxpayers in 1991 will be modest. ■

Fewer Forces, Fewer Bases

It is unlikely that the enormous troop cut now pending will arouse any great protest from the public. One side effect of the reduction, however, promises to be political dynamite.

The smaller force will not need—nor can it afford—the present number of military installations. Any attempt to close bases invariably brings a flood of angry calls, letters, and voter delegations to Capitol Hill.

"With a twenty-five percent force-structure cut coming, base closure on an unprecedented scale is coming," says Rep. Pat Schroeder (D-Colo.) of the House Armed Services Committee.

She and Rep. Les Aspin (D-Wis.), chairman of the Armed Services panel, are urging the Administration and Congress to adopt a "Get Serious" base closure plan to fit a shrinking military. A central feature of the proposal is a commission like the one in 1988 that led to eighty-six base closures, currently under way.

The reason the 1988 commission was successful was that its base closure list had to be approved or rejected in its entirety, with no haggling about changes or deletions. Both Congress and the Administration agreed to the whole list.

That avoided the syndrome that stopped most earlier attempts to close bases. To the local community, the base is a source of jobs, trade, "impact" money for the school system, and more. Communities usually take pride in their bases as well and react vigorously to news of their pending closure.

Determined local groups can nearly always create reasonable doubt about the absolute wisdom of closing any particular base, and their congressional delegations, with an eye on the ballot box, nearly always support their constituents.

The 1988 commission worked, Mr. Aspin said, because "the ground rules prohibited bargaining over individual bases proposed for closure."

Mr. Aspin and Ms. Schroeder want to see the same approach used now. They fault the Administration for reverting to the old methods and drawing up closure lists by itself.

Noting that twenty-nine of the thirty-five bases identified in January for closure by Secretary of Defense Dick Cheney were in the districts of Democratic members of Congress, Mr. Aspin said, "Dick Cheney is playing at base closings while playing politics." Cheney's approach, he said, "guarantees bases won't be closed."

The Air Force's new Program Executive Officer for Strategic Systems describes progress and problems.

Strategic Modernization in the Shakedown

By Robert S. Dudney, Executive Editor

JUST over seven months ago, on February 15, Brig. Gen. Joseph K. Glenn became the first of the Air Force's new Program Executive Officers and took up the task of overseeing six of USAF's largest and most important strategic weapon projects. His shakedown cruise was notably brief.

"I was on the job only three weeks," recalls the General, "when investigators from the General Accounting Office showed up to check on how I was doing."

Today, General Glenn encounters many such questioners—and no wonder. As Strategic Systems PEO, he has become a major player on the B-1B bomber, SRAM II air-launched missile, Advanced Cruise Missile, Small ICBM, Peacekeeper ICBM, and Peacekeeper rail-garrison basing system. That's practically the whole strategic program, minus the embattled B-2A bomber. To General Glenn, the situation looks like this:

- The entire modernization plan, not just the B-2, faces a time of testing. In the next six months, virtually every program faces critical tests, reviews, and political decisions.
- In purely technical terms, the prospects for success are good, and often excellent, for the Air Force's new systems.
- Even if the Air Force's new PEO-based acquisition setup works as advertised, it still will not solve the procurement system's most pressing problem: program instability caused by external factors.

These essential points were made in various contexts by General Glenn in recent talks with AIR FORCE Magazine about the policies, programs, and procedures taking shape within the Strategic Systems PEO office. In the new setup, General Glenn is joined by other PEOs for tactical/airlift, strike, space, C^3, and information systems programs. The B-2 is handled as a separate, special case.

General Glenn, who ran the B-2 program office until 1983 and since has worked as commander of the 4950th Test Wing at Wright-Patterson AFB, Ohio, as head of the Reconnaissance, Strike, and Electronic Warfare System Program Office at Systems Command's Aeronautical Systems Division, and on various special-access programs, seems

well suited to answer the bell. He has been given a tall order, however, a fact that becomes apparent in assessments of his programs and of the new acquisition system within which he must operate.

B-1B Challenges

The challenge is nowhere more evident than in the B-1B bomber program. The Air Force took delivery of its 100th and final bomber two years ago but continues to work on vexing problems.

The most urgent need, says General Glenn, is to develop and produce an "operationally acceptable" defensive countermeasure suite. Flight tests revealed defects in the original AN/ALQ-161 system. "Recovery" plans call for modifying the core suite and adding a separate radar warning receiver.

The Air Force is scheduled to start production of a modified system next spring. Before it does, the service must meet specific goals set by Congress, and outside analysts must certify the results. General Glenn suggests that this will prove difficult in the time left.

One problem has been delays in flight testing of the core, which was to have begun in September but which now won't start until this month at the earliest. Contractor Eaton AIL's system got through preliminary and critical design reviews. However, due to software problems, AIL was not ready for a pretest review.

Except for the delay, reports General Glenn, "that part [of the program] is going along pretty well."

Perhaps more troubling, or at least puzzling, are problems found in the tail warning function during operational tests this year. AIL voluntarily stopped delivery of the systems while the Air Force searched for solutions—thus far in vain.

"Right now, we don't have a defined solution to the problem that we've seen," concedes the General. "We went through the test program, and it seemed to be OK, and when we went back to run the operational tests, it didn't perform as we'd seen previously. So it's somewhat of a mystery."

Overall, says General Glenn, Air Force scrutiny of the program is intense. "We're more closely monitoring milestones," he notes. In fact, he adds, "we're monitoring 'inchstone' progress to make sure that we're getting what we expect."

On the big question—will the system be acceptable?—General Glenn is cautious, but he refuses to borrow trouble. "When we get finished," he says, "we probably will have things that fall short of our full expectations. Whether those are show-stoppers or not, it's hard to tell. Right now, I see no show-stoppers in the modification program."

Even if the Air Force's new PEO-based acquisition setup works as advertised, it still will not solve the procurement system's most pressing problem: program instability caused by external factors.

SRAM II

Also facing a critical series of tests in the months just ahead is the new AGM-131A Short-Range Attack Missile, slated for use on the B-1 and B-2 bombers.

SRAM II holds the promise of improving bomber survivability by reducing the need to overfly heavily defended areas. The plane could launch the longer-legged SRAM II outside the range of a target's defenses. Moreover, its supersonic speed, stealthiness, and variable flight profiles would provide more flexibility.

Flight tests, once set for September, have been pushed to next spring as a result of motor problems. The Hercules "pathfinder" motor performed well in test firings. However, says General Glenn, the propellant cracked during cold-temperature cycling conducted to ensure the long-term usefulness of weapons deployed at frigid northern bases.

Now, according to the General, the Air Force and Boeing, the prime contractor, appear to have come up with a design change that fixes the problem. "We have done preliminary tests of the fix," he says, "and we think it's on track" for the first live flight in April 1991.

General Glenn says that the modification will "slightly reduce" SRAM II's range, though it will still "in most circumstances" meet Strategic Air Command's requirements and, in any event, will surpass the range of the AGM-69A.

Advanced Cruise Missile

Unlike the case with the B-1 and SRAM II, the challenge posed by this third bomber-related system turns not on concerns about technology but about economics and industrial capability.

General Glenn points out that full-scale development of the stealthy AGM-129A missile has essentially ended, the test program has been successfully concluded, and operational ACMs, the first of which reached SAC in June, are meeting all requirements.

"The challenge," reports General Glenn, "is to *build* them, and build them to the highest standards of quality."

Specifically, the question is whether the Air Force should maintain its two current ACM contractors, General Dynamics and McDonnell Douglas, or cut the best deal possible with one of them and "buy out" the entire order. This question will be a major topic for review at a meeting of the Pentagon's Defense Acquisition Board this month. For General Glenn, there is no cut-and-dried answer.

"You can make a good argument," he says, "that head-to-head competition will provide incentive for the contractors to provide us a quality product at the lowest price."

He notes that, after the Air Force hired McDonnell Douglas as a second source, GD's ACM program improved in quality and performance—a healthy result of competition. "We don't want to give that up prematurely," says the General.

What's more, the Air Force spent $100 million to qualify McDonnell Douglas, and the company now has flown its first ACMs.

On the other hand, General Glenn notes, "we're not talking about tens of thousands of units. We're talking about 1,461 missiles, relatively low numbers. When you look at the quantities, does it make sense to keep two contractors and that pro-

duction base together?" In short, there may be too few missiles for two contractors to produce economically.

ICBM Projects

International and domestic politics will determine the fate of three intercontinental ballistic missile programs—the single-warhead MGM-134A Midgetman, the ten-warhead LGM-118A Peacekeeper, and a rail-garrison basing system to make Peacekeeper mobile.

All three, believes General Glenn, will come under close examination this fall as the Bush Administration thrashes out its 1992–97 six-year defense plan and its stance in new arms talks. Each system is vulnerable to budget or diplomatic pressure or both.

"We've got a major change coming up," declares General Glenn, "and it's just too early to tell where it might go."

Though clearly of secondary importance, technical questions or problems nevertheless exist in two of the three programs.

In the case of Midgetman, says General Glenn, questions center on the second stage. The next test launch of Midgetman—only its second—could well take place this month. It should go far toward determining whether the Air Force has fixed a problem that led to failure of the first Midgetman flight.

Flight Test Missile One, launched on May 11, 1989, was command-destroyed after 128 seconds of flight due to second stage problems. The cause was identified as variability in the nozzle's carbon-carbon material. The second missile will be fitted with a carbon-phenolic material exit cone similar to that on the first missile stage.

The most controversial element of Peacekeeper remains its guidance system—in particular, the delicate inertial measurement unit (IMU).

It's not a question of accuracy. General Glenn flatly declares that Peacekeeper accuracy "continues to be better than any other system in the world, so far as we know."

The problem, rather, concerns the reliability of the system, evidenced in the past by much higher failure rates than had been anticipated. This stemmed from a problem called "outgassing," meaning the presence of moisture, and from the unreliability of some accelerometers.

The IMU's failure rate, says the General, "was a concern, and still is to some degree," but it is much less than before.

"That's the good news," he says. "The bad news, though, is that because it's such a complex guidance system—especially the IMU—it will always be more expensive to repair than the previous generation of guidance systems, five or six times as many man-hours on average. That's the price of accuracy."

Despite the goal of pushing authority down to the lowest levels, "more and more real decisions are being pulled up to the top. . . . Probably the people doing this don't know they're doing it."

The rail-garrison program, which calls for stationing Peacekeeper ICBMs in what look like freight trains for possible movement in time of tension, has encountered no significant technical problems. In seeking to establish that a railbed could withstand the load imposed on it by the cold launch of a heavy missile, the Air Force has simulated such launches successfully. The service has transported the Peacekeeper guidance system on various railways to determine the impact of jostling on system accuracy.

Three Concerns

At present, General Glenn maintains a small staff: four action officers and several administrative hands. While each PEO differs in his methods, General Glenn has sought out and hired individuals with strong backgrounds in program management.

In the new acquisition system, launched by Secretary of Defense Dick Cheney in January, lines of accountability are clear, running from program director upward through the PEO to Service Acquisition Executive to the Defense Acquisition Executive, Under Secretary of Defense John Betti. Big service acquisition bureaucracies were swept away. The underlying principle was that the Pentagon would give the program manager more authority and more responsibility and then hold him accountable.

While he supports this reform plan, General Glenn expresses three specific concerns about how things are working out:

- Despite the goal of pushing authority down to the lowest levels, "more and more real decisions are being pulled up to the top level," principally the Pentagon staff but to some extent the service staffs, too. "Probably," the General says, "the people doing this don't know they're doing it. Philosophically, they believe decentralization is the right approach. In the real world, the natural reaction, when you have a problem, is to take action to keep it from happening again. That's centralization."
- The relationship between the PEOs and the Air Force's Washington-based acquisition staff "isn't well-defined, and that has created some stress. . . . There is a certain amount of jockeying and maneuvering going on," General Glenn notes. "It's a problem that will work itself out in time."
- Staffs at Air Force Systems Command headquarters and product divisions still are trying to define fully how they will support the PEOs. Today, says General Glenn, "these folks feel like they have two bosses," the commander of their particular organization and the new Program Executive Officer. "We're making good progress in sorting out the issue," he says, "but there's a lot to be done."

Even if these problems suddenly disappeared, General Glenn would expect no huge improvement in procurement. The truly big problems, he maintains, are not addressed by the organizational reforms. The biggest is external: budgetary chaos that keeps managers planning and replanning a program rather than executing it.

Concludes General Glenn, "I think we are working on ten percent of the problem, which is kind of frustrating." ■

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Development may be years—or decades—away, but work has begun on the next-generation ICBM.

New Options for the Strategic Arsenal

By Peter Grier

LAST year, scientists at Sandia National Laboratory, N. M., passed an important milestone in the development of a new nuclear warhead that can burrow underground to destroy hardened, buried targets.

At Tonopah Test Range, Nev., an aircraft flying at an undisclosed altitude dropped an inert Interim Earth Penetrator Weapon (IEPW) onto hard ground. After digging out and analyzing the warhead, Department of Energy (DoE) researchers found that its internal mechanism had survived undamaged. Their predrop calculations of stress, derived from tests of empty casings and preliminary IEPW designs, had been confirmed.

In a document submitted to Congress in March, DoE reported simply: "The weapon was operable."

With the cold war appearing to fade, continued development of leading-edge strategic warheads and delivery systems may seem anachronistic. But so long as nuclear arms exist, US officials maintain, the nation will need modernization programs to ensure that US deterrent forces remain safe and effective.

Earth-penetration technology is just one of the additions under consideration for the Air Force's nuclear arsenal. Work also has begun on weapons able to attack mobile strategic targets such as rail- and road-mobile Soviet intercontinental ballistic missiles. Under the Advanced Strategic Missile Systems (ASMS) program, the Air Force continues to investigate updated ICBM technologies. The program focuses on development of a new, more reliable guidance system as its top priority. Studies of possible new ICBM concepts are under way, though successors to the long-range LGM-118A Peacekeeper and MGM-134A Midgetman ICBM designs would not enter development for years, if not decades.

"We are thinking about things beyond the year 2000," says Col. Ted Kehl, ASMS director at the Ballistic Missile Organization, which is part of Air Force System Command's Space Division.

Last spring, Strategic Air Command (SAC) issued a tentative Statement of Need for a Minuteman ICBM replacement. It has given ASMS managers incentive to start pulling together their ideas for the next-generation ICBM. "It's the first piece of paper we've had that we could wave as we talk to folks about what we are interested in for the future," says Colonel Kehl.

The US nuclear weapons bureaucracy is not blind to the changes sweeping the world. Pentagon and DoE officials involved in nuclear weapons development say they realize that the conventional Soviet threat has declined. The problem, they say, is that arms-control treaties have yet to constrain Soviet strategic nuclear weapons development, and the US therefore needs to maintain a credible capability to respond to potential threats.

The annually produced "Nuclear Weapons Stockpile Memorandum," the bible of the nuclear weapons production process, already reflects thematic changes. Short-range and tactical systems are being deemphasized in favor of strategic systems. Emphasis is shifting from yield, size, and weight to safety, se-

curity, survivability, and surety of command and control.

Shake, Rattle, and Roll

The Peacekeeper missiles now based in silos would be redeployed into the proposed rail-garrison system. DoE hasn't yet focused on developing warheads for the Midgetman. The theory is that the missile, if approved by Congress, will carry a warhead similar in characteristics to those already designed for Peacekeeper. For these weapons, the key Air Force consideration is environmental testing.

Dr. Robert Barker, the Defense Secretary's Assistant for Atomic Energy, said to Congress this year, "We would expect the scientists and engineers to validate that the shake, rattle, and roll associated with a ground mobile system is something that the warhead could survive and still be safe and effective."

DoE's Stockpile Improvement Program (SIP) aims to improve the safety of existing weapons. B61-series tactical and strategic nuclear bombs are now in the SIP. In general, top safety concerns include increasing the percentage of nuclear weapons fitted with insensitive high explosive and replacing weapon electronics with new packages better protected against electric shock accidents.

Some thought is being given to nuclear weapon recycling. DoE recently ended a one-year "Multiple Use Study" evaluating the feasibility of repackaging and reusing older weapons. Plutonium from retired warheads is already extracted for reuse but must be reprocessed into a new "pit" before it can fit new weapons. DoE is now considering designing new warheads so that old "plutonium pits" can be used without remanufacture.

The exact number of weapons in the US strategic nuclear arsenal is highly classified. Experts outside the government estimate it at around 12,000, a figure that would decline somewhat under provisions of the draft Strategic Arms Reduction Talks (START) treaty. Already, however, the size of the stockpile is declining. Reagan Administration documents released by Congress show that the US has some ten percent fewer nuclear weapons today than it did in 1985.

US war plans allocate each of those warheads to a target, say military officials, but not all are deemed to be front-line weapons. A classified number of them, presumably the oldest ones, are counted in a category labeled "inactive reserve."

Among the new nuclear weapons rolling off government lines are the W80 warhead, fitted on a variety of cruise missiles, and the B83 modern strategic bomb. For the Air Force, the nuclear development program that's perhaps closest to a payoff involves the W89 digitally controlled warhead for the AGM-131A SRAM II short-range attack missile, to be carried on SAC bombers. It is now in Phase III, engineering development, DoE's last stage before final design and production. Safety is the SRAM II's prime consideration; recent press accounts have pointed out that the current SRAM doesn't use insensitive high explosive.

Buried Targets

For the future, the Air Force is working on other, more exotic weapon concepts. The earth penetrator is the most advanced.

For decades, SAC has been interested in acquiring the ability to attack buried targets. SAC's thinking has been that, with more and more of the Soviet national command structure being moved to underground bunkers and with the advent of hardened missile silos, earth-penetrating weapons would be necessary to destroy those targets that the adversary holds most dear.

The earth-penetrating warhead (EPW) program dates from the 1960s. Early work produced a basic EPW for use on the MGM-31 Pershing II, an intermediate-range theater nuclear missile deployed in Europe in 1983. This special type of warhead, however, never went into production, and the Pershing II now is being removed from western Europe under terms of the Soviet-American Intermediate-range Nuclear Forces arms agreement.

The EPW effort has continued, however, with an Air Force requirement for some sort of strategic EPW laid out in official SAC Statements of Need ever since the mid-1980s.

Designing a nuclear warhead that can withstand the shock of plunging many feet below ground before exploding is not an easy engineering task. DoE designers have apparently encountered some problems in meeting all weapon requirements. Last year the program was split into two parts: a short-term, interim EPW and a strategic or long-term EPW.

The Nuclear Weapons Council—a three-member group of top-level representatives from the DoD, the DoE, and the Joint Chiefs of Staff—coordinates all nuclear production. It voted last year to move the interim EPW into Phase III. Its design is classified, but it is likely that the interim weapon is an adaptation of an existing design, perhaps a standard bomb or reentry vehicle (RV) with a strengthened casing.

Little is currently being done on the strategic EPW, a project in Phase II (feasibility study). It is being led by the Air Force with Navy participation. Studies are still addressing multilayer geology, target vulnerability, and warhead candidate selection. "Many of the organizations involved in the project are waiting to see what happens on the interim EPW before committing additional effort on the strategic EPW," says one DoE document prepared for Congress.

Past DoD statements indicate that an EPW might be a bomber-borne weapon, a ballistic missile RV, or both. Test details indicate that possible targets include Soviet ballistic missile submarines hiding deep in ice-covered, Arctic Sea bastions, as well as bunkers and land-based missiles deployed in superhard silos. In 1987, experimental-design earth penetrators were dropped onto sea ice and frozen tundra at various Alaskan sites. Upon hitting soil, the devices burrowed three to thirteen feet underground, depending on the altitude from which they were dropped. In ice, penetration was four to seven feet.

The EPW may be the new weapon program closest to fruition, but it is far from being the only one under investigation. DoE and DoD studies are looking at next-generation methods for putting increasingly elusive strategic targets at risk.

Hypervelocity Weapons

The hypervelocity glide vehicle shapes up as a very-high-speed unmanned aircraft, presumably a sort of reentry vehicle with wings. DoE

researchers expect that the hypervelocity glide vehicle will formally enter Phase I of their development process, concept definition, this year. Until now, this project has been a joint DoE/Defense Advanced Research Projects Agency program. Glide vehicle warhead studies are complete and will undergo a final review in 1991. "DoD has several prime contractors studying the airframe," wrote Energy Under Secretary John Tuck in response to a congressional question earlier this year.

Another possible system is a strategic relocatable target (SRT) system. Ever since the USSR began to put ICBMs on wheels, the US has been struggling with how to locate and destroy them. Leaving the capabilities of the B-2 and other penetrating bombers aside, not much progress seems to have been made on developing advanced weapons capable of addressing this problem.

A ballistic missile SRT weapon could have some deterrent advantages over a manned bomber. Faster time on target could mean less opportunity for the target to run and hide. Still, says Eric Arnett of the American Association for the Advancement of Science's arms control program, "you have the virtually insolvable problem in the near term of finding relocatable targets before you blast them."

A joint DoD-DoE study in 1987 held that required sensor and advanced weapons technologies were too immature and recommended against proceeding with the project. Work on sensor improvement continues at the national labs. Officials may soon revisit the question of a strategic relocatable target warhead study.

One SRT weapon concept studied by ASMS officials would package an air-breathing vehicle inside a ballistic missile RV. Over a target area, the air-breathing minicruise missile would separate from the RV and loiter in a search pattern. "The big dilemma," says Colonel Kehl, "is getting enough on-board processing and sensors."

Another concept is the maneuvering reentry vehicle, or "MaRV." A MaRV was designed for the Pershing II. On the strategic level, however, the concept of a warhead using small flaps to jitter toward its targets has yet to see serious development. In the past, designers have built some experimental models. The Mk. 500 Evader was flight-tested on Minuteman in the mid-1970s, and the Advanced Maneuvering Reentry Vehicle (AMaRV) was tested in the early 1980s. The designs are sitting on the shelf. Paper studies are the only action currently going on in DoE's MaRV effort, and no experimental activities are planned.

The ABM Factor

A big reason for the Pentagon research into MaRVs in the 1960s and 1970s was the continued Soviet modernization of its ABM system deployed around Moscow. If the USSR further upgrades its national ABM capabilities, officials claim, the Air Force can build MaRVs that can evade strategic defenses and maintain Peacekeeper-type accuracies. Building a maneuvering warhead that improves on the Peacekeeper's circular error probable (CEP) would require a little something extra: real-time, terminal guidance from reconnaissance satellites.

The Pershing II MaRV was capable of internal terminal guidance. An on-board radar took snapshots of the target area and compared it with digital target "pictures" stored in memory. Course changes were made until the two sets of pictures matched. Terminal guidance by external sources of information would be a far more difficult feat, especially at the much higher speeds of ICBM reentry, and could be the key not only to zero-CEP accuracy but also to the targeting of mobile missiles and other relocatable assets.

"How to get smarts in and out of the vehicle—that's the question," says Colonel Kehl.

One obstacle is plasma buildup around RVs during reentry, a phenomenon that disrupts communications signals. Antenna windows are also a problem. Signals are affected by window ablation (melting, vaporization, or other damage).

In recent months, much of the ASMS effort has focused on a more prosaic technology: a new ICBM guidance system. SAC's demands, coupled with congressional budget cuts in other technology areas, have made this the top priority. About ninety percent of the roughly $66 million 1990 ASMS budget will go for guidance work.

The aim of the new system is not to increase accuracy but to reduce cost. Air Force officials say the constant maintenance required on current-generation, mechanical, gyro-based guidance sets is a big driver of ICBM operational budgets. Replacing moving parts with solid-state components could result in virtual elimination of this maintenance need. It might allow SAC to keep missile guidance sets in a dormant, quick-alert mode, eliminating the twenty-four-hour-a-day, fully up-and-running requirement.

The new guidance set is scheduled to enter full-scale development in the mid-1990s. It will be a generic system capable of being retrofitted into Minuteman IIIs.

Work on penetration aids has also been continuing at ASMS, though the specific Minuteman penetration aid program has fallen prey to budget cuts. In the past, penetration aid technology has focused on defeating radar-based ABM systems. Today, ASMS wants to learn how to deal with strategic defenses that include optical sensors.

"We have an effort under way today called 'Pyrotechnics' where we intend to do some flight tests," says Colonel Kehl. The point is to develop the same database in the optical countermeasures area that already exists in the radar countermeasures area.

Colonel Kehl says he's most frustrated by the lack of progress on the "target kill" part of his program—the MaRV, SRT, and other RV technology projects that Congress has moved to limit in the past. While lots of money has been spent in ICBM R&D in recent years, most of it has been full-scale development money for Midgetman and Peacekeeper, not dollars for cutting-edge work. "I really do think there is a need for a long-term commitment on the offense side," he says. ■

Peter Grier is a Washington-based defense correspondent for the Christian Science Monitor. *His most recent article for* Air Force *Magazine was "Three Tracks for Simulation" in the August 1990 issue.*

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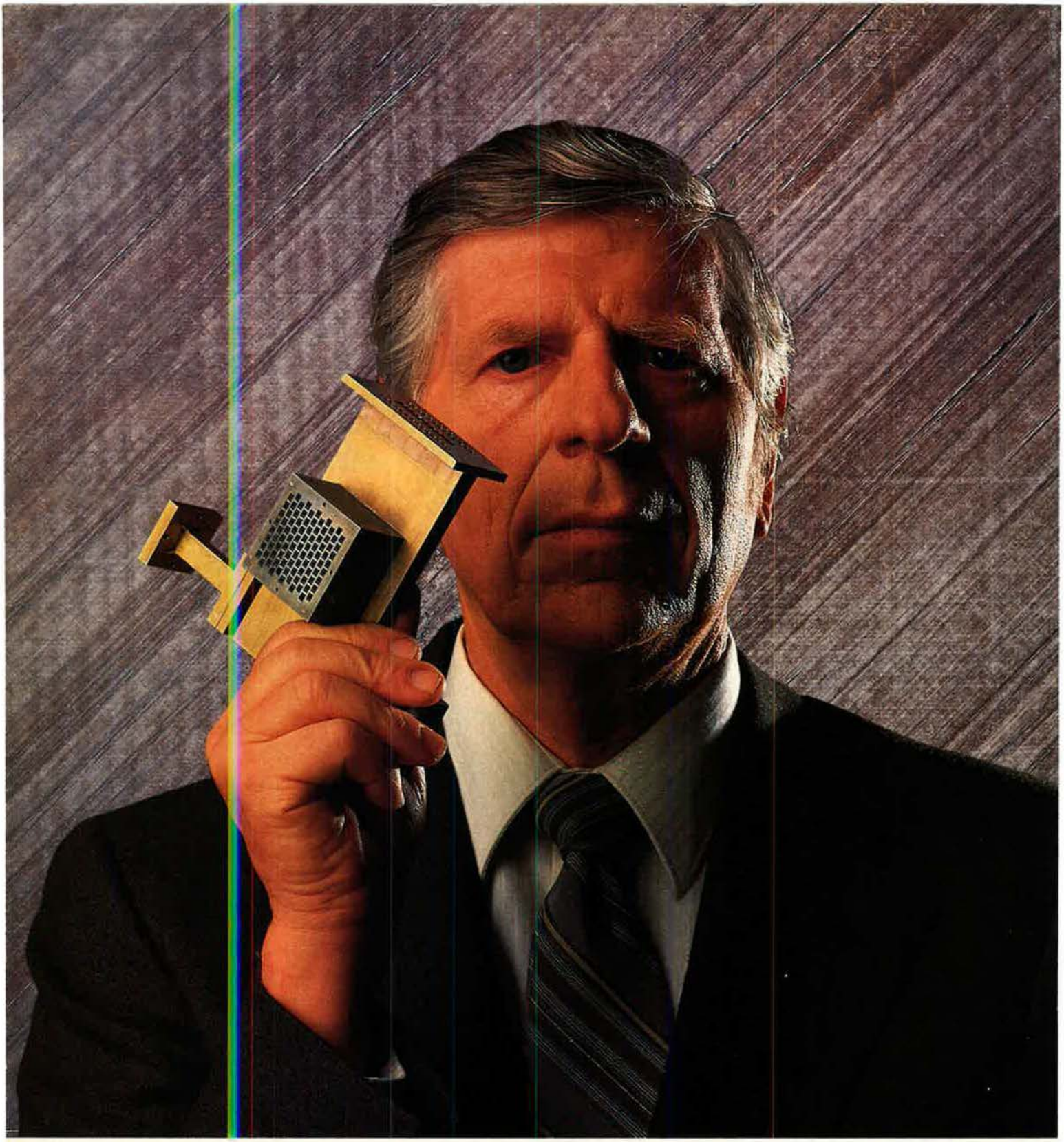

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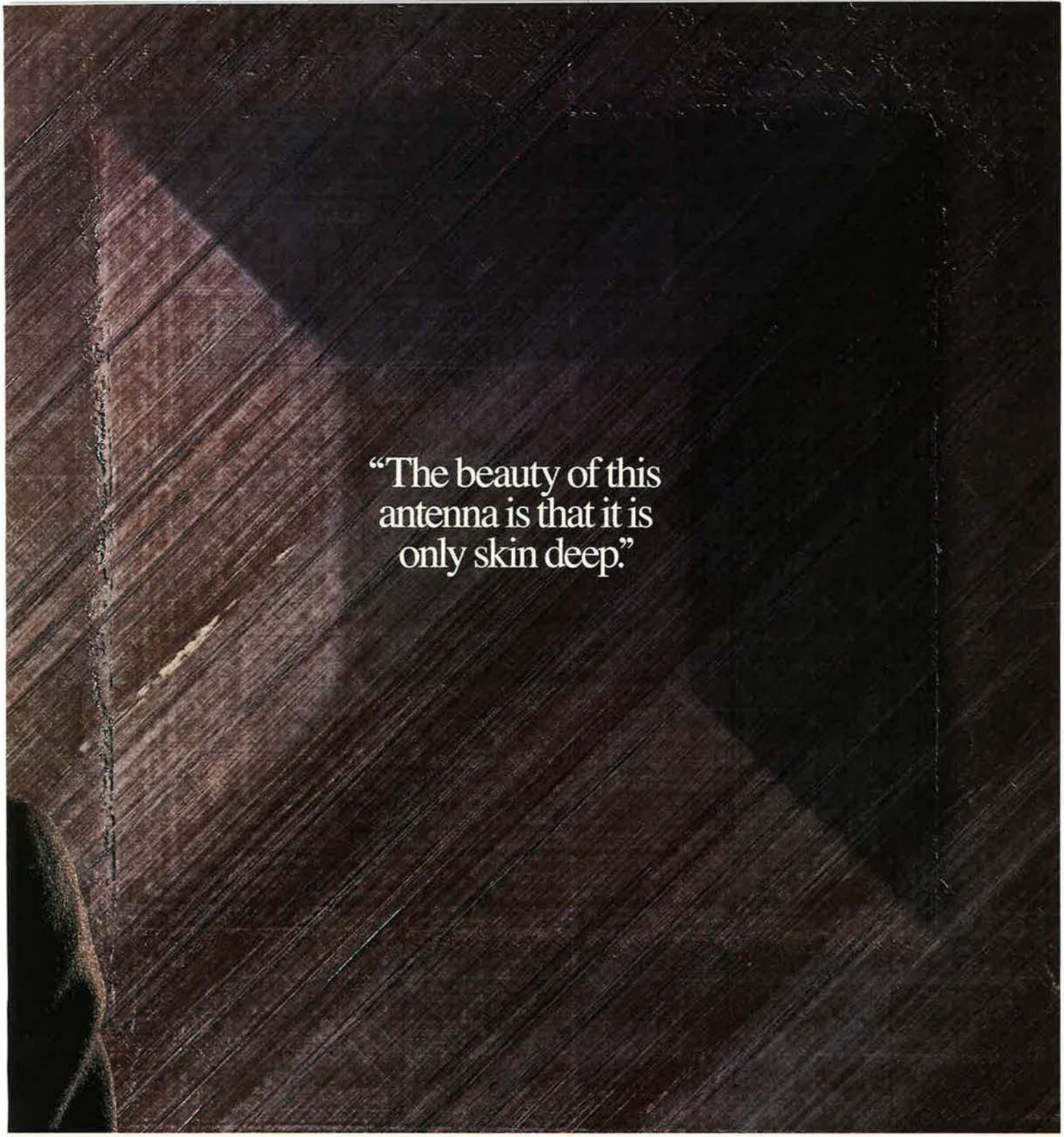

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Maneuverability at high angle of attack can mean the difference between life and death.

High Alpha

By F. Clifton Berry, Jr.

MANEUVERABILITY has long been a coveted characteristic in military aircraft designed for air-to-air fighting. When aerial combat escalated throughout World War I, fighter development on both sides seesawed in an intense competition to achieve greater maneuverability. In the United States, the quest for fighter aircraft maneuverability and agility continued through World War II and the Korean and Vietnam Wars to the present day.

In broadest terms, "maneuverability" refers to sustained capabilities for maneuvering, based on specific factors such as speed, turn rate (expressed in degrees per second), and power. The term "agility" means transient maneuverability; that is, ability to be quick and unpredictable *while* maneuvering. Agility is crucial to creating a winning edge in close-in fighter combat. A fighter that can outmaneuver an opponent and make fast transitions has more chances to kill or evade the enemy.

Having this agility at so-called high angles of attack—in technical terms, high alpha—can be a critical factor for success in close, air-to-air combat. This capability is being demonstrated today in this country's X-29 and X-31 experimental fighter programs and, to some extent, by a specially modified F/A-18 *[see box, p. 58]*. "The bottom line is minimum time to shoot," says Lt. Col. William L. Gotcher, Jr., current program manager for the X-29 effort, run out of Air Force Systems Command's Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio. "The degree of maneuverability at a high angle of attack could be the difference between killing and being killed."

Inevitably, much aerial combat will occur at close quarters, with adversaries operating within visual range of one another, armed with missiles and guns. Why will close-in combat occur, when so much technology is available for long-range fighting? There are several reasons. One is the existence of "rules of engagement." US authorities may require confirmed visual identification of an enemy before allowing US aircraft to fire. In addition, US fighter pilots may be surprised by low-observable enemy aircraft with substantial EW capabilities and be


X-31
ENI

forced into a close-in fight. Finally, what begins as a long-range fight may deteriorate into a close-in engagement.

A few key factors will determine the outcome of such an engagement. Quantifiable factors include power, speed, level of aircraft visibility, and agility. With superior power and speed, one can decline an engagement and fight another time, or one can overtake and blast an opponent before he can react. The value of low visibility is obvious. The subject of agility, however, is more complicated.

Four Possibilities

Every fighter aircraft has four possibilities for maneuver. They are pitch, or movement up and down about a plane's lateral axis; roll, or movement about the longitudinal axis; yaw, or movement around the vertical axis; and changes in airspeed. The pilot wants to be able to use any or all of those possibilities to maneuver his aircraft to win. He wants to shoot first, and he wants his first shot to kill. He should be able to point his aircraft's nose at any time and get off an accurate shot.

The traditional gauge of agility has been a fighter's turning ability. If the turn rate of a particular airplane is higher than that of an opponent's, then, in a close-in fight, its pilot will be able to turn inside the enemy and point his aircraft's nose—and its missiles and guns—at the enemy sooner than the enemy can reciprocate. The highest airspeed at which a given aircraft can execute a turn is called its "corner speed," expressed as a Mach number. Exceed the corner speed, and both aircraft and pilot are subjected to excessive G-forces—forces that can rip off the wings or render the pilot unconscious.

However, the pilot might be turning at an acceptable corner speed and attempt to tighten the turn, in order to quickly point the nose of his aircraft at the enemy aircraft. He does this by applying back pressure on the stick. That also will increase the G-load on the airplane. Again, the aircraft and the pilot risk adverse consequences, one of which is stalling.

The angle of attack is the angle formed by the longitudinal axis of the airplane and the direction of the relative wind *[see diagram below]*. Normal angle of attack (AOA) in cruising flight at one G is about five or six degrees. Current fighter wings stall at about fifteen degrees. At higher angles of attack, the airflow separates from the wing surface, sending lift to nearly zero and increasing drag dramatically.

In earlier aircraft the wing provided almost all of the lift, and, when the wing stalled, the aircraft fell. However, aircraft fuselages also provide lift. Therefore, with modern fighters, in the post-stall situation the pilot is flying a fuselage that is still providing lift, but the drag of the entire structure exceeds engine thrust.

If a pilot had at his disposal an airplane that could remain fully under control, in all three maneuvering axes, beyond today's expected stalling point, then he would have a terrific advantage against an enemy whose airplane was bound by the usual fighter performance parameters. He could turn and point more rapidly and still keep control of his aircraft.

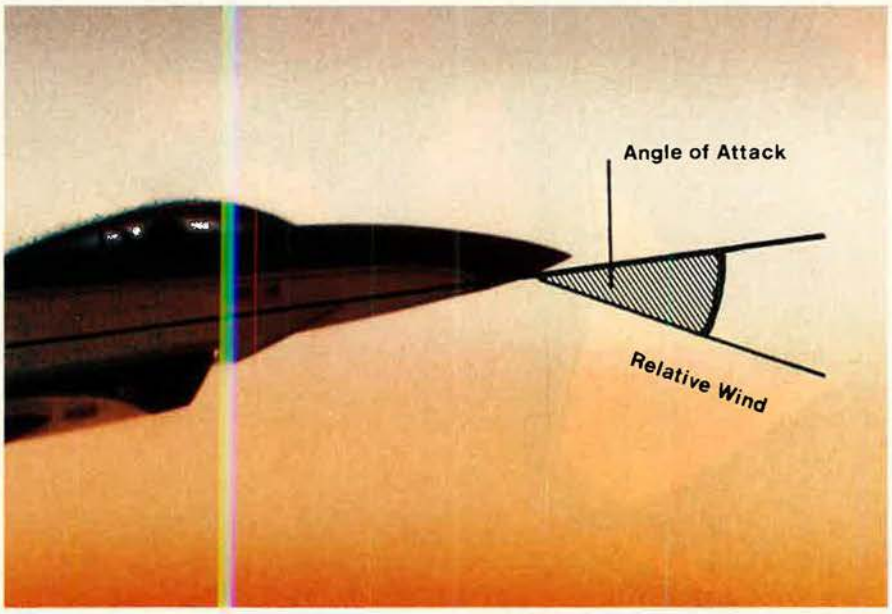
Very High Angles

That's where the X-29 and X-31 programs come in. Both are technology demonstrator aircraft powered by single General Electric F404 augmented turbofan engines. Both aircraft are increasing the potential for control at very high angles of attack through innovative approaches to the challenge.

Two X-29 aircraft were built by Grumman, under contract to the Air Force's Flight Dynamics Laboratory. NASA's part of the job is to perform the flight tests. Some components are from existing aircraft (the forward fuselage is from the F-5, landing gear and other parts are from the F-16), combined with new technologies such as fly-by-wire flight controls and use of graphite epoxy composites for the wing covers. The wings are swept forward instead of back, giving the X-29 its unique appearance. The composite wing covers are aeroelastically tailored; that is, they resist twisting under maneuvering loads.

Why forward-swept wings? In flight, the airflow over the forward-swept wing flows in toward the root of the wing instead of out toward the wingtip. The wingtips, and the ailerons out there, are in less disturbed flow at high angles of attack. The consequence is better control response, both at low speeds and at high angles of attack. Also, because of a supercritical airfoil, less sweep, and natural mass distribution to achieve area rule, drag in the transonic maneuvering range is twenty percent less on the forward swept wing, giving higher performance for a given engine size.

Other new X-29 technologies include a discrete variable-camber wing, close-coupled canards (in line with the wing), thirty-five percent longitudinal instability, triplex dig-



ital fly-by-wire flight-control systems, and horizontal movable strake flaps alongside the engine exhaust nozzles. The thin supercritical wing reduces buffeting and drag at transonic speeds. The segmented variable-camber flaps on the trailing edge of the wing change its effective curvature in flight to achieve the best combination of lift and drag for the several conditions of takeoff, cruise, maneuver, and landing. The devices act as flaps when moved together and as ailerons when moved asymmetrically. Forward of the wings, and in line with them, are the variable incidence canards. They are the primary pitch control surfaces but act in concert with the strakes and wing flaps.

The X-29's advanced flight-control system is fly-by-wire, three digital channels backed up by three analog channels. Inasmuch as the X-29 is statically unstable and requires constant control inputs for stability, the system transmits up to forty commands per second to the control surfaces.

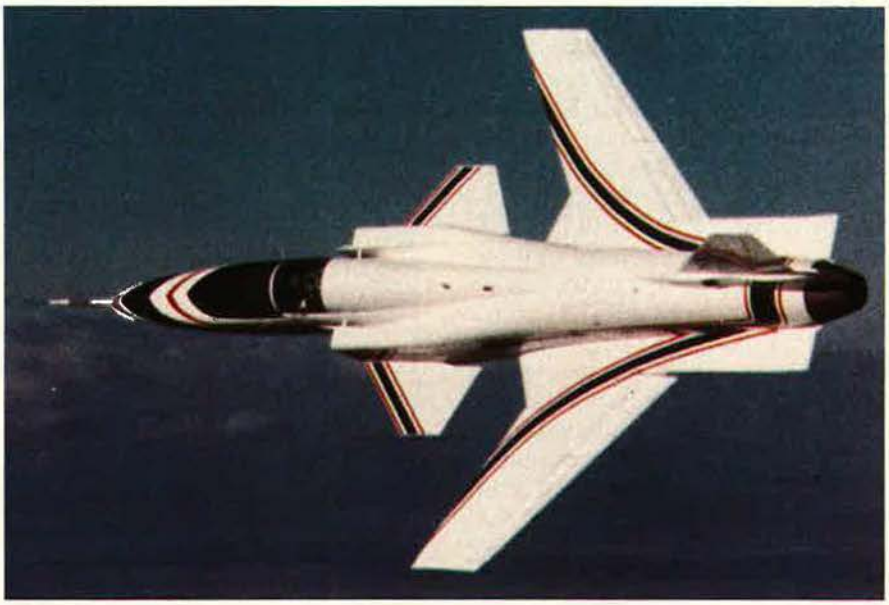
In the X-29, new technologies are integrated to provide a look at the future. They provide low approach speeds and low-speed control, meaning more fields for operation; transonic aerodynamic efficiency, leading to smaller and lighter aircraft; and reduced wing twist, leading to simplified designs.

Most important for the fighter community is the X-29's improved agility; that is, unrestrained air-combat maneuvering at far higher angles of attack than previously experienced.

How high is a high angle of attack? There is no simple answer; it depends on the pilot's resourcefulness and ability to keep the aircraft under control. For example, the F-16 has a built-in angle of attack limiter, which prevents the plane from exceeding an angle of attack of twenty-five degrees.

The flight-control system of X-29 No. 1 was set for a maximum of twenty-four degrees angle of attack. In its four years and 242 flights ending in December 1988, the aircraft flew repeatedly at twenty-two degrees AOA.

However, X-29 No. 2, which first flew on May 23, 1989, at Edwards AFB, Calif., has in its first forty-four flights flown at angles of attack *as high as sixty-six degrees*. The test program will take the aircraft to forty degrees AOA while it keeps the ability to maneuver in roll, pitch, and yaw. After that, it will demonstrate only pitch control at a seventy-degree angle of attack.



The Grumman-built X-29 Advanced Technology Demonstrator aircraft's forward-swept wings and advanced flight technologies allow unrestrained maneuvering at very high alpha. The second X-29 built achieved a sixty-six degree angle of attack.

Says NASA's chief X-29 test pilot Steve Ishmael, "The controllability is very good up to the maximum lift. Even up to a sixty-degree angle of attack, we have not yet found any reduction that is very sharp in maneuverability." Col. David McLoud of Tactical Air Command headquarters, Langley AFB, Va., also has flown the X-29. His conclusion: "Slow-speed, high-alpha maneuvering is where the X-29 would most probably outperform current frontline fighters."

Colonel Gotcher, the X-29 program manager, is dual-rated in fighters and helicopters and is a graduate of the US Navy Test Pilot School. Colonel Gotcher has been involved with test and evaluation at ASD for more than six years and has headed the X-29 program for more than two years. In his view, the X-29 high-AOA technology demonstrator program offers a very simple aerodynamic solution to achieving agility at high angles of attack. The program is critical to assess the tactical maneuvering advantages of the capability and to identify any critical limitations. At the same time, he maintains, the program helps to advance knowledge by providing data that will aid in calibrating future designs and defining agility.

X-31's Fast Start

It's not just the X-29 program, however, that is now pushing the frontiers of the tactical fighter art. One of the first undertakings to get going under the Nunn-Quayle program for joint US-NATO research and development was the Enhanced Fighter Maneuverability (EFM) project, embodied in the X-31 demonstrator aircraft. It is sponsored by the Defense Advanced Research Projects Agency and managed by the Navy. Rockwell International of the US and MBB of West Germany are the associate contractors. The X-31 uses thrust-vectoring of the engine as the approach to post-stall agility.

The project builds on research on post-stall performance conducted by MBB since 1977 and on Rockwell's experience with "X" aircraft and its "HiMAT," the Highly Maneuverable Aircraft Technology aircraft.

The X-31 program has moved along swiftly since concept feasibility was determined in 1986. Design, fabrication, and assembly of the first aircraft ran through 1987–89, with rollout of X-31 No. 1 on

March 1, 1990. The number one aircraft was ready to fly in August. The number two aircraft has rolled out and was being readied for first flight in early autumn.

The aircraft has supersonic capabilities built in and is designed to handle maneuver stress at nine Gs; however, the technology demonstration program flights will all be subsonic, up to Mach 0.9, and a 7.33-G limit will be observed.

The X-31 configuration evolved from separate designs by the two contractors. MBB's computer models and wind-tunnel tests produced designs that could retain control authority beyond the stall. Rockwell contributed its knowledge from the HiMAT project and from an independent R&D program dubbed SNAKE (for SuperNatural Kinetic Enhancement). Its R&D led to a conviction that thrust-vectoring of the engine exhaust was essential to maneuvering in the post-stall condition. A simple means to achieve thrust-vectoring was available. The Navy had provided it in an advanced F-14 by inserting paddles into the stream of the fighter's F404-GE-400 engine.

The ultimate X-31 design makes maximum use of existing systems, and forty-three percent of its weight is from parts of the F-16, F-16XL, F/A-18, and V-22 aircraft. The configuration is modified from MBB's proposal for the European Fighter Aircraft (EFA), with a double delta sweptback wing with both leading and trailing edge flaps. Controllable canards are mounted on the forward fuselage. Wings are covered with lightweight carbon fiber composites. Such composite materials are also used on canards, vertical surfaces, and thrust-vectoring paddles for the F404 engine.

Controls integrate flight and propulsion functions totally. This is definitely new technology and has required a hefty load of new software, but results in true integration of the controls and eased pilot work load. This approach also ensures that the aircraft's maneuverability is maximized.

The flight-test program for the X-31 will comprise 418 flights and nearly three years of effort, from autumn 1990 to mid-1993. After eighteen initial airworthiness flights, the aircraft will make eighty flights within the conventional envelope, all from the Palmdale, Calif., facility. The next step is to explore the post-stall envelope in 200 flights, first at Palmdale and then at the Naval Air Test Center at NAS Patuxent River, Md.

When those flights have been completed, the X-31 will be flown another eighty times to determine the optimal enhanced fighter maneuvering capabilities and to develop tactics. Finally, the aircraft will go through forty flights in a general tactical evaluation—the acid test of how much tactical advantage has been created by the enhanced maneuverability program.

At the X-31 rollout earlier this year, Rep. Denny Smith, an Oregon Republican and former Air Force pilot, maintained that the new demonstrator could have a big impact on future air combat. "From my own days as a fighter pilot," the Congressman observed, "I can say that getting close and shooting has been, and will remain, the staple of aerial combat. The X-31 will teach us vital lessons about maneuverability that we can apply to the design or the modification of future aircraft."

As is the case with most flying technology demonstrators, the X-29 and X-31 will probably never become series-production fighter aircraft. But it is a sure bet that the technologies they demonstrate will eventually find widespread applications. If some or any of those technologies can be applied to existing F-15, F-16, F-14, and F/A-18 aircraft, the US will be able to achieve improved air combat performance at a bargain. Over the long haul, those technologies are virtually certain to find their way into new generations of aircraft. ■

Fifty-Five Degrees for HARV

The extreme complexity of separated airflows at high angles of attack cannot be modeled adequately during the design process. Therefore, an airplane's characteristics remain estimates until it begins flying. By obtaining real flight-test information, wind-tunnel and computer analysis can be validated.

Since mid-1987, the National Aeronautics and Space Administration (NASA) has been conducting a three-phase flight research program on high angle of attack at its Dryden Flight Research Facility at Edwards AFB, Calif. The High Angle of Attack Research Vehicle (HARV) is a preproduction F/A-18 Hornet on loan from the Navy. NASA chose the F/A-18 because it has no angle of attack restrictions at normal center of gravity positions.

NASA has completed Phase One of the research program. It consisted of 101 flights for visual studies of airflow at angles of attack up to fifty-five degrees. NASA scientists and technicians modified the forward fuselage of the F/A-18 to emit special tracer smoke from small ports; the smoke would follow the airflow patterns. They also equipped the nose of the plane with 500 tiny holes from which an oil-based dye could be released in flight. Finally, they taped short pieces of yarn on the F/A-18. Airflow patterns, made visible by these techniques, were recorded on film and video for comparison with computer and wind-tunnel predictions. Additional data came from special sensors that measured pressure variations.

Phase Two, which NASA will continue for two years, focuses on evaluation of thrust-vectoring for increased maneuverability at moderate angles of attack and control at high angles of attack approaching seventy degrees. The plane vectors engine thrust by using paddles of Inconel metal mounted on the airframe near both engine exhausts. Special software and modified flight-control computers enable the pilot to command the optimum combination of flight control and vectored thrust.

For Phase Three, movable strakes will be mounted on both sides of the aircraft nose. The strakes will measure four feet long and six inches wide and will provide yaw control at high angles of attack. The strakes will be folded flush against the aircraft skin at low angles of attack and will deploy fully at higher angles of attack in order to interact with the vortices along the nose and produce side forces. Phase Three will run from 1992 to 1994.

F. Clifton Berry, Jr., is a former Editor in Chief of Air Force *Magazine. He saw USAF service in the Berlin Airlift, 1948–49. Later, he was a paratrooper and an officer in the 82d Airborne Division and served in Korea and Vietnam. His most recent article for this magazine, "The Push for Fighter Engines," appeared in the January 1990 issue.*

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From the hands-off launch to the low-margin landing, there's no boredom in flying the F/A-18.

Hornet

By Orr Kelly

As the pilot of a Navy F/A-18 Hornet strike fighter prepares to go to war, he does a very strange thing. With his engines roaring and his plane straining to break loose from the catapult yoke that holds it to the aircraft carrier deck, he very deliberately lifts his hands from the controls and grabs the handholds on his canopy.

Then, suddenly, the catapult snaps forward, and in the blink of an eye, the plane is hurled into the air. In that violent moment, it is safer to leave the flying to the plane's computer and its built-in sensors. Only when the plane reaches its flying speed of 125 knots does the pilot bring his right hand back down onto the control stick between his legs, grasp the throttles with his left hand, and become something more than a passenger.

He banks sharply away from the ship and begins a steep climb to altitude. Beneath the wings of the Hornet, conceived by the Navy as an airplane that would excel as both a light bomber and a fighter, hangs a full load of iron bombs, smart missiles, and AIM-7 Sparrow and AIM-9 Sidewinder air-to-air missiles. Even with this 17,000-pound burden, the twin-engined Hornet handles with remarkable agility.

At 30,000 feet, the pilot levels off. The attacking group forms up into a battle box with two Hornets in the lead, 4,000 to 6,000 feet apart, followed by one or two trail sections of two planes flying three to four nautical miles back. All the attacking planes carry bombs or air-to-ground missiles. If jumped by enemy fighters, they must defend themselves with their air-to-air missiles and their 20-mm M61A Gatling-type guns.

When the Hornet was born in the early 1970s, many experts thought the Navy needed two planes: a bomber and a lightweight fighter. The Navy resisted strong pressure to adapt the Air Force F-16 fighter for carrier use. Instead, it commissioned McDonnell Douglas and Northrop to convert Northrop's losing entry in the Air Force competition into a plane that would be both fighter and bomber for both the Navy and the Marine Corps. Other Navy bombers routinely fly with an escort of fighters. The Hornet, capable of switching in a moment from

With each aircraft's wings folded to a span of a mere twenty-seven feet, six inches, an impressive phalanx of F/A-18 Hornets lines up on the bow of USS Midway (CV-41) after a recovery. The Hornet has proven to be adept in both air-to-air and air-to-ground roles.

Photo © William G. Lotz 1990

a bomber to a fighter, is what the Navy calls "self-escorting."

At about a hundred miles from the target, the battle box splits up. Each of the two-plane sections takes a different route, adjusting airspeed to reach the goal from different directions about twelve minutes later. In the final dash to the target, the Hornets hug the earth to avoid detection by enemy radar.

Frightened and Uncomfortable

Going into combat, the pilot is flying fast and low. He is frightened and uncomfortable, buffeted by the rough air close to the ground and driven into his seat by gravity as he jinks the plane to avoid antiaircraft fire.

Suddenly, he is close to the target. He may have as little as twenty seconds to identify the target, lock on his radar, release his weapons, and escape.

Other members of his squadron flash by in maneuvers as precisely timed as any performed by the Blue Angels. If he is a moment too early, he risks a midair collision. If he is a few seconds too late, the fragments of a friendly bomb may blow him out of the sky just as surely as an enemy missile would.

In a well-coordinated attack, a flight of Hornets is in and out of the target zone in a few seconds, flying at different altitudes and from different directions, presenting a dizzying problem for the defenders.

This is a distinct change from the recent past, when standard tactics called for a thirty-second separation between attacking planes—time for bomb fragments to fall back to earth before the next plane attacked, but also time for gunners on the ground to aim and shoot at the follow-on attackers.

The obvious solution was to race toward the target at a low altitude to prevent detection, then pull up sharply above ground fire and bomb fragments. The planes would need only a few seconds of separation. The Navy's older bombers didn't have the energy for such a maneuver. As pilots experimented with the F/A-18 with its two powerful General Electric F404 engines, they found they had energy for a new trick—the "Hornet high pop."

In this tactic, the pilot begins his attack about five miles out, less than 200 feet above the ground, and flying about 600 miles an hour. As he approaches the target, he jams the throttles full forward with his left hand to kick in his afterburners, pulls hard back on the stick, and streaks upward at a forty-five-degree angle to 10,000 feet. There, well above the threat of small-arms fire and the fragmentation envelope, he rolls upside down, recovers, and drops his bombs from about 8,000 feet. Other Navy attack aircraft (the A-6 and A-7) can perform the pop-up and roll-over maneuvers. However, only the Hornet has enough energy to ascend to such a high altitude so rapidly.

To a nonpilot, it would seem simpler to pop up and then push the nose back down without rolling upside down. There are two reasons for the roll. One is that the plane can stand about five times as much pressure exerted toward the bottom of the plane as it can in the other direction, so the pilot can point his nose at the target much more quickly. The other reason is that popping up and back down subjects the pilot to the discomfort of negative gravity. Blood rushes to his head, and his lunch heads in the same direction.

The Hornet pilot is at his most vulnerable in the few moments he spends in the heavily defended area of the target. His work load is enormous: He must fly and navigate the plane, locate his target, drop his bombs accurately, watch for surface-to-air missiles and enemy fighters, and join up with his squadron mates for the flight back to the carrier. Only after a long, bitter debate did the Navy decide to make the basic Hornet a one-man plane, trading the advantage of another pair of eyes for lighter weight and a smaller aircraft.

Photo © William G. Lotz 1990

The Hornet pilot must shoulder an enormous work load. Besides flying, he must watch for enemy fighters and missiles, drop his bombs accurately, and join up with his squadron for the flight back to the carrier. It was only after a long and bitter debate that the Navy traded the advantage of another pair of eyes for the lighter weight and smaller dimensions of a single-seater.

The Glass Cockpit

Three innovations—since widely adopted in other planes—made it possible for the one-man Hornet to be both a bomber and a fighter. First is the Hughes APG-65 programmable radar. With a slight movement of the thumb of his right hand where it rests on the control stick, the pilot can switch his radar and all his weapon systems from air-to-ground to air-to-air. In the past, if he could do it at all, it took the pilot many

Photo © William G. Lotz 1990

With the aid of a flight-deck director, an F/A-18 completes final lineup with the catapult in preparation for takeoff. Seconds later the pilot will remove his hands from the controls, because during the violent takeoff from the carrier deck, it is safer to leave the flying to the plane's computer and its built-in sensor.

seconds to reconfigure the plane as a fighter.

Eugene C. Adam, the McDonnell Douglas engineer who is the father of the Hornet's innovative cockpit, says, "If you're in navigation or air-to-ground mode, if someone jumps you, you move that switch in any direction and the whole plane reverts to air-to-air. The computer says, 'This guy wants air-to-air *now!*' In less than half a second, you have it."

Adam's "glass cockpit" was the second crucial innovation. Three cathode-ray tubes replace most of the old round "steam gauge" dials familiar to generations of pilots. These screens display all the information the pilot needs to fly the plane and use it as a fighting machine. Whatever information the pilot needs at any moment can be projected onto his head-up display (HUD), so it appears to be floating out in space, where his eyes are focused in his search for enemy planes.

Coupled with the programmable radar and the glass cockpit is the hands on throttle and stick, or HOTAS, system. With all the critical control switches on the stick or throttle, the pilot never has to let go of the controls to fly or fight.

Once the pilot drops his bombs, he immediately moves his right thumb to prepare to deal with enemy fighters. His goal is to avoid a fight and get away as fast as possible. If he sees a hostile fighter, his first choice is to knock it out with a quick missile shot.

What if the first shot misses, and, as the pilots say, "the bogey is alive at the pass?" There may be no choice but to fight. At that moment, as the Navy's training manual says, "you are so scared you want to puke, and your IQ drops to fourteen."

It is also at that moment, as the two planes hurtle past each other at a combined speed of more than a thousand miles an hour and so close that the two pilots can actually see each other, that skill and training pay off. Does the other pilot have a gun? Is he carrying missiles? Then stay so close he won't have room for the missiles to arm themselves. What is his energy state? If he is making very tight turns, he is bleeding off energy at a rapid rate and may not be able to respond to your next maneuver. Is he pushing his plane to the limit, or is he holding something in reserve? Most critical: How good a pilot is he?

In the past, a pilot in a dogfight had to estimate the distance to his target and then use his gunsight to calculate how far in front of the other plane to aim so the bullets would arrive at the right moment.

In the F/A-18, the plane's radar measures the distance to the other plane and the computers do all the calculations with much more precision than the pilot could do them in his own mind. The computers even calculate how long a bullet will take to reach the target and how far the other plane will fly in that time. When the radar is locked on to the other plane and it is within range of the gun or one of the missiles, a strobe light on the HUD flashes "SHOOT . . . SHOOT . . . SHOOT." If the pilot presses the trigger on the stick, a hit is almost certain.

Seven-to-One Advantage

A Hornet pilot is justified in be-

Photo © William G. Lotz 1990

Two Hornets perform a fan break maneuver, demonstrating the aircraft's agility, which it retains to a remarkable degree even while carrying up to 17,000 pounds of ordnance. The Hornet is so capable that an F/A-18 pilot is justified in believing that the odds at the beginning of a dogfight are seven to one in his favor.

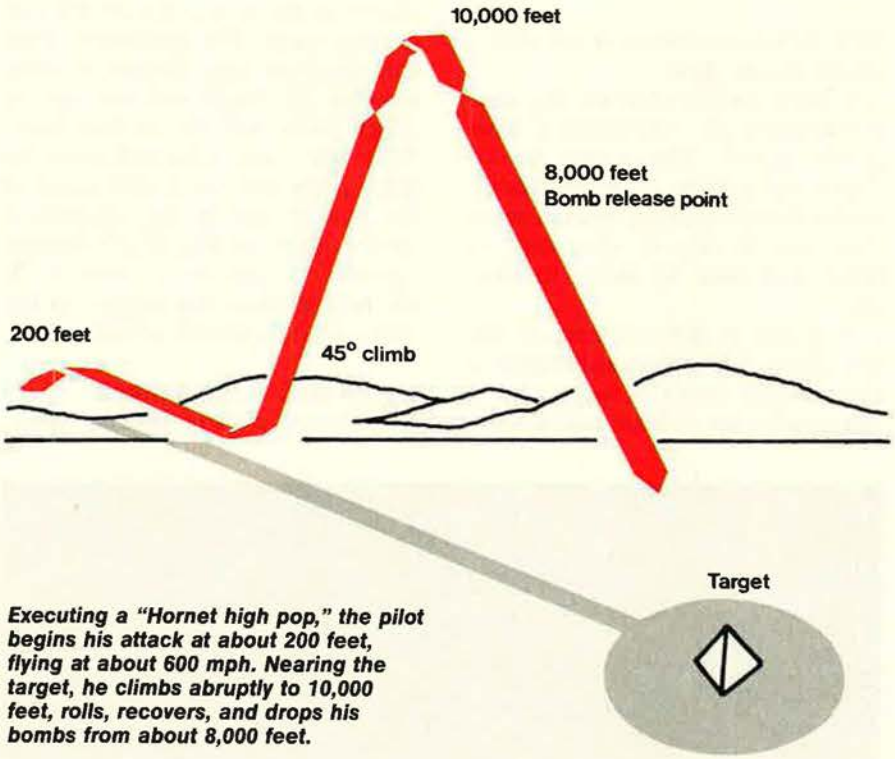
lieving that, as a dogfight begins, the odds in his favor are about seven to one. But he faces not just one enemy—the hostile pilot. He also faces another, more insidious enemy—time. Each second the fight lasts, the odds drop precipitously. The prodigious flow of fuel through the afterburners curtails the pilot's options, and a dogfight is like a big neon sign, drawing attention to itself.

Picture two planes involved in aerial combat. They fly up and down, around and around, all the time twisting and turning, losing energy and moving slower and slower. As the fight degenerates in this way, the Hornet, which has superior performance at very high angles of attack, has the advantage. But if the pilot cannot exploit that advantage quickly, he is in deadly trouble. With each twist of the planes, there is a flash of wing, calling attention to the fight. Every enemy pilot within a ten-mile radius—314 square miles—can be there within a minute. By that time, the odds of survival are one to one at best. If the fight lasts two minutes, the circle of danger expands to more than 1,200 square miles.

The first goal of a pilot who finds himself in a dogfight is a quick kill—the quicker the better. But even a quick victory can be dangerous. The fireball of an exploding plane is a magnet for hostile pilots. If a fight becomes prolonged, the wise pilot turns his thoughts to the best way to bug out and go home.

The key to a successful bugout, as with everything connected with aerial combat, is a poorly understood quality called situational awareness. Basically, it means the ability of a pilot to carry in his mind a total picture of what is going on around him.

Imagine how critical it is for a pilot to have a full grasp of the situation when he tries to leave the scene of a dogfight, whether or not he has scored a victory. How much fuel does he have left? How many enemy fighters are in the area, and where are they? Are there any friendly planes to provide protection? Most basically, he must know the way to the aircraft carrier.



Executing a "Hornet high pop," the pilot begins his attack at about 200 feet, flying at about 600 mph. Nearing the target, he climbs abruptly to 10,000 feet, rolls, recovers, and drops his bombs from about 8,000 feet.

Successful fighter pilots have this kind of awareness almost by instinct. Air Force Col. (later Brig. Gen.) Robin Olds, an ace in World War II and a near-ace (four MiGs destroyed) in Vietnam, is often cited as a pilot who had an uncanny ability to keep track of everything that was happening, even when fighting for his life. In one instance over North Vietnam, Colonel Olds was busy fighting two MiG-17s. Ten thousand feet above them, another American plane made a slashing gun attack on a MiG. Colonel Olds calmly radioed congratulations on a nice shot.

Stressful Landing

An Air Force pilot who successfully leaves the scene of a dogfight looks forward to setting down comfortably on a long runway. For the carrier pilot, the stresses he faces in a nighttime landing may exceed those of combat.

First comes the task of locating the carrier. The pilot knows where the ship is supposed to be, but it is his job to find his way aboard without radio chatter or a radar beacon. For maximum security against enemy attack, the Navy routinely operates in total EmCon, or emission control, with every electronic emission that might betray the ship's position—or help the pilot find his way home—turned off. The pilot must find his place in the landing pattern and come aboard "zip lip," without a word spoken.

As a pilot returning from a combat mission banks his Hornet and turns toward the carrier, ten miles ahead, for a nighttime landing, everything seems to happen in slow motion. The carrier comes into view as a postage-stamp-sized apparition, floating in the darkness. A single line of strobe lights marks the centerline of the deck. A vertical line of lights—the drop light—marks the stern. There is a faint glow off to the right from the sodium vapor lights around the island structure.

Just to the left, a round amber light—the "meatball," part of the Fresnel landing system—is centered between two green lines if the pilot is on the proper guide slope.

The pilot concentrates on three things: his airspeed, the centerline of the deck, and the meatball. On a dark night, there is no horizon and there are no other points of reference except those disembodied lights hanging out there in the darkness.

If the pilot flies so the lights marking the center of the deck form a straight line with the vertical lights on the stern, he is properly lined up for his landing. Most crucial of all is the meatball. If the pilot comes in

Photo © William G. Lotz 1990

The stress of landing on the tiny, moving target of the carrier deck may equal the rigors of air-to-air combat. The pilot, with a minuscule margin for error once touchdown is made, must fight his natural instinct to slam on the brakes, which would send the plane careening down the deck and into the sea if he somehow missed the arresting wire.

too high, he will miss the arresting wires and have to go around again. If he comes in too low and does not add power in time, he risks crashing into the stern of the ship.

As the pilot comes closer to the carrier, it becomes obvious that he is pursuing a moving target. Not only is the carrier moving away from him into the wind at some thirty-five miles an hour, but also, since he is headed for an angled deck, his landing area is moving away from him at an angle. This means that not only must he fly in a curve to compensate for the movement of his landing place, but he must also compensate for a crosswind caused by the fact that the deck is at an angle to the movement of the ship.

Landing on Less

The space for which he is headed is tiny. The runway of a military jet airfield may well be more than two miles long. The angled landing deck on a carrier such as USS *Coral Sea* (CV-43), one of the first to take the Hornet to sea, is only several hundred feet long. Within the length of this deck, the pilot must put his aircraft down and come to a stop in a space only 120 feet long. For a plane crossing the stern at 200 feet a second, that is only a fraction of a second's worth of space in which to set down. Width of the landing area is also critical. Other planes are parked on both sides of the deck, leaving a strip only eighty feet wide. This means that if a Hornet, with a wingspan of thirty-seven feet, is more than a few feet to one side or the other of the centerline, it is probably going to break something.

Normally, the meatball is set so the plane will catch the third of four cables stretched across the deck. For a perfect landing, the pilot must maneuver his plane so precisely that, when he crosses the stern, his tail hook is 14.5 feet above the deck and his head passes through an imaginary three-foot square.

In those last few moments, what had been an almost leisurely process changes abruptly. Everything goes into fast motion. The shape of the carrier looms out of the darkness, lights flash past, and the landing gear crunches down on the deck. If the pilot has been focusing almost all his attention on the meatball, as he should, the touchdown will come as an abrupt surprise.

The natural instinct, at that moment, is to cut off the engines, slam on the brakes, and stop. But what if the tail hook has missed the wire? Following one's instinct would send the plane careering down the deck and off into the sea. Instead of trying to stop, the pilot does just the opposite: He tries to fly. He slams the throttles forward and steels himself to go hurtling off into the darkness to make another landing attempt. If he has caught the cable, the sudden burst of power from the engines forces him backward, and then he is thrown forward hard against his restraining harness as the plane stops.

Quickly he releases the cable, folds the plane's wings, and moves forward to make room for the next plane. Then follows an experience that many pilots find even more stressful than the landing itself. A teen-aged member of the deck crew waves the pilot forward with a lighted wand. As the pilot taxis toward the bow of the ship, he feels his wheels slip on the oily deck. Onward the baton beckons him, into the darkness. At the edge of the abyss, he pivots and parks with the tail hanging out over the ocean. Even pilots with hundreds of landings to their credit make those last few movements with one hand on the ejection handle. They know that, if the plane slips over the side, the only realistic chance of survival is to eject and hope to be rescued.

With experience, daylight landings become fairly routine, even fun. But a pilot's feelings during a nighttime landing are never far from the edge of sheer terror. Even those with hundreds of landings to their credit think about dying. ■

Orr Kelly, a Washington-based writer, covered the Pentagon for the Washington Star *and for* US News & World Report. *This article is adapted from his book,* Hornet: The Inside Story of the F/A-18, *and is reprinted with permission of Presidio Press. Copyright 1990 by Orr Kelly.*

From Donald Duck to the Hat in the Ring, official archives register nearly 9,000 unit emblems.

Patches

By Jeffrey P. Rhodes, Aeronautics Editor

Photos by Paul Kennedy

DURING World War II, if an airman walked into certain pubs with the "wrong" shoulder patch, it was, at the very least, grounds for ridicule from the other patrons, a majority of whom usually belonged to another squadron.

A unit's insignia, usually taking the form of a uniform patch, has been a rallying device for squadrons and wings since the beginning of air combat. Patches are even written up in the regulations: "The Air Force encourages the use of emblems as a means of fostering unit pride and morale."

Today, Air Force Regulation 900-3 explains in great detail what can and can't be used as a unit symbol. Typically, however, it was the flyers and maintainers in the field who first started identifying themselves by use of distinctive symbols.

During World War I, the wearing of individual unit markings by ground troops was authorized soon after the American Expeditionary Force landed in France. However, by War Department order, the unit symbols devised by the Aero Squadrons were only to be used on

Members of the animal kingdom growl, crawl, snort, butt, or otherwise make their way onto the patches of Air Force units. Representative fauna include (clockwise from left) a tiger from the Air Force Reserve's 906th Tactical Fighter Group, an F-16 unit at Wright-Patterson AFB, Ohio; a spider from Air Force Space Command's 8th Missile Warning Squadron, a Pave Paws radar unit at Eldorado AFS, Tex.; a charging bull from the Air Force Prime BEEF (Base Emergency Engineering Force) civil engineering teams; and a rampaging billy goat from Air Training Command's 559th Flying Training Squadron, the T-37 instructor pilot trainers at Randolph AFB, Tex.

Bright, colorful unit patches differentiate various units, but they don't help folks hide once the shooting starts. Most units now wear subdued versions of their unit insignia on their work clothes. This low-visibility "family portrait," though slightly outdated, illustrates the typical chain of command. At Hurlburt Field, Fla., the 16th (AC-130H Spectre), 8th (MC-130E/H Combat Talon), and 20th (MH-53J Pave Low III and MH-60G Pave Hawk) Special Operations Squadrons come under the 1st Special Operations Wing (center). Previously, the 1st SOW reported to Twenty-third Air Force (upper left), which, in turn, reported to Military Airlift Command (center left). The 1st SOW now reports to the newly created Air Force Special Operations Command.

airplanes and, oddly, to differentiate crew luggage. The designs were not to be used as shoulder insignia.

Eight months after the Armistice, Brig. Gen. Billy Mitchell (at the time Acting Chief of the Air Service) insisted that he be given the authority to approve aircraft and unit markings. The emblems of the fifty-five Aero Squadrons that had seen service in France during the war were officially approved in November 1919.

The insignia, as much symbols of teams as football helmets are (and quick, visual means of identifying aircraft), ranged from the Seminole (later Sioux) chief in full warbonnet used by the 103d Aero Squadron (the Lafayette Escadrille, after it had been absorbed into the AEF) to the probing searchlight beams that formed the Roman numeral nine (IX) used by the 9th Aero Squadron.

Capt. Eddie Rickenbacker, America's leading ace in World War I, went into the automobile business after the war. He wanted to use the Hat-in-the-Ring symbol, which his unit (the 94th Aero Squadron) had made famous, as a decoration for

A few units still active today can trace their lineage to the very beginning of military aviation. The 27th (top) and 94th (right) Aero Squadrons from World War I are now known as the 27th and 94th Tactical Fighter Squadrons and are assigned to the 1st Tactical Fighter Wing at Langley AFB, Va. These two F-15 units were among the initial wave of US forces sent to Saudi Arabia for Operation Desert Shield this past summer. The 94th may be the best known squadron in Air Force history because of Capt. Eddie Rickenbacker (far right), the leading US ace of World War I. The 25th Aero Squadron (left) is now the 25th Strategic Training Squadron, the only flying unit directly assigned to Strategic Air Command's Strategic Warfare Center at Ellsworth AFB, S. D.

—Design © Walt Disney Productions

In 1959, for the sum of $1.00, Walt Disney Productions allowed Jiminy Cricket to serve as the mascot of the 3d Mobile Aerial Port Squadron at Pope AFB, N. C. (Jiminy, left, in subdued hues; right, in full color). The load adjuster in the dapper insect's right hand represents the squadron's loadmasters; the umbrella in his left, being used a parachute, represents parachuting combat controllers. Several cartoon characters were "called up" for service in World War I, and a whole host of funny-paper denizens, including many from Disney, saw service on unit patches in World War II.

Contractors are justifiably proud of their products, and pilots and crews usually love to brag about their aircraft. By providing patches such as these, contractors allow the blue-suiters to wear their aircraft on their sleeves, and the companies get some free advertising. The "F-16 Fighting Falcon" patch (upper right) is given to US pilots by General Dynamics. Pilots being pilots, GD has the patch made up bearing the flag of each nation that flies the aircraft. McDonnell Douglas gives the "Eagle Driver" patch to F-15 pilots, while the mechanics get the "Eagle Keeper" patch. Not to be outdone, pilots who flew slow and low in the Cessna O-2 forward air control aircraft (called "ducks" because of the way the main landing gear retracted) came up with their own knockoff design—the "Duck Driver" insignia.

Intercontinental ballistic missiles have only been a part of the Air Force since the late 1950s. As a result, many ICBM wings and squadrons were assigned the unit designation numbers of deactivated World War II bomb units. The new units adopted the insignia of their predecessors, adding missile symbols. The 490th Strategic Missile Squadron (left), a Minuteman II unit at Malmstrom AFB, Mont., descends from the 490th Bomb Squadron in World War II. The 400th SMS at F. E. Warren AFB, Wyo. (right), the only Peacekeeper unit in the Air Force, harks back to the 400th Bomb Squadron in World War II, and the unit today pays homage to its history by wearing the 90th Bomb Group "Black Pirates" insignia (far right) as its unofficial, "off-duty" patch. Not all missile units go quite that far back; the 91st Strategic Missile Wing (center), a Minuteman III wing at Minot AFB, N. D., was started as a strategic reconnaissance wing and was activated in 1948.

the car's grille, but the Army Air Service objected. Since legal ownership of the logo had never been established, Captain Rickenbacker used the emblem anyway. In the aftermath of his action, the first official regulations governing squadron insignia were issued on September 19, 1923.

During World War II, the rapid expansion of the Army Air Forces led to an avalanche of insignia being submitted to the War Department for approval. Almost 600 squadron and 200 wing, group, and higher headquarters emblems had been approved by 1944. Then, as today, the squadron patches tended to be much more colorful than the staid, "dignified" wing and headquarters designs.

The units didn't always come up with completely original designs. At the request of several squadrons, Walt Disney sent Mickey Mouse and Donald Duck to war. Bugs Bunny answered the draft board's call while under contract at Warner Brothers. Alley Oop and Krazy Kat also left their regular jobs in the funny papers to join the fight against the Axis.

The Air Force Historical Research Center at Maxwell AFB, Ala., is the keeper of all unit insignia. "We get close to 300 new emblems a year, including some that are changes that come from a unit's having its mission changed," said Jay Godwin, the archivist in the Office of Heraldry at Maxwell. "Most of them start out as just a rough sketch."

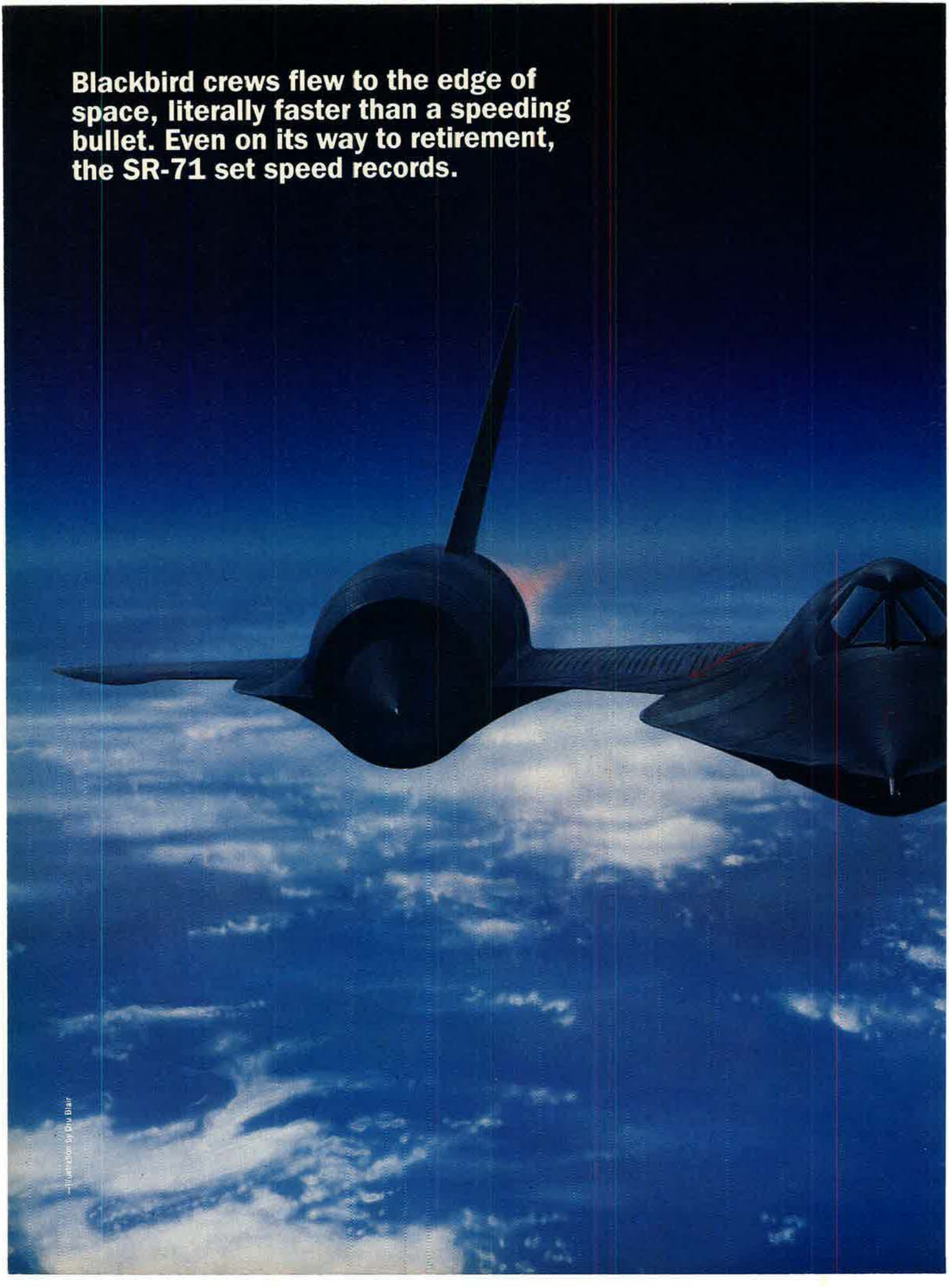
From early symbols of unit pride has sprung a complete branch of military heraldry. Close to 9,000 emblems of active and inactive units dating back to the beginning of military aviation are registered at Maxwell. "We still don't have them all," noted Mr. Godwin. "I think many units, especially the newer ones, aren't aware of AFR 900-3 and that their insignia designs have to be recorded with us."

The patches shown here are only a sampling of those thousands of official emblem designs (as well as a few unofficial ones), covering squadrons and wings that have flown or worked with everything the Air Force and its predecessors have had, from Nieuports and Spads to Peacekeepers and B-1Bs. ■

Some Air Force units fight only with electrons. The 28th Air Division at Tinker AFB, Okla. (top), has control over many of the Air Force's EC-135s and EC-130s and all of its E-3s. The 552d Airborne Warning and Control Wing, also at Tinker, flies Boeing E-3B/Cs; the unit dates back to 1955, when it flew RC-121s.

Although standard unit patches are seen less and less, Strategic Air Command crews still tend to wear them more than do crews of most other commands. This SAC "family portrait" represents a significant part of the Air Force's past and its future. The chain of command flows from SAC (lower right) to Eighth Air Force (upper right) to the 509th Bomb Wing at Pease AFB, N. H. (center). The 509th started out as a Composite Group during World War II, and the unit's 393d Bomb Squadron (top) was the unit that dropped the atomic bombs on Japan. Today, the 393d and the 715th Bomb Squadron (left) fly FB-111s, but not for too much longer. The aircraft are being turned over to Tactical Air Command, and the wing is to be deactivated when Pease is closed. The 509th BMW is scheduled to be reactivated in the mid- to late 1990s at Whiteman AFB, Mo., where it will be the first operational B-2 wing.

Blackbird crews flew to the edge of space, literally faster than a speeding bullet. Even on its way to retirement, the SR-71 set speed records.



—Illustration by Gru Blair

Almost Astronauts

By Greg Kline

THEY fit somewhere between aviators and astronauts, these men who flew the SR-71 Blackbird and its Lockheed siblings, the A-12 and the YF-12. They flew almost to the border of space, so high they could see the curvature of the Earth. Above 80,000 feet, nearly sixteen miles high, the sky overhead was deep blue, almost black, and stars were visible at noon.

They flew so fast they could literally pass a speeding bullet. Cruising speed exceeded 2,100 miles per hour, three times the speed of sound. They were armed only with cameras and radar—and, of course, that blinding speed. No enemy aircraft ever caught a Blackbird, let alone shot one down.

"It's sort of a fraternity, and not a very large fraternity," says retired Maj. Gen. Frank Elliott, one of these almost-astronauts. "There was only one outfit of SR-71s. There are not that many people who have flown it."

On the lapel of his sport coat, Elliott, sixty-five, wears his "fraternity" pin, a tiny pewter model of the SR-71 with a red "3+" embossed on it. "You have to have flown in excess of Mach 3 to get that pin," he explains. He's a silver-haired man who retains his military posture and sometimes lapses into a Chuck Yeager-like drawl common to many pilots of hot airplanes.

—Photo by Erik Simonsen

The SR-71 could well have flown into the twenty-first century, contends Elliott, and many other former crew members agree. When the Air Force retired the plane this year and shipped the dozen or so remaining Blackbirds to museums and to NASA, obsolescence wasn't the reason. It still holds world records for speed over a straight course (2,193 mph) and altitude in horizontal flight (85,069 feet). In March, the aircraft shattered the Los Angeles–Washington, D. C., speed record, making the trip in sixty-eight minutes, seventeen seconds, on its way to its new home, the National Air and Space Museum.

What doomed the SR-71 was money—or, rather, the lack of it. The plane was expensive to operate ($200 million to $300 million each year; $18,000 per hour for special fuel alone), and an existing network of satellites could perform its photographic mission. The cost to operate the fleet of SR-71s equaled the operating costs of two fighter wings, and their data could be obtained elsewhere.

—Photo by Eric Shulzinger

Because of the environment in which the SR-71 flew—above 80,000 feet and at speeds past Mach 3—the crew had to wear pressure suits (left). This fashion statement made them even look like astronauts.

—Photo by Eric Shulzinger

For almost twenty-five years, the SR-71 was the fastest means of getting reconnaissance information. The Blackbird, a quantum leap in technology when it first came out, is still a technological marvel, even in retirement.

Born in the Black

Frank Elliott had his eyes on the Blackbird early, when the plane was still "in the black" and unknown to all but a select few. He saw it well before the day that President Lyndon Johnson, trying to deflect soft-on-defense charges from challenger Barry Goldwater, raised eyebrows by publicly acknowledging the SR-71's existence during the 1964 Presidential campaign.

In 1962, the first of the super-secret spy planes—then designated A-12—were flying from the classified Groom Lake, Nev., testing facility, dubbed "the ranch." Elliott was commanding the 465th Strategic Aerospace Wing at Beale AFB, Calif. Specially modified KC-135 tankers from his unit carried out the in-flight refueling of the fledgling Blackbirds. The tanker pilots went through security checks before being assigned to the mission. Some crew members worked behind screens that prevented them from seeing what kind of plane was being refueled.

"We were doing this for two years before the airplane came out of the black," says Elliott, now retired and working as the economic development coordinator for the municipality of Rantoul, Ill. "By that time, I wanted to fly it so bad I could taste it."

He would wait six more years for the chance. It finally came in 1970 when, after a tour of duty at the Pentagon, Elliott was named commander of the 14th Strategic Aerospace Division at Beale AFB. By then, the SR-71s, now fully operational and flying missions over Vietnam and other world hot spots, were based there as part of the division's 9th Strategic Reconnaissance Wing.

Today, pictures and paintings of planes Elliott flew over a thirty-year Air Force career line the walls of his office: B-24 and B-52 bombers, F-4 Phantom fighters. The largest display is a montage depicting SR-71s. In one head-on photo of a parked Blackbird, the twin tail fins, bulging engine nacelles, and single eye of its front cockpit canopy give the plane the appearance of an angry insect. Another shot, looking down on the plane in flight, reveals its futuristic lines.

In his biography, former Soviet pilot Lt. Viktor Belenko, who defected in 1976, writes about (then) top-of-the-line Russian MiG-25 fighters attempting to intercept SR-71s operating along the Soviet Union's east coast. The Blackbirds taunted and toyed with the MiG-25s, reports Lieutenant Belenko,

In the very early days, the program was "black" (classified), but the airplane wasn't. This is the first photograph officially released of the Blackbird, identified by President Lyndon B. Johnson as the "A-11." It is actually a YF-12A, the interceptor member of the Blackbird family. Only three YF-12As were built. They were armed with four Hughes AIM-47 missiles.

In 1970, Brig. Gen. Frank Elliott commanded the 14th Strategic Aerospace Division, Beale AFB, Calif., and flew a Blackbird.

"scooting up to altitudes the Soviet planes could not reach and circling leisurely above them, or dashing off at speeds the Russians could not match."

Legend has it that the Blackbird could photograph the numbers on a license plate from an altitude of 80,000 feet. The Air Force never confirmed that, although it has admitted that one could probably identify a person from some of the SR-71's pictures.

Elliott is certainly not alone when he says that "a lot of tears were shed" over the demise of the SR-71. There is a mystique about these planes. For the public, it is a mystique built on flying speed, altitude, and the secrecy that shrouded the Blackbird. For the crew members, it likely comes from being almost-astronauts.

Elliott recalls undergoing "an astronaut physical" before being allowed to pilot the Blackbird. Preparations for an SR-71 flight in many ways resembled the launch process for a space mission.

Breathing Pure Oxygen

The plane's two-man crew, a pilot and reconnaissance systems operator, ate special meals before a flight and breathed pure oxygen. The oxygen purged nitrogen from their bloodstreams and prevented the high-altitude problem of severe cramping. They also underwent an abbreviated physical before being helped into their helmeted flight suits, garments nearly the same as those worn by early astronauts.

A seven-person ground crew strapped them into the SR-71 and gave the plane a detailed preflight examination. A truckload of crew members trailed it down the runway on takeoff, visually confirming that all systems were go. Then they were off ("You really get a kick in the tail when you start," says Elliott) and up and up and up, leaving a trail of shock diamonds and sonic booms behind them.

Finally, the crew would be alone. Even though they were at 80,000 feet and clipping along at three times the speed of sound, there was little sensation of speed, says Elliott. At that altitude, there were no visual clues as to their progress.

Outside, the temperature on certain portions of the SR-71's titanium skin neared 1,000 degrees Fahrenheit. Expansion from the heat made the plane grow nine inches longer during a normal flight—an amazing statistic considering the Blackbird's titanium skin. Once on the ground again, the plane would cool and contract to its former size. Inside, air-conditioning kept the tight-fitting cockpit at a cool sixty degrees.

Though the stars always were out at that altitude, there was little time to gaze at the constellations. Most of a flight was spent monitoring instruments and staying on course, recalls Elliott. When traveling at thirty-two miles a minute, a wrong turn can result in a detour of several hundred miles—or more—quickly. Planned turns started 100 miles ahead of the actual event. It was hard work. The plane's design may have been from the future, but its controls were strictly from the 1950s and 1960s, before cockpit computers took over many routine flying chores.

The All-Important "X"

SR-71 crews took off knowing their exact longitude and latitude, their precise location on the face of the Earth. An "X" on the ground under the front wheels of the plane's landing gear marked the exact spot. The crews needed to know just where they started to get where they were going. At an altitude of fifteen miles, there weren't any landmarks.

"This [aircraft] flew very conventionally, very responsive[ly]," Elliott says. "The systems were very reliable. We very seldom had any problems at all. But you could never relax. If you have a problem up there. . . ." Elliott's voice trails off. (Others did sometimes have mechanical problems, including a number of SR-71 "unstarts," or engine shutdowns in flight.)

Most Blackbird flights ranged in duration from two and a half to six hours. Some, however, might last as long as ten or twelve hours. One day, the destination may have been the Persian Gulf or Cuba, the next China or Lebanon, all places the planes are known to have operated over in an estimated sixty-five million miles of flying and spying.

On the ground afterward, support crews were warned not to touch the Blackbird for half an hour, until it cooled down. The postflight inspection checklist included 650 steps.

"It was one of a kind," Elliott says, a little sadly, lightly tapping an old photo of himself in a flight suit, helmet under the crook of his right arm, standing in front of an SR-71. His hair and the plane are black. ■

Greg Kline is a reporter for the Champaign-Urbana, Ill., News-Gazette, where for four years he covered events at Chanute AFB, Ill. This is his first article for AIR FORCE *Magazine.*

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There is real concern about what might happen to 30,000 warheads in a volatile USSR.

The Spooky Question of Soviet Nukes

By Susan Katz Keating

IF THE Soviet Union shatters under political, ethnic, and national pressures, what will happen to the nuclear weapons based in its contested regions? What is the likelihood that, under present security conditions, one or more of its estimated 30,000 warheads could be stolen and used to achieve local political or private goals, or even sold to another nation?

In light of recent events in the USSR, such questions are far from fanciful. "They are legitimate, worrisome issues," says Brookings Institution analyst Bruce G. Blair, a former Air Force officer and a student of Soviet nuclear weapons issues since the early 1970s. "They have been a growing concern in Washington, and the Soviets are very sensitive to the problem."

That is not surprising. Last January, Soviet television announced that Muslim separatists had stormed an arms dump in the Soviet Central Asian Republic of Azerbaijan. William H. Webster, director of the Central Intelligence Agency, stated in a February interview that the armed fundamentalists had attacked a nuclear weapons stockpile near the Azerbaijani capital of Baku. The raiders, he said, were driven off in a firefight with Soviet troops. In addition, one US intelligence official reports that dissidents almost captured a nuclear weapon.

When Lithuania began its war of nerves with Moscow, it didn't take too much imagination to see the breakaway republic in terms of other, more violent ethnic regions. Lithuania and its environs are home to one of the largest concentrations of nuclear warheads. Located there are a medium-range missile base and artillery shell depots.

Adding to this already disturbing picture is RAND Corp.'s prediction that the USSR will be in serious danger of civil war within five years. Already this year, hundreds of rebels have been killed in disturbances, not only in Azerbaijan but also in Tadzhikistan and Uzbekistan.

Concern exists that republics that contain large Islamic populations, such as Uzbekistan, harbor violent fundamentalist groups that may well be prepared to attempt to capture and transfer a nuclear weapon to an outside nation, such as Iran.

In these circumstances, no less an authority than Senate Armed Services Committee Chairman Sam Nunn (D-Ga.) has repeatedly voiced concern about what could happen to Soviet weapons. Even before the onset of today's unrest in the Soviet Union, Senator Nunn had called for a full-scale review of USSR and US nuclear safety procedures.

The Soviets are reported to have relocated to more secure positions some of their more vulnerable assets. US officials report that the Soviet central government has begun transferring certain weapons out of volatile non-Russian republics into the Russian republic. The move seems geared to bring about even closer central control of tactical nuclear weapons such as bombs, artillery shells, and warheads atop short-range missiles. Soviet strategic weapons, located for the most part in remote, heavily guarded Russian sites, are unaffected.

Cautious but Not Desperate

For the moment, at least, Moscow's actions seem dictated not by desperation but by extraordinary caution. "The pullbacks are being viewed as prophylactic in nature," reports one analyst assigned to the Defense Intelligence Agency (DIA). "In Lithuania and Latvia, there is grave concern that the Soviet Union will be placed in an embarrassing situation. Losing your nukes doesn't sit well with the international community."

In this murky and chaotic setting, it has become an arduous task for Westerners to keep precise tabs on the status of the entire Soviet nuclear arsenal. Says Mr. Blair, "No one knows exactly where all the warheads are."

Even the number of Soviet nuclear weapons is a mystery. Neither Washington nor Moscow has ever provided anything like an official, definitive, public accounting of the Soviet stockpile. In recent years, vague, quasi-official US estimates have appeared, suggesting that the number of Soviet warheads could be as low as 26,000 or as high as 46,000.

Perhaps the fullest public estimate can be found in "Soviet Nuclear Weapons," a 433-page, nongovernment report issued in 1989 by four private analysts. The authors—Thomas B. Cochran, William M. Arkin, Robert Norris, and Jeffrey Sands—based their findings on an exhaustive review of US publications, reports, hearings, and statements, supplemented by interviews. Even they, however, state frankly that the data on numbers are "highly speculative."

"There is grave concern that the Soviet Union will be placed in an embarrassing situation. Losing your nukes doesn't sit well with the international community."

The report suggests that Soviet warhead totals peaked in 1988 at around 33,000 weapons. A general consensus holds that today, following Soviet withdrawal or destruction of some of its weapons, the number has declined to roughly 30,000 warheads. However, allocation of warheads has not changed significantly.

In 1988, according to "Soviet Nuclear Weapons," the USSR's 33,000 warheads were allotted to sixty functional types of weapons and were integrated into eighty-five delivery systems. The warheads were almost evenly divided between strategic weapons and nonstrategic arms such as battlefield missiles, nuclear artillery, and bombs.

Strategic forces were reported to have some 17,200 nuclear warheads, 13,000 of them fitted on offensive weapons and held as spares and 4,200 on defensive weapons such as surface-to-air missiles (SAMs) and antiballistic missile weapons. Another 15,400 or so were assigned to substrategic land, air, and naval systems.

With regard to function, the largest group of warheads was concentrated on land-based, intercontinental ballistic missiles (ICBMs), which account for an estimated 7,600 warheads. Next came the warheads assigned to land-based, substrategic aircraft—that is, theater bombers and fighter-bombers—with an estimated 5,100 warheads.

The USSR's substrategic, land-based, surface-to-surface missiles (SSMs) carried approximately 4,700 warheads. Soviet SAMs dedicated to strategic air defense were assigned 4,100 warheads. Another approximately 4,000 nuclear warheads were fitted atop strategic, submarine-launched ballistic missiles (SLBMs).

About 2,000 nuclear-weapon shells had been stockpiled for use in nuclear-capable artillery. Naval antisubmarine warfare forces deployed about 1,400 nuclear depth bombs and other nuclear charges. For its part, the Soviet strategic bomber force had relatively few nuclear weapons (1,400). The remainder of the 33,000 weapons were scattered in other delivery systems.

Nuclear weapons have been assigned to all branches of the Soviet military. In rough estimate, the single largest portion of nuclear warheads is managed by the Strategic Rocket Forces (SRF). Next comes the Ground Forces, followed by the Troops of Air Defense, the Air Forces, and the Soviet Navy.

The high-profile ICBM force is dispersed among twenty-two bases managed by the SRF. These bases are located principally within the Russian republic, mainly along the

Trans-Siberian Railroad. Exceptions are two bases in the Ukraine (Derazhnya and Pervomaysk) and two in Kazakhstan (Imeni Gastello and Zhangiz Tobe). Another site, Dombarovski, sits on the border between Russia and Kazakhstan.

The two bases in the Ukraine were among only three in the USSR which house the nation's long-range SS-19 missiles. The SRF began removing these from the active inventory and replacing them with silo-deployed versions of the new, ten-warhead SS-24. Kazakhstan's ICBMs are newer models of the heavyweight, ten-warhead SS-18.

Soviet bombers are deployed on twenty-two bases, only five of which are located east of the Ural mountains. The western bases include several outside the Russian Republic. Some Tu-16 "Badger" medium-range bombers, for example, are based at Bobruysk in Byelorussia. Other bombers are stationed at Tartu in Estonia. Of five bases east of the Urals, only one is located in a non-Russian republic. That is Dolon, in Kazakhstan, which houses Tu-95 "Bears."

The four Soviet fleets deploy from thirty-eight naval bases. The Northern and Pacific Fleets have the principal responsibility for seagoing nuclear missions. The Baltic Fleet, headquartered at Baltiysk, near Kaliningrad (wedged between Lithuania and Poland), does have some nuclear-capable submarines. The Black Sea Fleet, headquartered in Sevastopol, is not known to have nuclear capabilities.

Sequestering the Warheads

Brookings analyst Blair cautions against equating the locations of nuclear weapon systems with the presence of warheads on a one-for-one basis. "People count delivery systems and assume there are nukes nearby," he says. "I don't believe they do have any warheads stored nearby. They are elsewhere, at depot sites."

US specialists believe that each of the Soviet Union's fourteen military districts has as many as three nuclear storage sites containing mostly 152-mm artillery shells, plus warheads for tactical missiles. The number of warheads per site is not known, but Mr. Blair estimates that each site could hold anywhere from the low teens of weapons to the low hundreds. A relatively small number of nuclear stockpiles is kept forward in ethnic regions, he adds, claiming that a majority is kept behind Russian territorial lines.

That is no accident. "The good news," says Mr. Blair, "is that the Soviets have an obsessive sense of control about nuclear weapons." That view is echoed by John Baker, a Soviet Affairs specialist at Pacific Sierra Research, a private think tank near Washington, D. C. "The Soviets have been thought to be very interested in command and control," maintains Mr. Baker. "There have been times, for example, when our tactical nuclear weapons were under the control of a lieutenant or a sergeant. That practice, of relying on a low-level officer, would be out of the realm of possibility for the Soviets."

Washington specialists maintain that the Soviet Union takes a multilayer approach to protecting its nuclear weapons, ranging from technical safing devices to large numbers of guards.

They say the Soviet Union has carefully instituted methods to slow the process by which a nuclear device could be activated. The simplest of these is the physical separation of warheads from launching devices. Even smaller systems, such as SAM launchers, are believed to be stored separately from corresponding warheads, the plan being to ship them forward in time of crisis or war.

While various military branches have control of the weapon delivery systems, the warheads themselves are under the watch of the Committee for Defense and State Security, the KGB. Several hundred KGB troops are assigned to each storage facility.

"The KGB has a major element exclusively concerned with this," says Robert T. Crowley, a former CIA official and co-author of *The New KGB: Engine of Soviet Power.* He claims that the KGB has been charged with the twin tasks of guarding and transporting the warheads. It has been singled out, says Mr. Crowley, because throughout the recent turmoil it "has maintained its integrity and discipline," in terms of supporting the Soviet regime.

Strengthening Their Grip

The vast majority of the KGB leadership, he adds, is ethnic Russian. In the past three years, the agency has tightened its supervision of non-Russian ethnic areas. Since 1987, for example, the KGB has replaced its top man in nine of the fourteen non-Russian republics. Leaders in Latvia and Kazakhstan were replaced this year.

US experts believe that a significant portion of Soviet warheads is equipped with electromechanical safety devices, similar to so-called Permissive Action Links (PAL) found on most US weapons. PAL devices are installed on the US Air Force's long-range missile and bomber weapons. Evidently, they are not routinely used on the Navy's deployed nuclear weapons.

Vice Admiral Gerald Miller, in 1976 testimony before Congress, provided the best official description of a PAL: "The Permissive Action Link program consists of a code system and a family of devices integral or attached to nuclear weapons, which have been developed to reduce the probability of an unauthorized nuclear detonation. The devices are designed to preclude the use of a nuclear weapon without first inserting the correct numerical code. The code system is a highly secure system, which permits the using unit to obtain the proper numerical code only after the PAL unlock has been authorized."

Maj. Gen. Geli Batenin, military advisor to the Communist Party Central Committee, told the USSR's Novosti press agency on May 15, "In the army, warhead technical safety is ensured by a range of tough precautions against unauthorized use, including electronic code and mechanical blocking, to be lifted only by the supreme military-political leadership, namely the president."

Some claim that on-alert Soviet ICBMs are not fitted with such locks, nor are the strategic missiles on patrolling Soviet submarines. However, only about half of Soviet ICBMs, and perhaps twenty percent of ballistic missile submarines, are on alert at any given time. By comparison, the US keeps almost all on-line ICBMs and sixty percent of on-line strategic submarines on alert status.

In the event of a crisis, say US authorities, President Mikhail Gorbachev and his Council of Defense would authorize the highest-ranking members of the Soviet General Staff to release the codes for locked nuclear weapons. The codes would pass via KGB gatekeepers to the individual military units.

The warheads are virtually impossible to use without the enabling codes. Even with codes activated, certain requirements must be met before a weapon will explode. It must satisfy certain conditions in flight. On-board sensors measure acceleration, number of Gs attained, passage through space, and rate of deceleration.

"All of these things must be done in the proper sequence, and to the proper degree, or the weapon will not explode," says Mr. Blair. "These are internal checks to make sure it flies the plan it is supposed to fly."

Lines of Defense

Western experts generally view weapons in Soviet ICBM fields as being safe under all but the most desperate circumstances. The story is different with respect to tactical weapons. These are more widely dispersed and come in contact with more personnel; therefore, they are more likely to fall into the wrong hands. This might be especially true in the case of SAM emplacements or other remote facilities where the weapons are kept in smaller compounds with fewer guards who might be vulnerable to well-planned attack.

Even so, says Mr. Baker, the probability of that happening is extremely low. "The likelihood of a nongovernment group getting hold of these weapons is no [greater] than [the likelihood of] the outbreak of genuine nuclear war."

The USSR's last line of defense against unauthorized use of a nuclear weapon probably would be physical deactivation. Experts say procedures are in place by which such weapons can be destroyed or effectively disabled.

There is little or no chance that rebel groups could use such stolen weapons, but there is concern that the weapons could be sold to another nation. The purchasing party would be in no better position to activate a warhead, says the DIA analyst. Yet if it could provide the proper type of laboratory, its scientists could extract the plutonium and use it to build a device.

The Soviet military itself presents another potential danger. The largest single custodian of nuclear weapons, the SRF, consists of 298,000 men. The vast majority of officers are ethnic Russian. Forty percent of the conscript SRF troops now are central Asians, who in most cases do not speak Russian and appear to have little affinity with the Moscow government.

In a recent interview with the Moscow *News*, Gen. Col. Igor Sergeyev, the SRF's deputy commander, was less than reassuring about his units. Though he spoke in glowing terms of past performance, noting that there had not been a single breach of regulations in fifteen years, he added that the quality of recruits has dropped sharply because college-bound students are now exempt from the draft.

Official Soviet statistics show that crime within the Soviet military is growing. It rose 14.5 percent over the last year, says the chief military prosecutor, Gen. Alexander Katusev. The Soviet military press has admitted that some sixty officers were killed by their own troops in the past year. One of the biggest problems is theft of small weapons for sale on the black market. *[See "Red Army Blues," March 1990 issue, p. 36.]*

"On the conscript level, they have wall-to-wall discipline problems," says Mr. Crowley. "They are drafted for two years, and there are terrible problems on the bottom level."

In these circumstances, Washington is at pains to assert that it remains confident that Soviet weapons continue to be firmly under control. Yet there is underlying unease.

Crime within the Soviet military rose 14.5 percent in 1989. The military press has admitted that some sixty officers were killed by their own troops in the past year.

In June, for example, Gen. Colin Powell, Chairman of the Joint Chiefs of Staff, affirmed his high confidence in effective Soviet management of nuclear systems. "I am clearly comfortable," he stated, "that those weapons will not get into improper hands."

Then he added a caveat. "We all, as a general proposition, have to watch carefully what's happening within the Soviet Union," he said, noting that Mikhail Gorbachev "has set a large number of forces loose, and he is riding a tiger. . . . We just have to watch it and conduct ourselves in a very prudent, cautious manner as this transformation takes place, and not act as if the transformation has already occurred and [we] know exactly what the Soviet Union is going to look like eight or ten years from now. We don't." ■

Susan Katz Keating, a writer for Insight *Magazine since 1985, specializes in military topics. Her last article for* Air Force *Magazine, "The Outstanding Airmen of the Year," appeared in the September 1990 issue.*

A House panel splits down the middle on the Soviet conventional threat.

Disputing the Fadeaway

THE Defense Policy panel of the House Armed Services Committee, in a report published in July, reached four cheerful conclusions about Soviet military power:

- The conventional force threat to the US and NATO is greatly diminished and cannot be revived.
- To a lesser degree, the conventional threat has also diminished globally. Large-scale interventions outside of Soviet territory are beyond the power of the Red Army.
- While the USSR continues to modernize its strategic forces, the risk of nuclear war has diminished. "The most likely scenario leading to nuclear war has always been escalation from a conflict in Europe," and the probability of such a conflict is now reduced, the panel said.
- Soviet military spending is clearly on the decline.

The report, issued with the approval of all seventeen Democrats on the panel, was rejected by all fifteen Republican members. "We strongly disagree with the certainty and finality with which the report dismisses Soviet military capabilities," the Republicans said in a dissenting statement.

The panel was impressed with Soviet progress and promises about force reductions, but its conclusions were obviously much influenced by the collapse of the Warsaw Pact late last year and the ensuing spread of political independence in eastern Europe.

According to the Pentagon's annual net assessment—essentially completed before the Berlin Wall came down—non-Soviet Warsaw Pact nations had contributed forty percent of the ground forces (albeit a smaller share of the combat potential) in the Western Theater of Operations.

The Soviet Union's "first strategic echelon, including a massive infrastructure of airfields, bases, depots, etc., has been wiped out," the panel said. "An attack on western Europe now requires crossing hostile territory in eastern Europe."

The Republicans noted that "whereas Soviet Defense Minister [Dmitri] Yazov announced on June 3 a ten-year timetable for reducing Soviet forces 'in such a way that they do not damage the armed forces' defense capacity and battle readiness,' pressure is building in the US for large cuts in defense spending beginning this year."

Even if the Soviets make massive reductions to their forces (currently at a strength of 4.2 million), they would have a long way to drop before reaching the current US level (2.07 million in 1990). The expectation is that US forces will be cut by twenty-five percent over the next five years.

The Republicans on the panel have not been alone in questioning the report's assertion that the Soviet military is now too weak to conduct operations away from home. A well-equipped force of four million—or of substantially less than that—would certainly seem sufficient to wage a conflict of considerable size. The Soviet invasion of Afghanistan, for example, was performed with about 100,000 troops.

"The fifty percent reduction achieved in the number of Soviet tanks produced last year, while impressive in percentage terms, still means they produced 1,700 tanks, nearly three times what Congress authorized the US to procure," said Rep. Bill Dickinson (R-Ala.), ranking Republican on the panel.

In many Soviet units, the quality of forces is rising at the same time that numbers are declining. Withdrawn equipment is mostly of older vintage, and delivery of improved equipment continues.

Over the past ten years, the Soviets have built 6,200 aircraft and 26,000 tanks, according to the Army's Gen. John R. Galvin, Supreme Allied Commander in Europe.

In "Demilitarization Is a One-Way Street," a signed article in the *Wall Street Journal*, Gerald Frost, director of the Institute for European Defence and Strategic Studies in London, says that the Soviets are following a "schizoid" policy.

On the one hand, he says, the Soviet Union does not balk at the idea of a reunified Germany as a member of NATO and urges the West not to think of the USSR as an adversary. "On the other hand," he points out, "it goes on improving the Soviet military machine, lavishly equipping it for the high-tech battlefield of the future."

Surveying the changes under way in the Soviet military program, Mr. Frost observes that "no major weapons development program has been stretched or canceled."

Soviet force modernization continues on a broad front. Significant gains are expected in air defense and other high-technology areas. The US Air Force has expressed particular concern about "fourth-generation" fighters, successors to the MiG-29 "Fulcrum" and the Su-27 "Flanker," now in development.

Today's Soviet fighters, the Air Force says, "have improved maneuverability, acceleration, and fire control capability equivalent to our current F-15 and F-16 fighters. It is also projected that the next generation of Soviet fighters will exceed the capability of our most advanced F-15s and F-16s."

Summing it up in a recent speech, General Galvin said that the Soviets will "remain strong. They will remain nuclear. They will remain, for some time to come, unstable and unpredictable and, to some degree, Russian." ■

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Sikorsky's was the first practical helicopter, but a different Russian and a younger Air Service got a chopper off the ground in 1922.

The Flying Octopus

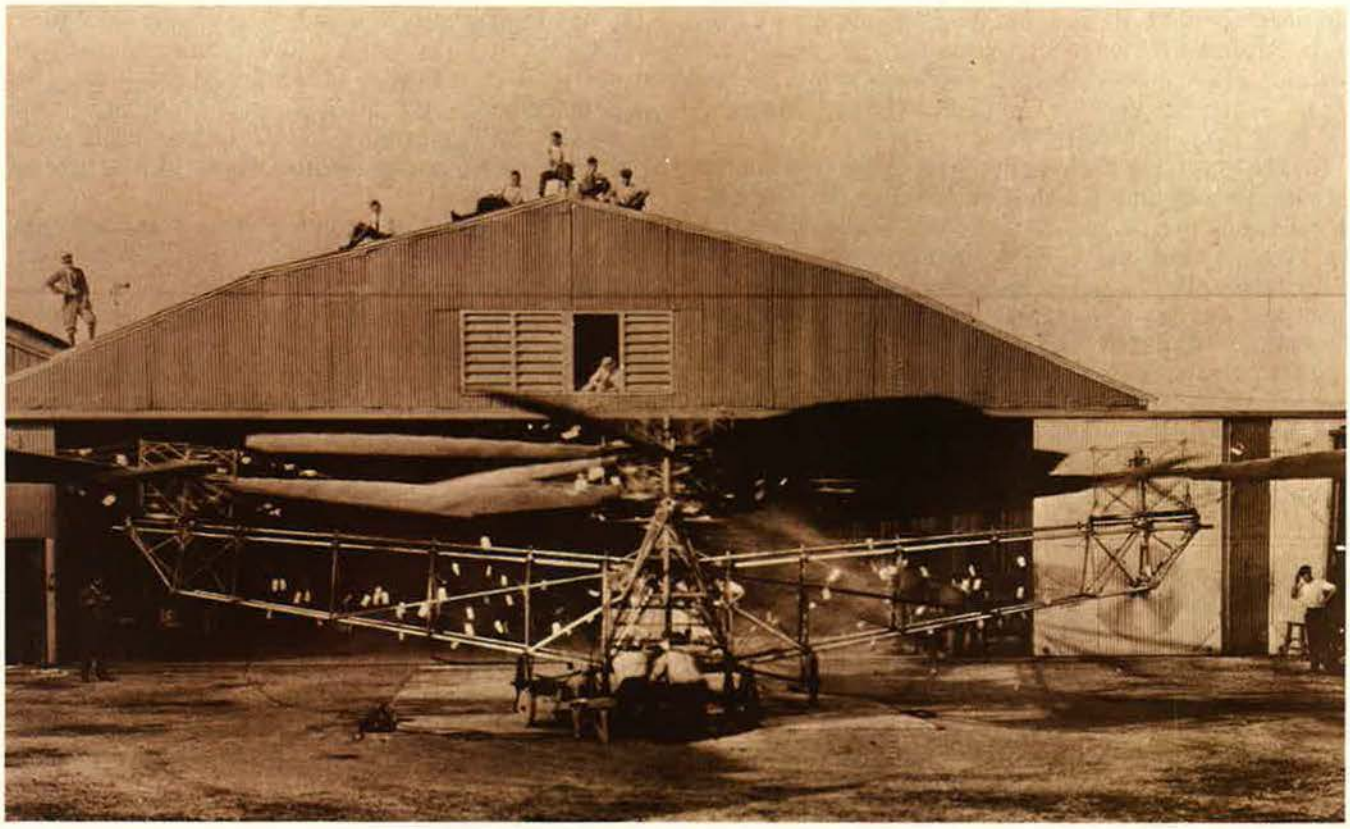
By C. V. Glines

Most aviation historians agree that Igor I. Sikorsky deserves credit for designing, building, and flying the first practical helicopter. His XR-4, the first rotary-winged aircraft accepted by the Air Force, weighed 1,900 pounds and could lift 500 pounds of payload. It first flew in January 1942 and was demonstrated to Gen. Henry H. "Hap" Arnold the next July. General Arnold liked what he saw. "The Army Air Force," said he, "has taken flyers before with not so much gain promised."

One "flyer" to which General Arnold may have been referring was an earlier helicopter venture. Sikorsky's helicopter was not the first bought by the organization that would eventually become the United States Air Force. World War I had stimulated many to explore the possibility of true vertical flight. None had solved the riddle of stability, but the potential of vertical lift machines for military purposes continued to interest many.

Among these were a few officers of the Army Air Service who had become intrigued with the writings of a Russian with a French name: Dr. George de Bothezat. De Bothezat, a scientist who had fled the Bolshevik Revolution, was a big, bearded man with a quick wit and a violent temper. He was also an extreme egotist who once boasted publicly, "I am the world's greatest mathematician and scientist."

In Russia, de Bothezat had gained international renown for his theories about vertical flight. He had earned degrees in five countries and had published two acclaimed theses: "General Theory of Blade Screws" and "Theory of Helicopter Stability." Both found their way to the library of the Air Service Engineering Division at McCook Field, near Dayton, Ohio.



Throughout much of 1921 and 1922, the project was shrouded in secrecy, but on December 18, 1922, Dr. George de Bothezat's assistants rolled out the "Flying Octopus" for its first test at McCook Field, near Dayton, Ohio, observed closely by de Bothezat (at left, in dark suit) and curious onlookers in and on top of the experimental craft's hangar.

In the early 1920s, McCook Field was the Air Service's engineering and flight test center. Workers investigated, researched, and developed any idea that might prove useful to the nation's young air arm. Maj. Thurman H. Bane, chief of the Division, read de Bothezat's treatises and felt that the theories had merit. He asked his superiors for permission to contact de Bothezat and invite him to Dayton. Permission was granted, and the Russian émigré was delighted to accept.

After de Bothezat arrived in Dayton, Maj. Gen. Mason Patrick, Chief of the Air Service, authorized a contract with him, without open bidding, for the construction of a helicopter. This unusual procedure was authorized because no other qualified bidders existed. However, de Bothezat first had to produce a written proposal to make the transaction legal.

Putting It on Paper

De Bothezat was exasperated by this bit of Army red tape, but he nevertheless submitted an eighteen-page letter. "The helicopter here disclosed," it stated, "is . . . to possess all qualities of inherent stability and maneuverability which are essential for the navigation of any vehicle of locomotion. The helicopter considered is essentially composed of four lifting blade screws identical in size and shape and disposed cross-wise."

The letter, accompanied by drawings and diagrams, further described the principles of operation and structure of the craft. General Patrick was impressed. In the 1921 budget, Congress appropriated the astonishing sum of $200,000 for work on the project. De Bothezat was hired as acting chief of the Engineering Division's Special Research Section at an annual salary of $10,000.

The government specified that de Bothezat was to produce "drawings and data to design, construct, and supervise flight tests of a helicopter." In turn, the government was to provide engineering assistants, materials, equipment, and hangar space.

When the Engineering Division received the first set of drawings and computations from de Bothezat, he was to receive $5,000. When the machine was fully constructed, he would receive another $4,800. If it actually left the ground, climbed to 300 feet, and returned to its takeoff point without mishap, he would receive further payments totaling $20,000. The craft was to be ready for flight by January 1, 1922—that is, in seven months.

To keep the curious away and allow de Bothezat and his assistants to work unmolested, the project was given "top secret" status. Work began in a tin-roofed hangar. When the machine began to take shape and outgrew the hangar, a wall of canvas was erected outside to enclose it from view.

Engineers assigned to work with de Bothezat enjoyed the task, despite the Russian's angry outbursts when things didn't go his way. He hovered over their workbenches, watching them turn his drawings into strangely shaped pieces of metal. He spent his waking hours tinkering, figuring, and writing furiously.

The existence of a top secret project right under their noses caused curious McCook test pilots to try to sneak a look at "the thing." Some took to the air to spy on the "mad scientist." At the end of routine test flights, they would swoop low and marvel at the crazy collection of tubing and blades. De Bothezat would shout curses in

Russian and shake his fists, but the pilots merely waved back. Several VIPs were allowed to view the machine, however. These included former Secretary of War Newton D. Baker, Secretary of Commerce Herbert Hoover, and Brig. Gen. Billy Mitchell.

Toward the end of 1921, de Bothezat realized he could not meet the deadline and pleaded for more time. He got an extension, and he and his assistants worked through the winter, spring, and summer, inching toward the day of reckoning. By the fall of 1922, the Air Service's first helicopter was near completion. On December 18, 1922, the machine was ready for the world to see.

Spectators quickly gathered around McCook Field as word of the aircraft spread. It had snowed the day before, but it was now sunny, with virtually no wind. Just after 9:00 a.m., the canvas walls parted, and de Bothezat's crew pushed their pride and joy to the center of the field.

Airborne Octopus

Several spectators gasped, snickered, and then broke into loud guffaws. They saw a strange framework of tubes and wires built into the shape of a giant cross, hung together with a spidery network of pulleys, chains, and metal strands. Four giant, six-bladed rotors were mounted on each end of the cross, and four other fans served as stabilizers. To an onlooker, the machine was a nightmare of steel and aluminum tubing, complicated gears, and guy wires.

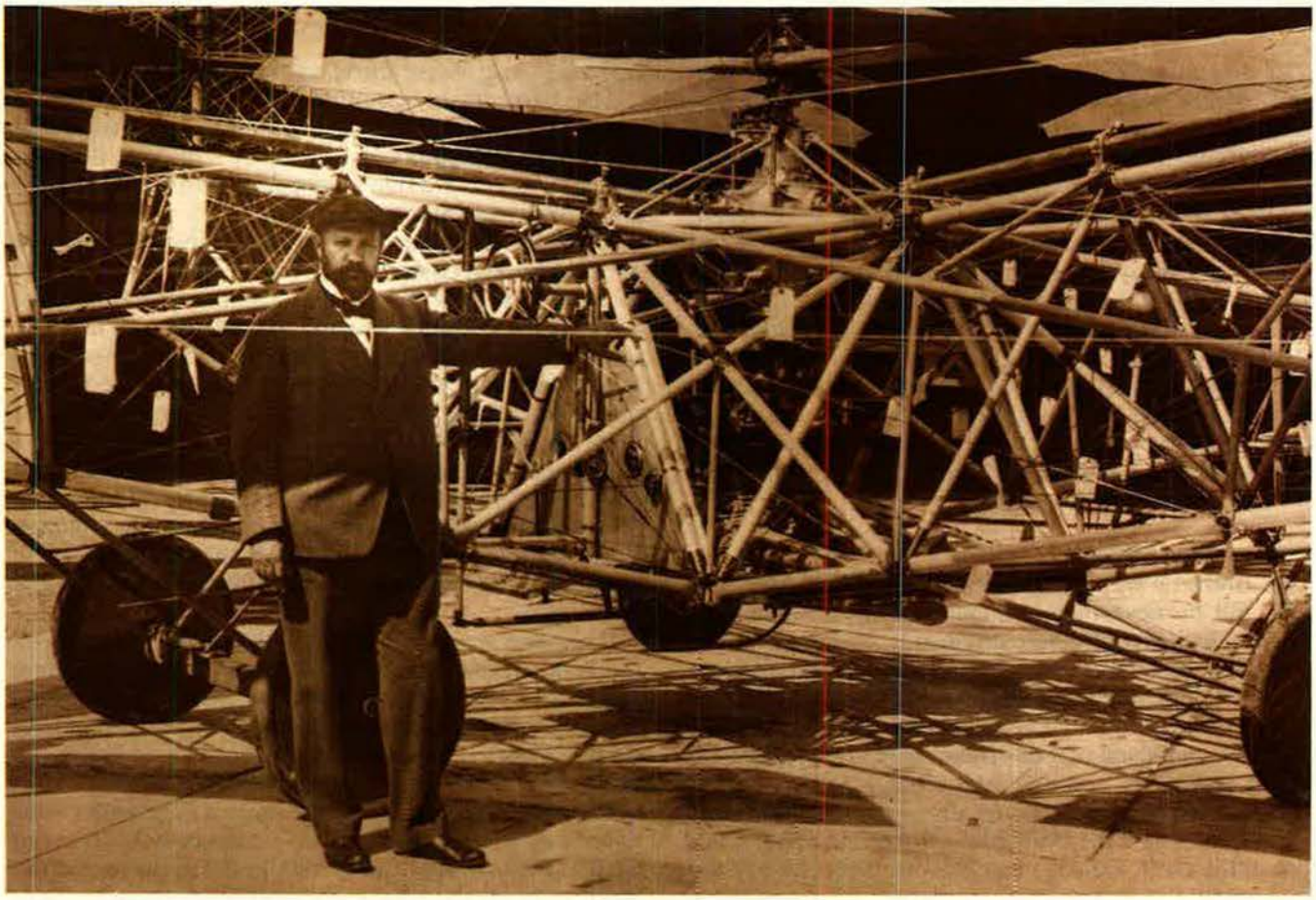
It was immediately dubbed "The Flying Octopus."

Thurman Bane (by then a colonel) had decided that he would serve as test pilot on the first flight. Taking his place in the pilot's seat, he slowly primed the engine and started it. The huge contraption started to vibrate as the four giant rotors began to turn slowly like horizontal windmills.

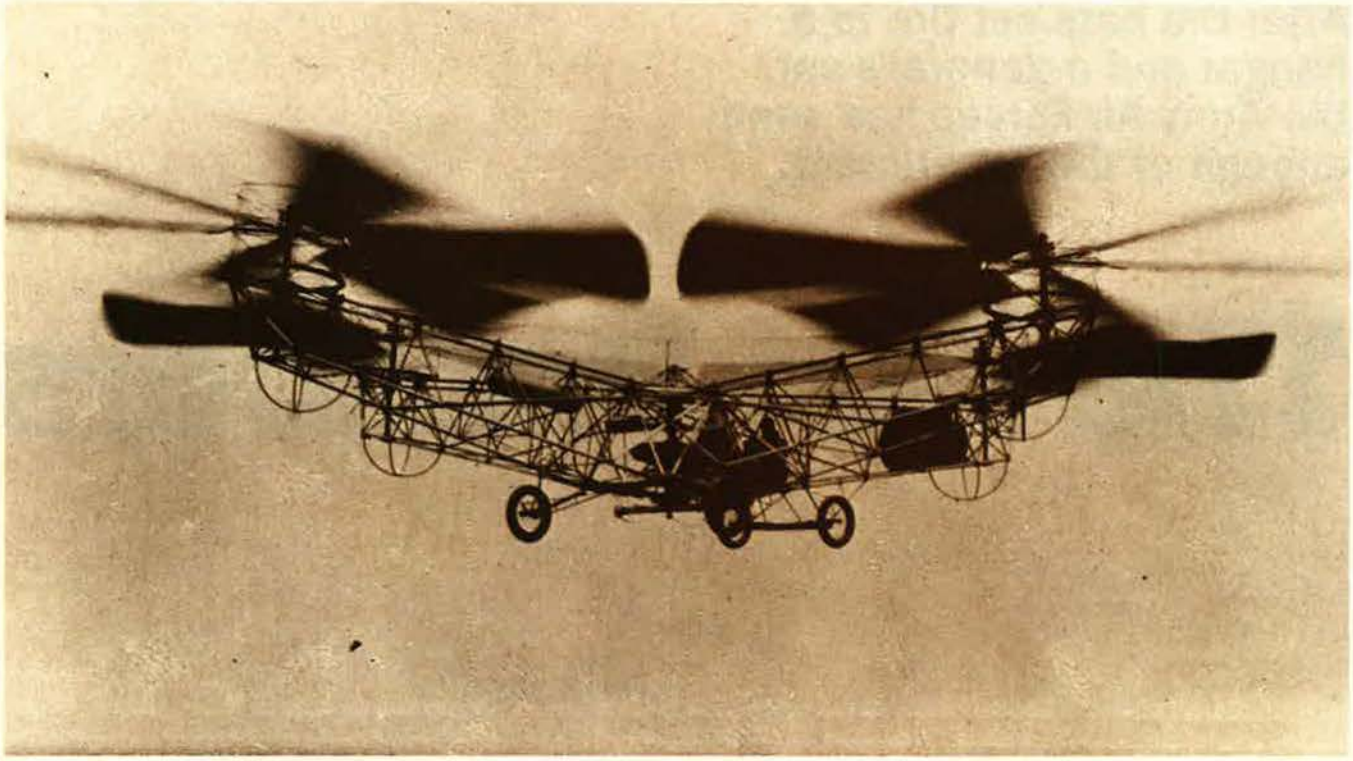
As Bane opened throttle, de Bothezat and his crew stood clear. According to one McCook Field observer, "the movement seemed graceful and there was no noise of friction in any part of the machine. The craft began to lift itself a little—an inch, two, three—until it was about three feet above ground. It hovered at an altitude of two to six feet for one minute and forty-two seconds. Hovering at this height, the helicopter drifted some 300 feet with the wind. Having drifted close to a fence, [Colonel] Bane made a quick landing, which was done under complete control."

The powerplant in the "Octopus" was a 180-horsepower Le Rhône engine, later replaced by a 220-horsepower British Bentley Rotary, which rotated in a horizontal plane directly in front of the pilot's lap. Brig. Gen. Harold R. Harris, one of the helicopter's test pilots, once observed that "the Bentley Rotary was a good engine except that it had a bad habit of throwing cylinders. Fortunately, it never threw one while the tests were underway."

The controls were similar to those of the day's fixed-wing aircraft. A stick and rudder pedals controlled the



Dr. de Bothezat's craft took the form of a giant cross with four identical six-bladed, horizontal rotors on each end. Four other fans worked as stabilizers. All of this was controlled through an elaborate network of gears, pulleys, chains, and guy wires. Shipping tags tied to the framework allowed engineers to observe airflow during test flights.



The Flying Octopus accomplished all of its initial test objectives. In 1923, it carried increasingly heavier payloads and set an endurance record of two minutes and forty-five seconds. Nevertheless, the project was canceled when structural changes specified by the Army Air Service produced no substantial improvements in the aircraft's performance.

pitch of the main blades, and an automobile-style steering wheel controlled the pitch of the three-bladed rotors mounted above the engine. A small hand throttle controlled the engine speed. There were so many gears, handles, and wheels to operate, said one test pilot, that "it not only looks like an octopus, it takes an octopus to fly it."

For example, the test pilot noted, "if the engine failed, the pilot had to reach forward to release the stop on the overall pitch wheel [and] grasp another wheel to adjust the pitch of the center stabilizing propellers so he could slow down the windmilling blades. At the same time, the pilot had to maintain lateral, longitudinal, and directional control with the stick. If he could do all this as he was falling, a fast twist was still needed on the main pitch control at the last minute to soften the landing."

General Harris recalled that "balancing the de Bothezat job . . . was really a tightrope walk in four directions."

Weird, but Workable

Weird as the de Bothezat contraption looked, it made over 100 flights and accomplished all of its initial test objectives. On January 23, 1923, it left the ground with two people aboard and lifted a payload of 450 pounds to a height of four feet. The next month, it set an endurance record of two minutes and forty-five seconds. In April 1923, it lifted four men off the ground.

In the late spring of 1923, the government contracted with de Bothezat for an improved version of the helicopter. The Air Service specified that he had to redesign the central part of the machine to give it strength and reduce the size of the main rotors and make them less flexible. The changes, however, produced no substantial improvements in the aircraft's performance. Reluctantly, General Patrick ordered the project canceled.

In a long letter, Colonel Bane praised de Bothezat. "It is my sincere belief," said the officer, "that your helicopter is the biggest aeronautical achievement since the first flight of the Wright brothers." No less a personage than Thomas A. Edison, who had experimented with helicopters in the 1880s, told the Russian, "You certainly have made a great advance; in fact, as far as I know, the first successful helicopter."

De Bothezat was keenly disappointed by the cancellation but went on to other projects. In 1936, he built another experimental model, which did not show marked improvement over the earlier version. Even so, he appeared before the House Military Affairs Committee that year to advocate continued helicopter research. He predicted that the chopper "would give rise to an entirely new method of warfare, battalions of swift and silently flying machine guns, able to land at night behind [an] enemy's lines."

On February 1, 1940, de Bothezat died in Boston following an emergency operation. He was fifty-eight. Long before then, de Bothezat's "Flying Octopus" had been sent to the McCook salvage yard. However, one rotor hub and four main blades have been preserved and are in the National Air and Space Museum's collection in Washington, D. C. ■

C. V. Glines is a regular contributor to this magazine. A retired Air Force colonel, he is a free-lance writer and the author of many books, most recently Attack on Yamamoto. *His last article for* AIR FORCE *Magazine, "Their Finest Hour," appeared in the September 1990 issue.*

After the bats set fire to a hangar and a general's car, the Army Air Forces had seen enough of the experiment.

The Bat Bombers

By C. V. Glines

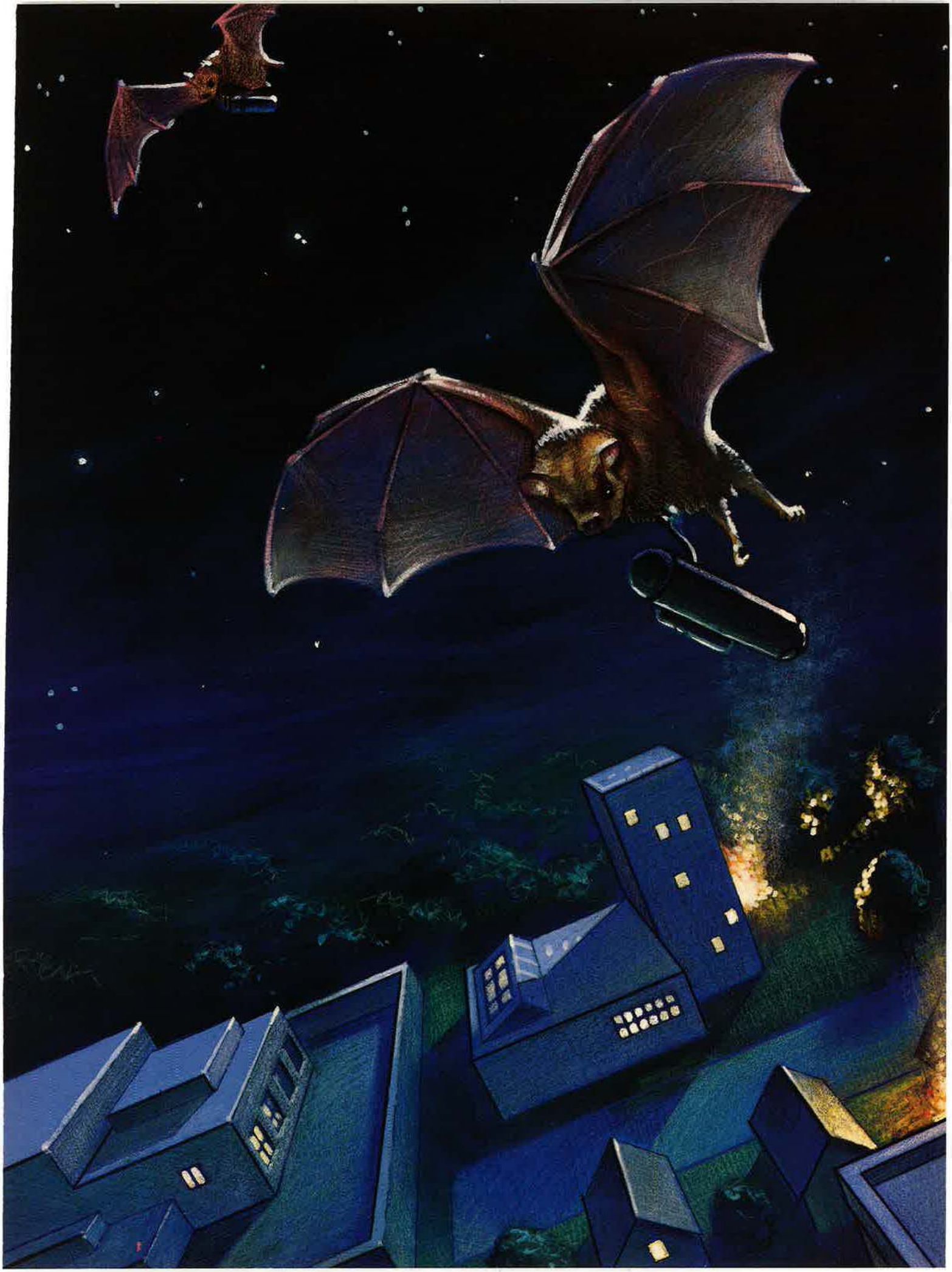
DR. Lytle S. Adams, a dental surgeon from Irwin, Pa., was vacationing in the southwestern US on December 7, 1941. Like millions of Americans, he was shocked at the news from Pearl Harbor and couldn't believe Japan had been able to mount such an attack. In those days, "Made in Japan" meant cheap, shabby, and inferior. Americans' image of Japan was of crowded cities filled with paper-and-wood houses and factories.

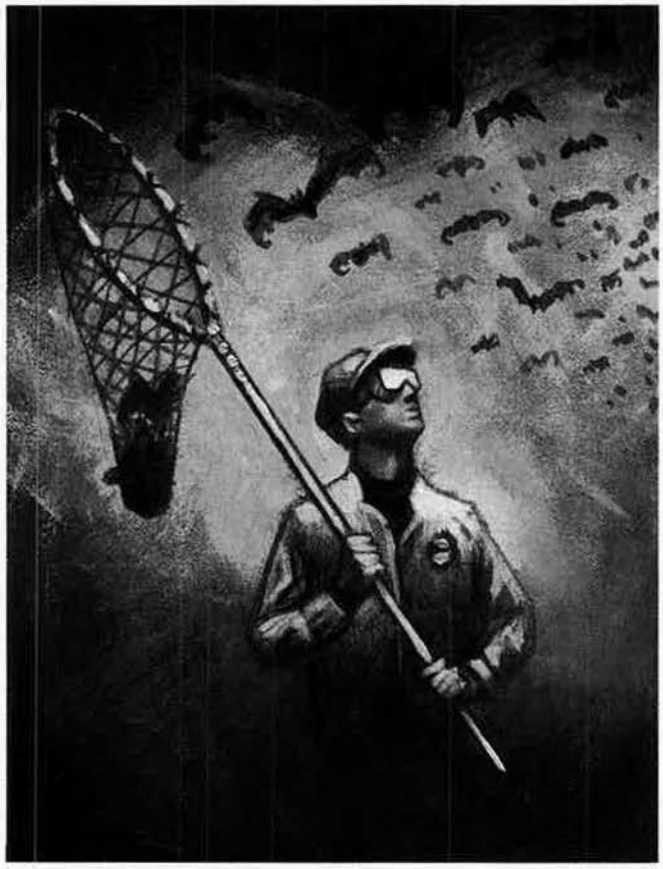
Dr. Adams pondered how the US could fight back. In a 1948 interview with the *Bulletin* of the National Speleological Society, Dr. Adams recalled: "I had just been to Carlsbad Caverns, N. M., and had been tremendously impressed by the bat flight. . . . Couldn't those millions of bats be fitted with incendiary bombs and dropped from planes? What could be more devastating than such a firebomb attack?"

Dr. Adams went back to Carlsbad and captured some bats. At home, he read everything he could find about the tiny flyers. He learned that there are nearly 1,000 species around the world and that each bat lives up to thirty years. The most common bat in North America is the free-tailed, or guano, bat, a small brown mammal that may catch more than 1,000 mosquitoes or gnat-sized insects—a load twelve times its own size—in a single night. Weighing about nine grams, it can carry an external load nearly three times its own weight.

On January 12, 1942, Dr. Adams sent to the White House a proposal to investigate the possible use of bats as bombers. In those days, well-meaning citizens were proposing all kinds of warfare ideas, most of them impractical. However, this idea, after being sifted through a top-level scientific review, became one of the very few

—Illustration by Chris Fauver





—Illustration by Chris Fauver

given the green light. It was passed to the Army Chemical Warfare Service (CWS) for further inquiry in conjunction with Army Air Forces. The official CWS history states simply: "President Roosevelt OK'd it and the project was on."

Dr. Adams and a team of field naturalists from the Hancock Foundation, University of California, immediately set to work and visited a number of likely sites where bats would be available in large quantities. Bats are found mostly in caves, though great numbers roost in attics, barns, and houses, under bridges, and in piles of rubbish. "We visited a thousand caves and three thousand mines," Dr. Adams later related. "Speed was so imperative that we generally drove all day and night when we weren't exploring caves. We slept in the cars, taking turns at driving. One car in our search team covered 350,000 miles."

A Choice of Bats

The largest bat found was the mastiff, which has a twenty-inch wingspan and could carry a one-pound stick of dynamite. However, the team found there weren't sufficient numbers available. The more common mule-eared, or pallid, bat could carry three ounces, but naturalists determined it wasn't hardy enough for the project.

Finally, the team selected the free-tailed bat. Though it weighed but one third of an ounce, it could fly fairly well with a one-ounce bomb. The largest colony of free-tailed bats found by Dr. Adams' naturalists, some twenty to thirty million, was in Ney Cave near Bandera, Tex. The colony was so large, according to a report by CWS Capt. Wiley W. Carr, that "five hours' time is required for these animals to leave the cave while flying out in a dense stream fifteen feet in diameter and so closely packed they can barely fly."

Collection of the bats was not difficult. Three nets, about three feet in diameter, on ten-foot poles were passed back and forth across the cave entrance as the bats flew out. As many as 100 could be caught on three passes. They were removed from the nets and placed in cages in a refrigeration truck. Dr. Adams took some to Washington, releasing them in the War Department building to show Army officials how they could each carry a dummy bomb.

In March 1943, authority to proceed with the experiment came from Hq. USAAF. Subject: "Test of Method to Scatter Incendiaries." Purpose: "Determine the feasibility of using bats to carry small incendiary bombs into enemy targets."

The bats' habits were studied intently. Meanwhile, Dr. L. F. Fisser, a special investigator for the National Defense Research Committee, began to design bombs light enough to be carried by bats. He did not find it difficult, because there was a precedent for miniature incendiaries. England's principal firebombs, used in World War I, were called "baby incendiaries." Filled with a special thermite mixture, these bombs weighed 6.4 ounces each.

Arming the Bats

Dr. Fisser designed two sizes of incendiary bombs for the bomber-bat experiments. One weighed seventeen grams and would burn four minutes with a ten-inch flame. The other weighed twenty-eight grams and would burn six minutes with a twelve-inch flame. They were oblong, nitrocellulose cases filled with thickened kerosene. A small time-delay igniter was cemented to the case along one side.

The time-delay igniter consisted of a firing pin held in tension against a spring by a thin steel wire. When the bombs were ready to use, a copper chloride solution was injected into the cavity through which the steel wire passed. The copper chloride would corrode the wire; when the wire was completely corroded, the firing pin snapped forward, striking the igniter head and lighting the kerosene. Small time-delay smokebombs were also designed so test flights of bats could be traced by ground observers. They burned for thirty minutes with a yellowish flame that could be seen several hundred yards away at night; white smoke was also emitted.

To load a bomb aboard a bat, technicians attached the case to the loose skin on the bat's chest by a surgical clip and a piece of string. Groups of 180 were released from a cardboard container that opened automatically in midair at about 1,000 feet, after which, says the CWS history, "bats were supposed to fly into hiding in dwelling and other structures, gnaw through the string, and leave the bombs behind."

In May 1943, about 3,500 bats were collected at Carlsbad Caverns, flown to Muroc Lake, Calif., and placed in refrigerators to force them to hibernate. On May 21, 1943, five drops with bats outfitted with dummy bombs were made from a B-25 flying at 5,000 feet. The tests were not successful; most of the bats, not fully recovered from hibernation, did not fly and died on impact. The bat-bomber research team was transferred a

few days later to an Army Air Forces auxiliary airfield at Carlsbad, N. M.

Newly recruited bats were placed in ice cube trays and cooled to force them into hibernation. They were then transported to the airfield to await test mission assignments. Captain Carr explains how the test cartons were prepared for the drop tests: "Bats were taken from the refrigeration truck in a hibernated state in lots of approximately fifty. They were taken individually by a biologist, and about a one-half inch of loose chest skin was pinched away from the flesh. While this operation was being done, another group was preparing the incendiaries. One operator injected the solution in the delay [mechanism], another sealed the hole with wax, and another placed the surgical clip that was fastened to the incendiary by a short string. . . . The incendiary was then handed to a trained helper who fastened it to the chest skin of the bat." Drops were made from a North American B-25 and a Piper L-4 Cub.

Complications Arise

There were many complications. Many bats didn't wake up in time for the drops. The cardboard cartons did not function properly, and the surgical clips proved difficult to attach to the bats without tearing the delicate skin. When these problems were somewhat resolved, new bats were taken up for drop tests with dummy bombs attached. Many simply took advantage of their freedom to escape or refused to cooperate and plummeted to earth.

The Army tests were called off on May 29, 1943, and Captain Carr prepared a final report. "The bats used at Carlsbad weighed an average of nine grams," he wrote. "They could carry eleven grams without any trouble and eighteen grams satisfactorily, but twenty-two grams appeared to be excessive. The ones released with twenty-two-gram dummies didn't fly very far, and three returned in a few minutes to the building where we were working. One flew underneath, one landed on the roof, and one attached itself to the wall. The ones with eleven-gram dummies flew out of sight. The next day an examination of the grounds around a ranch house about two miles away from the point of release disclosed two dummies inside the porch, one beside the house, and one inside the barn."

More than 6,000 bats were used in the Army experiments. In his secret report, dated June 8, 1943, Captain Carr concluded that a better time-delay parachute type container, new clips, and a simplified time-delay igniter should be designed if further tests were to be carried out. He also recommended a six-week controlled study of bats during artificial hibernation. After this, he said, another test should be conducted with 5,000 bats.

Captain Carr reported tersely that "testing was concluded . . . when a fire destroyed a large portion of the test material." He did not mention that, in one test, a village simulating Japanese structures burned to the ground. Nor did he state that a careless handler had left a door open and some bats escaped with live incendiaries aboard and set fire to a hangar and a general's car. Records do not reflect the general's reaction, but he could not have been pleased. Shortly thereafter, in August 1943, the Army passed the project to the Navy, which renamed it Project X-Ray.

—Illustration by Chris Fauver

The Sea Services Take Over

In October 1943, the Navy leased four caves in Texas and assigned Marines to guard them. Dr. Adams designed screened enclosures that were prefabricated at Hondo Army Air Field and placed over the cave entrances to capture the bats. A million could be collected in one night if necessary. By that time, the Navy had handed the project off to the Marine Corps.

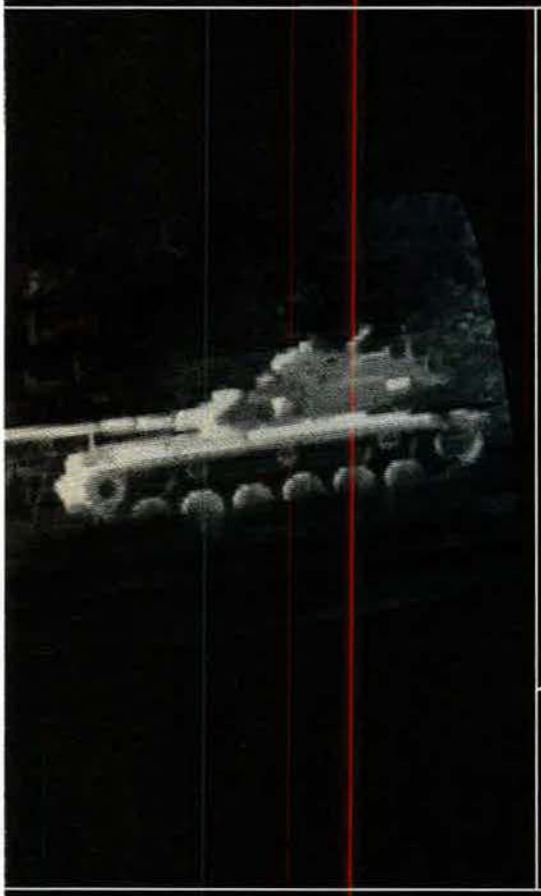
The first Marine Corps bomber-bat experiments began on December 13, 1943. In subsequent tests, thirty fires were started. Twenty-two went out, but, according to Robert Sherrod's *History of Marine Corps Aviation in World War II*, "four of them would have required the services of professional firefighters. A new and more powerful incendiary was ordered."

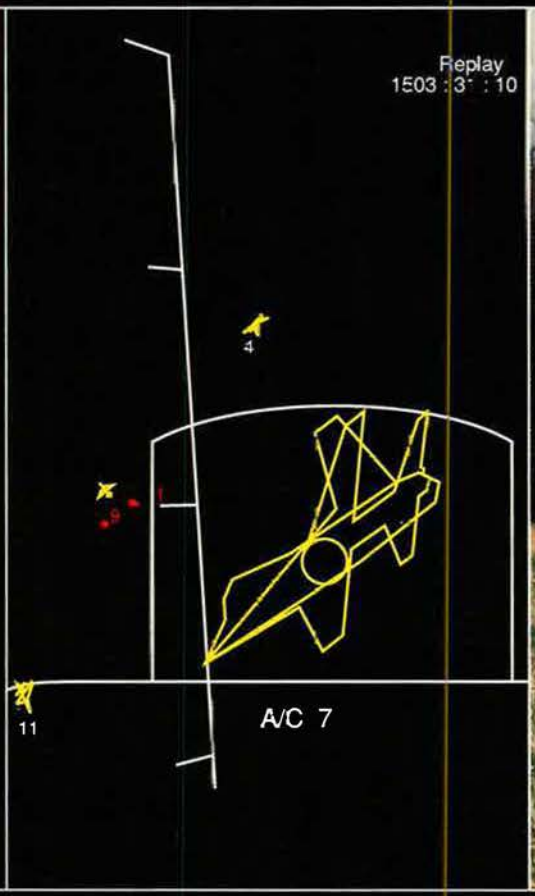
Full-scale bomber-bat tests were planned for August 1944. However, when Fleet Admiral Ernest J. King, Chief of Naval Operations, found that the bats would not be combat-ready until mid-1945, he abruptly canceled the operation. By that time, Project X-Ray had cost an estimated $2 million.

Dr. Adams was disappointed. He maintained that fires generated by bomber bats could have been more destructive than the atomic bombs that leveled Hiroshima and Nagasaki and ended the war. He found that bats scattered up to twenty miles from the point where they were released. "Think of thousands of fires breaking out simultaneously over a circle of forty miles in diameter for every bomb dropped," he said. "Japan could have been devastated, yet with small loss of life." ■

For more aviation history from C. V. Glines, see "The Flying Octopus," also in this issue.

Thousands Of Great Performances You May Never Have Heard About.





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Valor

By John L. Frisbee, Contributing Editor

Courage and Conviction

The skirmishes and battles that led to an independent Air Force were fought in Washington as well as in the field. Ken Walker was a hero in both arenas.

KENNETH Walker was a man of strongly held beliefs for which he was willing to risk his career or forfeit his life. His years as a military aviator were concerned with bombers and the Air Force doctrine of strategic air warfare that dominated World War II.

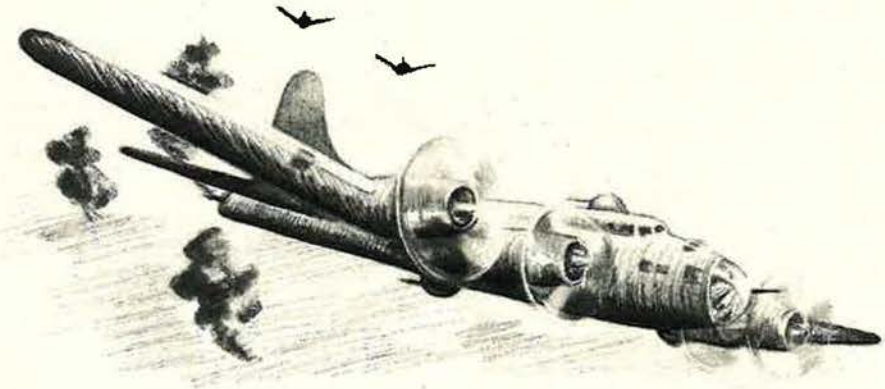
Walker earned his wings in November 1918. In the next decade, he served with and commanded bomber squadrons in this country and the Philippines before attending the Air Corps Tactical School in 1928–29. The Tactical School was the intellectual center of the Air Corps in those days. Walker was kept on as an instructor in bombardment.

He and other airpower pioneers—among them Donald Wilson, Harold George, Haywood "Possum" Hansell, and Laurence Kuter—developed analytical systems for determining the key elements that sustained an industrial society and that were vulnerable to bombing. They concluded that a new era of warfare, in which an industrial country could be defeated primarily by strategic bombing, lay just over the horizon. It followed that a nation's air arm should be independent and co-equal with ground and sea forces. These ideas were heresy in the eyes of the War Department General Staff, which did not burn heretics but could make life unpleasant for them.

In 1934, Ken Walker and four other Tactical School pioneers were invited to testify before the President's Commission on Federal Aviation (the Howell Commission) on the military aspects of aviation. The War Department tried by both direct and devious means to prevent their appearance in Washington, but the five officers decided to go at their own expense, though it probably would mean the end of their careers. World developments determined otherwise. All five became general officers, and their concept of airpower was proven correct.

On the eve of World War II, Walker, by then a lieutenant colonel, was assigned to the War Plans Division of the Army Air Forces staff.

Under the direction of Col. Harold George, Possum Hansell, Larry Kuter, and Walker formed the task force that wrote AWPD-1, the plan for organizing, equipping, deploying, and employing the AAF to defeat Germany and Japan should we become involved in the war that was engulfing Europe and the Far East. It was a monumental achievement, completed in less than a month. Then Japan attacked Pearl Harbor and the US was, in fact, at war.



Ken Walker had missed World War I. He did not intend to sit out World War II in Washington. Six months after Pearl Harbor, he was promoted to brigadier general and went to the Pacific, where Gen. George Kenney made him commander of the Fifth Air Force Bomber Command. Walker had precious little to work with in the fall of 1942—some thirty operational B-17s and about a hundred light and medium bombers.

Walker championed leadership by example as ardently as he was devoted to bombardment. He believed he should share the dangers of combat with his crews. Perhaps more important to him, Ken Walker judged that he could not help develop tactics for that theater without personal experience in combat.

Early on, he was awarded the Silver Star. He went several times to Rabaul, the hottest target in the theater. He came back from one mission with six feet of wing missing and from others with battle damage. General Kenney worried about his bomber commander, who was privy to much highly classified information, flying over enemy-held territory. In December, he ordered Walker to fly no more combat missions.

On January 5, 1943, contrary to Kenney's order, General Walker led twelve heavy bombers in a daylight attack on shipping in the harbor at Rabaul. The formation was intercepted by enemy fighters but put its bombs on target. One bomber was shot down. Walker's plane was last seen leaving the target with one engine burning and enemy fighters on its tail. A search failed to find any wreckage or survivors.

On the recommendations of Generals MacArthur and Kenney, Brig. Gen. Kenneth Walker was awarded the Medal of Honor posthumously. President Roosevelt presented the medal to General Walker's son in a White House ceremony on March 25, 1943. The Air Force had lost one of its most brilliant officers, who lived with the conviction that bombardment had changed the nature of warfare and that a "well-planned and well-conducted bombardment attack . . . cannot be stopped." ■

Reviews

By Jeffrey P. Rhodes, Aeronautics Editor

Attack on Yamamoto, by Carroll V. Glines. Almost fifty years after the event, controversy still rages over who really shot down Japanese Adm. Isoroku Yamamoto—Lt. Rex Barber or Capt. Thomas Lanphier. The author takes a critical look at the historical records, what was conjecture and what was fact in 1943, and what is fact in 1990 concerning the shootdown. While not resolving the question beyond a doubt, the author makes a very solid case for his conclusions. More than just a study of a contentious corner of the war, this book is a detailed and interesting look at one of the longest fighter intercepts in history—how it came about, how it was planned, and how it was executed to near-perfection. Orion Books, New York, N. Y., 1990. 240 pages with maps, photos, notes, bibliography, appendix, and index. $19.95.

Boeing B-52G/H Stratofortress, by Dennis R. Jenkins and Brian Rogers, and *McDonnell Douglas F-15A/B/C/D/E Eagle/Strike Eagle,* by Dennis R. Jenkins. The two latest volumes in the Aerofax Datagraph series profile two Air Force stalwarts, using the highly detailed format typical of these books. The F-15 book is particularly strong. Another interesting title is *Lockheed F-117A Stealth Fighter,* by Jay Miller. In addition to being as detailed as possible, given that much about this program is still sensitive, this look at the F-117 contains an in-depth discussion of radar operation and evasion and some basics of stealth technology. All titles: Aerofax, Inc., Arlington, Tex., 1990. *B-52/F-15:* 72 pages with photos, diagrams, charts, and acronym list. $14.95. *F-117:* 40 pages with photos, diagrams, and charts. $9.95.

The Fullness of Wings: The Making of a New Daedalus, by Gary Dorsey. "Would it be possible, using modern technology, to recreate the mythical flight of Daedalus?" was the question that set John Langford and his MIT team in motion. Nearly a decade later, Kanellos Kanellopoulos pedaled *Daedalus '88,* a sixty-eight-pound "plastic" airplane with the wingspan of a DC-9, across the Sea of Crete to Santorini (Thira Island) to set duration and distance records for human-powered flight, following the route of the mythical Daedalus. This book covers the epic seventy-two-mile voyage and tells the "inside" story of almost daily engineering and bureaucratic hurdles, team members' fears and disagreements, and the science behind the project. Viking Penguin, Inc., New York, N. Y., 1990. 350 pages with photos. $19.95.

The Last of the Bush Pilots, by Harmon Helmericks; *The Fork-Tailed Devil: The P-38,* by Martin Caidin; *The Fastest Man Alive,* by Brig. Gen. Frank K. Everest, Jr., with John Guenther; *Diary of a Cosmonaut: 211 Days in Space,* by Valentin Lebedev. These titles are the first in Bantam's "Air and Space" series, which will reprint one classic aviation book per month through at least mid-1991. *Bush Pilots* relates one pilot's flying adventures in the Arctic. *The P-38* details the story of the famous fighter and its development. "Pete" Everest tells what it was like to fly the X-2 in *The Fastest Man Alive. Diary of a Cosmonaut* describes the trials and triumphs of a seven-month space mission. All titles: Bantam Books, New York, N. Y., 1990. Various numbers of pages with photos and/or artwork. $4.95 apiece.

Screaming Eagle: Memoirs of a B-17 Group Commander, by Maj. Gen. Dale O. Smith. This story is reminiscent of a classic screenplay. The new group commander arrives at his posting to whip a demoralized, loss-devastated unit into combat shape, all the while struggling to keep his domestic problems (his wife had fallen for another man, and the commander feared for the welfare of his children) from affecting the job he had at hand. While it sounds like fiction, it isn't. Despite these problems, the author turned the 384th Bomb Group into a crack fighting outfit. Unlike many memoirists, the author writes openly about his fears and how he confronted them. His hair-raising combat experiences and the problems of command are vividly described. Algonquin Books, Chapel Hill, N. C., 1990. 241 pages with photos and appendices. $18.95.

War in Korea, 1950–1953, by D. M. Giangreco. This book relates the story of "America's forgotten war" through the eyes of the photographer. More than 500 pictures cover all the major aspects of the "police action"—the North Korean invasion, the amphibious invasion at Inchon, the drive to the Yalu, attacks and counterattacks, the air war, and the war at sea. The author, an editor for the US Army's professional journal, *Military Review,* writes just enough text to set the stage in each chapter, then lets the pictures and lengthy captions take over the story line. Many of the pictures are quite poignant, and few of them are the "standards" that illustrate many other books on the subject. Presidio Press, Novato, Calif., 1990. 336 pages with photos, maps, and bibliography. $40.00.

Other Titles of Note

Almanac of Soviet Manned Space Flight, by Dennis Newkirk. This book is exactly what its title implies: a complete list of all Soviet manned launches as well as a technical description of boosters, spacecraft, and space stations. A valuable addition to the text is the inclusion of many details omitted from "official" press accounts. Gulf Publishing Co., Houston, Tex., 1990. 391 pages with photos, diagrams, appendix, notes, and index. $29.95.

Colors and Markings of the F-100 Super Sabre, Part 1, by David W. Menard. For most of its career, the F-100's natural metal finish was a canvas for crews to adorn with a variety of stripes and designs. With many rare photos, including a number in color, this book (which began as a request in this magazine's "Bulletin Board" column), gives a unit-by-unit "Hun" history. Tab Books, Blue Ridge Summit, Pa., 1990. 64 pages with photos and diagrams. $11.95.

In Clouds of Glory: American Airmen Who Flew with the British During the Great War, by James J. Hudson. Of the 300 Americans who joined the Royal Air Force in World War I, 123 were killed or wounded, became POWs, or were listed as missing. Twenty-eight became aces, and this detailed book is the story of those flyers. University of Arkansas Press, Fayetteville, Ark., 1990. 290 pages with photos, maps, appendix, notes, and index. $26.95.

The Megaton Blasters: Story of the 4925th Test Group (Atomic), by Maj. John D. Hardison. The men of this secret, highly specialized unit wrote the Air Force's nuclear weapons operations manual in 1950. This book covers in great detail who the men were, what they wore, the hazards they faced, their aircraft, and the unit's targets, test sites, and weapons. Boomerang Publishers, Arvada, Colo., 1990. 40 pages with photos, diagrams, and charts. $15.95.

IN VIDEO—"Their Finest Hour: The Battle of Britain," by Lawrence Holland. A time machine on a hard disk, "Their Finest Hour" offers megabytes of fun and a chance to learn, too; it comes with a 192-page history book/instruction manual. Mr. Holland did his homework, incorporating the strategy and tactics of both sides. With a variety of mission choices, the user can develop both German and British pilots with specific mission histories. You'll share their anxiety as you try to make the French coast in your damaged Me-109 or close on an He-111 in your Hurricane. Tally ho! Copyrighted 1989, released 1990. Lucasfilm Games, available for IBM PC, XT, AT, PS/2, Tandy (512 RAM). $59.95.

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Viewpoint

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

The New Front Line

As the only real superpower remaining, we must take on challenges in difficult places. We cannot get there without airlift and tankers, and we cannot fight there without fighters.

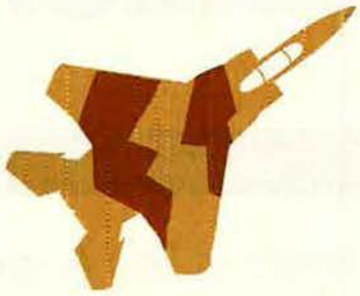
Strategy, someone once said, is using the available means to accomplish an end. For more than forty years, our military strategy has been focused on the European central front, and if the means to deflect a Soviet invasion seemed a bit on the scanty side, there were always the nukes as a last resort.

It has been a long time since anyone has truly believed that war would begin that way. NATO's real purpose has been to prevent war, not to fight one.

NATO has provided a respectable (and comfortable) reason to avoid preparing for trouble in the Mideast, perhaps the last place on Earth where one would choose to commit US forces. In addition to the heat and the sand and the alien culture, there is the long line of communication—some 6,000 miles from the east coast of the US—a worst-case logistics scenario.

However the confrontation with Iraq turns out, it has become clear that the central front can no longer govern either the end or the means of national strategy. The Soviet Union stands exposed as a Third World nation with a formidable nuclear and conventional capability, but the odds appear long against Soviet military adventurism. The United States has emerged from the cold war as the only superpower, which, like the carnival fighters of another era, must now take on challenges from the crowd—or pull back to Fortress America, allowing the world and its challenges to pass by. Saddam Hussein's sudden initiative threatened to have a lasting and crippling effect on the world's economy.

The confrontation in the Persian Gulf has made plain the importance of tactical airpower, whether land- or carrier-based. The budget arguments of this past year, however, have been strangely muted on the subject; instead, the emphasis has been on the B-2 and the modernization of our nuclear deterrent. Admittedly, there has



been strong support for the next-generation Advanced Tactical Fighter, but the present tactical force is dwindling, just as the need for it becomes apparent.

Tactical air, together with its supporting tankers, and airlift—most definitely airlift—are destined to be the Air Force's front line in the coming decade. When we consider that the Global Positioning System now provides instant navigation and landing aid to any "barestrip" in the world, the reaction capability has been remarkably enhanced.

It is curious that so little notice has been taken of the Air Force's tactical mobility. It may be that the long years of being rooted in European and Pacific bases have created an impression of fixed-base operation, an impression reinforced by the fact that the complexity of a weapon system like the F-15 does require sophisticated support. These fighter outfits, nevertheless, can travel the world at jet speed and be ready to operate in a remarkably short time, a far cry from the 1950s, when SAC was supreme and tactical air, in order to survive, played at being a bush-league SAC. In those days, mobility was generally limited to an exchange of airplanes on the alert pad. Today, our fighter force can crisscross the oceans, arriving at its destinations with a wide assortment of lethal weaponry, prepared for either air combat or precise ground attack. To allow this capability to wither would be the worst sort of shortsighted folly.

This is not to argue against a new bomber, for the Air Force and the nation must have a modern bomber force. The B-1B is a fine bomber, so capable and free of evident problems these days that it escapes notice by the often hostile news media. Doubtless the B-2 will also be a fine bomber, even an undetectable one, if it can manage its way through the congressional flak. An operational B-2, however, is some years off, while the threat exists now.

The Persian Gulf is unlikely to cool off more than temporarily. So long as the oil treasure exists, the area around the Gulf will be a source of trouble. Renewed large-scale Arab-Israeli conflict is an ever-present danger. Whatever happens in that region, the only logical response at our disposal is through the air. We cannot get there without airlift and tankers, and we cannot fight there without tactical aircraft.

The F-15 and F-16 in all their versions, coupled with realistic training in such exercises as Red Flag, have given us a fighter force that is better equipped and better trained than any in our history, although it is thin and getting thinner. If there should be any prolonged action, attrition would be hard to manage.

Saddam Hussein showed his hand just at the moment when the defense budget, already in trouble, was about to be shredded. Perhaps it *will* be shredded, given the predisposition of some of our elected gadflies, but some attention, at least, should be directed to the F-16, F-111, and F-15 deployments, and at least some mention should be made of how futile the President's stand would have been if he had not had these tactical assets at his disposal. ■

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

More than the Derby

In the public's perception, bluegrass meadows, bourbon whiskey, the US Gold Bullion Depository, and a certain horse race on the first Saturday of every May tend to crowd out the many other outstanding features of the fifteenth state, Kentucky. The state also possesses a lively interest in the past, present, and future of aerospace. A recent airshow at Bluegrass Field, cosponsored by AFA's Lexington Chapter, made this abundantly clear.

An audience of 70,000 turned out for three days of demonstrations by current and vintage aircraft, a "School Day" that saw gratifying participation by more than 20,000 young aviation enthusiasts, and numerous aerospace exhibits and displays. The airshow's theme, "Aviation Achievement Through Education," emphasized the necessity of encouraging young people to take an interest in their nation's aerospace future. Teacher Sue Darnell, Kentucky Aerospace Educator of the Year and winner of AEF's Christa McAuliffe Award for 1990, presented fifteen US Spacecamp scholarships and received a plaque honoring her achievements from Lexington Chapter President James R. Jenkins and State Vice President Frank Lamm.

Christa McAuliffe Award winner Sue Darnell accepts another honor, the Kentucky Aerospace Educator of the Year Award, from State Vice President Frank Lamm as Lexington Chapter President James Jenkins looks on.

Chapter members found one aspect of the airshow particularly encouraging: its joint sponsorship. In addition to AFA's participation, the Lexington Chapter of the Navy League and the Kentucky Aviation History Roundtable contributed greatly to the show's success.

Georgia AFJROTC Cadet of the Year Maj. Jessica Nickodem, here receiving her AFJROTC medal from Southeast Georgia President Maj. Donald Edmands, Jr., flanked by Chapter Vice Presidents TSgt. Mack Douse (left) and MSgt. Milton Snow, has been nominated for appointment to the Air Force Academy by Rep. Lindsey Thomas (D-Ga.)

Alabama Convention

Delegates to this year's Alabama State Convention gathered in Huntsville and received word on how civilians can make a difference in educating the general public. Edward O. Buckbee, director of the Space and Rocket Center in Huntsville, explained how Dr. Wernher von Braun enlisted his aid in creating a program for space-science education, which resulted in the establishment of the Center, where the public can view the hardware of rocketry and space exploration and acquaint themselves with the complexities involved.

Many AFA dignitaries attended the convention, chaired by Alabama State President H. R. "Bobby" Case, including National Vice President (South Central Region) Everett E. Stevenson, National Director Frank Lugo, Arkansas State President O. Wayne Lewis, and officers from all five Alabama chapters. O. V. Stephenson of Auburn was named Man of the Year, and the host Tennessee Valley Chapter garnered Chapter of the Year honors. Other awards distributed at the

The Thomas W. Anthony Chapter's fund-raising for a POW/MIA monument at Andrews AFB, Md., got a $1,000 boost from Air Force Credit Union representatives Bland Simmons (near right) and Jim Ericson (right). Accepting the check are, from left, 1776th Air Base Wing Commander Col. Richard Heinzman, the wing's Resource Manager Col. Richard Gordon, and Chapter President Sam O'Dennis.

convention included CAP Unit of the Year, given to the 117th Composite CAP Squadron; AFJROTC Unit of the Year, to Det. 31 from Butler High School in Huntsville; and AFROTC Unit of the Year, to Det. 5 at Auburn University.

Florida Looks Ahead

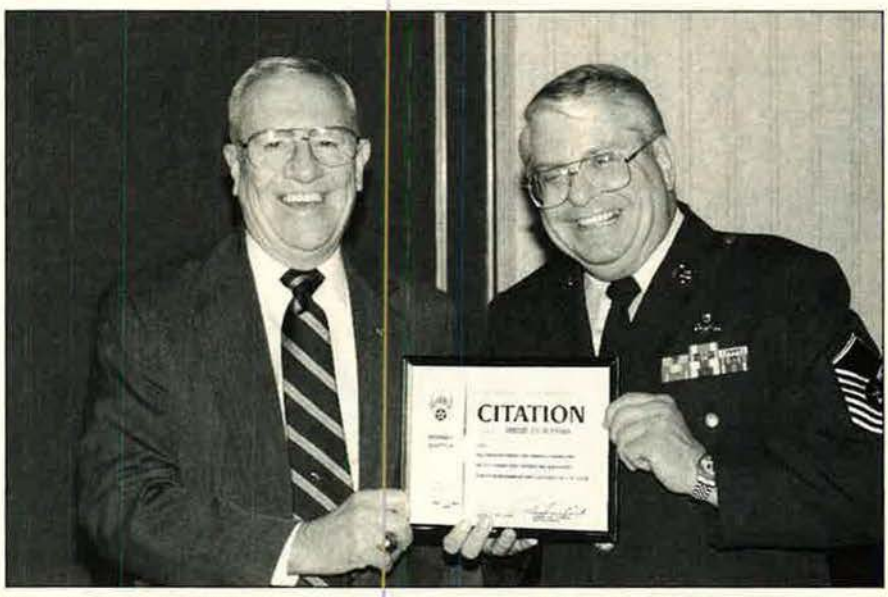
Florida, a leading state in so many AFA ventures, has taken steps to build the foundation of aerospace leadership in the next century. Florida AFA organized the state's AFJROTC units into the Kitty Hawk Air Society to promote academic excellence. The Society, which now has nineteen chapters, held its first state convention on the campus of Embry-Riddle Aeronautical University, where thirty-five top students got their first taste of college life, discussed AFROTC scholarships and Air Force Academy nominations, took orientation flights, and logged some flight-simulator time. State President Bill Bingham and National Vice President (Southeast Region) Roy Whitton addressed the convention. Col. Karl Price, USAF (Ret.), and Eric Doten, chancellor of the University, have been instrumental in the program's success.

Chapter News

Programs and resources are sure to be pivotal topics in the coming months, and the **General Charles A. Gabriel (Va.) Chapter** moved to the forefront in obtaining information on these issues when Lt. Gen. Robert L. Rutherford, USAF, Deputy Chief of Staff for Programs and Resources, gave an address to a large meeting at the Army-Navy Club in Arlington, Va.

Among those in the audience were Chapter namesake Gen. Charles A. Gabriel, USAF (Ret.); Gen. Charles Donnelly, Jr., USAF (Ret.); Lt. Gen. Carl Cathey, USAF (Ret.); and Brig. Gen. Richard Toner, USAF (Ret.). Chapter officials President Owen Wormser, Vice President Dick Ensign, Treasurer Jim Marstall, Secretary J. R. "Doc" McCauslin, and Vice President (Chapter Programming) Nancy Brown enjoyed the General's address, which was also heard by twenty-three industry representatives. The Chapter took the opportunity to donate $500 to the National Institutes of Health on behalf of the late Lt. Col. Bryant Dougherty, USAF, who recently died of cancer. Lieutenant Colonel Dougherty was the son of Gen. Russell E. Dougherty, USAF (Ret.), former Executive Director and current National Director of AFA.

The **Spirit of St. Louis (Mo.) Chapter** held its annual banquet to honor the Outstanding Airmen of the Year. Chapter President Raymond P. Massie, Jr., opened the proceedings, and Military Airlift Command's Deputy Chief of Staff (Requirements) Maj. Gen. Frank E. Willis served as guest speaker. Awards were given to MSgt. Mark A. Green of the Defense Mapping Agency in St. Louis as the outstanding active-duty Senior NCO; to SSgt. Lawrence E. Elliot of the 3545th



A gleeful SMSgt. Ed Blevins accepts his citation as Outstanding Senior NCO of the 3534th Recruiting Squadron from an equally jovial Harry Williams, President of the Roanoke Chapter, at a recent awards banquet in Virginia.

Recruiting Squadron in Columbia, Mo., as the outstanding active-duty Junior NCO; to MSgt. Ryan C. Rhea of the 157th Tactical Control Group at Jefferson Barracks in St. Louis as the outstanding non-active-duty Senior NCO; and to Sgt. Patrick T. O'Heron of the 121st Tactical Control Squadron at Jefferson Barracks as the non-active-duty Junior NCO. Don Kuhn served as awards chairman for the event.

The **Iron Gate (N. Y.) Chapter** mourns the loss of former Chapter President Herbert O. Fisher, who died at the age of eighty-one. Mr. Fisher, who also served as a National Director, was the retired head of aviation-industry affairs at the N. Y.–N. J. Port Authority and a veteran of the China-Burma-India theater in World War II.

Regional Workshops

On October 13, a workshop for the **North Central Region** will be held in Bloomington, Minn. The **Southeast Region**'s workshop will take place November 17–18, at Shaw AFB, Sumter, S. C.

Have AFA News?

Contributions to "AFA/AEF Report" should be sent to Dave Noerr, AFA National Headquarters, 1501 Lee Highway, Arlington, VA 22209-1198. ■

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Bulletin Board

For a history of the Air Force enlisted corps, the Chief Master Sergeant of the Air Force and the Office of Air Force History are seeking **airmen who served between 1939 and 1973** to fill out a questionnaire on their experiences. **Contact:** Captain Grandstaff, Office of Air Force History, Bldg. 5681, Bolling AFB, DC 20332-6098.

Seeking photographs, letters, and memorabilia connected with Keye Field or the Columbus Army Flying School at **Columbus AFB,** Miss. **Contact:** Sherry Medders, Public Affairs Office, 14 FTW/PA, Columbus AFB, MS 39701-5000.

Seeking the whereabouts of **Douglas Ferguson,** a graduate of class 49-B from Nellis AFB, Nev. He was stationed at Turner AFB, Ga., in 1949 and 1950. **Contact:** R. Williams, 7744 Lilac Rd., Bonsall, CA 92003.

Beginning collector seeks **patches** of all kinds. **Contact:** Jeff Handwerker, Rte. 2, Box W62, Tuttle, OK 73089.

Seeking information on **slang terms** in different languages around the world. **Contact:** Tim Chase, 1011 Fisk St., Scranton, PA 18509.

Seeking photos, clippings, or other memorabilia of **12th Supply Squadron**'s involvement in the Vietnam War. **Contact:** Lt. Toni DeSonia, 12th SUPS/LGSC, Randolph AFB, TX 78148-5000.

Seeking information on ***Miss Dana,*** a P-47, probably of the 39th Fighter Squadron, which was lost near Lae, Papua New Guinea. **Contact:** Maj. Dwight A. Klenke, USAF, US Embassy, Canberra, Australia, APO San Francisco 96404-5000.

Seeking contact with members of the **1st Experimental Guided Missile Squadron,** 1st Experimental Guided Missile Group, which was formed at Eglin Field, Fla., in 1946 or 1947. **Contact:** Ernest W. Leyh, 56 Hamilton Ave., Valley Stream, NY 11580.

Seeking photos, memorabilia, and reminiscences of people who worked in **Transportation Management, Finance, and Enlisted Aircrew,** for a history of these fields. **Contact:** 2d Lt. Shawna R. Wimpy, 3757th STUS, Sheppard AFB, TX 76311.

Seeking contact with former members of the **27th, 37th, 49th, 57th, 74th, 76th, 82d, 318th, and 465th Fighter-Interceptor Squadrons** who served at Dow, Ethan Allen, Griffiss, or Presque Isle AFBs between 1952 and 1960. **Contact:** Bill Green, 1460 Persimmon Ln., Fairview, PA 16415.

For a book on Army Air Corps/Air Forces and Royal Air Force **rescue boats in World War II,** seeking anecdotes and reminiscences from ditched aircrew members who were rescued by these boats. **Contact:** George R. Delgado, 1820 Delki St. NW, Palm Bay, FL 32907.

For a photo/narrative anthology, seeking photos and information on **celebrities who served in the military** in any capacity during World War II, Korea, or Vietnam. **Contact:** William VanOsdol, Central State University, 100 North University Dr., Edmond, OK 73034.

Seeking the **September 1951 issue** of AIR FORCE Magazine. **Contact:** Donald J. Spry, 1206 North Apache Ln., Payson, AZ 85541.

Seeking photos, memorabilia, and details on the furnishings of **World War II-era Nissen Huts** in England, including typical brands of cigarettes and chocolate, types of furnishing and decoration, and layouts, in order to recreate a hut as authentically as possible at Stanstead, England, former Hq. of the 344th Bomb Group. **Contact:** Colin W. Davis, Taylor Gardner Associates Ltd., Fossedene Manor, The Fosse Way, Near Combroke, Warwickshire CV35 9HS, England.

Seeking contact with Air Force personnel who were stationed at Misawa AB, Japan, with the **49th Fighter-Bomber Wing,** 5th Air Force, in 1954 and 1955. **Contact:** Scott W. Tyree, Box 7991, Winchester Station, Jackson Hole, WY 83001.

Seeking the whereabouts of the following B-17 crew members: **Lt. Peter Karanzalis,** copilot, who was from Philadelphia, and **SSgt. David R.**

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AFA

Bulletin Board

Davis, waist gunner, who was from Bismarck, Mo. **Contact:** John L. Pfeiffer, 29 Pleasant Hill Rd., Deerfield, NH 03037-1111.

Seeking contact with crew members who knew **Jose V. Ortega,** who was a bombardier with the 515th Bomb Squadron, 376th Bomb Group, and was killed on a mission to Ploesti Oil Fields, August 17, 1944, along with five others. Three survived. **Contact:** Gilbert Ortega, 55 N. Melrose Ave., Tucson, AZ 85745.

Seeking contact with members of the **587th Air Force Band** during World War II. Also seeking the whereabouts of **William L. Graves. Contact:** William D. Long, 3410 River Forest Dr., Fort Wayne, IN 46805.

Seeking information on **Alvin E. Crane, Jr.,** from Woodlands, Calif., who was a member of pilot class 48-B, and was rumored to have been KIA September 13, 1951, while flying a T-6 in Korea, possibly with the 6147th TCG. **Contact:** Capt. James T. Pace, USAF (Ret.) 1530 Dorsal St., Merritt Island, FL 32952.

Seeking information on the whereabouts of the following pilot graduates of Webb AFB, Tex.: **Murray Brush,** who was a fighter pilot at K-2 in Korea, **Ed Farrel,** and **Robert "Ken" Hayes,** who was a fighter pilot at K-55 in Korea. **Contact:** Jack Gilliland, 1232 Redwood Ln., Gulf Breeze, FL 32561.

Seeking the whereabouts of **Sgt. John Raymond Wearing** and **Sgt. Elmo Allen,** who were stationed in Stone, Staffordshire, England, during World War II and spent several furloughs with Mr. and Mrs. Young of Hayes, Middlesex. **Contact:** Veronica "Vicky" Chalk, 37 Bletchmore Close, Harlington, Hayes UB3 5EX, Middlesex, England.

I would like to correspond with **8th Air Force USAAF fighter pilots** who flew out of England. I especially want information on instrument flying procedures, radios, homing beacons, training, and radio procedures. **Contact:** Don Biondich, 4163 Chaparral Pl., Castro Valley, CA 94546.

Seeking information on the pilot of *Memphis Belle,* **Lt. Robert Morgan. Contact:** Col. Alfred J. Hanlon, USAF (Ret.), 6909 Andover Dr., Alexandria, VA 22307.

Seeking the whereabouts of **MSgt. Nicholas Vitullo,** whose last known address, in 1959, was in Alexandria, La. He was with the 55th Strategic Reconnaissance Wing stationed at Forbes AFB, Kan., from 1952 to 1955. Also seeking **James Campassino. Contact:** TSgt. G. John Chianello, USAF (Ret.), 9236 Antioch, Overland Park, KS 66212-3227.

Would like to purchase an original World War II **Aviation Cadet dress hat insignia.** It is three inches wide and two inches high, depicting horizontal wings with a vertical propeller through them. **Contact:** Ed Poole, 303 N. 90th St., Milwaukee, WI 53226.

Seeking the whereabouts of **Frank Gennarelli,** who served at McCook Field, Neb., and at Northwest Field, Guam, in 1944 and 1945, with the 331st Bomb Group, flying B-29s. Also seeking **William L. Shinn,** who flew with John Bigger from Tinian and Okinawa in 1945. **Contact:** Clarence M. Juett, 3057 Page St., Redwood City, CA 94063.

Collector seeks **B-57 memorabilia,** especially tech orders, aircrew and maintenance (all models) squadron patches, and manufacturer's desk models. **Contact:** SrA. Kathy Davis, USAF, 1100 E. Farmington Dr., #152, Vacaville, CA 95687.

Seeking contact with members of the 19th Bomb Group who knew **Paul A. Reimer.** He was in the 30th Squadron, and was lost on a mission to Rabaul on April 24 or 25, 1942. **Contact:** L. E. Fessenden, 3916 NE 114th Ave., Portland, OR 97220.

Seeking contact with members of the **329th Service Squadron, 440th Sub Depot,** and **861st Air Engineering Squadron** who helped set up and operate the American Air Base at Station 102, Alconbury, England, during World War II. **Contact:** 482d Bomb Group Assoc., Box 482, Warminster, PA 18974-0482.

Collector seeks **patches. Contact:** Walter Drutok, P. O. Box 1277, APO New York 09194.

Seeking the whereabouts of **Sgt. William C. Tench,** of Allentown, Pa., and the other survivors of a B-17 shot down at Kitzingen, Germany, on October 14, 1943. **Contact:** Flt. Lt. Chris Goss, RAF, 21 Embry Crescent, RAF Wattisham, Ipswich, Suffolk IP7 7RP, England.

Seeking the whereabouts of **Luke Blanche,** who was a member of pilot class 43-C, Lubbock, Tex. His last known address, in December 1943, was in London, while he was stationed with a B-17 group in southeast England. **Contact:** Chester K. Blackman, P. O. Box 748, Hanna, WY 82327.

Seeking historical data, photographs, or other memorabilia connected with the **Childress AAF Bombardier School** from 1942 to 1946. Also seeking information on **William D. Bagwell,** who was a pilot flying B-25s in the South Pacific. **Contact:** Maj. Walter Lockhoof, Jr., USAF (Ret.), 607 Ave. H NW, Childress, TX 79201.

Seeking contact with anyone who knew **Maj. Walter C. McMeen,** who was an Air Force helicopter pilot in Vietnam in 1965. **Contact:** Lt. Col. Tom Garcia, Box 15186, Tucson, AZ 85708.

Seeking information, photos, and serial number, on a B-17G named ***Dear Becky*** that was with the 324th Bomb Squadron, 91st Bomb Group, at Bassingbourne, England, from 1943 to 1945. Also seeking models 1/72, 1/200, and 1/432 scale. **Contact:** David Zeak, 522 Bay Ave., Point Pleasant Beach, NJ 08742.

Seeking contact with **airmen who were downed in Yugoslavia** during World War II and escaped or evaded capture, for the purpose of a 1991 reunion with helpers in Belgrade, Yugoslavia. **Contact:** J. C. Rucigay, 14 Ashley Dr., Ballston Lake, NY 12019.

Seeking the whereabouts of **Winfred and Vera Gordon,** of Mississippi, who were stationed at the USAF base at Burtonwood, England, from 1949 to 1952. **Contact:** Shirley Robertson (née Brookfield), 26 Coldstream Ave., Leven, Fife KY8 5NB, Scotland.

Seeking information on the whereabouts of **Richard Houser,** who was stationed in the Manchester, N. H., area in 1945 and knew a woman named Beatrice Warner. **Contact:** Margaret M. Brown, P. O. Box 701, Windham, NH 03087.

Seeking information on unit honors and awards for **Det. 1, 1146th USAFSAS,** which was also known as Cartographic Technical Squadron or AFELM DMAAC, operating at March AFB, Calif., during the 1970s. Also seeking **patches** from intelligence units. **Contact:** Ron Coleman, 7712 Warrior Ave., San Angelo, TX 76904.

Seeking contact with personnel from the **583d Bomb Squadron,** 381st Bomb Group, who were in England from 1943 to 1944, especially those who knew **2d Lt. Robert N. Weaver,** who was lost

on January 11, 1944. **Contact:** Richard L. Weaver, 507 Ashland Dr., Thibodaux, LA 70301.

Seeking donations of **class books of B-26 Marauder units** stationed at Del Rio, Tex., Dodge City, Kan., or other Marauder pilot and crew training schools. **Contact:** Maj. Gen. J. O. Moench, USAF, (Ret.), 905 Sweetwater Blvd. S., Longwood, FL 32779-3430.

Seeking contact with **Robert E. Fisher,** an American who served with the 427th RCAF Squadron and became a POW. **Contact:** Joyce Inkster, 55 Donly Dr. N., Simcoe, Ontario N3Y 5A5, Canada.

Seeking whereabouts of personnel from the **2d Sea Search Squadron** stationed at Langley Field, Va., during World War II. **Contact:** Leslie R. Pollok, P. O. Box 155, Falls City, TX 78113.

Seeking information on **General Orval R. Cook** from anyone who served with him. **Contact:** Lt. Col. Peyton E. Cook, 7722 Terra Manor, Boerne, TX 78006.

Seeking information on the whereabouts of **Maj. Niels Charles Jensen,** who was rescued after being shot down over Greenland during World War II. His last known address was in Washington, D. C., or Missouri. **Contacts:** Gloriajoyce Page, 5151 Whiteoak, Encino, CA 91316. Dean S. H. Lowy, Texas A&M, Aeronautics Dept., Bryan, TX 77840.

Seeking information on **David Ernest Christie,** who was a Flying Tiger pilot in the China-Burma-India theater during World War II. His last known address, in 1950, was in Pittsburgh, Pa. **Contact:** David C. Gawe, 43 Blue Spruce Ln., Ballston Lake, N. Y. 12019.

For books on **F-4 unit** histories, seeking initiation and operational stories, anecdotes, and cartoons from F-4 crew members with exchange duty tours, US service, or foreign F-4 units. **Contact:** Lee R. De Haven, C-24860, P. O. Box 29, Represa, CA 95671.

Seeking contact with crew members who knew **Lt. Harvey G. Del Fatti,** who was in the 321st Bomb Squadron, 90th Bomb Group, 5th Air Force, in the Pacific theater during World War II. **Contact:** Tommy Stierheim, 821 N. E. 59th Ct., Fort Lauderdale, FL 33334.

Seeking information on the whereabouts of two people who were based in Sculthorpe, England, in the mid-1950s: **Harold D. Walters,** of Blanchard, La., who was in the 85th Bomb Squadron, and **Gary Pat Adams,** of Anaheim, Calif., who was in the 84th Bomb Squadron. Also, I have an **85th Bomb Squadron patch** for sale. **Contact:** Richard L. McCormick, 307 S. Meridian St., Greenwood, IN 46143.

Seeking members of the **6th Bomb Group** who served on Tinian during World War II and would like to be members of the 6th Bomb Group Association. **Contact:** Newell W. Penniman, Jr., 6 Porter Ln., South Hamilton, MA 01982.

If you need information on an individual, unit, or aircraft, or if you want to collect, donate, or trade USAF-related items, write to "Bulletin Board," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Letters should be brief and typewritten. We cannot acknowledge receipt of letters to "Bulletin Board." We reserve the right to condense letters as necessary. Unsigned letters are not acceptable. Photographs cannot be used or returned.—THE EDITORS

Seeking photographs of custom-painted modern HGU-55 and -26 **USAF flight helmets,** particularly from Aggressor and fighter units. **Contact:** Peter Hall, 52 Gunning Rd., RAF Hospital Ely, Cambridgeshire CB7 4RT, England.

Seeking the whereabouts of **MSgt. Robert Lee Johns,** who was in Vietnam in the late 1960s and at Bolling AFB, D. C., until 1971, when he was transferred to Chanute AFB. He also served in Germany and Korea. **Contact:** Mary-Ann M. Boyce, 56 Croydon Dr., North Cape May, NJ 08204.

Seeking anecdotes and reminiscences from former members of the **457th Tactical Fighter Squadron,** for a squadron history. **Contact:** Mike Herculson, 457th TFS, Carswell AFB, TX 76127-6200.

Seeking information on the whereabouts of **John M. Goodwin** of Atlanta, Ga., who was in the US Army Signal Corps Electronic Training Group #14 in England in 1942 and was transferred to the 8th Air Force PRO in London in 1943. **Contact:** Samuel Lee, 01960 S. W. Military Rd., Portland, OR 97219.

Seeking information on the whereabouts of **Eugene Wiebking** and **Jay Troup,** both of whom were in the 9th Air Force and were prisoners in Germany after being shot down December 23, 1944. **Contact:** Ward C. Smidl, 1104 Whippoorwill Ln., Palatine, IL 60067.

Collector seeks **technical orders** for operation and maintenance of USAF ground-based **HF radio** receiving equipment, such as R-389, R-391, AN/TRD-9, AN/MSC-1, AN/MGC-2, and AN/URA-42. **Contact:** William J. Neill, 1231 Crescendo Dr., Roseville, CA 95678.

Historian seeks oral histories, correspondence, clippings, photos, and films relating to **Boeing P-26A** "Peashooters" at Wheeler Field, Hawaii, from 1937 to 1941 and at March Field, Calif., in 1934. **Contact:** David C. Larson, 42 Treetop Circle, Ormond Beach, FL 32174.

Collector seeks AFRES/ANG/USAF **patches,** especially those pertaining to Pease AFB, N. H., New Hampshire ANG, Vermont ANG, and Grenier Field, N. H. Seeking information on SAC's Project Warrior **nose art** on all FB-111s and KC-135s of the 509th Bomb Wing. **Contact:** Curtis J. Lenz, 32 June St., Nashua, NH 03060-5345.

Seeking information on the whereabouts of **Frank Morton,** who was in London, England, with the US Air Force between February and March 1944. **Contact:** Jacqueline daCosta, 11 Sackville Rd., Hove, Sussex BN3 3WA, England.

For a display on US involvement in the Philippines, Clark AB Historical Center is seeking **military artifacts** for display, especially uniforms, personal affects, anecdotes, diaries, photos, and memorabilia. **Contact:** Linda Wendell, Director, CAB Historical Center, PSC #1, Box 4479, APO San Francisco 96286-0006.

Collector seeks **AIR FORCE Magazines** from 1940 to 1947, ***Stars and Stripes*** from 1944 to 1947, and newspapers, pamphlets, and other printed material from 1941 to 1947. **Contact:** Dwain Christian, 3950E Garryana, Beale AFB, CA 95903.

Seeking a copy of a humorous quote, approximately half a page long, regarding **flight engineers** and their working relationships with navigators and pilots. **Contact:** Evelynn George, 1555 S. 28th St., Apt. 4, Arlington, VA 22206.

Seeking information on the whereabouts of **John Hunt,** who was in the Air Force and was stationed in Swindon, England, in 1968 and

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Bulletin Board

1969. **Contact:** Julie Nugent, 9D Burton St., Russell Square, London WC1H 9AQ, England.

Seeking people who served with **TSgt. Benjamin J. Davis, Sr.,** USAF (Ret.), at Lawson AFB, Ga., Shaw AFB, S. C., Landstuhl AB, West Germany, France, Andrews AFB, Md., Orlando, Fla., and Tinker AFB, Okla. **Contact:** TSgt. Benjamin J. Davis, Sr., USAF (Ret.), 2832 California St., San Francisco, CA 94115.

Seeking information, photos, etc., from aircrews and maintenance crews of **Cessna O-2Bs** in Vietnam, especially the 9th SOS, 14th SOW, and 14th ACW, to help in the restoration of aircraft 67-21443, 67-21446, and 67-21466. **Contact:** Don Nieser, 6221 Commodore Ln., Oklahoma City, OK 73162.

Seeking items **autographed** by early Air Force leaders, aces, and aviators, especially William Mitchell, Frank Luke, Frank Andrews, Claire Chennault, and Richard Bong. Also seeking AVG items. **Contact:** Tom Shane, 6109 Bridlington, Austin, TX 78745.

Seeking contact with members of the **8th Air Force Historical Society** who live in Pennsylvania. **Contact:** 482d Bomb Group Association, P. O. Box 482, Warminster, PA 18974-0482.

Seeking information on the whereabouts of **SSgt. Floyd E. Brown,** who was with the 668th Bomb Squadron, 416th Bomb Group, 9th Air Force, and was shot down over Amiens, France, with 1st Lt. L. J. Siracuse and SSgt. James S. Hume and was captured, imprisoned as a POW, and liberated in May 1945. **Contact:** Albert L. Taylor, 301 Laurel Blvd., Lanoka Harbor, NJ 08734.

Seeking contact with anyone who was associated with **B-57s** at Clark AB, the Philippines, or in southeast Asia. **Contact:** Warren E. Thompson, 7201 Stamford Cove, Germantown, TN 38138.

Seeking information on the whereabouts of **Sgt. Rodger K. Summerfield,** of Elkins, W. Va., and **Sgt. Huey C. Scott,** of Miami, Fla., both of whom were stationed at Eglin AFB, Fla., and later at Udorn AB, Thailand, in 1968 and 1969. Also seeking **Col. Ernie Miece,** who was the commanding officer of the 11th TRS at Udorn AB, Thailand, in 1968 and 1969. **Contact:** William Crean, 224 Paddock Way, Delran, NJ 08075.

Seeking contact with P-47 pilots from the **33d Fighter Squadron** who were in Iceland in 1943 and 1944. **Contact:** William M. Amburgey, 9409 Bramall Rd., Richmond, VA 23229.

Seeking a photo (preferably color) of an **F-100D, serial number 53-530,** from the 166th Tactical Fighter Squadron, 121st Tactical Fighter Wing, Ohio ANG, which crashed just south of the Camp Atterbury Range in Indiana on April 18, 1972. **Contact:** Richard Lindsey, 3124 Del View Dr., Del City, OK 73115.

Unit Reunions

9th Air Force Advanced Headquarters
Members of the 9th Air Force Advanced Headquarters (World War II) will hold a reunion October 19–21, 1990, in Colorado Springs, Colo. **Contact:** Harold C. Stuart, 4590 E. 29th St., Tulsa, OK 74101. Phone: (918) 743-7814.

79th Fighter Group
Members of the 79th Fighter Group (World War II), which included the 85th, 86th, and 87th Fighter Squadrons, will hold a reunion November 15–18, 1990 in New Orleans, La. **Contact:** Edwin Newbould, 1206 S. E. 27th Terrace, Cape Coral, FL 33904. Phone: (813) 574-7098.

544th SIW/544th ARTW
The 544th Strategic Intelligence Wing (SIW) will celebrate its fortieth anniversary along with former members of the 544th Aerospace Reconnaissance Technical Wing (ARTW) the week of November 12, 1990. **Contact:** Lieutenant Colonel Meyer, USAF, Hq. 544th Strategic Intelligence Wing (SAC), Offutt AFB, NE 68113-5000. Phone: (402) 294-4555 or (402) 294-5110.

Pilot Training Instructors
I am trying to locate instructors who participated in the training of aviation cadets and student officers in late 1951 and 1952. I am planning a fortieth-year reunion in 1992. **Contact:** Jack Gilliland, 1232 Redwood Ln., Gulf Breeze, FL 32561. Phone: (904) 932-5472.

Class 43-C
For the purpose of organizing a reunion, I would like to hear from members of Class 43-C, Eagle Pass, Tex. **Contact:** Lt. Col. Richard A. Barker, USAF (Ret.), 17291 Almelo Ln., Huntington Beach, CA 92649. Phone: (714) 846-5351.

Class 63-D
For the purpose of planning a reunion, I am trying to locate members of Pilot Training Class 63-D (Williams AFB, Ariz.). **Contact:** Col. Tony Orlando, USAF (Ret.), 8336 Kenwood Ave., Springfield, VA 22152. Phone: (703) 569-7145.

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.

88th Depot Repair Squadron
For the purpose of organizing a reunion, I would like to hear from members of the 88th Depot Repair Squadron who served in Genoa, Italy, during World War II. **Contact:** John B. Rasch, 7439 N. E. Neptune Dr., Otis, OR 97368. Phone: (503) 994-2926.

7167th Special Air Missions Squadron
I am seeking members of the 7167th Special Air Missions Squadron who served in Germany between 1951 and 1954 and who would be interested in holding a reunion. **Contact:** Richard D. Anderson, 6880 FM 1628, San Antonio, TX 78263.

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50-54	34.33	56.21	16.34
55-59	50.32	60.17	16.34
60-64	62.98	69.27	16.34

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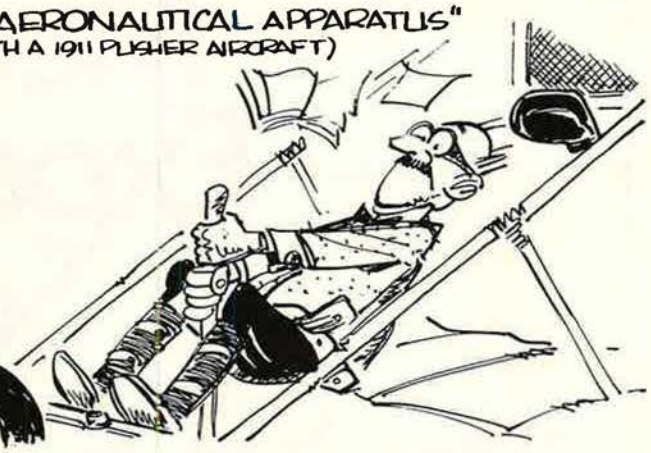
"RULES GOVERNING THE USE OF AERONAUTICAL APPARATUS"
(ACTUAL INSTRUCTIONS ISSUED WITH A 1911 PUSHER AIRCRAFT)

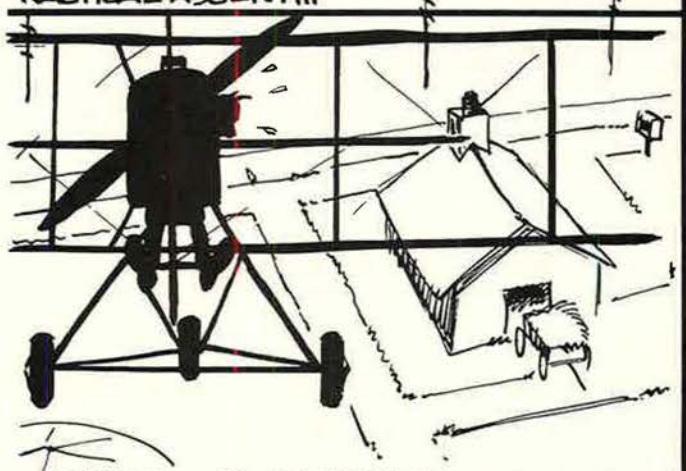
1." THE AERONAUT SHOULD SEAT HIMSELF IN THE APPARATUS & SECURE HIMSELF FIRMLY TO THE CHAIR BY MEANS OF THE STRAP PROVIDED.



2. OPENING THE CONTROL VALVE OF THE MOTOR, THE AERONAUT SHOULD AT THE SAME TIME GRASP THE VERTICAL STICK, OR CONTROL POLE, FOUND DIRECTLY BEFORE THE CHAIR.

... WHEN SUFFICIENT SPEED HAS BEEN ATTAINED, THE DEVICE WILL LEAVE THE GROUND & ASSUME THE POSITION OF AERONAUTICAL ASCENT...

... SHOULD THE AERONAUT DECIDE TO RETURN TO TERRA FIRMA, HE SHOULD CLOSE THE CONTROL VALVE OF THE MOTOR...



...THIS WILL CAUSE THE APPARATUS TO ASSUME WHAT IS KNOWN AS THE "GLIDING POSITION." EXCEPT IN THE CASE OF THOSE MACHINES WHICH ARE INHERENTLY...

... UNSTABLE. THESE LATTER WILL ASSUME THE POSITION KNOWN AS "INVOLUNTARY SPIN" & WILL RETURN TO THE EARTH WITHOUT FURTHER ACTION ON THE PART OF THE AERONAUT." END

TEST PILOTS GIVE HIGH MARKS TO THE V-22.

Four V-22 aircraft have flown a combined total of more than 160 hours.

The first government flight evaluation of the V-22 Osprey has been completed. Three Marine Corps test pilots evaluated the aircraft during thirty flight hours.

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OSPREY UPDATE

NO. 1 JUNE 1990

COUNTDOWN TO FIRST FLIGHT

History in the making:

Tooling fixtures removed June 30, 1990.

The C-17 stands on its own.

The proud team building the C-17 has recently moved this nation's newest airlifter from the giant steel tooling fixtures surrounding it during assembly. Now standing on its own landing gear for the first time, the C-17 is a dramatic display of American ingenuity at work.

Eighty-five hundred people—aircraft engineers, builders and support staff—have undertaken one of the most formidable tasks in the history of military airlift. Their dedication, patience and willingness to persevere in the face of any challenge are making it a success. Evidence of their achievement grows with each new milestone reached.

Its rugged landing gear will allow this new aircraft to land large payloads on remote airstrips around the world. Carrying over 80 tons, it will fly as far as 2,400 nautical miles without refueling —and land on a runway just 3,000 feet long.

Out of the joining tool now, this flexible airlifter is another step closer to first flight. And the dedicated team building it has another reason to be proud of their work.

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