MARCH 1991/$5

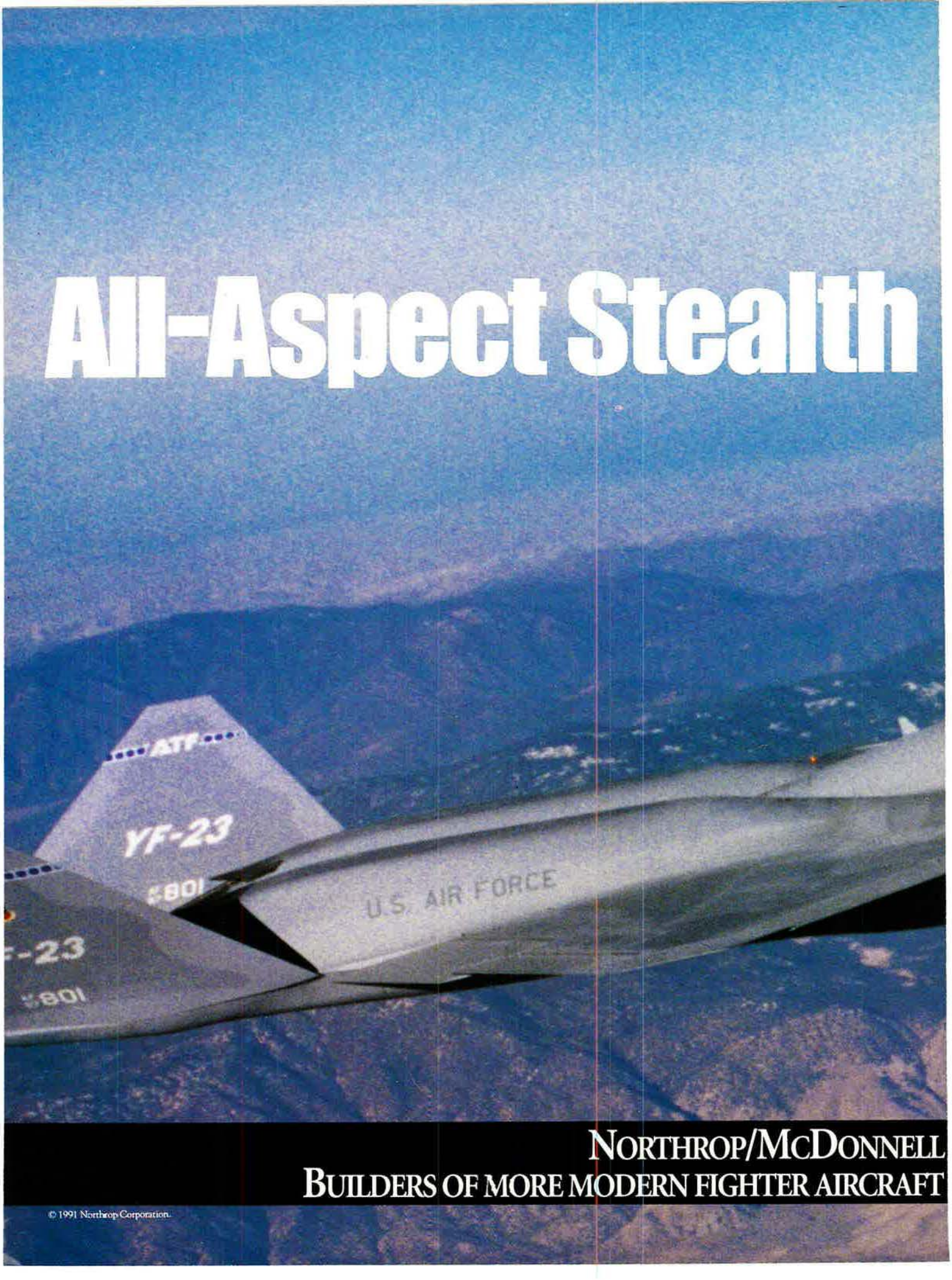
AIR FORCE

PUBLISHED BY THE AIR FORCE ASSOCIATION

MAGAZINE

First In, Last Out

The Forces of Desert Storm



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couldn't

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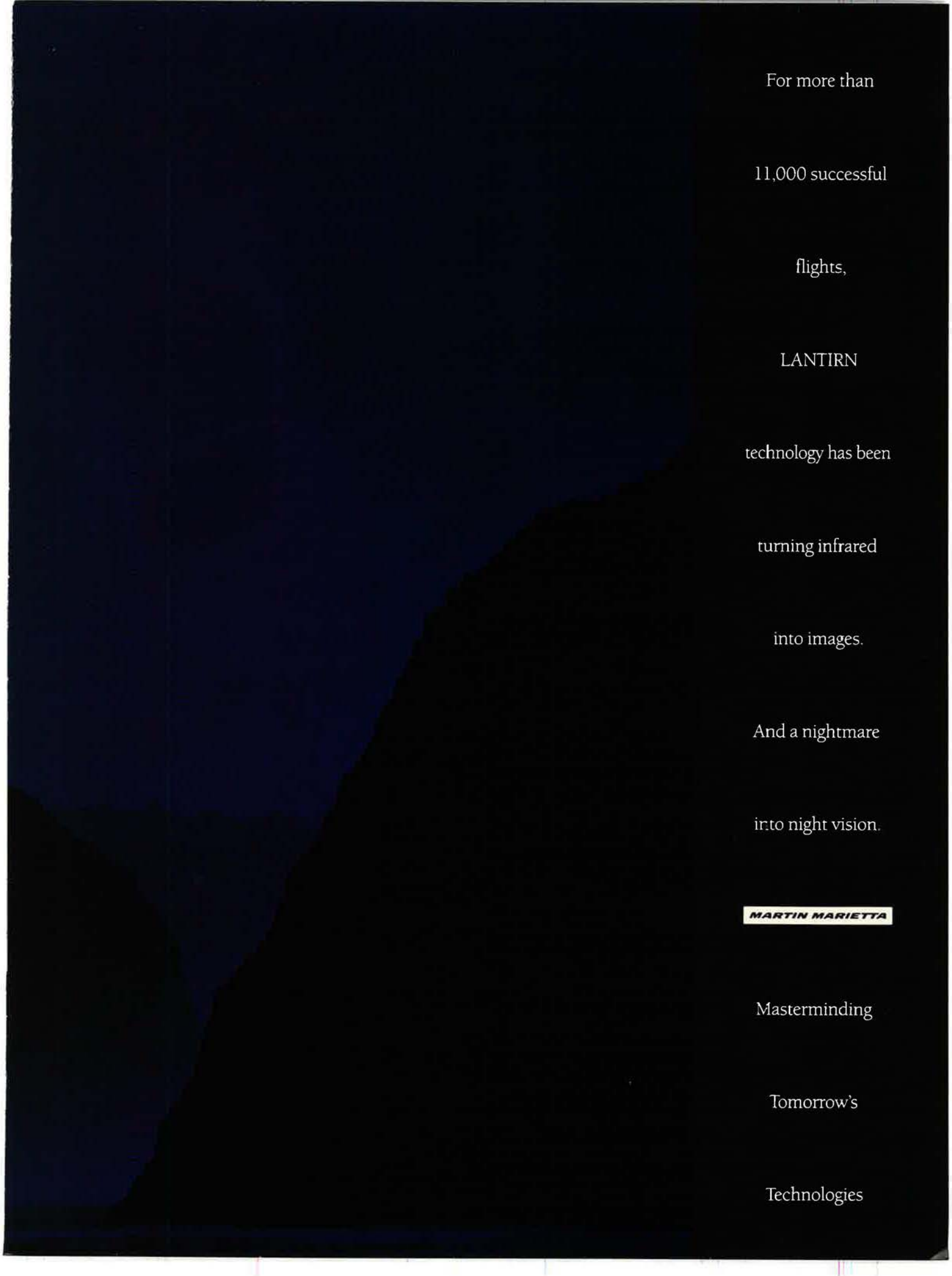
might be

a little

nervous."



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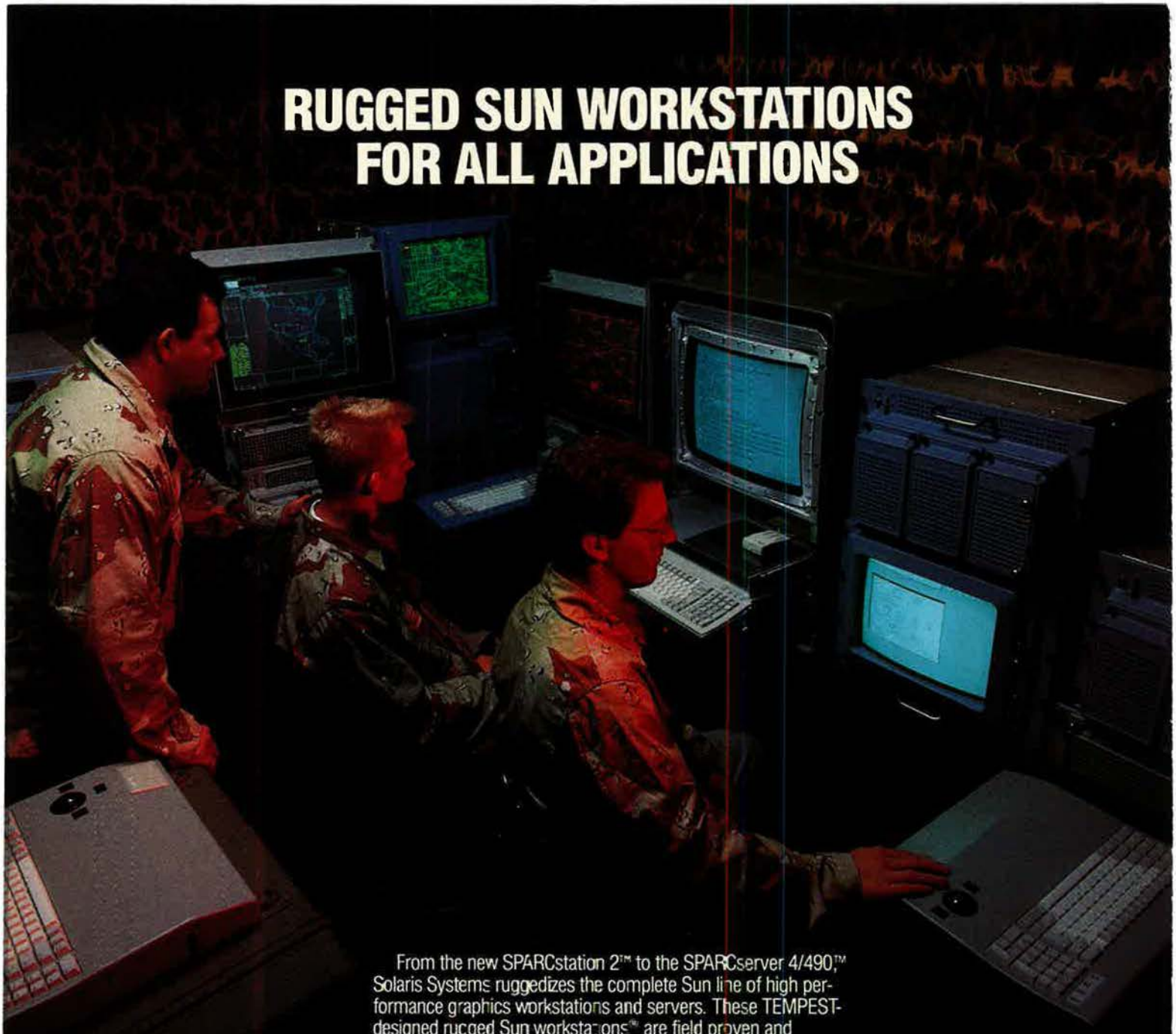

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March 1991, Vol. 74, No. 3

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Departments

About the cover: An F-4G Wild Weasel from the 35th TFW prepares to refuel during Operation Desert Storm. In a marriage of old technology with new, it carries HARMs to take out radar installations. Many new weapons proved their worth in the initial stages of the air war. Photo © Christopher Morris/Black Star.

The Forces of Desert Storm

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Editorial

By John T. Correll, Editor in Chief

The Force at War

Washington, D. C., February 8

THE GULF WAR took the nation by surprise, but it did not catch the armed forces unprepared. Even if the services had known the war was coming, no drastic changes would have been indicated to get ready for it.

Thus far, the campaign against Iraq has been a strong vindication of the doctrine, technology, training, plans, and requirements that the Pentagon and the military departments have been pursuing steadily all along.

That seems to amaze—and in some cases, disappoint—critics who had depicted the armed forces as a bunch of bunglers, wasting money on complicated weapons that didn't work and spinning scare stories about conflicts that would never happen.

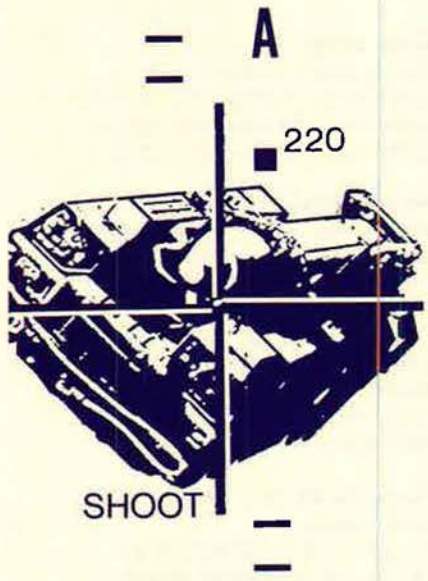
The aircraft, missiles, and munitions have been impressive and often spectacular.

Television viewers could judge for themselves. As they watched, a fighter rolled in on the Iraqi Defense Ministry in Baghdad and put a bomb neatly down the airshaft. They saw Patriot batteries knock incoming Scuds out of the sky. Infrared film footage showed them what the aircrews saw as a flight of F-15Es, equipped with LANTIRN navigation and targeting pods, bombed mobile Scud launchers, destroying at least three and perhaps seven on a single night attack.

The F-117A Stealth fighter has been a particular standout. Gen. Merrill A. McPeak, Air Force Chief of Staff, likens stealth to an ambush. Neither works perfectly every time, but there is "an overwhelming military advantage," he says, "when we come into a tactical situation with the element of surprise on our side."

US airpower effectively neutralized Iraq's Air Force, military radars, centralized air defense, and early warning systems in the opening days of the war and put major kinks in the supply and command and control systems.

It is impossible to avoid all civilian casualties and collateral damage, but the air operation has spared Iraqi citizens to a greater extent than they might realize. Careful targeting and precision guided munitions lessen the danger to noncombatants, and so does substantial accuracy with gravity weapons.



This is the force the critics depicted as a bunch of bunglers, wasting money on complicated weapons that wouldn't work?

Most strikes in urban areas have been at night, when most civilians are indoors. Planners avoid attack headings that align with hospitals, religious sites, and similar locations in case ordnance should fall short or long.

Military leaders are immensely pleased with the excellence of support operations and the rugged reliability of the systems. Despite heat, sand, and other complications, fighter aircraft average three sorties a day. The in-commission rate for combat aircraft hovers around ninety-three percent.

If an airplane is grounded by a broken part, a "Desert Express" airlifter delivers the needed item from a depot back home in forty-eight hours or less. That's faster than the mechanics could expect the part if they *were* back home.

Data from airborne radar provide field commanders an unprecedented grasp of activity in the battle area. The E-3 AWACS spots anything moving in the air, and the E-8A Joint STARS—still in development and operating with mixed military-contractor crews—keeps watch on ground traffic.

Every five weeks, strategic airlifters fly in tonnage equivalent to the total delivered in the Berlin Airlift.

Examples of success have been abundant in nearly all aspects of the operation. A much-maligned fax machine, built to military specifications at extra cost, stood up to blowing sand and kept transmitting target imagery while the casings melted off its commercial counterparts on desert runways.

In all of this, there are some ironies. During the second week of the war, Raytheon, the company that makes the Patriot missile, laid off another 300 workers. The defense industrial base, the source of the equipment doing so well in the Gulf, continues to disintegrate.

The following week, the Air Force confirmed that it will cut 130,000 more troops for budget reasons over the next five years. The nation has decided that five percent of GNP for defense is an unbearable burden. Some of those currently fighting in the Gulf will be forced out of service when and if they get home.

Despite an excess of pontificating, much of it transparently hostile, by radio and television journalists who wouldn't know a glide bomb from a plow handle, the coverage has been complete enough for the public to figure out what is going on in the Gulf.

Opinion polls report that public confidence in the armed forces is at the highest level in years. It remains to be seen how long this support will hold or how lasting the lessons will be.

For the moment, though, a majority of Americans seem to understand that US troops and weapons are the best in the world and that the nation's need for strong, flexible military power has not yet come to an end. ■

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Letters

A United Front

Let me first of all congratulate Col. Dennis M. Drew on his outstanding "We are An Aerospace Nation" *[see November 1990 issue, p. 32]*. We are indeed an aerospace nation, but when Colonel Drew makes the statement, "Land and naval forces, except in the most unusual circumstances, cannot operate without airpower, but airpower can function effectively—perhaps even decisively—without support from land and naval forces," he continues the no-win argument over which service is more important.

Instead of fighting among ourselves, we should be presenting a united front against those who would cut the military to the bone and then crucify us for being unable to respond as rapidly as they feel we should. We need to work toward a "military" position on issues and requirements, not an Air Force, Army, Navy, or Marine position. When new weapon systems are developed, that development should account for all users, not just those in a specific branch of the service. By developing one aircraft that can serve Air Force, Navy, and Marine needs, or a communications or computer system that is compatible with all branches of the military, we will be able to make better use of our dwindling dollars and, therefore, accomplish more with less.

While each branch of the service maneuvers and politicks to get the biggest share of the pie, the only thing they accomplish is that needed weapon systems and people programs have to be cut, delayed, and, in some cases, canceled. A united, cooperative military front will ensure that we enter the twenty-first century with personnel who are properly taken care of and state-of-the-art equipment that is reliable, technologically superior, and in sufficient quantities to complete the mission.

MSgt. Lance K. Nielson, USAF
Keesler AFB, Miss.

Military Power's Keystone

Maj. C. J. Krisinger, USAF, of the Naval War College makes statements in his letter *[see "Ends and Means," January 1991 "Letters," p. 6]* with which I cannot agree. He writes, "It is national interests and objectives that are the keystone of military power. . . ." To say that is to say that national interests and objectives are parts of a number of associated things that make up military power. Airpower is one of the things that makes up military power and can be properly called the keystone of military power. National interests are not part of military power; however, they may create a need for military power.

Perhaps Major Krisinger is thinking of some other group of things, which includes military power and of which national interests and/or objectives is the keystone. Surely he does not really mean that national interests are the keystone of military power.

Major Krisinger states that Colonel Drew is trapped in the "ends vs. means dilemma." However, Colonel Drew seemed to indicate that aerospace power is the keystone of military power in the same context in which seapower was the dominant power in earlier times and that we need aerospace power (a means) to help keep our sea-lanes open (an end). Colonel Drew clearly is keeping his "ends and means" in a proper relationship.

Lt. Col. Joe C. Lyons, AFRES (Ret.)
San Antonio, Tex.

Airpower's Conclusiveness

Let any who doubt that airpower can end a war *[see "The Indictment of Airpower," by John T. Correll, January 1991 issue, p. 4]* consult those Japanese who remember the end of World War II. General MacArthur stepped out of a C-54, not a landing craft or tank.

Japan's Navy may have been wrecked, but her Army (some 101 divisions) was in the field and largely unblooded, and they had several thousand planes for kamikaze use.

So why did they quit? Fear of losing another naval fleet? Of a land invasion? More atomic bombs? Aerial mines had paralyzed Japan's ports for months, and national starvation was imminent. Napalm and thermite had killed more people and destroyed more than *thirty times* as many square miles of her cities as the two atomic bombs did. There was no way to stop the bombing and mining, and napalm and thermite continued to incinerate three or four cities a week.

Read the Strategic Bombing Surveys. Those mines and bombs didn't float, swim, or march to Japan. Granted, American industry built the weapons, and the Army and Navy put the Army Air Forces into position to deliver them, but once the AAF was in position, the jig was up. *Airpower*—applied brutally and conclusively—ended that war. Properly used, it will end the next.

Yes, each service has a role, but any service, regardless of its capability, may be misapplied, as happened in Korea and Vietnam.

Those American airmen who died over Japan demonstrating airpower's conclusiveness must not be allowed to have died in vain. Otherwise, more soldiers, sailors, and airmen will be sacrificed to relearn what Douhet and Mitchell preached and LeMay proved.

James L. Pattillo
Santa Barbara, Calif.

LeMay's Legacy

What was Curt LeMay's legacy to us? Perhaps it was his forthrightness on a need for the preeminence of strategic airpower.

We could certainly call him the "Father of Low-Level Strategic Daylight Bombing." We could possibly call him one of those men most re-

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sponsible for bringing an early end to World War II, since not one American soldier had to die on mainland Japan during a land invasion.

His greatest single peacetime contribution to modern airpower was probably the iron will he manifested in ground and air discipline for his Strategic Air Command, which he commanded from 1948 to 1957.

The General's emphasis on an air safety program with teeth established a standard for all future air staffs to emulate. Every wing commander in SAC was held personally accountable for any Class A mishap and would be hauled on the carpet within twenty-four hours to appear before the General, whom we affectionately referred to as "Iron Ass." If the wing commander didn't have a damned good excuse for the incident, he was out of a job. It was as simple as that.

The late Sen. Stuart Symington said it all when he cited General LeMay's outstanding performance during the Berlin Airlift. In essence, the Senator said, "No Gordian knot ever stopped the indomitable will of this remarkable man."

Don Zweifel
Orange, Calif.

Uncool

I would like to applaud the Air Force for its rapid fielding of microclimate cooling equipment *[see "Cooler Wear for Desert Warriors," by Colleen A. Nash, December 1990 issue, p. 40].* However, as someone who helped to bring about this rapid fielding, I am somewhat surprised to see that the Army received no thanks or mention for its role in this program. The US Army Chemical Research, Development, and Engineering Center developed and fielded the filters used in this system, and the Army's Natick RD&E Center in Massachusetts developed and fielded the cooling vest. The Army Research Institute of Environmental Medicine provided data on the physiological aspects of body cooling, and we at Fort Belvoir, Va., provided hardware and engineering assistance for the early demonstrations and engineering tests.

Most of this work was done in the spirit of interservice cooperation (meaning without funds). Speaking for all of the Army guys involved, we are glad to see the troops benefit, but don't we deserve an "Army" somewhere in the article?

Chris Bolton
Fort Belvoir, Va.

Wiley With the Bats

I could not help but take a deep breath when I read "The Bat Bombers." *[See October 1990 issue, p. 88.]* Capt. Wiley W. Carr, quoted in the article, was my father. As young boys, my two brothers and I listened intently as our father described various projects he worked on during World War II. The most interesting project by far was the "bat project" detailed in C. V. Glines's article. Please allow me the opportunity to add to his article.

As amusing as this project appears to be, it did receive approval at the highest level. President Roosevelt personally endorsed the project with a penciled notation on the proposal sent to the Joint Chiefs of Staff that "this should be investigated."

At this early date, was FDR looking for a possible alternative to the massive bombing of cities like Tokyo, and the resulting loss of life, knowing that the Manhattan Project was under way?

The Air Forces had responsibility for the bats, while the Army had responsibility for the incendiary. If it has

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Letters

wings, give it to the Air Forces! Was this radar-emitting animal our first Stealth bomber? It does look strikingly similar to the B-2.

Dr. Louis F. Fieser (not "Fisser" as was stated in the article), in his book *The Scientific Method, A Personal Account of Unusual Projects in War and in Peace,* provides another excellent description of the project and its test results.

While it was not stated in the official report, my father felt the project was canceled in part because bats were possible carriers of germs, and the prospect of being accused of biological warfare was not acceptable. . . .

Capt. Wiley W. Carr (who retired as a Reserve lieutenant colonel) died in 1985 after a successful career in the chemical industry. I would like to thank you for printing this story.

Incidentally, Captain Carr's candid thoughts about wartime experiences had a profound effect on his sons. All three are serving in the armed services: Marine Lt. Col. Robert L. Carr, Marine Lt. Col. Edgar B. Carr, and the undersigned.

Maj. Wiley R. Carr,
Texas ANG
Houston, Tex.

The Battle-Damage Factor

Maj. Gen. George B. Harrison's "The Electronics of Attrition" *[see January 1991 issue, p. 68]* provided an informative and enlightening insight into the effects of electronic warfare on aircraft attrition. However, General Harrison may have painted too rosy a picture with his brief introduction on how attrition affects sortie generation. While he accurately portrayed "aircraft kill" effects on a commander's access to vitally needed resources, he failed to discuss the most devastating form of attrition—aircraft battle damage.

Throughout the history of aerial combat, all air forces have suffered aircraft losses from the effects of hostile fire. Not all these losses, however, resulted from downed aircraft. In fact, the largest percentage of loss, barring a repair capability, can come from battle damage. However, attrition rates do not include aircraft battle damage, which occurs at a rate four times that of aircraft loss. If aircraft return from a mission with battle damage, we must have the capability to repair them or they, in effect, become unreported statistics in the "war of attrition."

General Harrison's discussion identified the many ways that electronic combat can help decrease aircraft losses through confusion, deception, and destruction of enemy defenses. The article, however, failed to note that, unless his guns are destroyed, the enemy will retain the ability to fire his target-defense weapons. This, coupled with the improved survivability of our current aircraft, may compound problems of assessing attrition because of even higher rates of battle damage caused by "near misses" and the ability of our aircraft to return even after being hit.

If our commanders do not consider this "unseen attrition," they may find themselves without operational aircraft rather quickly during combat. A recent study on aircraft battle damage shows that a typical fighter wing that doesn't have a battle-damage repair capability can be reduced to fewer than fifteen operational aircraft after only ten days of conflict.

In his summary, General Harrison stated that "electronic combat is a complex structure of intricate relationships" and went on to say, "Individual factors by themselves may have only a small effect on force attrition, but in combination they have a great effect on long-term rates." While I agree with this, I must add that these statements cannot be applied to any single element of combat.

If we are to succeed in winning the air war, we must make a concerted effort, in which electronic combat's role is no more and no less important than our ability to overcome the "unseen" attrition—aircraft battle damage.

SMSgt. Joseph J. Matis III, USAF
USAF Aircraft Battle-Damage Repair Program Management Office
McClellan AFB, Calif.

Missing the Target

I was impressed with the Air Force's "Matching the Pilots to Their Tracks" effort, which was reported by Senior Editor James W. Canan in the December 1990 issue. On the surface, it would appear that this effort would put the right personality and temperament in the correct cockpit. Regrettably, where the Air Force misses the target is with its terrible track record on pilot retention. Regardless of the effort that is placed on the front end of the problem, it looks doubtful that matching the pilot to the cockpit will help to keep these young officers interested in remaining in the Air Force as a career.

Lt. Col. R. C. Weaver,
USAF (Ret.)
Santa Fe, N. M.

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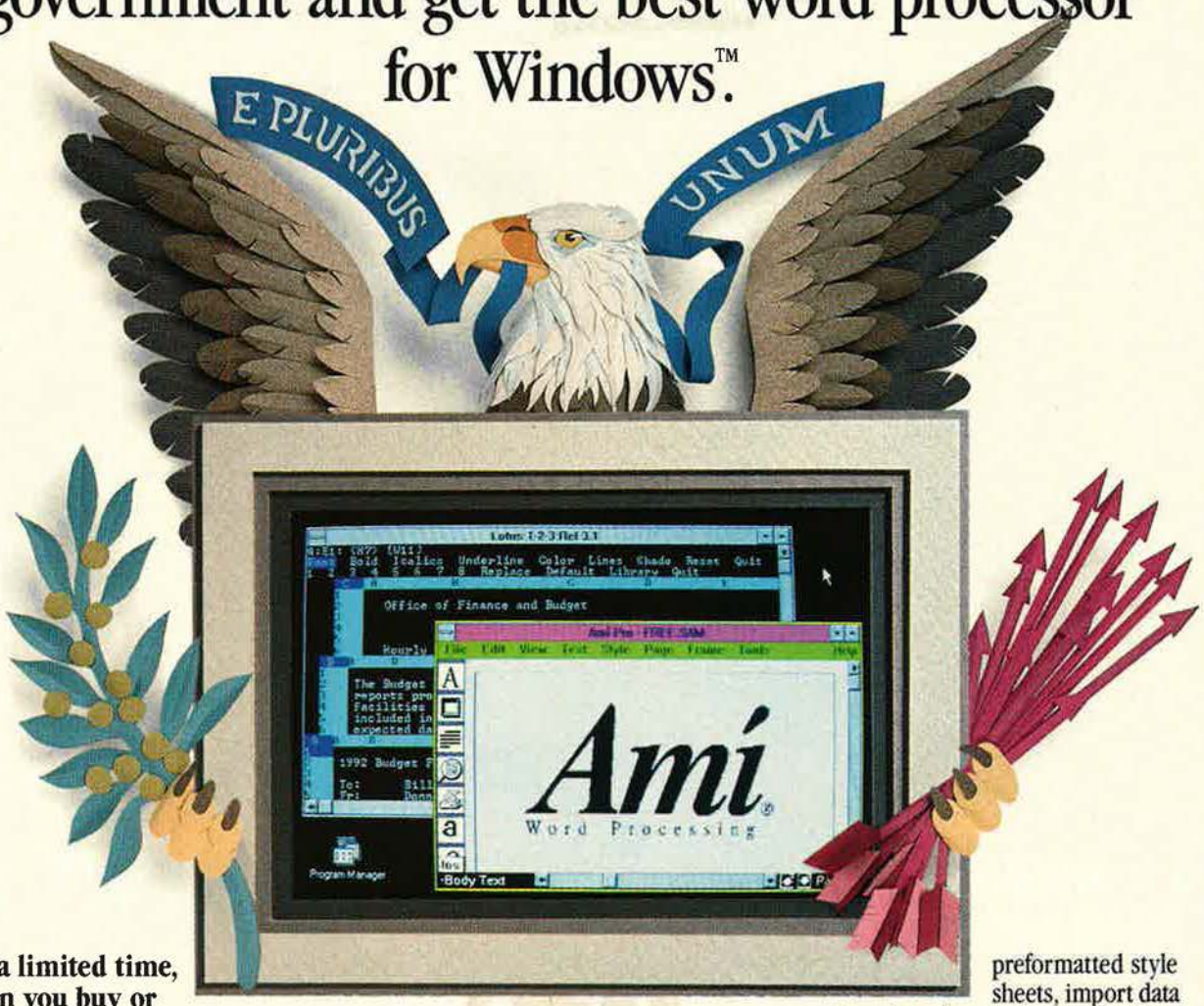

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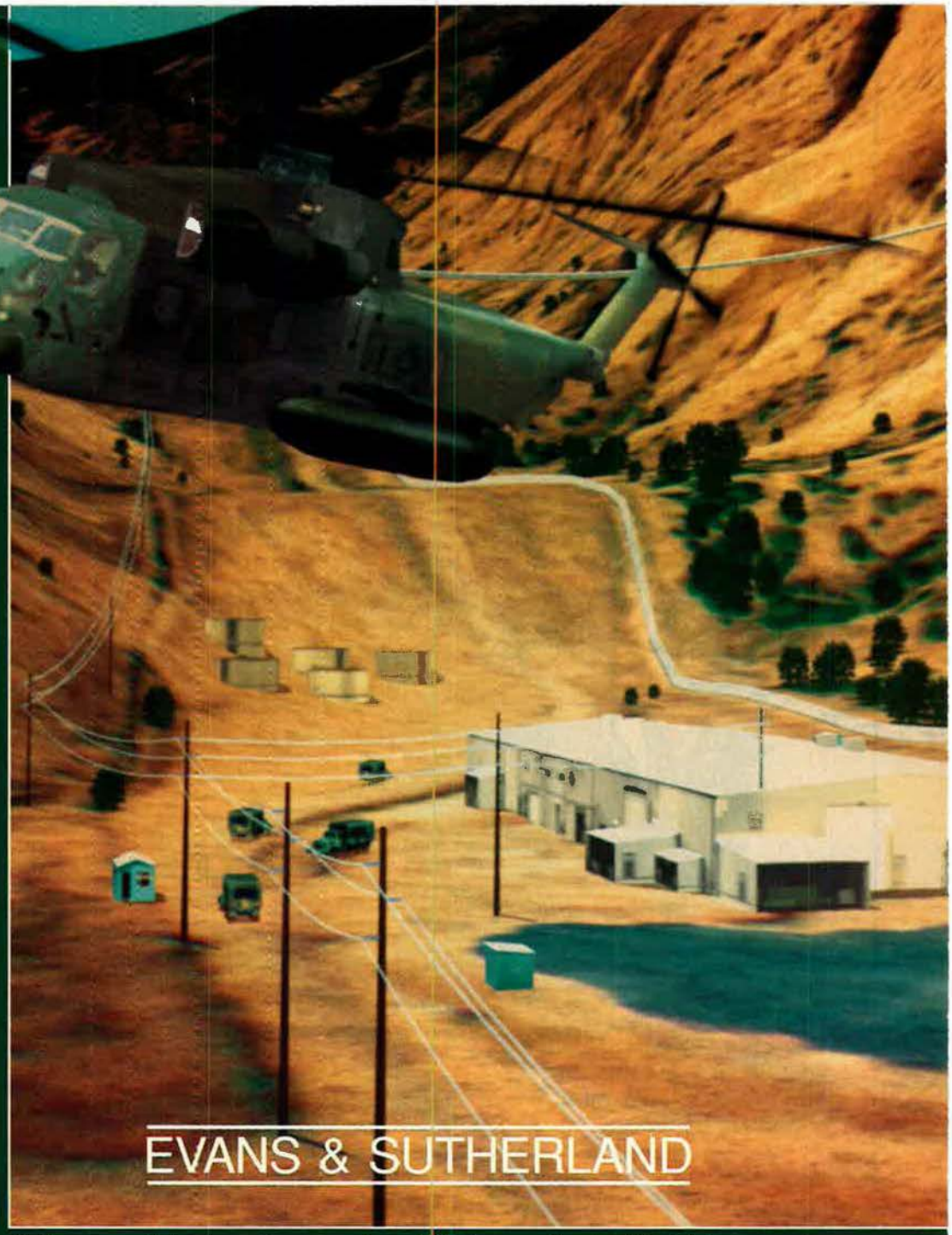

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For a complete picture of the new ESIG-4000, contact: Evans & Sutherland, Simulation Division, 600 Komas Drive, Salt Lake City, Utah 84108. Tel: 801-582-5847, Ext. 6521, Fax: 801-582-5848

The Chart Page

Edited by Colleen A. Nash, Associate Editor

Where Military Retirees Live

(As of September 30, 1989)

Mailing Address	Army	Navy	Marine Corps	Air Force	Total DoD
Alabama	18,465	5,640	1,272	13,216	38,593
Alaska	1,759	499	109	3,060	5,427
Arizona	11,051	5,758	2,068	18,942	37,819
Arkansas	6,862	4,187	831	9,250	21,130
California	41,208	86,357	18,940	68,940	214,901
Colorado	13,528	3,936	953	17,996	36,413
Connecticut	3,040	5,056	587	2,258	10,941
Delaware	1,216	724	162	2,971	5,073
District of Columbia	2,477	700	164	1,499	4,840
Florida	37,871	47,057	6,401	57,100	148,429
Georgia	29,951	8,301	2,743	16,445	57,440
Guam	309	646	50	308	1,313
Hawaii	5,041	3,411	833	3,047	12,332
Idaho	1,729	1,819	380	3,493	7,421
Illinois	9,960	6,839	1,628	9,896	28,323
Indiana	7,423	3,478	1,084	5,428	17,413
Iowa	3,054	2,037	478	2,493	8,062
Kansas	6,762	2,436	590	5,705	15,493
Kentucky	11,203	2,628	703	4,091	18,625
Louisiana	8,499	4,504	1,128	11,021	25,152
Maine	2,566	3,374	500	3,389	9,829
Maryland	14,564	10,751	1,721	10,370	37,406
Massachusetts	7,596	6,460	1,319	6,774	22,149
Michigan	8,224	4,740	1,373	7,227	21,564
Minnesota	4,393	3,178	707	3,949	12,227
Mississippi	5,577	4,562	749	8,864	19,752
Missouri	10,664	5,612	1,729	9,362	27,367
Montana	1,335	1,037	272	2,379	5,023
Nebraska	1,912	1,424	276	5,968	9,580
Nevada	3,130	3,626	849	8,730	16,335
New Hampshire	2,496	1,957	424	3,736	8,613
New Jersey	11,468	5,083	1,340	5,432	24,043
New Mexico	4,698	2,310	559	8,842	16,409
New York	13,797	8,059	2,205	10,304	34,365
North Carolina	22,352	8,735	7,245	13,557	51,889
North Dakota	652	336	64	1,377	2,429
Ohio	10,739	6,254	1,980	14,826	33,799
Oklahoma	11,801	3,771	985	11,441	27,998
Oregon	4,984	5,987	1,180	5,867	18,018
Pennsylvania	16,723	10,431	2,782	10,817	40,753
Puerto Rico	6,561	317	139	686	7,703
Rhode Island	1,348	3,506	249	883	5,986
South Carolina	13,931	10,099	2,286	13,534	39,850
South Dakota	1,012	510	100	1,999	3,621
Tennessee	13,310	7,862	1,824	9,980	32,976
Texas	54,056	18,594	4,803	68,981	146,434
Utah	2,508	1,377	334	4,073	8,292
Vermont	1,127	556	114	858	2,655
Virginia	30,656	36,201	5,751	19,585	92,193
Virgin Islands	134	56	10	44	244
Washington	18,757	16,933	1,876	17,674	55,240
West Virginia	3,450	1,956	607	2,565	8,578
Wisconsin	5,172	2,994	791	3,877	12,834
Wyoming	729	508	94	1,674	3,005
Other	10,037	7,670	700	8,436	26,843
Total	**543,867**	**403,559**	**89,041**	**564,675**	**1,601,142**

Source: US Department of Defense, *Defense '90.*

Valor

By John L. Frisbee, Contributing Editor

"The Bravest Man I Ever Knew"

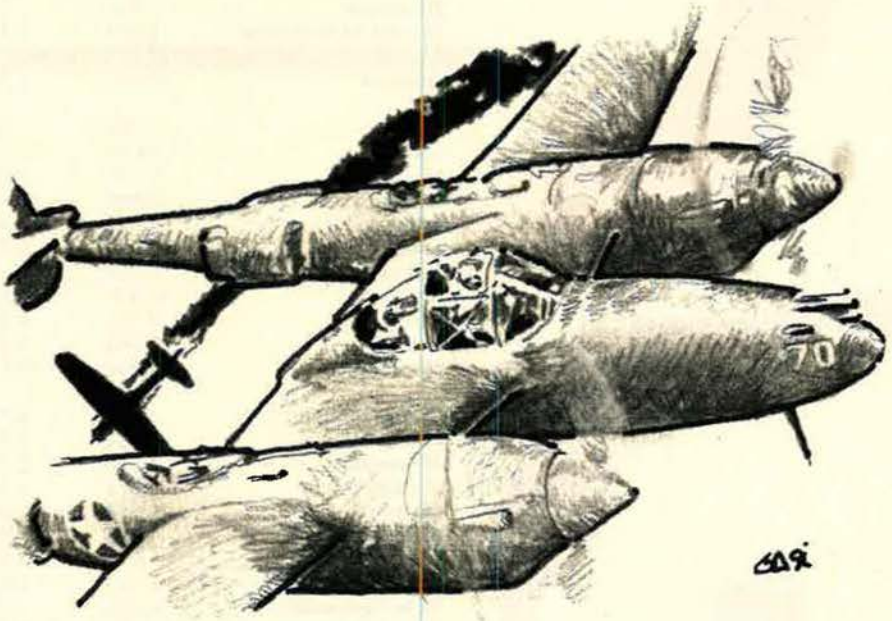
Few men have fought and died as gallantly as fighter ace Jerry Johnson.

ALASKA was not known as the spawning ground of aces during World War II. It was, in fact, the only combat theater that produced not a single ace, due to the lack of enemy targets. Nevertheless, two of the highest-ranking AAF aces in the Pacific—second-ranking Tom McGuire and fourth-ranking Gerald R. Johnson—cut their combat teeth over the Aleutian Islands. (Gerald R. Johnson often is confused with Gerald W. Johnson, one of the top aces in Europe.) Unlike McGuire, who never saw an enemy plane over Alaska, Jerry Johnson claimed two victories in September 1942, neither officially confirmed.

In March 1943, after completing his combat tour in the Aleutians and making the transition to P-38s, Jerry Johnson was assigned to the 49th Fighter Group in the southwest Pacific at the same time as McGuire, who later was transferred to the 457th Group. Fifth Air Force Commander Gen. George Kenney described Johnson as "little, soft-voiced, [and] black-haired." Johnson became one of Kenney's favorite fighter pilots, respected for his gallantry and admired by his squadron mates.

Any World War II fighter pilot will tell you that the ability to shoot accurately at a moving target from a moving platform was more important than piloting finesse. Jerry Johnson soon became known as one of the best shots in Fifth Air Force. While only three percent of fighter pilots have become aces, Johnson earned that distinction less than seven weeks after his first confirmed victories—a double—on July 26, 1943. At the end of his first Pacific tour in January 1944, he had tallied eleven confirmed victories and eleven probables, including a triple on October 15. He definitely was a man to be watched by Bong, McGuire, Kearby, Lynch, and other contenders for top honors.

Jerry Johnson didn't cool off during his R&R in the States. Returning to the Pacific in October, he was one of the first AAF fighter pilots to arrive at Tacloban on Leyte in the Philippines. P-38s from the 49th touched down as aviation engineers were laying the last pieces of steel mat on the freshly carved strip. Four hours later, Johnson shot down two enemy planes. The strip was under attack night and day as the Japanese tried desperately to wipe out the American foothold on Leyte. There were plenty of targets for eager Lightning pilots.



Johnson seemed to have a propensity for special days. On Armistice Day, November 11, he downed two more, and on December 7, the third anniversary of Pearl Harbor, he scored four in what his fellow pilots called the greatest exhibition of aerial gunnery they ever had seen.

Johnson ended the war as a lieutenant colonel and commander of the 49th Fighter Group, with twenty-two confirmed, twenty-one probables, two Distinguished Service Crosses, the Silver Star, and many lesser decorations. Shortly after V-J Day he was named commander of Atsugi AB near Yokohama, Japan.

On October 7, 1945, he was returning to Japan in a B-17 after a short absence from his command. Accounts of that flight vary widely. According to one source, Johnson was pilot of the B-17; another lists him as a passenger. The latter probably is correct, since his flight records at Norton AFB, Calif., show no previous flights as a crew member of a B-17 and no flight in any type of aircraft after September 30, 1945.

There is general agreement that the aircraft ran into very bad weather and, with its radios out, became hopelessly lost. As fuel ran low, the bail-out signal was given. It was discovered that one of the passengers had come aboard with no parachute. Jerry Johnson gave his to that man and went down with the plane. All who bailed out were saved.

According to *Fighter Aces* by Raymond Toliver and Trevor Constable, General Kenney told Johnson's father, "You are the father of the bravest man I ever knew, and the bravest thing he ever did was the last thing . . . when he did not need to be brave." Jerry Johnson, whose first concern always had been for the safety and well-being of his men, would not have agreed with Kenney's last words. For him, as for so many other Air Force heroes, bravery had no bounds of time or space. ■

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Washington Watch

By James W. Canan, Senior Editor

Airpower Opens the Fight

Put to the test of combat, the weapons and the troops performed superbly. The Gulf War is a telling repudiation of the critics' predictions.

Cruise missiles, launched by US warships in the Red Sea and the Persian Gulf and aimed at faraway command and communications centers, were the first weapons to strike Iraq. Then, in quick succession, came the stealthy F-117A attack fighters. Engines muted, they slipped through enemy air-defense radars and bombed airfields and missile sites.

Operation Desert Storm had begun, set off by an air campaign that would soon prove unprecedented in its intensity, precision, and lethality. Never before in war had so many air forces and aircraft worked together so well and with such telling effect.

Air traffic control—directing and coordinating the steady streams of multiservice, multinational, combat and support aircraft in and around Iraqi and Kuwaiti airspace—was enough in itself to bend the mind. All went smoothly, thanks to US Central Command's air tasking order and to the proficiency of allied pilots in executing it.

That ATO, drawn up by US Air Force Lt. Gen. Charles A. "Chuck" Horner, USCENTCOM's air commander, was the blueprint for the allied air campaign. It held up from the start.

Thirty-six hours into Operation Desert Storm, General Horner declared, "We've worked hard to bring together this very complex, very large campaign plan. We've been able to integrate all our forces because we all fly off a common air tasking order."

Success in the air came swiftly and was sustained. Gen. H. Norman Schwarzkopf, Commander in Chief of USCENTCOM and of the US-led coalition of forces, credited General Horner as having been "the architect of our air campaign" and called him "a superb leader."

Despite a brief lull and a temporary letdown caused by bad weather, the allied air campaign appeared to improve as it went along. Two weeks into it, General Schwarzkopf claimed "air supremacy" for the coalition throughout the region. He said his air forces had flown more than 30,000 sorties, averaging more than 2,000 a day and had lost only nineteen aircraft, all to ground fire (most of it from guns, not missiles) or in accidents.

"We've destroyed twenty-nine Iraqi fighter aircraft with not one single air-to-air loss on the part of the coalition," General Schwarzkopf asserted. He added that "not a single Iraci aircraft has penetrated the coalition airspace since this war began."

Said the CINC, "In the last three days alone, F-15s have shot down nine MiG-23s and Mirage F.1s. The Iraqi early warning system has completely failed, and their aircraft have been caught totally by surprise when we attacked them."

"Relentless" Attack

General Schwarzkopf claimed that "relentless" allied air attacks had destroyed or severely damaged most of Iraq's primary command, control, and communications facilities and air defense systems. As a result, he said, the Iraqis "have been forced to switch to backup [C³] systems [that are] far less effective and more easily targeted," and they "have abandoned centralized control of their air defense within Iraq and Kuwait."

This, he said, was "a very important point," because "it accounts, in part, for the very, very low attrition rate of coalition aircraft."

He emphasized that "pilot skills also account for that low attrition rate."

Desert Storm's dazzling demonstration of those skills under fire is part of a larger revelation: The Pentagon has made better decisions, and has spent its money more wisely, than it may have been given credit for.

Skillful pilots are a big part of the Pentagon's payoff. They are the products of smart recruiting, solid instruction, and realistic training in exercises approximating actual combat. The Air Force has put a premium on all such endeavors in recent times.

Desert Shield's triumphant air campaign was clearly a tribute to Pentagon systems-acquisition policies and programs as well, with emphasis on the Air Force role. Put to the test, aircraft and other systems performed superbly. They also proved to be rugged. Keeping them fit to fly and fight posed no major problems. USAF's combat aircraft, averaging three tough sorties every day, sustained an astounding mission capable rate of close to ninety percent.

Desert Storm also made a case for advanced technology. The air war left no doubt that advanced technology is conducive to—not at odds with—the durability and reliability of aircraft and their ancillary systems. The war may have discredited, once and for all, criticisms that the Pentagon wastes money on weapons that cost too much, don't work, or don't hold up.

The early days of Desert Storm were seen as validation of the Air Force's stated policy of "global reach, global power." In striking that theme, the Air Force never claimed that airpower can do it all, only that it can do an awful lot and that little else is possible without it.

Desert Storm soon made the point. By itself, airpower may not have been enough to dislodge Saddam Hussein's forces from Kuwait, but it surely was needed to soften them up, and it did so.

Skirting the Holy Places

Choosing targets and coordinating attacks on them in this Mideast war—a war that General Horner described as, "in some respects, a technology war, although fought by men and women"—were tasks complicated by humane considerations. His mandate, he noted, was to "avoid any damage to civilian targets and to the holy shrines that happen to be located in Iraq."

He continued, "We've looked at every target from the outset for avenues

of approach, the exact type of weapon to cause damage to the target but [to] preclude damage to the surrounding area, and precision delivery."

Early on, General Horner's headquarters provided eye-popping examples of such delivery. Videotapes from TV cameras aboard F-117s and F-111s showed the planes' laser-guided bombs hitting such targets as a runway, a missile storage building, and "my counterpart's headquarters in Baghdad" right on the money, with no collateral damage to civilian facilities.

General Horner described the planning of the air campaign as "an enormous effort" made possible by "a lot of computers [to] bring together the tens of thousands of minute details—radio frequencies, altitudes, tanker rendezvous, bomb configurations, who supports whom, who's flying escort."

He added, "There are just thousands and thousands of such details, and we work them together as one group, put them together in what we call a common air tasking order." He likened that ATO to "a sheet of music" from which "everyone sings the same song."

The ATO was the master plan for interservice and cross-national teamwork. "We've been able to execute because we've trained very hard," the air commander said. "You'll find sorties where a Saudi aircraft will drop bombs escorted by an American fighter and supported by other aircraft from [other] countries."

He related a recent example: Saudi Tornados, escorted by USAF fighters and supported by Navy EA-6B electronic countermeasures aircraft, had taken out a vital runway just across the Saudi border in Iraq.

"The types of aircraft we have in this campaign have been the key to its success," General Horner declared. "There's no doubt that our air defense and our awareness of what's going on in the air battlefield are a result, in large measure, of what the AWACS provides us and of the defense that aircraft such as the F-14 and the F-15 provide our forces."

Mission planning was the key to applying airpower in Desert Storm. The near-perfection of that planning was evident right from the start.

On the first night, as the Tomahawks headed for their targets, a four-ship flight of F-15Cs took off from their base in northeastern Saudi Arabia. They headed north, followed by other Eagle flights, to fly cover for the ground-attack aircraft, electronic warfare planes, and defense-suppression aircraft even then marshaling for missions into Iraq and Kuwait.

Imagery from an Air Force F-117A Stealth fighter taken at the outset of Desert Storm shows a doomed Iraqi air defense headquarters building caught in the aircraft's sighting cross during a precision bombing run. The dark spot in the upper right quadrant of the sighting cross is the entry point of a bomb dropped moments earlier by a preceding aircraft.

The F-15Es Swoop In

Only minutes after the first waves of Tomahawks and F-117As had taken enemy defenders by surprise, F-15Es armed with Mk. 82 and Mk. 84 iron bombs, cluster bombs, and runway-cratering bombs swooped into Iraq and Kuwait. To the south and west, B-52s were forming up after long flights from Diego Garcia over the Indian Ocean and all the way from Barksdale AFB, La., to pound Iraqi ground forces and facilities in Kuwait with an assortment of bombs, including parabraked M117s. AWACS planes shepherded the bombers. F-15Cs flew cover. Meanwhile, Air Force EF-111 Raven and EC-130 Compass Call electronic countermeasures planes, in concert with Navy EA-6B Prowlers, had moved into their assigned sectors of coverage to make life easier for aircrews on the attack.

With F-15Cs flying combat air patrol and F-4G Wild Weasels clearing the way through enemy fire-control radars, the first full-up Air Force strike package, with F-15Es and F-111Fs in the forefront, penetrated Iraqi airspace.

As the F-4Gs egressed, Navy F/A-18s, also armed with radar-homing AGM-88 HARM missiles, ingressed to take over for them.

Before the night was through, the allied air assault would involve virtually every type of Air Force, Navy, and Marine Corps combat aircraft deployed in the region through the previous five months, following Iraq's invasion of Kuwait on August 2. Army attack helicopters also came into play as part of special operations.

Over the next fourteen hours, without letup, the allied air arms of the US-led international coalition arrayed against Iraq flew more than 1,000 sorties. They would improve on that pace and intensity, averaging more than 2,000 sorties—half combat, half support—every twenty-four hours, with time out for a short stretch of bad weather, through the days and weeks to come.

US Central Command's headquarters in Saudi Arabia disclosed the makeup of the coalition attack force on that first night of the air campaign. The Air Force accounted for 530 of the attack aircraft, the Navy and Marines for ninety, Britain for twenty-four, and France and Saudi Arabia for twelve each.

The coalition attack force also included US Air Force, US Navy, Saudi, and Canadian counterair fighters and interceptors; US Air Force, US Navy, and British airborne warning and control aircraft; and US Air Force and British tankers. Rounding it out were aircraft of at least one service or nation devoted to such missions as electronic warfare, suppression of enemy air defenses (SEAD), and tactical re-

connaissance. The latter mission also involved the Navy's ship-launched Pioneer unmanned aerial vehicles (UAVs).

"The main thing we always try to do," explained an Air Force official, "is to take advantage of surprise and mass—to mass our air assets at specific locations at certain times to overwhelm the defenses, generate the necessary destruction, and egress. We apply the mass and set the timing of each successive wave—or force package—so that each complements the job done by the one that went before."

A Clockwork Operation

Timing is everything, "clockwork" the byword. TOT—time over target—of attack elements is a matter of only a minute or so. Aircraft must adhere to "deconflicting" flight paths, altitudes, and airspace boundaries while ingressing and egressing target zones in profusion and in rapid succession.

"You don't commit all assets in one wave," an official explained. "You like to hit targets with three to five waves, each of them, perhaps, with different types of airplanes, each ingressing and egressing in different locations. The idea is to make it difficult or impossible for the defenders to comprehend what's hitting them and where it's coming from."

In Desert Storm's early days of drumfire air assaults, the number and types of airplanes in each allied force package tended to remain constant from sortie to sortie against certain kinds of targets. Individual pilots and planes in those packages changed identities. Pilots rotated among cockpits. Planes were allocated "downtime." All schedules were aimed at keeping flyers fresh and aircraft mission capable.

Allied attack aircraft reportedly averaged three sorties every twenty-four hours. More often than not, each plane was flown by two different pilots and around the clock. Rotation of cockpit assignments depended on how far planes and crews had to fly to and from targets and on how tough the flying and fighting turned out to be. "Pilots striking downtown Baghdad on four-hour sorties may have flown only once a night," one source said.

The master plan for all that was the common air tasking order, the ATO, mentioned by General Horner earlier—a 600-page computer printout revised and redistributed daily to all air combat and support outfits.

—USN photo by TSgt. Perry Heimer

This view from a KC-135R shows a Marine Corps F/A-18 fighter being refueled by the Air Force tanker over the Persian Gulf. Air Force, Navy, Marine, and Army aircraft worked together in grand style, along with planes of several other nations, to rule the air and rain bombs on enemy forces and facilities in Operation Desert Storm.

General Schwarzkopf saw fit to enunciate the aims of the ATO.

"In our first phase," he said, "we wanted to disrupt leadership command and control; destroy centralized air defense command and control; attack combat aircraft in the air and on the ground to achieve air superiority; damage chemical, biological, and nuclear storage and production capability; and commence attack on Republican Guards [elite Iraqi troops in northern Kuwait and just north of the Kuwait-Iraq border].

"Once we had that done, we planned to go into a second phase, which was to destroy the air defense radars and missiles in the Kuwaiti theater of operation to achieve undisputed control of the air—some people call that air supremacy—and, finally, to sever supply lines in [that] theater. . . .

"Once that phase was completed, we planned then to isolate the Kuwaiti theater of operations, continue our attacks on the Republican Guards—and we have other objectives, which I will not discuss further."

Smacking the Airfields

The fundamental soundness and adaptability of the ATO became apparent as the bombing of enemy airfields went on and on, day after day. Allied air planners had targeted sixteen primary Iraqi airfields and twenty-eight dispersal airfields. Over two weeks, with time out for bad weather, allied planes flew more than 1,300 sorties against thirty-eight of those airfields, struck many of them at least four times, and put nine irreparably out of operation.

Ground-hugging British Tornado attack fighters armed with JP-233 cluster bombs accounted for a great deal of the damage to airfields and took relatively heavy losses early on.

"We never had any intention to render all of the airfields inoperable," General Schwarzkopf explained. "Our intention is to render the [Iraqi] *Air Force* ineffective."

This happened fast. More than two dozen Iraqi warplanes, including six Soviet-built Tu-16 "Badger" bombers and an Adnan radar plane, were destroyed on the ground. The Iraqis took to hiding their planes in hardened shelters, which became the objects of "systematic destruction," General Schwarzkopf said. Before long, seventy shelters had been blasted, and Iraqi aircraft were "running out of places to hide," said the CINC.

So the planes turned tail. Within days, eighty-nine Iraqi aircraft, including top-of-the-line MiG and Mi-

Pilots flying special operations helicopters on low-level missions in total darkness, smoke and fog, will be aided by the field-proven Hughes Aircraft Company Night Vision System, designated the AN/AAQ-16. HNVS is being installed on U.S. Army MH-47E Chinooks and MH-60K Blackhawks, on U.S. Air Force MH-60G Pavehawks, and a derivative of the system has been selected for the Marine Corps' V-22 tilt rotor aircraft. The system, produced by Hughes, has been installed on several other military helicopters, including the U.S. Navy's SH-2F Light Airborne Multi-Purpose System (LAMPS) MKI. The turret mounted infrared system provides the crew with TV-like imagery on a cockpit panel display.

Very thin aluminum foil helps make a large radar antenna physically manageable. The 94 radio frequency (RF) vertical feeds on the electronically-steered, Hughes-built Advanced Synthetic Aperture Radar System-2 (ASARS-2) antenna are made by stretch-shaping the aluminum foil, which is only six-thousandths of an inch thick, into a complex pattern. The process, called hydroforming, produces a feed which weighs about seven ounces, compared to traditional sheet-metal feeds that weigh two to three pounds each. Along with other design features, these lightweight feeds resulted in an antenna, including all its electronics, mechanics, and power supplies, that weighs only one-third as much as comparable units.

A 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 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.

A state-of-the-art workstation will help improve air traffic control in Germany. Thirty-two of the workstations, developed and built by Hughes and designated the AMD 44 airspace management display, will be installed in the Karlsruhe Upper Air Control Center. In addition to the full color, common controller workstations, Hughes has developed and installed five software test stations. The AMD 44 workstations use high resolution, 20- by 20-inch monitors along with built-in processors that can be upgraded easily to increase the workstations' performance if more computer power is required. The displays will be fitted into console structures already in the center.

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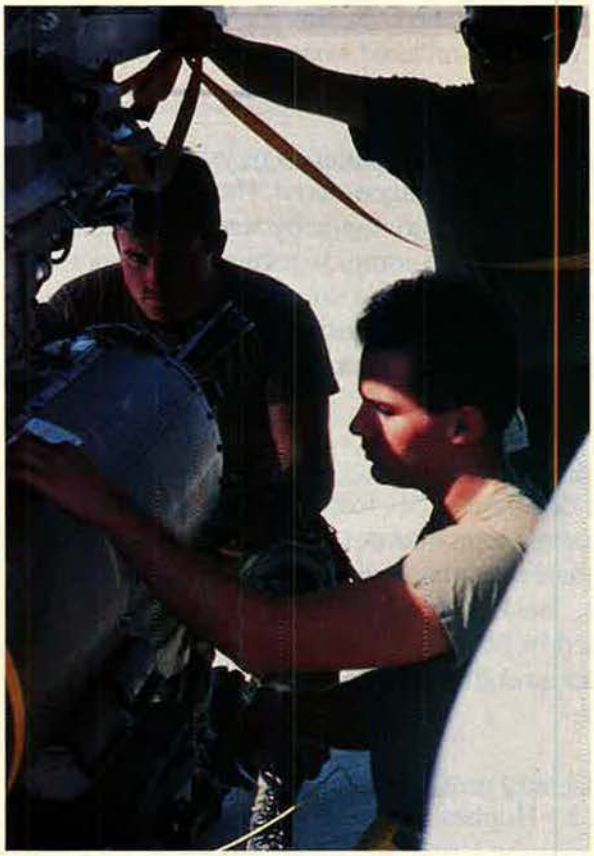
rage fighters and a warning-and-control radar plane, were flown out of harm's way to safe havens in Iran, presumably for the duration of the war.

Iraq's chemical, biological, and nuclear warfare plants were top targets on General Horner's ATO. Allied planes and ships mounted 535 sorties with Tomahawks and air-launched, precision guided missiles against thirty-one plant sites.

—USN photo by TSgt. Marvin Lynchard



SrA. Arthur Chestine of the 388th Aircraft Generation Squadron, Hill AFB, Utah, drives a bomb lift load truck bearing cluster bombs, a type heavily used in allied attacks on enemy airfields and troop concentrations. Desert Storm's air campaign, averaging 2,000 sorties each day, set records for intensity, precision, and lethality.

"We have destroyed all of their nuclear facilities," said the commander in chief of the coalition forces two weeks into the war. He reported that Baghdad Nuclear Research Center "has been leveled to rubble" and that more than half of the chemical and biological warfare plants "have been severely damaged or totally destroyed." General Schwarzkopf promised to "continue a relentless attack" on Iraq's "heinous" chemical/biological weapons facilities.

As the coalition's warplanes intensified their firepower against Iraqi ground forces in Kuwait, much of it directed at the Republican Guards, the countryside occupied by those forces took on the look of a moonscape. B-52s from Diego Garcia and Jidda, Saudi Arabia, bombed the Iraqi troops almost without letup.

Said General Schwarzkopf, "We're targeting the Republican Guards with about 300 sorties a day. We're using very accurate bombing even in bad weather. The many secondary explosions are confirming that we're inflicting continuous damage on them."

In a typical day, twenty-seven B-52s dropped 455 tons of explosives on the Republican Guards, "not to mention the other strikes that we're doing with F-16s, F-15Es, A-6s, etc.," the commanding General said.

In one fifteen-hour stretch, such bombing destroyed 178 trucks, destroyed or damaged fifty-five artillery pieces and fifty-two tanks, and caused "heavy secondary explosions from revetments and fires all over the area," including spectacular pyrotechnics from the explosion of 125 storage revetments "in the largest ammo storage area" in northern Kuwait, the CINC said.

He emphasized that allied planes were "attacking very close in to our [ground forces] positions, with over 300 sorties a day." He noted, for example, that Marine Corps F/A-18s and Air Force A-10s, in the course of one day, had destroyed at least fifty-four armored personnel carriers, eight tanks, a half-dozen self-propelled artillery pieces, and numerous FROG (free rocket over ground) missiles and heavy-equipment transports.

He tipped his cap to the Navy for its "great job in supporting the air campaign." Through the first two weeks of the war, General Schwarzkopf said, the Navy flew 3,500 sorties from six aircraft carriers and launched more than 260 Tomahawks. The Navy also took to launching SLAMs—Standoff Land-Attack Missiles, a version of the AGM-84 Harpoon antiship missile that was in advanced development when the war began and that the Navy rushed into operation.

Though flexible, the allied air plan was never freewheeling. Everything about it had long since been thought through, organized, and coordinated.

General Schwarzkopf set the objectives for the campaign last August, even before the massive US deployment to the Mideast in Operation Desert Shield. As the CINC worked up his strategy for the campaign to drive Iraqi forces out of Kuwait, General Horner got down to details about the air campaign.

There was nothing impromptu about the air commander's plan. He had known for quite some time that it might be needed. At CENTCOM headquarters, MacDill AFB, Fla., and in Air Staff plans and operations circles at the Pentagon, an Iraqi invasion of Kuwait had long ranked at or near the top of contingencies likely to confront the US in the post–cold war world.

General Horner and his staff had wide latitude. After the war began, he attributed the early success of the air campaign largely to "the freedom with which we've been able to plan it." Apart from "stringent guidance with regard to civilian damage and things of that nature," he had been given a free hand to "plan a very efficient military campaign," he said.

There were no mysteries about how to do it. The basic elements of the plan were the same as in any war and in such exercises as Red Flag. The whole idea is always to establish air superiority—and preferably air supremacy, which means uncontested control of the air—and then to destroy the enemy's offensive capabilities and roll back its defensive forces.

Gen. Colin Powell, Chairman of the Joint Chiefs of Staff, summed up: "The military objective that we set out to accomplish . . . is simply to eject the Iraqi army from Kuwait."

How? "First we're going to cut it off, and then we're going to kill it," General Powell declared. ■

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Aerospace World

By Jeffrey P. Rhodes, Aeronautics Editor

★ "The liberation of Kuwait has begun," said White House Press Secretary Marlin Fitzwater, announcing the start of coalition military action in the Persian Gulf on January 16. Operation Desert Shield, the buildup of US and coalition forces, became Operation Desert Storm as more than 1,200 combat sorties were flown and 106 cruise missiles launched against targets in Iraq and Kuwait during the first fourteen hours of the operation.

At a press conference after the raids, Gen. Colin Powell, the Chairman of the Joint Chiefs of Staff, announced that the raids included Air Force A-10s, B-52s, F-15C/Es, F-16Cs, F-111s, and F-117s; Navy A-6s, A-7s, and F/A-18s; Marine Corps A-6s, AV-8Bs, and F/A-18s; and Army AH-64 attack helicopters. Additionally, Royal Air Force Tornado, Royal Saudi Air Force Tornado, and Free Kuwait Air Force A-4 aircraft were flown in the initial attacks.

General Powell reported that eighty percent of the raids were effective. The unsuccessful missions were attributed to mechanical failure, targets obscured by weather, or failure of the crews to see the objective clearly. The Navy reported a ninety-four percent effectiveness rate with its conventionally armed BGM-109 Tomahawk land-attack cruise missiles: 100 of 106 missiles launched from three ships hit their targets.

Film released after the raids demonstrated the superlative performance of precision guided weapons. One clip showed an F-111 releasing two 2,000-pound weapons that flew through the door of a Scud mobile missile storage bunker. Another showed an F-117 pilot's drop of a 2,000-pound bomb directly down the airshaft of the Iraqi Defense Force headquarters in Baghdad.

The attacks were continuous during the first week, and more than 12,000 sorties had been made after the first seven days. The forces of Canada, Italy, France, and Qatar joined in the attacks after the initial wave. Coalition forces met minimal resistance in the air, and US officials claimed air superiority on January 23.

—USAF photo by SSgt. John Luszcz

Operation Desert Shield became Operation Desert Storm early in the morning of January 17 as coalition military forces attacked hundreds of targets in Iraq and Kuwait. US Air Force, Navy, Marine Corps, and Army pilots participated, as did pilots from three coalition nations. More than 12,000 sorties were flown during the first seven days. These F-16As, bombed up for daylight raids into Iraq, are from the Air National Guard's 174th Tactical Fighter Wing at Hancock Field, N. Y.

At the end of the first week, coalition pilots had shot down eight Iraqi MiG-29s, two MiG-25s, one MiG-23, and six Mirage F.1s. Coalition losses included nine aircraft lost to ground fire and two to noncombat accidents. Three helicopters were lost to noncombat operations. No aircraft was lost in air-to-air engagements.

Two Air Force A-10 pilots, Capts. Paul Johnson and Randy Goff, flying combat search-and-rescue cover operations over Iraq, became the first heroes of the war. The duo, members of the 354th Tactical Fighter Wing at Myrtle Beach AFB, S. C., strafed and destroyed an Iraqi truck while protecting a downed Navy aviator.

Their planes were refueled four times in flight as they orbited the area near the crash until a rescue helicopter could get to the Navy flyer. The only time the A-10 pilots actually saw the downed pilot was when he ran from his covering position to the helicopter. The mission took eight and a half hours to complete.

One star performer of the first week of fighting was the Raytheon-built MIM-104 Patriot missile. Patriots destroyed a majority of the Iraqi Scud missiles fired at Saudi Arabia and Israel. The US sent additional Patriot batteries to Israel after Haifa and Tel Aviv suffered minor damage in Scud attacks.

In preparation for the expected ground war, the Air Force deployed the two prototype Grumman E-8A Joint Surveillance and Targeting Attack Radar System aircraft to the Middle East shortly before the conflict began. Still in development, the aircraft (which will likely have some contract employees on board) will be used primarily to track Iraqi tanks and vehicles.

★ The demonstration/validation phase of the Advanced Tactical Fighter development effort ended as scheduled on December 31. The two competing airframe contractor teams and the two engine manufacturers

then submitted their final proposals to Air Force Systems Command's Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio, on January 2.

The Lockheed/Boeing/General Dynamics team flew its two YF-22 prototypes until December 28, making speed runs with the aircraft and gathering additional reliability data. Air Force Maj. Mark Shackelford and General Dynamics test pilot Jon Beesley flew the number one YF-22 (powered by two General Electric YF120-GE-100 engines) to angles of attack of sixty degrees during ten test flights over a one-week period.

Lockheed test pilot Thomas Morgenfeld launched an AIM-120A Advanced Medium-Range Air-to-Air Missile from the number two YF-22 (powered by two Pratt & Whitney YF119-PW-100 engines) during a December 20 test over the Pacific Missile Test Center at Point Mugu, Calif. Released at subsonic speeds and an altitude of 20,000 feet, the missile was well clear of the plane's internal weapons bays before its rocket motor ignited. The missile was not fired at a target and was heavily instrumented to accumulate test data. This was the only AMRAAM launch from either of the ATF designs.

The number one YF-22 prototype flew first, and it accumulated 52.8 hours on forty-three flights. The second aircraft was flown thirty-one times for a total of 38.8 hours. The YF-22 reached speeds in excess of Mach 2 and logged four hours of supersonic flight, although much of that was in afterburner and not in "supercruise," *i.e.*, supersonic flight without afterburners.

The demonstration/validation phase of the Air Force's Advanced Tactical Fighter program was concluded on December 31. The Northrop/McDonnell Douglas design, the YF-23, was the first to fly and the first to finish. The first YF-23 (top) is powered by two Pratt & Whitney YF119-PW-100 engines; the number two aircraft (bottom) is powered by a pair of General Electric YF120-GE-100 engines.

The Northrop/McDonnell Douglas YF-23 team completed flying in mid-December. The second prototype (powered by GE engines) was flown until December 18. The airplane was flown sixteen times for a total of twenty-two hours. The first YF-23 (with P&W engines) was last flown November 30. The two YF-23s were flown for more than sixty-five hours on fifty flights.

One of the YF-23s reached a top speed of Mach 1.8 in afterburner, while the number two aircraft hit a supercruise speed that was classified by the Air Force. The aircraft was flown as high as 50,000 feet. The YF-23 got the reputation of being a speed horse, but its fully movable tailplanes helped to make it quite maneuverable.

The ATF proposals submitted to ASD were not exactly lightweight. The Northrop/McDonnell Douglas proposal totaled more than 15,000 pages, while the Lockheed/Boeing/General Dynamics proposal weighed in at more than 20,000 pages. Pratt & Whitney's proposal for its YF119 engine topped 14,000 pages, while General Electric submitted 15,000 pages for its YF120 engine.

ASD will evaluate the proposals, and the Air Force is expected to announce the winning airframe team and engine contractor on April 30. The winners will likely be given dem/val contract extensions, since Congress has prohibited the program from entering full-scale development in FY 1991. An FSD contract is expected to be issued later this year.

All four ATF prototypes are now in flyable storage at the Air Force Flight Test Center at Edwards AFB, Calif. The winning airframe powered by the winning engine design will then be taken out of storage and will continue to be tested until FSD begins.

An AIM-120A Advanced Medium-Range Air-to-Air Missile was launched from the number two Lockheed/Boeing/General Dynamics YF-22 prototype (powered by P&W engines) on December 20. The missile, not aimed at a target, ignited well clear of the plane's internal weapons bays. All four prototype aircraft are now in flyable storage at Edwards AFB, Calif., awaiting the Air Force's decision.

Nebraska Air National Guardsmen 1st Lt. Keith Schell (left) and Maj. Raymond Terry (right) were recently presented the Air Force's "Well Done" Award for their actions in saving their RF-4C and returning safely to base after the plane suffered complete electrical failure.

★ Air Force Secretary Donald Rice announced on January 10 that Air Force Systems Command and Air Force Logistics Command will be integrated into a single new command, Air Force Materiel Command, effective July 1, 1992. The new command will be headquartered at Wright-Patterson AFB.

The two commands have been streamlining their operations since the summer of 1989. Secretary Rice said the two are ready to be merged into a "leaner, more focused, lower-overhead" acquisition and support system. The intent of the merger is to establish a completely integrated process for "cradle-to-grave management" of each weapon system.

The merger would also eliminate gaps in expertise when a weapon is handed over from the System Program Office (SPO, the developer) to AFLC. The combined command will be able to consider life-cycle costs earlier in a weapon system's life, and having the SPO in place after a weapon is fielded will make modifications easier.

Streamlining of each of the two commands eliminated 11,000 personnel slots, and an additional 16,000 jobs have been identified as elimination candidates through the 1990s. Another 900 slots are expected to be eliminated as a result of merging the two headquarters organizations.

★ **HONORS—Maj. Jeffrey W. Walls** (Clark AB, the Philippines), **Capt. David E. Lucia** (George AFB, Calif.), **SMSgt. Warren J. Dubose** (Kunsan AB, South Korea), and **SSgt. Billy D. Pruett** (detached duty at Fort Campbell, Ky.) have been named the 1990 recipients of the **Lance P. Sijan USAF Leadership Awards.** The awards are presented annually to two Air Force officers and two enlisted members who have demonstrated outstanding leadership with organizations at wing level and below. The awards are named for Capt. Lance Sijan, who evaded capture and withstood torture in Vietnam and was posthumously awarded the Medal of Honor.

John W. R. Taylor, editor emeritus of *Jane's All the World's Aircraft* and longtime contributing editor to AIR FORCE Magazine, was recently named the recipient of the **Lauren D. Lyman Award** for 1990. The award, named for Lauren D. "Deac" Lyman, a Pulitzer-prize winning aviation reporter and later a highly respected public relations executive, is presented annually by the Aviation/Space Writers Association to one aerospace journalist for career achievement.

Nebraska Air Guardsmen **1st Lt. Keith Schell** and **Maj. Raymond Terry** were recently presented the Air Force's **"Well Done" Award** for their actions in saving their RF-4C. Flying at low level near Grand Island, Neb., in January 1990, the RF-4 suddenly suffered complete electrical failure. Lieutenant Schell pitched the aircraft up to gain altitude and lowered the landing gear in anticipation of losing hydraulic pressure. Out of immediate danger, he and Major Terry tried to assess the situation, using hand signals and written notes. Unable to make contact, the crew of the duo's wingman (another RF-4), Maj. Sheldon Otto and Lt. Jeffrey Kloster, radioed air traffic controllers and declared an emergency. Major Otto and Lieutenant Kloster, also using hand signals, then escorted Lieutenant Schell and Major Terry back to base at Lincoln Municipal Airport. Using the aircraft-arresting system, Lieutenant Schell was able to bring the crippled jet in for a safe landing.

★ **PURCHASES**—ASD exercised a $113.8 million contract option with **Beech** in early January for twenty-eight additional **T-1A Jayhawk trainers.** This second option also includes provisions for aircraft flight testing and structural integrity testing. These aircraft will be used to teach tanker and transport pilots under the Air Force's new specialized undergraduate pilot training program. Forty-three (of a planned 211) T-1As are now under contracts totaling $226.4 million. *[For more on the T-1A program, see "Meet the Jayhawk," December 1990 issue, p. 34.]*

Fairchild received a $28.7 million ASD contract on January 7 for nine **C-26A operational support aircraft.** The company also received a logistics support contract. Options for an additional forty-four aircraft and logistics support bring the total value of the contract to $235 million. The nineteen-passenger C-26, a military version of the Metro III commuter airliner, can also be configured for medevac and light cargo missions. Thirteen C-26s are currently in service with the Air National Guard and the Army National Guard.

General Dynamics received a $1.8

Anniversaries

• *March 31, 1911:* Congress makes the first appropriation for military aviation, $125,000 for FY 1912. The Signal Corps immediately orders five new airplanes.

• *March 21, 1916:* The French government authorizes the formation of the *Escadrille Americaine.* The unit, made up of volunteer American pilots, is later renamed the Lafayette Escadrille.

• *March 16, 1926:* Dr. Robert H. Goddard launches the world's first liquid-fueled rocket at Auburn, Mass. The rocket reaches an altitude of 184 feet in 2.5 seconds.

• *March 5, 1936:* Vickers chief test pilot "Mutt" Summers makes the first flight of the Supermarine Type 300 from Eastleigh Airport in Hampshire, England. The brainchild of designer R. J. Mitchell, this prototype is the first of 18,298 Merlin-powered Spitfires of all marks to be built by 1945.

• *March 11, 1941:* President Franklin D. Roosevelt signs the Lend-Lease Act. The act's provisions allow the US to sell, transfer, exchange, lease, or lend any defense article, provided that the receiving country's defense is deemed to be vital to the defense of the United States.

• *March 28, 1941:* The Royal Air Force announces that 71 Squadron, composed of volunteer pilots from the US, is fully operational. This is the first of three Eagle Squadrons.

• *March 21, 1946:* Strategic and Tactical Air Commands are established at Bolling Field, D. C., creating the offensive components of the Air Force that exists today. Air Defense Command, also created this day, was deactivated in 1980.

• *March 1, 1951:* Secretary of the Air Force Thomas Finletter announces that the Boeing B-52 Stratofortress jet bomber has been ordered into production. He also announces that a version of the English Electric Canberra, to be designated B-57, will be license-built in the US by the Glenn L. Martin Co.

• *March 28, 1951:* The West German government announces that German casualties at home and on the battlefronts during World War II total more than 5,700,000—3,200,000 killed or missing in action; 500,000 civilians killed in bombing raids; and approximately 2,000,000 disabled veterans. The report also notes that the exact number of German casualties will never be known.

• *March 17, 1961:* The first operational Northrop T-38A Talon supersonic jet trainer is delivered to Air Training Command at Randolph AFB, Tex.

• *March 20, 1961:* The Air Force announces that, effective April 1, Research and Development Command will be redesignated Air Force Systems Command and Air Materiel Command will be redesignated Air Force Logistics Command.

• *March 16, 1966:* The Gemini 8 crew, Neil Armstrong and Air Force Maj. David Scott, successfully carries out the first docking with another vehicle in space. The two ships then start to spin, forcing the crew to undock and back away from the unmanned Agena target spacecraft. Finally, emergency procedures are needed to stop the capsule's motion, and the crew returns to Earth after just ten hours and forty-one minutes aloft. A faulty thruster in the capsule was later found to be the cause of the problem.

On December 20, Boeing employees involved in the "Air Force One" program celebrated the completion of the second VC-25A Presidential transport aircraft. The extensively modified 747-200, serial number 29000, was completed several months ahead of schedule because experience gained in modifying the first VC-25A sped up the production process.

billion ASD contract on December 18 for long-lead funding for 402 **F-16 fighter aircraft.** The original multi-year contract called for 600 aircraft but was cut because of budget constraints and a likely reduction in the number of Air Force fighter wings. The buy could also include aircraft for the Foreign Military Sales program. Work is scheduled to be completed by 1995.

In other F-16 news, **Portugal** signed a letter of agreement in late December for twenty **F-16A/B aircraft.** The deal is worth an estimated $400 million. The Portuguese Air Force will be the eighteenth air arm worldwide to fly the F-16.

On December 20, **Japan chose the General Electric F110-GE-129 engine to power its FSX aircraft,** a derivative of the F-16 to be co-developed with GD. The Japanese Air Self-Defense Force will require approximately 130 engines over seven years.

Allen Communication recently received a $4.1 million Air Force contract for design and development of twenty-one **interactive videodisc training courses for F-15 and F-16 maintainers.** The training aims to teach maintainers by acquainting them with the expertise of the best technicians currently working in the field. The courses will focus on engines, hydraulics, ejection systems, fuels, armament, and electrical systems.

Rockwell received a $33.3 million NASA contract addition on January 4 to **add drag parachutes to the space shuttle orbiter *Endeavour.*** The drag chutes will increase stopping power during landings and will reduce tire and brake wear. *Endeavour* will use the parachutes for six flights, beginning with its maiden voyage in 1992. If successful, the parachutes will be retrofitted to the other three shuttle orbiters. The parachute design was tested on the NASA NB-52 at the Dryden Flight Research Center at Edwards AFB last summer.

★ **DELIVERIES—Boeing** delivered the second and final **VC-25A Presidential transport** to the 89th Military Airlift Wing at Andrews AFB, Md., on December 20. This second "Air Force One" aircraft (assigned the contrived serial number 29000) is a modified 747-200 airliner and is identical to the VC-25 delivered last year. Delivery was scheduled for June of this year, but experience gained in modifying the first aircraft contributed to the early completion date.

General Electric transferred control of the west coast **Over-the-Horizon Backscatter radar** to the Air

Force in late December. The $300 million AN/FPS-118 radar provides 180 degrees of all-altitude surveillance from Alaska to Baja California at ranges of 500 to 1,800 nautical miles. The radar's transmit antenna is located near Christmas Valley, Ore., the receive antenna is outside of Tulelake in northern California, and its operations center is located at Mountain Home AFB, Idaho. The east coast OTH-B radar opened in April 1990.

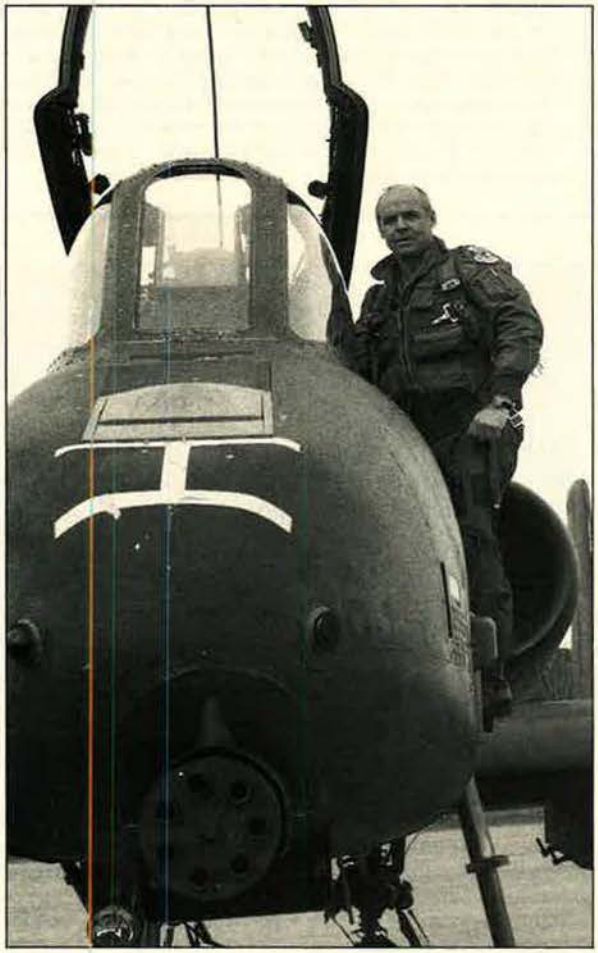
Sierra Research delivered the sixth and final **C-29A airways certification aircraft** to the Air Force in ceremonies at the company's Buffalo, N. Y., plant on January 11. The British Aerospace 125-800 executive aircraft modified with Sierra Research's automatic flight inspection equipment are used to inspect and calibrate en-route and terminal air traffic control and landing facilities at military bases worldwide. Four C-29s were deployed in pairs to Saudi Arabia as part of Operation Desert Shield from September 30 to December 31. Scott AFB, Ill., is the main operating location for the C-29s.

★ **MILESTONES—Assembly of the first McDonnell Douglas C-17A airlifter was completed** on December 21. Completion of the first test aircraft was a condition for award of Production Lot 3 funding. Lot 3 consists of four aircraft, and it brings the total number of C-17s (in addition to the test airplane) to ten. During the final assembly process, the C-17's flight-control system was tested, as was the operation of the elevators, rudder, ailerons, and flaps. The associated hydraulic and electrical systems were also tested. The aircraft (designated T-1 for its test status) has since been painted and will now undergo ground checks. First flight is scheduled to occur by June.

The first **Rockwell AC-130U gunship was flown for the first time** on December 21. The flight from the company's facility at Air Force Plant 42 at Palmdale, Calif., lasted two and a half hours before ending at the Air Force Flight Test Center at nearby Edwards AFB. Several more flights will be conducted before formal testing begins later this year. The new gunship features a General Electric 25-mm Gatling gun, a Bofors 40-mm cannon, and a 105-mm howitzer, as well as advanced sensors and avionics, including a Hughes APG-80 radar. This is the first of twelve gunships Rockwell will deliver under a $780 million contract. The first AC-130U will be delivered to the 1st Special Operations Wing at Hurlburt Field, Fla., in 1992.

Two pilots recently set flying milestones in the General Dynamics F-111 and the Fairchild A-10. Late last year, Capt. Lewis Insley, an instructor pilot with the 389th Tactical Fighter Training Squadron at Mountain Home AFB, Idaho, finished his career with a total of 5,056.9 hours in the F-111. Lt. Col. James Skiff, an Air National Guardsman with the 103d Tactical Fighter Group at Bradley ANGB, Conn., now holds the Air Force record for A-10 time, with 3,167.7 hours. He passed the 3,000-hour mark in early 1990 and set the record in late December.

The **Pioneer 6 satellite celebrated its twenty-fifth anniversary** on December 16. When it was launched into solar orbit in 1965, the aluminum sphere, thirty-seven inches in diameter, had a life expectancy of six months. The satellite has traveled more than 15.4 billion miles and is still



The graybeard among Air Force A-10 pilots is Lt. Col. James M. Skiff of the Air National Guard's 103d Tactical Fighter Group at Bradley ANGB, Conn. He has accumulated more than 3,100 hours in the "Warthog."

—USAF photo by MSgt. Karl King

Lessons Of Desert Storm

1. American defense technology works, and it saves lives.
2. Quality costs money and is worth the cost.
3. Planning pays off when it is founded on correct assumptions and informed analysis.
4. The ultimate test of defense systems operating in Desert Storm is verifying that earlier tests of the same systems were well designed and executed.
5. Our training and our approach to training are unexcelled.
6. Our military men and women are worthy of every accolade and honor.

Today is the tomorrow we all prepared for yesterday. Few outside our defense community — and Iraq — appreciate the level of preparation, commitment, teamwork, and technology on display in Desert Storm. Will it prevail? Bet on it.

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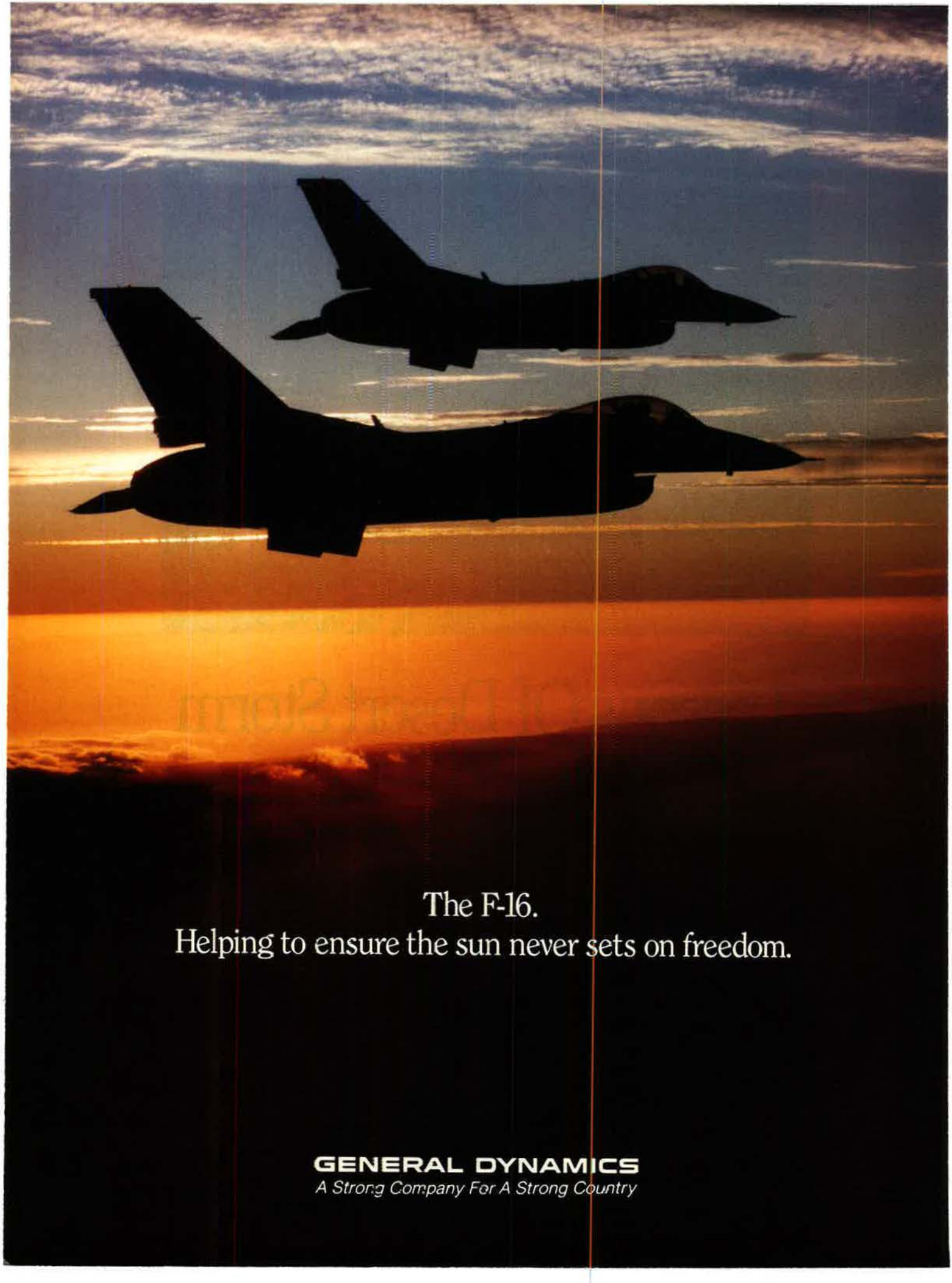
Technology. Systems. Solutions. ***People.***


The F-16.
Helping to ensure the sun never sets on freedom.
GENERAL DYNAMICS
A Strong Company For A Strong Country

The Coast Guard/Customs Service CARIBALL I (Caribbean Balloon) aerostat system recently passed the 25,000-service-hour plateau. Essentially tethered blimps, the aerostats, built by TCOM, are equipped with radar and other electronic systems for targeting, tracking, and intercepting illegal drug traffickers entering the US from Central and South America.

used periodically by NASA for solar wind experiments.

A record 1,632,201 visitors toured the Air Force Museum in 1990. The previous record of 1,493,984 people, set in 1988, was surpassed in early October. The facility at Wright-Patterson AFB, houses aircraft and other exhibits in two connected hangar-like structures covering 10.5 acres. It is the largest and oldest aviation museum in the world and Ohio's most popular free tourist attraction.

★ **NEWS NOTES—Strategic Air Command's fleet of Rockwell B-1B bombers was grounded** on December 20 after a second catastrophic engine failure in less than three months. The grounding order came as a safety precaution following a failure of the number three engine on a B-1 earlier that morning at Dyess AFB, Tex. The bomber's crew was making touch-and-go landings when the accident occurred. The crew was able to land safely. This incident was much like one that occurred in early October, and a failure in the engine's first-stage compressor fan blades has been determined as the cause of both. More critical was the failure in both instances of a retaining ring on the General Electric F101-GE-102 engines that was designed to keep failed blades in place. A new, thicker, stronger ring has been designed and is being installed as the first step to returning the aircraft to flight status. The B-1B fleet's alert status was not affected by the mishap, and the bombers remain available for use in a nuclear war.

The Bell-Boeing V-22 Osprey tiltrotor passed its initial shipboard-compatibility tests. Navy test pilots flew the two V-22s involved in the December 4–7 tests on board USS *Wasp* (LHD-1). The number four V-22 prototype was used for deck handling and maintenance evaluations; the number three prototype was used for landing and takeoff trials while the ship steamed off the Maryland coast near the Naval Air Test Center at NAS Patuxent River. The aircraft performed quite well on the amphibious assault ship, but a few minor, correctable discrepancies were discovered. The fifth V-22 prototype will fly this spring.

The **grounding of the AGM-69A short-range attack missiles** that occurred in early June *[see "Aerospace World," August 1990 issue, p. 21]* **has become permanent.** Secretary of De-

Index to Advertisers

Logicon delivered the Federal Aviation Administration's new computerized, voice-controlled air traffic control tower simulator on January 25. The $10 million simulator will be used to train air traffic control students at the FAA Academy in Oklahoma City, Okla. Students will talk to aircraft images through microphones, and the images will respond through a voice recognition system.

fense Dick Cheney made the grounding order for day-to-day operations and exercises permanent in December, based on the concerns that prompted the original grounding and the results of subsequent Air Force and Department of Energy studies. No health hazards are posed by the SRAMs, and the missiles will remain available for use in the event of a nuclear war.

The **Air Force Academy football team defeated Ohio State in the Liberty Bowl, 23–11,** on December 27 to finish the 1990 season with a 7-5 record. This marked the Academy's fifth bowl win (against two losses) since 1962 and its tenth bowl game since varsity football began in 1956 (the Falcons have an overall bowl record of 5-4-1). The Acacemy has recorded eighteen winning seasons in its history, eight of them in the 1980s. The Falcons' all-time record stands at 190-179-13.

The **National Museum of Naval Aviation** at NAS Pensacola, Fla., recently acquired **two rare World War II–era aircraft.** The pair, a Douglas SBD Dauntless and a Vought SB2U-2 Vindicator, spent the last forty-seven years at the bottom of Lake Michigan after suffering landing accidents on escort carriers that were conducting training operations on the lake. The SBD is actually an A-24 (the Army Air Forces version of the Dauntless) that was transferred to the Navy prior to the accident. The Vindicator is believed to be the last of its kind. The aircraft have several years of restoration ahead of them, but they will eventually be placed in the museum.

★ **DIED—John C. Morgan,** a World War II Army Air Forces Medal of Honor winner, on January 17 of an apparent heart attack in a hospital in Papillion, Neb. He was seventy-six. On July 18, 1943, as a twenty-nine-year-old second lieutenant, Morgan was flying on his first mission as the copilot of a B-17. Attacked by German fighters, the plane had its interphone system knocked out. Four of its crew were rendered unconscious because the oxygen system was cut, and the top turret gunner and pilot were severely wounded. Lieutenant Morgan had to fight off the pilot, who was crazed by a shot in the head, while maintaining position in the formation. Only after the bomb run was completed did the navigator come to the flight deck to assist Lieutenant Morgan. The crew returned safely. Later held as a POW, Mr. Morgan joined Texaco after the war and worked there for forty-five years.

Clarence L. "Kelly" Johnson, famed Lockheed designer, on December 21 after a long illness in a hospital in Burbank, Calif. He was eighty. Starting as a tool designer in 1933, he retired in 1975 as a senior vice president with the company. He played a leading role in the design of more than forty of the world's most advanced aircraft, including the P-38, P-80, U-2, SR-71, YF-12, and F-104. He headed the company's Advanced Development Projects section (the "Skunk Works") for thirty years. His honors include the Collier Trophy (twice), the Wright Brothers Memorial Trophy, the Daniel Guggenheim Medal, and the National Air and Space Museum Trophy. He received the Medal of Freedom from President Lyndon Johnson in 1964.

★ **UPDATE—The cause of the C-5A crash at Ramstein AB, West Germany** on August 29 *[see "Aerospace World," October 1990 issue, p. 23]* was determined to be **"uncommanded and inadvertent" deployment of an engine thrust reverser.** The technical manual notes that operation of a thrust reverser at takeoff speed while the flaps are deployed can cause significant loss of lift. A loss of lift in only one engine would cause the aircraft to lose speed and altitude and force the airplane into a bank. The C-5 banked left, hit a tree, and struck the ground on the left side of the nose. Since the accident, crews no longer engage the thrust reverser as part of their preflight checks.

Senior Staff Changes

RETIREMENTS: B/G Chalmers R. **Carr,** Jr.; M/G Robert D. **Eaglet**; M/G Eric B. **Nelson;** B/G Stanley O. **Smith.**

ANG RETIREMENT: B/G Darrel D. **Thomssen.**

CHANGES: B/G William B. Davitte, from Ass't Sec'y of the Air Force for Acq., for Strategic Modernization, Hq. USAF, Washington, D. C., to JCS Rep. for Conference on Confidence and Security Building Measures in Europe, J-5, Jt. Staff, Washington, D. C. . . . **B/G Kenneth R. Israel,** from IG, Hq. AFSC, Andrews AFB, Md., to PEO, C^3 Prgms., Hanscom AFB, Mass., replacing retired M/G Eric B. Nelson.

SCIENTIFIC AND TECHNICAL (ST) CHANGES: Robert C. Corley, from Dir., Astronautical Sciences Div., AFSTC, Space Sys. Div., AFSC, Edwards AFB, Calif., to Chief Scientist, Astronautics Laboratory, AFSTC, Space Sys. Div., AFSC, Edwards AFB, Calif. . . . **Ronald A. Jacob,** from Supervisory General Engineer, DCS/Engineering, AFDTC, AFSC, Eglin AFB, Fla., to Technical Advisor, 3246th Test Wing, AFDTC, AFSC, Eglin AFB, Fla. ■

Watching. Always Watching

Defense Support Program (DSP) satellites have been a cornerstone of NORAD's Tactical Warning and Attack Assessment system for 20 years. Using infrared detectors that sense the heat from missile plumes against the earth background, these orbiting sentries detect, characterize and report ballistic missile launches.

Built-in flexibility enables DSP to meet the evolving threats of a dynamic world. Continuous spacecraft upgrades have allowed the system to provide accurate, reliable data in the face of changing requirements — greater numbers, smaller targets, advanced countermeasures — with no interruption in service.

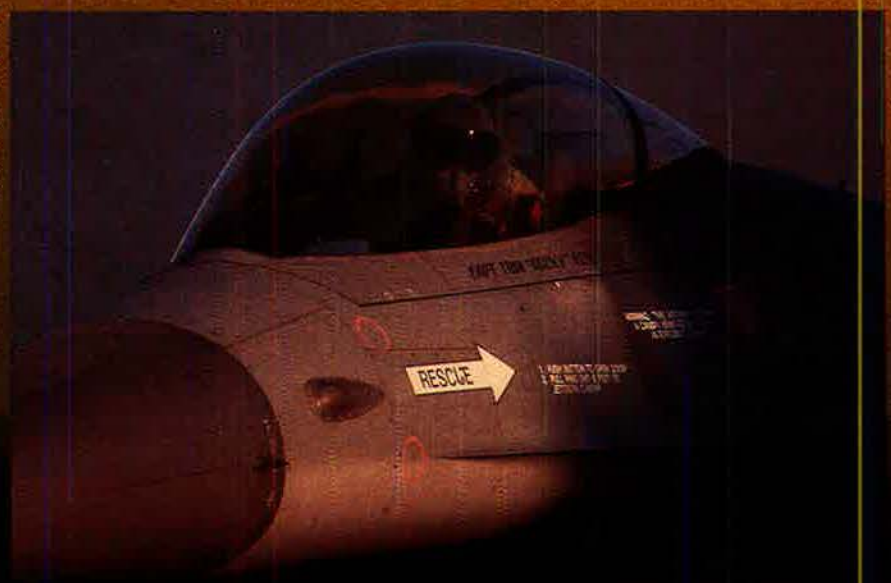
DSP: Two Decades of Proven Performance

TRW

TRW Space & Technology Group

By the third week of the war, 50,000 Air Force personnel and nearly 200 major active-duty, Guard, and Reserve units had answered the bell.

The Forces of Desert



—USAF photo by TSgt. Perry Heimer

Capt. Tom Constant of the 363d TFW, Shaw AFB, S. C., taxis his F-16 (left) for takeoff in the first hours of history's most intense air campaign. Wave after wave of allied warplanes struck Baghdad, hitting oil refineries, defense installations, airports, and Saddam Hussein's palace. Elsewhere, planes like this USAF F-15 hit Scud launchers; communication sites; radars; chemical, bacteriological, and nuclear facilities; and the elite Republican Guard. Allied ground crews generated 50,000 sorties in the first three weeks.

Storm

—USAF photo by SrA Rodney Kern

—USAF photo by SSgt. Scott P. Stewart

At left, an F-117A Stealth fighter of the 37th TFW from Tonopah TRA, Nev., is refueled by a KC-10 tanker of SAC's 22d AREFW from March AFB, Calif. At right is ghostly target imagery from an F-117A lining up for a precision attack on a Baghdad telephone-telegraph facility. The F-117A was the star of the campaign, and high-tech armament proved its worth in the first days of the war. Advanced fighters, smart weapons, night-fighting devices, and communications and surveillance equipment made air-to-ground sorties even more effective.

—USAF photo by SSgt. F. Lee Corkran

A US Air Force driver helps upload Mk. 84 2,000-pound bombs on an F-16 of the 401st TFW, Torrejon AB, Spain. Line crews, maintainers, weapons loaders, and other combat support personnel helped allied aircraft fly 1,200 sorties in the first fourteen hours and maintain a ninety-percent-plus fighter mission capable rate. Daily, eighty to eighty-five percent of allied sorties were flown by US aircraft. Iraq's largest ammunition depot in Kuwait was hit January 28; smoke from the explosion was visible for more than 200 miles.

IRAN

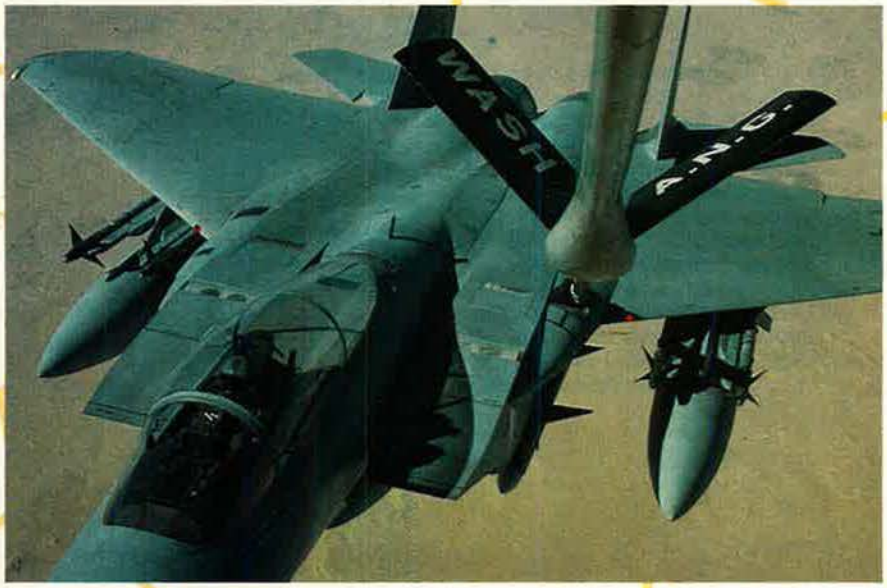
— © Christopher Morris/Black Star

In eastern Saudi Arabia, US Army troops tend a box launcher of the Patriot air-defense system. Patriot's Scud-missile-killing prowess made it one of the war's biggest winners as it fended off Iraqi missiles aimed at Dhahran, Riyadh, and cities in Israel. Other systems making impressive combat debuts were the Navy Tomahawk land-attack cruise missile and Standoff Land-Attack Missile, USAF laser-guided bombs, stealth aircraft, LANTIRN night navigation and targeting pods, and the Navstar Global Positioning System.

—USAF photo by TSgt. Hans Deffner

At a desert base, Sgt. Harland McCallum, assistant crew chief with the 963d AMU, readies his E-3 for takeoff. AWACS aircraft played a critical, behind-the-scenes role in the air war, keeping allied fighters posted on the moves of every Iraqi aircraft. Other forces playing vital but seldom seen parts included KC-10s and KC-135s, which conducted round-the-clock aerial refuelings, Joint STARS ground-surveillance planes, RC-135 and TR-1 reconnaissance planes, RF-4C tactical reconnaissance aircraft, and special operations forces and search-and-rescue aircraft.

—USAF photos by TSgt. Rose S. Reynolds



—USAF photos by TSgt. Rose S. Reynolds

F-15s of the 1st TFW, Langley AFB, Va., are refueled by a KC-135 of the ANG's 141st AREFW, Fairchild AFB, Wash. Iraq's air arm rarely came out to fight, and by February 8 the allies had destroyed at least thirty MiGs and Mirages in air-to-air combat and ninety-nine on the ground, without a single loss, and Iraqi fighters were fleeing to Iran. ANG and AFRES sent fighter, attack, and reconnaissance units; tankers; airlifters; and medical and support forces.

—USAF photo by MSgt. Bill Thompson

—USAF photo by MSgt. Bill Thompson

An F-4G Wild Weasel of the 35th TFW, George AFB, Calif., taxis out for a mission from a Gulf base. At right, a USAF weapons loader checks inventory in an ammunition depot, filled to overflowing with F-4Gs' radar-busting HARMs and other missiles. Weasel-HARM operations, plus those of EF-111A Raven and EC-130H Compass Call EW planes, were the key to allied success in the unseen electronic war. Major Iraqi communication, early warning, and air defense systems were destroyed, one reason allied losses were so light.

—USAF photo by SrA. Michael Eyer

C-5 airlifters at Rhein-Main AB, Germany, prepare to deploy to the Gulf. Military Airlift Command's C-5, C-141, C-130, and other units accomplished history's biggest airlift of troops, equipment, and supplies. On the eve of the war, MAC had flown more than 10,000 missions to the Gulf, carrying 370,000 passengers and 346,000 tons of cargo, plus thousands of short-range missions in the theater. In the first week of the war, AFLC moved 43,000 aircraft parts, fifty aircraft, and 44,000 tons of cargo through the system.

—USAF photo by SrA. Chris Putman

A conventionally armed, long-range USAF B-52 bomber takes off for a daytime bombing mission against its Gulf target. The venerable SAC BUFFs pounded Republican Guard units held as a strategic reserve on the Iraq-Kuwait border. On January 31, the Guard was hit by ten B-52 strikes. Such operations sought to soften up entrenched Iraqi troops for land battle, in which the Air Force has a big role. A-10s, F-16s, and other support fighters would hit Iraqi tanks, trucks, artillery, and troop formations while interdicting deeper targets.

—USAF photo by SSgt. F. Lee Corkran

US Air Force maintenance personnel work on a Canadian CF-18 fighter at a Mideast base. USAF cooperated closely with units of allied and sister services in the air war. The US Navy and Marine Corps contributed Tomahawk cruise missiles and such aircraft as F-14s, F/A-18s, AV-8Bs, A-6Es, A-7Es, KA-6s, EA-6Bs, and E-2Cs; Army UH-1 Cobra and AH-64A helicopters pounded enemy ground targets. Also performing well were British Tornados, Jaguars, Harriers, Victors, and Nimrods; Saudi F-15s and AWACS; French Jaguars and Mirages; Italian Tornados; and Kuwaiti A-4s.

The Forces of Desert Storm

According to the Air Force and DoD, USAF's Desert Shield/Storm forces, as of February 1, had been drawn from these major units.

Active Duty

1st Tactical Fighter Wing, Langley AFB, Va.
4th Tactical Fighter Wing, Seymour Johnson AFB, N. C.
10th Tactical Fighter Wing, RAF Alconbury, UK
20th Tactical Fighter Wing, RAF Upper Heyford, UK
23d Tactical Fighter Wing, England AFB, La.
33d Tactical Fighter Wing, Eglin AFB, Fla.
35th Tactical Fighter Wing, George AFB, Calif.
36th Tactical Fighter Wing, Bitburg AB, Germany
37th Tactical Fighter Wing, Tonopah Test Range Airfield, Nev.
48th Tactical Fighter Wing, RAF Lakenheath, UK
50th Tactical Fighter Wing, Hahn AB, Germany
52d Tactical Fighter Wing, Spangdahlem AB, Germany
347th Tactical Fighter Wing, Moody AFB, Ga.
354th Tactical Fighter Wing, Myrtle Beach AFB, S. C.
363d Tactical Fighter Wing, Shaw AFB, S. C.
366th Tactical Fighter Wing, Mountain Home AFB, Idaho
388th Tactical Fighter Wing, Hill AFB, Utah
401st Tactical Fighter Wing, Torrejon AB, Spain
314th Tactical Airlift Wing, Little Rock AFB, Ark.
317th Tactical Airlift Wing, Pope AFB, N. C.
435th Tactical Airlift Wing, Rhein-Main AB, Germany
60th Military Airlift Wing, Travis AFB, Calif.
62d Military Airlift Wing, McChord AFB, Wash.
63d Military Airlift Wing, Norton AFB, Calif.
436th Military Airlift Wing, Dover AFB, Del.
437th Military Airlift Wing, Charleston AFB, S. C.
438th Military Airlift Wing, McGuire AFB, N. J.
SAC wings with B-52 aircraft*
SAC wings with KC-135 and KC-10 aircraft*
SAC wings with RC-135 aircraft*
67th Tactical Reconnaissance Wing, Bergstrom AFB, Tex.
552d Airborne Warning and Control Wing, Tinker AFB, Okla.
507th Tactical Air Control Wing, Shaw AFB, S. C.
602d Tactical Air Control Wing, Davis-Monthan AFB, Ariz.
820th RED HORSE Civil Engineering Squadron, Nellis AFB, Nev.
823d RED HORSE Civil Engineering Squadron, Hurlburt Field, Fla.
Air Transportable Hospital, MacDill AFB, Fla.
Air Transportable Hospital, Homestead AFB, Fla.
Air Transportable Hospital, Holloman AFB, N. M.
Air Transportable Hospital, Myrtle Beach AFB, S. C.
Air Transportable Hospital, Tyndall AFB, Fla.
Air Transportable Hospital, Davis-Monthan AFB, Ariz.
Air Transportable Hospital, Langley AFB, Va.
Air Transportable Hospital, Shaw AFB, S. C.
Air Transportable Hospital, Seymour Johnson AFB, N. C.
Air Transportable Hospital, England AFB, La.
Special Operations Units

*DoD had not specified units by February 1, 1991.

Air National Guard

107th Fighter Interceptor Group, Niagara Falls, N. Y.
119th Fighter Interceptor Group, Fargo, N. D.
120th Fighter Interceptor Group, Great Falls, Mont.
125th Fighter Interceptor Group, Jacksonville, Fla.
142d Fighter Interceptor Group, Portland, Ore.
147th Fighter Interceptor Group, Ellington ANGB, Tex.
158th Fighter Interceptor Group, Burlington, Vt.
177th Fighter Interceptor Group, Atlantic City, N. J.
191st Fighter Interceptor Group, Selfridge ANGB, Mich.
102d Fighter Interceptor Wing, Otis ANGB, Mass.
144th Fighter Interceptor Wing, Fresno, Calif.
112th Tactical Fighter Group, Greater Pittsburgh IAP, Pa.
138th Tactical Fighter Group, Tulsa, Okla.
150th Tactical Fighter Group, Kirtland AFB, N. M.
162d Tactical Fighter Group, Tucson, Ariz.
169th Tactical Fighter Group, McEntire ANGB, S. C.
178th Tactical Fighter Group, Springfield, Ohio
180th Tactical Fighter Group, Toledo, Ohio
181st Tactical Fighter Group, Terre Haute, Ind.
185th Tactical Fighter Group, Sioux City, Iowa
188th Tactical Fighter Group, Fort Smith, Ark.
116th Tactical Fighter Wing, Dobbins AFB, Ga.
121st Tactical Fighter Wing, Rickenbacker ANGB, Ohio
122d Tactical Fighter Wing, Fort Wayne, Ind.
127th Tactical Fighter Wing, Selfridge ANGB, Mich.
131st Tactical Fighter Wing, St. Louis, Mo.
132d Tactical Fighter Wing, Des Moines, Iowa
140th Tactical Fighter Wing, Buckley ANGB, Colo.
174th Tactical Fighter Wing, Syracuse, N. Y.
152d Tactical Reconnaissance Group, Reno, Nev.
186th Tactical Reconnaissance Group, Meridian, Miss.
117th Tactical Reconnaissance Wing, Birmingham, Ala.
109th Tactical Airlift Group, Schenectady, N. Y.
130th Tactical Airlift Group, Charleston, W. Va.
135th Tactical Airlift Group, Baltimore, Md.
139th Tactical Airlift Group, St. Joseph, Mo.
145th Tactical Airlift Group, Charlotte, N. C.
153d Tactical Airlift Group, Cheyenne, Wyo.
164th Tactical Airlift Group, Memphis, Tenn.
166th Tactical Airlift Group, Wilmington, Del.
167th Tactical Airlift Group, Martinsburg, W. Va.
179th Tactical Airlift Group, Mansfield, Ohio
189th Tactical Airlift Group, Little Rock AFB, Ark.
118th Tactical Airlift Wing, Nashville, Tenn.
123d Tactical Airlift Wing, Louisville, Ky.
133d Tactical Airlift Wing, Minneapolis, Minn.
136th Tactical Airlift Wing, NAS Dallas, Tex.
137th Tactical Airlift Wing, Oklahoma City, Okla.
146th Tactical Airlift Wing, Channel Island ANGB, Calif.
110th Tactical Air Support Group, Battle Creek, Mich.
182d Tactical Air Support Group, Greater Peoria Airport, Ill.
128th Air Refueling Group, General Mitchell IAP, Wis.
134th Air Refueling Group, Knoxville, Tenn.
151st Air Refueling Group, Salt Lake City, Utah
157th Air Refueling Group, Pease AFB, N. H.
160th Air Refueling Group, Rickenbacker ANGB, Ohio
161st Air Refueling Group, Phoenix, Ariz.
170th Air Refueling Group, McGuire AFB, N. J.
190th Air Refueling Group, Forbes Field, Kan.
101st Air Refueling Wing, Bangor, Me.
126th Air Refueling Wing, O'Hare ARFF, Ill.
141st Air Refueling Wing, Fairchild AFB, Wash.
171st Air Refueling Wing, Greater Pittsburgh IAP, Pa.
129th Air Rescue Group, NAS Moffett Field, Calif.
105th Military Airlift Group, Newburgh, N. Y.
172d Military Airlift Group, Jackson, Miss.
226th Combat Communications Group, Martin ANGS, Ala.
281st Combat Communications Group, Coventry, R. I.
224th Joint Chiefs of Staff Squadron, Brunswick, Ga.
290th Joint Chiefs of Staff Squadron, Tampa, Fla.

Air Force Reserve

301st Tactical Fighter Wing, Carswell AFB, Tex.
419th Tactical Fighter Wing, Hill AFB, Utah
442d Tactical Fighter Wing, Richards-Gebaur AFB, Mo.
482d Tactical Fighter Wing, Homestead AFB, Fla.
917th Tactical Fighter Wing, Barksdale AFB, La.
315th Military Airlift Wing, Charleston AFB, S. C.
349th Military Airlift Wing, Travis AFB, Calif.
433d Military Airlift Wing, Kelly AFB, Tex.
439th Military Airlift Wing, Westover AFB, Mass.
445th Military Airlift Wing, Norton AFB, Calif.
446th Military Airlift Wing, McChord AFB, Wash.
459th Military Airlift Wing, Andrews AFB, Md.
512th Military Airlift Wing, Dover AFB, Del.
514th Military Airlift Wing, McGuire AFB, N. J.
440th Tactical Airlift Wing, General Mitchell IAP, Wis.
94th Tactical Airlift Wing, Dobbins AFB, Ga.
302d Tactical Airlift Wing, Peterson AFB, Colo.
434th Air Refueling Wing, Grissom AFB, Ind.
452d Air Refueling Wing, March AFB, Calif.
507th Tactical Fighter Group, Tinker AFB, Okla.
944th Tactical Fighter Group, Luke AFB, Ariz.
924th Tactical Fighter Group, Bergstrom AFB, Tex.
926th Tactical Fighter Group, NAS New Orleans, La.
907th Tactical Airlift Group, Rickenbacker ANGB, Ohio
908th Tactical Airlift Group, Maxwell AFB, Ala.
910th Tactical Airlift Group, Youngstown MAP, Ohio
911th Tactical Airlift Group, Greater Pittsburgh IAP, Pa.
913th Tactical Airlift Group, Willow Grove ARFF, Pa.
914th Tactical Airlift Group, Niagara Falls IAP, N. Y.
927th Tactical Airlift Group, Selfridge ANGB, Mich.
928th Tactical Airlift Group, O'Hare ARFF, Ill.
934th Tactical Airlift Group, Minneapolis, Minn.
916th Air Refueling Group, Seymour Johnson AFB, N. C.
940th Air Refueling Group, Mather AFB, Calif.
919th Special Operations Group, Eglin AFB, Fla.
932d Aeromedical Airlift Group, Scott AFB, Ill.
Approximately 600 Individual Mobilization Augmentees

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23. STATEMENT OF SERVICE		YEARS
a. CREDITABLE FOR BASIC PAY PURPOSES	1. NET SERVICE THIS PERIOD	05
	2. OTHER SERVICE	55
	3. TOTAL (LINE (1) PLUS LINE (2))	61
b. TOTAL ACTIVE SERVICE		61
c. FOREIGN AND / OR SEA SERVICE		13

SERVICE DATA

24a. SPECIALITY NUMBER AND TITLE: 2945-Avionics Specialist

b. RELATED CIVILIAN OCCUPATION AND D.O.T. NUMBER: Avionics Mfg.

25. DECORATIONS, MEDALS, BADGES, CITATIONS AND CAMPAIGN RIBBONS AWARDED OR AUTHORIZED

26. SERVICE EXPERIENCE

1. EFIS and weather radar, UC-25A (Air Force One)
2. EFIS and weather radar, USAF C-20B VIP Spec. Mission Squadron (C-SAM)
3. EFIS and CNI, Fully-aerobatic 8G PC-9 International Military Trainer
4. Digital avionics suite, ANGOSTA C-26A
5. AN/ARC-200 HF COMM, F-16 AND F/A-18
6. Digital avionics suite, TH-57

(Continued next page)

VA AND SERVICE D

N-PAY PERIODS / TIME LOST	b. DAYS ACCRUED LEAVE PAID	28a. INSURANCE IN FORCE	b. AMOUNT OF ALLOTMENT	c. MONTI DISCO
No Time Lost	60	[X] YES [ ] NO	24 mos.	N

29. VA CLAIM NUMBER	30. SERVICEMEN'S GROUP LIFE INSURANCE COVERAGE		
1	[X] $10,000	[X] $5,000	[ ] NO

THENTICATION

31. PERMANENT ADDRESS FOR MAILING PURPOSES AFTER TRANSFER OR DISCHARGE: 400 N. Rogers Road, Olathe, Ks.

32. SIGNATURE OF PERSON BEING TRANSFERRED OR DISCHARGED

33. TYPED NAME AND TITLE OF AUTHORIZING OFFICER: Mann, Capt., U.S. Armed Forces

34. SIGNATURE OF OFFICER AUTHORIZED TO SIGN

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Allied Signal Aerospace

This critical, crisis-prone region seems destined to be a main focus of future US defense planning.

Long Haul in the Middle East

By Stewart M. Powell

THE confrontation with Iraq provides a textbook case in how massive military emergencies can flare up overnight in the Middle East, a region drenched in danger but likely to dominate Washington's post–cold war defense plans.

The danger posed by sudden, unexpected military eruptions isn't likely to disappear anytime soon. A broad zone of violence extends from Iran to Morocco. Experts see it as the world's new number one flashpoint, now that Soviet power has ebbed from Europe. The war that broke out January 16 confirms that view.

Middle East crises always seem to come as a thunderous surprise in Washington. Unlike Europe, where US forces for forty years faced an enormous but more predictable Soviet threat, the Middle East is a cockpit of violent sectarianism, nationalism, religious strife, and Arab-Israeli hatred, all virulent and unpredictable.

In addition, Washington's stakes in the region are high. By decade's end, say some experts, the US may depend on the Gulf for twenty-five percent of its oil requirements. US trading partners in Europe and Asia are even more heavily dependent. Washington also remains the ultimate guarantor of the survival of Israel.

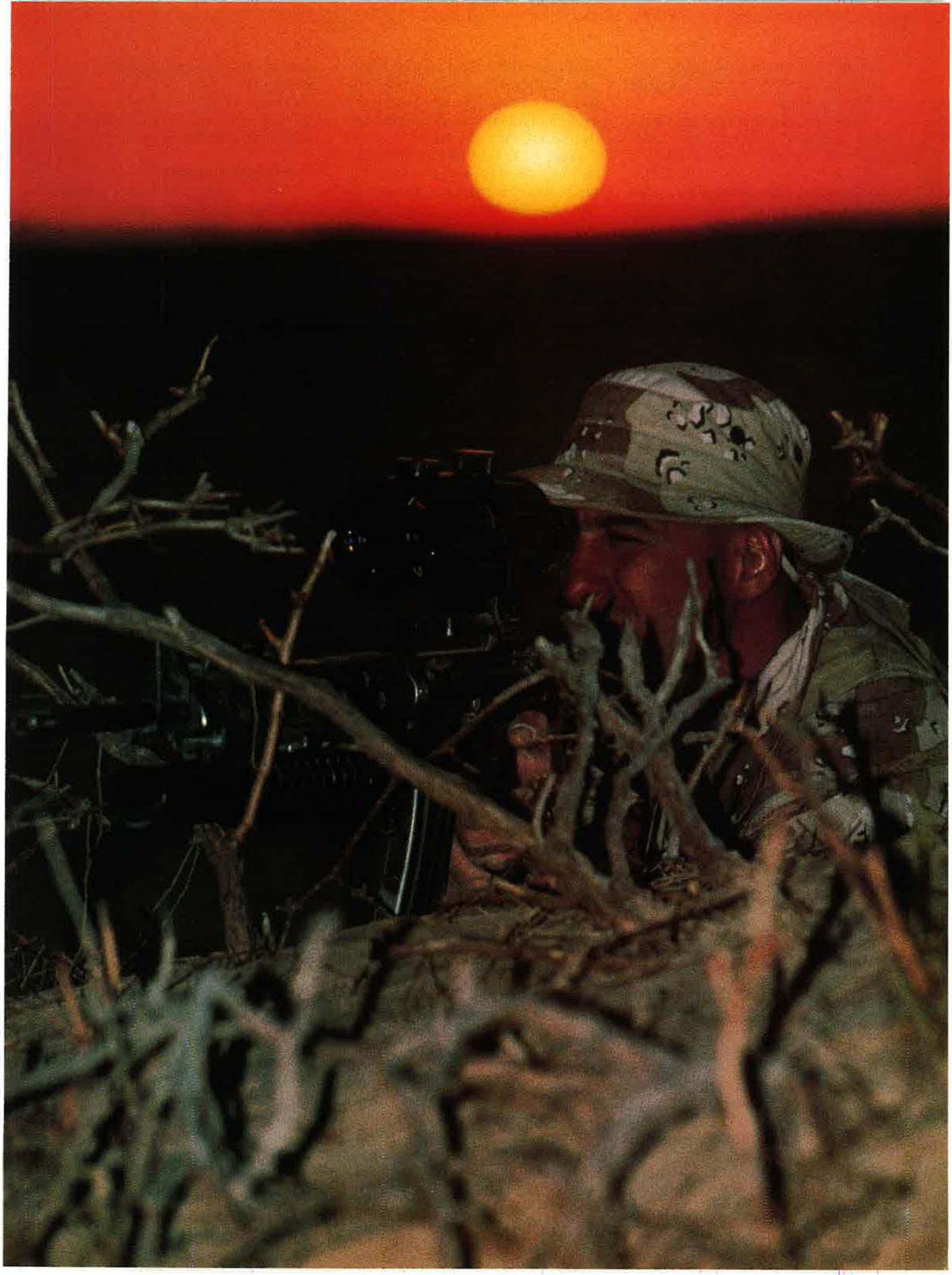
With the Middle East shaping up as a new locus of defense planning, the US now has begun to fashion a multifaceted response comprising direct and indirect use of military power, economic measures, and diplomacy—all designed to deal with a formidable array of potential threats.

The danger posed by sudden, unexpected military eruptions in the Middle East isn't likely to disappear anytime soon, and the US has begun to fashion its post–cold war defense with a combination of direct and indirect use of military power, economic measures, and diplomacy, designed to deal with a formidable array of potential threats.

An Immense Arsenal

In the Persian Gulf, the situation that the White House and the US military services faced in the second half of 1990 and early 1991 was sobering. Until confronted by the US, Iraq was in a position to overawe smaller neighbors with its immense arsenal of Soviet- and French-built weaponry financed by the nation's once-abundant oil revenues.

Depending on which expert you listened to, the California-sized land of 18,000,000 might have been as few as two years or as many as five years away from producing an



indigenous nuclear weapon—the long-anticipated and much-feared "Islamic bomb."

When it came to poison gas weapons, Baghdad not only had them, but also frequently used them—against Iranian troops in the 1980–88 Iran-Iraq War and against Iraq's own Kurdish minority. Experts estimated that Iraq could readily produce 1,000 tons of chemical agents a year.

Iraq also had been moving toward independent production of longer-range ballistic missiles—for example, a 1,200-mile-range missile able to blanket all significant targets in Israel. So acute was the threat that Washington felt compelled last summer to rush Patriot surface-to-air missiles to Israel.

—Photo by Thomas Hartwell/TIME

Egypt's participation in the coalition of forces built against Iraq drew harsh criticism from Islamic fundamentalists, but President Hosni Mubarak (shown here with King Fahd of Saudi Arabia) is pushing a plan for Egypt, Saudi Arabia, and Syria to forge long-term cooperation that would "transcend any specific situation."

Ties With Terrorism

For months, Saddam Hussein strengthened his nation's ties with international terrorism, prompting the US to warn him that US forces would retaliate for any attack.

As the crisis wore on, American intelligence agencies warned that Abu Nidal, working from Baghdad, could mastermind attacks on Americans to rival the machine-gun assault that killed eighteen people at the Rome and Vienna airports in December 1985. They noted that Baghdad had opened talks with Ahmad Jibril, leader of the Popular Front for the Liberation of Palestine–General Command, believed to have carried out the December 1988 bombing of Pan Am Flight 103 over Lockerbie, Scotland.

Fears that Saddam Hussein would one day use his military might were realized last summer at the disputed border between Iraq and Kuwait. The Iraqi leader moved troops up to the Kuwaiti border in late July, threatening to unleash a military solution to a long-running dispute over $2.4 billion in oil revenues and two strategically located Kuwaiti islands at the head of the Gulf.

Iraq then seized Kuwait in a move that gave Saddam Hussein control over twenty-two percent of world oil reserves—his own and Kuwait's—and the distinct prospect of intimidating Saudi Arabia, which controls thirty percent.

Saddam Hussein was the most dangerous, but hardly the only, menace in the region where a variety of despots and other hard men vie to lead the Arab, Islamic, or Palestinian cause.

Syria's wily and formidable leader, President Hafez Assad, posed a difficulty for the United States as the White House cozied up to him in a marriage of convenience. Assad was not only the *de facto* guarantor of peace in Lebanon but also a symbol of the breadth of Arab participation in the anti-Iraq coalition. The leader of Syria met face-to-face with Secretary of State James A. Baker III and with President Bush at a minisummit in Geneva.

"Unsavory Aspects"

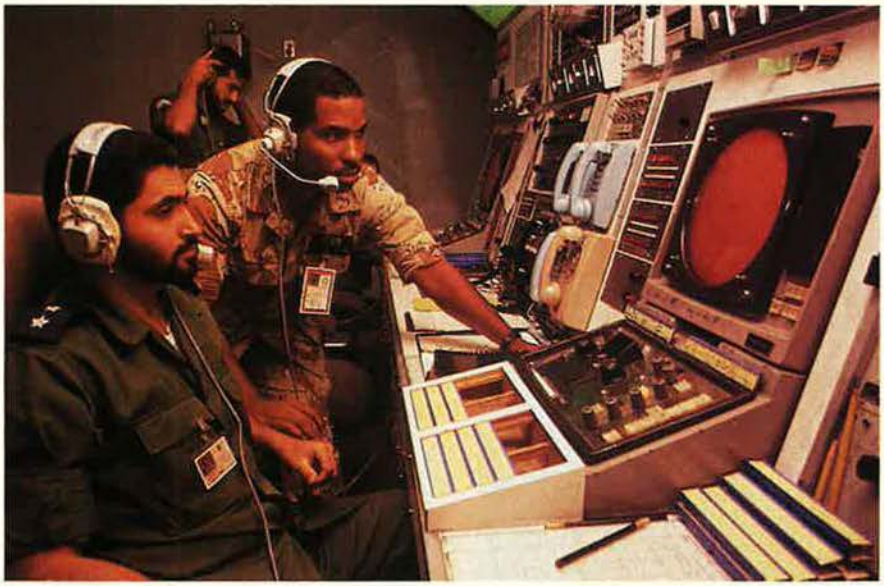
"There always is some danger when you deal with people who have unsavory aspects," conceded National Security Advisor Brent Scowcroft. At that time, however, Scowcroft maintained that the participation of Assad "significantly widens the spectrum of Arabs opposed to what the Iraqis have done."

The rapprochement stirred controversy nevertheless. Syria remains on the State Department's list of nations sponsoring terrorism, and officials cite Assad's support for anti-American terrorists. Damascus remains the home of Jibril's faction, suspected of planting the bomb on Flight 103 in retaliation for the downing of an Iranian Airbus by the US Navy's guided missile cruiser USS *Vincennes*.

Behind its limited and circumspect "cooperation" with the United States, Syria remains a regional power with which the US and Israel must certainly reckon. Syria's 404,000-member forces have more than 4,000 Soviet-made tanks, including T-72s, and 499 combat aircraft, including MiG-29s. Assad has begun buying weapons with the $2 billion in emergency assistance he received from Saudi Arabia and other Gulf nations for his nation's high-profile participation in the US-led coalition.

Across the Persian Gulf, non-Arab Iran also confronts the US with a major regional challenge. Canny Iranian politicians—most prominently, President Hashemi Rafsanjani—used the Gulf crisis to isolate conservative Islamic fundamentalist foes at home and to reach out to western Europe. Iran regained Iraqi-occupied territory in the wake of Saddam Hussein's August 1990 capitulation to Iranian terms in order to close off any threat from Iraq's eastern flank.

Iranian strategy remains what it has always been—strengthening its own hand in the Middle East arena, either by bolstering its own might or by weakening the power of rivals. Iran has made balanced overtures



—USAF photo by TSgt. Rose S. Reynolds

Sgt. Eugene E. Jiggitts of the 2d Combat Communications Group, Patrick AFB, Fla., and 1st Lt. Saled M. Sahrani of the Saudi Air Force track aircraft by radar. Joint training and commonality of equipment between US and Saudi forces have made many Desert Storm operations smoother than they might otherwise have been.

to both Iraq and Saudi Arabia in hopes that neither will prove to be much of a long-term rival for power in the region, long dominated by Iran's 55,000,000 people.

Iran wanted Saddam Hussein to be "weakened but not destroyed," says Shireen T. Hunter of Washington's Center for Strategic and International Studies.

Iranian-sponsored terrorism promulgated by Shiite Moslems remains a constant threat to the United States and the West in general. Saudi Arabia's Eastern Province —site of most of the US deployments—and Bahrain, Qatar, and the United Arab Emirates have large Shiite populations, which at times have been susceptible to appeals by Iranian clerics.

Ayatollah Sayyed Ali Khamenei, Iran's most prominent religious leader, has proclaimed that any Moslem who is killed while countering "the greedy interventionist schemes" of America "qualifies as a martyr."

Though he is relatively quiescent these days, Libyan leader Col. Muammar Qaddafi's oil-financed force of 85,000 troops armed with 1,800 Soviet-built tanks and 515 combat aircraft still gives him some leverage. He has as many as fifteen Soviet-built Sukhoi-24D "Fencer" fighter-bombers capable of midair refueling for long-range missions against Israel.

Qaddafi's Safe Haven

Qaddafi still uses terrorism and provides safe haven to terrorists, despite US bombing raids in 1986. He continues to undermine neighbors, attacking Chad in 1987 and more recently helping to overthrow Chad's US-backed regime, headed by President Hissen Habre. Rebel Chad leader Idriss Deby obtained money from Libya in what US officials called "the latest example of Libya's ongoing efforts to destabilize legitimate governments."

Inter-Arab, Arab-Iranian, and Moslem-Western conflicts may be dangerous, but it is tension between Arabs and Jews in Israel that poses the greatest long-term threat to regional peace.

Last October in Jerusalem, Israeli forces opened fire on stone-throwing Palestinians, who said they had come to Temple Mount to protect two mosques, Al-Aqsa and Dome of the Rock, from attacks by Jewish zealots vowing to raze the sacred site. The killing of at least twenty-one Arabs and the wounding of more than 140 created a new grudge that could explode at any time in Arab retaliation against Israel.

The Israeli action put immediate strains on the fledgling US-Arab coalition against Iraq, forcing Washington to join in a United Nations Security Council condemnation of Israel for only the second time since its foundation in 1948. Israel, remarked Baker, ought to be "able to exercise restraint."

The risks of international instability and even open Arab-Israeli conflict are growing. The Palestinian uprising, or Intifada, now in its fourth year, has brought death to more than 1,000 Palestinians and more than eighty Israelis. No end is in sight.

"If the [Mideast] peace process does not advance over the next several years," warns CIA Director William Webster, "the Intifada is

—USAF photo by MSgt. Jose Lopez

Sgt. Keith R. Smith, SSgt. Tom L. Davison, and Sgt. Greg A. Ware of the 443d Security Police Squadron, Altus AFB, Okla., lay down concertina wire along the perimeter of a Persian Gulf installation. The proliferation of chemical, biological, and nuclear weapons in the Mideast increasingly complicates US security.

—US Army photo by Spec. Samuel D. Henry

The US expects to expand training operations for indigenous forces in the Middle East. Above, Saudi National Guard officers observe a static display of US equipment. Below, Lt. Col. M. Hassoon, a pilot and commander of the 3d Squadron, Saudi Arabian Air Force, goes over his preflight checklist.

likely to become more violent, terrorism will probably rise, and Arab pressure on the United States to impose a settlement will increase."

Equally worrisome, in some ways, is the underlying poverty and instability that threatens a key US ally, Egypt. This huge Arab nation, the region's political center of gravity, now finds itself beset by Islamic fundamentalism and economic uncertainty.

Early in the Gulf military crisis, Egyptian President Hosni Mubarak moved 30,000 troops across the Red Sea to Saudi Arabia to take a leading role in a twenty-seven-nation coalition of forces built against Iraq. The high-profile role exposed Mubarak's regime to the fury of Islamic fundamentalists opposed to cooperation with American "infidels."

—USAF photo by TSgt. Rose S. Reynolds

Before the Blast

In October, a squad of killers reportedly trained by the National Islamic Front's military regime in neighboring Sudan assassinated the speaker of the parliament, Rifat Mahgoub. A country-wide crackdown found widespread support for the Islamic movement. The tensions, claims Mokhtar Noh of the radical Muslim Brotherhood, are at "the point before the big blast."

The faltering state of the Egyptian economy is another problem for the impoverished nation of more than 54,000,000, which has been sorely affected by the Gulf crisis. Egyptians have lost revenue from the Suez Canal, where shipping has slowed. Tourism revenues are off. The expulsion of Egyptian workers from Iraq and Kuwait has shut off the estimated $2 billion in annual remittances Egyptian workers sent home to their families.

Washington moved to relieve Egypt of the need to repay more than $7 billion in debt to the US, but the concession appears unlikely to do more than ease Egypt's plight slightly.

There is better news from an unlikely place—Lebanon. Sectarian struggles among Moslems, Palestinians, and Maronite Christians have been forcibly suspended. Syrian troops enforced a power-sharing accord worked out in 1989 by Arabs at Taif, Saudi Arabia. Barricades, car bombs, and uncertainty have been replaced in Beirut by a stability unknown since 1975, when the Sunni Moslem minority-turned-majority began pressing for a greater role in governing the nation.

Transcending Boundaries

Several Mideast threats seem to transcend national boundaries. For example, the continued proliferation of weapons of mass destruction increasingly complicates US security.

Nations, even friendly ones, in recent years have plunged ahead on programs to develop chemical weapons, biological weapons and, in the case of Israel and Iraq, nuclear weapons. Six Middle East nations have acquired chemical and biological weapons: Iraq, Iran, Libya, Syria, Egypt, and Israel, according to W. Seth Carus, a specialist with the Washington Institute for Near East Policy. Foreign-made missiles went to Iraq, Iran, Libya, and Syria. Israel has its own. Syria has obtained intermediate-range missiles.

"Nuclear proliferation," warns CIA Director Webster, "combined with the spread of chemical and biological weapons and the missiles to deliver weapons of mass destruction, has the potential to place many regional conflicts on the brink of catastrophe."

Chemical weapons sharpen threats that can ignite preemptive attacks. For example, Saddam Hussein once boasted that his country didn't need nuclear arms because binary nerve gas weapons can "make the fire eat half of Israel."

Both Iraq and Iran used poison gas during their eight-year stalemate, stirring concern that the 1925 Geneva Protocol, banning use of chemical weapons, has been irretrievably breached.

Libya has the largest poison gas facility in the Third World, erected in the desert outside Tripoli with the help of German, Swiss, and Japanese companies. According to intelligence estimates, this "pharmaceutical" plant (Tripoli's cover story)

can produce up to forty tons of chemical agents per day. Libyan forces reportedly used chemical agents in 1987 during the incursion into Chad.

Syria's two chemical weapon production facilities are capable of producing several hundred tons of nerve and mustard gas each year, according to US experts. Egypt, which apparently provided poison gas shells to Syria before the 1973 Arab-Israeli war, has an arsenal as well, although it last used chemical agents against royalist forces in North Yemen in the mid-1960s.

Israel has the most modern, battle-ready chemical warfare arms. Israel is also believed capable of developing biological weapons on short notice. It insists that the arsenals are for deterrent purposes only, and Jerusalem has never ordered chemical agents used in warfare.

In recent years, the most menacing development had been Baghdad's pursuit of nuclear weapons, allegedly to offset Israel's own arsenal of doomsday arms.

A permanent security organization in the Mideast, led by Arab nations and bolstered by United Nations guarantees, could include an expanded role for the Saudi-led, six-nation Gulf Cooperation Council, but the final arrangement is likely to entail at least temporary participation of US ground and air forces.

Multifaceted Response

Confronted with such durable threats to its interests, the US has embarked on a multifaceted response.

In military terms, the Air Force can count on wider and longer deployments, not only in Saudi Arabia, but in Bahrain and the United Arab Emirates as well. Long-term Gulf deployments of US warships are expected to increase dramatically beyond the three to four vessels that prowled the shallow waters before the invasion of Kuwait. The Navy had six aircraft carriers on station in the Indian Ocean and Arabian Sea early this year, with one or two occasionally entering the 600-mile-long Persian Gulf.

Experts expect the US eventually to withdraw most ground forces from Saudi Arabia. Heavy equipment, ammunition, and other materiel will stay behind, prepositioned, much as has been done in Europe for years.

The US expects to expand training operations for local, indigenous forces. Officials say US Army Special Forces country teams will build up units not only in Saudi Arabia but also in other Arab nations. US advisors worked with those Kuwaiti forces that managed to escape the Baghdad blitz.

The Gulf Cooperation Council, a loose organization of six Arab nations, already had formed a 10,000-member rapid deployment force of limited capability. Now the GCC force is to receive more and better training. Defense Secretary Dick Cheney sees such a well-trained multinational force serving as a "peacekeeping force" for the area.

Beyond that, says Cheney, "indigenous military capabilities" will be improved across the region. Billions of dollars' worth of additional equipment will be funneled to US allies on top of what already has been sent.

The objective, says Under Secretary of State for Security Assistance, Science, and Technology Reginald Bartholomew, a former US ambassador to Lebanon, is "to build a Saudi and a Gulf force capability that will, in effect, drive up significantly the costs to anybody looking to take a whack at them."

That's not all. The Bush Administration envisions a rigid arms-control system to thwart the development by rogue nations of nuclear, chemical, and biological weapons and of long-range ballistic missiles. It wants international safeguards to prevent Saddam Hussein from acquiring additional technology with which to produce weapons of mass destruction. Secretary of State Baker says the blueprint aims to "contain" Saddam Hussein and to "create a new world order based on international law and not international outlaws."

Finally, senior US officials envision a permanent security organization led by Arab nations and bolstered by United Nations guarantees. The US already has urged an expanded role for the Saudi-led Gulf Cooperation Council.

The US will have to tailor its security framework to fit those of regional powers. Iran, for example, has discussed a "regional security system" with Arab nations to thwart Iraqi ambitions and obviate a need for foreign forces. Egypt's Mubarak is pushing a plan for Egypt, Saudi Arabia, and Syria to forge long-term cooperation to "transcend any specific situation."

The final arrangement is sure to entail US participation. US ground and air forces likely will stay as long as they are wanted and likely will depart when the Arabs give the word. ■

Stewart M. Powell, national security correspondent for Hearst Newspapers, has covered defense for a decade in Washington and London. His most recent article for AIR FORCE *Magazine was "Desert Duty" in the February 1991 issue.*

More and more, Gorbachev is forced to depend on the old instruments of power: the Red Army, the KGB, and the Party.

The Soviet Hard-Liners Return

By Harriet Fast Scott

IT WAS in June, at Russia's Communist Party Conference in Moscow, that the angry, bitter Soviet defense establishment first rose up and confronted its tormentors. It is a scene that has in recent months become only too common—and troubling.

Gen. Col. Albert Makashov, commander of the Volga-Ural Military District, flung a torrent of recriminations at liberal reformers, charging them with ignoring huge threats building up against the USSR.

"The NATO bloc is being strengthened," he warned, "when the Warsaw bloc no longer exists. Germany is being reunited and probably will be a member of NATO. Japan is becoming the decisive force in the Far East. Only our own scientist-chaps twitter . . . that no one intends to attack us." (Here, the conference delegates applauded.)

Warming to his theme, Makashov pressed on, issuing threats against national and ethnic groups agitating for independence. "We Army Communists cannot conceive of the Union without Russia, or Russia without the Union," Makashov warned. (Applause.) "For this, we are prepared to fight." (Thunderous applause.)

In the nine months since then, the Soviet military has made a comeback. Statements such as those of the fiery Makashov, so extraordinary at the time, are commonplace today. Reactionary elements of the Army, the KGB, the bureaucracy, and the Communist Party demand that the Kremlin restore power and prestige to the military and use it to bring internal and external security.

The pressure clearly has had its effect. President Mikhail S. Gorbachev, by early winter, had come to depend more and more on the traditional organs of power—the Party, the KGB, and the Red Army—to assert his authority over rebellious republics. Signs of rising military influence were everywhere apparent.

It was the growing influence of the military to which former Foreign Minister Eduard Shevardnadze referred when he warned on December 20, "Dictatorship is coming," and then resigned.

In response to the Army's demands, President Gorbachev issued decrees that forbade republics to organize their own armed forces.

—Reuters/Bettmann

As Soviet republics become more and more rebellious, reactionary elements in the military are increasing their pressure on the Kremlin to take a hard line. Opposite: In Vilnius, Lithuania, a Red Army paratrooper attacks a news agency photographer as soldiers take over the local TV tower in January.

On January 7, the Defense Ministry deployed thousands of crack troops and sent them into action to stop draft-dodging and desertion in seven Soviet republics—Latvia, Lithuania, Estonia, Georgia, Armenia, Moldavia, and the Ukraine. Within days of the deployment, the crackdown led to deaths in Lithuania and Latvia.

The Kremlin threatened to use broad constitutional powers to

maintain the 4,000,000-strong armed forces.

The Interlocking Alliance

The army's influence is reinforced by its alliance with the Communist Party. Three out of every four officers, including virtually all generals, are Party members. It draws support from industrialists and ideologues in the arts and the intelligentsia and even from parts of the Russian Orthodox Church.

In the military itself, however, ideological conflicts are growing, pitting reform-minded younger officers against reactionaries eager to protect the military establishment. Ethnic conflicts can be found everywhere. In short, the Soviet military is passing through a profound institutional crisis.

In recent months, Western diplomats tended to view the threat of a military coup in the Kremlin as remote. There was no doubt, however, that the Soviet military was a pressure group that President Gorbachev could ill afford to ignore.

For several years, the danger of a military coup has been the bogeyman of the liberal Soviet press. In mid-September, the liberal newspapers *Moscow News* and *Literaturnaya Gazeta* both warned that hardline Soviet military officers might be tempted to overthrow Gorbachev, despite his popularity with younger officers.

Commentator Vladimir Sokolov speculated in *Literaturnaya Gazeta* on September 12 that someday the military-industrial complex might find that the cheapest and most promising way to regain power would be to launch a coup.

At about the same time, some fifty top officials of the Soviet military industry signed a petition in *Pravda,* saying that the USSR's situation was "critical and getting out of control."

Liberal Soviet journals called attention to a number of possible Soviet Bonapartes who would, they said, be willing and able to seize power. Here are the "most-often-mentioned candidates for military dictatorship":

General Igor Rodionov. According to one Soviet journal, Rodionov, fifty-four, was principally "noted for his bloody repression of dissent two years ago in Tbilisi, Georgia, and [has] since [been] assigned to a Moscow military academy."

Rodionov's career has been well chronicled in the Soviet press. He once commanded what the Kremlin referred to as the "limited contingent of Soviet forces" in Afghanistan. Before his assignment as commandant of the prestigious Voroshilov Military Academy of the General Staff, Rodionov was commander of the Transcaucasus Military District, with headquarters in Tbilisi.

It was here in April 1989 that Soviet troops, armed with sharpened shovels, moved in to break up a demonstration, killing twenty demonstrators. All of the dead were unarmed, and all but two were women. Two were sixteen-year-old schoolgirls, eight were in their twenties, and one was seventy. Pictures of the dead are still found on the walls of establishments in Tbilisi.

In his current position as commandant of the Voroshilov Military Academy, Rodionov is in an excellent position to influence the Soviet high command. All Soviet generals and admirals in operational positions attend the Academy's two-year course, either shortly before or shortly after being promoted.

Gen. Col. Albert Makashov. The fifty-two-year-old senior Army officer's June performance, and his pugnacious character, make him a prime suspect. He graduated at the top of his class from the Academy of the General Staff. His Volga-Ural District is of key importance.

In July, Western newspapers reported that the outspoken Makashov had been reassigned from the Soviet Union to Iraq as a military advisor. When Iraqi troops invaded Kuwait on August 2, Makashov was again in the headlines. Soviet spokesmen vigorously denied that the General had ever left his district in the USSR.

Makashov has wide connections. He was Rodionov's top deputy in the Transcaucasus and was in charge of the area devastated by Armenia's earthquake in 1988. The two officers sometimes utter statements that are remarkably similar, almost identical.

Gen. Boris Gromov. Described in one press article as "a hero of the war in Afghanistan now in charge of the military in much of the west of the country," Gromov, forty-seven, is also a member of the Congress of People's Deputies.

Gromov is in a category apart from Rodionov or Makashov. Like Rodionov, he looks every inch the general, and he has often been described as the most admired general in the Soviet armed forces. Gromov is vigorously backed by *Soyuz* ("Union"), a powerful conservative group comprising some 500 People's Deputies.

When interviewed in September, however, Gromov declared in unequivocal terms that "a military coup is out of the question."

Plans for a Coup

Others disagreed. September issues of *Moscow News* gave major play to coup allegations made by *Shchit* ("Shield"), a liberal union formed in 1989 to guard the interests of servicemen. The union maintained that reactionary elements within the Army had a plan for taking control of the entire Soviet Union, "region by region." Under the reported plan, a state of emergency would be declared in the Soviet Far East. Nonmilitary media would be taken over. Transmitters for jamming foreign broadcasts would be switched on. All information to the population would be issued by military transmitters. Once the Far East came under martial law, there would be a pause to determine the reaction of nonconspirators among the military and political leaders.

"If something untoward happens," the report said, "the coup could be called off before it reached Moscow."

The deputy chairman of Shield, Vitaly Urashev, said that the Army would carry out a coup only on orders of the Communist Party. He claimed that Shield has clandestine members spread throughout the military. Through them, he continued, Shield has learned that the Army had carried out experimental coup attempts in the Far East.

When paratroopers suddenly appeared in Moscow early in September, alarmed Soviet Deputies began to ask questions and to demand answers. Defense Minister Dmitri Yazov assured them the troops had come to the capital (in September) to take part in a big national military parade (in November).

In the September 26 session of the Supreme Soviet, Yazov was compelled to try to explain other suspicious movements of troops. He noted that there were "rumors of the Dzerzhinsky Division planning to support a coup." The troops in question, he claimed, were "digging up potatoes in the Moscow Oblast."

Few took the explanations at face value. Wrote one Moscow reporter, "The cadets [of the Ryazan School] did not believe that the transported division had been flown in, in bullet-proof vests and steel helmets and with combat hardware, just to harvest potatoes."

In September, *Moscow News* held a roundtable discussion on the subject, bluntly titled "Military Coup in the USSR?" General Gromov did not appear personally, but he sent his views. He later criticized *Moscow News* for its reporting of the meeting, stating that it "forgot tact and journalistic ethics in [an] attempt to achieve maximum emotional impact."

The furious Gromov even filed charges against *Komsomolskoye Znamya* and a People's Deputy, Col. Vilen Martirosian. The cause of action was an article in the journal titled "Military Coup Possible." Colonel Martirosian had claimed there were forces engaged in "sabotaging, fomenting discontent, and organizing artificial shortages." He identified Generals Rodionov and Makashov as the prime culprits, adding, "I would also put Gromov on that list."

In December, however, Gorbachev carried off a surprise move. He fired his Minister of Internal Affairs, Vadim Bakatin, who had opposed the use of force against demonstrators. In his place, the Soviet leader installed Party apparatchik Boris Pugo, a Latvian ex-KGB general. At the same time, the Kremlin transferred Gromov to the Ministry (also known as the MVD), where he serves as Pugo's deputy.

The elevation of Gromov to his interesting new assignment may have stemmed, at least in part, from the actions of one Lt. Col. Victor Alksnis, a Latvian who is a People's Deputy and one of the two founders of the powerful *Soyuz*.

Izvestia published remarks Alksnis had made about a tense, mid-November meeting between Gorbachev and some servicemen-Deputies. Said Alksnis, "A strange thing happened there: The country's President was left without the armed forces."

In that November 13 session, Gorbachev met with 1,100 military men who hold seats in government councils. Hostility filled the room. Complaints of the officers were many and bitter. Previously, explained Alksnis, political tension in the Soviet Army, for the most part, had been a matter of generals opposing *perestroika*, but the November 13 meeting "was a conversation of the deaf and the blind."

—Reuters/Bettmann

After soldiers moved in to suppress the independence movement in Lithuania, the Baltic republic's citizens rallied to protect their parliament from the Red Army. The claim of Soviet Lt. Col. Victor Alksnis that the Red Army "will not march" against the Soviet people calls to mind a similar statement made about the Chinese People's Liberation Army in 1989.

"Driven to Extremity"

Alksnis maintained that the Red Army "will not march" against the Soviet people. However, he went on to give a fuller explanation of what the Army may be prepared to do: "The Army has been driven to extremity by the actions of nationalists. If the necessary measures are not taken, people will take to the streets with weapons. That will not be a military coup. The military [members] will defend their own human rights."

It is remarkable that these statements were hurled at the Soviet President by a lieutenant colonel.

Gorbachev delivered his State of the Union address at a stormy session of the Supreme Soviet on Friday, November 16. When talking about the armed forces, he rebuked Alksnis for saying he had lost the Army. He called the charge "shallow and emotional." Yet one after another, Deputies called for more drastic measures to stop the disintegration of the state.

The next day, Gorbachev returned with a series of proposals. One called for the Supreme Soviet to "ensure the prestige of those who maintain the security of our state."

This and other moves clearly were intended to placate the defense establishment, and they partially succeeded. After Gorbachev spoke, Alksnis expressed guarded support. "Yes, we [military men] have had a conflict with you," said Alksnis. "But I personally, and my voters and the Army, support your

actions aimed at the salvation of the state."

Then Alksnis issued a blunt warning: "The credit of confidence in you has been exhausted."

Because he is a strong advocate of using force, his enemies call Alksnis the "Black Colonel." He seems to have struck a chord among the armed forces, where discontent is rife over conditions of service and the army's role in republics demanding independence. Officers are bitter about shabby treatment after coming home from eastern Europe and about wholesale releases.

Alksnis is not just an ordinary colonel. He is the grandson of the legendary Soviet Civil War hero Yakov Alksnis, who served as commander of Soviet Air Forces from 1931 to 1938, when he was arrested and shot in one of Stalin's purges.

Some Army men say Alksnis's extreme views do not represent mainstream military thought. There are many factions in the armed forces, they say, and signs of stress and alternative leaders increasingly are coming into the open.

One such leader is Capt. Vladimir Lopatin, scourge of the military establishment. When twenty-eight-year-old Lopatin ran for People's Deputy in 1989, he was an unlikely candidate to play David to the Ministry of Defense's Goliath, given that he was a Party member of Russian nationality, was a propagandist assigned to an aviation unit, and was once active in Communist youth work. The new Congress of People's Deputies, however, formed a Commission on Military Reform, and he became its chairman. From that position, Lopatin accused the top leadership of causing a crisis.

On July 4, 1990, an open letter signed by Lopatin and forty-six other frustrated reformers, Deputies, scientists, and even the chairman of the Committee of Soldiers' Mothers was published in *Komsomolskaya Pravda,* the liberal youth daily. Its title: "The Army Needs Protection. From Whom?"

Conditions of Stress

Lopatin and the other signers of that letter described the conditions that led to stress throughout the military services. Some 280,000 military families, they noted, need better living conditions. The utter security of older officers' positions is depriving most officers of the ability to advance in the service. The letter charged that, in 1990 surveys, only about twelve percent of the enlisted men and noncommissioned officers showed any interest in making a career of military service. They charged that the nation's military spending cannot be accurately counted or sensibly regulated by the state. They pointed out that, since 1986, 15,000 military servicemen had died—more than were lost in the eight-year war in Afghanistan. These military men died "as the result of accidents, fighting, acts of violence." Conditions, said the letter's signers, were so bad that one in five of the dead was a suicide.

The signers declared that the Soviet military leaders were creating a volatile situation. The military elite, they wrote, is forming a bloc with the conservative forces to protect its interests. They claimed that military reforms had been torpedoed and the proponents persecuted.

Lopatin and the other signers listed five essential steps for fixing the situation: Give the Defense Ministry responsibility for managing the entire military budget; prepare and debate a real program for conversion of military industries to civilian output; put the armed forces, KGB, and MVD off-limits to political parties; fire the reactionary hacks in the Ministry of Defense and defense panel of the Supreme Soviet; and stop using the armed forces as an internal police force.

The hierarchy was irate. Within a week, senior Soviet officers launched a counteroffensive with an open letter, "Is This How the Army Should Be Protected?" It ran on July 12.

The seventy-eight signers of the rebuttal were identified only by last name and first initial. However, two deputy defense ministers and the commanders in chief of three of the four TVDs appear to have signed it, as do the four commanders of forces in eastern Europe, seven military district commanders, and many military district political officers.

The senior officers shifted the blame for housing shortages to local civilian authorities. They blamed the Supreme Soviet for failing to adopt a Defense Ministry reform package.

Ignoring the plight of enlisted personnel, the senior officers noted that junior officers receive only 300 rubles per month, forcing below the poverty line a family of four in which the wife cannot find work.

Military Murders

The senior leaders also asked, what about the stress faced by officers? In 1989 forty-two were murdered and in 1990 more than 100. Everybody should be alarmed that the number of draft-dodgers has risen, the seventy-eight signers said.

Then came the response from the establishment's truly big guns. It was in the form of a letter, "Do Not Rub Salt Into the Wound!" and was published in *Komsomolskaya Pravda*. It was signed by Soviet Marshal Sergei Akhromeyev, personal military advisor to Gorbachev; Marshal Nikolai V. Ogarkov, Chairman of Soviet Veterans; and twenty-six other high-ranking marshals and generals.

This letter addressed none of the complaints registered by Lopatin and the others. It rejected the reformers' idea of a professional army, calling it a "harebrained scheme."

The radical reformers were accused of "taking note of everything positive emanating from the United States and its allies in Europe." The most noteworthy statement, however, was probably this: "We are convinced that the military danger from the United States still exists today."

It is impossible to predict with any confidence the final outcome of today's unsettled conditions. Internal developments in the Soviet Union could still result in a major resurgence of the Soviet military and other security forces, and that could well damage, or even bring to a close, the new era of Soviet-American cooperation. ■

Harriet Fast Scott, a Washington consultant on Soviet military affairs, is a member of the General Advisory Committee on Arms Control and Disarmament. Her translation and analysis of the Third Edition of Marshal V. D. Sokolovski's Soviet Military Strategy *is a standard reference work, as are her four other books on Soviet military matters, written with her husband, Dr. William F. Scott.*

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Soviet Aerospace Almanac

Edited by Colleen A. Nash, Associate Editor

Information for this Almanac was compiled from a variety of sources. Because the Soviet Union publishes relatively little data about its armed forces, some details are necessarily estimates.

In addition to reviewing this material and serving as general advisors, William F. Scott and Harriet Fast Scott prepared several items, including "Organization of the Soviet Armed Forces" and "Top Leaders of the Soviet Armed Forces."

Soviet Combat Organization

Normal peacetime training and housekeeping of Ground Forces and Air Forces (except certain strategic elements) are exercised through the commanders of the fourteen Military Districts and the remaining commanders of Groups of Forces in eastern Europe. Administrative support is provided by the individual services. Commanders in chief of the Strategic Rocket Forces, Troops of Air Defense, and Navy are responsible for training their own forces, as specified by the General Staff.

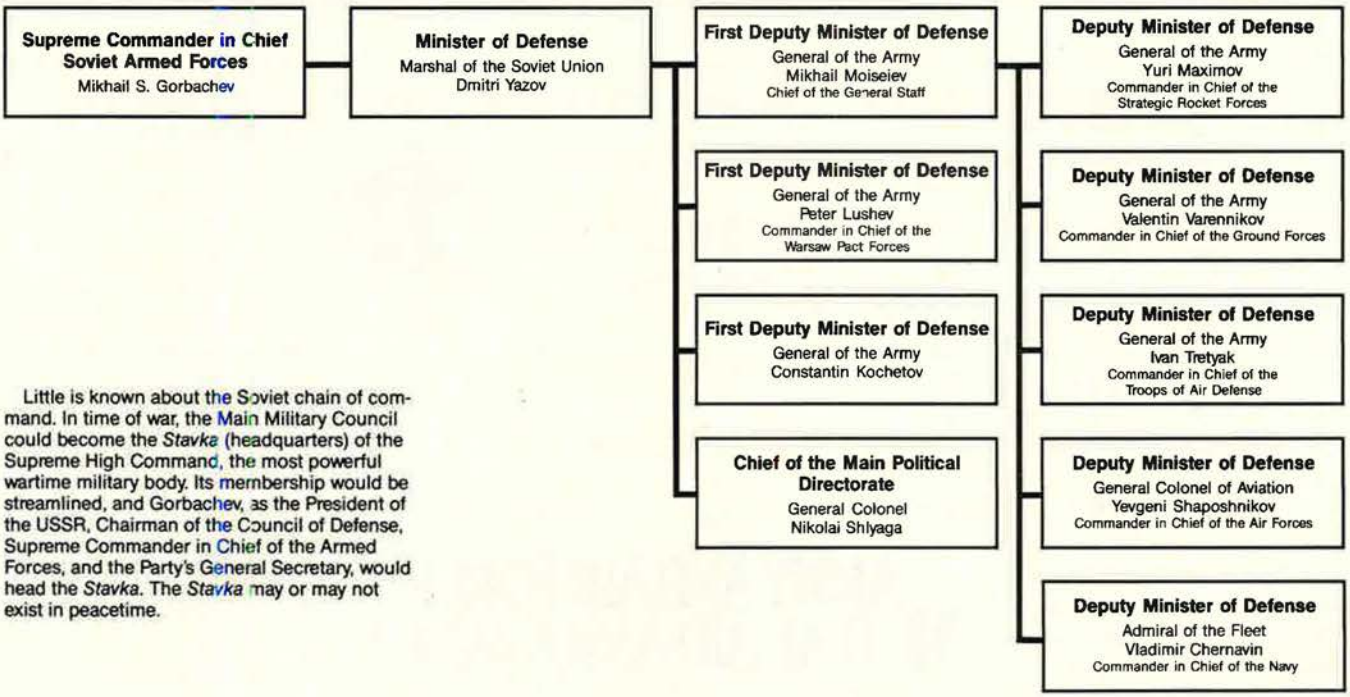
The four commanders in chief of Theaters of Military Operations (TVDs: Western, Southwestern, Southern, and Far Eastern) have high commands, reporting directly to the General Staff. In a wartime situation, a commander in chief would be designated and a high command formed in the Northwestern TVD. Each TVD commander in chief has operational command and control over the Ground and Air Forces units, plus specified Naval units, within his area.

A TVD could include several "fronts," each with its own armies and corps. In some cases, Ground and Air Forces units in a Military District would become a "front."

TVDs do not encompass defined geographical areas—they are referred to as "strategic directions." The Western TVD appears to include the Baltic, Byelorussian, and Carpathian Military Districts, the Northwestern TVD the Leningrad Military District, and the Southwestern TVD the Kiev and Odessa Military Districts. The Southern TVD takes in the Turkestan and Transcaucasus Military Districts, while the Far Eastern TVD includes the Transbaykal and Far Eastern Military Districts. The Moscow, Volga-Ural, North Caucasus, and Siberian Military Districts are under control of the General Staff and serve as strategic reserves.

Commanders in chief of TVDs are combined-arms commanders, directing ground and air operations in their areas during conflict and reporting directly to the Soviet Supreme High Command, as would commanders in chief of the Troops of Air Defense and Strategic Rocket Forces. Certain Navy units would be directly under the Supreme High Command. Other Naval Forces might be under designated oceanic TVD commanders in chief.

The Soviet Supreme High Command



Little is known about the Soviet chain of command. In time of war, the Main Military Council could become the *Stavka* (headquarters) of the Supreme High Command, the most powerful wartime military body. Its membership would be streamlined, and Gorbachev, as the President of the USSR, Chairman of the Council of Defense, Supreme Commander in Chief of the Armed Forces, and the Party's General Secretary, would head the *Stavka*. The *Stavka* may or may not exist in peacetime.

Top Leaders of the Soviet Armed Forces

Marshal of the Soviet Union Dmitri Timofeyevich Yazov. Born 1923. Russian. Minister of Defense since May 1987. Entered service in 1941. From 1942 to 1945, on Volkhov and Leningrad Fronts. From 1956 to 1961 and 1963–65, on the staff of the Leningrad Military District. In Main Directorate of Cadres, army commander, and again Main Directorate of Cadres 1970–76. First Deputy Commander of Far Eastern Military District 1976–79. Commander, Central Group of Forces (Czechoslovakia) 1979–80, Central Asian Military District 1980–84, Far Eastern Military District 1984–87. Deputy Minister of Defense for Cadres January–May 1987. Member of the Central Committee CPSU since 1987 (Candidate 1981–87). Candidate member of the Politburo June 1987–July 1990. Deputy of the Supreme Soviet 10th and 11th sessions. Frunze Military Academy (1956). Voroshilov Military Academy of the General Staff (1967). Promoted 1990.

General of the Army Mikhail Alexeievich Moiseiev. Born 1939. Russian. Entered service in 1958 as a sailor. First Deputy Minister of Defense and Chief of the General Staff since December 1988. Regimental, divisional, army commander. Chief of Staff (October 1985–87), then Commander of the Far Eastern Military District (January 1987–88). Member of the Central Committee CPSU since 1990. People's Deputy USSR (1989). Frunze Military Academy (1972). Voroshilov Military Academy of the General Staff with a Gold Medal (1982). Promoted 1989.

General of the Army Peter Georgievich Lushev. Born 1923. Russian. Commander in Chief of United Armed Forces of the Warsaw Pact (1989). Served as First Deputy Minister of Defense since July 1986. Entered service in 1941. Commanded infantry company during war. Commander Kantemirov Tank Division, army commander, First Deputy Commander in Chief, Soviet Forces Germany (1973–75). Commander of the Volga Military District (1975–77), Central Asian Military District (1977–80), Moscow Military District (1980–85). Commander in Chief, Soviet Forces Germany (1985–86). Member of the Central Committee CPSU (1981–1990). Deputy of the Supreme Soviet 10th and 11th sessions. People's Deputy USSR (1989). Malinovski Tank Academy (1954). Academy of the General Staff (1966). "Hero of the Soviet Union" (1983). Promoted 1981.

General of the Army Constantin Alexeievich Kochetov. Born 1932. Russian. First Deputy Minister of Defense since 1989. Joined the Soviet Army in 1950. Commander of Southern Group of Forces (Hungary) (1982–85), Transcaucasus Military District (1985–88), Moscow Military District (1988–89). Deputy of the Supreme Soviet 11th Session. People's Deputy USSR (1989). Frunze Military Academy. Voroshilov Military Academy of the General Staff. Promoted 1988.

General Colonel Nikolai Ivanovich Shlyaga. Born 1935. Byelorussian. Chief of the Main Political Directorate since July 1990. Entered service in 1955. In Komsomol and Party work. Deputy sector head, Administrative Organs Department of the Central Committee CPSU (to 1983). First Deputy Chief, then Chief of Political Directorate of Central Group of Forces (1983–1987). In Central Committee apparatus of State and Law Department. Deputy Chief of the Main Political Directorate (December 1989–July 1990). Member of the Central Committee CPSU (1990). Higher Party School of Central Committee CPSU (1972). Lenin Military-Political Academy (1975). Promoted 1990.

General of the Army Yuri Pavlovich Maximov. Born 1924. Russian. Commander in Chief of Strategic Rocket Forces since June 1985 and Deputy Minister of Defense. Joined Red Army in 1942. Division commander (1965), then First Deputy Commander of an army (1969). First Deputy Commander of the Turkestan Military District (1973–76). On special assignment (1976–78). Commander of the Turkestan Military District (1979–84). Commander in Chief of Southern TVD (1984–85). Candidate (1981), then Member of the Central Committee CPSU (1986–1990). Deputy of the Supreme Soviet 10th through 11th sessions. People's Deputy USSR (1989). Frunze Military Academy (1950). Academy of the General Staff (1965). "Hero of the Soviet Union" (1982). Promoted 1982.

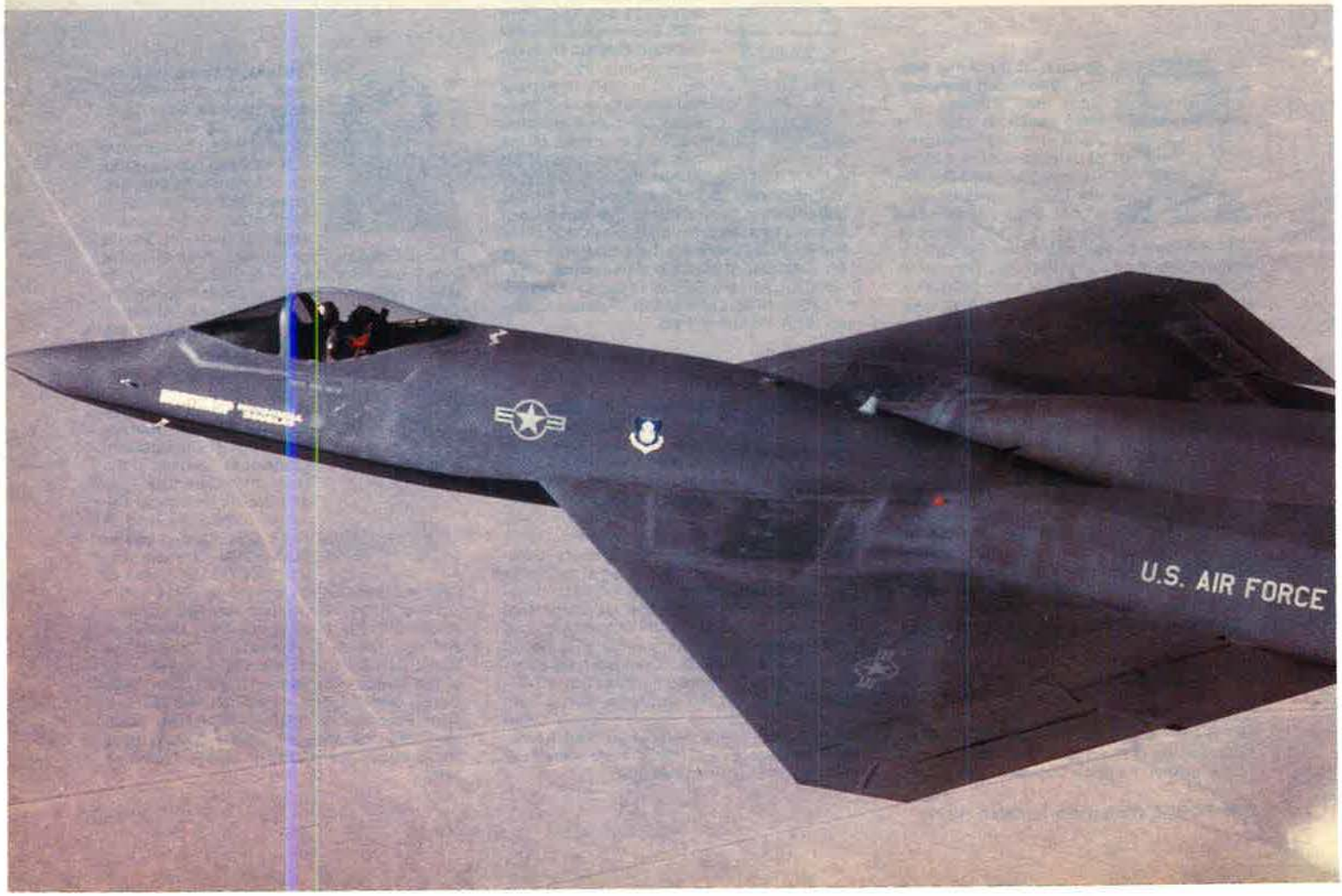
General of the Army Valentin Ivanovich Varennikov. Born 1923. Russian. Commander in Chief of the Ground Forces since 1989 and Deputy Minister of Defense. Joined Red Army in 1941. First Deputy Commander in Chief of Soviet Forces Germany (1971–73). Commander, Carpathian Military District (1973–79). Headed Ministry of Defense Operational Group in Afghanistan (1979–84). First Deputy Chief of the General Staff (1979–89). Candidate Member of the Central Committee CPSU (1986–1990). Deputy of the Supreme Soviet 9th and 10th sessions. People's Deputy USSR (1989). Frunze Military Academy (1954). Voroshilov Military Academy of the General Staff (1967). "Hero of the Soviet Union" (1988). Promoted 1978.

General of the Army Ivan Moiseievich Tretyak. Born 1923. Ukrainian. Commander in Chief of Troops of Air Defense (VPVO) since June 1987 and Deputy Minister of Defense. Entered service in 1939 as cadet. Wounded in action on second Baltic Front. Commander of Byelorussian Military District (1967–76), Far Eastern Military District (1976–84). Commander in Chief, Troops of the Far East (1984–86). Inspector General (1986–87). Candidate (1971), then Member of the Central Committee CPSU (1976–1990). Deputy of the Supreme Soviet 7th through 11th sessions. People's Deputy USSR (1989). Frunze Military Academy (1949). Academy of the General Staff (1959), higher academic courses of same (1970). "Hero of the Soviet Union" (1945), "Hero of Socialist Labor" (1982). Promoted 1976.

General Colonel of Aviation Yevgeni Ivanovich Shaposhnikov. Born 1942. Russian. Commander in Chief of the Air Forces since July 1990 and Deputy Minister of Defense. Entered service in 1959. Commander of Air Forces of the Odessa Military District, Soviet Forces Germany, commander of an air army. First Deputy Commander in Chief of Air Forces (1989–1990). Member of the Central Committee CPSU since 1990. Gagarin Military Air Academy. Academy of the General Staff. Promoted 1990.

Admiral of the Fleet Vladimir Nikolaievich Chernavin. Born 1928. Russian. Commander in Chief of the Navy since December 1985 and Deputy Minister of Defense. Joined the Navy in 1947. Commanded one of the first Soviet nuclear submarines (1959). Chief of Staff and First Deputy Commander of the Northern Fleet (1974–77). Commander of the Northern Fleet (1977–81). Chief of the Main Naval Staff and First Deputy Commander in Chief of the Navy (1981–85). Candidate (1981), then Member of the Central Committee CPSU (1986–1990). Deputy of the Supreme Soviet 10th and 11th sessions. People's Deputy USSR (1989). Naval Academy (1965). Academy of the General Staff (1969). "Hero of the Soviet Union" (1981). Promoted 1983.


YF-22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Organization of the Soviet Armed Forces

Restructuring of the Soviet Armed Forces continues, with reductions in numbers of both personnel and weapons. At the same time, essential weapon systems are being modernized throughout all of the services: Strategic Rocket Forces, Ground Forces, Troops of Air Defense, Air Forces, and Navy.

The five Soviet services do not include Troops of Civil Defense, Troops of the Tyl (rear services), Construction Troops, or other support organizations, all of which are under the Ministry of Defense. Although the Border Guards and Internal Troops, subordinate to the KGB and the Ministry of Internal Affairs (MVD), respectively, are no longer legally part of the Soviet Armed Forces, they work together as closely as ever. Within the past year, selected airborne units have been placed under operational control of the KGB to help maintain order in troubled areas.

The Soviets sometimes refer to the Ground Forces, Strategic Rocket Forces, Troops of Air Defense, and Air Forces as the Soviet Army. Functions performed by the US Air Force are spread across the latter three Soviet services.

The **Ministry of Defense** and the **General Staff** provide centralized command and control. Immediately subordinate to the Minister of Defense, who is roughly comparable in authority to the US Secretary of Defense and the Chairman of the JCS combined, are the Chief of the General Staff and the Commander in Chief of the Warsaw Pact Forces, an organization that today has only limited combat utility.

The **Strategic Rocket Forces,** still considered first among the services, consist of approximately 1,400 land-based ICBMs. Modernization of the force continues, with emphasis on heavy SS-18s (Mods 5 and 6), rail-mobile and silo versions of the new SS-24, and the road-mobile SS-25.

The **Ground Forces,** numerically the largest of the five services, are divided into motorized rifle and tank troops, airborne troops, rocket troops, and troops of air defense. While active divisions have decreased from approximately 214 to 190, mobilization divisions have increased from three to six. The Conventional Forces in Europe (CFE) Treaty will bring about further changes.

The **Troops of Air Defense** (VPVO) were formed in 1948 as PVO-Strany. In the early 1980s, many of the VPVO aircraft were assigned to tactical air units and air defense districts were changed. Current Soviet writings state that this reorganization, directed by Marshal Nikolai V. Ogarkov, proved to be such a serious mistake that it led to Ogarkov's dismissal as Chief of the General Staff in 1984. Following Ogarkov's ouster, the Troops of Air Defense were returned, in general, to the organization that existed in the 1970s.

While the number of aircraft in the VPVO is being reduced, approximately one-fourth of the inventory is now fourth-generation. Approximately a quarter of SAM launchers consists of SA-10s, able to engage several targets simultaneously. Some launch units have phased-array acquisition and guidance radars, which provide a cruise missile detection capability.

Moscow's antimissile defenses (PRO) have been upgraded to a two-layered system. Work continues to improve antisatellite defenses (PKO), operational since 1971. Research is being conducted on high-energy laser, particle beam, and kinetic energy technologies.

The **Soviet Air Forces** are divided into three major elements: Strategic Air Armies of the Supreme High Command (VGK), Air Forces of the Military Districts and Groups of Forces, and Military Transport Aviation (VTA).

The Soviets refer to these elements as long-range (strategic), frontal (tactical), and military transport aviation. Long-range aviation and military transport aviation both have a commander; frontal aviation does not.

Although there have been some reductions in numbers, the air armies of the VGK continue to modernize. MiG-21s and -23s are being replaced by the Su-27 "Flanker" and late-model MiG-23 "Flogger." Tu-26 "Backfire" production remains constant, with a lower production for the "Bear-H." The Tu-160 "Blackjack" is in an operational unit, although production remains low.

Frontal aviation is being modernized and numbers of aircraft reduced, with older aircraft placed in storage or assigned to training units. There has been little reduction in capability. To keep within arms-control limitations, approximately 300 aircraft from frontal aviation have been transferred to naval aviation, which is excluded from treaty limitations. "Army aviation," which consists of helicopters, should be updated in 1991 with the introduction of two new attack helicopters, the "Havoc" and the "Hokum." ("Army aviation" in the Soviet Armed Forces is not the same as "Army Aviation" in the United States.)

Military Transport Aviation has reduced its number of aircraft while increasing its total lift capability. This is the result of replacing the ancient, prop An-12 "Cub" aircraft with the Il-76 "Candid." Almost all of the new An-124 "Condor" transport aircraft have been assigned to the VTA. These larger aircraft have been used extensively to fly airborne and MVD troops to trouble spots in the Soviet Union to assist local troops in maintaining order. Aeroflot, the Soviet airline, serves as a reserve of VTA.

The **Soviet Navy** gives first priority to submarines, which carry approximately a third of the Soviet nuclear warheads, and to aircraft, which previously were for bombing and reconnaissance. As noted above, Naval aviation now has fighter-bomber aircraft, recently transferred from frontal aviation. The new 65,000 displacement-ton carrier, *Admiral Kuznetsov* (formerly *Tbilisi*), capable of carrying high-performance aircraft such as the Flanker and "Fulcrum," may be followed by two larger carriers now under construction. While the number of surface ships has been reduced somewhat, the actual combat capability of the surface fleet has not been affected.

To meet the requirements of the CFE Treaty, the Soviet Union is destroying some of its older military equipment while moving the more modern equipment east of the Urals. Further reductions in tanks and artillery still will be required. A START Treaty would result in significant reductions in strategic offensive forces, although not comparable with the reductions demanded by CFE. Soviet military leaders do not expect the restructuring currently under way to be completed before the year 2000. ■

Soviet Active Military Population, 1990

Ground Forces	1,473,000
Air Forces	320,000
Navy	394,000
Strategic Defense Forces	500,000
Strategic Attack Forces (includes Strategic Rocket Forces and strategic elements of the Air Forces and Navy)	376,000
Command/General support	925,000
Total	**3,988,000[1]**

[1]Further reductions are planned.

Virtually the entire Soviet male population serves in the Armed Forces at one time or another. Most are called to active duty at age eighteen. Two years later (three years later for sailors), they are "discharged into the reserves." Reforms now under way may change this. They remain in the reserves, subject to call-up at any time, until they reach age fifty. Citizens receiving reserve commissions may spend their entire careers as part-time reservists, or they may be called to a period of active duty, particularly if they possess critical skills. The maintenance of a large reserve is the basic element of the Soviet military mobilization plan.

Although the Border Guards of the KGB and Internal Troops of the MVD are no longer officially parts of the Soviet Armed Forces, they continue to work closely together.

Significant Military Deployments Outside the Soviet Union, 1990

There are an estimated 2,800 Soviet advisors and technicians in Cuba. Cuba itself has significant deployments of its own forces to other Third World countries.

Eastern Europe	510,000
Mongolia	37,000
Latin America (including Cuba)	7,500+
Middle East and North Africa	6,000–7,000
Asia (including Vietnam)[1]	4,000–4,500
Sub-Saharan Africa	4,000+
India	400+
Afghanistan	less than 200

[1]Estimate does not include transient Soviet naval presence.

USSR and US Aircraft Production[1]

	1987		1988		1989	
Equipment Type	**USSR**	**US**	**USSR**	**US**	**USSR**	**US**
Bombers	45	52	45	22	40	0
Fighters/fighter-bombers	700	550	700	550	625	470
Antisubmarine warfare fixed-wing aircraft	5	10	5	5	5	10
Military helicopters	450	360	400	340	400	280
AWACS	5	10	5	5	5	2

[1]Total military production, including exports.

USSR and US Missile Production[1]

	1987		1988		1989	
Equipment Type	**USSR**	**US**	**USSR**	**US**	**USSR**	**US**
ICBMs	125	24	150	12	140	9
SLBMs	100	0	100	0	100	21
SRBMs	750	0	650	0	700	0
Long-range SLCMs[2]	200	170	200	260	200	420
Short-range SLCMs[2]	1,100	570	1,100	380	1,100	180

[1]Total military production, including exports.
[2]SLCMs divided at 600 kilometers.

USSR and US Naval Ship Production[1]

Equipment Type	1987		1988		1989	
	USSR	US	USSR	US	USSR	US
Ballistic missile submarines	2	0	1	1	2	1
Attack submarines	7	2	7	3	7	5
Other submarines	0	0	1	0	0	0
Aircraft carriers	0	0	0	0	1	0
Cruisers	0	4	1	3	1	3
Destroyers	3	0	3	0	3	0
Frigates and corvettes[2]	5	2	5	0	7	1

[1]Total military production, including exports.
[2]Includes paramilitary ships.

Lineup of Soviet Military Power, 1990

Strategic Nuclear Missiles

1,373* (approx.)—Intercontinental ballistic missiles (ICBM). SS-11: 350. SS-13: 60. SS-17: 75 (with 300 warheads). SS-18: 308 (with 3,080 warheads). SS-19: 300 (with 1,800 warheads). SS-24 (Mod 1): 20 (with 200 warheads). SS-24 (Mod 2): 40 (with 400 warheads). SS-25: 220 (with 220 warheads).

**The total ICBM figure does not include ICBMs held in reserve for flight testing.*

924—Submarine-launched ballistic missiles (SLBM). SS-N-6: 192. SS-N-8: 280. SS-N-17: 12. SS-N-18: 224. SS-N-20: 120. SS-N-23: 96.

Air Defense

2,160—Interceptors. MiG-23 Flogger: 900. MiG-25 Foxbat: 350. Su-15 Flagon: 400. Su-27 Flanker: 170. MiG-31 Foxhound: 300. MiG-21 Fishbed: 40.

6,750—Strategic surface-to-air missile (SAM) launchers. SA-2: 2,200. SA-3: 950. SA-5: 1,900. SA-10: 1,700.

4,720—Tactical SAM launchers. SA-4: 1,300. SA-6: 800. SA-8: 825. SA-9: 425. SA-11: 325. SA-12A: 70. SA-13: 825. SA-15: 20. SA-19: 130.

10—Airborne warning and control aircraft. Il-76 Mainstay: 10.

100—Antiballistic missile launchers. ABM-1B Galosh. (The ABM system is being upgraded to the maximum total of launchers allowed by the ABM Treaty.)

9,000*—Warning systems. These include early warning and ground control intercept radars.

**Most recent figure available, 1989.*

Air Forces

155—Long-range strategic bombers. Tu-95 Bear: 140. Tu-160 Blackjack: 15.

395—Medium-range bombers. Tu-22M Backfire: 195 (excludes Backfires with Soviet Naval Aviation). Tu-16 Badger: 80. Tu-22 Blinder: 120.

1,395—Tactical counterair interceptors. MiG-21 Fishbed: 110. MiG-23 Flogger: 495. MiG-29 Fulcrum: 650. Su-27 Flanker: 140.

2,550—Ground attack aircraft. MiG-27 Flogger: 805. Su-17 Fitter: 575. Su-24 Fencer: 840. Su-25 Frogfoot: 330.

75—Tanker aircraft. M-4 Bison: 40. Tu-16 Badger: 10. Il-78 Midas: 25.

590—Tactical reconnaissance and electronic countermeasures aircraft. MiG-21 Fishbed: 10. MiG-25 Foxbat: 185. Su-17 Fitter: 110. Su-24 Fencer: 235. Yak-28 Brewer: 50.

182—Strategic reconnaissance and ECM aircraft. Tu-16 Badger: 130. Tu-22 Blinder: 30. Il-20 Coot: 22.

3,000—Transport, liaison, and support helicopters.

1,800—Training aircraft. Includes 900 fixed-wing, of which perhaps 800 are combat capable, and 900 rotary-wing aircraft.

669—Military air transports assigned to Military Transport Aviation (VTA). An-22 Cock: 55. An-12 Cub: 150. Il-76 Candid: 435. An-124 Condor: 29.

1,465—Transports in other elements of the armed forces. An-12 Cub: 325. Others: 1,140.

1,700—Civil aviation aircraft (Aeroflot). An-12 Cub: 150. Il-76 Candid: 75. Other medium- and long-range transports: 1,475.

Ground Forces

48,000—Main battle tanks. T-54/-55: 16,000. T-62: 9,000. T-64: 8,000. T-72: 11,000. T-80: 4,000.

1,450—Surface-to-surface missiles. FROG-3/-5/-7: 550. SS-21 Scarab: 250. SS-1 Scud B: 650.

47,775—Artillery pieces, mortars, and multiple rocket launchers. Artillery pieces: 30,560. Mortars: 10,115. MRLs: 7,100. (Total does not include more than 4,000 antitank artillery pieces.)

55,500—Infantry fighting vehicles and armored personnel carriers.

3,815—Combat and support helicopters.* Mi-2 Hoplite: 550. Mi-4 Hound: 15. Mi-6 Hook: 450. Mi-8 Hip: 1,340. Mi-24 Hind: 1,400. Mi-26 Halo: 50. Mi-10 Harke: 10. Mi-28 Havoc and Hokum are still in development.

**Total includes 1,580 Hip-E/H and Hind-D and -E gunship helicopters. Figures include only assets subordinate to Army Aviation.*

Naval Forces

61—Ballistic missile submarines. Delta: 42. Yankee: 13. Typhoon: 6.

117—Nuclear-powered general-purpose submarines. Cruise missile attack: 44. Attack: 73.

127—Diesel- and electric-powered general-purpose submarines. Cruise missile attack: 15. Attack: 108. Training: 4.

18—Other submarines. Includes both nuclear-powered and nonnuclear-powered boats.

4—Guided missile V/STOL aircraft carriers (*Kiev* class).

2—Guided missile aviation cruisers (*Moskva* class).

31—Cruisers. *Kirov*-class nuclear-powered guided missile: 3. Guided missile: 28.

41—Destroyers. Includes 38 guided missile destroyers.

181—Frigates and corvettes. Includes 32 *Krivak*-class guided missile frigates.

885—Small surface-ship combatants. Patrol: 140. Coastal patrol and river/roadstead: 404. Mine warfare: 341.

121—Amphibious warfare ships and craft.

89—Major auxiliary ships. Material support: 62. Underway replenishment: 27.

Naval Aviation

255—Strike and bomber aircraft. Tu-22M Backfire: 125. Tu-16 Badger: 110. Tu-22 Blinder: 20.

150—Fighter and fighter-bomber aircraft. Su-17 Fitter: 70. Yak-38 Forger-A: 80.

40—Tankers (Tu-16 Badger).

140—Reconnaissance and electronic warfare aircraft. Tu-16 Badger: 105. Tu-95 Bear-D: 20. Tu-22 Blinder: 5. Su-24 Fencer-E: 10.

470—Antisubmarine aircraft. Tu-142 Bear-F: 55. Mi-14 Haze-A: 95. Ka-27 Helix: 95. Ka-25 Hormone-A: 90. M-12 Mail: 90. Il-38 May: 45.

455—Transport, miscellaneous, and training aircraft.

Totals for air defense interceptors, strategic bombers, and tactical aircraft include aircraft in operational units only.

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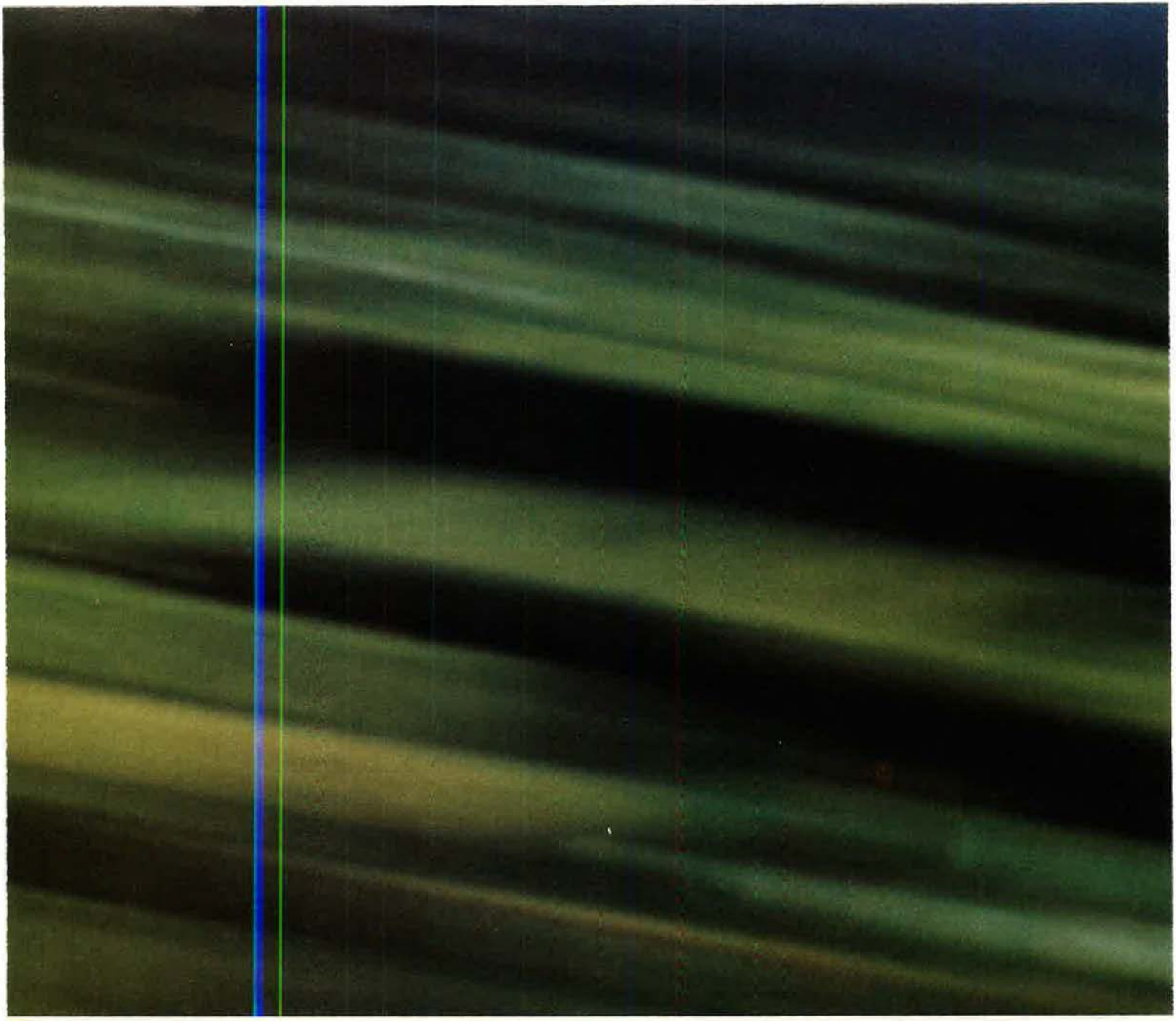

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The ALQ-184 jamming pod is being deployed on U.S. Air Force F-4s and F-16s.

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Where quality starts with fundamentals

Gallery of Soviet Aerospace Weapons

By John W. R. Taylor

Bombers and Maritime

Beriev A-40 Albatross

This elegant sweptwing amphibian was first spotted on photographs taken by a US reconnaissance satellite passing over the Beriev OKB facilities at Taganrog, in the northeast corner of the Sea of Azov. In the spring of 1988, Rear Adm. William O. Studeman, US director of naval intelligence, referred to it as a possible ASW/surveillance/minelaying aircraft with the provisional Western designation Tag-D. The prototype made an unexpected first public appearance in the Aviation Day flypast at Tushino Airport, Moscow, on August 20, 1989. The commentator described it as an aircraft for search and rescue, with the Soviet designation A-40 Albatross. It was credited to a design team led by A. Konstantinov.

A feature in *Red Star* stated that the A-40 will be confined to SAR missions near the coast and that the next task confronting its designers is to produce a similar aircraft capable of operating anywhere in the Pacific. Equipment was said to include extensive radio, radar, electro-optical sensors, and searchlights to detect shipwreck survivors by day or night. A rescue team with power boats, life rafts, and other specialized equipment can be carried, and there is room for up to 60 survivors, who enter the aircraft via hatches in the side of the hull with the aid of mechanized ramps. On-board equipment to combat hypothermia is available, together with resuscitation and surgical equipment and medicines. Loss of life in accidents to Soviet nuclear submarines at sea has emphasized the value of aircraft of this type.

A 20 ft stores bay in the bottom of the hull aft of the step, the large nose radar, unidentified dielectric hemispheres at the rear of the large pods that house the main landing gear under the wingroots, cylindrical containers (possibly ESM) above the wingtip floats, an in-flight refueling noseprobe, and other features indicate that Admiral Studeman's role assessment could also be correct. The 1990 edition of DoD's *Soviet Military Power* states that "the Soviets are still modernizing their fixed-wing ASW force and are on the verge of deploying a jet amphibian (the largest ever built) for this mission."

Power Plant: two Soloviev D-30KPV turbofans, each 26,455 lb st, on pylons above rear of hull.
Dimensions: span 137 ft, length excl noseprobe 141 ft, depth of hull forward of wing 13 ft 2 in.

Beriev M-12 Tchaika (NATO "Mail")

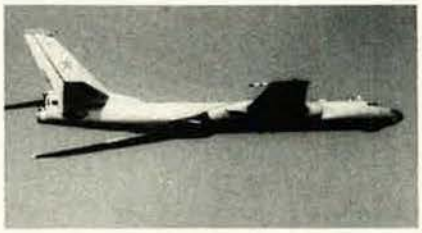
About 75 of an estimated 100 M-12 twin-turboprop amphibians, built from 1964, are in service for overwater surveillance and antisubmarine duties within a 230-mile radius of shore bases of the Soviet Northern and Black Sea Fleets.

Power Plant: two Ivchenko AI-20M turboprops; each 4,190 ehp. Internal fuel capacity approx. 2,905 gallons.
Dimensions: span 97 ft 5¾ in, length 99 ft 0 in, height 22 ft 11½ in, wing area 1,130 sq ft.
Weight: gross 68,345 lb.
Performance: max speed 378 mph, service ceiling 37,000 ft, max range 4,660 miles.
Accommodation: crew of five.
Armament and Operational Equipment: torpedoes, depth charges, mines, and other stores for maritime search and attack carried in internal bay aft of step in bottom of hull and on four pylons under outer wings. Radar in nose "thimble"; MAD (magnetic anomaly detection) tail-sting.

Ilyushin Il-38 (NATO "May")

The airframe of this intermediate-range shore-based antisubmarine/maritime patrol aircraft was developed from that of the Il-18 airliner in the same way that the US Navy's P-3 Orion was based on the Lockheed Electra. Standard equipment includes a large radome under the forward fuselage and a MAD tail-sting, with two internal weapons/stores bays forward and aft of the wing carry-through structure.

Beriev A-40 Albatross (TASS)



Tupolev Tu-16N (NATO "Badger-A") (Swedish Air Force via FlygvapenNytt)

Tupolev Tu-16R (NATO "Badger-D")

Il-38s of the Soviet Naval Air Force are encountered frequently over the Baltic and North Atlantic. A Soviet Treaty of Friendship and Cooperation, signed with Yemen in October 1979, permits patrols over the Red Sea, Gulf of Aden, Arabian Sea, and Indian Ocean from a base in that country. Periodically, deployments have been made to Libya and Syria. About 59 Il-38s are in service with Soviet naval units. Others equip No. 315 Squadron of the Indian Navy, based at Dabolim, Goa.

Power Plant: four Ivchenko AI-20M turboprops; each 4,250 ehp. Fuel capacity 7,925 gallons.
Dimensions: span 122 ft 9¼ in, length 129 ft 10 in, height 33 ft 4 in.
Weights: empty 79,367 lb, gross 140,000 lb.
Performance: max speed 448 mph at 21,000 ft, max range 4,473 miles, patrol endurance 12 hr.
Accommodation: crew of twelve.
Armament and Operational Equipment: variety of attack weapons and sonobuoys in weapons bays.

Tupolev Tu-16 (NATO "Badger")

Thirty-nine years after the first flight of the prototype of this medium bomber, about 70 Tu-16s are estimated to remain operational in the strike role, mostly with the Smolensk and Irkutsk air armies. Replacement with Tu-22M Backfires has been under way since the mid-1970s, and some of the redundant bombers have been modified to serve with the force of 20 Tu-16 in-flight refueling tankers and 135 Tu-16s equipped for reconnaissance and ECM missions in support of the attack units, there being no variant of Backfire configured for such tasks. Soviet Naval Aviation still has around 100 Tu-16 attack aircraft, plus 70 tankers and up to 80 reconnaissance and ECM variants. The attack aircraft carry antiship cruise missiles with standoff ranges varying from 55 to more than 185 km and are often supplemented by air army Tu-16s in naval exercises. A further 175 former air army and Naval Aviation Tu-16s are in storage.

Current versions of the Tu-16 are as follows:

Tu-16A (Badger-A). Basic strategic jet bomber, able to carry nuclear or conventional free-fall weapons. Glazed nose with small undernose radome. Armed with seven 23 mm guns. Some equipped as in-flight refueling tankers **(Tu-16N)** using a unique wingtip-to-wingtip transfer technique to refuel other Badgers or a probe-and-drogue system to refuel "Blinders." About 120 operational with Chinese Air Force and Navy (still being built in China as Xian H-6).

Tu-16K-10 (Badger-C). Antishipping version, first shown in 1961 Aviation Day flypast. AS-2 ("Kipper") winged missile carried in recess under fuselage (Badger-C Mod carries AS-6 "Kingfish" missiles under wings). Wide nose radome, in place of glazing and nose gun of Badger-A. No provision for free-fall bombs. Operational with Soviet Northern, Baltic, Black Sea, and Pacific Fleets.

Tu-16R (Badger-D). Maritime/electronic reconnaissance version. Nose like that of Badger-C. Larger undernose radome. Three radomes in tandem under weapons bay.

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

Tu-16R (Badger-F). Basically similar to Badger-E, but with electronic intelligence pod on pylon under each wing. Late versions have various radomes under centerfuselage.

Tu-16 (Badger-G). Converted from Badger-B. Generally similar to Badger-A, but with underwing pylons for two AS-5 ("Kelt") rocket-powered air-to-surface missiles that can be carried to a range greater than 2,000 miles. Free-fall bombing capability retained. Majority serve with antishipping squadrons of the Soviet Naval Air Force. Some passed on to Iraq.

A Soviet Navy Tu-16, probably a Badger-G, has been illustrated with an ECM nose thimble of the kind seen beneath the in-flight refueling probe of "Bear-G." It can be assumed that it also carries further pods like those of Bear-G on its center or rear fuselage.

Tu-16K (Badger-G modified). Specially equipped to carry AS-6 (Kingfish) air-to-surface missile under each wing. Large radome, presumably associated with missile operation, under center-fuselage, replacing chin radome. Device mounted externally on glazed nose might help to ensure correct attitude of Tu-16 during missile launch. Operational with Soviet Northern, Black Sea, and Pacific Fleets.

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

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

Tu-16R (Badger-K). Electronic reconnaissance variant

with nose like Badger-A. Two teardrop radomes, inside and forward of weapons bay (closer together than on Badger-H); four small pods on centerline in front of rear radome. Chaff dispenser aft of weapons bay. *(Data for Badger-G follow.)*

Power Plant: two Mikulin RD-3M-500 turbojets; each 20,920 lb st. Internal fuel capacity 11,560 gallons.

Dimensions: span 108 ft 3 in, length 114 ft 2 in, height 34 ft 0 in, wing area 1,772.3 sq ft.

Weights: empty 82,000 lb, normal gross 165,350 lb.

Performance: max speed 652 mph at 19,700 ft, service ceiling 49,200 ft, range with 6,600 lb bomb load 4,475 miles.

Accommodation: crew of six (eight to ten in Tu-16Rs).

Armament: seven 23 mm AM-23 guns; in twin-gun turrets above front fuselage, under rear fuselage, and in tail, with single gun on starboard side of nose. Two Kingfish missiles; or up to 19,800 lb of bombs in internal weapons bay.

Tupolev Tu-22 (NATO "Blinder")

Tu-22s were the first Soviet operational bombers with supersonic dash capability. About 75 remain operational alongside Tu-16s in medium-range units of the air armies, mostly in such support roles as ECM jamming and reconnaissance. The Soviet Navy has about 30 bombers and 20 equipped for maritime reconnaissance and ECM duties, based mainly in the southern Ukraine and Estonia to protect sea approaches to the USSR. Versions identified by NATO reporting names are as follows:

Blinder-A. Original reconnaissance bomber version, first seen in 1961, with fuselage weapons bay for free-fall nuclear or conventional bombs. Limited production only. The Libyan and Iraqi air forces each have a few.

Blinder-B. Similar to Blinder-A, but equipped to carry an AS-4 (NATO "Kitchen") air-to-surface missile recessed in weapons bay. Larger radar and partially retractable flight refueling probe on nose.

Blinder-C. Maritime reconnaissance version, with six camera windows in weapons bay doors. Dielectric panels, modifications to nosecone, etc., on some aircraft indicate ECM and electronic intelligence roles. Flight refueling probe like Blinder-B.

Blinder-D. Training version. Cockpit for instructor in raised position aft of standard flight deck, with stepped-up canopy. Used by Soviet and Libyan air forces.

Power Plant: two Koliesov VD-7 turbojets in pods above rear fuselage, on each side of tailfin; each 30,900 lb st with afterburning. Lip of each intake is extended forward for takeoff, creating annular slot through which additional air is ingested.

Dimensions: span 78 ft 0 in, length 132 ft 11½ in, height 35 ft 0 in.

Weight: gross 185,000 lb.

Performance: max speed Mach 1.4 at 40,000 ft, service ceiling 60,000 ft, max unrefueled combat radius 1,490 miles.

Accommodation: crew of three, in tandem.

Armament: single 23 mm gun in radar-directed tail mounting. Other weapons as described for individual versions.

Tupolev Tu-22M (NATO "Backfire")

The designation Tu-22M, long used in the Soviet Union, seems now to be accepted in the West for this supersonic swingwing medium bomber. More than 170 are operational with the Smolensk and Irkutsk air armies, to attack deep theater targets, and Naval Aviation units of the four Soviet fleets are equipped with a total of 160 Tu-22Ms. Production continues at the rate of 30 aircraft a year. There are two operational versions:

Tu-22M-2 (Backfire-B). Initial series production version. Wing sweep variable from 20° to 65°. Slightly inclined lateral engine air intakes, with large splitter plates. Two twin-barrel guns in tail mounting. Above-nose fairing usually replaces optional in-flight refueling probe.

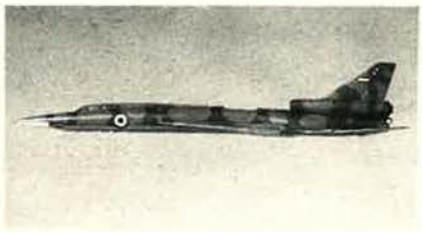
Tu-22M-3 (Backfire-C). Advanced production version with wedge-type air intakes. Upturned nosecone with small pod at tip. No visible in-flight refueling probe. Single GSh-23 twin-barrel 23 mm gun, with barrels one above the other, in aerodynamically improved tail mounting.

Backfire is capable of performing nuclear strike, conventional attack, and antiship missions, its low-level penetration features making it more survivable than earlier Soviet bombers. It is deployed primarily for operation in Europe and over the Atlantic, with about one-quarter of the force in the far east of the Soviet Union. Although Backfire has been used for development launches of new-generation cruise missiles, it is unlikely to become a designated AS-15 carrier. However, recent deployment of a new short-range attack missile with Backfire has increased significantly its weapon-carrying capability. *(Data for Backfire-B follow.)*

Power Plant: two unidentified engines, each with probable rating of more than 45,000 lb st with afterburning.

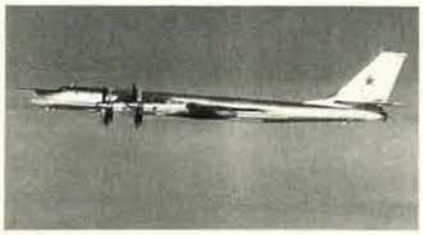
Dimensions: span 112 ft 6½ in spread, 76 ft 9¼ in swept; length 129 ft 11 in; height 35 ft 5¼ in.

Weight: gross 286,600 lb.



Tupolev Tu-22 (NATO "Blinder")

Tupolev Tu-22M-3 (NATO "Backfire-C") (TASS)



Tupolev Tu-142 (NATO "Bear-H") (UK Ministry of Defence)

Performance: max speed Mach 2.0 at high altitude, Mach 0.9 at low altitude, max unrefueled combat radius 2,485 miles.

Accommodation: crew of four, in pairs.

Armament: primary armament of two AS-4 ("Kitchen") air-to-surface missiles, carried under the fixed center-section panel of each wing, or a single Kitchen semi-recessed in the underside of the center-fuselage, and/or short-range attack missiles. Multiple racks for 12 to 18 1,100 lb bombs sometimes fitted under the air intake trunks. Alternative weapon loads include up to 26,450 lb of conventional bombs, or mines. Soviet development of decoy missiles has been reported, to supplement very advanced ECM and ECCM. Two GSh-23 twin-barrel 23 mm guns, with barrels side by side horizontally, in radar-directed tail mounting.

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

Now in their thirty-seventh year of continuous production, these remarkable propeller-driven aircraft remain a formidable spearhead of Soviet strategic nuclear attack and maritime airpower. Of 159 Bears now flying with the Soviet air armies, most are of the upgraded Bear-G or new-production Bear-H missile-carrying versions. Similarly, most of the 60 Soviet Naval Aviation Bears are of the F model, which differs so greatly from earlier versions that its designation was changed from Tu-95 to Tu-142. Details of these and other major current versions are as follows:

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

A Bear-D was the first version seen, in 1978, with a faired tailcone housing special equipment in place of the normal tail turret and associated radome. A similar tail is fitted to Bear-G.

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

Bear-F. Antisubmarine aircraft. First of the Tu-142 series of extensively redesigned Bears, with more highly cambered wings and longer fuselage forward of the wings. Deployed initially by the Soviet Naval Air Force in 1970. Reentered production in the mid-1980s. Originally, Bear-F had enlarged and lengthened fairings aft of its inboard engine nacelles, and undernose radar. The main underfuselage J-band radar housing is considerably farther forward than on Bear-D and smaller in size. There are no large blister fairings under and on the sides of the rear fuselage, and the nosewheel doors are bulged prominently, suggesting the use of larger or low-pressure tires. Bear-F has two stores bays for sonobuoys, torpedoes, and depth charges in its rear fuselage, one of them replacing the usual rear ventral gun turret and leaving the tail turret as the sole defensive gun position. The variants of Bear-F are identified as follows:

Mod 1: As original Bear-F, but reverted to standard-size nacelles. Chin-mounted J-band radar deleted. Fewer protrusions.

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

Mod 3: MAD boom added to fin tip. Fairings at tips of tailplane deleted. Rear stores bay lengthened and narrowed.

Mod 4: Chin radar reinstated. ECM thimble radome on nose, plus other fairings.

Most of approximately 55 Bear-Fs in service with the Soviet Northern and Pacific Fleets are now to Mod 3 or Mod 4 standard.

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

Bear-H. New-production version based on Tu-142 airframe, but fuselage shortened to length of Tu-95. Carries six AS-15 (NATO "Kent") long-range cruise missiles on an internal rotary launcher, with provision for two more under each wingroot. Bear-H attained initial operational capability in 1984, and more than 70 are now deployed, some in the Far East. Features include a larger and deeper radome built into the nose and a small fin-tip fairing. There are no elint blister fairings on the sides of the rear fuselage, and the ventral gun turret is deleted. Some aircraft have only a single twin-barrel gun, instead of the usual pair, in the tail turret.

Bear-J. Identified in 1986, this is the Soviet equivalent of the US Navy's E-6A and EC-130Q TACAMO aircraft,

equipped with VLF communications avionics to maintain an on-station/all-ocean link between national command authorities and nuclear missile armed submarines under most operating conditions. Large ventral pod for VLF trailing-wire antenna, several kilometers long, under center-fuselage in weapons bay area. Undernose fairing as on Bear-F Mod 4. Fin-tip pod with trailing edge as on some Bear-Hs. Satcom dome aft of flight deck canopy. Operational in comparatively small numbers with the Soviet Northern and Pacific Fleets, it appears to use a modified Tu-142 Bear-F airframe.

Duties of the Bears have included deployments to Cam Ranh in Vietnam and to staging bases in Cuba and Angola. Bears have been encountered off the US east coast during transits between Murmansk and Cuba and during elint missions from Cuba. Bear-Hs from Dolon air base in the central USSR have flown simulated attack and training missions against the US and Canada. Other Bears, including missile-armed Gs, have a theater role and conduct regular combat training exercises against naval and land targets in the northern Pacific region. The Indian Navy has eight Tu-142M Bear-Fs for maritime reconnaissance. *(Data for Bear-F follow.)*

Power Plant: four Kuznetsov NK-12MV turboprops; each 14,795 ehp. Internal fuel capacity 25,100 gallons. Equipped for in-flight refueling.

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

Weight: gross 414,470 lb.

Performance: max speed 575 mph at 25,000 ft, over-target speed 518 mph at 41,000 ft, unrefueled combat radius 5,150 miles.

Armament: as described for individual versions.

Tupolev Tu-160 (NATO "Blackjack")

About 24 Tu-160 long-range supersonic strategic bombers have been delivered to date. The first operational squadron was formed at Dolon air base in the central USSR three years ago, and a second has since been reported. It is expected that at least 100 Tu-160s will be built in a complex that has been added to the huge Kazan airframe plant, but production has slowed during the past year.

Comparison with USAF's latest strategic bomber, the B-2, is interesting. The two aircraft could hardly be more dissimilar. The subsonic, flying-wing, two-crew B-2 represents the epitome of stealth technology, to ensure optimum possibility of penetrating the world's most densely structured defenses against air attack. The supersonic, four-crew Blackjack is configured like the B-1B, its scant attention to low-observables reflecting the depletion of US air defenses. It was believed initially to be intended as a high-altitude standoff cruise missile launcher. However, the rotary launcher inside each of its two huge weapon bays can carry short-range attack missiles similar to USAF's SRAMs, as an alternative or in addition to ALCMs, for defense suppression during low-altitude penetration missions at transonic speed.

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

Tupolev Tu-160 (NATO "Blackjack") (Piotr Butowski)

Power Plant: four 55,115 lb st afterburning turbofans, identified to date only as "Type R." Provision for in-flight refueling presumed.

Dimensions: span 182 ft 9 in spread, 110 ft swept; length 177 ft; height 42 ft.

Weight: gross 606,260 lb.

Performance: max speed Mach 1.88 at high altitude, service ceiling 60,000 ft, max unrefueled combat radius 4,535 miles.

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

Armament: no guns; internal stowage for up to 36,000 lb of free-fall bombs, short-range attack missiles, or ALCMs. Each rotary launcher carries 12 AS-16 ("Kickback") SRAMs or six ALCMs, currently AS-15s ("Kents"), to be superseded by supersonic AS-19s.

MiG-21bis (NATO "Fishbed-N") (Lutz Freundt)

MiG-23ML (NATO "Flogger-G") (Lutz Freundt)

MiG-23UM (NATO "Flogger-C") (TASS)

Fighters

MiG-21 (NATO "Fishbed")

Following reequipment of the Legnica and Vinnitsa air armies and the withdrawal of MiG-21s from the Frontal Aviation inventory, few Fishbeds remain in first-line service in the Soviet tactical air forces. Early variants continue to be flown by other air forces worldwide, but versions still operated by Soviet air forces of the military districts and groups of forces (MD/GOF) are primarily as follows:

MiG-21bis (Fishbed-L). Third-generation multirole air combat fighter/ground-attack version, with R-25-300 turbojet in place of the R-11 and R-13 of earlier versions. Wider and deeper dorsal spine fairing, updated avionics, and generally improved construction standards. Internal fuel capacity increased by 79 gallons. Search range of radar (NATO "Jay Bird") 12 miles. Zero-speed, zero-altitude ejection seat.

MiG-21bis (Fishbed-N). Advanced version of Fishbed-L with further improved avionics. Rate of climb at T-O weight of 15,000 lb, with 50 percent fuel and two "Atoll" missiles, is 58,000 ft/min. Armament uprated to two radar-homing AA-2C Atolls and two "Aphids," or four Aphids. Some aircraft have nuclear capability. *(Data for MiG-21bis Fishbed-L follow.)*

Power Plant: one Tumansky R-25-300 turbojet; 16,535 lb st with afterburning. Internal fuel capacity 766 gallons. Provision for three external tanks with maximum capacity of 471 gallons and for two JATO rockets.

Dimensions: span 23 ft 5½ in, length 51 ft 8½ in, height 13 ft 5½ in, wing area 247 sq ft.

Weights: empty 11,800 lb, gross 20,940 lb.

Performance: max speed Mach 2.1 above 36,000 ft, Mach 1.06 at low altitude; design ceiling 62,300 ft; range about 700 miles on internal fuel, 1,150 miles with three external tanks.

Accommodation: pilot only.

Armament: one twin-barrel 23 mm GSh-23 gun with 200 rounds. Typical underwing loads for interception role include two AA-2/2D (K-13A) and two AA-2C air-to-air missiles; two K-13As and two UV-16-57 (sixteen 57 mm) rocket pods; two drop tanks and two missiles. Typical ground-attack loads are four UV-16-57 rocket packs; two 1,100 lb and two 550 lb bombs; or four S-24 240 mm rockets.

MiG-23 (NATO "Flogger")

Soviet production of the MiG-23 ended in the mid-1980s, and replacement of early-model MiG-23MF (Flogger-B) air combat fighters with MiG-29s and Su-27s continues. Late-generation Floggers still serve with the Legnica and Vinnitsa air armies and remain a major component of Frontal Aviation and APVO home defense interceptor units. They are expected to serve through the mid-1990s and are flown by at least 17 other air forces. Current variants identified by unclassified NATO reporting names are as follows:

MiG-23MF (Flogger-B). Single-seat air combat fighter with 27,500 lb st Tumansky R-29 turbojet. Equipment includes J-band radar (NATO "High Lark"; search range 53 miles, tracking range 34 miles) in nose, Sirena-3 radar warning system, infrared search/track pod beneath cockpit, and Doppler. Described as the first Soviet aircraft with a demonstrated ability to track and engage targets flying below its own altitude. Standard version for Soviet air forces from about 1975 and for other Warsaw Pact air forces from 1978.

MiG-23UM (Flogger-C). Tandem two-seater for both operational training and combat use, with 22,485 lb st Tumansky R-27 turbojet. Slightly raised second cockpit to rear, with retractable periscopic sight for occupant, and modified fairing aft of canopy.

MiG-23MS (Flogger-E). Export version of MiG-23M Flogger-B, with R-27 engine and equipped to lower standard. Smaller radar (NATO "Jay Bird"; search range 18 miles, tracking range 12 miles) in shorter nose radome. No infrared sensor or Doppler. Armed with "Atoll" missiles and GSh-23 gun.

MiG-23B (Flogger-F). Export counterpart of Soviet air forces' MiG-27 ground attack/interdictor. Has the nose shape, laser rangefinder, raised seat, cockpit external armor plate, and larger, low-pressure tires of Flogger-D, but retains the power plant, variable-geometry intakes, and GSh-23 twin-barrel gun of the MiG-23MF. Provision for AS-7 "Kerry" missiles.

MiG-23ML (Flogger-G). Basically similar to MiG-23MF, but with R-35F engine, rear fuselage fuel tank deleted, much smaller dorsal fin, lighter-weight radar, and, on some aircraft, an undernose sensor pod of new design.

MiG-23BN (Flogger-H). As Flogger-F, but with small fairing for radar warning receiver added on each side at bottom of fuselage, immediately forward of nosewheel doors.

MiG-23MLD (Flogger-K). Development of Flogger-G, identified by dogtooth notch at junction of wing glove leading-edge and intake trunk on each side, to generate vortices to improve stability in yaw at high angles of attack. This compensates for smaller ventral folding fin

and small dorsal fin. New IFF antenna forward of windscreen. AA-11 "Archer" close-range air-to-air missiles on fuselage pylons. Pivoting weapon pylons under outer wings.

The former total of some 1,800 Flogger-B/G/K fighters serving with the Soviet strategic air defense force and tactical air force regiments has been reduced significantly during the past year, most of the redundant aircraft being placed in storage or assigned to training schools. On all versions, wing sweep is variable manually, in flight or on the ground, to 16°, 45°, or 72°. *(Data for Flogger-G follow.)*

Power Plant: one Tumansky R-35F-300 turbojet, rated at 28,660 lb st with max afterburning. Variable-geometry air intakes and variable nozzle. Internal fuel capacity 1,519 gallons. Provision for 211 gallon external fuel tank on centerline pylon, and two more under fixed wing panels. Two additional 211 gallon tanks may be carried on nonswiveling pylons under outer wings for ferry flights, with wings at 16° sweep. Attachment for assisted takeoff rocket on each side of rear fuselage.

Dimensions: span 45 ft 10 in spread, 25 ft 6¼ in swept; length excl probe 52 ft 1¼ in; height 15 ft 9¾ in; wing area 401.5 sq ft spread, 368.1 sq ft swept.

Weights: empty 22,485 lb, max external weapons 6,615 lb, gross 32,625–39,250 lb.

Performance: max speed Mach 2.35 at height, Mach 1.15 at S/L, service ceiling 59,055 ft, combat radius 715 miles with six air-to-air missiles, 435 miles with 4,410 lb bombs.

Accommodation: pilot only.

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

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

The MiG-25 interceptor and its reconnaissance counterpart, the MiG-25R, remain the fastest combat aircraft ever put into first-line service. The airframes are manufactured primarily of arc-welded nickel steel, with titanium in areas subject to extreme heating, such as the wing leading-edges. Emphasis was placed on high-speed, high-altitude capability and, in the interceptor, a radar/missile fit that would permit attack over a considerable range. Maneuverability was less important against the original threat of high-flying supersonic bombers, and the end product is strictly a "straight and level" aircraft that even pilots of Third World air forces now fly routinely. Thirty years after the design was finalized, about 400 MiG-25s continue to equip the Soviet strategic interceptor force; a further 50 interceptors and 120 reconnaissance MiG-25s serve with the tactical air forces. Others fly in the national markings of Algeria, India, Iraq, Libya, and Syria. Six versions have been identified:

MiG-25 (Foxbat A). Basic interceptor, with large radar in nose, and four air-to-air missiles under wings. Slightly reduced wing sweep toward tips, which carry antiflutter bodies housing avionics.

MiG-25R (Foxbat-B). Reconnaissance version. Described separately in *Reconnaissance, ECM, and Early Warning Aircraft* section.

MiG-25U (Foxbat-C). Trainer with redesigned nose section, containing separate cockpit with individual canopy, forward of standard cockpit and at a lower level. No search radar or reconnaissance sensors in nose.

MiG-25R (Foxbat-D). Reconnaissance version. Described separately.

MiG-25M (Foxbat-E). New-build development of Foxbat-A with changes to radar and equipment to provide limited look-down/shoot-down capability comparable with that of "Flogger-B." Undernose IRST pod.

MiG-25BM (Foxbat-F). First illustrated in Soviet press in 1986, this "Wild Weasel" type of defense suppression aircraft carries four AS-11 (NATO "Kilter") antiradiation missiles to attack surface-to-air missile sites over long standoff ranges. Airframe generally similar to Foxbat interceptors but with dielectric panel aft of radome on each side of front fuselage. Additional small blister on each side at rear of nose radome. Dielectric panel on nose of each outboard weapon pylon. Auxiliary tank for 5,500 kg (12,125 lb) of fuel on fuselage centerline. Entered service in 1988. *(Data for Foxbat-E follow.)*

Power Plant: two Tumansky R-15BD-300 turbojets, each 24,700 lb st with afterburning. Internal fuel capacity approx 4,600 gallons. Electronically controlled variable ramps in intakes.

Dimensions: span 45 ft 9 in, length 78 ft 1¾ in, height 20 ft 0¼ in, wing area 611.7 sq ft.

Weights: basic operating 44,100 lb, gross 82,500 lb.

Performance: never-exceed combat speed, with missiles, Mach 2.83, max speed at low altitude, with missiles, Mach 0.85, service ceiling 75,400 ft, max combat radius 900 miles.

Armament: air-to-air missiles. These may comprise one infrared and one radar homing example of the AA-6 (NATO "Acrid") under each wing. Alternatively, one AA-7 ("Apex") and a pair of AA-11s ("Archer") or AA-8s ("Aphid") can be carried under each wing.

MiG-25U (NATO "Foxbat-C") (TASS)

East German MiG-29 (NATO "Fulcrum-A") (Lutz Freundt)

MiG-29 (NATO "Fulcrum-C") (Jon Lake)

MiG-29K (NATO "Fulcrum-D")

MiG-29 (NATO "Fulcrum")

Operational in its basic single-seat landbased form since early 1985, the MiG-29 is a twin-engine combat aircraft comparable in size to the US Navy's F/A-18 Hornet. Comparison of its general configuration with that of the much larger Su-27 shows that the two designs are strikingly similar in most respects; even in such detail as current tailfin location, the manner in which the mainwheels retract into the wingroots, and the use of hinged doors that shield the engine air intakes against foreign object ingestion during takeoff and landing. In the MiG, engine air is then taken in through louvers in the upper surface of the wingroot extensions. Its NO-193 pulse-Doppler look-down/shoot-down radar is supplemented by a laser rangefinder and an infrared search/track sensor in front of the windscreen. Operating in conjunction with a helmet-mounted target designator, these enable the MiG to avoid emission of detectable radar signals when approaching targets. Sustained turn rate is much improved over earlier Soviet fighters, and simulated combats have been carried out in the post-stall region. The MiG-29 will not enter a flat spin, is reluctant to enter a normal spin, and will recover as soon as the controls have been released. Its controls are hydraulically actuated.

Although operated primarily as a single-seat counter-air fighter, the MiG-29 has a full dual-role air combat/attack capability and has been displayed by the Polish Air Force with an underwing armament of four 57 mm rocket pods and two AA-11 missiles. Academician Rostislav A. Belyakov, general designer of the Mikoyan OKB, has referred to its "substantial growth potential." The full list of MiG-29 variants identified to date is as follows:

MiG-29 (Fulcrum-A). Basic landbased single-seater, seen in three models:

(1) The original single-seat production version, with two ventral tail fins similar to those of the Sukhoi Su-27.

(2) First version displayed in public, when a detachment of six from Kubinka air base made a goodwill visit to Finland on July 1, 1986. Instead of ventral fins, this variant has its dorsal fins extended forward as what appear to be simple overwing aerodynamic fences but are packed with countermeasures flares.

(3) Differs from second variant in having extended-chord rudders.

MiG-29UB (Fulcrum-B). Combat trainer with second seat in front of the normal cockpit, under a continuous canopy. Nose radar replaced by radar rangefinder. Periscope above canopy. Underwing stores pylons retained.

MiG-29 (Fulcrum-C). Generally similar to the latest variant of Fulcrum-A, but with more deeply curved top to fuselage aft of the cockpit, containing extensive equipment. This may have been transferred from inside the lower fuselage to provide room for extra fuel.

MiG-29K (Fulcrum-D). Maritime version, used for ski-jump takeoff and deck landing trials on board the Soviet Navy carrier *Tbilisi* (now *Admiral Kuznetsov*) in late 1989. Basically similar to Fulcrum-A with original short-chord rudders. Upward folding outer wing panels, with bulged tips, probably for electronic support measures equipment. Strengthened landing gear, with arrester hook. No intake FOD doors required for carrier operation, permitting deletion of overwing louvers and internal ducting in center-section, which now provides much increased integral fuel tankage. No APU airscoop on rear fuselage or flare dispenser "fences" forward of dorsal fins. Different IRST. Expected to form standard close-range air defense/attack force on *Admiral Kuznetsov* and its sister ships.

MiG-29M (FBW Fulcrum). An experimental MiG-29, with quadruplex digital fly-by-wire controls and a "glass" cockpit, with CRTs, was flown for the first time by Mikoyan chief test pilot Valery Menitsky in late 1989. Features include a different tailplane, a slightly changed wing position, and modifications to change the center of gravity. Claimed to be more comfortable to fly, with increased permissible angle of attack, better maneuverability, and improved cruise efficiency.

More than 500 MiG-29s have replaced MiG-21s, Su-15s, and some MiG-23s in Soviet units stationed in Germany, Hungary, and in the USSR west of the Urals. Deployment of other MiG-29 regiments along the Chinese border began in 1989. Deliveries have also been made to the air forces of Cuba, Czechoslovakia, the former East Germany (now flying in Luftwaffe markings), India, Iran, Iraq, North Korea, Poland, Romania, Syria, and Yugoslavia. Manufacture is centered at a factory in Moscow. *(Data for Fulcrum-A follow.)*

Power Plant: two Sargisov (Leningrad/Klimov) RD-33 turbofans, each 18,300 lb st with afterburning. Internal fuel capacity 1,153 gallons. Provision for two external tanks under wings and one under fuselage.

Dimensions: span 37 ft 3¼ in, length 56 ft 10 in, height 15 ft 6¼ in, wing area 378.9 sq ft.

Weights: empty 24,030 lb, gross 34,390–40,740 lb.

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

Accommodation: pilot only (two seats in tandem in Fulcrum-B).

Armament: six medium-range radar/IR homing AA-10 (NATO "Alamo-A/B") and/or close-range AA-11 ("Archer") air-to-air missiles on three pylons under each wing. Provision for carrying AA-9 ("Amos") and AA-8 ("Aphid") missiles. Able to carry bombs, 57 mm, 80 mm, and 240 mm rockets, and other stores in attack role. One 30 mm GSh-301 gun in port wingroot leading-edge extension.

MiG-31 (NATO "Foxhound-A")

First Soviet interceptor to offer true look-down/shoot-down and multiple-target engagement capability, the MiG-31 Foxhound-B inherits its configuration from "Foxbat" and appears to have a generally similar arc-welded nickel steel structure to speed development and production. It is, however, a very different aircraft, with a crew of two and reduced emphasis on highest attainable speed. The large pulse-Doppler radar is said to embody technology found in the Hughes AN/APG-65 digital radar of the Navy's F/A-18 Hornet; its search range is said to be 190 miles and tracking range 167 miles. Other equipment includes an infrared search/track sensor, radar warning receivers, and active infrared and electronic countermeasures. Offset tandem twin-wheel main landing gear units for operation from rough ground and gravel.

Deployment of MiG-31s with APVO air defense regiments had begun by early 1983, and more than 160 are operational, at bases from the Arkhangelsk area near the USSR's western borders to Dolinsk on Sakhalin Island, north of Japan. Production is centered at the Gorki airframe plant.

The reconnaissance Foxhound-B is listed in the *Reconnaissance, ECM, and Early Warning Aircraft* section.

Power Plant: two Tumansky turbojets; each 30,865 lb st with afterburning. Fuel capacity probably similar to MiG-25.

Dimensions: span 45 ft 11¼ in, length of fuselage (nose-cone tip to end of jetpipes) 70 ft 6½ in.

Weights: empty 48,115 lb, gross 90,725 lb.

Performance: max speed Mach 2.5 at height, combat radius 1,055 miles.

Accommodation: crew of two, in tandem.

Armament: aircraft seen to date each had four AA-9 (NATO "Amos") radar homing long-range air-to-air missiles in pairs under fuselage, and twin mounts for AA-8 ("Aphid") air-to-air missiles on one large pylon under each wing. These pylons, and outer underwing pylons not yet observed, can probably increase the number of AA-9s to eight.

Sukhoi Su-15 (NATO "Flagon")

The number of Su-15s in home defense units is believed to be less than 400, in three versions, as follows:

Flagon-E. Single-seat interceptor. R-13F-300 turbojets, each rated at 14,550 lb st. Major production version, operational since second half of 1973.

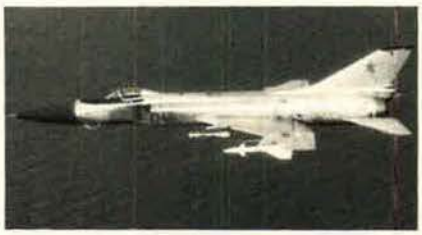
Flagon-F. Last known production version, identified by ogival nose radome instead of conical type on earlier variants. Generally similar to Flagon-E but with uprated engines.

Flagon-G. Two-seat training version of Flagon-F with probable combat capability. Individual rearward hinged canopy over each seat. Periscope above rear canopy for enhanced forward view. Overall length unchanged. *(Data for Flagon-F follow.)*

Power Plant: two afterburning turbojets, reported to be Tumansky R-13F2-300s; each 15,875 lb st.

Dimensions: span 30 ft 0 in, length 70 ft 0 in, height 16 ft 8½ in.

MiG-31 (NATO "Foxhound")



Sukhoi Su-15 (NATO "Flagon-F") (Swedish Air Force)

Sukhoi Su-27 Prototype (NATO "Flanker-A") (A. Lloyd)

Sukhoi Su-27UB (NATO "Flanker-C") (Martin Fricke)

Weights: empty 24,250 lb, gross 39,680 lb.

Performance: max speed Mach 2.1 above 36,000 ft, service ceiling 65,600 ft, combat radius 620 miles.

Accommodation: pilot only.

Armament: one radar homing and one infrared homing AA-3 air-to-air missile (NATO "Anab") on outboard underwing pylons; AA-8 infrared homing close-range missile ("Aphid") on each inboard pylon. GSh-23L 23 mm gun pods or fuel tanks on two underbelly pylons.

Sukhoi Su-27 (NATO "Flanker")

The Su-27 was designed specifically for air-to-air combat and was the first Soviet fighter to have fly-by-wire flight controls as standard. These give it outstanding agility and a very tight turning circle; but development was not easy, and two pilots lost their lives before major airframe redesign provided the production configuration. There are no ailerons. Instead, one-piece differential tailerons operate in conjunction with flaperons and rudders for pitch and roll control. Wing leading- and trailing-edge flaps are controlled manually for takeoff and landing, computer controlled in flight. No composites, but a considerable amount of titanium is used in the airframe. The current 1970s-style cockpit instruments will be superseded by CRTs in the near future. Already, the integrated fire-control system enables the track-while-scan coherent pulse-Doppler radar, IRST sensor, and laser rangefinder to be slaved to the pilot's helmet-mounted target designator and displayed on the wide-angle HUD. A range of more than 2,500 miles on internal fuel removed the need for external tanks, but an in-flight refueling capability is now under development. Refueled from an Il-78 and Su-24 buddy tanker, one test Su-27 flew nonstop 8,700 miles from Moscow to the Pacific coast of the USSR and back.

Versions identified by NATO reporting names are as follows:

Flanker-A. Prototypes, the first of which flew on May 20, 1977. Followed by many preseries aircraft, all with curved wingtips, and tail fins mounted centrally above engine housings.

Flanker-B. Single-seat landbased production version, with square wingtips carrying launchers for air-to-air missiles, tailfins located outboard of engine housings, extended tailcone, and other changes. Able to carry reconnaissance pack on centerline pylon. First flown April 20, 1981.

Flanker-B variant 2. First mentioned by Rear Adm. William O. Studeman, USN, in the spring of 1988. Basically similar to landbased Flanker-B but with movable foreplanes.

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

Flanker-D. Fully developed version of Flanker-B variant 2, for ramp-assisted operation from Soviet Navy carriers. First seen on *Admiral Kuznetsov* in 1989. Folding outer wing panels, twin-wheel nose landing gear, added arrester hook. Long tailcone of landbased version deleted, to prevent tailscrapes during takeoff and landing. Able to refuel in flight and to carry centerline buddy pack.

Also used for trials on the *Admiral Kuznetsov* is a **side-by-side two-seat version** of Flanker-D with foreplanes. The nose has been widened, with a deep fairing behind the canopy. The wing extensions are carried forward to the tip of the nose; the nosewheel leg has been moved forward and retracts rearward; no radar or IRST are fitted; the gun and wingtip missile rails are retained, but no other pylons were fitted during deck trials. This version was described officially as a deck-landing trainer, but might also be the basis for an attack aircraft.

Series production of the Su-27 is centered in a plant at Komsomolsk, Khabarovsk Territory. About 200 are in service with Soviet strategic air defense forces, including units based in the Kola Peninsula and in the far east of the USSR, as replacements for older types such as the Yak-28P, Su-15, and Tu-28P/128. Operating in conjunction with the AEW&C "Mainstay," they have been particularly active in simulated interceptions of NATO aircraft over the Barents Sea. All fighter components of the Legnica and Vinnitsa air armies are reequipping with Su-27s, which would have sufficient range to escort Su-24 "Fencer" deep-penetration strike missions. Look-down/shoot-down weapon systems and beyond-visual-range air-to-air missiles provide formidable potential against low-flying aircraft and cruise missiles. Fine-grille hinged screens in the engine air intakes guard against FOD during takeoff and landing.

A specially prepared Su-27, known as the P-42, holds 28 world records, including a climb to 12,000 m (39,370 ft) in 55.5 seconds. Some are in the FAI category for STOL aircraft. *(Data for standard Flanker-B follow.)*

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

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

Weight: gross 48,500–66,135 lb.

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

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

Yakovlev Yak-38 (NATO "Forger")

The Yak-38 remains the only operational jet combat aircraft that shares the Harrier's V/STOL capability, but it requires three engines, rather than one, to make this possible. When first observed on board the carrier/cruiser *Kiev*, in 1976, it made only vertical takeoffs. STOL takeoff became routine after perfection of an automatic control system by which the lift engines are brought into use, and the thrust-vectoring rear nozzles rotated, at the optimum point in the takeoff run. Puffer-jets at the wingtips and tail help to give the aircraft commendable stability during takeoff and landing. But payload/range capability is limited, and Western pilots might not enthuse over an electronic system that ejects the pilot automatically if aircraft height and descent rate are sensed to indicate an emergency. There are two versions, known by the following NATO reporting names:

Forger-A. Basic single-seat combat aircraft. Ranging radar in nose. Prototype was completed in 1971, and production began in 1975. Twelve appear to be operational on each of the four Soviet carrier/cruisers, in addition to Forger-Bs and about 19 Kamov Ka-25 or Ka-27 helicopters. Forger-A has also been operated from the carrier *Admiral Kuznetsov*. Primary roles are assumed to be reconnaissance, strikes against small ships, and fleet defense against shadowing maritime reconnaissance aircraft. Production was believed to total about 75 by late 1986, with limited subsequent manufacture.

Forger-B. Two-seat trainer, of which two are deployed on each carrier/cruiser. Second cockpit forward of normal cockpit, with its ejection seat at lower level, under a continuous canopy. Rear fuselage lengthened to compensate for longer nose. No ranging radar or weapon pylons. Overall length about 58 ft 0 in. *(Data for Forger-A follow.)*

Power Plant: one Tumansky R-27V-300 turbojet, without afterburner, exhausting through two vectored-thrust nozzles that can turn up to 10° forward of vertical for VTOL; 15,300 lb st. Two Koliesov/Rybinsk RD-36-35FVR liftjets in tandem aft of cockpit, inclined forward at 13° from vertical; each 6,725 lb st.
Dimensions: span 24 ft 0 in, width with wings folded 16 ft 0 in, length 50 ft 10¼ in, height 14 ft 4 in, wing area 199 sq ft.
Weights: basic operating (including pilot) 16,500 lb, gross 25,795 lb.
Performance: max speed Mach 0.95 at height, Mach 0.8 at S/L, service ceiling 39,375 ft, combat radius 115–230 miles.
Accommodation: pilot only.
Armament: four pylons under inner wings for 5,730–7,935 lb of stores, including AS-7 "Kerry" short-range air-to-surface missiles, armor-piercing antiship missiles, AA-8 "Aphid" air-to-air missiles, gun pods each containing a 23 mm twin-barrel GSh-23 cannon, rocket packs, bombs, and auxiliary fuel tanks.

Yakovlev Yak-41 (NATO "Freestyle")

The existence of this second-generation Yakovlev V/STOL fighter/attack aircraft was revealed by Rear Adm. William O. Studeman, USN, in the spring of 1988. Its general configuration was first shown in a 1989 DoD artist's impression of a Yak-41 on the deck of the Soviet Navy carrier *Admiral Kuznetsov*. In fact, this aircraft has not yet carried out ship trials, and there is no certainty that it will be based on the new class of 65,000-ton carriers.

The artist's impression was based on initial overhead satellite photography and gives no suggestion of the engine configuration. A report in a usually well-informed French aviation magazine has suggested that the Yak-41 is powered by a single vectored-thrust turbofan, designed under the leadership of Eng Khachaturov, on the lines of the Harrier's Rolls-Royce Pegasus. However, a liftjet/vectored-thrust multiengine power plant similar to that of the Yak-38 seems more likely. Evolutionary changes by comparison with the Yak-38 include a refined airframe configuration with the now conventional twin tailfins, a nose radar, and supersonic capability.

Attack Aircraft

MiG-27 (NATO "Flogger")

This single-seat variable-geometry ground attack aircraft has many airframe features in common with the MiG-23. It has the same basic power plant as the MiG-23MF, but with a two-position (on/off) afterburner nozzle and fixed engine air intakes, consistent with the primary requirement of transonic speed at low altitude. Two versions are operational:

Yakovlev Yak-38 (NATO "Forger-A") (TASS)

Sukhoi Su-17M-1 (NATO "Fitter-H")

MiG-27 (Flogger-D). Initial version, with forward portion of fuselage completely redesigned by comparison with interceptor versions of MiG-23. Instead of having an ogival radome, Flogger-D's nose is sharply tapered in side elevation, with a radar ranging antenna and a small sloping window covering a laser rangefinder. Doppler navigation radar in nose. Additional armor on flat sides of cockpit. Seat and canopy raised to improve view from cockpit. Wider, low-pressure, mainwheel tires. Six-barrel 30 mm Gatling-type underbelly gun replaces GSh-23 of interceptor. Bomb/JATO rack under each side of rear fuselage, in addition to five pylons for external stores, including tactical nuclear weapons and the air-to-surface missiles known to NATO as AS-7 "Kerry," AS-10 "Karen," AS-12 "Kegler," and AS-14 "Kedge." Bullet-shaped antenna above each glove pylon, associated with missile guidance. Radar warning receiver blister on each side of front fuselage, ahead of nosewheel bay.

MiG-27M (Flogger-J). Identified in 1981 and since delivered in successively upgraded versions. Wider and deeper nose, with lip at top over less sloping window for laser rangefinder. Blister fairing under nose, with rectangular window at front, probably provides rearward laser designation capability for laser-guided bomb delivery. Bullet-shaped antennas above wingroot glove pylons and external armor on sides of cockpit deleted. Wingroot leading-edge extensions on some aircraft. Armament includes two SPPU-22-01 gun pods on underwing pylons, with gun barrels that can be depressed for attacking ground targets.

About 830 Flogger-Ds and Js are deployed with Soviet tactical air forces (with which they operated in Afghanistan) and Naval Aviation units. The somewhat similar aircraft known to NATO as Flogger-F and H are MiG-23s. Both have been operated by Soviet units, but are basically export counterparts of the MiG-27, equipped to lower standards. *(Data for Flogger-J follow.)*

Power Plant: generally similar to MiG-23MF, but R-29B-300 engine rated at 25,350 lb st with afterburning.
Dimensions: span as MiG-23, length 56 ft 1¼ in.
Weights: max external load 9,920 lb, gross 39,900–45,635 lb.
Performance: max speed Mach 1.77 at height, Mach 1.1 at S/L, service ceiling 45,900 ft, combat radius (lo-lo-lo, with underbelly tank, four 1,100 lb bombs, and two "Atoll" missiles) 240 miles, max ferry range (3 external tanks) 1,550 miles.
Armament: described above.

Sukhoi Su-17, Su-20, and Su-22 (NATO "Fitter-C, D, E, F, G, H, J, and K")

Two years ago, more than 1,000 of these single-seat swingwing attack fighters constituted one-third of the Soviet tactical ground attack force. Many have since been put into storage, assigned to training schools, and passed to Soviet Naval Aviation to supplement the 75 Su-17s that it deployed at land bases of the Baltic Fleet for antishipping strike and amphibious support roles, with a further unit in the Pacific. Variants in Soviet service are as follows:

Su-17 (Fitter-C). Basic single-seat attack aircraft for Soviet air forces, with Lyulka AL-21F-3 turbojet. Manual wing sweep control, to 28°, 45°, and 62°. Curved dorsal fin between tail fin and dorsal spine fairing. Equipment said to include SRD-5M (NATO "High Fix") I-band centerbody ranging radar, ASP-5ND fire-control system, Sirena-3 omnidirectional radar warning system, and SRO-2M IFF. Operational since 1971 in relatively small numbers. Serves also with Soviet Navy and, as **Su-20** with reduced equipment standard, with air forces of Algeria, Czechoslovakia, Egypt, Iraq, and Poland.

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

Su-17U (Fitter-E). Tandem two-seat trainer for Soviet air forces. Generally similar to Fitter-D but without electronics pod. Deepened dorsal spine fairing, providing additional fuel tankage. Port wingroot gun deleted.

Su-17UM (Fitter-G). Two-seat trainer variant of Fitter-H, with combat capability. Deepened dorsal spine fairing and drooped front fuselage like Fitter-E. Taller vertical tail surfaces. Shallow ventral fin (removable). Starboard gun only. Laser rangefinder fitted.

SU-17M-1 (Fitter-H). Improved single-seater for Soviet air forces, with same deepened spine and tail modifications as Su-17UM. Doppler navigation radar fitted internally in deepened undersurface of nose. Retains both wingroot guns. About 165 Fitter-H/Ks are equipped for tactical reconnaissance duties, typically with a centerline sensor pod, an active ECM pod under the port wingroot, and two underwing fuel tanks.

Su-17M-3 (Fitter-H). As Su-17M-1 but with improved avionics and launcher for air-to-air missile between each pair of underwing pylons.

Su-17M-4 (Fitter-K). Single-seat version identified in 1984. Dorsal fin embodies small cooling air intake at front.

The later versions exported to Angola, Libya, Peru, Syria, Vietnam, and Yemen have a more bulged rear fuselage to house a Tumansky R-29BS-300 turbojet, with rearranged external air ducts and a shorter plain metal shroud terminating the rear fuselage. This change of power plant, together with variations in equipment standard, is covered by the following changes to the Soviet type designation:

Su-22 (Fitter-F). Export counterpart of Fitter-D with modified undernose electronics pod. Tumansky R-29B turbojet, rated at 25,350 lb st with afterburning. Gun in each wingroot. Weapons include AA-2 "Atoll" air-to-air missiles. Aircraft supplied to Peru had Sirena-2 limited-coverage radar warning receiver and virtually no navigation aids. Some basic US-supplied avionics fitted subsequently.

Su-22 (Fitter-G). Export counterpart of Su-17 Fitter-G, with R-29B engine.

Su-22 (Fitter-J). Generally similar to Fitter-H but with Tumansky engine. Internal fuel capacity 1,656 gallons. More angular dorsal fin. Atoll air-to-air missiles. Supplied to Libya and Peru.

Su-22M-4 (Fitter-K). Similar to Soviet Air Force Fitter-K, for Czechoslovakia, the former East Germany, and Poland. *(Data for Su-17M-4 Fitter-K follow.)*

Power Plant: one Lyulka AL-21F-3 turbojet, rated at 24,700 lb st with afterburning. Internal fuel capacity 1,200 gallons. Up to four 211 gallon drop-tanks under fuselage and wings.
Dimensions: span 45 ft 3 in spread, 32 ft 10 in swept; length 61 ft 6¼ in; height 16 ft 5 in; wing area 430 sq ft spread, 398 sq ft swept.
Weight: gross 42,990 lb.
Performance: max speed Mach 2.09 at height, Mach 1.14 at sea level, ceiling 49,865 ft, max range 1,430 miles at height, 870 miles at sea level.
Accommodation: pilot only.
Armament: two 30 mm NR-30 guns in wingroots; nine pylons under fuselage and wings for up to 9,370 lb of nuclear weapons, bombs, rocket pods, air-to-surface rockets, 23 mm gun pods, two AA-2 (Atoll), AA-8 ("Aphid"), or AA-11 ("Archer") air-to-air missiles, AS-7 ("Kerry"), AS-9 ("Kyle"), or AS-10 ("Karen") air-to-surface missiles, or a reconnaissance pod.

Sukhoi Su-24 (NATO "Fencer")

In accordance with the more defensive posture adopted by Soviet forces during the past year, many Fencers have been reassigned from first-line to rear-echelon units or passed to MD/GOF and Soviet Naval Aviation. The total number of Fencers remains at more than 800, of which 240 form the primary strike components of the Legnica and Vinnitsa air armies. The mission of others is tactical deep-interdiction. Some of the Naval aircraft are assigned to maritime reconnaissance with the Baltic Fleet air force. Exports include 15 supplied to Libya, more than 20 to Iraq, and 12 ordered by Syria.

Smaller and lighter than USAF's F-111, with three-position (16°, 45°, 68°) variable-geometry wings, the Su-24 entered first-line service in December 1974 as a replacement for the Yak-28 (NATO "Brewer"). Its ability to deliver a wide range of air-to-surface missiles provides defense suppression and some hard-target kill potential. A specially developed long-range navigation system and electro-optical weapon systems enable the Su-24 to penetrate hostile airspace at night or in poor weather with great precision and then deliver ordnance within 180 ft of

its target. Its already-impressive combat radius was increased in the 1980s by the addition of an in-flight refueling probe and provision for carrying buddy refueling tanks—a development which necessitated development of a similar probe for the Su-27s that escort Fencers on combat missions. Five versions may be identified by NATO reporting names:

Fencer-A. Identifiable by rectangular rear fuselage box enclosing jet nozzles.

Fencer-B. Rear fuselage box around jet nozzles has deeply dished bottom skin between nozzles. Larger brake parachute housing.

Fencer-C. Introduced in 1981. Important equipment changes. Multiple fitting on nose instead of former simple probe. Triangular fairing forward of each fixed wingroot, on side of air intake, housing RWR equipment, and also on each side of fin, near tip. Chord of lower part of tail fin extended, giving kinked leading-edge.

Fencer-D (Su-24MK). Introduced in 1983, with added in-flight refueling capability. Slightly longer nose (approx 2 ft 6 in); large overwing fences integral with extended w ngroot glove pylons optional, for AS-14 (NATO "Kedge") missiles; undernose antennas deleted; blister for laser ranger/designator added aft of nosewheel bay; and single long noseprobe.

Fencer-E. Reconnaissance variant of Fencer-D used by tactical and naval air forces. Ability to carry air-to-surface missiles retained. Units deployed include two squadrons along the Chinese border.

Fencer-F. Electronic warfare version, to replace the Brewer-E model of the Yak-28 for electronic jamming, sigint, and reconnaissance duites. *(Data for Fencer-D follow.)*

Power Plant: two Lyulka AL-21F-3A afterburning turbojets; each 24,700 lb st. Internal fuel capacity estimated at 3,435 gallons. Provision for two or four large external tanks on wing and glove pylons.

Dimensions: span 57 ft 10 in spread, 34 ft 0 in swept; length 80 ft 5¾ in; height 16 ft 3¾ in.

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

Performance: max speed Mach 2.18 at height, Mach 1.15 at S/L, service ceiling 57,400 ft, combat radius (lo-lo-lo) over 200 miles, (hi-lo-hi, with 6,615 lb weapons and two external tanks) 650 miles.

Accommodation: pilot and weapon systems officer side by side.

Armament: one six-barrel 30 mm Gatling-type gun on starboard side of belly; eight pylons under fuselage, wingroot gloves, and outer wings for 17,635 lb of guided and unguided air-to-surface weapons, including nuclear weapons, 57 mm to 370 mm rockets, up to 36 bombs 23 mm gun pods, and such missiles as AS-7 (NATO "Kerry"), AS-10 ("Karen"), AS-11 ("Kilter"), AS-12 ("Kegler"), AS-13 ("Kingbolt"), and AS-14 (Kedge).

Sukhoi Su-25 and Su-28 (NATO "Frogfoot")

The prototype of this modern counterpart of the Soviets' Ilyushin Il-2 *Shturmovik* close support aircraft of World War II flew for the first time on February 22, 1975. The pilot is protected by an all-welded cockpit of titanium armor. Pushrods rather than cables actuate the control surfaces, main load-bearing members are damage-resistant, the engines are widely separated in stainless steel bays, and the fuel tanks are filled with reticulated foam for fire protection. A total of 256 flares is packed into containers above the engine nacelles and tailcone for protection during eight attack runs. These and other survivability features account for 7.5 percent of the aircraft's normal takeoff weight. The big wings support ten pylons for a wide range of ordnance, including chemical weapons and self-protection air-to-air missiles. The accuracy of the laser guidance system is claimed to place bombs within 16 ft of a target over a standoff range of 12.5 miles. The engines will run on any fuel likely to be found in a combat area, including MT gasoline and diesel oil; and the Su-25 can ferry into a forward operating area, on its underwing pylons, a four-pod servicing kit adequate to keep it operating independently of ground equipment for 12 days.

More than 300 Su-25s have been delivered from the Tbilisi airframe plant to Soviet tactical units and the air forces of Afghanistan, Bulgaria, Czechoslovakia, Hungary, and Iraq. Some of the Soviet air force aircraft were passed to Naval Aviation units during the past year. Versions identified to date are as follows:

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

Su-25UB (Frogfoot-B). Tandem two-seat operational conversion and weapons training version. Raised rear cockpit. Taller tailfin. Gun and weapons pylons retained. With arrester hook under rear fuselage, this version has been used for deck landing training on dummy flight deck marked out on runway at Saki naval airfield and on deck of carrier *Tbilisi* (now *Admiral Kuznetsov*).

Sukhoi Su-22M-4 (NATO "Fitter-K") (Václav Jukl/Letectvi + Kosmonautika)

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

Sukhoi Su-25K (NATO "Frogfoot-A") (Lutz Freundt)

Sukhoi Su-25UB (NATO "Frogfoot-B") (Lutz Freundt)

Su-25UT (Frogfoot-B). Generally similar to Su-25UB but without weapons and arrester hook. Under consideration as advanced trainer for DOSAAF.

Su-28. Export model of Frogfoot-B. *(Data for Frogfoot-A follow.)*

Power Plant: two nonafterburning Tumansky R-195 turbojets, each 9,921 lb st. Provision for two underwing fuel tanks.

Dimensions: span 47 ft 1½ in, length 50 ft 11½ in, height 15 ft 9 in, wing area 362.75 sq ft.

Weights: empty 20,950 lb, gross 32,187–38,800 lb.

Performance: max level speed at S/L Mach 0.8, max attack speed, airbrakes open, 428 mph, service ceiling 22,965 ft, range with combat load at S/L 466 miles, at height 776 miles.

Accommodation: pilot only.

Armament: one twin-barrel 30 mm gun (3,000 rds/min) in port side of nose. Eight underwing pylons for 9,700 lb of air-to-surface weapons, including pods for 23 mm guns with twin barrels that pivot downward, 57 mm to 370 mm rockets, laser-guided missiles, and 1,100 lb incendiary, antipersonnel, and chemical cluster bombs. Two small outboard pylons for AA-2D (NATO "Atoll") or AA-8 ("Aphid") air-to-air missiles. Weapons load is to be increased to 14,100 lb.

Reconnaissance, ECM, and Early Warning Aircraft

Antonov An-12 (NATO "Cub-A, B, C, and D")

The large hold of this four-turboprop transport can accommodate a wide variety of equipment for special duties. Four variants may be identified by NATO reporting names:

Cub-A. Electronic intelligence (elint) version. Generally similar to basic Cub transport, but with blade antennas on front fuselage, aft of flight deck, and other changes.

Cub-B. Conversion of Cub transport for elint missions. Examples photographed over international waters by the crews of Norwegian and Swedish combat aircraft each had two additional radomes under the forward- and center-fuselage, plus other antennas. About 10 produced for Soviet Naval Air Force.

Cub-C. ECM variant carrying several tons of electrical generation, distribution, and control gear in the cabin, and palletized jammers for at least five wavebands faired into the belly, plus chaff/flare dispensers. Glazed nose and undernose radar of transport retained. An ogival "solid" fuselage tailcone, housing electronic equipment, is fitted in place of the usual gun position.

Cub-D. This further variant of the An-12 reflects the huge efforts being made by the Soviet Union to ensure effective handling of every conceivable ECM task. Equipment differs from that of Cub-C to perform different active countermeasures duties. About 20 Cub-C and D aircraft are believed to serve wih the Soviet Navy.

Antonov An-74 AEW&C Variant (NATO "Madcap")

A photograph taken during Mr. Gorbachev's visit to the Antonov design bureau shows, in the background, the much-modified tail of an An-74 bearing the serial number SSSR-780151. This has a large, sweptforward fin and rudder, at the top of which is mounted an AEW&C (airborne early warning and control) rotodome. It can be assumed that this aircraft bears the same relationship to the Ilyushin "Mainstay" as does the Grumman E-2C Hawkeye to the Boeing E-3 Sentry, with similar potential for export to selected customers. Production is likely to be at an early stage, with a few aircraft completed and considerable effort still required to perfect the avionics.

Ilyushin Il-20 (NATO "Coot-A")

This electronic intelligence (elint)/reconnaissance aircraft appears to be a conversion of the standard Il-18 four-turboprop transport. An underfuselage container, about 33 ft 7½ in long and 3 ft 9 in deep, is assumed to house side-looking radar. Smaller containers on each side of the forward fuselage each contain a door over a camera or other sensor. About eight antennas and blisters can be counted on the undersurface of the center- and rear-fuselage, plus two large plates projecting above the forward-fuselage.

Ilyushin Il-22 (NATO "Coot-B")

The Il-22 is another of the numerous adaptations of the basic Il-18 airframe that has been put to good use by the Soviet armed forces. All that can yet be published is that it is an airborne command post, operational in substantial numbers. It would be logical to expect a variety of external fairings and antennas, as on USAF EC-135s.

Ilyushin Il-76 AEW&C Variant
(NATO "Mainstay")

Development of this AEW&C version of the Il-76 began in the 1970s. About 25 currently operate with MiG-29, MiG-31, and Su-27 counterair fighters of the APVO home defense force and Soviet tactical air forces, mainly in the Soviet northwestern TVD centered on the Kola Peninsula. Mainstay's configuration is conventional, with a pylon-mounted rotating "saucer" radome, lengthened fuselage forward of the wings, a new IFF system, comprehensive ECM, and flight refueling probe. In *Soviet Military Power,* DoD stated that Mainstay improves substantially Soviet capabilities for early warning and air combat command and control compared with the earlier Tu-126. It provides the Soviet forces with the capability to detect and track aircraft and cruise missiles flying at low altitude over land and water and could be used to help direct fighter operations over European and Asian battlefields as well as to enhance air surveillance and defense of the USSR. Its Soviet designation is reported to be A-50.

MiG-21 (NATO "Fishbed-H")

Two versions of this single-seat fighter are operated by the Soviet air forces and their allies as specialized tactical reconnaissance aircraft:

MiG-21R (Fishbed-H). Basically similar to MiG-21-PFMA, but with a pod housing forward-facing or oblique cameras, or elint sensors, on the fuselage centerline pylon. Suppressed ECM antenna at midpoint on dorsal spine and optional radar warning receivers in wingtip fairings.

MiG-21RF. (Fishbed-H). Generally similar to MiG-21R, but based on MiG-21MF. Total of 60 Fishbed-Hs of both models estimated in service with Soviet tactical air forces.

MiG-25 (NATO "Foxbat-B and D")

Generally similar to the basic MiG-25 interceptor, the reconnaissance variants have a modified wing and carry one of a variety of camera/SLAR modules in the nose. Equipment believed to include Doppler navigation system and side-looking airborne radar (SLAR). No armament. Slightly reduced span. Wing leading-edge sweep constant from root to tip. Total of about 120 Foxbat-Bs and Ds estimated in service with the Soviet tactical air forces. Foxbat-B also operational in Algeria, India, Libya, and Syria. Two versions have been identified in service, as follows:

MiG-25R (Foxbat-B). Module that identifies this version has five camera windows and various flush dielectric panels aft of a very small dielectric nosecap for radar.

MiG-25R (Foxbat-D). Similar to Foxbat-B but reconnaissance module has larger SLAR dielectric panel, further aft on side of nose, and no cameras. Supplied also to Libya.

The MiG-25 Foxbat-F, a Wild Weasel type of defense suppression aircraft, is listed under the main MiG-25 entry in the *Fighters* section.

Dimension: span 44 ft 0 in.
Weights (Foxbat-D): basic operating 43,200 lb, normal gross 79,365 lb, max gross 90,400 lb.
Performance: max speed Mach 0.98 at low altitude, Mach 2.83 (nominal) at height, service ceiling 75,450 ft, operational radius 560 miles.

MiG-31 (NATO "Foxhound B")

This reconnaissance version of the MiG-31 has cameras and sensors in its nose, like the MiG-25R.

Mil Mi-8 (NATO "Hip-D, G, J, and K")

Versions of this medium-size helicopter adapted for various electronic duties have been allocated the following NATO reporting names:

Hip-D. For airborne communications role. Generally similar to Hip-C transport, but with canisters of rectangular section on outer stores racks and added antennas.

Hip-G. Airborne communications version. Rearward inclined antennas projecting from rear of cabin and from undersurface of tailboom, aft of box for Doppler radar.

Hip-J. Additional small boxes on sides of fuselage, fore and aft of main landing gear legs, identify this ECM version.

Hip-K. Communications-jamming ECM version with a rectangular container and array of six cruciform dipole antennas on each side of cabin. No Doppler radar box under tailboom. A Hip-K derivative, first seen in 1990, has an airframe and power plant of Mi-17 standard and a much-enhanced antenna array. Behind the main landing gear on each side is a large panel-like 32-element array, with a separate four-element array to the rear, on the tailboom. A large radome is mounted on each side of the cabin, below the jet exhaust, with a further triangular container in place of the rear cabin window. Six heat exchangers can be seen under the front fuselage.

Myasishchev M-17 (NATO "Mystic")

The Deputy General Manager of the Molniya Scientific and Industrial Enterprise has referred to a "test-bed" aircraft that was designed by the Myasishchev OKB, powered by a single nonafterburning version of the engine designed for the Tu-144 supersonic airliner. It was described as an aircraft with high aspect ratio wings, intended for flight at low subsonic speeds at extremely high altitudes. Such an aircraft had first been observed at Ramenskoye flight test center in 1982. It was assumed to be a military reconnaissance vehicle in the class of USAF's Lockheed U-2C/TR-1, and was given the NATO reporting name Mystic. Molniya has since assumed responsibility for the former Myasishchev OKB.

Two versions of the M-17 have received NATO reporting names:

Mystic-A. Known to Molniya by the name *Stratosfera,* two prototypes of this single-engine version of the M-17 have been identified. SSSR-17401 was used for a number of atmospheric research flights in 1989–90, and also set a total of 25 international class C-1 i/j records (subject to confirmation) for speed, climb, and altitude. They included a speed of 456 mph around a 500 km closed circuit, and sustained altitude of 71,785 ft. A second example (SSSR-17103) is now included in the outdoor exhibition of historic Soviet aircraft at Monino. Power plant of this version is an RD-36-51V, rated at 15,430 lb st. Its configuration is shown in the illustration above.

Antonov An-12 (NATO "Cub-C")

Ilyushin Il-20 (NATO "Coot-A")

MiG-25R (NATO "Foxbat-B") (P. R. Foster)

Myasishchev M-17 (NATO "Mystic-A") (Piotr Butowski)

Mystic-B. Known to Molniya as *Gueofizika* ("Geophysics"), this twin-engine version of the M-17 has also been publicized as an environmental research and "working" aircraft, but it has obvious military applications. The aircraft shown in early illustrations is numbered SSSR-01552, has Aeroflot insignia, and represents an early example of what is almost certainly the originally planned production M-17. Changes by comparison with Mystic-A include a lengthened and roomier nose, a raised cockpit, a small underfuselage radome forward of the nosewheels, and side-by-side jet nozzles. The engines are 1,020 lb st Solovievs of unknown type.
Dimensions: span 133 ft 6 in (A), 123 ft 4 in (B), length 69 ft 6½ in (A), 74 ft 5½ in (B), height 15 ft 9 in.
Weight: gross 44,000 lb (A, record flights).
Accommodation: pilot only.
Armament: none.

Sukhoi Su-17 (NATO "Fitter-H and K")

About 165 of the Su-17 (Fitter-H/K) fighters serving with Soviet tactical air force units are equipped for reconnaissance duties. Equipment includes, typically, an underfuselage pod containing sensors, an active ECM pod under the port wing fixed center-section, plus two external fuel tanks.

Sukhoi Su-24 (NATO "Fencer-E")

Reconnaissance/attack and electronic warfare versions of the Su-24 are listed under the main entry for this aircraft in the *Attack Aircraft* section.

Tupolev Tu-16 (NATO "Badger-D, E, F, H, J, and K")

Details of these maritime, photographic, and electronic reconnaissance versions of the Tu-16, and ECM chaff-dispensing and jamming versions, can be found under the main Tu-16 entry in the *Bombers and Maritime* section.

Tupolev Tu-22 (NATO "Blinder")

See main Tu-22 entry in *Bombers and Maritime* section.

Tupolev Tu-95 (NATO "Bear")

See main Tu-95 entry in *Bombers and Maritime* section.

Transports and Tankers

Antonov An-12BP (NATO "Cub")

Unlike its Western counterparts, the Soviet Military Transport Aviation force (VTA) uses its 600 aircraft primarily to carry equipment and cargo. The 1,600 long- and medium-range aircraft of the national airline, Aeroflot, with their crews, provide immediately available troop transport capability, as well as supplementing VTA's freight-carrying fleet. During the past decade, VTA has modernized 75 percent of its inventory, and An-12BPs have been replaced by far more efficient Il-76s. Fewer than 150 remain, mostly in units located along the southern and far eastern periphery of the USSR. Another 200 serve with the Soviet air armies and air forces of military districts and groups of forces, together with 300 short-range transports.

The medium-range An-12BP entered service 32 years ago. Its usefulness is limited by lack of an integral rear loading ramp/door. Instead, the bottom of the rear fuse-

lage is made up of two longitudinal doors that hinge upward inside the cabin to permit direct loading from trucks on the ground or airdropping of supplies and equipment. A full load of 60 paratroops can be dispatched via this exit in under one minute.

An-12s serve with ten other air forces, and developed versions are in production in China under the designation Y-8 for both transport and maritime patrol duties. The Soviet Cub-A, B, C, and D elint and ECM versions are described separately.

Power Plant: four Ivchenko AI-20K turboprops; each 3,945 ehp. Normal fuel capacity 3,672 gallons; max capacity 4,781 gallons.

Dimensions: span 124 ft 8 in, length 108 ft 7¼ in, height 34 ft 6½ in, wing area 1,310 sq ft.

Weights: empty 61,730 lb, gross 134,480 lb.

Performance: max speed 482 mph, service ceiling 33,500 ft, range 2,236 miles with max payload.

Accommodation: crew of six; 44,090 lb of freight, 90 troops or 60 parachute troops. Built-in freight handling gantry with capacity of 5,070 lb.

Armament: two 23 mm NR-23 guns in manned tail turret.

Antonov An-22 (NATO "Cock")

Until the An-124 "Condor" became available, the An-22 was the only Soviet transport aircraft capable of lifting the Soviet Army's main battle tanks and theater missile systems. The prototype flew for the first time on February 27, 1965. Production was terminated sooner than expected, in 1974, and only 45 An-22s are now available to VTA. Each has a max payload of 176,350 lb, loaded via a rear ramp.

Power Plant: four Kuznetsov NK-12MA turboprops; each 15,000 shp.

Dimensions: span 211 ft 4 in, length 190 ft 0 in, height 41 ft 1½ in, wing area 3,713 sq ft.

Weights: empty 251,325 lb, gross 551,160 lb.

Performance: max speed 460 mph, range 6,800 miles with 99,200 lb payload.

Accommodation: crew of five or six, 28–29 passengers in cabin forward of main freight hold. Four traveling gantries and two winches to speed freight handling.

Armament: none.

Antonov An-26 (NATO "Curl")

The twin-turboprop An-26 freighter was the first aircraft to embody Oleg Antonov's unique rear-loading ramp. This forms the underside of the rear fuselage when retracted, in the usual way, but can be slid forward under the rear of the cabin to facilitate direct loading on to the floor of the hold, or when the cargo is to be airdropped. Max payload is 12,125 lb; conversion of the standard freighter to carry troops or litters takes 20 to 30 minutes in the field. In addition to military models assigned to air commands in regiments and squadrons, more than 200 Aeroflot An-26s are available to the Soviet Military Transport Aviation force; others are flown by about 27 foreign air forces. Those operated by some nations, including Angola and Mozambique, have a rack on each side of the fuselage below the wing for bombing missions. A derivative known as the Y-14 is under development in China.

Power Plant: two Ivchenko AI-24VT turboprops; each 2,820 ehp. One 1,765 lb st RU 19A-300 auxiliary turbojet in starboard nacelle for turboprop starting and to provide additional power for takeoff, climb, and cruising flight, as required.

Dimensions: span 95 ft 9½ in, length 78 ft 1 in, height 28 ft 1½ in, wing area 807.1 sq ft.

Weights: empty 33,113 lb, gross 52,911 lb.

Performance: cruising speed 273 mph at 19,675 ft, service ceiling 24,600 ft, range 683 miles with max payload.

Accommodation: crew of five, plus station for load supervisor or dispatcher. Electrically powered mobile hoist, capacity 4,409 lb, and conveyor to facilitate loading and airdropping. Provision for carrying 40 paratroops or 24 litters. Improved An-26B version has rollgangs and mechanical handling system, enabling two men to load and unload three 8 ft long standard freight pallets in 30 minutes.

Armament: none on Soviet air forces' An-26s.

Antonov An-32 (NATO "Cline")

This specialized "hot and high" short/medium-range transport is being produced currently in Kiev at the rate of at least 40 a year, many for Soviet air forces service. India ordered 118, Peru has 15, some have gone to Afghanistan, and at least four other customers have been reported. The basic airframe is similar to that of the An-26, except for having triple-slotted trailing-edge flaps, automatic leading-edge slats, much-enlarged ventral fins, and a full-span slotted tailplane. Powered by two 5,112 ehp Ivchenko AI-20D Series 5 turboprops, the An-32 is able to operate from airfields 13,000 to 14,750 ft above sea level in an ambient temperature of ISA + 25°C and can transport three metric tons of freight over a 683-mile stage length, with fuel reserves. Maximum payload is specified as 14,770 lb, but an An-32 lifted 15,996 lb to 2,000 m while setting 14 official records for height, sustained height, and payload to height.

Antonov An-26 (NATO "Curl") (Lutz Freundt)

Antonov An-32 (NATO "Cline") (TASS)

Antonov An-74 (NATO "Coaler-B") (Aviation Magazine Int'l/ Jacques Marmain)

Antonov An-124 (NATO "Condor") (M. J. Hooks)

In addition to the basic transport version, the An-32 is available with equipment for a variety of duties, including fisheries surveillance, firefighting, and air ambulance complete with operating theater.

Dimensions: span 95 ft 9½ in, length 78 ft 0¼ in, height 28 ft 8½ in.

Weights: empty, equipped 38,158 lb, gross 59,525 lb.

Performance: max cruising speed 329 mph, service ceiling 30,840 ft, range with max payload 534 miles, with 12,125 lb payload 1,243 miles.

Accommodation: crew of three or four; freight, or 42 paratroops and a jumpmaster, or 24 litters and up to three medical attendants.

Armament: normally none, but Peruvian aircraft have two racks for bombs on each side of the fuselage below the wing.

Antonov An-72 and An-74 (NATO "Coaler")

The basic An-72 was conceived as a STOL replacement for the An-26 that would be able to operate from unprepared airfields or from surfaces covered with ice or snow. The high location of the engines was adopted primarily to avoid foreign object ingestion. Their efflux is ejected over the wing upper surface and then down over large multislotted flaps to provide a considerable increase in lift for short-field operation, using the so-called "Coanda effect." Two prototypes were built, of which the first flew on December 22, 1977, and received the NATO reporting name Coaler-A. Features included a Doppler-based automatic navigation system and, on the second prototype, a "slide-forward" loading ramp of the kind fitted to the An-26. These aircraft, and a preseries batch of eight, were built at Kiev. Manufacture of the production versions, with extended wing span, lengthened fuselage, and other refinements, was then transferred to a plant in Kharkov. The following variants are being produced currently, at the rate of 20 aircraft a year:

An-72A (Coaler-C). Light STOL transport for military and civil operation. Crew of three on flight deck. Conventional landing gear, with twin-wheel nose unit and two wheels in tandem on each main unit. D-36 turbofans fitted initially will be superseded eventually by 16,550 lb st Lotarev D-436s.

An-72AT (Coaler-C). Cargo-carrying version of An-72A, equipped to accommodate international standard containers.

An-72S (Coaler-C). Executive transport version, with cabin divided by bulkheads into three separate compartments. Can be adapted to carry a light vehicle, freight, 38 passengers, or eight litters.

An-74 (Coaler-B). Specialized version for operation in the Arctic and Antarctic, with flight crew of five. More advanced navigation aids including inertial navigation system, provision for wheel/ski landing gear, and greatly increased fuel. Airframe identical with that of An-72A, but with larger nose radome.

An-74A, An-74AT, and An-74S. These versions appear to be generally identical to the equivalent An-72 models, except for having the enhanced avionics and longer nose of the An-74.

In addition, an AEW&C variant is flying and has received the NATO reporting name "Madcap" (see *Reconnaissance, ECM, and Early Warning Aircraft* section).

Power Plant: two Lotarev D-36 high bypass ratio turbofans; each 14,330 lb st.

Dimensions: span 104 ft 7½ in, length (An-72) 92 ft 1¼ in, height 28 ft 4½ in, wing area 1,062 sq ft.

Weights: max payload 22,045 lb, gross 76,060 lb.

Performance (at T-O weight of 72,750 lb): max speed 438 mph, normal cruising speed at 32,800 ft 342–373 mph, ceiling 35,100 ft, takeoff run 3,050 ft, landing run 1,525 ft, range 497 miles with max payload or 2,980 miles with max fuel.

Accommodation: crew of three (normal) or five (An-74); main cabin designed primarily for freight, but (except for An-74) folding seats for 68 passengers along side walls and on removable central seats and provision for 24 casualties on litters, 12 seated, and attendant. In combi role, An-74 carries eight mission staff, plus 3,307 lb of freight in rear compartment.

Armament: none.

Antonov An-124 (NATO "Condor")

The An-124 is the Soviet counterpart to the USAF/ Lockheed C-5 Galaxy, with a slightly larger wing span and higher gross weight. The first of two prototypes flew on December 26, 1982, and 24 production aircraft had followed from the Kiev plant by early 1991. Deliveries to VTA, the Soviet Military Transport Aviation force, began during 1987, to replace the turboprop An-22. Three have been made available to Air Foyle of the UK for charter flights.

Except for having a low-mounted tailplane, the An-124's general configuration is similar to that of the C-5. It has an upward hinged visor-type nose and rear fuselage ramp/door for simultaneous front and rear loading/unloading. Advanced features include a quadruple redundant fly-by-wire control system, titanium floor throughout the main hold, and 12,125 lb of composites, making up 16,150 sq ft of its surface area and giving a weight saving of more than 4,410 lb. The 24-wheel landing gear enables the An-124 to operate from unprepared fields, hard packed snow, and ice-covered swampland. The oleos can be deflated, so that the aircraft "kneels" to facilitate front loading. Payloads range from the largest Soviet battle tanks to complete missile systems, Siberian oil well equipment, and earth movers.

In September 1990, an An-124 carried 451 Bangladeshi refugees from Amman to Dacca, as a consequence of the Gulf crisis. It had been equipped rapidly with chemical toilets, a 150 gallon drinking-water tank, and large quantities of foam rubber to line the cargo hold in lieu of seats. It was planned to evacuate a total of more than 4,500 people in ten flights over a ten-day period.

An An-124 set 21 official records by lifting a payload of 377,473 lb to a height of 35,269 ft on July 26, 1985, exceeding by 53 percent the previous record set by a C-5A. In a further dramatic demonstration of its potential, on May 6–7, 1987, an An-124 set a closed-circuit distance record by flying 12,521.2 miles nonstop around the periphery of the Soviet Union.

Power Plant: four Lotarev D-18T turbofans; each 51,590 lb st. Fuel capacity quoted as 507,063 lb.

Dimensions: span 240 ft 5¾ in, length 226 ft 8½ in, height 68 ft 2¼ in, wing area 6,760 sq ft.

Weights: nominal max payload 330,693 lb, gross 892,872 lb.

Performance: max cruising speed 537 mph, range 2,795 miles with max payload, 10,250 miles with max fuel.

Accommodation: crew of six, plus loadmaster and re-

serve crew; up to 88 passengers on fully pressurized upper deck; freight on lightly pressurized lower deck, positioned by two electric traveling cranes with total lifting capability of 44,100 lb.
Armament: none on aircraft seen to date.

Antonov An-225 Mriya

There is no evidence yet that the An-225, the world's largest airplane and the first with a gross weight exceeding one million pounds, has any planned military use. It lacks a rear door and ramp for "straight-through" loading, and will be used initially to carry Soviet space shuttle orbiters, components of the Energiya launch rocket, and similar giant loads, externally on mounts above its fuselage, as a replacement for the converted "Bison" bomber used to date. There could well be occasions when an aircraft with a maximum internal or external payload of 250 metric tons would form a useful supplement to VTA's An-124s in ferrying major military loads over long distances. It has also been claimed that the An-225 could be used as a launcher for future space plane/space fighters.

Known by its design bureau as *Mriya* ("Dream"), the An-225 was conceived as a scale-up of the An-124, with six turbofan engines instead of four, and a similar 50 percent increase in gross weight and payload. Standard An-124 wings were attached outboard of a new center-section, and the fuselage was lengthened, without altering the cross section of the freight hold. Twin tailfins were installed on the new rear fuselage, to preserve optimum control with external loads in place. Each main landing gear was given seven pairs of wheels in tandem, compared with five pairs on the An-124, to retain the latter's ability to turn on narrow runways. The rear four pairs on each side are steerable.

Despite its size, the prototype An-225 was completely unknown in the West until it was unveiled at Kiev on November 30, 1988. It made a 75-minute first flight only three weeks later, on December 21, taking off from what the TASS news agency described as "a 1,000 m [3,280 ft] runway." In service, it is intended to operate from airfields with an 11,500 ft runway. After three months of testing, the An-225 set a total of 106 records by taking off at a weight of 1,120,370 lb, with a payload of 344,576 lb, flying around a 2,000 km closed circuit in 3½ hours, and reaching a height of more than 39,000 ft en route. The first flight with the Soviet shuttle *Buran* mounted on its roof beams was made on May 13, 1989, and the An-225 was flown to the Paris Air Show in this form one month later. At that time, only the prototype had been completed. One more has been funded, and further An-225s will be built as required. Antonov's General Designer, Pyotr Balabuyev, claims that everyday cargoes could be hauled by the An-225 at a ton/mile cost 30 percent lower than that offered by the An-124. The 141 ft long cabin could accommodate sixteen large freight containers, or up to 80 Lada automobiles.
Power Plant: six Lotarev D-18T turbofans; each 51,590 lb st.
Dimensions: span 290 ft 0 in, length 275 ft 7 in, height 59 ft 4¾ in.
Weights: nominal payload 551,150 lb, gross 1,322,750 lb.
Performance: cruising speed 435–528 mph, range with 440,900 lb internal payload 2,800 miles.
Accommodation: crew of six; internal or external freight.
Armament: none on prototype.

Ilyushin Il-76 (NATO "Candid-B")

In the same class as USAF's C-141 StarLifters, 450 Il-76s constitute around 70 percent of the current VTA inventory, with deliveries continuing at the rate of 50 a year. The Ilyushin OKB was given the task of producing a replacement for the An-12BP medium-range transport, able to haul 40 metric tons of freight over a distance of 3,100 miles (5,000 km) in under six hours in the harsh operating conditions of Siberia. The prototype flew for the first time on March 25, 1971. By July 1975, Il-76s were able to set 25 official records, including a payload of more than 70 metric tons lifted to a height of 38,960 ft and a speed of 532.923 mph around a 1,000 km circuit with the same load.

Design features include rear-loading ramp/doors, full-span leading-edge slats and triple-slotted flaps for good field performance, a navigator's station in the glazed nose, with ground-mapping radar in a large undernose fairing, and a unique and complex 20-wheel landing gear. The entire accommodation is pressurized, making it possible to carry 140 troops or 125 paratroops as an alternative to freight. Advanced mechanical handling systems are fitted for containerized and other freight. Equipment for all-weather operation includes a computer for automatic flight control and automatic landing approach.

The unarmed Il-76/76T/76TD versions are known to NATO as Candid-A. Deliveries to a development squadron of military Il-76Ms (Candid-B), with rear guns and small ECM fairings, began in 1974. Current operators include the air forces of Algeria, India, Iraq, Czechoslovakia, and Poland, as well as the VTA, which can also draw on the 125 Il-76Ts and Ms of Aeroflot as necessary. Packs of ninety-six 50 mm infrared countermeasures flares can

Antonov An-225 Mriya, with orbiter Buran (J. M. G. Gradidge)

Iraqi Ilyushin Il-76M (NATO "Candid-B") (Anton Wettstein)

Myasishchev VM-T Atlant conversion of M-3 (NATO "Bison") bomber (TASS)

be carried in the landing gear fairings and/or on the sides of the rear fuselage of Soviet aircraft operating into combat areas.

The following data refer to the basic military Il-76M. Also in service is an improved version, designated Il-76MD, with an increased gross weight of 418,875 lb, max payload of 105,820 lb, and additional fuel to extend max range by 745 miles.
Power Plant: four Soloviev D-30KP turbofans; each 26,455 lb st. Fuel capacity 21,615 gallons.
Dimensions: span 165 ft 8 in, length 152 ft 10¼ in, height 48 ft 5 in, wing area 3,229.2 sq ft.
Weight: gross 374,785 lb.
Performance: cruising speed 466–497 mph at 29,500–39,350 ft, nominal range 3,100 miles with payload of 88,185 lb, max range 4,163 miles.
Accommodation: crew of seven, incl two freight handlers; up to 140 passengers.
Armament: two 23 mm twin-barrel GSh-23L guns in tail turret.

Ilyushin Il-78 Tanker (NATO "Midas")

Development of Midas began in the mid-1970s, to replace modified Myasishchev M-3 ("Bison") aircraft which have supported the "Bear/Bison" strategic attack force for many years. According to DoD's *Soviet Military Power*, the first unit of Midas tankers entered operational service during 1987; about 12 are now operational. Each Il-78 is able to refuel up to three aircraft simultaneously,

Kamov Ka-25BSh (NATO "Hormone-A")

using the probe-and-drogue technique. Two refueling pods are mounted conventionally under the outer wings. The third hose and drogue are streamed from a box-type pod on the port side of the rear fuselage. *(Data generally as for Il-76.)*

Myasishchev M-3 Tanker (NATO "Bison")

The 40 Bison strategic bombers that were modified into probe-and-drogue in-flight refueling tankers will remain in service until the Il-78 "Midas" fleet is large enough to take their place entirely. The designation M-4 has always been associated with the bombers, but Soviet sources insist that M-3 is correct for the tankers. One other retired bomber, known as VM-T *Atlant* (registered SSSR-01502), was modified to carry on its back the *Buran* space shuttle orbiter and large components of the Energiya rocket launch vehicle. This necessitated substitution of a new tail unit, with two large rectangular fin-and-rudder assemblies. Maximum payload is 40 metric tons, requiring the removal of *Buran*'s orbital maneuvering system engines, tailfin, and other components before it could be transported. *(Data for tanker follow.)*
Power Plant: four Mikulin AM-3D turbojets; each 19,180 lb st.
Dimensions: span 165 ft 7½ in, length 154 ft 10 in.
Weight: gross 350,000 lb.
Performance (as bomber): max speed 620 mph at 36,000 ft, service ceiling 45,000 ft, max unrefueled operational radius 3,480 miles.

Helicopters

Kamov Ka-25 (NATO "Hormone")

About 100 Ka-25s continue in Soviet Navy service; others are operated by India, Syria, Vietnam, and Yugoslavia. Built in 1966–75, they can be seen in three forms:

Ka-25BSh (Hormone-A). Basic shipbased ASW version, with flat-bottomed housing for undernose search radar; racks for small stores, including sonobuoys, on the starboard side of the fuselage; cylindrical canisters on each side of lower fuselage for markers, smoke generators, or beacons. Some aircraft have an underfuselage weapon bay. Most have ESM equipment in the tailboom, under a "flower pot" housing. Each of the four wheels of the landing gear can be enclosed in an inflatable pontoon. Dipping sonar is housed in a compartment at the rear of the cabin, but the Ka-25 is unable to operate with this at night or in adverse weather, through lack of automatic hover capability. Ka-25s have served on missile frigates, cruisers, the helicopter carriers *Moskva* and *Leningrad*, and carrier/cruisers of the *Kiev* class.

Hormone-B. Special electronics variant, to provide over-the-horizon target acquisition for cruise missiles carried by ships. These include SS-N-3B (NATO "Shaddock") missiles launched from *Kresta I* cruisers, SS-N-12 ("Sandbox") missiles from *Kiev*-class carrier/cruisers and *Slava*-class cruisers, SS-N-19 ("Shipwreck") missiles from the battle cruisers *Kirov* and *Frunze*, and SS-N-22 missiles from *Sovremennyy*-class destroyers. *Kiev*- and *Kirov*-class ships each carry three Hormone-Bs, the others one. Larger undernose radome with more spherical undersurface. When radar is operating, all four wheels of landing gear can be retracted upward to offer minimal interference to emissions. Cylindrical radome under rear of cabin for data link equipment. Cylindrical fuel canister on each side of lower fuselage.

Ka-25PS (Hormone-C). Similar to Hormone-A but equipped to provide midcourse guidance for long-range ship-launched surface-to-surface missiles. Yagi aerial on nose associated with guidance system. With operational equipment removed, many are used on utility and search-and-rescue missions. *(Data for Hormone-A follow.)*
Power Plant: two Glushenkov GTD-3F turboshafts; each 900 shp (later aircraft have 990 shp GTD-3BMs).
Dimensions: rotor diameter (each) 51 ft 7¾ in, length of fuselage 32 ft 0 in, height 17 ft 7½ in.
Weights: empty 10,505 lb, gross 16,535 lb.
Performance: max speed 130 mph, service ceiling 11,000 ft, range 250–405 miles.
Accommodation: crew of two on flight deck; two or three systems operators in main cabin, which is large enough to contain 12 folding seats for passengers.
Armament: two 18 in ASW torpedoes, nuclear depth charges, and other stores in underfuselage weapons bay, when installed.

Kamov Ka-27, Ka-28, and Ka-29 (NATO "Helix")

Design of the Ka-27 was started in 1969, with the aim of producing a helicopter that could be stowed in much the same space as the Ka-25 with its rotors folded, despite much greater power and capability, and that could be operated independently of ground support equipment. Titanium and composite materials are used extensively throughout the airframe, with special emphasis on resistance to corrosion at sea.

The basic ASW version of the Ka-27 was first observed on the stern platform of the Soviet guided missile destroyer *Udaloy* in 1981. DoD had already referred to what it called "Hormone variant" helicopters carried in telescoping hangars on *Sovremennyy*-class destroyers, and NATO assigned to them the reporting name Helix. In 1983, at least 16 Ka-27s were seen on board the *Kiev*-class carrier/cruiser *Novorossiysk*, since when the replacement of Hormones with Helix variants has continued. Versions identified to date are as follows:

Ka-27PL (Helix-A). Basic ASW helicopter, with probable crew of three. Equipment includes undernose 360° search radar, ventral weapons bay for torpedoes and other stores, sonobuoys, IFF, radar warning antennas on nose and above tailplane, ESM radomes above rear of power plant pylon fairing and on tailcone, flotation gear container on each side of fuselage, dipping sonar compartment in rear of fuselage, and pod for twin gyro compasses under tailboom. Normally operated in pairs; one aircraft tracks the hostile submarine, the other drops depth charges. More than 100 operational. Eighteen ordered for Indian Navy.

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

Ka-28 (Helix-A). Export version of ASW Ka-27, operational in Yugoslavia. TV3-117VK turboshafts each rated at 2,170 shp. Described as being effective against submarines cruising at up to 40 knots, at a depth of 1,640 ft, out to 124 miles from its base, by day and night.

Ka-29TB (Helix-B). Combat transport version first shown at 1989 Aviation Day display. Heavy armor on wider flight deck and engine bay. Four-barrel Gatling-type machine gun behind downward-articulated door in starboard side of nose. Four pylons on outriggers can carry four-round clusters of AT-6 (NATO "Spiral") air-to-surface missiles and 57 mm or 80 mm rocket pods. Undernose sensor pods for missile guidance and electro-optics. ESM "flower pot" above engine bay fairing, forward of IR jamming pod. Two-part upward/downward-opening cabin door for speedy exit of 16 assault troops in cabin. More than 30 in service.

Ka-29? First shown on board carrier *Admiral Kuznetsov* in August 1990. Shallow pannier extends full length of underfuselage. Added large panniers on sides, fore and aft of main landing gear. APU repositioned above rear of power plant fairing, with air intake at front. No ESM or IR jamming pods above fairing. Conical tailcone. No stores pylons. Unidentified structure at rear of fuselage pod. No apparent gun door or armor. Many more detail changes. Likely EW jamming helicopter to support seaborne assault force.

Ka-32 (Helix-C). Civil transport and flying crane versions, with folding seats for 16 passengers as alternative to mission equipment, litters, or freight. *(Data for Ka-29TB follow.)*

Power Plant: two Isotov TV3-117VK turboshafts; each 2,225 shp.
Dimensions: rotor diameter (each) 52 ft 2 in, length of fuselage 38 ft 0¾ in, height 17 ft 8½ in.
Weight: empty 12,170 lb, gross 27,775 lb.
Performance: max speed at S/L 155 mph, service ceiling 16,400 ft, range 500 miles.
Accommodation: flight crew of two, with seat for third person; up to 16 combat-ready troops as alternative to mission equipment.
Armament: see above.

Kamov Ka-29TB (NATO "Helix-B") (Jane's/Paul Beaver)

Mil Mi-6 (NATO "Hook") (Lutz Freundt)

Mil Mi-8T (NATO "Hip-C") (Lutz Freundt)

Kamov Ka-? (NATO "Hokum")

Although the combat helicopter known to NATO as Hokum has been undergoing flight testing since 1984, few facts about it are known for certain. A Soviet designation of Ka-4? has been quoted widely, but senior members of the Kamov OKB have denied the existence of a Ka-41 Hokum. This suggests that other references to an original OKB designation of Ka-136 and current Ka-34 may be nearer the mark.

Hokum's primary mission is uncertain. DoD still believes that mission to be battlefield air defense against opposing antitank helicopters and lower-performance fixed-wing, ground-attack aircraft. This would give it a unique and valuable new helicopter capability. However, the 1989 edition of *Soviet Military Power* hedged its bets by adding that "Hokum, like other army aviation elements, can be used in a variety of roles, including countering enemy attacks, preparing for and executing counter-offensives, and supporting combined-arms offensives into an opponent's territory." European observers are happier with this likely role, which is supported by the undernose Gatling-type gun and underwing rocket pods on the artist's impression, with air-to-air missiles for secondary armament. *Soviet Military Power* suggests a conventional tandem two-seat gunship configuration, with raised rear cockpit under a continuous glazed canopy.

Bearing in mind that the previous Kamov military helicopters have been produced mainly for naval use, it is possible that Hokum is also envisaged as an escort for "Helix-Bs" on the Soviet Navy's carriers. It has the usual Kamov coaxial contrarotating and widely separated three-blade rotors, with swept blade tips; a streamlined fuselage with a tapered nose like that of a jet attack aircraft, with pitot, transducer to provide data for a fire-control computer, and undernose sensor pack; and a retractable landing gear. Survivability is enhanced by use of infrared suppressors, infrared decoy dispensers, and armor. In 1990, Hokum appeared to be still under development, with only prototypes involved in flight and structural testing. DoD expects it to enter service in the near future.

Power Plant: probably two Isotov TV3-117VK turboshafts; each 2,205 shp.
Dimensions: rotor diameter 45 ft 10 in, length excl nose probe and gun 44 ft 3½ in, height 17 ft 8 in.
Weight: gross 16,500 lb.
Performance: max speed 217 mph, combat radius 155 miles.

Mil (WSK-PZL Swidnik) Mi-2
(NATO "Hoplite")

Manufacture of this smallest helicopter in the current Mil range was transferred to the WSK-PZL at Swidnik in Poland in 1964. More than 5,250 have been delivered for military and commercial service, with the air forces of Bulgaria, Czechoslovakia, the former East Germany, Hungary, Iraq, North Korea, Libya, Poland, Syria, and the Soviet Union among known operators. The USSR has received well over 2,000, and production is continuing.

Power Plant: two Polish-built Isotov GTD-350 turboshafts, each 400 shp.
Dimensions: rotor diameter 47 ft 6¾ in, length of fuselage 37 ft 4¾ in, height 12 ft 3½ in.
Weights: basic operating 5,213 lb, gross 8,157 lb.
Performance: max speed 130 mph at 1,640 ft, service ceiling 13,125 ft, range 360 miles with max fuel, 105 miles with max payload.
Accommodation: pilot on flight deck; eight passengers, 1,543 lb of freight, or four litters and medical attendant in cabin.
Armament: provision for air-to-surface rocket pod, or two "Sagger" missiles, on each side of cabin, and two 7.62 mm guns in cabin; alternatively, one 23 mm gun on port side, four 7.62 mm gun pods, and two 12.7 mm guns in cabin.

Mil Mi-6 (NATO "Hook")

When announced in the autumn of 1957, the Mi-6 was the world's largest helicopter. It was also the first Soviet production helicopter fitted with small fixed wings to offload the main rotor in cruising flight. These wings are normally removed when the aircraft operates in a flying crane role, carrying external freight. More than 860 production Mi-6s are believed to have been delivered for commercial and military service, the latter currently with the air forces of Algeria, Iraq, Peru, the Soviet Union, and Vietnam. The basic task of these helicopters is to haul guns, armor, vehicles, supplies, freight, or troops in combat areas; but some are equipped for command support roles. Replacement with Mi-26 "Halos" has been under way in the Soviet army for some years.

Power Plant: two Soloviev D-25V turboshafts; each 5,500 shp.
Dimensions: rotor diameter 114 ft 10 in, length of fuselage 108 ft 10½ in, height 32 ft 4 in.
Weights: empty 60,055 lb, gross 93,700 lb.
Performance: max speed 186 mph, service ceiling 14,750 ft, range 385 miles with 17,637 lb payload.
Accommodation: crew of five; normally, 70 combat-equipped troops, 26,450 lb of internal freight, or 41 litters and two medical attendants. Max slung cargo 17,637 lb.
Armament: some aircraft have a 12.7 mm gun in the nose.

Mil Mi-8 (NATO "Hip")

Since 1961, more than 10,000 Mi-8s and uprated Mi-17s (described separately) have been delivered from plants in Kazan and Ulan Ude for military and civil use. About 2,400 of these support Soviet armies in the field. Many others are operated by Soviet air forces, and military Mi-8s have been supplied to at least 39 other air forces. Primary combat task of the Mi-8, for which the crews are well trained, is to put down assault troops, equipment, and supplies behind enemy lines within 15–20 minutes of a nuclear or conventional bombardment/strike. Versions currently deployed are as follows:

Hip-C. Standard equipment of Soviet army support forces, carrying 24 troops or freight, loaded via rear

clamshell doors and ramp. Twin rack for stores on each side of cabin, able to carry 128 × 57 mm rockets in four packs, or other weapons. More than 1,500 in service. Some uprated to Mi-17 standard, as Mi-8T and Mi-8TB.

Hip-D. For airborne communications role; see page 71.

Hip-E. Development of Hip-C, with emphasis on weapons for escort duties. One flexibly mounted 12.7 mm machine gun in nose. Triple stores rack on each side of cabin, able to carry up to 192 rockets in six suspended packs, plus four "Swatter" antitank missiles on rails above racks. About 250 in service with Soviet ground forces. Some uprated to Mi-17 standard, as Mi-8TBK.

Hip-F. Export counterpart of Hip-E. Missile armament changed to six "Saggers."

Hip-G. For airborne communications duties; see page 71.

Hip-H. See entry on Mi-17.

Hip-J and K. ECM versions; see page 71.

Power Plant: two Isotov TV2-117A turboshafts; each 1,700 shp. Standard fuel capacity 494 gallons, max ferry capacity 977 gallons.

Dimensions: rotor diameter 69 ft 10¼ in, length of fuselage 59 ft 7¼ in, height 18 ft 6½ in.

Weights: empty 16,007 lb, gross 26,455 lb.

Performance: max speed 161 mph at 3,280 ft, service ceiling 13,050 ft, range 311 miles as passenger transport.

Accommodation: crew of two or three; up to 32 passengers, but normal military configuration is for 24 combat-equipped troops on tip-up seats along cabin side walls; 8,820 lb of freight internally, 6,614 lb externally; or 12 litters and attendant.

Armament: see individual model descriptions.

Mil Mi-14 (V-14) (NATO "Haze")

The Mi-14 shore-based amphibious helicopter flew for the first time in 1973. Overall dimensions, power plant, and dynamic components are generally similar to those of the Mi-17, reflecting parallel development from the Mi-8 airframe. New features to suit the Mi-14 for its primary role as an antisubmarine aircraft include a boat hull of the kind used on the Sikorsky Sea King, a small float attached to the tailskid, and a sponson on each side at the rear, carrying an inflatable flotation bag, to confer a degree of amphibious capability. The landing gear is fully retractable. Operational antisubmarine equipment can be seen to include a large undernose radome, a retractable sonar unit housed in the starboard rear of the planing bottom forward of what appear to be two sonobuoy or signal flare chutes, a towed magnetic anomaly detection (MAD) "bird" stowed against the rear of the fuselage pod (now in much lower position, as illustrated at right), and a Doppler radar box under the tailboom. Weapons include torpedoes and depth charges carried in a weapons bay in the bottom of the hull.

Three versions of the Mi-14 are in service:

Mi-14PL (Haze-A). Basic ASW version, with crew of four or five, as described above.

Mi-14BT (Haze-B). Mine countermeasures version, identified by fuselage strake and air-conditioning pod on starboard side of cabin and deletion of MAD. Two additional equipment boxes under the tailboom, to each side of the Doppler container. In service with Soviet, German, and Polish navies.

Mi-14PS (Haze-C). Search-and-rescue version in service in Soviet Union and Poland. Double-width sliding door at front of cabin on port side, with retractable rescue hoist. Searchlight on each side of nose.

Of at least 230 built, ten have been exported to Bulgaria, 14 to Cuba, 12 to Libya, at least five to Poland, six to Romania, eight to the former East Germany, 12 to Syria, and unknown quantities to North Korea and Yugoslavia. Production continues.

Power Plant: two Isotov TV3-117 turboshafts, each 1,950 shp.

Dimensions: rotor diameter 69 ft 10¼ in, length overall incl rotors 83 ft 0 in, height 22 ft 7¾ in.

Weight: gross 30,865 lb.

Performance: max speed 143 mph, range 575 miles.

Accommodation: crew of four or five in Haze-A.

Mil Mi-17 (NATO "Hip-H")

The Mi-17 has an airframe basically identical to that of the Mi-8, but with more powerful TV3 engines in shorter nacelles, with the intakes positioned above the midpoint of the sliding cabin door. The tail rotor is repositioned on the port side of the vertical stabilizer, and the engine air intakes are fitted with deflectors to prevent the ingestion of sand, dust, or foreign particles at unprepared landing sites. If an engine fails, the output of the other is increased automatically to 2,200 shp for sustained single-engine flight. Many are operational in the Soviet armed forces and with combat units in Central America. They have the same armament options as the Mi-8, supplemented by 23 mm GSh-23 gun packs, and with external armor plate on the cockpit sides. Export deliveries include 16 to Cuba in 1983 and others subsequently to Angola, India, Nicaragua, North Korea, Papua New Guinea, Peru, and Poland. Mi-8s can be uprated to Mi-17 standard, and many of those in Soviet service have been converted with TV3 engines and port-side tail rotor (see Mi-8 entry).

Latest version of the Mi-17, first shown at the 1989 Paris Air Show, is the Mi-17-IVA, with 2,225 shp TV3-117VM engines. Weights and performance are generally unchanged, except for greatly improved rate of climb and ceiling. *(Data for basic Mi-17 follow.)*

Power Plant: two Isotov TV3-117MT turboshafts; each 1,920 shp.

Dimensions: rotor diameter 69 ft 10¼ in, length of fuselage 60 ft 5¼ in, height 15 ft 7¼ in.

Weights: empty 15,653 lb, gross 28,660 lb.

Performance: max speed 155 mph, service ceiling 11,800 ft, max range 590 miles with auxiliary fuel.

Accommodation and Armament: as for Mi-8 Hip-E.

Mil Mi-24, Mi-25, and Mi-35 (NATO "Hind")

More than 2,300 of these formidable gunship helicopters have been delivered from plants in Arsenyev and Rostov. In addition to the Soviet armed forces, they have been supplied to Afghanistan, Algeria, Angola, Bulgaria, Cuba, Czechoslovakia, the former East Germany, Hungary, India, Iraq, Libya, Mozambique, Nicaragua, North Korea, Peru, Poland, Vietnam, and Yemen. Used operationally in Chad, Nicaragua, Sri Lanka, Angola, and Afghanistan, and in the Iran-Iraq War (where at least one Iranian F-4 Phantom fell victim to a "Spiral" antitank missile fired from a Hind), they have accumulated unrivaled combat experience. Production is reducing from a peak rate of more than 15 a month.

The fact that the Mi-24 was designed originally as a heavily armed assault transport for a squad of troops (a capability that is retained in all versions) means that it lacks the slim silhouette that is optimum for a gunship; but progressive changes to the airframe, power plant, operational equipment, and weapons, and the addition of infrared jammers, exhaust suppressors, and flare dispensers as a result of combat experience, plus increased armor, have maintained the aircraft's effectiveness through a succession of variants, as follows:

Mi-24 (Hind A, B, and C). Early versions designed as armed transports for squad of eight fully-equipped assault troops. Crew of three on large flight deck.

Mi-24D (Hind-D). First observed in 1977. Basically similar to late-model Hind-A, with TV3-117 engines and tail rotor on port side, but with front fuselage completely redesigned and heavily armored for primary gunship role, although transport capability retained. Tandem stations for weapon operator (in nose) and pilot have individual canopies, with rear seat raised to give pilot an unobstructed forward view. Air data sensor boom forward of top starboard corner of bulletproof windscreen at extreme nose. Under nose is a four-barrel Gatling-type 12.7 mm machine gun in a turret, slaved to adjacent electro-optical sight, and providing air-to-air as well as air-to-surface capability. Four hardpoints under stubwings for 32-round packs of 57 mm rockets, 20-round packs of 80 mm rockets, UPK-23 pods each containing a twin-barrel 23 mm gun, up to 3,300 lb of chemical or conventional bombs, PFM-1 mine dispensers, or other stores; four AT-2 (NATO "Swatter") antitank missiles on wingtip launchers, with RF guidance pod under nose on port side. Provisions for firing AK-47 guns from cabin windows. Many small antennas and blisters, including "Odd Rods" IFF and radar warning antennas. Infrared jammer in "flower pot" container above forward end of tailboom; decoy flare dispenser initially under tailboom, later triple racks (total of 192 flares) on sides of center-fuselage. Export models, including those for Cuba, India, and Afghanistan, are designated **Mi-25.**

Mi-24W (Hind-E). As Hind-D, but with modified wingtip launchers and four underwing pylons for a total of up to twelve AT-6 (Spiral) radio-guided, tube-launched antitank missiles in pairs, and enlarged undernose guidance pod on port side. AA-8 ("Aphid") air-to-air missiles can be carried on the underwing pylons. Export models are designated **Mi-35.**

Mi-24P (Hind-F) (Mi-24P = *pushka*, "cannon"). First shown in service with Soviet forces in 1982 photographs. Generally similar to Hind-E but nose gun turret replaced by a twin-barrel 30 mm GSh-30-2 gun on starboard side of front fuselage. Bottom of nose smoothly faired above and forward of sensors. Export models are designated **Mi-35P.**

Mi-24 (Hind-G). First identified at Chernobyl, after the accident at a nuclear power station, this version lacks the usual undernose electro-optical and RF guidance packs for antitank missiles. Instead of wingtip weapon attachments, it has "clutching hand" mechanisms, associated with NBC (nuclear/biological/chemical) warfare, on lengthened pylons. Other features include a lozenge-shaped housing with cylindrical insert under the port side of the cabin, a bubble window on the starboard side,

Mil Mi-14PL (NATO "Haze-A") (Piotr Butowski)

Mil Mi-17 (NATO "Hip-H") (Piotr Butowski)

Mil Mi-35P (NATO "Hind-F") (Peter J. Cooper)

Mil Mi-24 (NATO "Hind-G") equipped for NBC warfare (Lutz Freundt)

and a plate of triangular shape mounted in the tailskid. Small numbers of Hind-Gs are deployed individually throughout the Soviet ground forces. A second version of Hind-G has been seen, with a very large camera inside the main cabin. *(Data for Mi-24P follow.)*

Power Plant: two Isotov TV3-117 turboshafts; each 2,200 shp.

Dimensions: rotor diameter 56 ft 9 in, length excl rotors and gun 57 ft 5 in, height 21 ft 4 in.

Weights: empty, equipped 18,078 lb, gross 26,455 lb.

Performance: max speed 208 mph, service ceiling 14,750 ft, range, internal fuel 310 miles.

Accommodation: crew of two; flight mechanic, and provisions for eight troops or four litters in main cabin.

Armament: see individual model descriptions. Max external load 5,290 lb.

Mil Mi-26 (NATO "Halo")

Design of the Mi-26 heavy-lift helicopter began in the early 1970s to meet the requirement for an aircraft of greater capability than the Mi-6, for day and night operation in all weathers. Except for the four-engine twin-rotor Mi-12, which did not progress beyond prototype testing, it is the heaviest helicopter yet flown anywhere in the world. Its rotor diameter is smaller than that of the Mi-6, but this is offset by the fact that the Mi-26 is the first helicopter to operate successfully with an eight-blade main rotor. Other features include a payload and cargo hold very similar in size to those of a C-130 Hercules, loading via clamshell doors and ramp at the rear of the cabin pod, and main landing gear legs that are adjustable individually in length to facilitate loading and to permit landing on varying surfaces. The Mi-26 flew for the first time on December 14, 1977, began in-field testing and development with the Soviet air forces in early 1983, and was fully operational by 1985. More than 60 have since been built for military and civil use, and the first export deliveries, of ten for India, began in June 1986. Infrared jammers, exhaust heat suppressors, and decoy dispensers can be fitted to production aircraft. Under development is an uprated version with more powerful engines, all-composites rotor blades, and max payload of 48,500 lb.

The 1990 edition of DoD's *Soviet Military Power* states that "new variants of the 'Halo' are likely in the early 1990s to begin to replace 'Hooks' specialized for command support."

In the course of establishing five world helicopter payload-to-height records, in 1982, an Mi-26 lifted a total mass of 125,154 lb to a height of 2,000 m, including a payload of 25,000 kg (55,115 lb).

Power Plant: two Lotarev D-136 turboshafts; each 11,240 shp. Max fuel capacity 3,170 gallons.

Dimensions: rotor diameter 105 ft 0 in, length of fuselage 110 ft 8 in, height to top of main rotor head 26 ft 8¾ in.

Weights: empty 62,170 lb, gross 123,450 lb.

Performance: max speed 183 mph, service ceiling 15,100 ft, range 497 miles.

Accommodation: crew of five; about 40 tip-up seats along side walls of hold; seats can be installed for about 85 combat-equipped troops, plus four more passengers in compartment aft of flight deck. Other loads include two airborne infantry combat vehicles or a standard 44,100 lb ISO container.

Armament: none.

Mil Mi-28 (NATO "Havoc")

Because of its origins as an assault transport, the Mi-24 "Hind" offers a large target for ground fire. When designing the Mi-28, the Mil Bureau was able to begin with a clean sheet of paper and produce a two-man attack helicopter with heavy armament but altogether slimmer and less vulnerable, particularly against the threat of weapons using thermal imaging systems. The result is an aircraft truly in the class of the US Army's AH-64A Apache. The original prototype, flown for the first time on November 10, 1982, had less developed sensors and a three-blade tail rotor. The switch to a Δ_3 (delta 3) tail rotor, comprising two independent two-blade rotors set as a narrow X on the same shaft, relieves loads in flight. The agility of the Mi-28 is further enhanced by doubling the hinge offset of the main rotor blades by comparison with the Mi-24.

The general configuration is similar to that of the slightly smaller Apache. Its IFR instrumentation is conventional, with autostabilization, autohover, and hover/heading hold lock in the attack mode. Survivability has received particular attention. The fuel tanks are protected by a thick second skin of composites. All vital units and parts are redundant and widely separated. The cockpits have armored glass transparencies and are protected by titanium and composite armor. Energy-absorbing seats and landing gear are designed to protect the crew in a 40 ft/second vertical crash landing. Escape by parachute would be facilitated by a system that blasts away the doors and stubwings in an emergency, although there is no provision for main rotor separation. A door aft of the port stubwing gives access to a compartment large enough to enable the crew to land and pick up two persons in a combat rescue situation.

Mil Mi-26 (NATO "Halo") (Peter J. Cooper)

Mil Mi-28 (NATO "Havoc") (Peter J. Cooper)

The 30 mm 2A42 gun currently fitted is identical with that on many Soviet Army ground vehicles and uses the same ammunition. It is fired by the navigator/gunner in the front cockpit, together with the aircraft's guided weapons. The pilot fires only unguided weapons. Operational equipment includes a swiveling undernose turret for a daylight optical sight and laser ranger-designator, with a housing on each side for low-light-level TV and FLIR night combat systems. Radar warning, flare dispensing, and IR suppression systems will be standard on production Mi-28s, which are expected to enter service in 1991–92.

Power Plant: two Isotov TV3-117 turboshafts; each 2,205 shp. Internal fuel capacity approx 500 gallons. Provision for four underwing tanks.

Dimensions: rotor diameter 56 ft 5 in, length excl rotors 55 ft 3½ in.

Weight: gross 25,130 lb.

Performance: max speed 189 mph, service ceiling 19,000 ft, max range 292 miles.

Accommodation: crew of two, in tandem.

Armament: one 30 mm 2A42 gun in undernose turret. Four underwing pylons for 4,230 lb of stores, typically two UV-20 pods of 20 57 mm or 80 mm rockets and total of 16 AT-6 (NATO "Spiral") antitank missiles. Missile guidance equipment in thimble radome on nose.

Airborne Tactical Missiles

AS-2 (Mikoyan K-10; NATO "Kipper")

First seen at the 1961 Aviation Day display, this airplane-configuration missile, with underslung turbojet, was described by the commentator at Tushino as an anti-shipping weapon. Radar is carried in the nose of the Tu-16 carrier aircraft, and guidance is believed to be inertial, with optional command override and active radar terminal homing. A 2,200 lb high-explosive warhead is believed to be normal, although a nuclear armed version has been reported.

Dimensions: span 16 ft 0 in, length 32 ft 10 in.

Weight: 9,260 lb.

Performance: max speed Mach 1.2, range 75 miles.

AS-11 missile (NATO "Kilter") (Jane's/Nick Cook)

AS-5 (NATO "Kelt")

The transonic AS-5 has a similar airplane-type configuration to that of the turbojet-powered AS-1 ("Kennel"), which it superseded. The switch to liquid rocket propulsion eliminated the need for a ram air intake and permitted the use of a larger radar inside the hemispherical nose fairing. Guidance is said to be inertial, with radar terminal homing that can be switched from active to home-on-jam as required. A 2,200 lb high-explosive warhead is standard.

Well over 1,000 AS-5s had been delivered by the spring of 1976. A few may be operational.

Dimensions: span 15 ft 9 in, length 28 ft 2 in.

Weight: 6,615 lb.

Performance: max speed Mach 0.9 at low altitude, Mach 1.2 at 30,000 ft, range 110 miles at low altitude, 200 miles at height.

AS-7 (NATO "Kerry")

Carried by the MiG-23BN "Flogger," MiG-27 Flogger, Su-17 "Fitter," Su-24 "Fencer," and Yak-38 "Forger," this first-generation tactical air-to-surface missile is said to have a single-stage solid-propellant rocket motor, radio command guidance system, and 242 lb hollow-charge high-explosive warhead.

Dimensions: span 2 ft 11½ in, length 11 ft 6 in.

Weight: 650 lb.

Performance: max speed transonic, range 3 miles.

AS-9 (NATO "Kyle")

This is a liquid-propellant antiradiation missile, with a configuration similar to that of the much larger AS-4 "Kitchen," with passive radar homing and a 330–440 lb warhead for defense suppression. It is said to arm MiG-25, MiG-27, Su-17, Su-24, Tu-16, and Tu-22M aircraft.

Dimensions: span 6 ft 6½ in, length 19 ft 9½ in.

Weight: 1,650 lb.

Performance: max speed supersonic, range 56 miles.

AS-10 (NATO "Karen")

The laser homing Karen is a solid-propellant rocket-powered air-to-surface missile resembling "Kerry," from which it may have been developed. It carries a 220 lb high-explosive warhead and is operational on MiG-27, Su-17, Su-24, and Su-25 attack aircraft.

Dimensions: span 3 ft 2½ in, length 11 ft 6 in.

Weight: 660 lb.

Performance: max speed transonic, max range 6.2 miles.

AS-11 (NATO "Kilter")

Kilter was revealed officially in the form of an inert round, carried on a trolley beneath the fuselage of an Su-24, at the Moscow Air Show in August 1989. It is an antiradiation missile of conventional cruciform clipped-delta wing/tail fin configuration, with passive radar homing head and a solid-propellant rocket motor. A blast fragmentation warhead of about 285 lb has been estimated. Kilter forms primary armament of the "Foxbat-F" defense suppression version of the MiG-25, as well as being one of the wide range of weapons compatible with the MiG-27 and Su-24.

Dimensions: span 3 ft 11¼ in, length 14 ft 1¼ in.

Weight: estimated at 925 lb.

Performance: range approx 30 miles.

AS-12 (NATO "Kegler")

Not yet illustrated in the open press, the solid-propellant Kegler is described as a lightweight successor to the AS-9 with a different seeker and improved performance. In particular, it is believed to permit low-level launch, to improve aircraft survivability. It is carried by the Su-24, Su-25, and Tu-22M.

Dimensions: span 2 ft 11½ in, length 12 ft 7½ in.

Weight: 770 lb.

Performance: range 21 miles.

AS-13 (NATO "Kingbolt")

Nothing is known about this tactical air-to-surface missile except that it is carried by the Su-24.

AS-14 (NATO "Kedge")

This Maverick-type tactical solid-propellant air-to-surface missile is carried on the extended wingroot glove pylons of the "Fencer-D" version of the Su-24, and probably by the Su-25. When carried by the MiG-27 "Flogger," it is accompanied by an underfuselage data link pod for guidance of the AS-14, which employs laser terminal homing. The warhead could be a 551 lb GP bomb. Kedge is also carried by Iraqi Air Force Mirage F1s, together with a French Thomson-CSF Atlis designator pod.

Dimensions: span 4 ft 2½ in, length 12 ft 7 in.

Weight: 1,375 lb.

Performance: range 7.5 miles.

AT-2 (NATO "Swatter")

This standard Soviet antitank weapon forms the missile armament of the Mi-24 ("Hind-A and D") helicopter gunship and is carried by the "Hip-E" version of the Mi-8. The solid-propellant Swatter-A/B employs semiauto-

matic command to line-of-sight (SACLOS) guidance via elevons on the trailing-edges of its rear-mounted cruciform wings and two small movable canard surfaces at the nose. Swatter-C is said to be similar but with semiactive laser guidance. *(Data for Swatter-A/B.)*
Dimensions: span 2 ft 2 in, length 3 ft 9¾ in.
Weight: 65 lb.
Performance: cruising speed 335 mph, range 1.85 miles.

AT-3 (NATO "Sagger")
In conformity with the Soviet practice of not supplying advanced equipment on its export aircraft, the manually commanded to line-of-sight (MACLOS) wire-guided Sagger replaces "Swatter" on the "Hip-F" version of the Mi-8, as well as arming the Polish-built Mi-2 and Gazelles of the Yugoslav services.
Dimensions: span 1 ft 3 in, length 2 ft 10 in.
Weight: 25 lb.
Performance: speed 265 mph, range 1.85 miles.

AT-6 (NATO "Spiral")
Unlike earlier Soviet helicopter-launched antitank missiles, Spiral does not appear to have a surface-launched application. It is a solid-propellant missile, with a warhead weighing about 22 lb. Tube-launched and radio command–guided, possibly with semiactive laser terminal homing, it equips the "Hind-E and F" versions of the Mi-24, the Mi-28 "Havoc," and the Ka-29TB "Helix-B."
Dimensions: span 1 ft 0 in, length 5 ft 10 in.
Weight: 55 lb.
Performance: range 3 miles.

AA-2 (NATO "Atoll")
Designated K-13A in the USSR, the basic **AA-2** Atoll is the Soviet counterpart to the American Sidewinder 1A (AIM-9B), to which it is almost identical in size, configuration, and infrared guidance. It was followed by the **AA-2D,** with improved seeker, that has long been standard armament on home and export versions of the MiG-21 and is carried by the Su-25 as well as export models of the MiG-23 and Sukhoi Su-22. A solid-propellant rocket motor and 24 lb fragmentation warhead are fitted.
A radar-homing version of Atoll, designated **AA-2C,** can be carried on the outer stores pylon under each wing of the multirole versions of the MiG-21, in addition to IR homing Atolls on the inboard pylons. Length is increased to 11 ft 6 in and weight to 205 lb. Range of the AA-2C is 5 miles. *(Data for AA-2D follow.)*
Dimensions: length 9 ft 3½ in, body diameter 5.12 in, fin span 1 ft 8¾ in.
Weight: 165 lb.
Performance: cruising speed Mach 2.5, range 1.85 miles.

AA-2-2 (NATO "Advanced Atoll")
A photograph shows the compound-swept forward control fins of the AA-2-2 IR homing Advanced Atoll. It is probably comparable with the AIM-9P version of Sidewinder.

AA-3 (NATO "Anab")
This solid-propellant air-to-air missile arms Sukhoi Su-15 interceptors. Each aircraft normally carries one Anab with an I/J-band semiactive radar seeker and one with an infrared homing head.
Dimensions: length 10 ft 10 in (IR) or 11 ft 9½ in (SAR), body diameter 8.66 in, wing span 3 ft 5½ in.
Weight: 575 lb (IR), 595 lb (SAR).
Performance: range 1.85 miles (IR), 6.2 miles (SAR).

AA-6 (NATO "Acrid")
This air-to-air missile is one of the weapons carried by the "Foxbat-A and E" interceptor versions of the MiG-25. Its configuration is similar to that of "Anab," but it is considerably larger, with a 110 lb warhead. The version of Acrid with an infrared homing head is normally carried on each inboard underwing pylon, with a semiactive radar homing version on each outer pylon.
Dimensions: length 19 ft 8¼ in, body diameter 9.85 in, wing span 5 ft 11 in.
Weight: 1,015 lb.
Performance: cruising speed Mach 2.2, range 18.5 miles.

AA-7 (NATO "Apex")
This air-to-air missile is one of the two types carried as standard armament by interceptor versions of the MiG-23 and is reported to be an alternative weapon for the MiG-25. Apex has a solid-propellant rocket motor and exists in infrared and semiactive radar homing versions (Soviet designations R-23T and R-23R, respectively). Warhead weight is 66 lb. *(Data for R-23R follow.)*
Dimensions: length 14 ft 9 in, body diameter 8 in, wing span 3 ft 5 in.
Weight: 518 lb.
Performance: range 12.5 miles.

AA-8 (NATO "Aphid")
Close-range air-to-air missile carried by late-model MiG-21s, MiG-23s, MiG-25s, MiG-29s, MiG-31s, Su-15s, Su-17s, Su-25s, Su-27s, and Yak-38s, Aphid is a highly maneuverable solid-propellant weapon with infrared homing guidance and a 13.2 lb warhead. Its Soviet designation is R-60.
Dimensions: length 6 ft 10½ in, body diameter 5.12 in, wing span 1 ft 5¾ in.
Weight: 143 lb.
Performance: range under 1,650 ft min, 3 miles max.

AT-3 (NATO "Sagger") and SA-7 "Grail" (bottom) on Yugoslav Gazelle

AT-6 (NATO "Spiral") on outer pylon of Mi-28 (Brian M. Service)

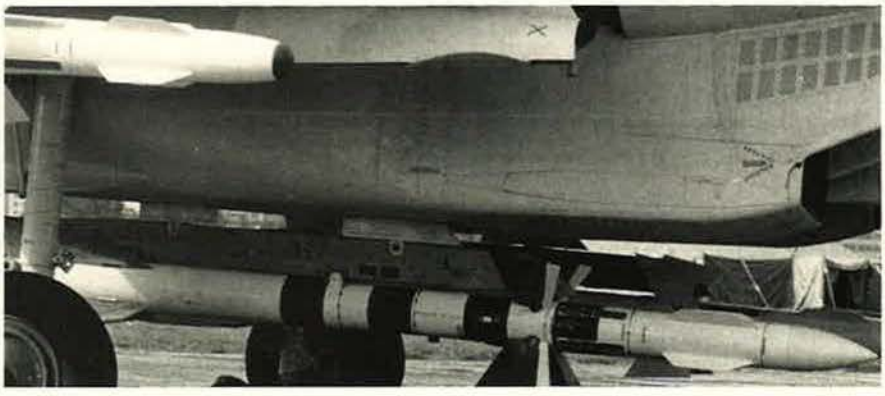
AA-7 under wing, AA-8s under fuselage of MiG-23 (Jane's/Nick Cook)

AA-8 (NATO "Aphid") on MiG-21 (Janes/Paul Beaver)

AA-9 (NATO "Amos")
This radar homing long-range missile is reported to have achieved successes against simulated cruise missiles after look-down/shoot-down launch from a MiG-25M interceptor. It is standard armament on the MiG-31, is an alternative weapon for the Su-27, and is regarded as being in the same class as the USN AIM-54 Phoenix. Amos is believed to have a solid-propellant rocket motor and to combine semiactive radar/inertial midcourse guidance with active radar terminal homing. A passive radar homing version has been reported, for use against AWACS aircraft.
Dimensions: length 13 ft 1½ in, body diameter 15.75 in, wing span 3 ft 3½ in.
Weight: 990 lb.
Performance: range 45 to 93 miles.

AA-10 (NATO "Alamo")
The AA-10 has generally similar capabilities to those of the AA-9. It has a complex configuration, with long-span reverse-tapered cruciform control surfaces to the rear of and in line with its small foreplanes. Four versions have been identified:
Alamo-A. Short-burn semiactive radar homing version, for use over medium ranges. Standard armament of MiG-29 and Su-27.
Alamo-B. Short-burn infrared homing version. Carried by Su-27 and MiG-29.
Alamo-C. Long-burn semiactive radar homing version, for use over longer ranges. Carried by Su-27.
Alamo-D. Long-burn infrared homing counterpart of Alamo-C. Carried by Su-27.
Dimensions: length 12 ft 11½ in (A), 11 ft 10½ in (B), 15 ft 1 in (C), body diameter 7.3 in; wing span 2 ft 3½ in.
Weight: 440 lb (A), 385 lb (B), 529 lb (C).
Performance: range 15.5 miles (A and B), 22 miles (C).

AA-11 (NATO "Archer")
This close-range missile was one of the weapons displayed for the first time at the 1989 Soviet Air Show at Khodinka. Control appears complex, with movable sets of vanes and fins fore and aft of fixed cruciform surfaces at the front of the missile, control surfaces at the trailing-edge of each of the cruciform tail fins, and four thrust-vectoring control vanes in the rocket exhaust. They are expected to confer great maneuverability, particularly when the missile is launched at large off-boresight target angles. Other features of Archer include infrared guidance, active radar fuze (probably to be superseded by active laser type), and a fragmentation warhead of about 33 lb. It is carried by the MiG-29 and Su-27. Soviet designation is R-73.
Dimensions: length 10 ft 0 in, body diameter 6.9 in, span of tail fins 1 ft 8½ in.
Weight: 275 lb.
Performance: range 5 miles.



IR (top) and radar homing versions of AA-10 (NATO "Alamo") on Su-27 (Piotr Butowski)

AA-11 (NATO "Archer") on Su-27 (Jane's/Nick Cook)

Antihelicopter "Grail"
In addition to carrying AT-3 antitank missiles, Gazelle helicopters license-built by SOKO for the Yugoslav Air Force carry SA-7 Grail tube-launched IR homing missiles for use against other helicopters. A four-tube installation on some Mi-24 helicopters has been reported. ■

The Chairman is under enormous pressure to restructure the armed forces. He has some strong views of his own.

The Powell Perspective

By Charles W. Corddry

DURING the first phase of the US military mobilization in and around Saudi Arabia, Robert S. McNamara got off a letter to Gen. Colin L. Powell, Chairman of the Joint Chiefs of Staff, congratulating him on the amazing speed and efficiency of the operation. Nothing was ever done so efficiently in his seven years as defense secretary in the 1960s—a time marked by the build-up in Vietnam—McNamara later remarked.

Nor, it must be added, did McNamara ever attempt anything so audacious during the Vietnam War. That reality weighed heavily in Colin Powell's early development as an officer. Like other officers who have achieved high rank, he has come to scorn Vietnam-type gradualism and tit-for-tat moves in the mobilization and application of military force.

When the United States goes to war, he has always insisted, it should go with overwhelming force and go to win.

Using overwhelming force is not, of course, a concept invented by General Powell. Samuel P. Huntington, the director of Harvard's Center for International Affairs, is only one of many prominent analysts in and out of government who in recent years have argued that the US should always capitalize on its unique abilities in this regard when it must go to war.

The difference, however, is that General Powell is in a position to press home the point as he goes about the task of reshaping the US military and leading it toward the next century. He clearly intends to do so, even though there are some glaring contradictions between, on one hand, the Joint Chiefs of Staff Chairman's clear concept of neces-

Gen. Colin L. Powell (left), Chairman of the Joint Chiefs of Staff, with Marine Cpl. Vincent Rivero (right), surveys a Marine position in Saudi Arabia near the Kuwait border. General Powell firmly believes in "a decisive military strategy that seizes the initiative, one that is designed to win."

—AP/Wide World Photos

sary force and, on the other, his and the Defense Secretary's plans for drastic reductions in the size of the US military services.

General Powell personally has great power to help design future US military forces. His personal influence is strong. He has also acquired new powers as a result of the latest defense reorganization measure, the 1986 Goldwater-Nichols Act, and he has given notice in his polite way that he will not hesitate to exercise them. An example is his determination to see that the strategic deterrent is modernized, even if the money to pay the bill can be found only by forcing heavy cuts on other military elements.

"There are some functions which we have to protect," the Chairman argues, "even at the expense of a disproportionate cut from another service or another component. . . . We must have the most modern strategic forces possible, and that will probably mean a disproportionate cut somewhere else."

A Need to Restructure

In the summer of 1990, there was great skepticism about the US's ability to move its forces swiftly to the far reaches of the world. A mere two weeks before the Iraqi invasion of Kuwait, the event that touched off the awesome Desert Shield mobilization, the Senate Armed Services Committee gave poor marks to US capability to project its power into the Persian Gulf region, which was Washington's declared strategy.

"The United States has never acquired capabilities sufficient to implement this strategy," the committee charged in its report on the Fiscal 1991 Defense Authorization Act, dated July 20, 1990. "To meet potential force-projection missions [in the high-threat environment of the Gulf or in other remote parts of the world], the United States must restructure its forces."

There is in fact a great deal of restructuring going on and being planned for future, smaller forces, with the Joint Chiefs of Staff Chairman calling the tune. General Powell took up his post in October 1989, more aware than most of the transition into which US defense policy was heading and of the need to create a new strategic framework. He saw the need to identify and protect a "Base Force"—a minimum, don't-go-below-this force to defend US interests in a still-dangerous world. The move down to this force was to be gradual, not headlong by any means.

Early in his term, he told Congress: "We must continue to provide a credible strategic deterrent through a modern triad, protect our interests globally, retain a highly mobile and ready force for crises and contingencies, and through all of the coming restructuring avoid foreclosing options for hedging against a new or renewed threat."

All this required continued US forward presence, though thinned down, and a rapid reinforcement capability anchored in the United States.

The Pentagon's Gulf contingency plans might have been around for a while—since the declaration of the Carter Doctrine in 1980—but it fell to General Powell to refine and implement them under what he called "clear political direction" from President Bush and Defense Secretary Dick Cheney.

Saddam Hussein's forces invaded Kuwait on August 2. By early November, an expeditionary force of some 230,000 had been deployed. That was Phase One, and it enjoyed wide political support. Phase Two began November 8, the General said, when the President ordered deployment of another 200,000-plus US troops. This controversial action was seen by many critics (including McNamara) as a policy change—from deterrence and defense in Saudi Arabia to preparation for an offensive against Saddam Hussein's forces in Kuwait and against Iraq itself.

In the view of Colin Powell the soldier, however, the military chiefs had only provided the Commander in Chief a more powerful offensive option. They had kept the military mission aligned with Bush's political aim. "The mission," General Powell told a somewhat agitated Senate Armed Services Committee on December 3, "is to take action to achieve our political objective if Saddam Hussein does not change his mind."

At that committee session, the General also succinctly stated a position on strategy that is applicable beyond any specific crisis at hand. The Joint Chiefs and Gen. Norman Schwarzkopf, the US commander in the Gulf region, believed that there must be "a decisive military strategy that seizes the initiative, one that is designed to win."

For the top military leader of a global superpower, that hardly qualifies as a revolutionary declaration. It reflects the lessons that military men believe were driven home by the gradualism practiced in the long Vietnam War and, in General Powell's case, by the "never again" atmosphere in the office of Secretary of Defense Caspar W. Weinberger in 1983–86, when Powell served as his senior military assistant.

"The one thing I've learned over the years is that you put in the necessary force to deal with the enemy's capabilities, and that's what we're doing," he explained in the tense early weeks of Operation Desert Shield, promising that the US force "will be more than adequate."

Above All, a Realist

Colin Powell is above all a realist. When he surveys the outlook for the next several years, he knows that he and the other Joint Chiefs must reckon with declining budgets, possibly throughout their terms. He and Secretary Cheney may now be working a squeeze strategy in the huge, cumbersome military establishment in the hope of pressing more rational decisions out of the service bureaucracies.

General Powell has told the Navy's senior admirals, for example, that his preferred minimum US military force—the floor, not the ceiling—calls for keeping twelve deployable aircraft carrier battle groups, down by two. He adds, however, that if the Navy could somehow eke out more of the warships within the coming constraints, fine.

General Powell is a friendly, outgoing man, self-confident and articulate—an officer who came to his position with "all the tickets," as Sen. John W. Warner, the Armed Services Committee's ranking Republican, observed in reflecting on the Chairman's career. He could, in the estimation of the Virginia senator, one day earn the reputation of "soldier-statesman."

It was not by any accident that

Colin Powell emerged as JCS Chairman and principal military advisor to the President and defense secretary, nor was he just cast up by the system. President Bush already knew him well as a trusted military professional and astute government insider. It may well be that no other Chairman, or anyhow very few of the previous eleven, came to the job so well matched to special times and circumstances.

General Powell was of a new generation of officers, ready to deal with the final acts of the cold war, "the transformations that we have prayed and hoped for" in the Soviet Union and eastern Europe, and the multiple dangers—which too soon became apparent—that lay ahead. The US must adjust to the change, not ignore it, he said. Making his point with fine irony, General Powell said, "We must not . . . hope that it [the sudden change that occurred in 1989 and 1990] will disappear and let us return to comforting thoughts about a resolute and evil enemy." So much for nostalgia for cold war "stability."

General Powell was President Reagan's last national security advisor, meeting with Soviet President Mikhail Gorbachev five times while serving in that capacity. He then briefly commanded the Army's far-flung Forces Command before President Bush tapped him to become the top US military man. When he was nominated, he was only fifty-two years old, the youngest officer ever to get the job, but he had thirty-two years of diversified military experience and unusual exposure to the top-level workings of the White House and Defense Department.

All of this has provided General Powell with confidence and independence in the political arena, where ultimate decisions are made. Witness the blunt but cheerful comment he made when a senator asked about different and presumably less fettered advice given by military men after they leave active duty:

"I am not reluctant or afraid to give . . . the Secretary of Defense, the President, or any other member of the National Security Council my best, most honest, candid advice, whether they like it or not. And, on some occasions, they do not like it."

"I will confirm that," Cheney chimed in.

In the months that General Powell has gone about his duties restructuring US forces and managing crises abroad, reaction to him in the Pentagon and at the Capitol has been positive. He noted that, in his first ten weeks as Chairman, "I helped the President and the Secretary with crises in Panama [the invasion and the capture of Manuel Noriega], on the border of Nicaragua and Honduras, in El Salvador, and in the Philippines."

For the last seven months, of course, he has been preoccupied with the military emergency in the Gulf. From his earliest days at the helm, in fact, General Powell's watch has been marked by one crisis after another. Had it not been for this reality, his impact on long-range defense planning might have been even greater than it has been, says Rep. Les Aspin, the Wisconsin Democrat who chairs the House Armed Services Committee.

"Go With Everything You Can Carry"

Representative Aspin says that the Chairman is, "from my perspective, the Capitol Hill perspective, doing very well." The veteran legislator says that General Powell remains cautious about the use of force, but that the General's philosophy is, "If you do use it, you go with everything you can carry. Don't be timid. Don't be slow."

It is a credo with which Representative Aspin agrees. "I think it's right," he says. He adds that it is "ingrained in the Vietnam generation."

Sometime late in 1989, as Pentagon officers now tell it, designing "a revised blueprint for a changing world" was put at the top of the Defense Department's agenda. With the Soviet conventional (but by no means the nuclear) threat getting ever smaller on the scope, with Congress pressing down even more than the Administration on the military budget, and with significant regional dangers looming, "restructuring" slowly began to get under way.

Projected 1995 end strength of the active-duty force, a fundamental influence on all other elements, was clearly going down. While there may have been lesser goals along the way, the objective now is a reduction of 500,000 uniformed personnel from the Pentagon's long-standing force of some 2,100,000.

The nation also now knows—and this seems to be a clear contradiction—that, barring any sudden change, plans for cuts in 1991 will go forward as if US military forces were not still engaged in a major Persian Gulf deployment. Congress

Colin Powell's Rules

Gen. Colin Powell, the JCS Chairman, has over the years collected thirteen rules or thoughts to live by. He keeps them on a small white card labeled "Colin Powell's Rules":

1. It ain't as bad as you think. It will look better in the morning.
2. Get mad, then get over it.
3. Avoid having your ego so close to your position that, when your position falls, your ego goes with it.
4. It can be done!
5. Be careful what you choose. You may get it.
6. Don't let adverse facts stand in the way of a good decision.
7. You can't make someone else's choices. You shouldn't let someone else make yours.
8. Check small things.
9. Share credit.
10. Remain calm. Be kind.
11. Have a vision. Be demanding.
12. Don't take counsel of your fears or naysayers.
13. Perpetual optimism is a force multiplier.

ordered a 100,000-member cut for Fiscal 1991, close to 63,000 more than Secretary Cheney and General Powell proposed.

Thus there has been a side-by-side buildup and build-down, a situation for which there is not likely any precedent.

Already questions are being raised about whether the United States will even be able to conduct a Desert Storm–style operation with the force that, under General Powell's plan, can be projected to exist in the mid-1990s.

For the moment, he envisions a Base Force of about 1,600,000 uniformed personnel, containing twelve Army divisions (down six from present levels), a 450-ship Navy (down eighty-nine warships), three Marine divisions and air wings (same number, but with deep manpower cuts), approximately twenty-six Air Force active-duty and reserve forces tactical fighter wings (down about ten), and modernized strategic nuclear forces reduced in number as a Strategic Arms Reduction Talks treaty may specify.

The Four Forces

General Powell envisions a new unified command plan under which there would be strategic nuclear forces, an Atlantic Force, a Pacific Force, and a Contingency Force. They would be backed up by modernized, and probably expanded, mobility forces. One of General Powell's top planners, Gen. George L. Butler, USAF, recently appointed commander in chief of Strategic Air Command, has described such forces as "the long pole in the tent of power projection and a resource [that] is being rigorously scrutinized as we draw early lessons from" the Gulf operation.

Ideally, this restructured US force would be ready to handle anything from the strategic nuclear deterrence mission to what General Powell calls "the contingency no one ever predicted." The latter would require forces "ready to go on a moment's notice." However, there is skepticism that the budgets projected for the 1990s will be adequate to support even the greatly shrunken forces now contemplated by General Powell.

The defense budget in 1995 is now expected to be nineteen percent lower in inflation-adjusted terms than it was in 1990. These difficulties are speculative so far, and much could change between today and the middle 1990s.

In short order after his appointment, Colin Powell became one of the Administration's top communicators on national security, traveling the country with a message about "enduring realities" in a world that he describes as changing but not changed.

These realities are spelled out in great detail in speech after speech to make the point that the United States must stay engaged across the globe and be prepared to face down challenges to its own and allied interests. "We've heard it again and again," the Chairman tells his audiences. "America cannot be the world's policeman. Yet, as I've learned time and again in the . . . months that I've been Chairman of the Joint Chiefs of Staff, when there's trouble, when somebody needs a cop, guess who gets called to restore peace? We do."

He puts at the top of his list of contemporary defense realities the fact that the Soviet Union, "now and in the future, is the only country that has the capacity to destroy the United States in thirty minutes." Hence the General's insistence on maintaining a modern, effective strategic nuclear deterrent.

Other realities are the US's transatlantic and transpacific interests. For General Powell, a fourth factor is "the reality of the unknown," meaning the appearance of sudden danger that will prompt the use of the Contingency Force.

The planning for a gradual build-down of the post–cold war US military forces went ahead last fall and winter, even at a time of buildup in the Persian Gulf. "America's need for strong armed forces will not pass," said General Powell, who tried to make the point that a strong force could be built and the nation could "save some money as well," so long as the Pentagon was not pushed into drastic, precipitous reductions.

On the day that Iraq invaded Kuwait, the Defense Department had planned to reveal new strategic plans and details of the future Base Force in secret briefings for the relevant members of Congress. President Bush dealt with the need for restructuring in a speech at Aspen, Colo., which received fairly little attention. Representative Aspin tells how everybody showed up for the session with Secretary Cheney and General Powell. The Defense Department, Aspin says, was "tired of being banged around" about the new strategy and had planned to describe the "future shape of US military forces." It didn't get off the ground, according to the Armed Services Committee Chairman. "Nobody was interested," he recalls. "They all wanted to know about the invasion."

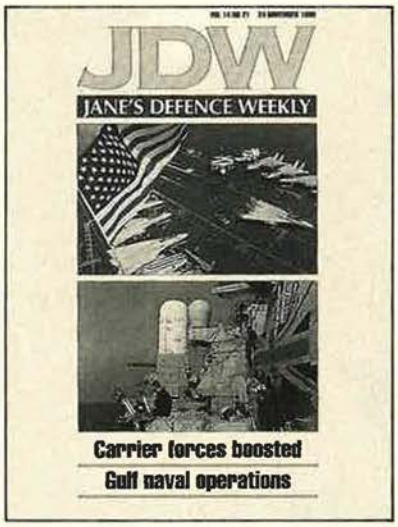
Thereafter, Aspin says, at least until this year's defense hearings, Congress was unable to get any information on the new strategy.

There is an interesting footnote to all the studies underlying the development of the Base Force plan, as told by General Butler in a speech last September on "New Directions in American Military Strategy."

"As the twin specters of Soviet hegemony and Iranian aggression receded," he said, "we devoted a great deal of time and attention to the focus of future US military planning to preserve regional stability and access" in the Persian Gulf. "Ultimately, consensus formed around the long-term threat posed by Iraq, which emerged from eight years of war with a messianic zeal, an appetite for weapons of mass destruction, and a shattered economy."

Therefore, said the General, in "late 1989," the Central Command "was directed to turn its attention to developing a new regional defense plan for the Persian Gulf, based on thwarting potential Iraqi aggression aimed at dominating the Arabian Peninsula. . . . On balance, the thrust of our strategic judgments was largely on the mark, thus providing sound conceptual footing for the remarkable success to date of Operation Desert Shield." ■

Charles W. Corddry, a defense correspondent in Washington for the Baltimore Sun, has covered military and foreign policy issues for nearly fifty years. His most recent article for AIR FORCE *Magazine was "Beyond the Wall" in the March 1990 issue.*



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The future looked strong for UAVs even before their large-scale infusion into the Mideast.

Steady Course for Unmanned Aircraft

By James W. Canan, Senior Editor

CERTAIN types of military systems are always more vulnerable than others when defense budgets get tight. Those that fall by the wayside at belt-cinching time usually are benign varieties. They are nonlethal, built to support the systems that shoot. The services like them but can live without them.

In the past, pilotless reconnaissance planes have been prime examples of such systems. They were put into play during the Vietnam War but never really caught on with field commanders, who used them unevenly. After the war, with defense spending on the wane, they were taken out of service, and plans for new ones, such as the Boeing Compass Cope high flyer for the Air Force, petered out for lack of funding and fervor.

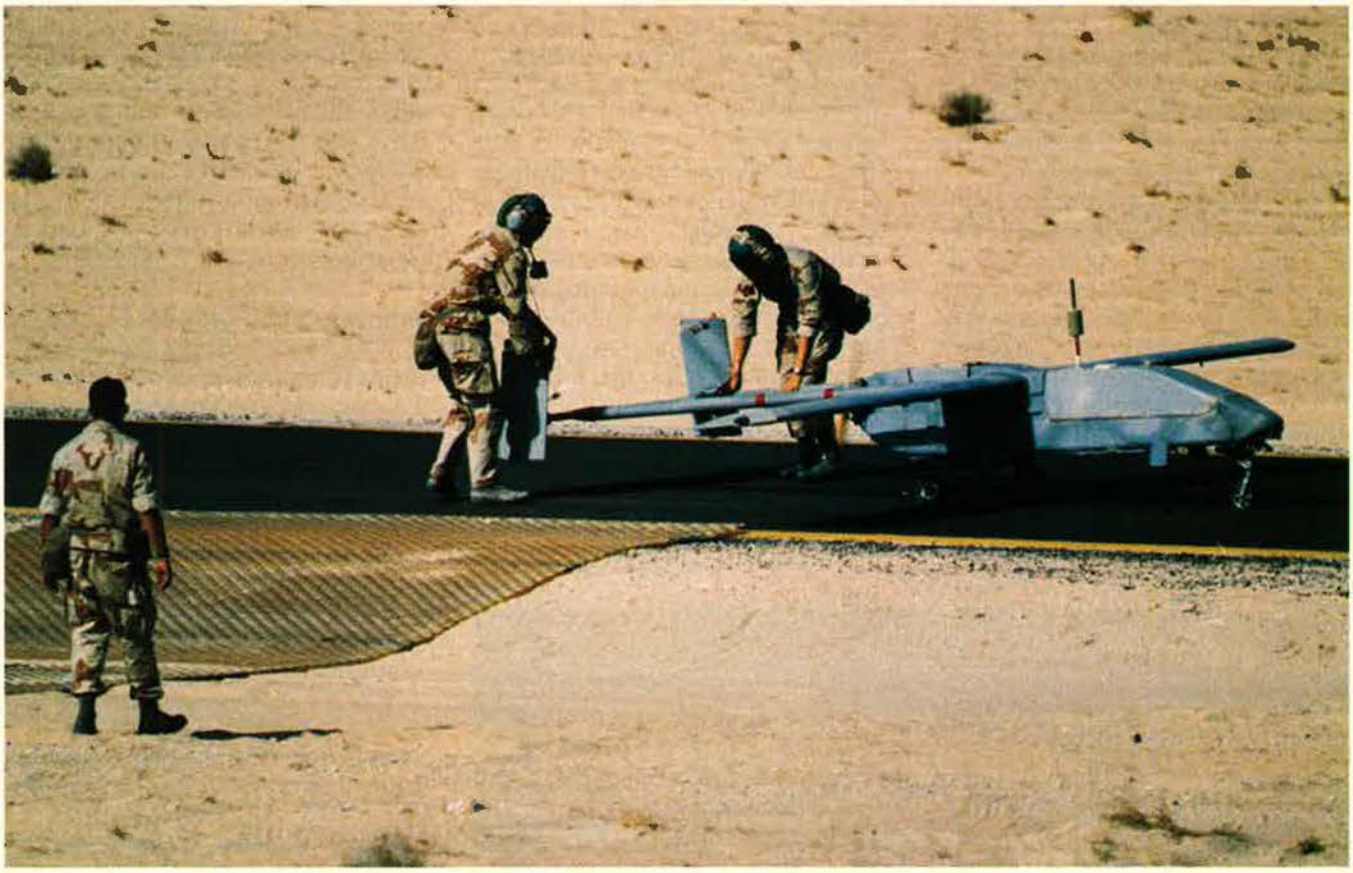
Times have changed for pilotless reconnaissance planes, now called Unmanned Aerial Vehicles. They are coming into their own. Their development is now orchestrated by a Defense Department office with joint-service clout. They have proved their worth in reconnaissance and surveillance in and around the Persian Gulf and are in heavy demand by US land and sea forces in those environs.

The future was looking a lot brighter for UAVs even prior to their large-scale infusion into the Mideast. Over the past two years, it has become increasingly apparent that UAVs have the makings of a big and growing business. Defense industry officials estimate that more than fifty companies now are jockeying for advantage in the UAV arena and that the end is not in sight.

Last year, the Electronic Industries Association conducted its "Unmanned Systems Market Study" and concluded that "the future looks very promising" for UAVs. EIA reckoned that Pentagon budgets for UAV programs, now standing at about $300 million a year, could jump to $2 billion a year by the turn of the century and that the total market for UAVs in the military and civil sectors, including production for drug-law enforcement, could top $3 billion a year.

Among the armed services, only the Air Force, which flew UAVs with mixed success in the Vietnam War, has yet to field them as part of its contemporary force. Its leaders

US Marines (opposite) retrieve a Pioneer Unmanned Aerial Vehicle on the runway following a reconnaissance flight. The Marine Corps and the Army have special units for operating UAVs. Pioneers and shorter-range Pointers have proved their worth in reconnaissance roles around the Persian Gulf.



claim that this has nothing to do with any institutional prejudice against unpiloted planes.

Faster and Farther

To fulfill its special requirements for tactical reconnaissance, the Air Force says, it needs jet-powered UAVs that can fly much farther and faster than the propeller-driven drones engaged in such reconnaissance for the Army, Navy, and Marines in the Mideast. Those jet planes would have to get in and out in a big hurry, with no loitering.

The Air Force has just such a flying machine in mind, with a round-trip range of 1,300 kilometers on preprogrammed routes, equipped to take TV and infrared pictures of preselected targets along the way and to transmit the images in digital form to ground stations via secure, line-of-sight data links while homeward bound.

In complexity, cost, and performance, such UAVs would be several cuts above those now being flown by the Army and the Marines for perimeter patrol in Saudi Arabia.

"Those systems do a shorter-range, very specific mission that lends itself to organic employment by ground forces," explains Maj. Gen. Richard E. Hawley, director of operations for the Air Force deputy chief of staff for Plans and Operations. "But that's not the mission that the Air Force is responsible for. Ours is to complement that mission with a deeper, tougher one, which tends to drive up requirements and costs."

General Hawley declares, "The Air Force is interested in buying [a UAV] at an affordable price to do the mission we're tasked to do, the mission the taxpayers pay us to do, and I think we've demonstrated that."

As a show of earnest intention for UAVs, Air Force officials cite the tactical reconnaissance roadmap drawn up by Tactical Air Command (TAC) a few years ago. That roadmap looked ahead to modernizing TAC's fleet of manned reconnaissance planes, currently RF-4Cs, and, for the first time, to building a complementary fleet of unmanned aircraft for spotting and sizing up targets deep inside enemy territory and for assessing after-attack damage to them.

The Navy and Marines also aspire to a tactical reconnaissance UAV that will fly as far, and do the same things, as the one required by the Air Force. The Navy is overseeing development of such a UAV for the three services. The Air Force's job in the partnership is to supervise the development of a sensor suite that will be common to the complementary UAVs and to piloted planes.

Martin Marietta Corp.'s Electronic Systems Co. is the prime contractor for the sensor suite, called ATARS (Advanced Tactical Airborne Reconnaissance System), and is responsible for integrating it in pods to be carried by Air Force RF-16s and Navy RF-18s.

Teledyne Ryan Aeronautical is developing the medium-range UAV that will incorporate ATARS. Sometimes referred to as a UARV (unmanned air reconnaissance vehicle), that plane is derived from the Model 324 UAV that Teledyne Ryan has long produced for Egypt and is expected to be smaller, faster, and a much better performer all around. Full-scale development is well along.

Shooting for 1995

The Air Force expects to put the medium-range ATARS UAV into operational service in 1995, providing all goes well. No big problems have reared up or are anticipated.

The Defense Department's Unmanned Aerial Vehicles Joint Project Office (JPO) is the overseer of this program. Headed by Rear Adm. William C. Bowes, the JPO was created by the Office of the Secretary of Defense in 1988 at the urging of Congress to consolidate the unmanned-plane programs of the individual services under unitary management and to standardize UAVs for multiservice purposes wherever possible.

Teledyne Ryan Aeronautical, builder of this jet-powered unmanned plane and many others, is developing a medium-range jet UAV for the Air Force and the Navy. Equipped with Martin Marietta's Advanced Tactical Airborne Reconnaissance System (ATARS), the UAV will complement ATARS-carrying RF-16 and F/A-18 reconnaissance planes.

Congress had grown weary of watching the services go their separate ways in developing—or in neglecting to develop—UAVs. Programs had shown a tendency to get out of hand in terms of mission requirements and costs. The Army's Aquila UAV program, which suffered from catchall requirements and escalating costs, was the most egregious example. It was finally put out of its misery.

On being organized, the new UAV JPO set about drawing distinctions among the increasingly rich assortment of craft that fly autonomously or by remote control, courtesy of computers and without resident pilots. The JPO issued the first official definition of a UAV as "a powered aerial vehicle . . . designed to carry a nonlethal payload," thus distinguishing between UAVs and ballistic missiles, semiballistic missiles, and all manner of sophisticated cruise missiles and other types of standoff weapons.

Some of these weapons come close to qualifying as unmanned airplanes because of their built-in ability to fly far, find targets, jink, and loiter before zooming in for the kill. Tacit Rainbow, a radar-busting flying machine developed for the Air Force but scrapped this year, was a well-publicized example.

Drones built for wreaking destruction are not the business of the UAV JPO and are not covered in its UAV master plan. That document, first drafted in 1988 and updated a year ago, is a blueprint for the development of multiservice UAVs for such missions as reconnaissance; surveillance; target-spotting and target-acquisition; command and control; detecting the prior use of nuclear, chemical, and biological weapons; electronic warfare; collecting weather data; "special operations support"; and "disruption and deception," according to the master plan.

It calls for acquisition of UAVs in four categories: close range, short range, medium range, and "endurance." As a general rule, close-range systems would fly only a few kilometers from launchpoints; short-range systems, about 150 km; and medium-range UAVs, as far as 650 km. The range and other performance requirements of "endurance" systems, once known as HALE (high altitude long endurance) systems, are classified.

Pointers and Pioneers

UAVs seen today in Saudi Arabian surroundings are the close-range Pointer, built by the Army for itself and the Marines, and the short-range Pioneer, built by the Navy for itself, the Marines, and the Army.

Pioneers have lived up to their name in paving the way for UAVs yet unborn.

Pioneers were originally developed and produced at Israel Aircraft Industries' Mazlat plant, the source of reconnaissance and targeting drones that did great work for Israeli forces during their victorious campaign in Lebanon's Bekaa Valley in 1982. The US Navy first put IAI-built Pioneers to the test in its Persian Gulf operations during the Iran-Iraq war, long before Iraq invaded Kuwait, and found that the UAVs could identify cargo and everything else on the decks of ships—and read the names on the sides of the ships—quite handily from 1,500 feet.

Pleased with the results (the Commander of the US Sixth Fleet reported that Pioneer performed "flawlessly" and "has added a new dimension to real-time intelligence"), the Navy arranged to have Pioneers produced in the US and tapped AAI Corp. of Cockeysville, Md., as the licensed producer. IAI is teamed with AAI.

The Navy attaches such importance to Pioneers that it delayed deploying the battleship *Wisconsin* to Mideast waters for three months while the ship was rigged for the UAVs. At this writing, the Navy is rushing to outfit the battleship *Missouri,* too, to carry Pioneers.

The Marine expeditionary force afloat in the Gulf and on shore in Saudi Arabia contains three companies whose sole purpose is the operation of Pioneer systems, each consisting of five to eight aerial vehicles and a ground control setup.

The Army also has units devoted to the operation of UAVs. As Oper-

Marines prepare a Pioneer for launch from its takeoff truck, part of the UAV's extensive ground handling and control system. The Pentagon's UAV Joint Project Office, created in 1988 to oversee all military UAV programs, is looking beyond Pioneer to a more capable craft now in the making.

ation Desert Shield got under way, the Army dispatched its 1st UAV Platoon, equipped with Pioneers, from Fort Huachuca, Ariz., to Saudi Arabia to support the 82d Airborne Division.

The 82d had already come equipped, quite by chance, with UAVs of another sort.

It happened that the airborne division was engaged in testing the Pointer close-range UAV system last summer, as part of the Army's Pointer development program, just as Iraq invaded Kuwait. When the 82d left for Saudi Arabia, it took along six Pointer UAVs—all it had—and three ground control stations. It put them right to work scouting the surrounding sands, and, gratified by their performance, placed a call back home for as many as it could get.

As a result, "we were cleaned out" of development-model Pointers previously earmarked for Stateside operational testing, says a JPO official.

Pointers are simple, inexpensive machines for doing an uncomplicated but indispensable mission: looking over the next dune or the next hill to see what's there or whether, for instance, anything had come and gone in the night. It is the peering, probing kind of mission traditionally carried out by infantry scout platoons, a mission that often runs into ambushes that result in firefights and fatalities.

The 500-Foot-Tall Soldier

It has been said by US troops in Saudi Arabia that having Pointers on their side is like having 500-foot-tall soldiers with binoculars.

That is how high Pointers customarily fly. Developed for the Army by AeroVironment Inc. of Simi Valley, Calif., each Pointer UAV is six feet long, has a nine-foot wingspan, is made of balsa wood and lightweight composite material, is launched like a javelin from a vehicle moving into the wind, and has an operational radius of three miles. Pointers are powered by quiet, battery-operated electric motors. They televise the terrain and transmit black-and-white video pictures for viewing and/or cassette taping.

A full-up Pointer system, consisting of four aerial vehicles, a ground control unit, and accessories, costs about $200,000. The UAV itself costs only $16,000 and would probably drop in price to well under $10,000 in mass production, officials estimate.

Pointers, easily portable, are tailor-made for small units. Each system can be carted around by an infantry company in two backpacks weighing forty pounds each. Two men can set up and launch a Pointer in five minutes. The UAV is hard to hear, spot, and shoot down from the ground.

Pointers are now being prepared for use in the American war on drugs. Congress earmarked $1.3 million late last year for the Drug Enforcement Administration to buy Pointers modified to take TV pictures in color rather than black and white.

The reason: When DEA goes to court in a drug-trafficking case, it "may have to be able to say that it can ID the dealer because it has a [Pointer] picture of him in his blue jacket getting out of his green car," a Pentagon official explains.

Boeing's high-flying, propeller-driven Condor "endurance" UAV, Sikorsky's doughnut-shaped Cypher UAV, and an E-Systems UAV, among others, are also being eyed for surveillance jobs.

Pioneer complements Pointer quite nicely in combat zones. It is much more complex and costly, flies much farther and higher, and does much more of the same.

Each Pioneer system, transported by truck, is composed of five UAVs, a ground (or shipboard) control unit, a portable control station, two remote receiving stations, and pneumatic or rocket-assisted launchers. Driven by a pusher propeller and powered by a two-cylinder internal combustion engine, a Pioneer UAV is designed to fly between 1,000 feet and 13,000 feet above sea level at sixty to ninety-five knots and to land just like a manned airplane. Its radius is about 220 kilometers.

Pioneer UAVs have demonstrated time and again that they can stay

airborne, as advertised, for at least five hours. Each can accommodate TV and forward-looking infrared (FLIR) sensors for reconnaissance, surveillance, target-spotting and target-acquisition, and battle-damage assessment. A Pioneer must be within sight of a ground control station to transmit its images.

The "Showpiece"

For the next-generation short-range UAV, the Pentagon is looking beyond Pioneer in a program that a JPO spokesman calls "our showpiece."

That program, begun a year and a half ago, involves competing contractor teams. One is McDonnell Douglas Missile Systems and Developmental Sciences Corp. with its Sky Owl; the other is Israel Aircraft Industries and TRW Military Avionics and Surveillance Group with its JIMPACS (Joint-Services Improved Multimission Payload Aerial-Surveillance Combat-Survivable System), a modernized IAI Impact UAV.

Both UAVs have twin engines but differ markedly in some other respects. For example, Sky Owl lands by parachute, whereas JIMPACS has fixed landing gear.

Both teams began test flights last fall. Their UAVs will go head-to-head in a six-month flyoff, scheduled to get under way in mid-March, to determine which will win the much-coveted full-scale production contract.

The Navy will be the contracting agent for the JPO, but the first block of UAVs slated for production, beginning early next year, will go to the Army and Marines. The Army plans to buy at least fifteen systems a year through 1997. The production program is expected to be worth several hundred million dollars, perhaps topping the billion-dollar mark.

A variant designed for sea surveillance and capable of deck landings and takeoffs will come afterward. Its development program will be open to, and is expected to attract, additional UAV contractors, such as Canadair.

Modular subsystems, such as avionics, are the key to multimission, multiservice UAVs. A standard airframe for all the services could be equipped with different components to satisfy the mission requirements of each. Equipment for mission planning and control, launch and recovery, data communications, and image processing could be very similar, if not identical, for all.

The short-range (200 to 300 km) UAV slated for the ground and sea services will use TV and FLIR sensors to perform real-time reconnaissance and surveillance. Its whole purpose, says the JPO master plan, is to "provide commanders with targeting and battle management information on which to base combat decisions."

The medium-range UAV being developed by Teledyne Ryan for the Air Force, Navy, and Marines is also a highly complex system, made up of EO and IR sensors, state-of-the-art electronic gear for data communications and mission planning, hardware for air and surface launches, and ground handling and test equipment.

As required by the JPO, that reconnaissance drone must be able to fly at medium to high subsonic speeds out to 650 km from its launch-point, navigate accurately enough to touch base at any number of preprogrammed "observation points" along the way, and gather images of surface targets that are clear enough to satisfy "national imagery interpretability rating scale 4"—meaning, for example, that trucks can be readily identified by type, such as cargo, flatbed, or van.

The Navy and Marines will launch the medium-range reconnaissance UAV from fighter aircraft, most likely F/A-18s. The Air Force will launch it from the ground by catapult and in the air from F-16s. The Fighting Falcon will also play another tactical reconnaissance role. The Air Force plans to replace its fleet of venerable RF-4Cs with RF-16s bearing ATARS pods.

The Air Force regards unmanned planes as chiefly useful for reconnaissance of stationary targets, such as bridges, depots, and communications and command centers, in heavily defended locations.

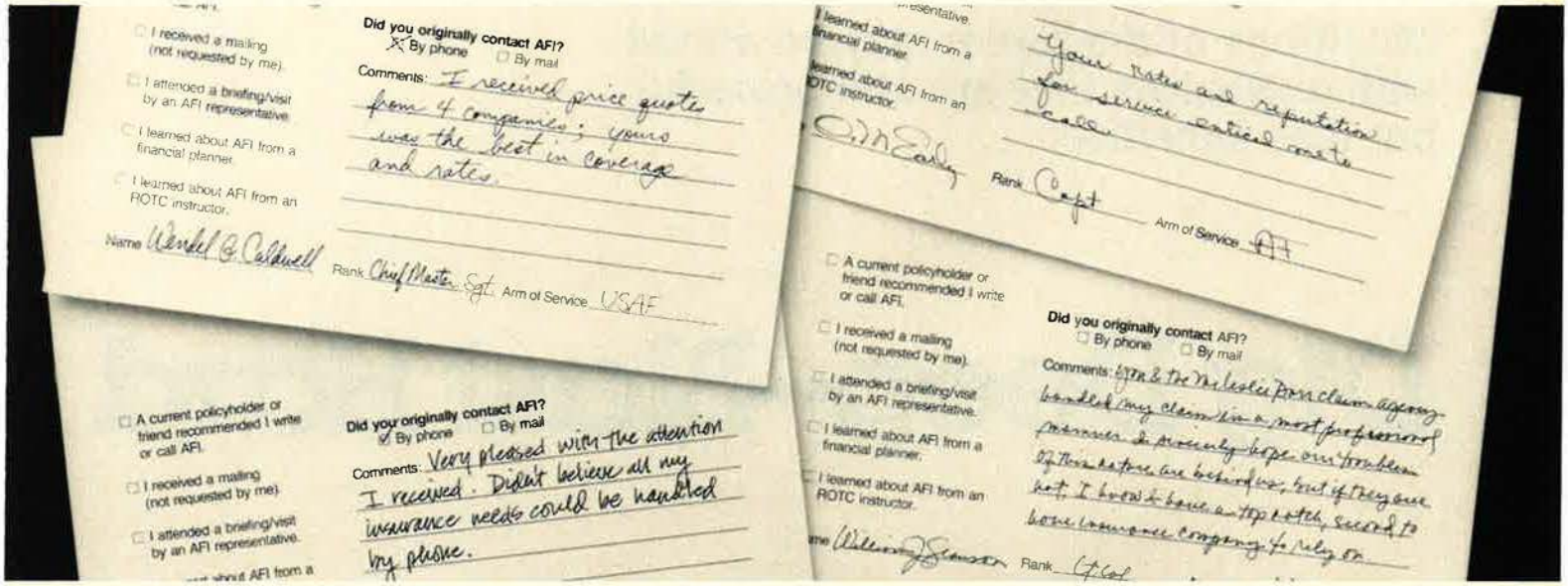
"We see the UARV as a great complement to the manned platforms," General Hawley says, "but it will have some disadvantages as well as advantages. For one thing, it won't be as responsive as the manned plane. There won't be the real-time feedback—instantaneous communication—that comes from having eyeballs in the air."

As a rule, the UAVs will be sent on missions "where the threat is dense, where we would risk an unacceptable attrition rate of our manned [reconnaissance] force," he explains.

Or, as one UAV champion at the Pentagon said, "Our motto is 'No widows, no POWs, with UAVs.'" ■

—Photo by John Gaffney

RF-4Cs like this one with the Alabama ANG's 117th Tactical Reconnaissance Wing will give way in the near future to RF-16s. The Air Force believes that UAVs will prove invaluable for reconnaissance of fixed targets in heavily defended areas but that manned reconnaissance planes will remain necessary for spotting and tracking mobile targets behind the lines and will provide greater flexibility than do UAVs.



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Munitions of the future may be armed with explosives that are still powerful but less sensitive.

Dig Deep—Blast Hard

By Colleen A. Nash, Associate Editor

THE current breed of conventional high explosives works well. Perhaps too well, says the Air Force. It would be useful to have weapons that matched the punch of current warheads but were less sensitive to detonating on impact.

As enemies dig in their defense against air attack—Iraq is the most recent case—the Air Force needs munitions that can penetrate deep underground to destroy hardened, buried targets. In such a high-velocity impact, however, today's explosives tend to detonate prematurely.

For the experts who deal in military explosives, this "oversensitivity" of materials is crucial. It is "the key problem for the Air Force right now," says Gary L. Parsons, chief of the Energetic Materials Branch of Air Force Systems Command's Wright Laboratory's Armament Directorate at Eglin AFB, Fla.

Scientists at the directorate's High Explosive Research and Development (HERD) Facility are intent on producing a safer material known as Insensitive High Explosive, or IHE. With a true IHE, explosive material "will never detonate unless we specifically want it to," says Capt. Paul R. Schomber, a top Armament Directorate physical chemist. "Anybody who handles it can pick it up, drop it, kick it, shoot it, and nothing is going to happen. It's just like a piece of wood."

Plans call for the Air Force to fill most of its newer munitions with IHE by 2000. In the past, explosives experts devised formulas to produce truly insensitive materials. The service has yet to find such a material that also can meet two requirements: that it have a reasonable cost and that it be as energetic as today's more volatile types.

The Air Force has cause to believe that its scientists will overcome the current problems and provide a solution to meet all criteria. The IHE program, now in advanced development, probably is within five years of perfecting an IHE for use in general-purpose bombs. Once this happens, IHEs will have a profound effect on the safety, readiness, and effectiveness of the munitions inventory.

Moreover, experts are at work on new types of explosives usable in antiaircraft, air-defense suppression, and direct airfield-attack weapons. Other types of weapons would be used for antiarmor operations, now carried out with the Mk. 20 Rockeye, the AGM-65 Maverick, the CBU-89 Gator, and the CBU-87 Combined Effects Munition. Also in the works are systems for area denial and channelization, soft targets, point targets, and, most especially, hard targets.

Going Underground

Most modern military forces today are going underground and hardening key facilities. The Air Force therefore must be able to destroy or neutralize deeply buried command and control bunkers, hardened runways, and bridge piers. This was especially true in planning for air strikes against military facilities in Iraq.

To do this, the weapon must be able to penetrate to

some depth before the explosive detonates. Otherwise, the force of the blast dissipates harmlessly above the target. "The munitions we have now are designed to attack fixed, hardened targets above the surface," says Lt. Col. (Colonel selectee) Steve Henrich of the Aeronautical Systems Division's Development Plans Office at Eglin, "but not underground at as great a depth as is stated in the new requirement."

The Air Force thus has gone to work on creating hard-target penetrators—weapons with warheads, explosives, and fuzes for destroying hardened targets. Col. Howard J. Bush, chief of the Armament Directorate's Munitions Division, says the service is seeking to double the hard-target-killing power of its munitions.

Many technological obstacles exist. A major hurdle is getting the explosive material not only to survive the force of the weapon's impact against the armor, concrete, or stone that surrounds a truly hard, buried target, but also not to detonate until the appropriate time.

"When it hits the structure, unless [the explosive] is insensitive, the act of hitting [the structure] is going to set it off," says Captain Schomber.

The physics of the matter is simple. High-velocity impact with the ground can create cracks in the explosive within a bomb or missile. When such cracks occur, loose pieces of the explosive slide at high speeds, rubbing against the casing or against other pieces of explosive. Experts say it's a bit like striking the head of a match against a rough surface, with identical consequences.

Pentagon munitions expert Robert L. Henderson says the solution to this problem might lie in the use of an IHE, since it would be far less likely to explode before the fuze went off. "If you could develop and use an IHE," says Mr. Henderson, "then one of the biggest challenges is already taken care of."

The impact of IHE on readiness also could be great. For example, weapons safety classifications have a significant impact on storage capability and procedures, notably in Europe. This provides further impetus for the Air Force to seek IHEs.

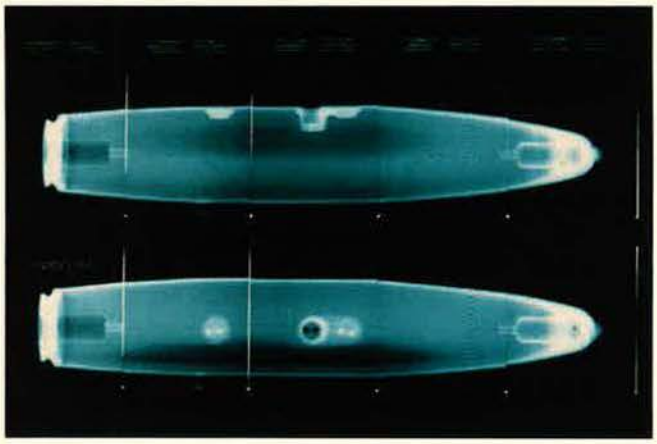
In order to increase the readiness of its tactical fighter forces, the Air Force strives to maintain its weapons as close to its aircraft as possible. However, the safety and storage considerations associated with sensitive explosives can interfere with that objective.

The lowest safety-hazard classification today is class 1.1, and most Air Force weapons fall into this category. Under current safety rules, the military is barred from storing class 1.1 weapons within 3,620 feet of inhabited buildings or within 1,300 feet of parked aircraft.

Off-Limits Igloos

This creates a big problem in Europe. Because of the restrictions, says Colonel Bush, "we'd only be able to use twenty percent of our [weapon storage] igloo space." The other eighty percent would be unusable due to the proximity of buildings and planes.

In the early 1980s, the Air Force conducted an experiment that demonstrated the prudence of such safety measures. Technicians put several sortie loads of conventional, class 1.1 bombs into a hardened aircraft shelter and detonated the pile. "We not only destroyed the shelter they were in," says Mr. Parsons, "but we threw pieces of shelter so far that we would have damaged other



Scientists at USAF's High Explosives Research and Development Facility, Eglin AFB, Fla., are intent on producing a safer explosive. Above, X rays are used to search for flaws in the bomb case or explosive load.

shelters. Instead of being able to store more sortie loads in a shelter, we ended up having to take stuff out."

The advent of insensitive munitions foreshadows a radically new concept in weapons storage. That, says Mr. Parsons, is because "the probability of an accident occurring is so low."

For example, weapons that achieve a 1.2 rating, slightly higher than the 1.1 found in most contemporary munitions, can be stored far closer to critical areas—within 800 feet of inhabited buildings and within 480 feet of parked aircraft.

Achieving the highest safety-hazard classification, 1.6, would dramatically change the Air Force's ability to manage its weapons inventory. Class 1.6 explosives could be stored within 195 feet of buildings or parked aircraft. That, explains Colonel Bush, would mean USAF could use 100 percent of its igloo space on European bases.

Mr. Parsons says IHEs offer "a great bonus in readiness." Not only can IHE-laden bombs be stored hundreds of feet closer to aircraft; in addition, more sortie loads can be safely stored in hardened aircraft shelters.

"You can have everything there that you need to fight with when you need it," says Mr. Parsons.

The degree of sensitivity assigned to a particular type of explosive is determined by how it responds to a battery of shock, thermal, and impact tests. To qualify as a generic IHE, an explosive must pass two tests. First comes a so-called "stack" test. Technicians detonate one bomb in a stack containing many bombs. If the test is successful, the shock from the blast of the single weapon will not cause "sympathetic detonation" of its neighbors.

The second trial is a thermal test, known as a "fast cookoff." In this procedure, technicians drench a bomb in fuel and set it on fire. It is permissible for the casing of the bomb to break open and for the explosive to burn, but there must be no detonation.

Explosives passing these two tests receive the safety-hazard classification of 1.2 and are considered true IHEs.

Doing a Slow Burn

A few types of IHEs can pass a second, far more challenging set of tests.

One is a "slow cookoff," designed to simulate the dangers created by a fire next to a munitions dump. The test bomb is placed inside an oven; each hour, technicians raise the oven temperature by three degrees Centigrade. "Most explosives are more sensitive to a slow cookoff than to a fast cookoff," says Mr. Henderson. In addition, a slow cookoff is much more dangerous. Because the explosive becomes more sensitized, the reaction is more violent.

If the bomb doesn't detonate or, in the event of detonation, "if no part of the bomb goes more than fifty feet, the explosive has passed the test," says Colonel Bush.

The final examination is the bullet impact test. In this examination, a bomb must withstand three .50-caliber machine-gun shots without detonating.

Explosives that pass the slow cookoff and bullet impact tests receive the 1.6 safety-hazard rating.

The Air Force wants IHEs with the optimum 1.6 rating. Explosives in use today, such as Tritonal, pass none of the tests and are thus relegated to an undesirable safety-hazard class of 1.1.

Mr. Parsons says the Air Force's desire for IHE grew out of its experience in the Vietnam War. The Air Force and the Navy had some "extremely serious incidents," he notes, and "our own weapons damaged us."

As a prime example, he cites a serious accident that occurred at Da Nang. "We had tremendous amounts of munitions on the flight line, ready to be used," recalls Mr. Parsons. Then a fire set off one pile of bombs, which set off a chain reaction of explosions. As a result, "aircraft were damaged. Munitions were blown all over the place."

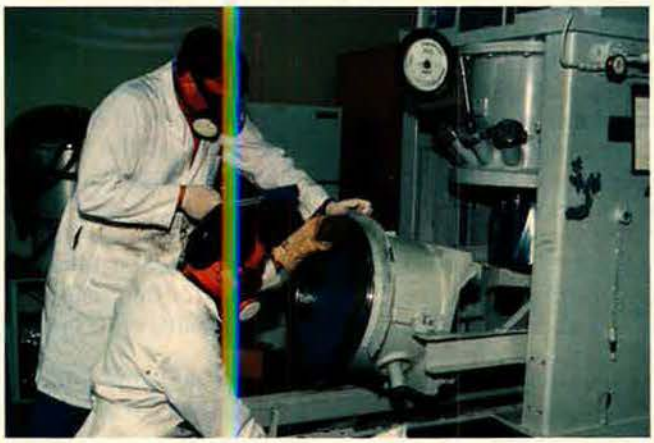
"In the past when we developed explosives," says Colonel Bush, experts knew that "the idea was to get as much energy as you can. They didn't care about the sensitivity; they were just concerned about performance."

A "Remarkable Explosive"

Today only one qualified IHE exists. It is Triamino-Trinitro-Benzine (TATB), an explosive developed by the Department of Energy for use in newer nuclear weapons.

Mr. Parsons says it has proved to be "a remarkable explosive"—safe, yet as powerful as Tritonal, the explosive contained in most of today's bombs.

Why doesn't the Air Force put TATB in all its bombs?



Processing technicians William Watts (left) and Tom Sprague carefully transfer explosive mix to containers for transport to a bomb loading facility. IHEs will greatly improve the safety, readiness, and effectiveness of the munitions inventory.

The answer, says Mr. Parsons, is that the exotic explosive continues to be difficult to produce, and, for a chemical explosive, it is expensive in the extreme—about thirty dollars per pound. The prohibitive price has kept TATB out of all conventional weapons.

The Air Force is looking to get the functional equivalent of this type of IHE for about the same cost as Tritonal or TNT—about one to two dollars per pound. The high explosive to fill a standard 500-pound bomb therefore would cost between $200 and $300. If the Air Force used TATB, however, it would have to pay about $6,000 to fill the same bomb.

In truth, the Air Force also wants a material that is even more powerful than TATB. Most of the IHEs devised and tested so far have proven to be a bit less powerful than Tritonal.

One example is the new explosive AFX-1100, a blend of Tritonal, aluminum, and a wax-like substance. It's safe, but its explosive force is only about eighty-five percent that of Tritonal. Tactical fighter force users deemed this unacceptable.

"This is the problem we are chasing now," says Colonel Bush. "They are going back now to the drawing board to figure out how to get this insensitive explosive—and others with more energy—equivalent to what we have in the inventory today."

Several candidate explosives have been developed in-house, by the Navy, and by Atlantic Research Corp. Some of them seem likely to have the required explosive power. The Air Force is testing them now at the HERD Facility. Two promising types are being evaluated:

AFX-920. Colonel Bush says that this compound, developed over recent years by HERD scientists, looks highly promising. The Air Force has not yet subjected it to all of the required tests. However, so far it seems to have an energy level comparable to that of Tritonal and seems to be coming close to meeting the required criteria for insensitivity.

Nitroguanidine (NQ) and Nitro-Triazolo-one (NTO). These explosives can't be used alone, but they could be used in a compound with other materials. One idea is to use TNT as a glue and add these substances to it. The Air Force has discovered that a special type of wax can be added to TNT to make a very insensitive blend.

New, insensitive high explosives have created a demand for new techniques to detonate them properly and safely.

Ron Boulet, Chief of the Armament Directorate's Fuzes and Guns Branch, is one of the leaders in the work on insensitive munitions fuzing. Every time the IHE experts succeed in lowering the sensitivity of an explosive, says Mr. Boulet, "I have a problem setting it off. If it's less sensitive to a bomb that is sitting alongside it, then it's also less sensitive to a booster [fuze explosive]."

Another problem: Tactical commanders typically want to be supplied with stockpiles of "all-up rounds"—bombs with fuzes already installed—to maximize combat readiness.

"So," explains Mr. Boulet, "the booster and the fuze that I put in the bomb can't be allowed to degrade the IM [Insensitive Munitions] criteria. If I make it sensitive again when I install the fuze, then I've destroyed what [was] accomplished.

"We haven't solved that problem." ■

Reviews

By Jeffrey P. Rhodes, Aeronautics Editor

Admiral Arleigh Burke: A Biography, by E. B. Potter. This is the story of the life of a busy man. Arleigh Burke first gained fame when he and his destroyers pursued the Japanese through the Solomons in 1943. Transferred to Adm. Marc Mitscher's staff, the "Big Swede" was instrumental in bringing the carrier to the forefront of the Navy's drive across the Pacific. Rear Admiral Burke then played an important role in the Korean War truce talks. President Eisenhower picked him, over ninety-one more senior officers, to be Chief of Naval Operations. During his three terms as CNO, he initiated the Polaris sea-launched ballistic missile program. More recently, the Navy named its new DDG-51 class of destroyers after him. Random House, New York, N. Y., 1990. 495 pages with photos, maps, diagrams, sources, notes, and index. $24.95.

Callback: NASA's Aviation Safety Reporting System, by Rex Hardy. The Aviation Safety Reporting System, through its monthly bulletin *Callback,* provides an anonymous forum for pilots and ground personnel to report on and learn from operational errors, misjudgments, and violations. The author, the original editor of *Callback,* surveys the bulletin and takes a close look at several safety issues, including communications problems, midair near-collisions, cockpit automation, and clearance deviations; gives the history and philosophy behind the US reporting system; looks at how other countries research air safety; and even includes "Good Grief" anecdotes, such as the story of how a crop duster killed a bull (don't ask). Smithsonian Institution Press, Washington, D. C., 1990. 192 pages with line drawings by Bob Stevens and one chart. $24.95.

Guadalcanal: The Definitive Account of the Landmark Battle, by Richard B. Frank. What Cornelius Ryan did for Normandy and Arnhem, Mr. Frank does for this pivotal confrontation in the Pacific. The battle for Guadalcanal was the first major US offensive against Japan and the very first American operation to be fought on land, at sea, and in the air simultaneously. The battle lasted six months, losses on both sides were heavy, and the fight involved every weapon from bayonets to battleships to bombers. The author's sources for this massive volume include the Japanese Defense Agency's 101-volume war record, translated Japanese war documents, declassified US radio intelligence, and other official records. Random House, New York, N. Y., 1990. 801 pages with photos, maps, appendices, notes, and indices. $34.95.

A P.O.W.'s Story: 2801 Days in Hanoi, by Larry Guarino. The author saw Hanoi twice during his thirty-two-year career. After an action-filled tour in Europe, he was sent to China and flew P-51s over the city late in World War II. Two wars and twenty years later, his fiftieth mission over North Vietnam ended abruptly when his F-105 was shot down and he got a closer look at the city than he would have liked. The eleventh American to be taken captive, he spent nearly eight years in two of Hanoi's least desirable places, the Zoo and the Hanoi Hilton. During this time his son finished school, became a fighter pilot, and flew a tour in Vietnam himself. This is a story of horrific physical and mental agony, but one of great courage and survival. Ivy/Ballantine Books, New York, N. Y., 1990. Paperback, 341 pages with photos and diagrams. $4.95.

Scream of Eagles: The Creation of Top Gun—And the US Air Victory in Vietnam, by Robert K. Wilcox. In 1968, the Navy was losing one F-4 for every two North Vietnamese MiGs shot down. In terms of actual numbers, the losses weren't critical, but a trend like that could not be permitted to continue. Part of the problem was unfamiliarity with the weapons, but a larger part was lack of emphasis on air combat maneuvering—dogfighting—during training. In 1969, the Navy's Fighter Weapons School was created at NAS Miramar, Calif., to remedy that situation. Despite a training structure that resisted all change, the school, popularly known as Top Gun, survived. The dividends came at war's end, when Naval aviators were racking up a kill ratio of better than twelve to one. John Wiley & Sons, Inc., New York, N. Y., 1990. 295 pages with photos and glossary. $22.95.

Vietnam: The Decisive Battles, by John Pimlott. This book concentrates on seventeen key battles in order to tell the military history of the Vietnam War. Each of the accounts centers around a two-page "you are there" painting that shows all of the participants at the height of an engagement, with an explanation of the battle depicted and a chronology of events. The descriptions of the battles, which range from the French defeat at Dien Bien Phu through Operation Bolo and Khe Sanh to the fall of Saigon, also include tactical maps and photographs to support the text. Numerous boxes describe key weapons or events elsewhere at the time of the battle. Macmillan Publishing Co., New York, N. Y., 1990. 200 pages with photos, maps, art, line drawings, glossary, bibliography, and index. $39.95.

Wings for the Navy: A History of the Naval Aircraft Factory, 1917–1956, by William F. Trimble. For nearly forty years, the huge Naval Aircraft Factory in Philadelphia, Pa., was the only government-owned and -operated Naval aircraft-production facility in the country. The NAF built long-range flying boats during World War I, was instrumental in developing catapults and arresting gear between the wars, and was one of the primary centers for the development of pilotless airplanes and guided missiles after World War II. With its "own" factory, the Navy was able to compare costs of aircraft and supplies bought from private contractors. The NAF was not always successful, and the mistakes are covered here as completely as the successes are. Naval Institute Press, Annapolis, Md., 1990. 413 pages with photos, appendices, notes, bibliography, and index. $35.95.

Other Titles of Note

AIM/FAR 1991, by the Tab/Aero Staff. This compilation of both the Federal Aviation Administration's *Airman's Information Manual* and the Federal Air Regulations features all of the changes made during 1990. The book also includes much additional information for pilots and others in aviation. The books are also sold separately. Tab/Aero Books, Blue Ridge Summit, Pa., 1991. 576 pages with charts, glossary, and indices. $11.95.

America's National Battlefield Parks: A Guide, by Joseph E. Stevens. This book tells the story of the fighting that took place at each of the thirty-eight battlegrounds administered by the National Park Service. It also presents detailed, self-guided walking and automobile tours keyed to Park Service numbered tour stops and other basic information. University of Oklahoma Press, Norman, Okla., 1990. 337 pages with photos, maps, and index. $29.95.

A Few Great Captains, by DeWitt S. Copp. A paperback reprint of the classic volume on the birth of airpower, this is the story of the hurdles that Frank Andrews, Henry H. "Hap" Arnold, Ira Eaker, Benjamin D. Foulois, Carl A. "Tooey" Spaatz, and their compatriots had to overcome in military aviation's struggle for acceptance. EPM Publications, McLean, Va., 1990. 530 pages with photos, notes, bibliography, and index. $19.95. ■

In this outfit, the airplanes fly but the operators (usually) don't.

The Drone Pilots

By Jeffrey P. Rhodes, Aeronautics Editor

Photos by Guy Aceto, Art Director

AS COMMANDER of the 82d Tactical Aerial Targets Squadron at Tyndall AFB, Fla., Lt. Col. Bill Boss is in charge of thirty-four aircraft. He also operates five boats. "I am the only flying squadron commander in the Air Force who has his own navy," he jokes.

Besides its seagoing commander, the 82d has other strange features. For example, most day-to-day work —launching, flying, recovering, and maintaining full-scale and subscale target drones used on the Gulf Test Range—is done by civilian contract employees.

The squadron has veteran pilots, each with more than 3,000 hours of flight time, but they don't fly in front-line aircraft. They fly in full-scale drones as safety pilots while ground controllers fly the aircraft from a remote site.

In the full-scale drone arena, the squadron is making a transition to a "new" aircraft. The 1950s-vintage Convair F-106 Delta Dart, phased out three years ago as an Air National Guard interceptor, is starting a second career as the QF-106 drone. Now fully operational, the QF-106 gives the Air Force a ma-

Showing an F-100 and an F-106 (background) on the tarmac, this photo could have been taken in the 1950s, but these aircraft are two full-scale drones flown today by the 82d Tactical Aerial Targets Squadron at Tyndall AFB, Fla. After use, subscale drones (opposite, a pair of MQM-107s with a BQM-34 in the background) are fully refurbished and live to get shot at again.


0528
MQM-10

neuverable, full-scale target capable of sustaining supersonic speeds, unlike its predecessor, the QF-100.

For all this, however, the drone-flying unit performs vital and largely unnoticed tasks. The skill with which it carries out its duties allows Air Force pilots to employ air-to-air missiles. Moreover, the unit played an important role in the late 1980s during developmental tests of the AIM-120A Advanced Medium-Range Air-to-Air Missile.

Harder Than It Looks

Flying a drone isn't like flying a radio-controlled model airplane. The operation is complex, requiring close coordination of groups on the ground and water and in the air.

Safety is a primary concern. The airspace above the Gulf Test Range is restricted, and the range's over-water location allows drones to be flown and shot at without endangering populated areas. Moreover, many flights are made within line-of-sight radar distance of Tyndall.

Before technicians launch a subscale drone, such as the Beech MQM-107 Streaker or the Teledyne Ryan BQM-34A Firebee, the 82d TATS's two twenty-three-foot-long boats patrol St. Andrew's Sound, clearing out any and all boaters. The unit also uses the government's standard Notice to Mariners to keep them away.

Boat traffic in and around the test area is monitored by a crew flying in one of the unit's two de Havilland Canada/Sierra Research E-9A aircraft. Using the plane's AN/APS-128D sea surveillance radar, the crew relays the position of boats to the ground station controlling the drone. The E-9 is also used to relay telemetry data from the missile test to the ground control station.

"We'll fly over boaters," explains Colonel Boss, "but we won't shoot missiles while we're over them."

To control full-scale and subscale drones in flight, technicians use either the radar-based Drone Tracking and Control System (DTCS) or the sophisticated, transponder-based Gulf Range Drone Control Upgrade System (GRDCUS, pronounced "gird-cuss"). A series of towers along the Florida panhandle is used to triangulate the position of the drones, relay commands to them, and receive telemetry data.

If a QF-100 or a QF-106 loses contact with the ground controllers, a preprogrammed response takes over. The aircraft automatically takes itself up to an altitude of 20,000 feet and then begins a thirty-degree, right banking turn. If the drone does not reacquire the ground control signal within six minutes, the aircraft's internal self-destruct package will blow up the drone.

The "bomb" used for self-destruction is an AIM-9 Sidewinder missile warhead carried in the aircraft. Should the drone become so badly damaged from a test missile that it can no longer be safely controlled, ground controllers blow it up on command. If a full-scale drone "turns renegade" on takeoff or landing, the controllers attempt to fly it into the ground rather than risk detonating the warhead at such a low altitude.

Overall, the aim is to keep the drones flying. Says Colonel Boss, "If the drone performs well and doesn't get shot down, it's a successful mission for us."

The subscales, roughly one-third the size of the QF-106 and the QF-100, do much less damage if they lose control. Their abort process is also less violent. When a Firebee or Streaker goes haywire, ground controllers order the offending aircraft to deploy parachutes and float to earth.

The Teledyne Ryan BQM-34A Firebee (top) has been in service for nearly four decades, but the new generation of Firebee features a digital flight-control system. The Beech MQM-107D Streaker (above) doesn't fly as fast or as high as the Firebee. Both subscale drones are shown on Tyndall's launchpad near St. Andrew's Sound.

Fetching and Fixing

A subscale drone also normally ends its mission by "hitting the chutes." If the mission was brief, the drone can be flown back to Tyndall, where it deploys its parachutes and drifts down onto a circular plowed field, two miles in diameter, near the launchpad.

The act of opening the parachute canopy shuts down the vehicle's jet engine, and the fuel drain opens and dumps out the little remaining JP-4. The parachute detaches and the fuel drain closes on impact. The Streaker comes down nose first. Its nose-

cone, made of thin aluminum packed with Styrofoam, is crushed as it absorbs the impact. The Firebee glides down more or less parallel with the ground.

When necessary, the drones parachute into the Gulf of Mexico, where they are retrieved by a crew in one of the 82d TATS's two 120-foot-long recovery ships. These vessels, built by Swiftships, feature full communications suites and even have "fish finders" to locate the wreckage of the occasional drone that sinks.

By staying in touch with ground controllers, the ship's captain generally knows where a drone will splash down. Each ship, powered by four 1,400-h.p. Detroit Diesel engines, can reach speeds of twenty-eight knots and usually arrives in the area shortly after impact.

The aluminum-hulled ships steer near the drone. The ship's crane, which can extend to forty-three feet, deploys a hook encircled by a large rubber doughnut (to minimize damage to the drone). A diver attaches the hook to the drone, and a winch pulls it aboard. Each ship has cradles for four drones, and four more can be stored on deck.

Florida Offshore, the civilian contractor running the Tyndall operation, in 1990 recovered drones valued at nearly $13 million. "We have more than paid for the entire ship operation just by the recovery of the drones we otherwise would have lost," asserts Fred Wilcox, the firm's site boat manager.

The Convair F-106 Delta Dart interceptor, phased out of ANG service three years ago, is starting its second life as a full-scale target drone. All full-scale drones' wingtips and vertical stabilizers are painted orange, but QF-106s' rudders retain the fin flash insignia of their last unit, mainly for rudder balance.

When the drone is safely aboard, workers disconnect its batteries and rinse salt water residue from the engine. Once back at Tyndall, the subscale drone is checked, stripped down by maintenance technicians, rinsed completely, and left to dry on the tarmac.

Then the unit's expert maintenance crews take over. The maintenance shop is fully self-sufficient, having sheet-metal, Fiberglas, electronics, and engine repair sections. Newly arrived drones are uncrated and assembled there. The civilian technicians even repair and repack parachutes.

"The folks in maintenance have saved drones where the only thing that was the same was the tail number," notes Colonel Boss. In fact, the unit's maintainers have more practical experience with aircraft battle-damage repair (ABDR) techniques than anybody else in the Air Force.

The General Electric J85 jet engine is still used in Air Force T-38 trainers and Firebee drones. A number of older aircraft also used that powerplant. "We went to static displays at air bases and got some spares for the J85 engines," recalls John Kotz, the subscale-drone manager. "After the parts were reconditioned, we put them in the drones and were able to save quite a bit of money."

The maintainers fix and refuel the continuous infrared (CIR) pods used on both the full-scale drones and the Streakers. These wingtip pods, manufactured by Hayes, burn liquid propane and act as heat sinks on drones that can reach 1,800 degrees Fahrenheit. Such searing heat provides a better target for infrared guided missiles, and, because the CIR pods are some distance from a drone's engine and fuselage, a direct hit will

The Gulf Range Drone Control Upgrade System (GRDCUS), a state-of-the-art computer system, can control up to four full-scale drones at one time. Above, Marty Walker, a contract software analyst, works a GRDCUS station. The control stick on the desktop is used to fly the drone.

The wing pylons on the QF-100 above have been modified with a chaff-and-flare dispenser to imitate enemy aircraft more realistically for test missiles. Drone pilots find the cockpit (below) Spartan at best. Anything unrelated to flight safety and unneeded for testing is removed. Notice the lead weights where a gunsight once was.

only destroy a wingtip, which can be replaced, and not the whole drone. This improves the odds of reusing the vehicle.

Launching and Controlling

When a drone is reassembled, it undergoes a thorough bench test. Once fully rebuilt and cleared for flight, it goes to the launchpad area, where it is inspected to make sure nothing came loose in transit. Then it is tipped up to remove air bubbles from the fuel tank.

Workers then take a weight-and-balance measurement. Next, they install the RATO (rocket-assisted takeoff) bottle and adjust it for the particular mission. The angle at which the bottle is set determines the drone's takeoff angle.

Four launch rails are available. They are compatible with either the Streaker or the Firebee. The metal rails are covered with an ablative coating to withstand intense heat produced by the takeoff and thus last longer. The countdown is computerized, but the launch director actually pushes a launch button.

"A subscale launch is the ultimate bottle rocket," says Colonel Boss. The launches are spectacular; the unit even maintains a set of bleachers (at a safe distance from the pad) to allow school groups and other spectators to watch.

The RATO bottle produces 11,000 pounds of thrust during a

burn time of two and one-half seconds. It hurls the drone to a speed that allows the drone's jet engine to sustain flight. The expended bottle usually falls from the drone over land, where contractors can recover it. Maintainers inspect the casing and, most times, refill it with solid fuel and reuse it.

The Air Force and the Navy have operated the Firebee as a target drone since the 1950s. However, BQM-34As now have a digital flight-control system allowing more precise operations. They can fly at speeds of 690 mph, reach altitudes of 60,000 feet, and cover distances of nearly 800 miles.

The Streaker doesn't fly as fast or as high as the Firebee, but the MQM-107 can still hit speeds of 594 mph and altitudes of 40,000 feet. The differences between the two drones allow simulations of different types of targets.

The DTCS was built by Vega Precision Laboratories during what Colonel Boss refers to as "prehistory." By that, he means that the system is obsolete and can only be used to control a single subscale or full-scale drone at a time. It uses pen and paper plotters and rudimentary gauges and can only be used when a drone is in flight, not during takeoff or, in the case of the full-scales, on landing.

Other Means of Control

When QF-100s are flown "nullo" (with no pilot aboard), contractor personnel control takeoffs and landings from a mobile radar van parked at the end of the drone runway, a 7,000-foot strip that has no navigation aids or lighting. The van has two radars (primary and backup) and an operator in the downstairs area who feeds information to the two operators upstairs.

These two positions, on the top of the van, are called "Echo" and "Romeo." Together, these two operators manually fly the full-scale drone during takeoff and landing. "Echo" handles pitch and power while "Romeo" controls rudder and ailerons. A number of functions are automatic to ease task saturation. Just in case he is needed, a third person, the Launch Control Destruct Officer, also sits on the roof.

Jim Wood, the flight operations manager for GE Government Services, the company that runs the drone operations at Tyndall, maintains that there are similarities between flying a plane from the truck and from the cockpit. "There is no G sensation," he says, "but you learn by experience with the drone and from what you know as a pilot."

The van personnel control the drone until it is thirteen miles downrange and 10,000 feet high. Control is then handed over to DTCS. The process is reversed for landings.

Use of the van can be eliminated when GRDCUS is used to control the drone. The much more sophisti-

The squadron's two 120-foot-long recovery ships rest at Tyndall's marina after a day of fishing subscale drones out of the Gulf of Mexico. The value of drones recovered last year more than paid the entire cost of the contract-run operation. Tyndall also has one eighty-five-foot-long boat and two twenty-three-foot-long boats.

cated GRDCUS is everything DTCS is not.

"The basic requirement for the system is to control four drones from takeoff to landing while tracking thirteen objects—four targets, four missiles, four shooters, and one other [object], such as the E-9," says Bud Dickens, the GRDCUS director.

The system consists of six mainframe computers and uses sixteen large color displays. GRDCUS and the drones "talk" to one another every millisecond. The controller can see the pilot's display, a god's-eye view of the entire airspace or just a part of it, and a real-time display of telemetry data. It takes about six months for controllers to learn the system fully.

GRDCUS really came into its own during the AMRAAM development tests. Four full-scale drones were routinely flown to put the missile through its paces.

No Hands

For human pilots, the drone business can seem pretty sporty at times. An individual pilot, for example, sometimes flies aboard a full-scale drone while the ship is being commanded by a ground controller who is practicing. This is done mainly to save the drones because, if something goes wrong, the pilot is there to take over immediately and fly or land the plane.

"You have not experienced the ultimate fear until you are being flown by a guy in a room with no windows fifty miles away," says Maj. Danny Fender, one of the active-duty pilots assigned to the 82d TATS.

A controller can't control unless he previously served as a fighter pilot, so he must stay proficient by actually flying the aircraft. However, virtually everything other than life-support equipment and basic flight instruments has been removed from the QF-100s and QF-106s. It is about as close to pure flying as you can get.

Most of the civilian technicians who maintain the drones have been at Tyndall for many years. When the contract changes, they simply switch employers.

They are experienced in switching parts between the F-100s to be flown for proficiency and those to be flown as targets. For example, because it's hard to find a flight-qualified ejection seat for an F-100, the workers will pull one from a plane when it is to be flown nullo and might not come back. Items such as gunsights are replaced with lead to compensate for the weight loss.

The QF-100s, most of which are at least thirty-five years old, are well maintained. The drones undergo a "ground wiggle" test every fourteen days to make sure the van's radar can operate the plane's control surfaces. Every fifty-six days, the aircraft are hooked up to test sets and "flown" on a simulated mission.

The first North American F-100 Super Sabres were converted into drones in 1979. The main reason the QF-100s are now being replaced is because successful missile tests have sent most of the F-100D production line to the bottom of the Gulf of Mexico.

"The F-100 could take a licking," observes Colonel Boss. "We have just a handful left, and we'll use them until they are gone." When the QF-100s are gone, DTCS will be replaced by GRDCUS and the subscale drones will be converted to operate from the newer system.

The QF-106 is the Air Force's third major full-scale drone conversion effort. Technicians at the Aerospace Maintenance and Regeneration Center at Davis-Monthan AFB, Ariz., pull the F-106s out of long-term storage and return them to flight status. The aircraft are then flown to East Alton, Ill., where American Electronic Laboratory, a subcontractor to Honeywell, converts F-106s to QF-106s. This costs about $290,000 and takes about six months for each aircraft.

"It is a fairly complicated modification effort," says Bill Tracy, QF-106 program manager at the Air Force Development Test Center at Eglin AFB, Fla., who notes that the F-106 uses mechanical linkages. "We had to install servos so it could connect with the new digital drone-control system."

Modifications include the installation of new antennas and transponders and an internal electronic countermeasures set. The underwing tank pylon is also modified to accept the ALE-40 chaff-and-flare dispenser. The plane's radar, fire-control system, and air-refueling receptacle and plumbing are removed.

The QF-106 is far different from the QF-100. "We have a study program to see if we can put an IR pod on the wingtip," notes Mr. Tracy. "The -100 could lose a wingtip [on a missile test]. The -106 has a wet wing. We're not quite sure if it is coming back if it loses a wingtip." The QF-106 also doesn't have flaps, which necessitates some procedural changes for ground controllers. ■

MILLIONS OF MEN

AND WOMEN HONOR

THIS FLAG BY

SERVING UNDER IT.

WE'D LIKE TO TAKE

THIS OPPORTUNITY

TO HONOR THEM.

BOEING

When the Japanese closed the Burma Road, the route to China was over the Himalayas by air.

Flying the Hump

By C. V. Glines

After March 1942, the Hump (here, seen from a C-87 flying from Jorhat, Assam, India) was the only route into China.

IN MID-December 1941, in the wake of Japan's massive land, sea, and air offensive in the Far East and its attack on Pearl Harbor, the Allies had no doubts about the need to support China fully to keep it in the war. China's forces would tie down Japan on the mainland. China would provide bases for attacks on Japan. In any event, Gen. Claire Chennault's China Air Task Force, the "Flying Tigers," had to be supplied.

Suddenly, in March 1942, supplying China became immeasurably harder. Japanese forces cut the Burma Road—the only overland path to China—and all land supply ceased.

The Allies came back with a response unprecedented in scope and magnitude: They began to muster planes and pilots to fly over the world's highest mountain range. The route over the Himalayas from India to Yunnanyi, Kunming, and other locations in China was immediately dubbed "the Hump" by those who flew it.

Though relatively short, the route is considered the most dangerous ever assigned to air transport. The reason is apparent from this description contained in the official Air Force history:

"The distance from Dinjan to Kunming is some 500 miles. The Brahmaputra valley floor lies ninety feet above sea level at Chabua, a spot near Dinjan where the principal American valley base was constructed. From this level, the mountain wall surrounding the valley rises quickly to 10,000 feet and higher.

"Flying eastward out of the valley, the pilot first topped the Patkai Range, then passed over the upper Chindwin River valley, bounded on the east by a 14,000-foot ridge, the Kumon Mountains. He then crossed a series of 14,000–16,000-foot ridges separated by the valleys of the West Irrawaddy, East Irrawaddy, Salween, and Mekong Rivers. The main 'Hump,' which gave its name to the whole awesome mountainous mass and to the air route which crossed it, was the Santsung Range, often 15,000 feet high, between the Salween and Mekong Rivers."

Pilots had to struggle to get their heavily laden planes to safe altitudes; there was always extreme turbulence, thunderstorms, and icing. On the ground, there was the heat and humidity and a monsoon season that, during a six-month period, poured 200 inches of rain on the bases in India and Burma.

Fifty Years Ago

If the US was to conquer such obstacles, it would have to build an organization to ensure the smooth flow of planes, people, and supplies. The seeds of such an organization already existed. On May 29, 1941—fifty years ago this spring—the US Army had created the Air Corps Ferrying Command. Out of this small organization grew the US Air Transport Command, under the command of Maj. Gen. Harold L. George.

"It seems almost incredible," Gen. William H. Tunner remarked in his memoirs, "that up until three o'clock in the afternoon of May 29, 1941, there was no organization of any kind in American military aviation to provide for either delivery of planes or air transport of materiel."

When the Japanese closed the Burma Road, the US devised an initial plan that called for sending 5,000 tons of supplies each month over the Hump into China as soon as possible. American C-47s delivered the first,

small load of supplies in July 1942. It was a meager beginning. If the resupply effort was to be greatly expanded, airfields would have to be built, pilots would have to be trained, and transports would have to be manufactured and ferried to the China-Burma-India (CBI) theater.

The air transport task in the CBI fell first to Maj. Gen. Lewis H. Brereton, commander of Tenth Air Force. The Ferrying Command was to deliver seventy-five C-47s to the CBI, but some were diverted to support British forces in North Africa. Of the sixty-two that finally reached the theater, about fifteen were destroyed or lost, and many of the rest were out of service for long periods due to a shortage of parts and engines.

It was obvious that the theater air commander should not be responsible for a supply route reaching from factories in the US to destinations in China. On October 21, 1942, Air Transport Command (ATC) officially took over the task.

Operations under ATC began in India on December 1. The original small air transport unit was established as ATC's India-China Wing. As air transport activity increased, it became the India-China Division, comprising several wings. "Every drop of fuel, every weapon, and every round of ammunition, and 100 percent of such diverse supplies as carbon paper and C rations, *every* such item used by American forces in China was flown in by airlift," General Tunner said later.

Tonnage flown across the Hump increased slowly. Thirteen bases were established in India and six in China. Curtiss C-46s gradually replaced the Douglas C-47s and C-53s. Consolidated C-87s, the cargo version of the B-24, and some war-weary B-24s were added. In December 1942, 800 net tons were delivered to China. In July 1943, 3,000 tons were delivered. The target was 5,000 tons per month, but Gen. Chiang Kai-shek, the Chinese leader, wanted more. President Franklin D. Roosevelt personally ordered the target increased to 10,000 tons a month.

"Safer to Bomb Germany"

Increases in tonnage came at great cost. In the last six months of 1943, there were 155 accidents and 168 fatalities. General Tunner commented in his memoirs, perhaps somewhat facetiously, "It was safer to take a bomber deep into Germany than to fly a transport plane over the Rockpile from one friendly nation to another."

Aircrews were in short supply. Those on hand were flying more than 100 hours per month. Pilots, most of whom had never before flown a twin-engine aircraft, were quickly recruited from among basic flying training school instructors in the Air Training Command. They were sent to bases at Assam, Karachi, and later Gaya, India, for checkout in the C-46 Commando.

Accidents mounted. Spare parts soon were in short supply. Maintenance personnel were inexperienced and worked under severe handicaps. Col. Edward H. Alexander, commander of the India-China Wing, reported, "Except on rainy days, maintenance work cannot be accomplished because shade temperatures of from 100 degrees to 130 degrees Fahrenheit render all metal exposed to the sun so hot that it cannot be touched by the human hand without causing second-degree burns."

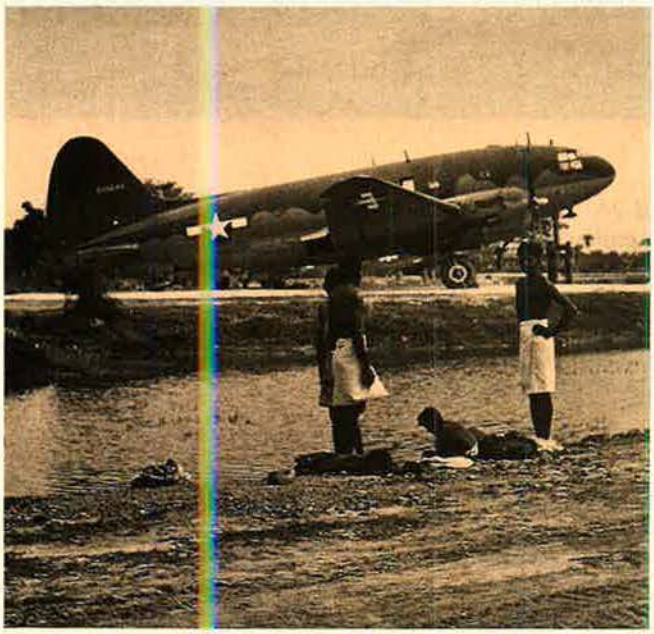
In November 1943, the ATC Ferrying Division

opened the "Fireball" run from Florida to India. C-87s and, later, C-54s were put to work flying high-priority parts from the Air Service Command depot at Patterson Field, Ohio, to India. The aircraft were based at Miami, and crews were stationed at key points along the routes to Brazil, central Africa, and India.

Emergency shipments from the States could arrive in the CBI in as little as four and a half days after order placement.

In the organization of the complex Hump operation, a key player was Brig. Gen. Cyrus R. Smith, president of American Airlines, who served as chief of staff to General George. General Smith acted as a troubleshooter. In the fall of 1943, after the operation suffered many air accidents, he visited the theater to report on conditions.

"We are paying for it in men and airplanes," General Smith reported. "The kids here are flying over their head—at night and in daytime—and they bust [the aircraft] up for reasons that sometimes seem silly. They are not silly, however, for we are asking boys to do what would be most difficult for men to accomplish; with the experience level here, we are going to pay dearly for the tonnage moved across the Hump. . . . With the men available, there is nothing else to do."



The Curtiss C-46 Commando (like this one, somewhere in the China-Burma-India theater) was the workhorse of Air Transport Command's India-China Division. The airplane was part of the Hump challenge for hastily recruited and trained ATC aircrews and pilots, and the accident rate was high.

One of the unforeseen requirements was for the establishment of a search-and-rescue organization. Many crews, forced to bail out or crash-land, struggled for weeks, despite injuries, burns, and disease, to find safety. Terrain was so rugged that survivors would spend an entire day traveling one or two miles.

In the beginning weeks, when a plane was down, the first available transport crew went in the first available aircraft to conduct the search. This quickly proved unsatisfactory.

At Chabua, Capt. John L. "Blackie" Porter, a former stunt pilot, started "Blackie's Gang" with two C-47s. His gang carried Bren .30-caliber machine guns. The copilot carried one in his lap, while the other was kept in the cargo area. They sometimes carried Thompson machine guns and hand grenades. In 1943, virtually every rescue of crew members was due primarily to the efforts of Blackie's Gang.

The Search for Sevareid

One of the first of Blackie's rescue missions was a search for the twenty crew members and passengers, including CBS correspondent Eric Sevareid, who had bailed out of a C-46 in the Naga hill country of northern Burma. The area was populated not only by Japanese, but also by headhunters *[see "America's Headhunter Allies," June 1988 issue, p. 84]*. The men were found, and supplies were dropped. Lt. Col. Don Flickinger, the wing flight surgeon, and two medics parachuted to assist the survivors. A ground party walked in and took them to safety.

After many such successes, the US created a special search-and-rescue organization with Captain Porter as its commander. He was lost in action in December 1943 while on a search mission.

In early 1944, tonnage to China reached the presidential goal of 10,000 tons per month. Soon, however, more was requested, and more was delivered. Brig. Gen. Earl S. Hoag, in charge of the India-China Wing at the beginning of that year, predicted that his men would deliver 77,000 tons during the last six months of 1944. His estimate was too conservative; more than twice that much was delivered. The rapid rise stemmed from a sharp increase in the number of aircraft and men, assigned to back up decisions made by President Roosevelt, British Prime Minister Winston Churchill, and the Combined (UK-US) Chiefs of Staff at a June 1944 strategy meeting.

General Tunner took command of the India-China Division of ATC in August 1944. A 1928 West Point graduate and strict disciplinarian, he made many changes in the interest of efficiency. One significant innovation was the introduction of production line maintenance, the brainchild of Lt. Col. Bruce White, a former executive with Standard Oil of New Jersey in China.

Planes brought in for maintenance would pass through three to ten stations as if on a factory production line. At each station, a plane would go through different maintenance functions. A rigorous inspection completed the procedure. If approved, each aircraft would be test-flown before being sent back to the line.

The concept became standard practice throughout the Army Air Forces on bases with large numbers of a single type of aircraft.

When General Tunner arrived, pilots rotated out after 650 hours of flying time. Many pilots were flying as much as 165 hours a month in order to pile up the time and go home quickly. General Tunner's flight surgeon reported that fully half of the men were suffering from operational fatigue. Several accidents stemmed directly from such fatigue.

General Tunner immediately increased to one year the time a pilot would remain in the theater. He also increased the number of flying hours to 750. "It didn't make the pilots happy," the General wrote later, "but . . . it kept quite a few of them alive."

"One hundred percent of such diverse supplies as carbon paper and C rations, every such item used by American forces in China was flown in by airlift," said Gen. William H. Tunner, who took command of the India-China Division in 1944. These infantrymen, loading C-47s in Burma, could testify to the diversity of the cargo.

The Accident Rate Declines

He appointed Col. Robert D. "Red" Forman as chief pilot, and, as training improved, the accident rate began to decline. When General Tunner took over the India-China Division, four-engine Douglas C-54s were being introduced. They could carry three times the load of the C-47s and would eventually replace them and the C-46s. As the Air Force history states, the operation brought airlift into "the age of big business."

General Tunner felt that his hard-nosed management approach would result in improved efficiency and performance. "I had been sent to this command to direct American soldiers, and while I was their commander, by God, they were going to live like Americans and be proud they were Americans."

General Tunner inaugurated malaria-prevention spraying operations, using stripped-down B-25 "Skeeter Beaters." According to Tunner, this, combined with the use of repellents and mosquito nets, drove down the incidence of disease.

In 1944, General Tunner changed the route of the C-54 flights, creating a more direct flight to China. This placed the transports over 150 miles of Japanese-held territory and within range of Japanese fighters. To defend his aircraft, he requested and received fighter protection. "Enemy action was of little consequence" afterward, he reported.

Another area that needed improvement, as far as General Tunner was concerned, was the search-and-rescue capability, which he called "a cowboy operation." He appointed Maj. Donald C. Pricer, a Hump pilot, as commander of the unit and assigned to the job four B-25s, a C-47, and an L-5, all painted yellow. One of the first tasks was to pinpoint all known aircraft wrecks in the theater, the better to eliminate "duplication of work, for, after all, aluminum was scattered the length and breadth of the route."

It was during this period, moreover, that the helicopter was introduced into the theater and began to prove its potential as a rescue vehicle *[see "The Skyhook," July 1988 issue, p. 104].*

General Tunner ordered each base to establish a jungle indoctrination camp, with mandatory attendance for all new arrivals in the theater. Newcomers had to spend time in the jungle under the supervision of trained guides.

The General encouraged the introduction of competition into the operation and challenged each unit to beat its own records and those of other units. He authorized the publication of a newspaper, with prominent display given to tonnages carried over the Hump by individual units. He also encouraged the creation of press releases. One told of training elephants to load drums of gasoline quickly aboard aircraft. The photo that accompanied this story reached hundreds of newspapers.

The success of the Hump operation under ATC became apparent from statistics released on August 1, 1945. On that day, the command had flown 1,118 round trips, with a payload of 5,327 tons. A plane crossed the Hump every minute and twelve seconds; a ton of materiel was landed in China four times every minute. All of this was accomplished without a single accident.

When the war was over, Air Force historians added up the figures. The peak month was July 1945, when 71,000 tons of cargo were carried. Some 650,000 tons of gasoline, munitions, other materiel, and men had been flown over the Hump during the airlift, more than half of the tonnage delivered in the first nine months of 1945.

Besides helping to defeat Japan, the Hump operation was the proving ground for mass strategic airlift. The official Air Force history comments: "Here, the AAF demonstrated conclusively that a vast quantity of cargo could be delivered by air, even under the most unfavorable circumstances, if only the men who controlled the aircraft, the terminals, and the needed materiel were willing to pay the price in money and in men." ■

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. His most recent article for AIR FORCE *Magazine, "In Pursuit of Pancho Villa," appeared in the February 1991 issue.*

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

AFROTC Support

The **General E. W. Rawlings (Minn.) Chapter** has long recognized that support of ROTC is one of its top missions. Its good work in this area paid off abundantly this year. Doyle E. Larson, president of Minnesota AFA, attending a Commander's Call at the University of Minnesota to present a Medal of Merit to State Vice President for ROTC Affairs Col. Dave Dean, was called to the podium to receive a remarkable set of documents. Fifty-six cadets and staff members of the University of Minnesota AFROTC Detachment had signed up for membership in AFA, which translates to a membership rate of 100 percent. Mr. Larson was understandably pleased and offered heartfelt thanks and appreciation to Colonel Dean, the first occupant of his current post, who has taken cooperation between AFA and AFROTC to a higher level.

The Rawlings Chapter has picked up in 1991 where it left off in 1990. Last year, the chapter distributed $54,000 in ROTC scholarships, and already this year it has provided $25,000 to four ROTC detachments.

Massachussetts AFA has also taken steps to tighten AFA-AFROTC cooperation. Through an innovative program, five outstanding cadets from Massachusetts AFROTC detachments attended AFA's National Convention, all expenses paid, in return for staffing the State Hospitality Suite. The cadets, Andrew Schaffer of the University of Massachusetts, Chance Saltzman of Boston University, Christopher Hollinger of the Gordon College division of the University of Lowell, and Paul Kahn of the Massachusetts Institute of Technology,

Former New York State AFA President and National Vice President (Northeast Region) Thomas Hanlon and his wife Barbara display the presidential citation he received at a testimonial dinner in Buffalo, N. Y. The Hanlons are flanked by New York State President Vincent Tampio (left) and National Director William Rapp.

Jack Loosbrock, Former Editor, Dies

John F. Loosbrock, longtime editor of AIR FORCE Magazine, subsequently its publisher, and Deputy Executive Director of the Air Force Association, died January 7. He was seventy-two.

From 1951 until his retirement in 1980, Jack Loosbrock—in roles ranging from writer and editor to manager and problem-solver—was often AFA's solution to predicaments as they arose. In all of this, he worked closely with his friend and colleague, AFA Executive Director Jim Straubel, who preceded him in death on December 15.

Many in AFA will recall him as unflappable under pressure and the master of the well-crafted phrase. Conversation with Loosbrock was never dull. Those he supervised and taught (and with him, the two were usually synonymous) remember his special ability to inspire, motivate, and reassure.

Jack Loosbrock was born in Omaha, Neb., and educated at Marquette University. During World War II, he was an infantry officer, decorated for his performance in combat. He joined AFA in 1951 as managing editor of AIR FORCE Magazine. After his retirement from AFA, he was vice president for Public Affairs for the Aerospace Industries Association from 1980 to 1986.

He is survived by his wife, the former Renée Armine; two daughters, Mary L. Miers of Bethesda, Md., and Madonna Minarick of San Antonio, Tex.; a son, John F. Loosbrock III, of Deland, Fla.; and three stepsons, Neil, Douglas, and Eric Armine.

got a firsthand look at the inner workings of AFA, heard speakers from the top civilian and military echelons of the Defense Department, and met with such luminaries as John L. Levitow, recipient of the Medal of Honor. In return, Massachusetts AFA got top-notch, enthusiastic work from the cadets, making the Hospitality Suite a popular spot at the Convention.

Massachusetts President David R. Cummock had high praise for the program, terming it "mutually beneficial" and saying that the improvement in AFA-AFROTC relations "far outweighs the monetary cost." He singled out the originator of the program, Capt. John B. Steele, the Arnold Air Society advisor at Det. 370, University of Massachusetts, for special praise. Mr. Cummock also recognized the important contributions of Capt. David U. Peay of Det. 355, Boston University, who made travel and other arrangements for the cadets.

The **Piedmont (N. C.) Chapter** hopes that its recent tree-planting efforts in conjunction with AFROTC cadets in the Neil Armstrong Chapter of the Arnold Air Society will result in a living monument to the cooperation between the two organizations. In the aftermath of the destruction wrought by Hurricane Hugo and in keeping with the Arnold Air Society's national ecological project, the Armstrong Chapter sought to replace trees uprooted on its campus at the University of North Carolina–Charlotte. Piedmont Chapter President Floyd S. Wilson made sure that the cadets had the full support of the Piedmont Chapter, and the first tree, a red maple, was planted late last year. Mr. Wilson, Cadet Capt. Jay Stewart, and UNCC Dean of the College of Education and Allied Professions Dr. Bill Heller took part in the ground-breaking.

Behind Desert Shield

Operation Desert Shield (predecessor to Desert Storm) riveted the attention and support of AFA members across the nation. In Illinois, the **Greater Rockford (Ill.) Chapter** received a Desert Shield briefing that Chapter President Jim Larkins deemed "superb." Meeting jointly with the National Contract Management Association, the Rockford Chapter hosted Lt. Col. Rich Anders and Lt. Cindy Trevino of the ANG's 126th Air Refueling Wing. Colonel Anders, the wing's director of Operations, presented a fine overview of air refueling and the role of the air reserve forces. Next, the audience of more than 100 heard Lieutenant Trevino's vivid account of the exceedingly different culture encountered by Americans in Saudi Arabia. Aided by slides and videotape, the Lieutenant gave the audience an idea of the many adjustments that US service members, especially women, have had to make during the operation.

The **Jerry Waterman (Fla.) Chapter,** in concert with several other organizations, tried to ease the sense of deprivation felt by the dependents of those on duty in the Persian Gulf. They hosted a holiday party on December 22 for 1,000 spouses and children of USAF, Army Reserve, Marine Reserve, and Florida Air National Guard personnel in the Tampa, Fla., area, who have deployed to Saudi Arabia. The Waterman Chapter, along with the Professional Partners of the Red Cross, the Military Affairs Council of the Tampa Chamber of Commerce, the city of Tampa, USAA, and local media outlets, provided a gift for each child attending and gift certificates and other prizes for the spouses. Bill Myers of the International Independent Showmen's Association provided rides and entertainment for the children, contributing to the party's exceptional success.

Members of the **Gen. Bruce K. Holloway (Tenn.) Chapter** got a striking insight into the magnitude of the airlift side of Desert Shield. Meeting with

Coming Events

May 10–11, **Maryland State Convention,** Andrews AFB, Md.; May 10–12, **North Dakota State Convention,** Minot, N. D.; May 17–18, **Alaska State Convention,** Anchorage, Alaska; May 17–18, **South Carolina State Convention,** Myrtle Beach, S. C.; May 31–June 2, **Alabama State Convention,** Mobile, Ala.; May 31–June 2, **New York State Convention,** Niagara Falls, N. Y.; June 7–9, **New Jersey State Convention,** Atlantic City, N. J.; June 8, **Missouri State Convention,** Whiteman AFB, Mo.; June 14–16, **Mississippi State Convention,** Biloxi, Miss.; June 15, **Georgia State Convention,** Atlanta, Ga.; June 21–22, **Arkansas State Convention,** Hot Springs, Ark.; June 21–22, **Ohio State Convention,** Youngstown, Ohio; June 22, **New Hampshire State Convention,** Pease AFB, N. H.; June 28–29, **Louisiana State Convention,** Bossier City, La.; July 13, **Kansas State Convention,** Wichita, Kan.; July 19–20, **Colorado State Convention,** Lowry, Colo.; July 19–21, **North Carolina State Convention,** MCAS Cherry Point, N. C.; July 19–21, **Pennsylvania State Convention,** Pittsburgh, Pa.; July 19–21, **Texas State Convention,** San Antonio, Tex.; July 21, **Delaware State Convention,** Dover, Del.; July 25–28, **Florida State Convention,** St. Augustine, Fla.; July 26–28, **Virginia State Convention,** Crystal City, Va.; August 2–3, **Minnesota State Convention,** Hinckley, Minn.; August 3, **Indiana State Convention,** Bloomington, Ind.; August 15–17, **California State Convention,** Edwards AFB, Calif.; August 22–24, **Utah State Convention,** Ogden, Utah; September 6–7, **Washington State Convention,** Seattle, Wash.; September 16–19, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C.

USAF Squadron Officer School Commandant Brig. Gen. Elwood P. Hinman talks to a group of Arnold Air Society AFROTC cadets after his speech at the AAS Bi-Area Conclave in Blacksburg, Va. National Vice President (Northeast Region) R. Donald Anderson and other AFA officials also addressed the conclave.

the Chambers of Commerce of Knoxville, Maryville, and Oak Ridge and with local Kiwanis Clubs, chapter members were told by Military Airlift Command's Deputy Chief of Staff for Operations Maj. Gen. John M. Nowak that by mid-November the amount of personnel and supplies delivered was equivalent to the transport of the citizens of Knoxville (population: 175,400), together with their personal belongings, to Saudi Arabia. Noting that the operation had already surpassed the Berlin Airlift in terms of tonnage delivered, the General asked the audience to envision a line of midsize cars ten abreast, extending from Atlanta to St. Louis. That image would help them understand the scope of the airlift required for Desert Shield.

Among those who heard the General's address were Knoxville Mayor Victor H. Ashe; Knox County Executive W. Dwight Kessel; Col. Rex Jones, professor of air science at the University of Tennessee; Rev. Ted F. Baker of the First United Methodist Church; and Wayne L. Stephenson, Tennessee AFA president. Brig. Gen. Walter J. Bacon, USAF (Ret.), served as toastmaster, and Jack K. Westbrook was chairman of the highly successful luncheon meeting.

Chapter Members Honored

Paul McVey, **Contrails (Kan.) Chapter** president, and Kenneth Hagler, former Contrails treasurer, each received Medals of Merit in honor of their long service to AFA. The medals were presented by State President Samuel M. Gardner during ceremonies at Garden City, Kan.

Gen. James E. Hill, USAF (Ret.), an active member of the **Colorado Springs/Lance Sijan (Colo.) Chapter,** was recently inducted into the Colorado Aviation Hall of Fame. General Hill had a distinguished thirty-seven-year Air Force career, including achievement of ace status in World War II and culminating as commander in chief of NORAD before his retirement in 1979. Inducted along with General Hill was William Feder. Mr. Feder, a former president of the **Mel Harmon (Colo.) Chapter,** is a thirty-year veteran of the Civil Air Patrol and was instrumental in the creation of the International B-24 Museum.

Col. Kenneth Herman, USAF (Ret.), a member of the **San Bernardino (Calif.) Chapter,** was recently elected president of the newly chartered Berlin Airlift Veterans Association, an organization whose objectives include preserving the memory of the Berlin Airlift and supporting current airlift activities.

Bill Shea, a member of the **Ak-Sar-Ben (Neb.) Chapter,** received an expression of gratitude at the Aviation 2000 conference from Omaha Mayor J. P. Morgan for his current service as director of the Aviation Institute at the University of Nebraska at Omaha and for past accomplishments as FAA Associate Administrator for Airports.

Have AFA News?

Contributions to "AFA/AEF Report" should be sent to Dave Noerr, AFA National Headquarters, 1501 Lee Highway, Arlington, VA 22209-1198. ■

Bulletin Board

Seeking contact with anyone who served with the **3920th Air Police Squadron** at RAF Brize Norton, England, between 1955 and 1957. **Contact:** Richard Gamache, 110 Beaumont Ln., Palm Beach Gardens, FL 33410.

Seeking information on how the **F-89D #111330 was moved to the Chicago lakefront** in the summer of 1955 for its participation in a General Motors show called "Powerama." **Contact:** David Menard, 5224 Longford Rd., Dayton, OH 45424.

Seeking contact with Air Force personnel who were involved with developing plans for a **lunar base and lunar observatory** during the late 1950s. **Contact:** Jeffrey Richelson, 5 W. Glebe Rd., C-24, Alexandria, VA 22305.

Seeking information on the following aircraft and nose art: **a B-24 with the name *Ruby's Rickshaw*** and a picture of a woman in a rickshaw cracking a whip while being pulled by a Japanese; a **P-40 called *Rosy Cheeks,*** painted with a large-busted woman with stockings and a very short skirt, walking; and a C-47 showing a topless Hawaiian dancer. **Contact:** J. R. "Bill" Bailey, 1541 Eastwood Dr., Slidell, LA 70458.

Seeking contact with **SSgt. John Breen** and **SSgt. Carl Ruehl,** waist gunners who bailed out of aircraft #376 on August 31, 1943, after a mid-air collision. Also seeking contact with **John Connors,** who was with Company E, Air Corps Recruit Det., Kelly Field, Tex., in June 1941. **Contact:** George Collins, Rte. 1 Box 1032, Niceville, FL 32578.

Seeking contact with members of **pilot Class 47-C,** who started pilot training at Randolph AFB, Tex., in September 1946. **Contact:** Maj. William R. Forrester, Jr., USAF (Ret.), 304 Lynch St., Edgefield, SC 29824.

Seeking people who are interested in the preservation of **B-17s. Contact:** The B-17 Association, 6 Seedy Mill, Hanch, Lichfield WS13 8HQ, England.

Seeking contact with members of the **354th Fighter Group** or the **10th Photo Reconnaissance Squadron,** stationed at Finthen Airfield (also called Ober Olm Airfield), near Mainz, Germany, in 1944–45. Also seeking contact with P-40 pilots or crew members interested in sharing photos, books, manuals, and reminiscences for a future book. **Contact:** David S. Dunlap. 7301 Lafayette Square, Aliquippa, PA 15001.

Seeking contact with associations for the following World War II Bomb Wings: **100th, 509th,** and **340th. Contact:** SSgt. Victoria L. Shirkey, USAF, Whiteman Heritage Center, P. O. Box 6074, Whiteman AFB, MO 65305-5000.

Seeking contact with other **model-builders** to sell or swap kits, photos, and information. **Contact:** Michael T. Vinogradov, Bolshoi Prospect P. S. 71-4, Leningrad 197101, USSR.

Seeking contact with **Byron "Buzz" Howard,** whose last known address, in 1977, was with the 463d TAW at Dyess AFB, Tex. **Contact:** L. B. Groover III, 103 Appleseed Ct., Peachtree City, GA 30269.

Seeking contact with **P-47 Thunderbolt pilots** who were in Europe in 1944 and remember investigating a single RCAF Halifax Bomber, with wheels down, on a course for Germany. **Contact:** Tom Stephens, R. R. #3, Tweed, Ontario K0K 3J0, Canada.

Seeking information on the whereabouts of **Kaven Paine,** USAF, who was stationed at RAF Mildenhall, England, in 1986. **Contact:** Julie Nelson, 5 Paine Rd., Heartsease Estate, Norwich, Norfolk NR7 9UN, England.

Seeking color slides or photos of the **RF-51s flown by the 45th TRS** at Kimpo, Korea, in 1952–53. **Contact:** Maj. Gary E. Sparks, USAF (Ret.), 1332 S. Camino Seco, Tucson, AZ 85710.

Seeking the whereabouts of the following people who were at Elmendorf AFB, Alaska in 1955–57: **Sgt. James Nail, Sgt. C. C. Patton, Sergeant Sasser,** and **Amn. Hubert Milton Fogel. Contact:** Douglas Jameson, 2442 E. Maple Ave., Flint, MI 48507.

Seeking the whereabouts of **Lt. Robert H. McCoy** and **Lt. Robert E. Buck,** both of the 678th Bomb Squadron, 444th Bomb Group, 58th Bomb Wing. **Contact:** W. R. Cundell, 17 Brookway Dr., Greensboro, NC 27410.

Seeking contact with former members of the **15th Tow Target Squadron** who served on Shemya in the Aleutians from 1943 to the end of World War II. **Contact:** Richard Amon, 6609 Ashton Dr., Sebring, FL 33870.

Seeking information on the whereabouts of **TSgt. Alan B. Olkives** and **A1C James Emery,** who were stationed at Clark AB, the Philippines, in 1966. **Contact:** Charles Connor, 9 Payne Ave., Runnemede, NJ 08078.

If you need information on an individual, unit, or aircraft, or if you want to collect, donate, or trade USAF-related items, write to "Bulletin Board," AIR FORCE Magazine, 1501 Lee Highway, Arlington, Va. 22209-1198. Letters should be brief and typewritten. We cannot acknowledge receipt of letters to "Bulletin Board." We reserve the right to condense letters as necessary. Unsigned letters are not acceptable. Items or services for sale or otherwise intended to bring in money will not be included. Photographs cannot be used or returned.—THE EDITORS

Seeking the whereabouts of **Sgt. Gabriel Sanchez** of Del Monte, Calif., **Sgt. John Maddox** of Brooklyn, N. Y., and **TSgt. Raymond "Pete" Leach** of Pusan, South Korea, who were all with the 11th Tactical Reconnaissance Squadron at Udorn AB, Thailand, in 1968–69. **Contact:** Bill Crean, 224 Paddock Way, Delran, NJ 08075-1629.

Seeking contact with members of **K-5 BNS Section** of the 47th A&E Squadron who were at RAF Sculthorpe or RAF Alconbury, England, during 1958–59. **Contact:** MSgt. Guy K. Moore, USAF (Ret.), 104 N. Crescent Dr., Blytheville, AR 72315.

Seeking the whereabouts of **George McLauchlan** and **Marty Howard,** who were in the 18th Bomb Squadron, 34th Bomb Group, at Westover Field, Mass., in 1941. **Contact:** Ernest T. "Mo" Moriarty, W. 105 Warwick Rd., Orange, MA 10364.

Seeking World War II airborne and ground **radio sets** and Signal Corps–related equipment. Also seeking radio manuals and Technical Orders for radio equipment of this era. **Contact:** Dallas Watson, 5900 N. Braeswood #109, Houston, TX 77074.

Seeking photos of the nose art of a **B-24D named *Penelope,*** serial number 42-40195-F. **Contact:** Byron Sibbet, P. O. Box 18609, 7301 N. E. Loop 820, North Richland Hills, TX 76180.

Seeking information on and photos of a **B-25 named *Lynette,*** which was stationed in or near North Africa during World War II. **Contact:** Lynette Burke, 2603 Wildwood Dr., Haughton, LA 71037.

In order to trade patches and pictures, I am seeking correspondence with paratroopers from the **82d or 101st Airborne Divisions** taking part in Operation Desert Storm. **Contact:** Antoine J. Givaudon, 34 la Gaillarderie, 78590 Noisy le Roi, France.

Seeking the whereabouts of the crew of a **B-17 that crash-landed in occupied France on December 31, 1943.** Also, my footlocker was left at RAF Podington, England. What are the chances it is still in storage somewhere? **Contact:** Herbert Brill, 4800 Cortland Dr., Corona Del Mar, CA 92625.

For a book on development of the flying wing, I am seeking contact with people who were involved in flight testing, servicing, maintenance, and modification of the **YB-49-XB-35 at Muroc Field, Calif.,** between 1946 and 1950. Also seeking those involved with the N-1M and N-9M series of aircraft from 1941 to 1945. **Contact:** Dennis Miller, 12541 Day Rd., Mishawaka, IN 46545.

Seeking information, photos, and correspondence with anyone who was **stationed in Thailand during the Vietnam War,** especially with special operations personnel and FACs. **Contact:** Richard Anderson, 631 Green Ave. SW, Massillon, OH 44647.

Collector wishes to obtain **A-2 and other leather flight jackets.** Also seeking other World War II aviation items and Vietnam-era medical unit and Dust-Off patches. **Contact:** Maj. Charles C. Blanchard III, USAF (Ret.), 145 Lanman Rd., Niceville, FL 32578.

Seeking the whereabouts of **1st Lt. Robert E. Mills,** a navigator assigned to the 487th Bomb Group stationed in Lavenham, England, near Cambridge, during World War II. He flew thirty-four combat missions over Europe. **Contact:** Allen Booth, 446 Waterbury Dr., Fayetteville, NC 28311-1308.

Collector seeks **space memorabilia** from the US and Soviet Union, especially items flown in space and material from spacecraft. Have material that was carried on the moon during Apollo missions to trade. **Contact:** Dennis K. Bylina, P. O. Box 25844, Colorado Springs, CO 80936.

Seeking contact with the following B-17 crew members of the 390th Bomb Group, World War II: **Lt. George McKee,** pilot; **Douglas G. Grant,** co-pilot; **John R. McLaughlin,** bombardier; **Felix Sparacino,** gunner, and **John Delaloye,** radar operator. **Contact:** Mannie Banner, 5725 Templar Crossing, West Bloomfield, MI 48322.

The Berlin Airlift Veterans Association is seeking contact with all personnel who served on or supported the **Berlin Airlift. Contact:** Joseph Studak, 3204 Benbrook, Austin, TX 78758.

Seeking information on the whereabouts of a **silver pheasant,** awarded by the town of Hunstanton, Norfolk, England, to the 47th Bomb Wing at RAF Sculthorpe in 1953 in thanks for its lifesaving efforts during the severe winter floods. **Contact:** Herbert Foster, 58 Hammerton St., Pudsey, West Yorkshire LS28 7DD, England.

Seeking contact with a present or former member of the **310th Air Refueling Squadron** or the historian for that unit. I have a brass plaque for the Ellis Award for the period from May to August 1960 for that squadron. **Contact:** Lt. Col. J. R. Leech, USAF (Ret.), 3618 Saint Moritz St., Orlando, FL 32812.

Seeking information on or photos of **air ambulances prior to World War II,** especially prior to 1930. **Contact:** Col. David M. Lam, Hq. USEUCOM, Box 471, APO New York 09128.

Seeking contact with individuals involved in the production, issue, and use of **silk or fabric maps.** I especially would like to contact those who used them for survival or escape. **Contact:** Terrill M. Aitken, Oregon Military Museum, Camp Withycombe, Clackamas, OR 97015.

Seeking contact with retired chief master sergeants in the **Aircrew Life Support** career field. **Contact:** CMSgt. James P. Rooney, 1128 Dimrock, Schertz, TX 78154.

Collector seeks USAF and USAAF aircraft **cockpit items,** also diaries, logs, pictures, and other memorabilia for a future museum. **Contact:** Robert Hill, 4563 Coachman Cir., Las Vegas, NV 89119.

Seeking information on any publications about the **Air Transport Command** in the western Pacific after World War II. **Contact:** William R. Nelson, 1801 Williams St., Suite 201, Denver, CO 80218.

Bulletin Board

Seeking information on **USAAF/USAF Training Groups and Wings** from 1945 to 1977. **Contact:** John Turford, 6-66 Elora Dr., Hamilton, Ontario L9C 7B3, Canada.

Seeking information on an **attempt to teach chimpanzees to fly airplanes** at Shaykh Uthman, Yemen, in 1942–43. **Contact:** Craig Wilson, Features Dept., Akron Beacon Journal, 44 E. Exchange St., Akron, OH 44308-0640.

Seeking contact with **Canadians who served in the US forces** during World War II and with Americans who served in the Canadian forces. **Contact:** Fred Gaffen, 82 Florizel Ave., Nepean, Ontario K2H 9R1, Canada.

Seeking alumni of the **Hahn American High School** at Hahn AB, West Germany, who attended in the 1970s and 1980s. **Contact:** Jane M. Endres, P. O. Box 9051, Austin, TX 78766-9051. ■

Unit Reunions

Air Forces Escape and Evasion Society
The Air Forces Escape and Evasion Society will hold a reunion May 1–5, 1991, in Irvine, Calif. **Contact:** Clayton C. David, 19 Oak Ridge Pond, Hannibal, MO 63401. Phone: (314) 221-0441.

Canberra Ass'n
Former B-57 Canberra crew members will hold a reunion August 30–September 2, 1991, at the Red Lion Inn Hotel in Sacramento, Calif. **Contact:** Reginald Petty, 9127 Green Ravine Ln., Fair Oaks, CA 95628. Phone: (916) 988-8215.

NCANG Jet Fighter Pilots
The North Carolina ANG F-86 Jet Fighter Pilots/156th Fighter Squadron will hold a reunion June 14–15, 1991, at the Ramada Inn Hotel in Charlotte, N. C. **Contact:** Blaine B. Nash, 918 Hartford Ave., Charlotte, NC 28209. Phone: (704) 523-3054.

Red River Valley Fighter Pilots
Members of the Red River Valley Fighter Pilots Association "River Rats" will hold a reunion April 24–28, 1991. **Contacts:** Patti Sheridan, 6237 S. Greenwich Rd., Derby, KS 67037. Phone: (316) 788-7525. Col. Bill Schwob, USAF (Ret.), 5915 Winding Ridge, San Antonio, TX 78239. Phone: (512) 656-4336.

Santa Ana AAB
A fiftieth-anniversary reunion of the Santa Ana (Calif.) AAB Wing (SAAAB) will be held April 20, 1991, at the Orange Coast College in Costa Mesa, Calif. Former cadets, military and civilian personnel, and guests are invited. **Contact:** SAAAB Wing, P. O. Box 1764, Costa Mesa, CA 92628. Phone: (714) 631-5918.

Shaw Field
Personnel assigned to Shaw AAF, S. C., between 1941 and 1947, including permanent party and student pilots, will hold a fiftieth-anniversary reunion August 23–25, 1991, in Sumter, S. C. Personnel assigned to Shaw AFB after 1947 are also invited. **Contact:** Ralph G. MacDonald, P. O. Box 534, Shaw AFB, SC 29152-0534. Phone: (803) 773-7591.

Shemya Veterans
Personnel stationed on Shemya Island between 1943 and 1945 (all services) will hold a reunion August 5–10, 1991, in Dayton, Ohio. **Contact:** Maj. James H. Sample, USAF (Ret.), 608 N. Colbert, Sherman, TX 75090. Phone: (903) 893-0180.

1st Air Commando Ass'n
Members of the 1st Air Commando Association who served in the China-Burma-India theater will hold a reunion May 30–June 2, 1991, at the Holiday Inn Central Hotel in Omaha, Neb. **Contact:** Duane K. Fudge, Box 326, Newman Grove, NE 68758. Phone: (402) 447-2271.

3d Airborne Command Control Squadron
Members of the 3d Airborne Command Control Squadron will hold a reunion May 28–31, 1991, at Grissom AFB, Ind. **Contacts:** Jack Suggs, 7645 Oak Leaf Dr., Santa Rosa, CA 95409. Phone: (707) 538-3192. Don Wilson, Rte. 1, Box 574-A, Tupelo, MS 38801. Phone: (601) 680-4972. Chase Huber, 2 Parkway Terrace, Peru, IN 46970. Phone: (317) 473-4314 or (317) 473-5551.

9th Bomb Group
Members of the 9th Bomb Bomb Group will hold a reunion May 9–12, 1991, in Colorado Springs, Colo. **Contact:** Herbert W. Hobler, 295 Mercer Rd., Princeton, NJ 08540. Phone: (609) 921-3800.

19th Bomb Group
Members of the 19th Bomb Group will hold a reunion June 13–15, 1991, in San Antonio, Tex. **Contacts:** James A. Kiracofe, 274 Quinn Rd., West Alexandria, OH 45381. Phone: (513) 839-4441. Robert E. Ley, 3574 Wellston Ct., Simi Valley, CA 93063. Phone: (818) 703-7717.

20th Air Depot Group
Members of the 20th Air Depot Group and attached squadrons who served in New Orleans, La., North Africa, and Italy between 1942 and 1945 will hold a reunion August 22–25, 1991, at the Stouffer Dublin Hotel in Dublin, Ohio. **Contact:** Norman H. Lane, 12917 Jerome Rd., Plain City, OH 43064. Phone: (614) 873-4300.

29th Air Service Group
The 29th Air Service Group, 13th Air Force, and attached units will hold a reunion July 8–13, 1991, at the Adam's Mark Hotel in Charlotte, N. C. **Contact:** Frank Pace, 315 W. 15th St., Dover, OH 44622. Phone: (216) 343-7855.

Class 42-B
Members of Class 42-B will hold their fiftieth-anniversary reunion May 11–15, 1991, in Colorado Springs, Colo. **Contact:** Len Horner, 4410 Marigold Ln., Littleton, CO 80123.

Class 43-F
Members of Class 43-F (Luke Field, Ariz.) will hold a reunion in May 1991 at Disneyland in Anaheim, Calif. **Contact:** Ed Pawlak, 629 Delano, Prescott, AZ 86301.

Class 44-K
Members of Class 44-K (Vernon, Enid, and Altus) will hold a reunion June 27–29, 1991, in Des Moines, Iowa. **Contacts:** Lt. Col. James F. Mulligan, USAF (Ret.), 1665 Westridge Dr., Dubuque, IA 52001. Phone: (319) 582-0411. Doug McLaren, 1117 W. Hovey, Normal, IL 61761. Phone: (309) 454-7962.

58th Bomb Wing
Members of the 58th Bomb Wing (40th, 444th, 462d, and 468th Bomb Groups and 25th, 28th,

78th, and 86th Air Service Groups) who served in China, India, and Tinian during World War II will hold a reunion August 21–25, 1991, in Oshkosh, Wis. **Contacts:** Clarence M. Miller, 8149-K N. 107th St., Milwaukee, WI 53224. Phone: (414) 355-8611. John Roman, Jr., 106 Cassidy Ct., Cary, NC 27511. Phone: (919) 469-3436.

58th Fighter Ass'n
The 58th Fighter Association, which includes veterans of the 58th Pursuit Group and 58th Fighter Group (World War II), 58th Fighter Bomber Wing (Korea), and 58th Tactical Training Wing (Luke AFB), will hold a fiftieth-anniversary reunion June 6–9, 1991, in Phoenix, Ariz. **Contact:** Anthony J. Kupferer, 2025 Bono Rd., New Albany, IN 47150. Phone: (812) 945-7649.

Class 70-08 (H)
Members of Pilot Training Class 70-08 who were trained between June 1969 and June 1970 at Randolph AFB, Tex., are planning to hold a reunion in July 1991. **Contact:** David R. Smith, 21606 N. E. 73d Pl., Redmond, WA 98053. Phone: (206) 868-4727.

90th Bomb Group
The 90th Bomb Group (Western Division), which served during World War II, will hold a reunion May 16–18, 1991, in Santa Maria, Calif. **Contact:** Irvin Hartman, 233 E. Foster Rd., Santa Maria, CA 93455. Phone: (805) 937-1856.

303d Bomb Group
Members of the 303d Bomb Group "Hell's Angels" who served during World War II will hold a reunion May 24–28, 1991, at the Marriott Hotel in Schaumburg, Ill. **Contact:** Lt. Col. Harold A. Susskind, USAF (Ret.), 2602 Deerfoot Trail, Austin, TX 78704. Phone: (512) 441-6475.

312th Bomb Group
The 312th Bomb Group will hold a reunion August 22–25, 1991, at the Radisson Hotel in Pittsburgh, Pa. **Contact:** Paul M. Stickel, 1136 Gray Ave., Greenville, OH 45331. Phone: (513) 548-5767.

314th TCW/TAW
Veterans who served with the 314th Troop Carrier Wing/Tactical Airlift Wing will hold a reunion May 23–26, 1991, at the Marriott Hotel in Nashville, Tenn. **Contact:** Bart McCarthy, 361 Monaco Dr., Hermitage, TN 37076. Phone: (615) 885-3689.

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.

315th Fighter Squadron
The 315th Fighter Squadron, 324th Fighter Group (World War II), will hold a reunion May 16–19, 1991, in Nashville, Tenn. **Contact:** Eugene J. Orlandi, 311 North St., East Northport, NY 11731. Phone: (516) 368-9193.

344th Bomb Group
The 344th Bomb Group will hold a reunion August 21–25, 1991, in Colorado Springs, Colo. **Contact:** Lambert Austin, 5747 Darnell, Houston, TX 77096. Phone: (713) 774-3030.

351st Bomb Group
Members of the 351st Bomb Group, stationed in Polebrook, England, during World War II, will hold a reunion June 11–15, 1991, in Omaha, Neb. **Contact:** Ben Schohan, 398 Catawba Ave., Westerville, OH 43081. Phone: (614) 882-8410.

392d Bomb Group
The 392d Bomb Group, 2d Air Division, 8th Air Force (World War II), will hold a reunion July 3–5, 1991, in Dearborn, Mich. **Contact:** Teddy Egan, 2619 Lafayette Ave., Winter Park, FL 32789-1372.

443d Fighter Squadron
Members of the 443d Fighter Squadron, 327th Fighter Group (World War II), will hold a reunion August 21–25, 1991, at the Holiday Inn Hotel in Providence, R. I. **Contact:** R. B. Mullaney, 49 Tampa Ave., Warwick, RI 02886-5720. Phone: (401) 737-3188.

622d Air Refueling Squadron
The 622d Air Refueling Squadron will hold a reunion May 1–4, 1991, in Alexandria, La. **Contact:** Daniel Sloan, 1507 Hwy 1204, Pineville, LA 71360. Phone: (318) 640-4208.

3520th Flying Training Wing
The 3520th Flying Training Wing, a B-47 unit (1950–1955), will hold a reunion in May 1991 at McConnell AFB, Kan. **Contact:** Maj. Gen. Lou Coira, USAF (Ret.), 421 Golfcrest Dr., San Antonio, TX 78239. Phone: (512) 655-9743.

Air Weather Service
To organize a reunion, I am seeking names and addresses of Air Weather Service members who served in Europe and Casablanca during the 1940s. I would also like to hear from radiomen who served at Hoersching AB, Austria. **Contact:** Joseph Stubbs, 2234 W. Randolph Ave., Enid, OK 73703. Phone: (405) 242-5686.

Chambley AB
I would like to hear from military and civilian personnel who served at Chambley AB, France, from 1954 until the base closed who would be interested in holding a reunion. Personnel included the 21st Fighter Bomber Wing (and tenant units), the 7002d Air Base Squadron, and the Army's SCARWAF soldiers and officers. I am also interested in any current reunions or reunion plans regarding these units. **Contact:** MSgt. Charles R. Timms, USAF (Ret.), 1616 Rex Dr., Marietta, GA 30066. Phone: (404) 859-1868 or (404) 565-1180.

18th Special Operations Squadron
For the purpose of planning a reunion, I am trying to locate aircrew and support personnel who flew AC-119K Stinger gunships in southeast Asia out of Phan Rang, Da Nang, and Nakhon Phanom. **Contact:** Col. Richard D. Iversen, USAF (Ret.), 8525 N. E. 110th Pl., Kirkland, WA 98034. Phone: (206) 820-2596 or (206) 394-4132.

33d Fighter Squadron
For the purpose of organizing a reunion, I would like to hear from personnel assigned to the 33d Fighter Squadron during World War II who served in Iceland. **Contact:** Col. Malcolm L. Nurnberg, USAF (Ret.), 312 Mission Hill Way, Colorado Springs, CO 80921. Phone: (719) 488-3781.

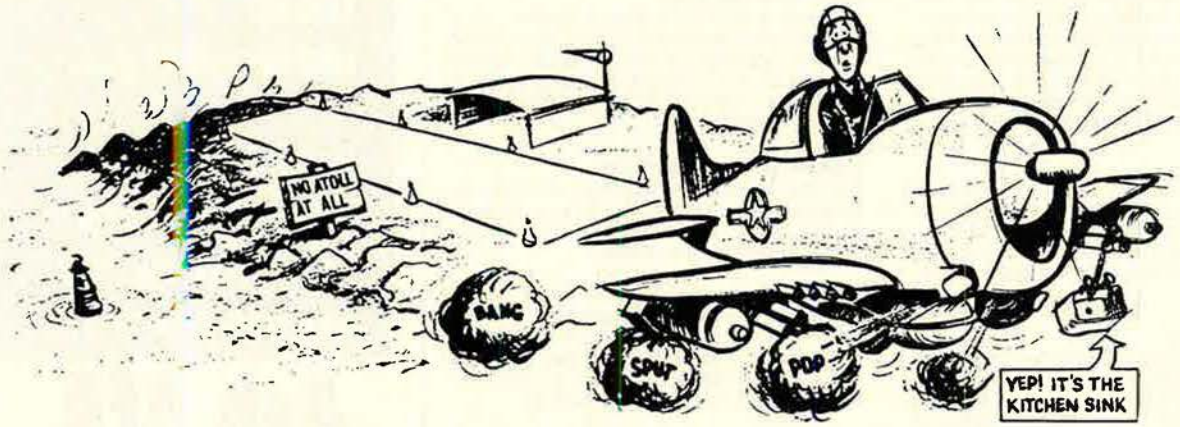
75th Fighter Squadron
Seeking contact with World War II veterans of the 75th Fighter Squadron, 23d Fighter Group, 14th Air Force, who are not already on the list for our annual reunions. **Contact:** Joe Brown, 909 Santa Rosa Blvd., Apt. 325, Fort Walton Beach, FL 32548. Phone: (904) 243-3429.

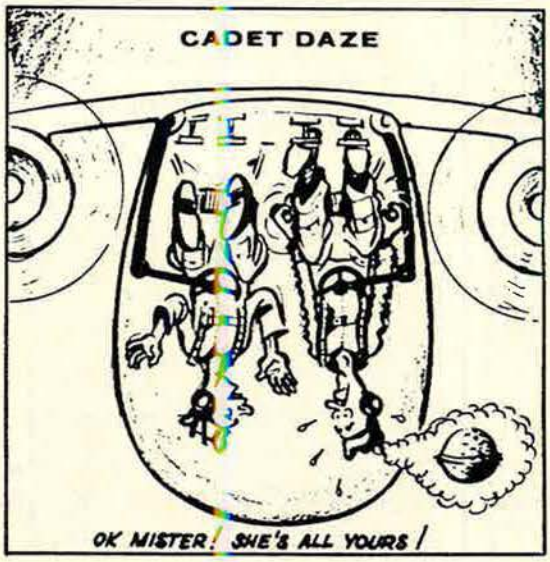
3081st Aviation Depot Group
For the purpose of planning a reunion in 1991 in Rapid City, S. D., I would like to hear from personnel who served at Rushmore AFS, S. D., in the late 1950s and early 1960s. **Contact:** Jim Aarhus, Rte. 2, Box 250-A, Hayfield, MN 55940. Phone: (507) 477-2458. ■

Bob Stevens'

"There I was..."

Cartoonist Bob Stevens is ill and may be out of action for several months. In the meantime, we'll rerun a few of his previous panels. This month's is the very first "There I Was . . ." to appear in AIR FORCE Magazine. It ran in January 1964, and the introduction noted that the series was "dedicated to all those aging warriors who bombed from around 18,000 feet or who flew fighters with honest-to-goodness props on 'em or who sweated it out on one island after another or in North Africa or the ETO or you-name-it."





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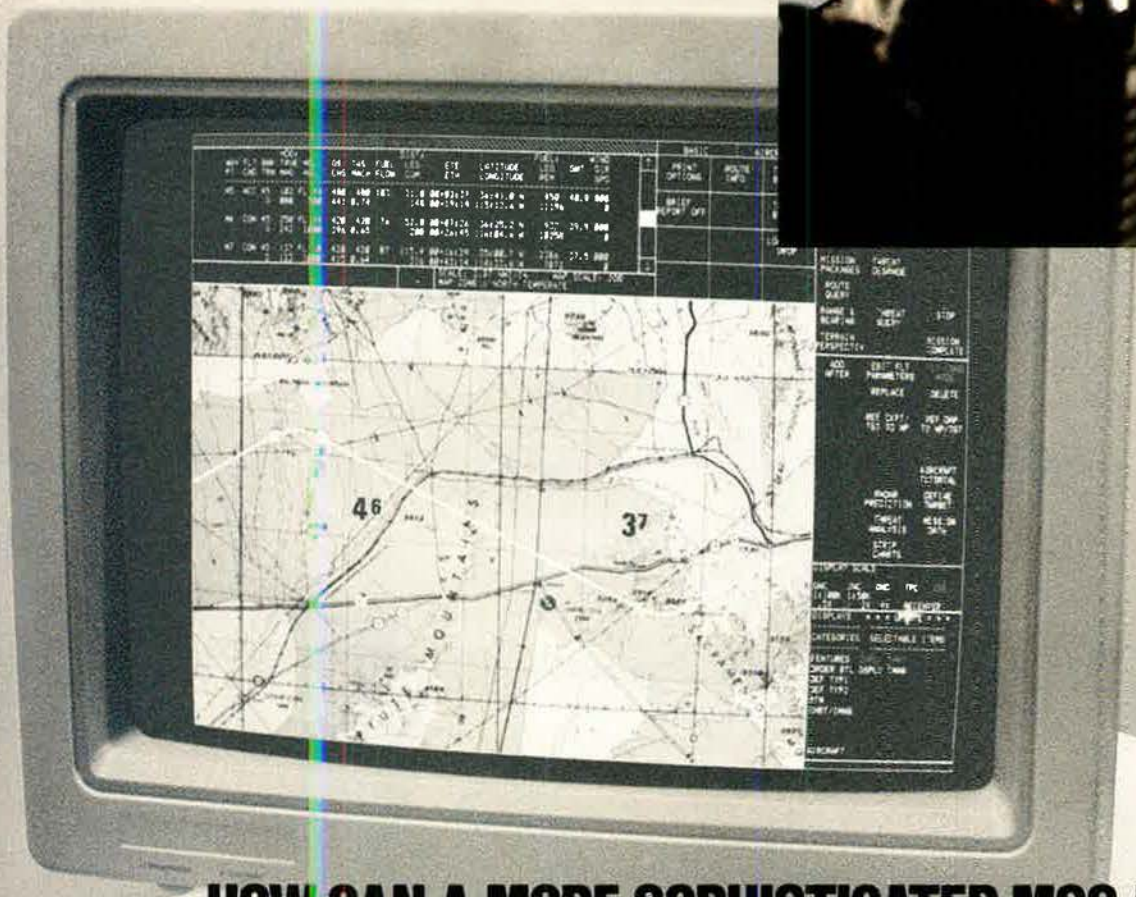

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