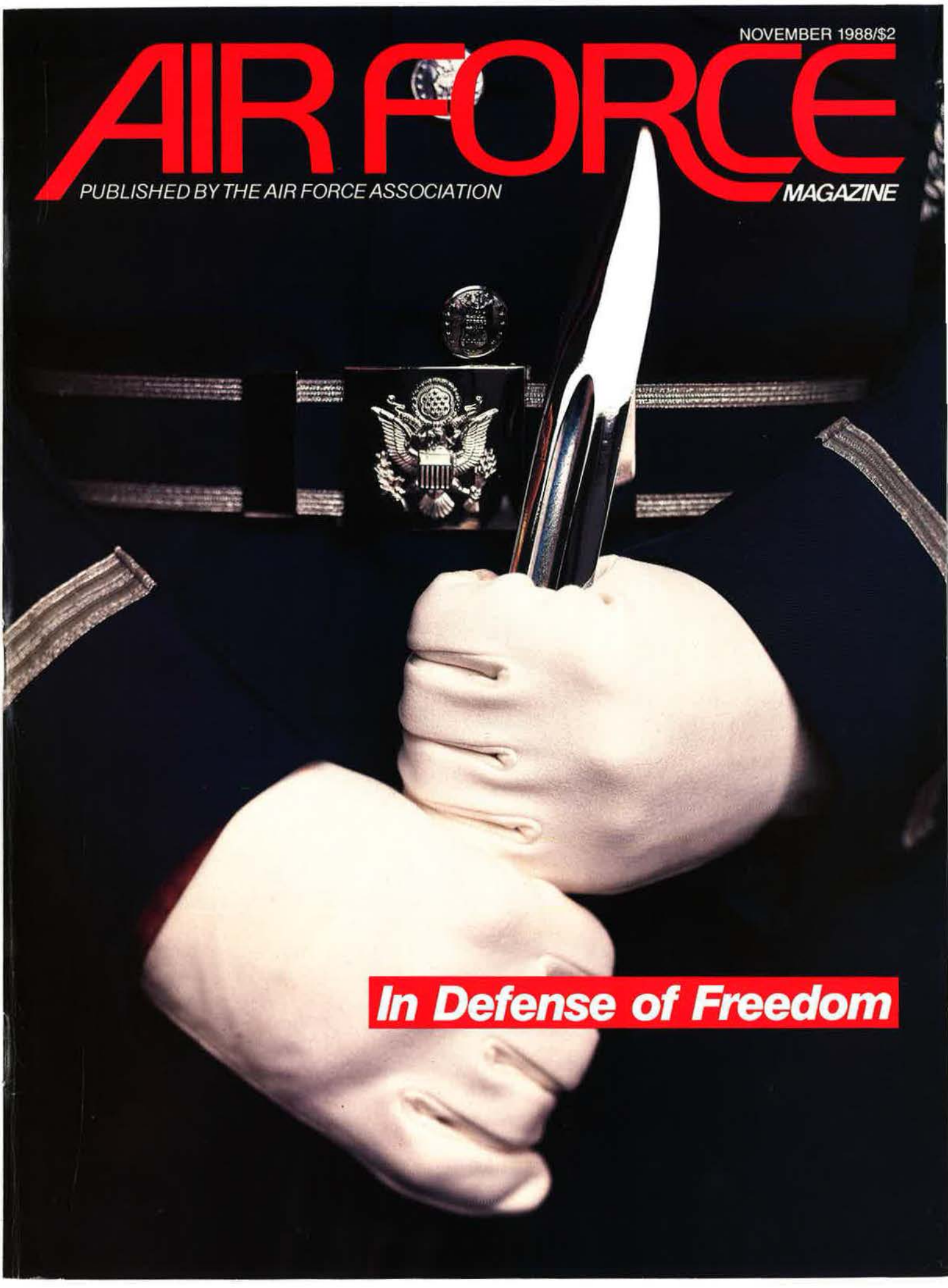
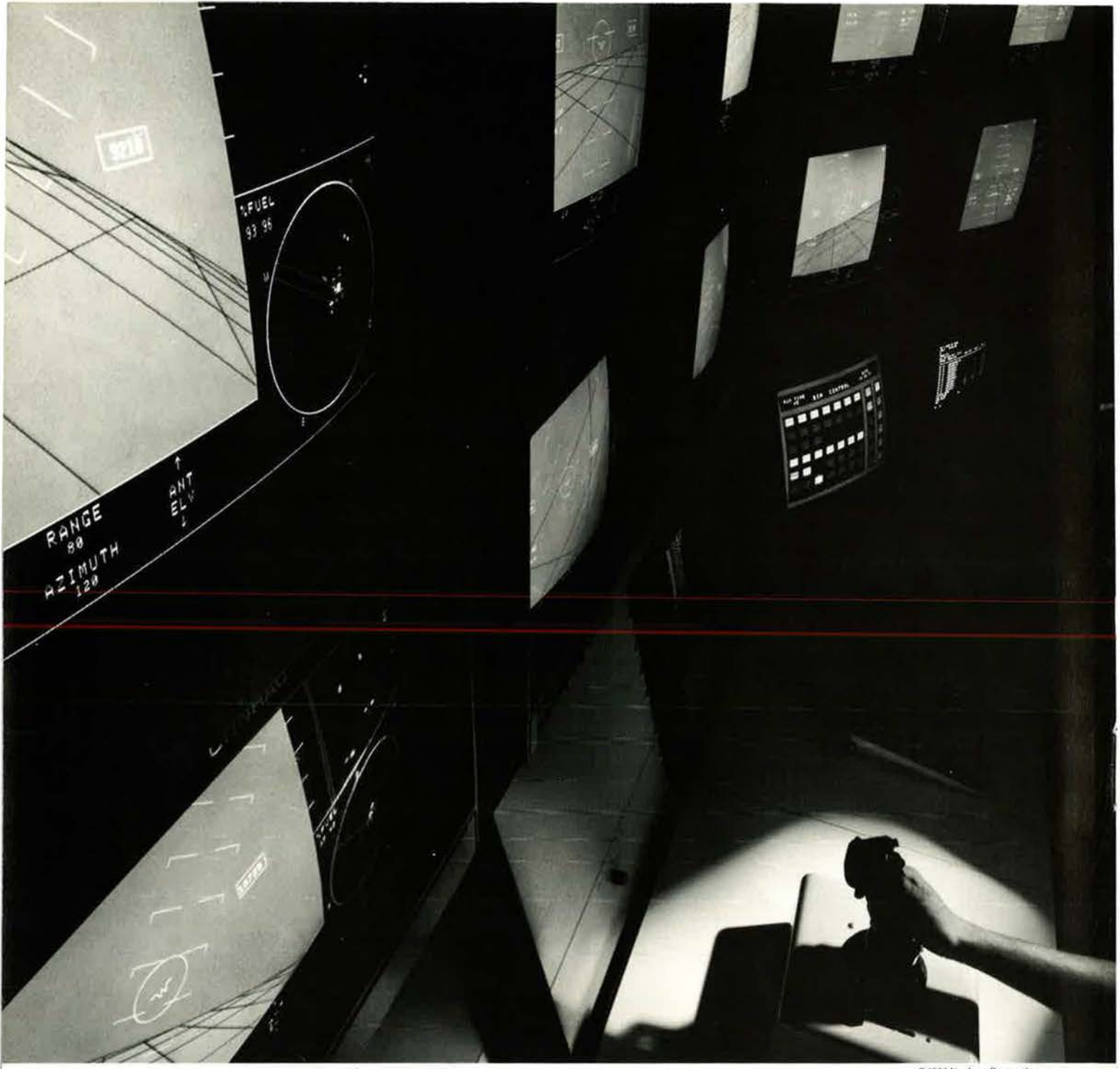
NOVEMBER 1988/$2

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION



In Defense of Freedom



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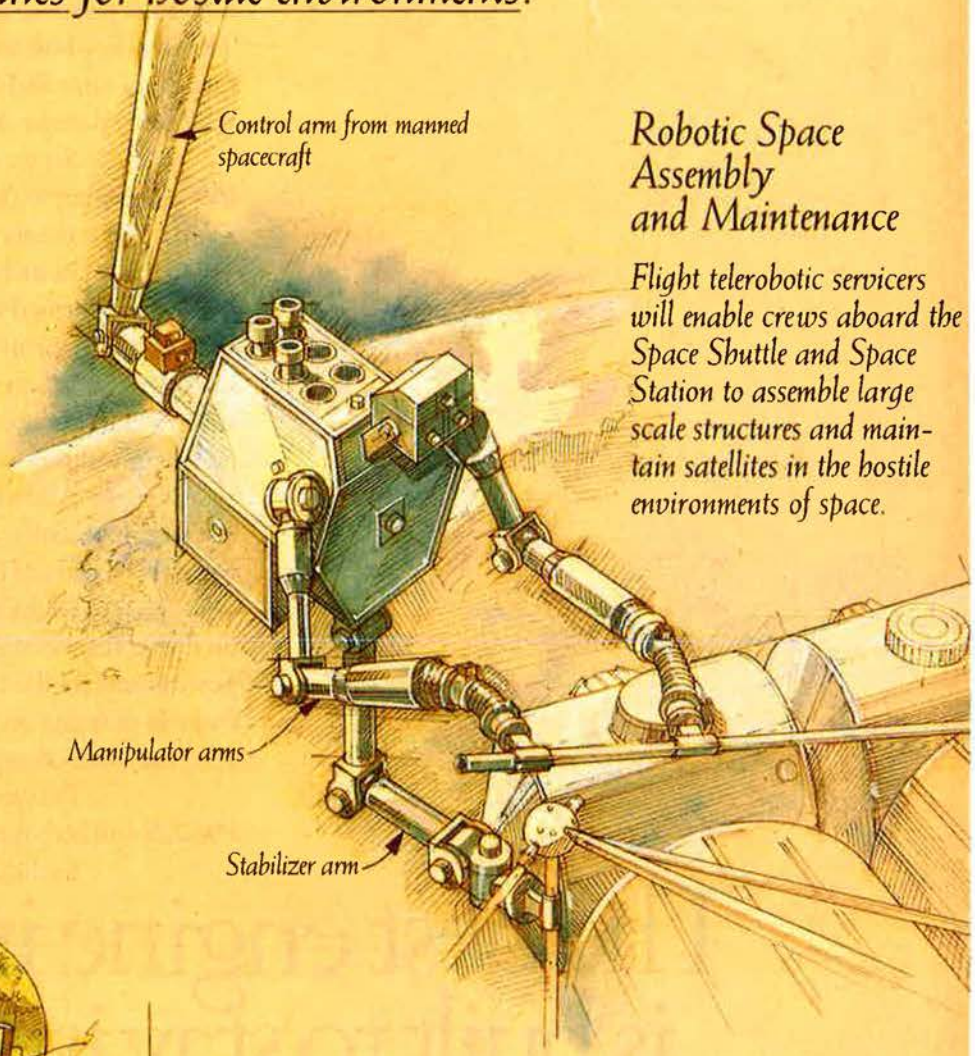
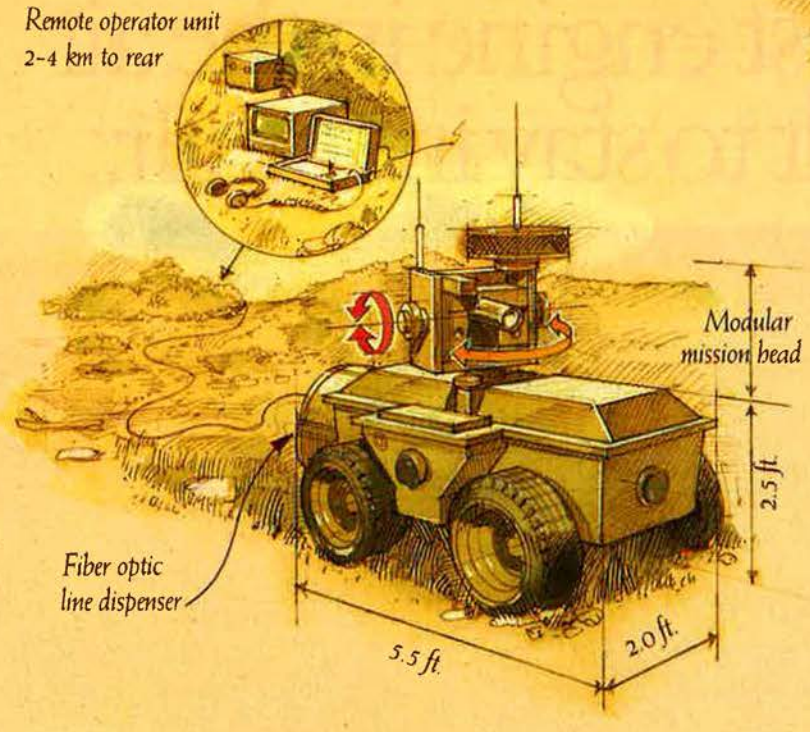


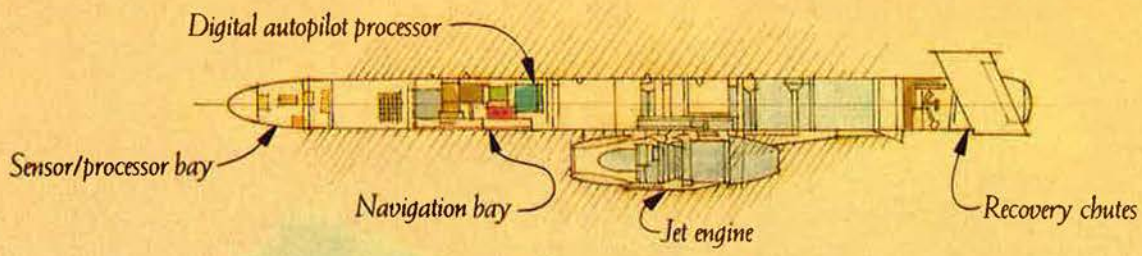
Robotic Space Assembly and Maintenance

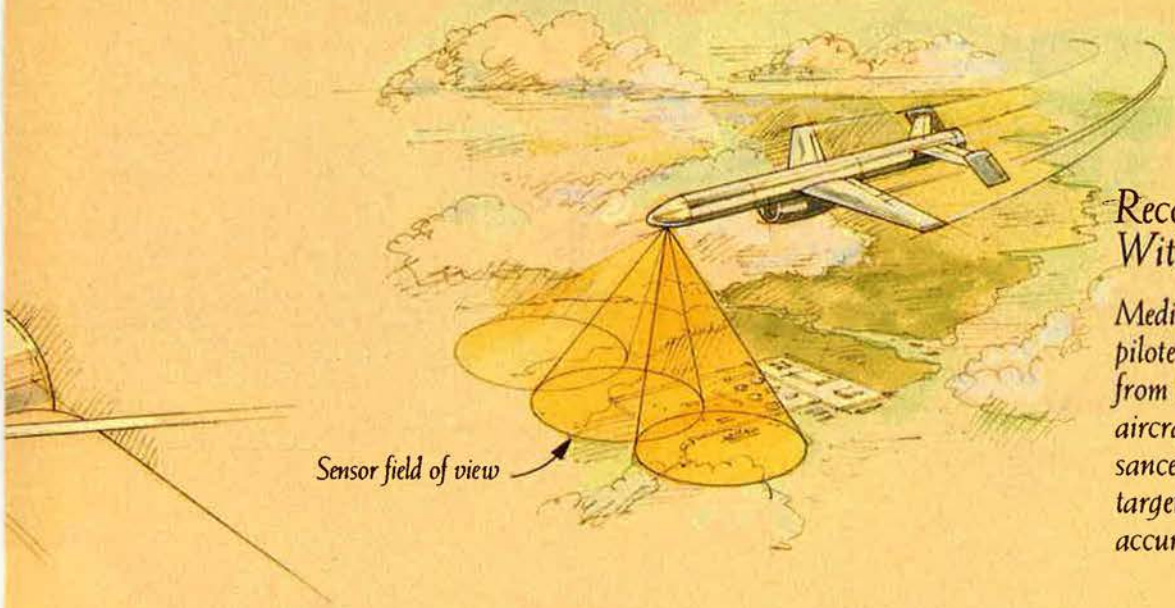
Flight telerobotic servicers will enable crews aboard the Space Shuttle and Space Station to assemble large scale structures and maintain satellites in the hostile environments of space.



Robots Prepared for Action

Advanced remotely controlled robots, many utilizing artificial intelligence, have wide-ranging military applications. Vehicles for reconnaissance, target designation, weapons platforms, resupply and medical evacuation will improve troop survivability and provide force multipliers for battlefields of the future.





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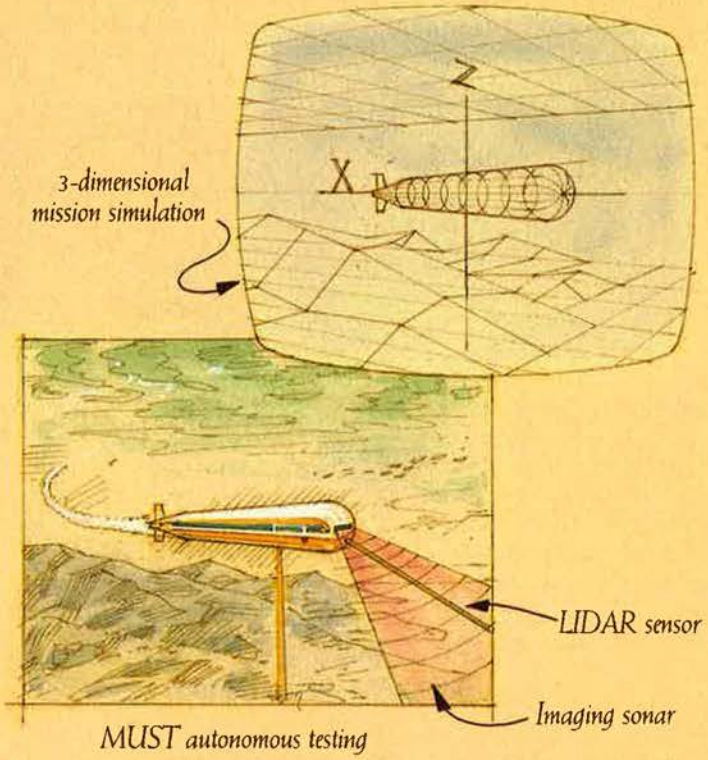

MUST autonomous testing

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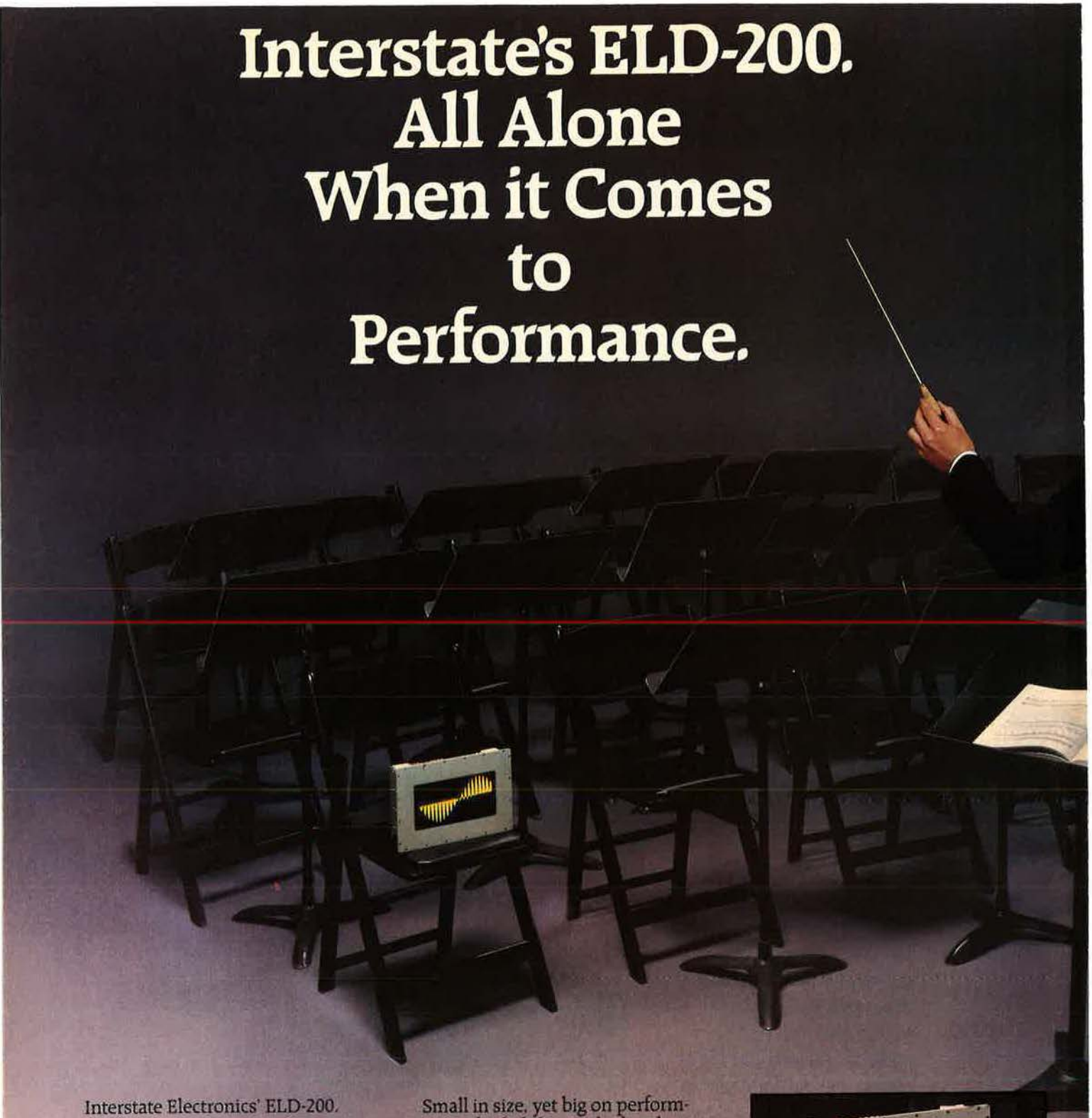

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NOVEMBER 1988
VOLUME 71, NUMBER 11

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Page 50

Page 60

About the cover: The gleaming steel of this USAF Honor Guardsman reflects more than light; it also reflects the pride and dignity of this elite unit. A special section on "Readiness and Staying Power" begins on p. 40. (USAF photo by SSgt. Brigitte L. Wright)

Special Section: Readiness and Staying Power

Generating Sorties and Sustaining Combat / By Robert S. Dudney 40
It's not how many airplanes you have, it's what you can do with them.

Readiness, Pacific Style / By Robert S. Dudney 45
Amid the changes in this vast region is the combat orientation of support units.

Look What They've Done to the Boneyard / By Jeffrey P. Rhodes 50
USAF gets $12 worth of products for every dollar it spends at Davis-Monthan.

AFA National Convention

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An Editorial

In Defense of Freedom

The 1988–89 Statement of Policy of the Air Force Association, adopted by delegates to AFA's National Convention on September 20, 1988.

THE fundamental duty of our government is to preserve our rights and freedoms. For more than forty years, a policy of deterrence—peace through strength—has served that end well.

In this election year, we are privileged to exercise the most fundamental right of a free society—the right to vote. That entitlement and all the other political, social, and economic freedoms guaranteed in the Constitution are rare commodities in the world. Those governments that suppress the rights of their citizens find the American creed a subversive one. Our freedoms were won by force of arms and when so challenged have been defended by force of arms.

But the price of freedom has always been high. That price today is the massive effort required to create and sustain the military forces vital to the task of deterring potential enemies. When the will and means to deter are lacking, the cost is American blood.

This Association is concerned that complex trends and events—apparently improved relations with the Soviet Union, deficit pressures, partisan politics, and the alleged defense procurement scandal—threaten to sap the will of American leadership to provide those means. There is a chorus of voices singing that we need not, or cannot, or will not, or should not do as much as we have in our own defense, thus jeopardizing the tremendous gains made over the past decade.

The task of defending the nation, however, is not getting any easier. US relations with the Soviet Union are at a forty-year peak. Yet the argument that this improvement allows the US to reduce its commitment to its own defense is fatuous. However real the changes in the Soviet Union, the goals and motivation behind Soviet foreign policy appear not to have changed. Even if they have, nagging questions remain: Will advocates of reform in the Soviet Union remain in power? Will Soviet arms-control violations continue? Will Soviet support of international terrorism continue?

Nor is arms control the panacea some hope. The treaty to ban intermediate-range nuclear missiles is a promising start, but cannot serve as a blueprint for START (Strategic Arms Reduction Talks). The Intermediate-range Nuclear Forces (INF) Treaty incorporates excellent precedents, but the complexity of the treaty and lingering doubts about verifiability indicate that the road to deep strategic reductions will require much more caution. This nation's arms-control policy must be predicated on a delicate balance between real arms reductions and deployments that really deter the Soviets. The danger of succumbing to the lure of superficially attractive reductions that exacerbate instability and ultimately reduce security must be avoided.

Without unequivocal evidence of irreversible political change in the Soviet Union, this Association believes that the nation must attend to Soviet capabilities. The Soviet military buildup proceeds today, uninterrupted, with a breadth and depth that remain mind-boggling. Soviet doctrine, strategy, and tactics remain geared to conquest, not to defense. Under such circumstances, security cannot be built on the basis of the goodwill of those who continue to deny the legitimacy of our political and economic institutions. Soviet military capabilities, along with technologically sophisticated threats to US security interests that can develop in virtually any part of the world, dictate that the ability to deter, and if necessary defeat, those who challenge US interests remains a practical and absolute necessity.

But while the task remains daunting, the defense budget is shrinking, and the Air Force is shrinking with it. Retrenchment is a fact of life. The keys to success in managing these reductions will be balance and ingenuity.

Manpower Is Fundamental

The core of the effort, as always, is people. Quality people constitute the bedrock foundation of an effective military. Adequate attention to the basic concerns of Air Force people, both uniformed and civilian, is fundamental to the health, vitality, and effectiveness of US forces. Without this very basic thrust, aircraft will lose their effectiveness for lack of pilots, research and development will suffer for lack of engineers, and maintenance will be degraded as experienced enlisted forces leave the military. Yet the erosion of military pay relative to the private sector, inadequate resources, and on-again, off-again funding make career planning a dicey business. The Air Force Association believes that steps must be taken to provide compensation, direct and indirect, commensurate with the sacrifices the nation expects of military professionals. This attention must extend to the fulfillment of the most basic of humanitarian concerns—a full accounting of those who served in Southeast Asia and whose fates are still unknown. AFA applauds the efforts of the past and those under way to achieve this account-

The Collins CP-1516/ASQ Automatic Target Handoff System (ATHS) helps ensure clear, quick, C^3I communications. It facilitates air/air and air/ground interoperability, and provides target steering cues on HUDs or CRT displays.

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ing and calls upon the next Administration to continue them with renewed vigor.

The commitment to people is also reflected in the complementary dedication to providing our fighting men and women with the most effective weapon systems possible. In this context, the five elements of strategic modernization—intercontinental ballistic missiles (ICBMs), submarine-launched ballistic missiles, bombers, command control communications and intelligence (C^3I) facilities, and strategic defenses—are and must remain the top priority. If the deterrent capabilities of US strategic forces should falter, there will be no second chance to correct the error.

Yet some of these programs, including the B-1B bomber, the Peacekeeper, and the Small ICBM, have been particularly vulnerable to entanglement in a partisan web of politics. AFA decries the unfortunate trend for certain weapon systems to become inextricably linked to the political fortunes of one political party or the other. Incessant politicking does serious and constant harm to the ability to plan intelligently for the nation's defense. The degeneration of key policy and program issues into partisan squabbles misleads those adversaries we must deter concerning the nation's will and capabilities, leads to *ad hoc* foreign and military policies, disrupts successful programs, creates ill will between the military and Congress, and results in roller-coaster defense budgeting. Ultimately, military capabilities suffer from such willy-nilly decision-making. AFA urges all to set aside partisan interests when considering US security. The defense of the nation cries out for bipartisan consensus.

—USAF photo by SSgt. Keith Walker

The Peacekeeper is and should remain the cornerstone of ICBM modernization. The phenomenal accuracy and reliability of the deployed Peacekeeper force belie its critics, and this missile redresses the serious strategic imbalance in time-urgent hard-target capability. The cost-effectiveness and survivability inherent in rail-garrison basing fully justify continued deployment of the Peacekeeper. Budget considerations, however, have put the other ICBM modernization program, the Small ICBM, on hold. AFA recognizes the benefits that accrue from such a small, mobile missile—survivability and post-attack capability—and would support continuation of the program, should ample funding be available.

AFA also applauds the tremendous success of the two-bomber program to modernize the air-breathing component of the triad. The unjustifiably maligned B-1B bomber is deployed and capable right now of performing its mission. Those who engage in politically motivated attacks against the B-1 serve the nation's security poorly and fail to consider the synergistic effects of systems and tactics that permit the bomber to penetrate to its targets. The B-2 Stealth bomber is the other critical link in the bomber-modernization program and will virtually negate the Soviet investment of billions of rubles in air defenses.

In the future, however, the very basis of strategic deterrence might shift. If research proves the technology feasible, deployment of defensive systems would enhance deterrence by complicating attack planning and reducing the chances of a successful nuclear strike. Continued research and development in the Strategic Defense Initiative is essential in view of the spread of nuclear and ballistic missile technologies and continuing modernization of Soviet strategic offensive and defensive arsenals.

The Mix of Requirements

The primacy of strategic requirements does not detract at all from the urgency of balanced modernization of conventional forces. Burgeoning threats in the developing world, ranging from terrorism to low-intensity conflict to very intense local conflict, the imbalance of forces in Europe, changing requirements, and the global reach of the Soviet military require flexible and modern nonnuclear aerospace systems with a wide range of capabilities. Indeed, the treaty to ban intermediate-range nuclear forces has removed one rung of the "escalation ladder" and renders particular urgency to this conventional modernization.

In this context, the Air Force's ability to provide close air support and battlefield air interdiction for ground troops is crucial. The Army and the Air Force have cooperated closely in the effort to upgrade these capabilities. AFA supports the economy of the A-16 and A-7F in these roles. The Army, too, agrees wholeheartedly with the basic approach taken by the Air Force.

The Air Force, with the support of the Congress and

the Administration, has enjoyed tremendous success in developing a new generation of tactical and theater weapons, while upgrading and improving the readiness and sustainability of extant forces. Deployment of the C-17, the advanced medium-range air-to-air missile, and the F-15E will further enhance the tactical forces, and the Advanced Tactical Fighter will provide a crucial technological edge in the mid-1990s.

AFA applauds the Air Force's success in restoring the nation's space-launch capabilities and developing a new generation of launch vehicles. This success will allow the Air Force to support its forces with vital space assets. All of these initiatives deserve continuing support.

The budget crunch threatens future gains. Tactical forces are being cut back in an effort to protect the readiness gains of the past. Yet, even with a smaller force, readiness and sustainability will decline if the deep cuts recently imposed on the Air Force continue. Furthermore, production of a large number of systems will be starting or peaking in the early to mid-1990s. This modernization, needed to replace aging systems and old designs, is in jeopardy. Only a long-term, steady commitment to the nation's defense needs can avoid the "Calvin Coolidge Air Force"—one plane with which the pilots take turns. Space assets, too, will have to compete for scarce funds on an equal basis.

The ability to support this modernization is also endangered by the recent alleged procurement irregularities, which complicate already tense industry and government relations. Continued development and deployment of state-of-the-art military systems require a stable and intelligently designed procurement system and close government/industry cooperation. No law can legislate morality; regulations cannot eliminate greed. Wrongdoers must be punished. But a new round of piecemeal procurement reforms, approved before recently established reforms have been completely digested, would be self-defeating.

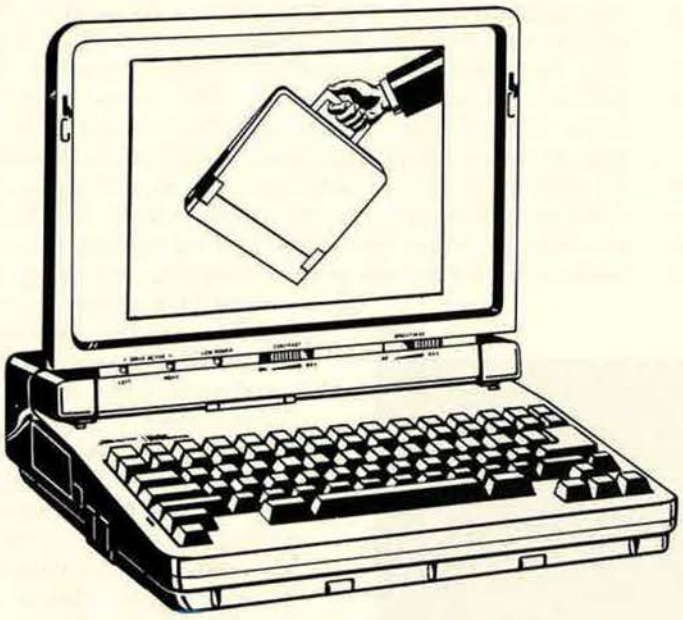
Naysayers seize on the alleged scandal to argue that defense industries are corrupt and that enriching them is wrong. Such an argument demeans the honest, competent efforts that are overwhelmingly prevalent in the defense business and, furthermore, trivializes the security needs of the United States.

Modernization also rests on an industrial base that has, unfortunately, deteriorated over the past decades. Foreign competition, perverse incentives imposed by the procurement system, and inadequate funding and planning have undermined industry's ability to satisfy US defense and mobilization needs. This Association believes firmly that the tremendous effort needed to determine the causes of the relative decline of American industry and to implement solutions will be critical to the future economic and national security of the US. Without such an effort, the nation will be relegated to the status of a second-rate power, incapable of meeting its own defense needs. Strong support for an expanded, balanced research and development effort is critical to this effort.

A source of serious concern to this Association is the fundamental redefinition of the role of the military in meeting US national security needs inherent in the negative chorus of "needn't, can't, won't, and shouldn't." Defense, critics argue, must be cut to reduce the federal deficit, because a reduced deficit is critical to national security.

Legitimate social and economic concerns must not be confused with national security. Defense did not cause, nor does it perpetuate, the deficit. This Association believes that the nation's military resources ought to be based on valid requirements and the types of threats posed by our adversaries. Nor can the military services cure the nation's drug problems. Any effort to involve the military in law-enforcement operations, beyond the already considerable contributions in the area of surveillance, should be regarded with skepticism.

Elections symbolize the freedom to choose. The poet Dante, it was recently paraphrased, "reserved the lowest circle of Hell for those who do not care—for those . . . who, endowed with freedom and power, make no use of it; the kind of men who, observing a battle between tyrants and those who would be free, remain indifferent." The policies that lead to weakness are often tempting and easy. But that weakness, in turn, tempts our adversaries. The first line of defense is always the moral courage to care and the clarity of vision needed to achieve a consensus and to support those forces that fight for freedom. Without it, the peace and security that underlie all free choice cannot be secured. ■



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Airmail

The Afghan War

I just wanted to express my appreciation for your article on "The Afghan War" [by Richard Mackenzie in the] September '88 issue. It was an excellently written analysis of the real causes of the Soviet defeat.

Sen. Robert W. Kasten, Jr.
(R-Wis.)
Committee on Appropriations
Washington, D. C.

The Guard's Proud Record

I am angry—angry and resentful at the way some persons in politics and the press have savaged the National Guard. In the 1988 Presidential campaign, Sen. Dan Quayle—one man, one political candidate, one former National Guardsman—has had his military service scrutinized. In the process, the entire National Guard has had its honor impugned and demeaned by persons who, by virtue of their positions, should know better.

The underlying message left by this controversy seems to be that service in the Guard in the late 1960s and early 1970s was done solely by individuals trying to evade the draft. In essence, the charge is that being a Guardsman was just one step away from being a draft-dodger. That's not only unfair. It's an insult to the men and women who have served honorably in the Guard—especially those who served tours of duty in Vietnam as National Guardsmen.

Guardsmen served in Vietnam in combat. From January 26, 1968, when the first units were called to federal active duty, until the last units were released, more than 22,700 Army and Air National Guardsmen were federalized. Of that number, more than 9,000 saw service in Vietnam. An additional 4,000 Air Guardsmen were sent to bases in Korea and Japan. For example, Colorado's 120th Tactical Fighter Squadron was the first Air National Guard unit to be sent into combat. In May 1968, we deployed to Phan Rang AB in the Republic of Vietnam. For the next year, 350 Colorado Air Guardsmen put together a combat record that was the envy of the other three active Air Force fighter squadrons assigned there. We flew 6,127 sorties, 5,905 of which were in combat. Our unit's actions resulted in the 140th Tactical Fighter Wing (our parent organization) receiving the Air Force Outstanding Unit Award with "V" device for valor.

For the Army Guard nationwide, results were similar. Included among the 4,000 individual awards earned were sixteen Distinguished Service Medals, fifty-five Silver Stars, one Distinguished Flying Cross, six Legions of Merit, more than 1,000 Bronze Stars, and 681 Purple Hearts.

Of the 58,000 names carried on the Vietnam Memorial in Washington, D. C., ninety-six belong to members of the National Guard.

I understand that it is the nature of politics to closely investigate every aspect of a candidate's life. And there's no arguing the fact that some men did join the Guard during that period thinking they would evade the draft. But remember this: Service in the National Guard was a legal alternative, as it is today, to serving in the active forces.

I don't know why Senator Quayle joined the Guard. Nor will I speculate. This, however, I do know: The National Guard, as a service, has a proud record—not only in Vietnam, but in the Berlin Crisis, the Korean War, World Wars I and II, and all the way back to the American Revolution. This nation has come to depend on the Guard and the rest of the reserve forces to the point where, today, one-third of its combat capability rests in the hands of citizen soldiers, sailors, airmen, and Marines.

For journalists, political pundits, and others to ignore these facts at the expense of those who serve, and have served, so honorably does a gross disservice to all of us.

Maj. Gen. John France,
USAF
Adjutant General,
State of Colorado
Aurora, Colo.

Do you have a comment about a current issue? Write to "Airmail," AIR FORCE Magazine, 1501 Lee Highway, Arlington, Va. 22209-1198. Letters should be concise, timely, and legible (preferably typed). We reserve the right to condense letters as necessary. Unsigned letters are not acceptable, and photographs cannot be used or returned.

Packard on Target

The article "Packard on Pentagate" *(see "Washington Watch," September '88 issue, p. 32)* was right on target. For those of us who worked and are still trying to work in that environment created by a pork-barrel-oriented Congress and its resulting bureaucracy, the fact remains that common sense doesn't even enter into it. While David Packard is on target and has identified the problem exactly, it will take a lot of high-powered people to suck it up before anything changes.

Gen. Earl T. O'Loughlin,
USAF (Ret.)
East Tawas, Mich.

A long time ago I listened to a savvy senior general liken defense procurement to a huge water-soaked log drifting with the current, with 1,000 ants on it. Each ant had one leg in the water and insisted, "*I'm* steering this thing." The question is, with all the heat from Congress to perfect the unperfectable, will the end result of reform be 2,000 ants on the log—with room for a congressional finger in the pie, of course?

Col. Robert J. Hagreen,
USAF (Ret.)
Summerville, S. C.

Reinventing the Wheel?

This is in reference to "SAC Extends Its Wings" *(see August '88 issue, p. 44).* The article is voiced in such a way that one feels that B-52s doing conventional bombing and using bases away from their home base is something new. Once again the wheel has been reinvented by some guy at headquarters trying for another star for his uniform. Just ask any B-52D model crewdog about said activities. I think you will find that D

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model crews were excellent examples of the "whole man" concept in terms of bombing anything, anywhere, with whatever weapon a D model could hold—conventional or nuclear. And, I might add, it was done well with 1950s-vintage "gear-and-pulley" bomb-nav sets, not the twin INS Boeing OAS systems that allow any guy with moderate digital dexterity (*i.e.*, a button pusher) to bomb with excellent results.

Mark A. Richards
Kent, Wash.

KC-135 Replacement

This letter is in response to Mr. Fuehr's letter in the August '88 issue in which he criticized USAF for "casually accepting the idea that we will be flying sixty-five-year-old airplanes."

The KC-135 fleet has been around for thirty-one years and is programmed to be active beyond the year 2000. Modification programs, such as the structural integrity program for the fuselage and the current wing reskin program, will add 27,000 flight hours to each aircraft. The average-time airplane is around 12,000 hours, and the high-time airplane is more than 30,000 hours. Given the current airplane hours at the current flying rates and the estimated economic life of 42,000 hours, it is no wonder that we can expect the KC-135 to proceed into the twenty-first century.

There are two engine-modification programs that are providing increased fuel offload capabilities, fuel economy, and expanded use of US and NATO airfields for the KC-135. The KC-135E is reengined with JT3D engines that are commercially available from retiring Boeing 707 aircraft. The KC-135E is mainly flown by Guard and Reserve units and can offload eighty-five percent more fuel than the A model in a 2,500-nautical-mile refuel radius. The KC-135R is currently being produced at a rate of three per month with the CFM56 engines. The fuel offload capabilities are 150 percent greater than the A model in a 2,500-nautical-mile refuel radius.

Consider the cost of replacing a fleet of 638 KC-135s currently flying worldwide. The KC-135A averaged $3.24 million per copy when produced. The reengining and modification programs cost a fraction of what it would take to produce new airframes for refueling. It would take a fleet of 110 KC-10s to replace the KC-135 fleet at a cost of $47.9 million per copy. Although the KC-10 can carry much more fuel than the KC-135, one KC-10 can only be in one place at one time. Because there are so many KC-135s, flexibility and required training can be maintained.

These are just a few reasons why this valuable aircraft is and will be flying for years to come. The need for aerial refueling is critical, and there will be a need to replace the KC-135 fleet eventually. However, that time has not yet come.

William R. Fields
170 CAMS/MAFAV, NJANG
McGuire AFB, N. J.

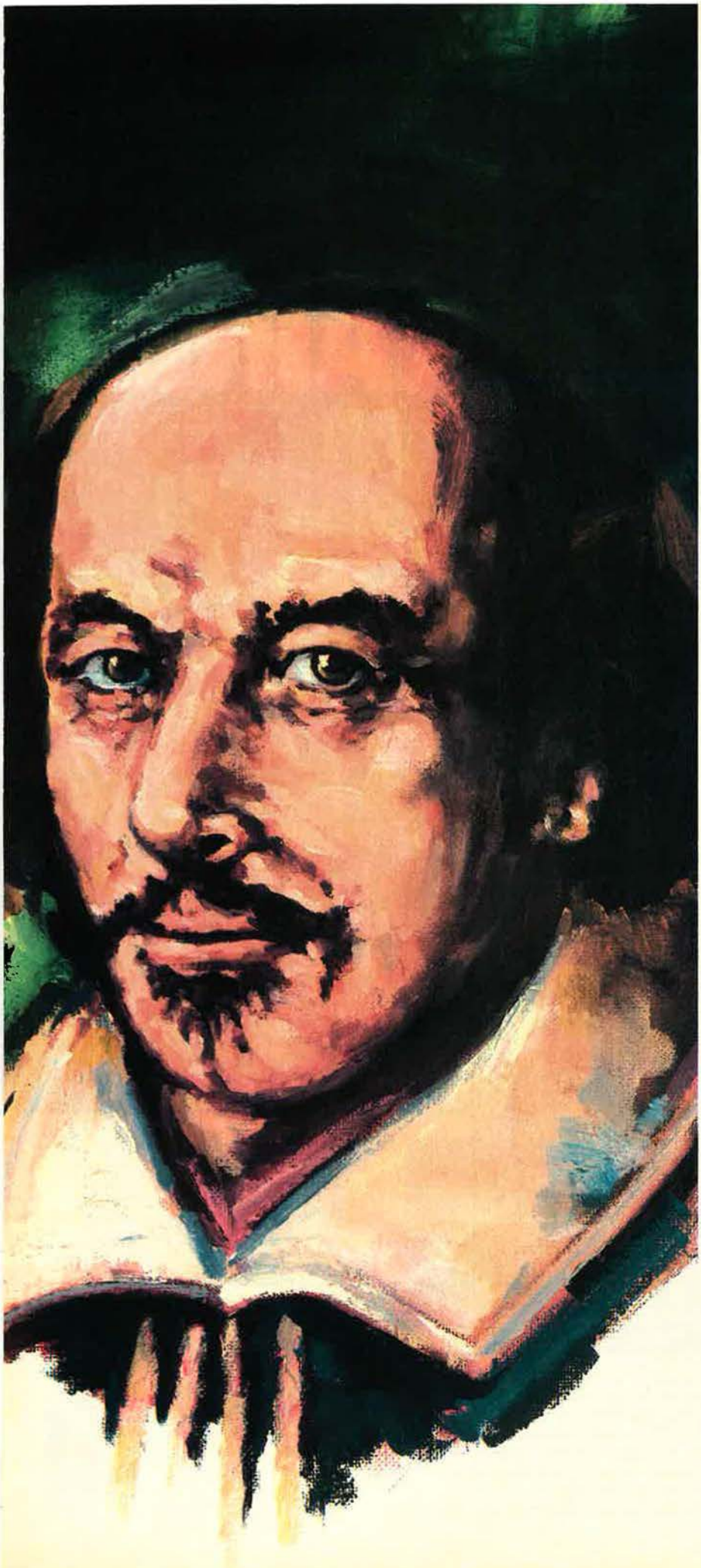
Streamlined Drugbusting

With reference to the several recent articles on "drugbusting," I have long believed that the federal government has not taken advantage of existing resources to mount a successful "battle" against the drug barons, and further believe those existing resources have not been reinforced with ample manpower to do the job. A first priority should be the adoption of a Citizen Corps [proposed by the] Democratic Leadership Council, Sen. Sam Nunn (D-Ga.), Chairman *(see p. 30 of the September '88 issue).* The Citizen Corps would provide manpower for the drugbusting war, remove many potential "customers" and pushers of drugs from idle days in the nation's streets, and help employ our idle youth.

Next, management of the drugbusting war must be given to one agency by consolidating under one "czar" the myriad of agencies now involved.

Citizen Corps inductees (after basic training) should be assigned to the Border Patrol, and the Border Patrol should be assigned to the Coast Guard. In addition, Federal Aviation Agency (FAA) Air Traffic Control should be assigned to the Coast Guard, effectively placing all borders and ports of entry (sea and air) under the agency so named to guard our coasts. I would also include the Immigration and Naturalization Service (and its new air force) as a unit of the Coast Guard. The entire augmented Coast Guard should then be placed under the Treasury Department, where control of alcohol, tobacco (which are also surely drugs), and firearms rests. The entire federal effort would then be centralized under a high cabinet official in the person of the Secretary of Treasury, who would no doubt nominate an assistant as "czar."

Additional benefits of the Citizen Corps concept would be the personal improvement that a majority of



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William Shakespeare
English Dramatist
1564-1616

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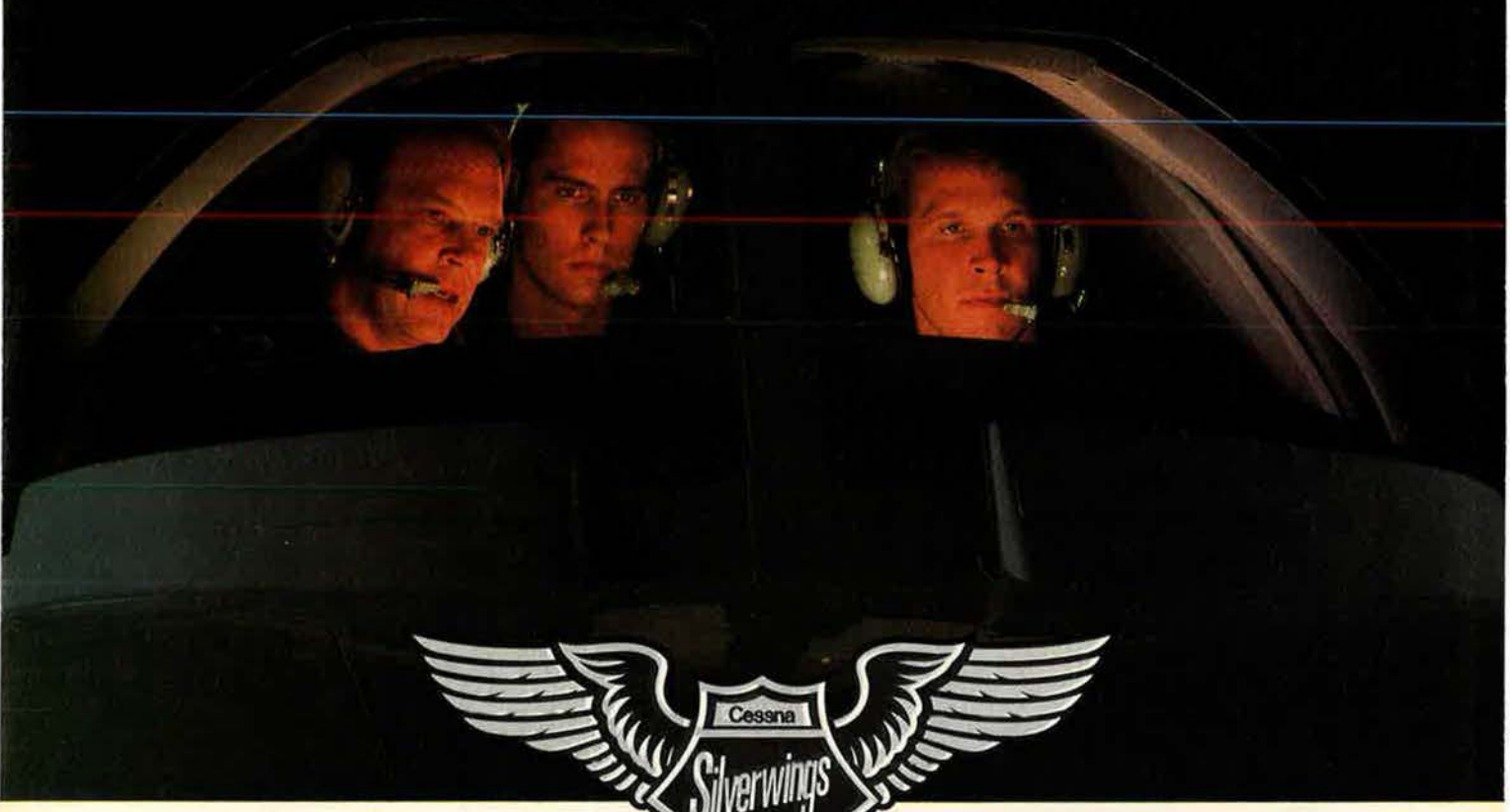

Implementation of Air Training Command's Tanker, Transport, Training System (TTTS) will be the most significant change in USAF pilot training methodology in 30 years. It will affect every aspect of the United States Air Force pilot training system.

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[participants has] always enjoyed from (military) basic training in discipline, self-improvement, and education. It goes without saying that the same Citizen Corps would contribute to our national security by being a "ready reserve" capable of augmenting our conventional forces if the need arises.

Lt. Col. John R. Reynolds,
USAF (Ret.)
Roy, Wash.

More on First Rome Raid

• *The background of the following two letters is this: Lieutenant Colonel Atherton reported ("Airmail," September '88 issue, p. 21) that the first bombing of Rome was conducted on July 18, 1943, by 301st Bomb Group, based in Tunisia—not on July 19, 1943, by US bombers flying out of Benghazi, Libya, as stated by official sources ("July Anniversaries," July '88 issue, p. 38). We replied that resolution of the discrepancy might hinge on whether Lieutenant Colonel Atherton's group bombed Rome proper or the outskirts of the city.*—THE EDITORS

Regarding the date of the raid on Rome, my source of information is the list of my missions as prepared by the operations office of my squadron. During that time, I was flying on almost consecutive days, and it is possible the typist just carried to the next day instead of skipping one day. This is, of course, in reference to your reiteration of July 19 as the date of the first Rome bombing.

However, I am concerned with the report that the first raid was conducted by planes from Libya. Libya was probably twice as far from the target as we were in Tunisia. The crews of the 301st B-17 Bomb Group were briefed and advised about being the first to bomb Rome, and we were provided with special maps of the city with certain areas outlined, which under no condition could be bombed. Most conclusive of all, as we leveled out across the city on our bomb run there was no smoke, fire, pockmarks, or demolition, which would have been present if Rome [had been] bombed prior to the 301st's raid.

Lt. Col. Roy L. Atherton,
USAF (Ret.)
Gresham, Ore.

I was flying P-38s from Tunisia during [the time in question]. The 82d Fighter Group and 97th Fighter Squadron escorted bombers over Naples on July 17, and again on the 19th, we escorted B-25s over Rome.

As there were three fighter groups operational in North Africa at that time, it is possible that another group escorted the raid that Lieutenant Colonel Atherton reports that he flew on. Also, the raid over Rome that we escorted was only four hours and forty-five minutes long, while he reports that his flight time was seven hours and forty-five minutes. The difference could be the extra time from his base to our fighter escort rendezvous point and return.

Lt. Col. Heber M. Butler,
USAF (Ret.)
Garland, Utah

Meyer's Awards

Your list of Gen. John C. Meyer's decorations *("Aerospace World," September '88 issue, p. 44)* omitted some very impressive awards. In addition to receiving those awards listed, General Meyer received the Distinguished Service Cross with two oak leaf clusters, the Air Medal with fourteen oak leaf clusters, and the Purple Heart. Since all of these are combat-related decorations, they should have been included. So far as I know, General Meyer may be the only airman since World War I to hold three Distinguished Service Crosses, America's second-highest award for valor and the equivalent of the Air Force Cross. His official photo clearly shows all the above awards.

MSgt. James B. Walker, Jr.,
USAF (Ret.)
Dayton, Ohio

• *Space limitations frequently prevent us from publishing a fuller account of awards received by individuals.*—THE EDITORS

Workhorse Wimpy

As an American who trained in Canada as an observer (navigator-bombardier) in the British Commonwealth Air Training Plan and flew in Wellingtons with RAF 203 Squadron in the Middle East and India, I read with both interest and emotion the book review, "Workhorse Wimpy" *(see "Airman's Bookshelf," April '88 issue, p. 93).* I feel moved to add this to the story.

After OTU at Limavady, Northern Ireland, our crews were sent to RAF Torpedo school at Turnberry, Scotland, to train as night torpedo bombers. The drill was, one Wimpy to fly and drop flares behind Axis shipping that was sailing under cover of darkness from Sicily to Tunisia. A second would come down to twenty feet and drop [its ordnance]. Then the roles would be reversed. Obviously the danger was not enemy action but a wingtip hitting the sea.

Thank God, by the time we got to North Africa the Axis troops had surrendered, or I probably wouldn't be writing this.

John W. Gordon
Middleburgh, N. Y.

OSS Mitchells

This is an appeal for information from anyone who knows anything about a small group of seven B-25 Mitchells that flew special operations missions for the OSS (Office of Strategic Services) from November 1943 to May 1944. These birds were an element of the 122d Liaison Squadron, 68th Tactical Recon Group, and flew out of Manduria in southern Italy. They flew supply airdrop missions for the OSS to partisans and special forces in Italy and the Balkans. I believe that the personnel of the 122d Squadron were probably recruited from among the four B-25 groups of Twelfth Air Force; the 310th, 321st, 12th, or 340th Bomb Groups (Medium). The unit commander was a Col. Robert (I believe that was his given name) Smith.

After eight years of extensive research for a book on US Army Air Forces special operations units of World War II, I've had some real frustrations tracking down any information or photos from this unique outfit. So if you were in this Fifteenth Air Force outfit in any capacity, or know anything about it, please drop me a line. I need your help to preserve this little piece of history.

Maj. Bernie Moore
5809 Tuckertown Lane
Fayetteville, N. C. 28314

Raid on Rangoon

On December 1, 1943, I flew my first mission as a combat cameraman with the 7th Bomb Group to bomb Rangoon, Burma, in what turned out to be the longest aerial battle of the China-Burma-India theater, as fifty-six Japanese Zeros attacked our formation for seventy minutes on its way to and from the target.

Tenth Air Force combined with Fourteenth Air Force from China to put up about fifty-five planes for this raid, in which six B-24s were shot down, including a B-24 carrying one of three combat cameramen from the 10th Combat Camera unit. Many of the planes that returned had extensive damage, including mine. The losses were that high because the British fighter top cover that was supposed to protect our formation did

not contact our flight until we were well on our way back to base in Pandaveswar, India.

That battle may have been the longest air-to-air battle in history, or at least in World War II. I would like to give it its proper place in history in a book I am about to finish on my experiences as an Army Air Forces combat cameraman.

Lt. Col. Edward R. Evans, USAFR (Ret.)
316 N. Clybourn Ave.
Burbank, Calif. 19505

Vietnam Airlift

I am beginning preparations for a new book on the Air Force airlift mission during the Vietnam War, to include the MATS/MAC role as well as the in-country airlift mission of TAC/PACAF.

I would like to make contact with airlifters of the period who would be willing to contribute recollections and photographs. Anyone who was involved in airlift in any capacity—pilots, navigators, flight engineers, loadmasters, aerial port, maintenance, combat control, command and control, etc.—and on any airlift aircraft, please contact me at the following address.

Sam McGowan
HC 61, Box 65
Argillite, Ky. 41121

RF-4 Research

I am doing research for a book on the RF-4 and am interested in corresponding with aircrew or ground personnel who have a story to tell. Any photos sent will be copied and returned.

Please send information to the following address.

R. Moreau
508 Briarglen
Coppell, Tex. 75019

Ploesti Mission

I am currently searching for copies of the Awards Orders for the aircrews that participated in the low-level bombing mission against the oil fields at Ploesti, Romania, on August 1, 1943. In particular, I need those orders pertaining to the 44th Bomb Group (H) and the 98th Bomb Group (H). I would be most happy to reimburse costs for the photocopying of such orders or will promptly return same if they could be loaned to me.

In addition, are there any ground crewmen who worked on any of the Ploesti aircraft who might have pictures that could be used in a book I am writing about the aircraft and crews that flew that day? The bomb groups involved include the 44th, 93d, 98th, 376th, and 389th. I would be most grateful for any assistance that anyone could provide.

Steven D. Nylen
7652 Muirfield Dr.
Las Vegas, Nev. 89117
Phone: (702) 362-1390

MiG Photographs

I am currently working on a two-volume set of books on the export and service use of MiG fighters outside the Soviet Union. The first volume will cover the MiG-15 through the MiG-21, with the second covering the MiG-23 through the MiG-29.

I have been researching this project for a number of years and have built up a substantial database on nations that have used MiG fighters (and their Chinese-built variants). The database includes information on the types received, numbers, and historical data on service use within the country, including combat use, if any. I have also managed to collect a large number of photos. However, most are clippings or copies, and few are of the quality needed for publication or for use as reference materials to produce accurate drawings and color paintings.

I am writing in hopes that some of your readers may be able to assist me with my search for MiG photography, especially photography of MiGs in service with African nations, Asian nations, Middle Eastern nations, and Cuba.

Any information that any of your readers may be able to furnish me would be greatly appreciated and will receive full credit in my books.

Nicholas J. Waters III
5509 Darby Lane
The Colony, Tex. 75056

Vietnam Casualties

I am currently researching a project concerning the Vietnam conflict. I am looking for background information on *all* US casualties (KIA or accidental death—USN, USMC, USA, USAF, USCG, civilian). Data on the units to which individuals were assigned, units' bases, and locale of incident are the types of information I need. I basically have all names, pay grades, etc. If anyone can offer the above information, it would greatly help.

David W. Schill
132 Harding Ave.
Moorestown, N. J. 08057

Me-262 Crash

In September 1945, two Me-262 aircraft crashed at Pittsburgh, Pa., during a ferry flight to Freeman Field. The first was destroyed, and the second jet was badly damaged. On September 30, 1945, a FW-190D crashed at Freeman Field during an aerial-demonstration flight before a crowd of aviation writers and publishers. Lieutenant Haynes, the pilot, was killed.

I wish to obtain copies of any photos your readers may have that show the wreckage of these aircraft to illustrate these events in [a forthcoming] book. All expenses in this regard will be reimbursed.

Also, I wish to locate Kingdom Knapp, formerly of the 453d Bomb Squadron, Watton, England, who flew special missions in Mosquito aircraft for the OSS during World War II.

Norman Malayney
519 Semple St. #3
Pittsburgh, Pa. 15213-4315

Aircraft Clocks

I am gathering information for a book on military primary aircraft clocks.

Request information on the use of an Elgin watch (clock) in the bomb bay of the RB-47 or B-47 aircraft. It was a watch movement housed in a case of about one to one and a quarter inch in diameter with a screw in the middle of the back of the case. I believe it was used in the RB-47 to record the time on photos. I need to know the exact way it was used; perhaps a crew chief, photo specialist, or pilot can help me.

CMSgt. Rodney V. Councell, USAF (Ret.)
Rte. #2 Box 213AA
Greensboro, Md. 21639
Phone: (301) 482-6485

Roll Call

I am trying to locate the following individuals who served with me in the 25th/60th Communications Squadron, Wiesbaden, Germany, 1949–52, and/or 604th Communications Squadron, Ramstein, Germany, 1957–61: Leroy O. Cooley, Albert R. Soden, Edward J. Sousa, Hugo Richer, and any others who served with me in the 246th Signal Operations Co. during World War II and in the Air Force afterward.

Please contact me at the address below.

MSgt. Johnnie Huggins, Jr., USAF (Ret.)
30031 SW 169th Ave.
Homestead, Fla. 33030

I am trying to locate Sgt. James Allen Biggerstaff. Jim was stationed in Panama during the past three to five

years. His last known address was: PSC Box 1347, APO Miami 34001.

Anyone who knows how I might locate Sergeant Biggerstaff is asked to contact me at the address below.

Capt. George C. Frazier,
USAFR (Ret.)
12472 Bentbrook Dr.
Chesterland, Ohio 44026
Phone: (216) 729-1401

The University of Florida Billy Mitchell Drill Team members are starting an alumni association. Many former members have graduated over the past fifteen years, and we would like to keep in contact with them. Please contact the address below.

Billy Mitchell Drill Team
AFROTC Det. 150
204 Van Fleet Hall
Gainesville, Fla. 32611

I am attempting to contact officers in my unit who served in the years 1944 and 1945. The unit was United States Strategic Air Forces in Europe (USSTAF), Office of the Director of Medical Services.

The officers are listed below, with ranks and hometowns as of 1944–45.

Col. Ralph E. Stone, Pittsburgh, Pa.

Maj. Bennie T. Withers, San Angelo, Tex.

Col. Herbert B. Wright, Shaker Heights, Ohio

Rita Crean Tlamsa
162 Ellison Ave.
Bronxville, N. Y. 10708

I am looking for anyone who knew TSgt. Robert M. Jacoby, S/N 15099433, a B-29 Fire Control Chief in the 871st Bomb Squadron, 497th Bomb Group, 73d Bomb Wing. He usually flew with a crew referred to as "Skin Hounds" in a B-29 named *Fickle Finger* piloted by H. E. Walker. He was flying in a B-29 named *Dixie Darling* when he became MIA in December 1944. He was six feet four inches tall, the tallest man in some photos in a wing or group commemorative booklet. Does anyone have one of these commemorative booklets, or know anything about Sergeant Jacoby? If so, please contact Mrs. C. E. Stafford (Jacoby's wife) at 546 Wentworth Ave., Battle Creek, Mich. 49105.

Lt. Col. Howard R. Ebersole,
USAF (Ret.)
Plymouth, Minn.

Former P-38 and P-51 pilot with 401st Fighter Squadron, 370th Fighter Group, 12th TAC, Ninth Air Force, in Europe seeks former comrades. I was an Army Air Forces cadet, Class 44-D and 44-E, training at Reno, Nev.; Wickenburg, Ariz.; Tucson, Ariz.; Victorville, Calif.; and Portland, Ore.

Please contact me at the address below.

Bernard (Bud) Casper
31072 Paseo Valencia
San Juan Capistrano, Calif. 92675

A book was written a few years ago about a mission we flew during World War II in October 1943. The target was the ball-bearing works at Schweinfurt, Germany, and they knew we were coming.

The book was called *Black Thursday*. . . . I have tried unsuccessfully for years to obtain a copy of that book. If anyone out there is willing to sell or even loan me a copy to read and return, I shall forever be in your debt.

SMSgt. Ernest P. Morgan,
USAF (Ret.)
1678 Fieldgreen Overlook
Stone Mountain, Ga. 30088
Phone: (404) 981-6168

• *Reader Morgan will be happy to learn that* Black Thursday *is by Martin Caidin and appeared as a paperback in 1981, published by Bantam. The ISBN number is 0-553-13582-1. Copies should be available in secondhand bookshops.*—THE EDITORS

The Yugoslav Air Force is trying to locate USAAF pilots and crew members who were shot down over Yugoslavia during World War II. They

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will be invited to a reunion-celebration with their rescuers at the Yugoslav Embassy in Washington, D. C., on December 22, 1988. If you are a candidate or know one, please contact the address below.

Lt. Col. David Potts
Hq. USAF/CVAIP
Washington, D. C. 20330-2006
Phone: (202) 697-6377

Hindsight and time have heightened my interest in my father's military service history, which I failed to obtain prior to his death. The very interesting story "The First Victory," by Theodore Hamady *(p. 68, April '88)* stirred my imagination as I read of Lts. Douglas Campbell's and Alan Winslow's life-and-death struggle in the air above my father's life-and-death struggle in the trenches below.

If Messrs. Campbell and Winslow are still living, I would appreciate assistance in contacting them or any World War I veterans who may have known or served with my father—George S. Partridge. He served in the US Army 3d Infantry Division, and particularly the 38th Regiment, in the following:

AEF Aisne-Marne Offensive—Chateau-Thierry Sector, July 1918
Vesle Sector, August 1918
Gondrecourt Area (training), August–September 1918
St.-Mihiel Offensive, St.-Mihiel Sector, September 1918
Meuse-Argonne Offensive, Montfaucon Sector, September–October 1918
Army of Occupation, December 1918–May 1919

Please contact me at the address below.

Lt. Col. George R. Partridge, USAF (Ret.)
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Prattville, Ala. 36067
Phone: (205) 365-8368

I would like to hear from members of the 643d Squadron or anyone from the 409th Bomb Group. I would also like to hear from P-38 pilots who checked out in the A-26 and flew combat missions with the P-38 and from anyone who has pictures of the formation.

Freeman Skipton
1107 Pearl
Garden City, Kan. 67846

I am seeking some help on how to get in touch with some retired USAF officers.

I met them in the years 1982–84, when I was working in King Abdul Aziz AB in Dhahran, Saudi Arabia. They are: Edward Smith, Oakley Dollard, and Robert Parker.

I'll be grateful if you can extend help.

Butch H. Medina, Jr.
Mary's Refreshment
Central Market, Bacolod City
6100, Philippines

I am trying to find the following crew members of the B-17 *Cock o' the Sky* in the 710 Squadron, 447th Bomb Group, Eighth Air Force, in England: C. F. Boehringer, C. F. Gillisse, L. D. Harris, R. Marchitello, R. D. Wallace, and R. L. Zimmerman.

Please contact me at the address below.

W. G. Russell
521 Russell Lane
Weatherford, Tex. 76087
Phone: (817) 594-3495

I have been trying to locate Amn. Joey Odom from Florida. We were sta-

tioned at Carswell AFB, Tex., Hospital Squadron during 1965–66. Joe was a hospital corpsman at the time.

I would really appreciate anyone with information about Joe contacting me at the address below.

Stu Herrold
Box 146
Emmitsburg, Md. 21727

I am trying to locate the family of an airman whose last name was Martin. He was stationed at RAF Bentwaters in Suffolk, England, during 1952–54. He had a daughter, Karen, and a son, Leon. They lived at 104 Myrtle Rd. in Ipswich before returning to San Bernardino, Calif. Their friend and neighbor in Ipswich was Sandra Farnish, then aged eight. Any information about this family would be appreciated. I will pass it on to Sandra.

Lt. Col. Saul S. Harris, Jr., USAF (Ret.)
26 Station St.
Swaffham, Norfolk, England

I am trying to locate two other former commanders of the 69th TAC RCN Group. They are: Col. Eugene C. Woltz and Col. John T. Shields.

Any help will be appreciated.

Arthur F. Fite, Jr.
630 Hillyer High Rd.
Anniston, Ala. 36201

Collectors' Corner

I am looking for an Army World War II-type Stinson L-5 aircraft (restorable condition). I would appreciate any information.

Please contact me at the address below.

Maj. Charles T. McLaurin, USAFR (Ret.)
Box 355, Rte. 4
Rockingham, N. C. 28379

I am a collector of USAF patches. I am especially interested in collecting Vietnam-era, electronic-warfare, and patches of those units involved with the April 1986 raid on Libya. Any donations would be greatly appreciated. I am willing to buy or trade for any of the above-mentioned items.

SSgt. Kenneth L. Oswald
42ECS/42AMU
Box 4528
APO New York 09194-5375

I have a deep interest in researching the history and preserving the flight uniforms of the Army Air Forces in World War II.

I recently obtained a World War II fleece-lined flight jacket with the insignia of the 472d Bomb Squadron (Bomby the Bear) painted on the back. The painting is contemporary to the jacket and is signed by the artist, R. Hammar.

If any readers have information about Mr. Hammar or the 472d Bomb Squadron, I would very much appreciate hearing from them. I feel that, if possible, the history surrounding the jacket, and the artwork that decorates it, should be preserved along with the jacket itself.

Peter Kirkup
51 Birch Ave.
Farmingdale, N. Y. 11735

I am a collector of USAF patches who is looking to trade with other collectors/traders.

I am interested in patches from the regular Air Force, Air National Guard, Air Force Reserve, and foreign and NATO air forces.

If you have any information that would possibly be useful to me, please write to the address below.

Robert A. Wilkinson
P. O. Box 84416
San Diego, Calif. 92138-4416

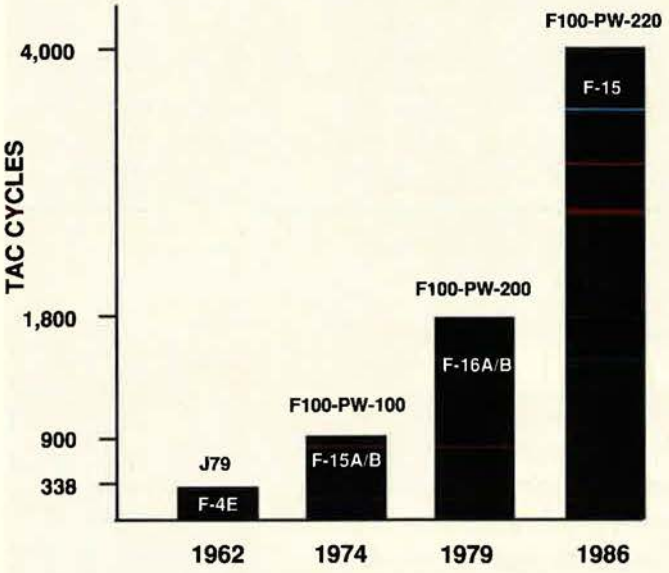
The Chart Page

An Anatomy of the "Ilities"

Edited by Colleen A. Nash, STAFF EDITOR

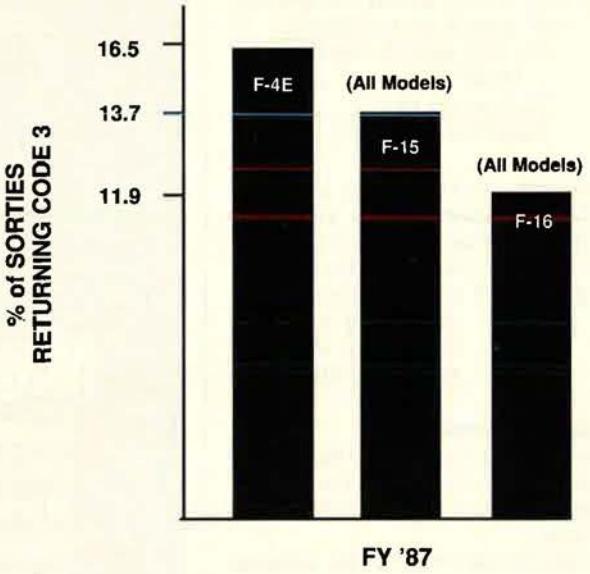
Reliability, maintainability, mission-capability of planes. Readiness and sustainability of forces. The unglamorous "ilities," once given short shrift, now command serious attention. The Air Force's R&M 2000 initiative, launched in 1985, is being pushed hard to help USAF squeeze more combat power out of its force in the face of slack budgets, rising costs, and a declining manpower pool. Advances can be seen in fewer equipment failures, reduced maintenance, and lower support costs. Still, tight funding for spare parts could cause the effort to falter. Gains, payoffs, and concerns are fully evident in the following charts.

Muscular Modern Power Plants



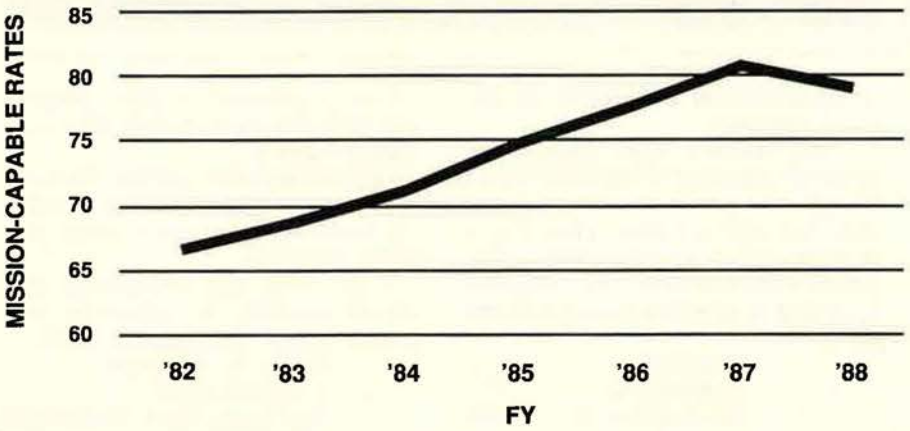
Today's modern engines require proportionally fewer hot section overhauls than their predecessors. This chart demonstrates hot section overhauls per given number of "tac cycles." (A tac cycle refers to a sequence an engine goes through—for example, "idle" to "military power without afterburner.") It is a key measure of engine performance under stress. Engines in F-15s show a tenfold improvement over those in F-4s. Maintenance needs and downtime for the aircraft are lower.

Fighters: Hard to Break



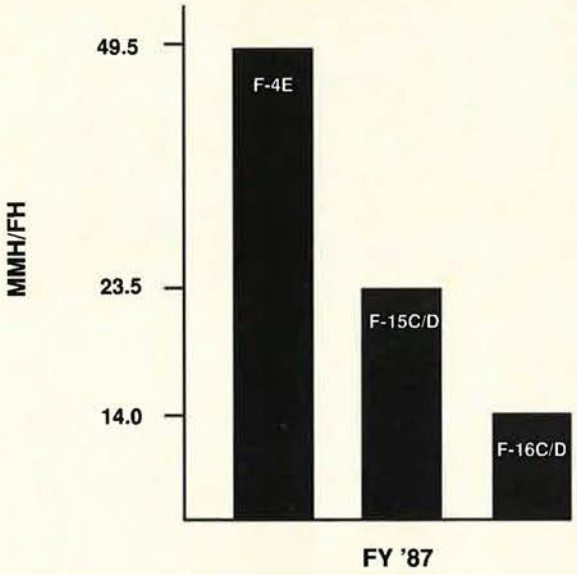
This chart shows the comparative break rates for certain fighter aircraft systems. "Code 3" means a serious system failure that prevents the aircraft from flying until it is fixed. (Code 1 means all systems function properly; Code 2 means a malfunction that does not have to be fixed right away.) F-16 and F-15 reliability stands significantly higher than that of the earlier generation F-4. F-16s, thus, spend less time in the shop and more in the air.

Improved Mission Capability



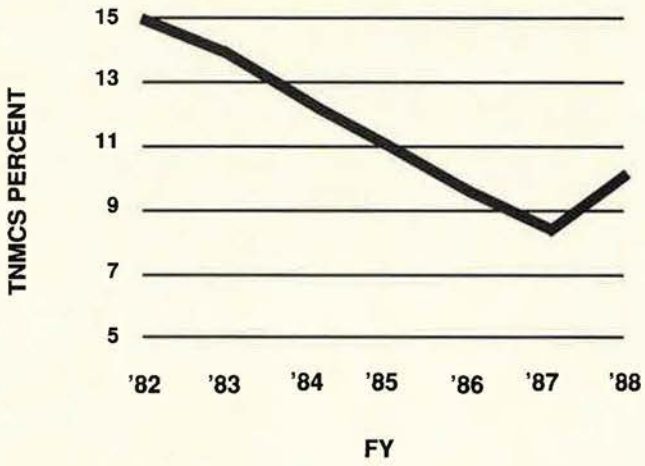
This chart shows the mission-capable (MC) rates for aggregate USAF aircraft. Equipment is rated "mission-capable" if it can perform at least one of its primary missions. (It is "fully mission-capable" when it can perform all of them.) In FY '87, the MC rate for the F-16C/D came in at a stunning 90.6 level, compared to an MC rate of 83.0 for the F-15C/D. Far behind was the F-4E, with an MC rating of only 72.4. Since FY '82, overall mission-capable rates have increased steadily as more modern aircraft have entered the fleet.

Maintenance Man-Hours Per Flying Hour



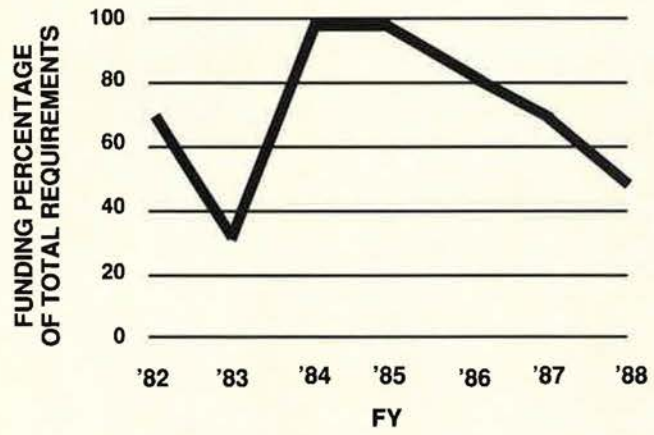
This chart demonstrates that the latest model F-16C/D aircraft is not only less likely to break than other aircraft but is also easier to maintain and repair—almost two times easier than is the case with the F-15C/D and more than three times easier than is the case with the F-4E. Result: lower personnel cost, more efficient use of manpower, and higher aircraft availability.

"Total Not Mission-Capable Supply" of Aircraft



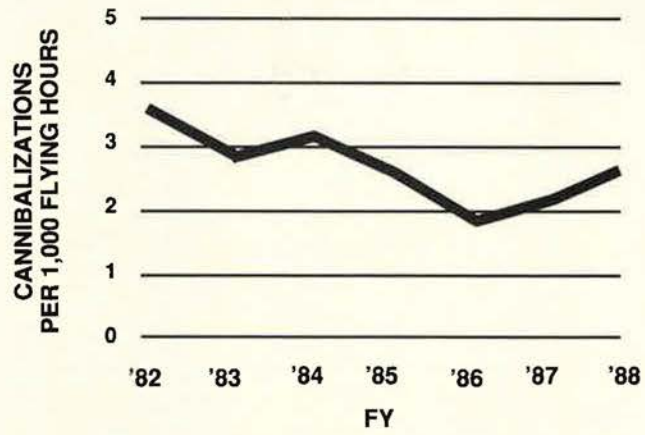
This chart shows the percentage of aggregate USAF aircraft rated total not mission-capable supply (TNMCS). TNMCS means that one or more parts are missing from the aircraft and that therefore the aircraft cannot perform its mission. From FY '82 to FY '87, the percentage of TNMCS was cut nearly in half. Now, however, it is edging upward. The situation today remains much improved over that of the early 1980s.

The Spare Parts Roller Coaster

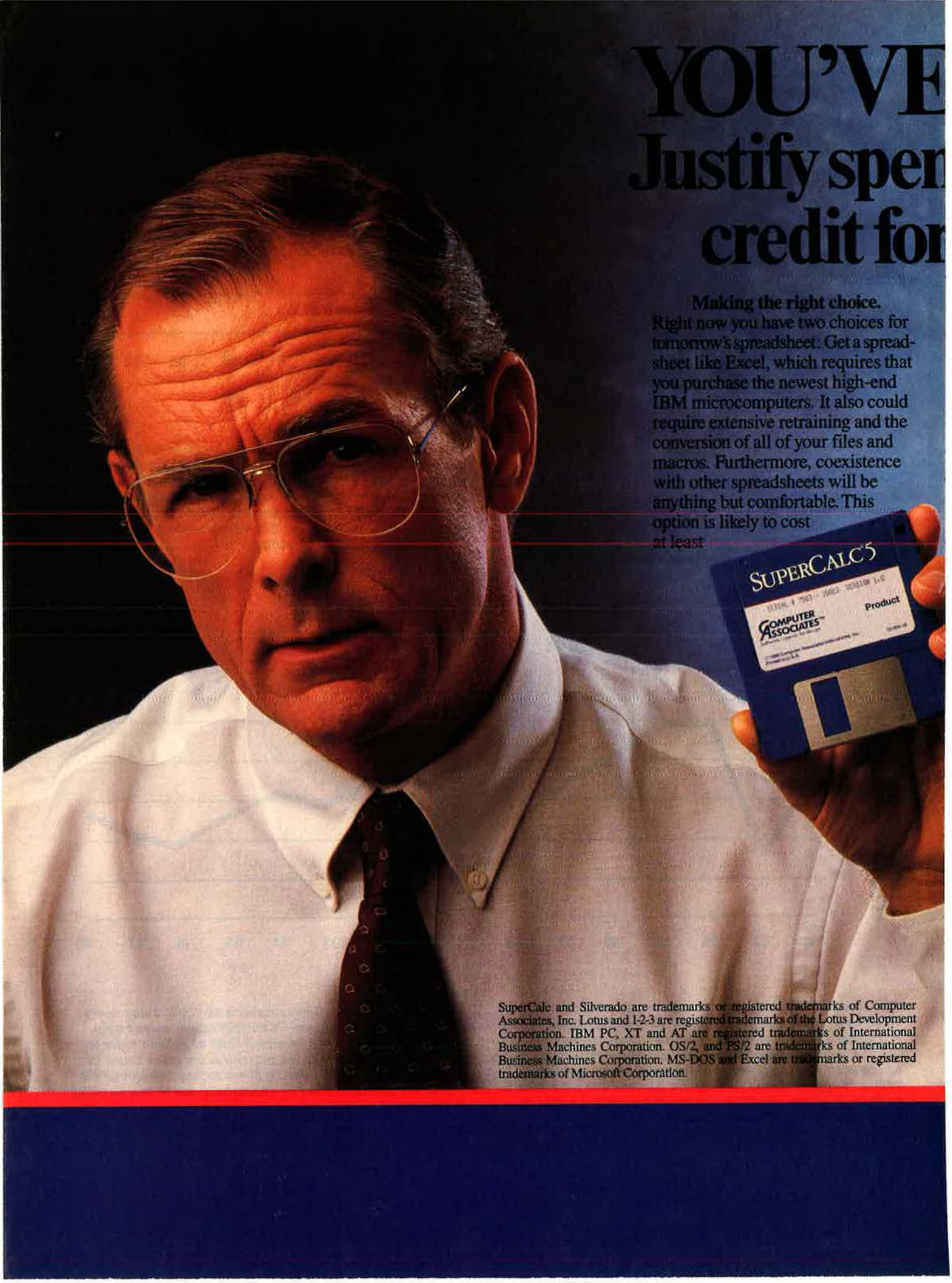


This chart shows the trend in funding for spare parts, measured as a percentage of total spare parts requirements. Financial support for spares has been up and down, ranging from a low of about thirty percent to a high of 100 percent, depending on the year. The combined figure over the past seven years comes to approximately seventy-five percent. The trend clearly is down, however, sparking concern about USAF's ability to hold its currently high combat readiness level.

Creeping Cannibalizations



This chart shows the cannibalizations per 1,000 flying hours for aggregate USAF aircraft. "Cannibalization" means stripping a temporarily out-of-service aircraft of parts in order to keep other aircraft flying. The practice is the prime cause of "hangar-queen" aircraft. After a steep decline throughout the 1980s, the rate has turned up—principally due to spares being in tight supply.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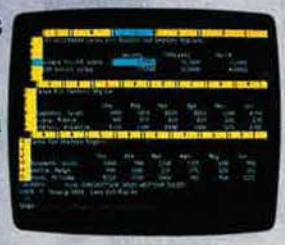

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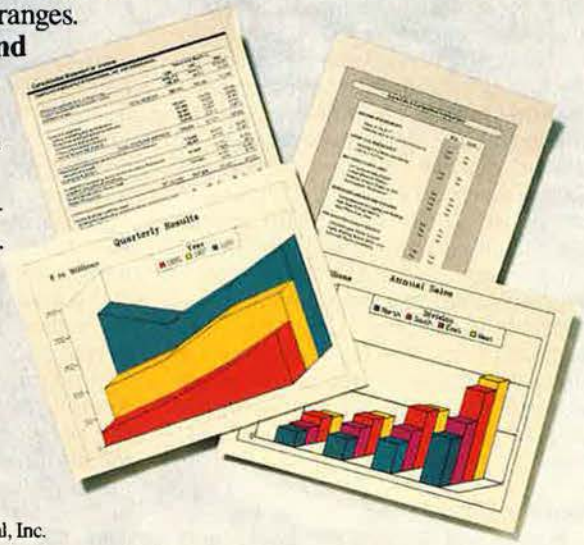

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Capitol Hill

By Brian Green, CONGRESSIONAL EDITOR

Washington, D. C.

"Buy America" House Bill

A House subcommittee has marked up a bill to protect the US defense industrial base by limiting US production of weapon systems and components to domestic manufacturers "to the maximum extent practicable" within five years of enactment of the measure.

The bill, introduced by Rep. Mary Rose Oakar (D-Ohio), is based on the premise that the nation's defense industrial base must be self-sufficient in providing all US national defense needs. The domestic-source requirement could be waived by the President on a case-by-case basis only after consideration of the impact of such a waiver on domestic industrial capability and economic costs.

To justify the measure, supporters of the bill cite the risk inherent in relying on foreign sources for national-security needs, a lack of hard knowledge concerning the specifics and extent of foreign dependency, and the inability of the US defense industrial base to mobilize to meet currently identified requirements.

The strong "buy America" slant to the bill runs counter to a major conclusion of the recent AFA report *Lifeline in Danger: An Assessment of the United States Defense Industrial Base.* The report argues that "it would be foolish in the extreme to ignore critical vulnerabilities and foreign dependencies," but that "a reasonable degree of interdependence and interoperability is logical" since the US is committed to fighting alongside its allies. Total independence of the US defense industrial base, the report says, is neither desirable nor affordable.

Money Bills Close

House and Senate conferees and White House negotiators, racing against an October 1 deadline to complete work on Fiscal Year '89 defense funding bills, completed work on a compromise authorization bill that will replace the bill vetoed by President Reagan last August.

The new authorization bill contains key compromises on arms control, SDI spending, and ICBM modernization funding:

- The ban on tests of depressed-trajectory ballistic missiles was dropped. The measure in the vetoed authorization bill required DoD to define the term "depressed trajectory" and then imposed a unilateral moratorium on tests of missiles that fit the definition, to be in force so long as the Soviets refrained from similar testing. Other arms-control measures in the bill were left unchanged. These included provisions on US compliance with SALT II Treaty limits on multiwarhead delivery vehicles, US compliance with the narrow interpretation of the ABM Treaty, and creation of a program to ensure the safety and reliability of US nuclear weapons in preparation for a very low nuclear test threshold or an outright ban of nuclear testing.
- SDI funding remained at $4.1 billion, but restrictions on how that money could be spent were removed. The vetoed bill had limited spending on space-based interceptors (which would destroy ballistic missiles and warheads by colliding with them) to $85 million, out of $330 million requested. Spending floors on three other programs—free electron lasers and two ground-based interceptors—were also eliminated.
- The compromise bill provides $600 million of $793 million requested for research and development on MX rail-garrison basing, of which no more than $250 million can be obligated prior to February 15. At that time, a report is due from the new Administration concerning plans for the remaining $350 million. Funding for the Small ICBM remains at $250 million. The vetoed bill provided $250 million for each program, with another $250 million to be allocated by the next Administration.

At press time, congressional appropriators were still working to beat the October 1 deadline, but the authorization compromise was expected to ease their way. Among other bills that had been stuck in the authorization logjam, the base closure bill to provide expedited procedures for closing unnecessary military installations can now be considered.

Aldridge Hits Critics

Secretary of the Air Force Edward C. "Pete" Aldridge, Jr., fired a broadside at critics in Congress for unfair attacks on the B-1B bomber, micromanagement, support of "pet" programs, efforts to create a "super acquisition agency," and lack of interest in "improving the efficiency of defense spending by closing unnecessary bases, consolidating functions, or canceling marginal programs."

With regard to the B-1B, the Secretary noted that "in spite of the rhetoric from some congressional critics, the Soviets know the B-1 is a fully mission-ready aircraft."

He blasted "the current rush of proposed [legislation] that calls for the creation of a centralized acquisition process." He argued that "more legislation . . . will add more layers to the bureaucracy, require more reports . . . [and] further isolate the operational expertise in each of the services from those who would determine what weapons we need and how they can be operated."

His criticism comes in the wake of a number of bills to radically revamp—again—DoD's acquisition structure. Rep. Dennis Hertel (D-Mich.) has introduced a bill to create an independent procurement corps, an elite group of highly trained procurement professionals. Another Hertel bill would create an Acquisition Agency to perform all DoD acquisition functions, and a bill sponsored by Sen. Alan Dixon (D-Ill.) would dramatically increase the power of the Under Secretary of Defense for Acquisition.

Inouye to Chair Senate Unit

Sen. Daniel Inouye (D-Hawaii) will take over the Defense Subcommittee of the Senate Appropriations Committee in January, provided the Democrats retain control over the Senate after this month's election. Sen. John Stennis (D-Miss.), the current Committee and subcommittee chairman, is retiring. ■

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Aerospace World

By Jeffrey P. Rhodes, AERONAUTICS EDITOR

Washington, D. C.

★ Robert Barthelemy, manager of the National Aerospace Plane (NASP) Joint Program Office at Wright-Patterson AFB, Ohio, briefed the media at AFA's National Convention in September on the progress of the X-30 program.

First of all, Dr. Barthelemy said, the X-30 is *not* the "Orient Express" that President Reagan mentioned in his State of the Union address several years ago, nor is it an operational vehicle or even a prototype. It *is* strictly a research vehicle and technology demonstrator.

The goals of the X-30 program are to develop an air-breathing, manned, single-stage-to-orbit (SSTO) vehicle capable of hypersonic cruise (speeds above 4,000 mph) and horizontal takeoff and landing from conventional runways. The vehicle will also be fully reusable and have a powered go-around capability, unlike the Space Shuttle.

The Air Force has assumed leadership of the NASP program. The Defense Advanced Research Projects Agency (DARPA), the National Aeronautics and Space Administration (NASA), the Navy, the Strategic Defense Initiative Organization (SDIO), and industry, meanwhile, will all play key roles.

In an unusual agreement, the five competing airframe and engine contractors (McDonnell Douglas, North American, General Dynamics, Pratt & Whitney, and Rocketdyne) are all working on different areas of materials research and are freely sharing the information among themselves. In areas common to all airframes (such as landing gear), the contractors will probably form a consortium to develop these items and remove them from the competition.

The selection of one airframe contractor and one engine contractor is scheduled for the start of full-scale development (Phase III) in 1990. Dr. Barthelemy now thinks that two of the Phase II companies may be the prime contractors, with the other Phase II companies serving as principal subcontractors, much like the relationship Northrop has with McDonnell Douglas on the F/A-18 aircraft.

—NASA photo by Fred D. Jones

NASA's Langley Research Center in Hampton, Va., recently began test flights with this Convair F-106B that has been modified with a leading edge vortex flap. The plane's left wing has an array of flow direction cones that indicate positions of the wing's vortex system. The expected benefit is a twenty to thirty percent increase in the lift/drag ratio at transonic speeds. About fifty sorties will be flown. Air Force Lt. Col. Alfred J. Wunschel was pilot for the first flight.

Current plans call for two X-30s to be built for flying and another aircraft or parts to be built for static test. Dr. Barthelemy says that studies indicate that the X-30 will be in the 200,000- to 300,000-pound gross takeoff weight class and will have landing speeds higher than those of normal aircraft. The length of runway the X-30 will need is well within the limits of what's available now. First flight is scheduled for FY '94 and an SSTO flight in FY '96.

As an indication of the size of the test range needed for this research craft, an X-30 taking off from Edwards AFB, Calif., traveling at Mach 10 and making a continuous 2-G turn, would need to start the turn over Oregon. It would then arc over Idaho and Montana before straightening out over Wyoming and Colorado. The base leg to Edwards would start over New Mexico. With a continuous 2-G force in the turns at Mach 15, the X-30 would fly a path taking it over Canada, Michigan, Indiana, Kentucky, Tennessee, Arkansas, Texas, and Mexico before lining up to land at Edwards.

★ The summer months saw all sorts of missiles being tested at various locations. Here's a brief rundown.

Ten AIM-120A advanced medium-range air-to-air missiles **(AMRAAMs)** built by Hughes were fired during June, July, and August. All but three shots were successful.

On June 3, an AMRAAM fired from an F/A-18 at a QF-86 drone at the Pacific Missile Test Center (PMTC) at Point Mugu, Calif., had a hardware failure and "failed to meet the objectives of its mission." This test was repeated on June 24, and the nearly twelve-foot-long missile passed within lethal range of the target.

On July 21, an AMRAAM launched from an F-15 at the Gulf Test Range near Eglin AFB, Fla., destroyed a QF-100 drone. The next day, an F/A-18-launched AIM-120 scored a direct hit

against a QF-86 at the PMTC. This was the first test missile to carry production software. An AMRAAM fired from an F/A-18 over the Naval Weapons Center range at China Lake, Calif., passed within lethal range of a QF-86 on July 29.

A dual launch was conducted from an F-15 over Eglin on August 3. The first 335-pound missile tracked the target, but an anomaly developed, resulting in a miss. The second AIM-120 passed within lethal range of the second QF-100. A week later, a second F-15 dual launch resulted in a miss and a direct hit against a pair of QF-100s. On August 23, an AMRAAM launched from an F-15 over the White Sands Missile Range in New Mexico scored a direct hit on a maneuvering QF-100.

The Hughes-built AMRAAM's scoreboard now stands at fifty-two successes (including eighteen direct hits) in sixty-seven valid launches. Two other shots were ruled "no tests."

The **first Raytheon-built AMRAAM** was fired on September 7 at Eglin. The shot appeared to meet all mission objectives, but an anomaly developed prior to intercept, and the missile became unstable.

A Rockwell **AGM-130** powered glide bomb successfully covered its entire glide-boost-glide profile and scored a direct hit on a ground target at Eglin on August 31. This was the fifth launch of a full-up guided test vehicle and the third of eight planned tests in the missile's development, test, and evaluation (DT&E) program.

The missile was released from an F-4E flying at Mach 0.9 at approximately 500 feet above ground level. After its release, the AGM-130 climbed to 2,000 feet, fired its rocket motor, and maintained a constant altitude. After the F-4 weapon systems officer identified the target, the missile locked on and was automatically guided to the target. Standoff range was approximately fifteen miles.

The first Rockwell **GBU-15** (the AGM-130's nonboosted forerunner) was launched from an F-16 in late July at the Air Force Flight Test Center at Edwards AFB, Calif. The GBU-15 was launched from an F-16D, and initial weapon flight was manually controlled via data link from the launching aircraft. Weapon control was then switched to a second aircraft, and the GBU-15 was guided to a direct hit. The first GBU-15 launch from an F-15E was conducted in early summer.

The Navy successfully carried out two tests of inert **BGM-109 Tomahawk** sea-launched cruise missiles in late August. On August 23, a conventional land attack Tomahawk (TLAM-C) was launched from the destroyer USS *Merrill* (DD-976) toward a target in the Naval Weapons Center Range. The missile was recovered after an 800-mile flight. On August 25, a Tomahawk was fired from the USS *Conolly* (DD-979) and made a 300-mile flight to engage a ship target near the Virginia Capes. The missile was recovered at Camp Lejeune, N. C.

The Navy also carried out two tests of the UGM-133A **Trident II,** or D5, sea-launched ballistic missile. Both SLBMs were launched from a flat pad at Cape Canaveral AFS, Fla., and the August 27 test was successfully carried out in the Atlantic Missile Test Range. On September 19, a D5 was

NASA's Ames-Dryden Flight Research Facility has begun its High Alpha (high angle of attack) research program with this specially equipped and instrumented F/A-18 on loan from the Navy. The program will investigate airflow in high angle of attack attitudes, nose-high flight relative to flight path, and post-stall maneuverability assisted by thrust vectoring. The High Alpha program will run until 1992.

LTV has developed a unique system that applies a protective coating to keep commercial airliner parts unmarred during the manufacturing process. Before the introduction of the new applicator, which saves money and time, technicians either used a cumbersome tape machine to apply the plastic film or applied it by hand.

This is an artist's conception of the Martin Marietta/McDonnell Douglas Advanced Launch System (ALS) vehicle that will be capable of lifting eighty tons of payload into low earth orbit. Boeing and General Dynamics are the other two contractors selected to continue into Phase II of the ALS development effort.

destroyed by range safety officers shortly after liftoff. The failure is under investigation and was the third in fifteen Trident II launches.

★ There have also been a number of things going on in the space-launch arena recently. Here are some of the highlights.

The Air Force picked three companies from a list of seven contractors for system design and technology demonstrations through preliminary design review of the heavy-lift **Advanced Launch System** (ALS) on August 16. The Phase II contractors will be Boeing Aerospace, General Dynamics Space Systems Division, and the team of Martin Marietta and McDonnell Douglas Astronautics.

Negotiations with the companies were not complete, though, and no contract values were announced. When awarded, the contracts will be a cost-plus-award-fee type with a cost-plus-fixed-fee line item for special studies. The Phase II contracts are for a minimum of twenty-four months, after which a winning ALS design will be chosen.

The ALS boosters must meet both civil and defense space-launch needs for the late 1990s and beyond. The new system must be able to place payloads weighing up to 160,000 pounds into low-earth orbit at significantly reduced cost per pound of payload.

The Air Force launched a Martin Marietta **Titan 34D** rocket carrying a classified military payload from Cape Canaveral AFS on September 2. It was the third successful Titan 34D launch since the April 1986 explosion of a Titan 34D at Vandenberg AFB, Calif. Unfortunately, on this latest launch, the rocket's upper stage failed to reignite in orbit, and the satellite achieved a useless orbit.

Three days later, the Air Force successfully carried out the first launch of a **Titan II** intercontinental ballistic missile that had been refurbished as a space-launch vehicle. The Titan II, launched from Vandenberg, carried a classified Navy payload. Martin Marietta has converted fourteen Titan IIs into space boosters. Three more are scheduled to be modified.

Israel joined the world's space-launch community on September 19, as the experimental satellite **OFFEQ-1** was launched on a Shavit ("comet" in Hebrew) booster from an unspecified site in the Negev desert. The OFFEQ-1, which has a useful life of only a few weeks, is designed to test the Israel Space Agency's (ISA) ability to put a satellite into orbit and check the functional ability of its subsystems in a space environment.

On September 9, President Reagan conditionally approved export licenses for Hughes to launch three US-made communications satellites on Chinese **Long March** boosters. If final approval is granted by the President, the Congress, and the allied committee that must approve technology transfers, these would be the first US satellite exports to a non-Western country.

In order to receive approval, the Chinese must sign formal agreements ensuring that the satellites will be protected against technology transfer and that the Chinese accept responsibility for potential liability from damages resulting from accidents.

The satellites to be launched are two communications satellites for AUSSAT, the Australian space agency, and the former Westar-6, which has been refurbished and is now called **Asiasat.**

The Chinese, meanwhile, launched their first weather satellite, called **Fengyun 1,** on the first launch of the Long March 4 booster on September 7. The satellite, in a sun-synchronous orbit, was launched from a new complex in Taiaiyuan, near Beijing.

Finally, the Air Force launched the last two **Oscar** navigation satellites for the Navy from Vandenberg on August 25. The twin, 140-pound satellites were launched into a 600-nm polar orbit by a Scout booster. Oscar satellites have been launched since 1964. One of them has been in operation for twenty-one years. The Navstar Global Positioning System satellites will replace the Oscars.

★ **PURCHASES**—Rockwell's **North American Aviation** division was awarded a $47.3 million contract by Naval Air Systems Command on August 26 **for detailed design refinement and for fabrication and construction of two X-31 Enhanced Fighter Maneuverability (EFM) demonstrators.** This Phase III contract calls for an initial systems checkout within the first twelve hours of flight testing, to be done at Rockwell's plant in Palmdale, Calif. Testing will eventually shift to the Naval Air Test Center at NAS Patuxent River, Md., where a team of Rockwell, Messerschmitt-Bölkow-Blohm (the X-31's principal subcontractor), Navy, and German test pilots will fly the aircraft. First flight is scheduled for late 1989.

Under a $3 million contract awarded by the Coast Guard, **Grumman's** St. Augustine, Fla., division **will**

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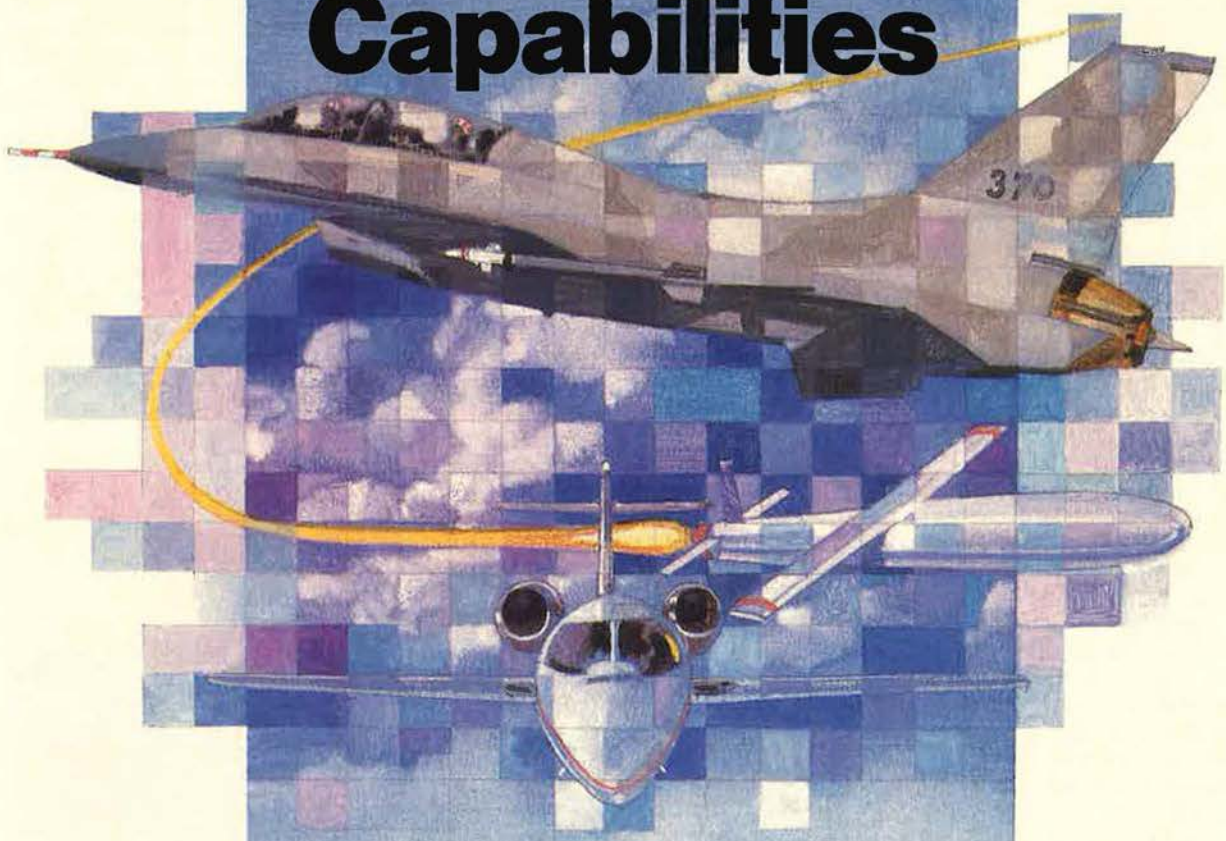

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modify and equip three Aérospatiale HH-65A Dolphin helicopters with a decklock system for operations at sea. The system, produced by Fairey Hydraulics Ltd., consists of a probe that locks into a grid system on the landing pad of Coast Guard cutters. The decklock system allows the helicopter to shut down after landing, rather than remain running to produce a downforce to hold the helicopter until it can be secured. Contract options worth $9 million call for the production of ninety-three installation kits and fifty-three removable probes. The Coast Guard will make the additional installations.

Air Force Systems Command's Electronic Systems Division (ESD) at Hanscom AFB, Mass., awarded contracts worth up to $75 million each to **Boeing Aerospace, IBM's Federal Systems Division, and Unisys** for the Department of Defense's Software Technology for Adaptable, Reliable Systems **(STARS)** program office. STARS will design and integrate "software engineering environments" to speed the production of military software. The contractors will seek ways to increase software development automation. They will also design reusable software programs and make the new technologies available industry-wide through a public-domain repository to improve software productivity.

On August 16, Air Force Systems Command's Aeronautical Systems Division at Wright-Patterson AFB, Ohio, awarded contracts totaling $59 million for 480 **standard flight data recorders** (SFDRs). The contracts include full-scale development and initial production of the crash-survivable recorders, which keep a record of individual aircraft-wear data (such as engine usage and fatigue) and help determine the causes of catastrophic mishaps.

Under a leader-follower arrangement, **SLI Avionic Systems** (361 recorders) and **AiResearch Tucson Division** (119 units) will produce the recorders in four configurations that will be used to equip seventeen aircraft.

★ **DELIVERIES**—The **first of twenty-four** General Dynamics **F-16C and D model fighters were delivered to Osan AB, Korea,** on August 20. The first single-seat F-16C was ferried to Osan from the GD plant in Fort Worth, Tex., by Lt. Col. James A. Spitzer, chief of the 51st Tactical Fighter Wing's F-16 special project office. The wing will begin conversion from McDonnell Douglas F-4Es to the new aircraft later this fall.

Late last October, **the Air Force accepted the first of three F-15E** Weapon System Trainers **(WSTs)** at Luke AFB, Ariz. The first trainer will be used to provide safety of flight and systems operations training for F-15E pilots and weapon system officers. The other units will provide full mission training. The F-15E WST features simulation of all avionics for air-to-air and air-to-ground missions, including synthetic aperture radar and electro-optical and infrared sensor simulation for the aircraft's LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) pods. Loral Defense Systems/Akron (Ohio) is building the

After ten years of restoration, "Shoo Shoo Baby," the last known aircraft that flew combat missions in World War II and can still fly under its own power, was rolled out at the 512th Military Airlift Wing's hangar at Dover AFB, Del., on September 10. The B-17G (serial number 42-32076), shown here taxiing by a C-5, was scheduled to be flown to the Air Force Museum on October 13.

—Photo by Paul Jackson

Representative NATO aircraft and crews gathered at Lossiemouth, Scotland, to participate in an unusual "All the Eights" meet on August 8, 1988. The units included the 8th MAS (USAF; C-141B); VXN-8 (USN; UP-3A); 8e Escadre de Chasse (France; Alpha Jet); 8e Smaldeel/Escadrille (Belgium; Mirage 5BA); 8o Stormo and 8o Gruppo (Italy; G.91Y, G.222RM, and 808RM); and the host unit (shown here), No. 8 Squadron (RAF; Shackleton AEW Mk. 2). Three US Navy helicopter units, HC-8, HT-8, and HS-8, also sent representatives.

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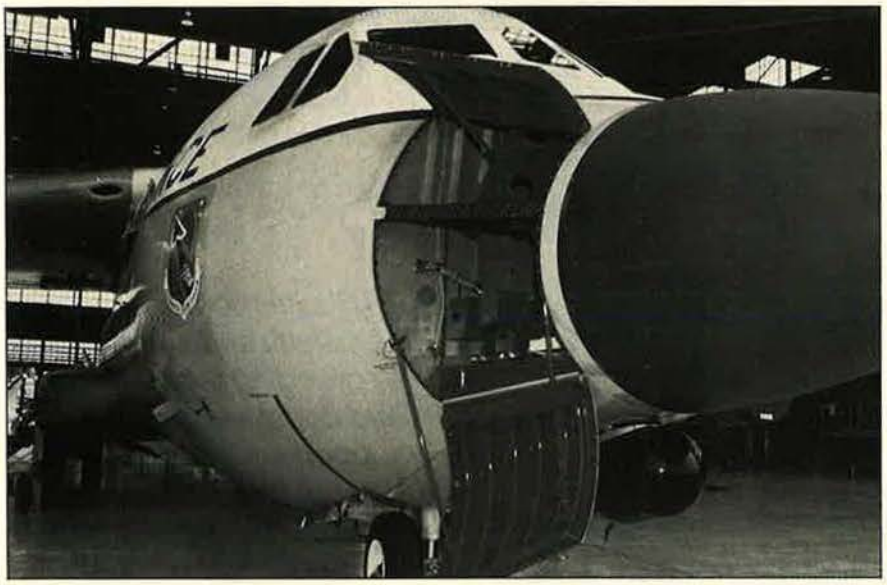

The rhinoplasty performed on this NC-141A will give the Air Force a unique capability to test the performance of new radar systems or analyze improvements to current radar systems at a much lower cost. Called the electronic counter-countermeasures advanced radar test-bed (ECCM-ARTB), the NC-141 is now undergoing airworthiness tests at the 4950th Test Wing at Wright-Patterson AFB, Ohio.

WSTs. The delivery of the WST marks the first time in history that an advanced simulator has been delivered concurrently with the aircraft.

★ **MILESTONES—The first piece of the first McDonnell Douglas C-17 airlifter was assembled** on August 24 at the Douglas plant in Long Beach, Calif. The first part is a sixty-eight-foot-long tiedown rail, the central structural member of the cargo floor of the C-17. The rail consists of two sections of 7.25-inch-by-three-inch-thick aluminum extrusion. The assembled C-17 airframe will contain 227,000 pieces, 121 miles of electrical wiring, 4,720 feet of hydraulic lines, and more than 100 avionics units. More than 6,500 Douglas employees are now working on or supporting the C-17 program.

Ernest O'Campo (foreground) and Steve Ybarra (opposite O'Campo) begin assembly of the first McDonnell Douglas C-17 airlifter at the Douglas plant in Long Beach, Calif., on August 24. This initial component, a sixty-eight-foot-long tiedown rail, is the central structural member of the airlifter's cargo floor.

Capt. Bruce Young, now assigned to the 90th Strategic Missile Wing at F. E. Warren AFB, Wyo., **recently became the 20,000th graduate of the 4315th Combat Crew Training Squadron** at Vandenberg AFB, Calif. The 4315th CCTS has been the "schoolhouse" for intercontinental ballistic missile launch officers for the past twenty-five years. Captain Young, a native of St. Louis, Mo., is serving as an LGM-118A Peacekeeper launch-control officer.

The **first** BGM-109 Gryphon ground-launched cruise missiles **(GLCMs) were removed from Europe** on September 8 under the terms of the new Intermediate-range Nuclear Forces (INF) Treaty. The missiles were removed from RAF Molesworth in Britain and were later airlifted to Davis-Monthan AFB, Ariz., where they will be destroyed. The eighteen missiles at RAF Molesworth were the last of 364 missiles deployed to Britain, West Germany, Italy, and Belgium. US Ambassador to the Court of St. James Charles Price II and UK Defence Minister George Younger were present at the removal activities.

Meanwhile, **Military Airlift Command crews flew their 100th mission in support of the** verification process for the **INF Treaty** on August 25. Twenty inspectors from the US On-Site Inspection Agency (OSIA) flew from Yakota AB, Japan, to Ulan Ude in the Soviet Union aboard a C-141. The inspectors were met and taken to the missile site by the Soviets. The 100th mission was flown just seven weeks after the treaty went into effect.

In a nautical milestone, **Magnavox Electronic Systems Co. delivered its 4,000,000th production sonobuoy** to the Navy on September 22. Sonobuoys are expendable underwater devices that detect, localize, and classify enemy submarines and transmit the information to such orbiting anti-submarine warfare (ASW) aircraft as P-3s, S-3s, and SH-60s. Sonobuoy procurements have been competitively bid since the early 1960s, and Magnavox is the first company to reach the 4,000,000 plateau. Passive sonobuoys have fallen in price from $500 apiece to $250 today.

The Pratt & Whitney **F100-PW-220 engine passed the 50,000-hour flight milestone** in early August and is proving to be one of the most reliable engines in Air Force history. The engines have not experienced a single in-flight shutdown and have achieved a 99.5 percent mission-capable rate. During 1987, the unscheduled removal rate for the -220 was one-sixth

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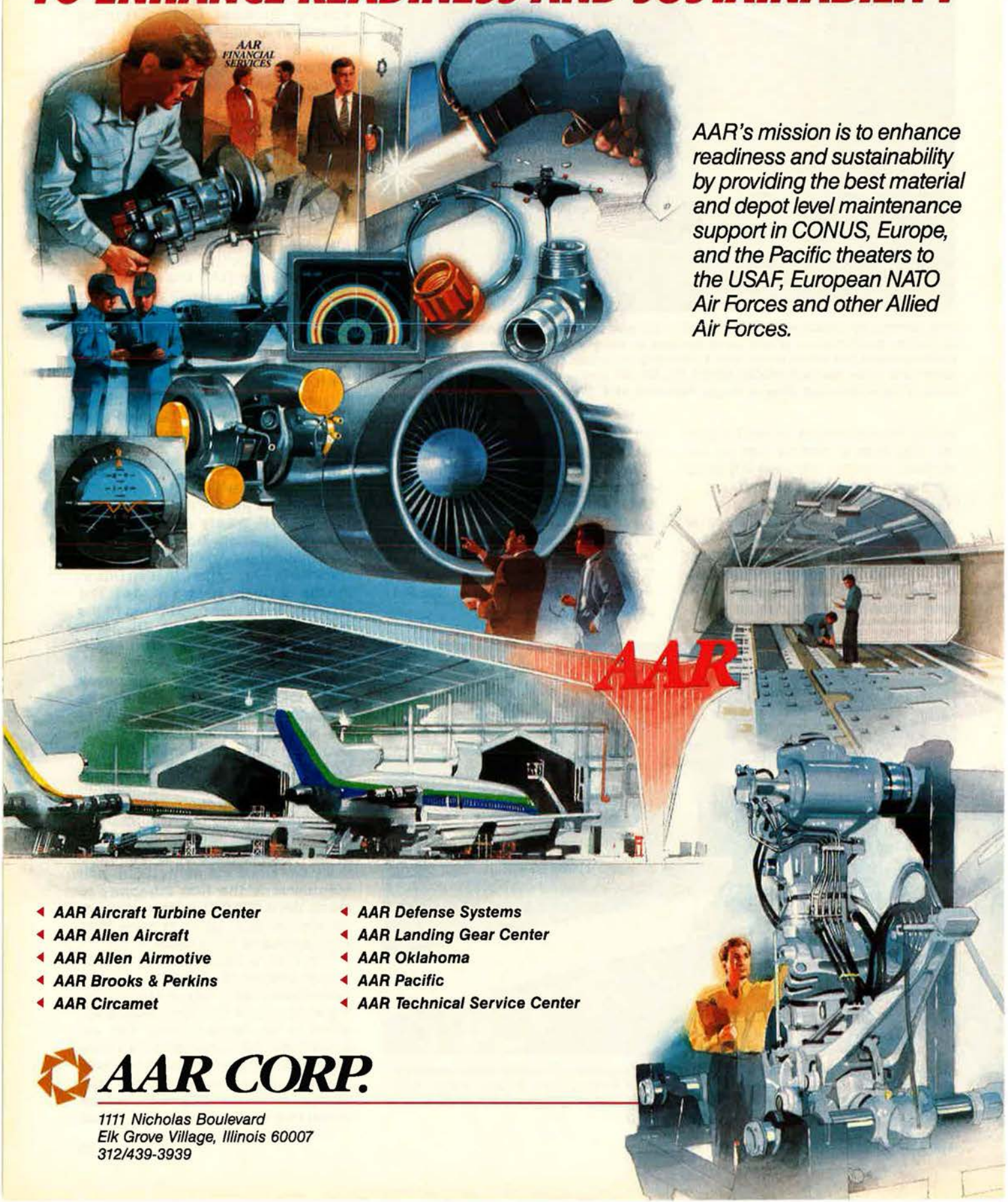

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SSgt. Tim Oran, NCOIC of medical information systems at the Air Force Academy hospital, saved the life of one-year-old Lisa Rickard on August 23 by administering cardiopulmonary resuscitation after she suffered a seizure in a local supermarket. Lisa had two more seizures after paramedics arrived, but now she is doing fine. Sergeant Oran first learned CPR in the fifth grade, but had never used it before the incident.

that of earlier F-15 and F-16 engines. More than 470 -220 engines are flying with the Air Force at three bases and with five foreign air forces. More than 900 F100-PW-220 engines have been ordered.

★ **NEWS NOTES—US military forces combined to give Smokey the Bear a hand in combating massive forest fires** in Yellowstone National Park in late August. One Air Force Reserve unit and three Air National Guard C-130 units deployed to Klamath Falls, Ore., and Helena, Mont., to help the US Forest Service control the blazes. Using the modular aerial firefighting system owned by the Forest Service, crews can discharge 3,000 gallons of retardant in under ten seconds. As of September 10, crews had dropped more than 1,400,000 gallons of retardant. On the ground, 1,200 Marines from Camp Pendleton, Calif., and 1,400 soldiers from Fort Lewis, Wash., also helped fight the fires.

The Department of Defense confirmed in mid-September that **work is progressing on an earth penetrator nuclear warhead.** The earth penetrator, which has not advanced past study, would be designed for use against hardened Soviet command posts that have been buried deep underground. The Defense Acquisition Board approved the Air Force Statement of Need, and Secretary of Defense Frank Carlucci has also approved the effort. Two projects are reportedly under way—one that would modify existing weapons and a second that would be a long-term effort.

Repairs to the USS *Stark* (FFG-31), heavily damaged by two Iraqi Exocet antiship missiles in the Persian Gulf in May 1987, **were completed** in August, and the ship went out for sea trials on August 29–30. The ship returned to active duty with the Atlantic Fleet and its homeport of Mayport, Fla., shortly after completion of the trials. The repairs, which included replacing the ship's Combat Information Center, half of the superstructure, and a fifty-foot section of the hull, were done at the Ingalls Shipbuilding yards in Pascagoula, Miss. Repair costs were in the $90 million range, well below original estimates.

The American Council on Education recently announced that **graduates of the Air Force Test Pilot School** at Edwards AFB, Calif., **can now earn as many as seventeen semester hours toward a master's degree in engineering.** Basing its findings on textbook research, student and staff interviews, and instructors' backgrounds, the Council's Center for Adult Learning and Education Credentials can recommend that three graduate hours be awarded for avionics systems integration. Two hours each can be awarded for aerodynamics, linear control theory, and systems management. Four hours can be awarded for flight mechanics and also systems performance. The credit recommendations are retroactive and affect all graduates of the

November Anniversaries

- *November 13, 1908:* Wilbur Wright, in a Wright biplane at Auvours, France, and Henri Farman, in a Voisin at Issy, France, both set a world altitude record of eighty-two feet.
- *November 7, 1918:* Dr. Robert H. Goddard demonstrates tube-launched solid-propellant rockets at the Aberdeen Proving Ground in Maryland.
- *November 11, 1918:* The Armistice ending World War I is signed at 5:00 a.m. in a railway car at Compiègne, France. The Armistice would take effect at 11:00 a.m.
- *November 11, 1928:* Sir George Hubert Wilkins and Lt. Carl B. Eielson make the first flight over Antarctica in a Lockheed Vega.
- *November 22, 1943:* The first Cairo Conference opens with Franklin D. Roosevelt, Winston Churchill, and Chiang Kai-shek in attendance.
- *November 1, 1953:* The Air Reserve Personnel Center is established at Det. 1, Hq. Continental Air Command, Lowry AFB, Colo.
- *November 6, 1953:* A Boeing B-47 Stratojet is flown from Limestone AFB, Me. (now Loring), to RAF Brize Norton, England, in four hours and fifty-three minutes to establish a new transatlantic speed record from the continental US.
- *November 1, 1953:* NACA test pilot Scott Crossfield becomes the first person to exceed Mach 2. His Douglas D-558-II Skyrocket research plane was dropped from a Navy P2B-1S (B-29) at an altitude of 32,000 feet over Edwards AFB, Calif.
- *November 7, 1963:* The Northrop-developed three-parachute landing system for the Apollo command module is successfully tested at White Sands, N. M.
- *November 14, 1973:* The US airlift to Israel during the Yom Kippur War ends. During the thirty-three-day airlift, Military Airlift Command carried 22,318 tons of supplies. Also on this date, the first production McDonnell Douglas F-15A Eagle is delivered to the Air Force at Luke AFB, Ariz.
- *November 30, 1978:* The last Boeing LGM-30G Minuteman III ICBM is delivered to the Air Force at Hill AFB, Utah.
- *November 28, 1983:* The ninth Space Shuttle mission (STS-9) is launched, marking two milestones—Mission Commander John Young becomes the first person to make six spaceflights, and *Columbia* is the first spacecraft to be launched with a crew of six. The ten-day flight is also the first on which the European Spacelab module is used.

school who started class after July 1974.

The **pilot shortage in the Royal Australian Air Force is so critical that the RAAF Staff College in Canberra will be closed for a year.** Mid-level students and instructors from the college are needed for flying and filling administrative positions. The RAAF lost 123 pilots—mainly to the commercial airlines—last fiscal year, and forty-two pilots either left the RAAF (or indicated they would do so) in July alone. This compares with a previous ten-year average loss of forty-seven pilots per year. A reenlistment bonus of A$70,000 (US $56,000) had been offered as a possible solution, but after taxes, the bonus came to only A$35,000 (US $28,000) for signing up for an additional six-year hitch. Few took advantage of the offer.

★ **DIED**—Retired **Gen. Lauris Norstad,** brilliant air strategist during World War II and later Supreme Allied Commander, Europe, died September 12 of heart ailments at Tucson, Ariz. He was eighty-one.

General Norstad graduated from West Point in 1930 and was brought to Washington by Gen. H. H. Arnold, who admired the young officer's analytical powers. General Norstad planned the air operations for the Allied landings in North Africa, Sicily, and Italy. He also helped plan the final bombing offensive against Japan. After the war, he helped plan the size and composition of the Air Force when it became a separate service in 1947. He assumed command of the US Air Forces in Europe in 1951 and became Supreme Allied Commander, Europe in 1956. A holder of the Distinguished Service Medal and the Silver Star, General Norstad retired from the Air Force in 1963. He later became chairman and chief executive officer of Owens-Corning Fiberglas.

Dr. Luis W. Alvarez, Nobel Prize-winning physicist and aviation innovator, died August 31 of cancer at his home in Berkeley, Calif. He was seventy-seven.

During the early part of World War II, while he was at the Massachusetts Institute of Technology, Dr. Alvarez invented the radar-guided, ground-controlled approach of aircraft landing in poor visibility. The system gained wide acceptance, and he was awarded the Collier Trophy in 1946. Later in the war, he was a key member of the Manhattan Project team, which developed the atomic bomb. He was a witness at the first test firing at Alamogordo, N. M., and flew as an observer on a B-29 flying chase on the Hiroshima mission. He spent most of his career at the Lawrence Livermore National Laboratory at the University of California at Berkeley. He won the Nobel Prize in 1968 for his work in identifying subatomic particles. He was named a professor emeritus at Cal-Berkeley in 1978.

Senior Staff Changes

RETIREMENTS: L/G Leonard H. **Perroots;** B/G Gorham B. **Stephenson.**

CHANGES: B/G Buster C. Glosson, from DCS/Plans, Hq. USAFE, Ramstein AB, Germany, to Dep. Ass't Sec'y of Defense for Legislative Affairs, OSD, Washington, D. C. . . . **M/G James W. Hopp,** from Cmdr., LMSC, and DCS/Log. Mgmt. Sys., Hq. AFLC, Wright-Patterson AFB, Ohio, to Cmdr., Ogden ALC, AFLC, Hill AFB, Utah, replacing M/G (L/G selectee) Robert P. McCoy . . . **L/G Hansford T. Johnson,** from Dep. CINC, Hq. USCENTCOM, MacDill AFB, Fla., to Dir., Joint Staff, OJCS, Washington, D. C. . . . **ANG B/G Phillip G. Killey,** from Adj. Gen., S. D. ANG, Sioux Falls, S. D., to Dir., ANG, Washington, D. C., replacing ANG M/G John B. Conaway . . . **Col. (B/G selectee) John F. Phillips,** from Vice Cmdr., LMSC, Hq. AFLC, Wright-Patterson AFB, Ohio, to Cmdr., LMSC, and DCS/Log. Mgmt. Sys., Hq. AFLC, Wright-Patterson AFB, Ohio, replacing M/G James W. Hopp . . . **B/G John J. Salvadore,** from Ass't for General Officer Matters, DCS/Personnel, Hq. USAF, Washington, D. C., to Cmdr., USAF Recruiting & Commissioning Prgm., Hq. ATC, Randolph AFB, Tex., replacing retiring B/G E. Daniel Cherry. ■

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Generating Sorties and Sustaining Combat

BY ROBERT S. DUDNEY, SENIOR EDITOR

As it updates its plans to counter Soviet power in Europe, the Air Force seems intent on suspending the laws of mathematics. The service is embarked on a course that calls for Western air forces to "outnumber" the Warsaw Pact air fleet in battle—though these units are to remain inferior to the adversary in size.

What is significant for US Air Forces in Europe (USAFE) is not only the quantity of warplanes at its disposal. The specific dimension of the USAFE force, which now deploys 700 aircraft, is a separate issue. At the heart of the emerging plan, say US officers, would be superiority of a different sort: the ability of USAFE and its allies to fly more actual combat missions, and for longer periods, than the foe.

The upshot is a USAFE warfighting program that complements the traditional emphasis on putting fighters on the ramp with steps that will multiply the readiness and persistence of today's force.

USAFE's aircraft, air bases, maintenance units, logistic systems, supply operations, weapons, and other assets are all being reshaped in a campaign aimed at forging a readier force that not only can pack a big punch but also deliver it around the clock for long periods.

The most conspicuous advance thus far is a marked rise in the number of sorties that USAFE and the allies can squeeze from their scarce aircraft, compared to the 1960s and 1970s. Today, USAFE's sortie-generation powers are "at least twice as good, maybe more," says Maj. Gen. Michael A. Nelson, a top Air Force operations officer at Allied Command Europe in Belgium. "[The difference is] big—and significant."

More modest but still important are improvements in USAFE's powers to provide munitions, fuel, and parts to sustain operations longer.

Incomplete Solution

The strides may explain, in part, why USAFE seems more upbeat about being able to combat massed

This F-16 is being rearmed for yet another sortie by its crew, wearing their chemical-biological warfare suits, at Hahn AB in Germany. Not only do the F-16s break less often than their predecessors, but maintenance crews can "turn" the newer aircraft for combat in less than half of the time it took for the F-4.

Pact air attacks. Of every raiding force sent against NATO, one officer now claims, as much as twenty percent of attackers would be downed by swarming Western defenders—in the early going, at least.

"If he comes over on this side of the fence," says USAFE Commander in Chief Gen. William Kirk, "we'll eat his lunch. He will take massive losses."

For all its promise, the effort is regarded by US officers as a less than complete solution to problems they face. They would prefer to have a larger fighter force, as well as a ready one, but concede that the Pentagon budget crunch makes the prospect of a buildup remote at best.

The situation is not without its problems, the major one being the force's lack of sustainability. How far USAFE has come—and has yet to go—in crafting the force that it says it requires is pointed up in talks with officers and troops responsible for USAFE readiness.

Nowhere, these experts say, is the command exerting greater effort, and making more visible progress, than in the areas that contribute to USAFE's capability to generate combat sorties. These vital factors are many and varied. Among them: day-to-day readiness of aircraft, training of aircrews, weapons reliability and effectiveness, and resilience in local base facilities and infrastructure.

Improvement in peacetime aircraft availability rates forms the bedrock of USAFE's ability to generate sorties. Officers point out that the mission-capable rate of combat squadrons in Europe, up significantly since 1980, now stands near an all-time high.

The value of having ready fighters—finely tuned, well maintained, and fully equipped—is underlined by an F-16 squadron operations officer. "We can be ready with the entire squadron, all twenty-four jets going up, in only half a day," he asserts. "It wouldn't take us very long."

This capability, all agree, marks a reversal of the situation facing USAFE wings early in the decade. What accounts for the turnaround?

One key factor is better funding, sustained for several years, of peacetime readiness accounts. This has helped USAFE come up with the spare parts, repair equipment, and other items needed to keep aircraft and other weapons well-supplied and in fighting trim. In fact, the index of aircraft out of action for lack of parts has declined precipitously since the early 1980s.

Even more impressive than the supply situation has been a dramatic

improvement in the quality of work performed by maintenance crews. Not long ago, performance had deteriorated to a worrisome level. A large number of specialists, officers note, simply didn't know how to repair or maintain their weapons.

Now, officials contend, that problem is largely a thing of the past. The main reason: better training. The command today is taking its best workers off the flight line to become instructors, where they can impart their hard-earned knowledge to many others.

"Part of our old philosophy," recalls a senior maintenance man, "was to keep the good people working on airplanes and put the dead, the sick, the lame, and the lazy down in training. So our people knew just enough to get by. Now, they really learn what to do."

Equally critical to sortie generation in the early days of war, many experts maintain, would be USAFE's success in its drive to prepare the human element of its force for the rigors of nonstop combat. That, USAFE planners make clear, is a priority of high order. The command stresses pilot training, explains one operations officer, because it translates into "no-kidding combat capability."

Part—but only part—of the effort involves giving pilots an adequate number of flying hours. Time in the cockpit has increased markedly from the 184,892 hours that they flew in 1980. The typical pilot gets to fly three to four sorties every week.

High-Quality Training Time

As important as the quantity, however, is the quality of the training that pilots receive while they are in the air. Here, USAFE is going to great lengths to make sure that the time the individual pilot spends in the air provides training that is as realistic as possible.

With the opening of the Air Combat Maneuvering Instrumentation facility on Sardinia, for example, US and other NATO pilots are now able to conduct extremely realistic air-to-air combat training. What's more, they participate frequently in low-level operations during Red Flag exercises in the US, though not as often as they would like.

There are limits. Despite all its efforts, say officers, USAFE can never recreate the stresses and strains that pilots would face in the melee over Europe in the opening days of conflict.

Sharpening the peacetime readiness of men and materiel, while important, is but one element in USAF's drive to prepare its European forces to generate enough combat sorties to match an outsized foe. Also getting major attention: pursuit of a more persistent fighter force able to stay in action long after Day One.

Innovative steps are being taken to produce aircraft and weapons that break down less often, can be fixed quicker with less manpower, and are more effective. The aim, officers note, is to keep Air Force F-15, F-16, F-111, and other warplanes out of the maintenance bays and in the air, where they would help even the odds in the air battle.

Progress on this score, say planners, is nowhere more evident than in the increased reliability of USAFE's latest aircraft. In simplest terms, fighters are not breaking as often. "I compare the situation with twenty-five years ago, when I was

an F-100 pilot in Europe," says General Nelson, "and the difference is just incredible."

The leading factor: USAFE's force of 228 General Dynamics F-16C multirole fighters, currently deployed in West Germany and Spain. USAFE officials report that the F-16, with advanced design and components, breaks less than half as frequently as the F-4 jets it replaces. As senior maintenance workers tell it, the plane is on the ground far less than its predecessor was.

"What I've learned from being around F-16s for three years," says an F-16 crew chief at Ramstein AB, Germany, "is that the harder you fly 'em, the better they stay fully mission-capable."

Flight controls are triple-redundant, with backup systems to backup systems, meaning that they seldom cause flying downtime for the jet. Officers also point out that aircraft electronics, long a source of reliability problems, are greatly improved on the F-16, the F-15, and the other USAFE planes. Explains one: "Printed circuits work a lot better than vacuum tubes at six Gs and [when] bouncing them on the ground."

Faster Fixes for Aircraft

The steps go beyond reliability improvements. Because airborne components and combat systems will sometimes break down, the Air Force is working hard to make them increasingly easier to fix.

For USAFE, the wartime advantages would be great. Maintenance consumes enormous numbers of man-hours, not to mention the pressure it puts on spare-parts supplies, facility space, and support. Making the aircraft easy to maintain thus contributes directly to the command's ability to put combat power in the air time and again.

In Europe, improvements are strikingly visible. The new fighters, say repair troops, are far easier to maintain and "turn" for combat. The F-16, for example, requires fifteen hours for a major maintenance job—much less than the thirty to thirty-five hours typically taken for the less-sophisticated F-4. On top of that, the job can be performed by about half the number of personnel.

Result, in the words of an F-16 maintenance chief: "When the flag goes up, you can turn this airplane and get more sorties" than the F-4.

Future gains might be equally large. Current plans call for the Advanced Tactical Fighter, the eventual replacement for today's F-15s, to require half the maintenance time and support to fly twice as many sorties as the Eagle it replaces.

One source of improved maintainability, USAFE officers say, is incorporation of diagnostic electronics that tell the repair troops what is wrong with the airplane. "The big advantage of the F-16," says one, "is that it tells you what's wrong with it. With the F-4, you break wire bundles open for days before you find the problem."

In addition, the aircraft benefits from smarter design, including more accessible placement and greater simplicity of components. For example, engine crewmen find it easier to remove the nozzles on the F110-GE-100 engine.

Complementing the advantages of more reliable and maintainable weapon systems, Air Force officers maintain, is the greater effectiveness of the arms now coming into USAFE. As one puts it, "These weapons will keep our own attrition down, which is a big factor in the business of generating sorties."

Air Force officers, for example, point with satisfaction to the recent gains in USAFE's ability to suppress enemy air defenses that pose a mortal threat to its pilots. The situation is said to be much improved as a result of the deployment of such electronic-warfare assets as EC-130 Compass Call, EF-111 Raven aircraft, and teams of F-4G Wild Weasel and F-16 aircraft.

This is not all. One officer maintains, "I can think of four or five classified programs, off the top of my head, that will help us understand the threat and help us get the sortie through safely."

The planned introduction of the AIM-120 advanced medium-range air-to-air missile (AMRAAM) will help USAFE pilots take on the foe at a greater and therefore safer range. What's more, USAFE's capability to generate sorties around the clock, with great effectiveness, will grow with the soon-to-be-realized deployment of the LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) pod system.

Turning Night into Day

The LANTIRN dual-pod system, which effectively turns night into day for the pilot in the cockpit, is scheduled to be deployed on select USAFE F-15 and F-16 fighters, giving them a poor-weather, night-attack capability. This, explains an officer, "is something that we really haven't had in this theater. That's a major advance."

When it comes to improving its powers to generate more sorties, USAFE's most significant new "weapon" may not be an aircraft or missile at all. The weapon, rather, will be more prosaic—the base structure from which American forces would fly and fight.

All signs are that USAFE's critical network of runways, taxi areas, maintenance shops, weapons stockpiles, and support infrastructure is being updated and modified in ways that make it more likely that the system can continue to function even after heavy Soviet attack.

The effort is assigned high priority within USAFE and in the entire Air Force. The objective: Prepare the system to be able to stand up to Warsaw Pact air strikes aimed at putting it out of action, then recover sufficiently to be able to launch aircraft.

USAFE, officers concede, has a long way to go. They note that the present vulnerabilities of the base system, illustrated in the 1985 Salty Demo exercise at Spangdahlem AB, Germany, range from ground attack to disruption of communications and fuel supplies *(see "Fighting Under Attack," October '88 issue, p. 50).* Efforts are under way to alleviate the worst problems.

Most visible is the push in USAFE, and in NATO generally, to shelter its aircraft from attack. The NATO goal is to provide shelters for 100 percent of its fighter force. While Alliance funds are sufficient to cover only seventy percent of the cost, CINCUSAFE has set down a policy of sheltering all in-place and reinforcing aircraft at US main operating bases. Seventy percent of reinforcing planes deployed to collocated bases are to be sheltered. Funds are already programmed for this task. Radar-operations and avi-

onics-repair units also are due to get shelters at selected bases.

More important, the Air Force is pursuing its Air Base Operability program, designed to enhance the protection, survivability, recovery, and regenerative powers of the base infrastructure.

Initiatives to this end are numerous. The most important features of this program include: plans to construct an Alternate Launch and Recovery Surface (ALARS) at each USAFE base, provision of Emergency Landing Strips (ELS) at selected sites, dispersal of facilities, camouflage and deception, installation of Survivable Collective Protection Shelters (SCPS) for better chemical warfare protection of base personnel, improved damage-assessment capability, better means for explosive-ordnance removal, equipment for rapid runway repair, mobile aircraft arresting gear, redundant base communications, and better backup power systems.

Added to these passive measures are efforts to enhance active defense of USAFE bases. Officers foresee major gains flowing from the US-German program to deploy Roland and Patriot air defense missile units around bases in the Federal Republic. In addition, the United States has procured and the British are now operating thirty-two Rapier short-range air defense batteries around seven US bases in Britain.

Overall progress has created confidence among officers based at Ramstein AB, headquarters of USAFE, about sortie generation in wartime. Higher readiness, more persistent and effective weapons, and more resilient fighter bases, they say, already are paying dividends, and the picture for the future looks brighter.

The Sustainability Gap

That, however, is not the entire picture. Equally important to the Air Force, but far more worrisome to these officers, is another issue: how long USAFE would be able to sustain this stronger force in combat. Senior officers contend that, despite improvements, the force would not have enough replenishment parts, munitions, fuel, and other consumable items at its disposal.

The situation is far from desperate. Higher defense budgets throughout the 1980s have enabled the command to alleviate some of the worst shortages and bottlenecks that characterized the Air Force's stockpiles of war-reserve materiel in the 1970s. Spare parts hoarded for wartime use, for example, are at nearly twice their former low level. More munitions are available.

Even so, officers continue to identify the inadequacy of stockpiles as a significant constraint on their combat capabilities. These are well below requirements. Worse, today's levels seem certain to decline.

One senior leader who worries greatly about this problem is USAFE's Commander in Chief, General Kirk. "We're not back down to where we were in the late 1970s, but we're starting that way," he warns. "If there isn't adequate funding to replace [those items being consumed by the operating force], we will eventually go back down to that 'hollow force' " of the 1970s.

One area of major concern is war-reserve spare parts and other replenishment items. USAFE documents show that funding for these, after big rises early in the decade, has fallen far short of one-for-one replacement levels for the last four years. As a result, parts to keep airplanes flying and missiles working today are being taken from stockpiles that had been built up for wartime use.

Today, one officer reports, up to sixty percent of the parts required to keep USAFE's aircraft mission-capable come directly from the command's War Readiness Spares Kits (WRSK) or Base Level Self-Sufficiency Spares (BLSS) kits inventory. "We know that we're not going to buy any—zero—WRSK and BLSS this year or next year," he adds. "So we're just maintaining and praying for tomorrow. There's no stockpiling."

Scarce Smart Munitions

Nearly as troubling, in a different way, is the situation with respect to USAFE's stockpile of wartime munitions. The inventory of air-to-air and air-to-surface weapons would permit the fighter force to fly 100 percent of wartime missions. But most of those missions would be flown with relatively unsophisticated general-purpose bombs, cluster-type weapons, and older-generation guided missiles.

What is missing, in the view of USAFE officers, is an adequate supply of modern, highly accurate "smart" or precision munitions such as the AGM-88 HARM radar-killer and AGM-65 IIR Maverick tank-killer missiles. These officers would also like to see improvements to the Gator air-delivered mine weapon.

Apart from inadequate numbers, the munitions are said to be mal-positioned. Most are stored in a handful of depots in Europe and would have to be transported, under attack, to various air bases.

Overarching these local sustainability problems is the larger difficulty of reinforcing USAFE's in-place aircraft with US fighters based in the United States. Insufficiency of intertheater airlift remains one of USAF's principal concerns. Though major gains have been achieved in the past decade, the 1989 funded airlift force will provide no more than 47,000,000 ton-miles per day of strategic cargo airlift, well below the current goal, which is 66,000,000 a day.

Thus, USAFE has a ways to go before it can be confident about overcoming the Warsaw Pact's numerical superiority. Still, the force appears to have little option but to continue trying to rewrite the laws of mathematics. ■

Once, support units carried on peacetime operations while combat forces trained for war. That's just one of the things that has changed.

Readiness, Pacific Style

BY ROBERT S. DUDNEY
SENIOR EDITOR

WHEN one travels across the vast Pacific region, the special factor working against combat preparation of Pacific Air Forces becomes fully apparent. Command readiness has risen to a peacetime high, but PACAF will always have a long way to go.

Literally. The immense Pacific theater, an endless maritime expanse covering twelve time zones, confronts PACAF's war planners with the need to overcome distances far in excess of those that would face military men in a war in Europe or elsewhere. Consider the realities:

In contrast with locally concentrated US Air Forces in Europe, PACAF in a war emergency would find its 296-plane force spread out over 2,700 miles from Japan to the Philippines. A gap of 7,500 miles—twice the breadth of the US—separates the command's forward tactical fighter bases from CONUS sources of resupply. Distances from bases to targets in the Soviet Union, North Korea, and Vietnam stretch up to 750 miles.

These distances, say experts, are sure to affect airpower in significant ways. Deployment of fighters would tie up a large portion of the US tanker fleet. Ordnance loads might be reduced to give attack planes longer legs to reach faraway targets. Airlifters would probably ferry fewer parts and munitions in order to accommodate heavier fuel loads. The list goes on.

In consequence, officers in PACAF headquarters at Hickam AFB, Hawaii, are striving to surmount these limitations with a Pacific style of combat preparation aimed at minimizing distance. Weapons, logistics, and training have distinctive features. Even PACAF's concept of force employment is different from that in other theaters.

"We look toward very large force employment," explains Maj. Gen. Michael Kerby, Vice Commander in Chief of PACAF. "You really have to marshal theater forces to have an impact over here. We would have to concentrate large force in a small area and gain local air superiority to employ airpower effectively in the Pacific."

On attack missions, for example, PACAF pilots could not afford to burn precious fuel searching for holes in Soviet air defenses, a tactic more suitable for Europe. Instead,

the US would be more likely to get through that net by putting together a big strike package and blowing a hole in the net.

The demands of the Pacific present a formidable readiness challenge for Gen. Merrill McPeak, PACAF's Commander in Chief since the retirement of Gen. Jack Gregory this summer. His forces, relatively few in number, must rely on superior training, coordination, and flexibility.

Much to Build On

There is much in PACAF to build on. The peacetime force that General McPeak inherits has seldom seemed better prepared for war. There can be little doubt that it is superbly equipped and trained. The question is whether such readiness can be sustained in austere budget years to come.

For a major combat command, PACAF is small. Its 296 warplanes, organized into only fourteen squadrons, are deployed in three air forces at different locations: Fifth Air Force in Japan, with 14,000 personnel at three major bases; Seventh Air Force in Korea, with 10,000 personnel at five major bases; and Thirteenth Air Force in the Philippines, with 8,000 personnel at Clark AB.

All told, there are 60,000 Air Force officers, airmen, and civilians in the Pacific, only about half of whom are directly assigned to PACAF. The remainder includes crews associated with Strategic Air Command B-52 bombers and tankers, Tactical Air Command E-3 Airborne Warning and Control System aircraft, and Military Airlift Command C-5, C-141, and other lifters.

In PACAF's preparations for combat in the Pacific, few matters receive greater attention than the quality of its aircraft.

Because the PACAF force is small, the Air Force is working hard to provide it with superb mounts. Results of USAF's fighter modernization, in full swing in the Pacific since 1985, can now be seen—a force of warplanes that is not only more sophisticated and effective but more reliable and easier to maintain than previously.

All fighters in both squadrons of PACAF's 432d Tactical Fighter Wing (TFW) at Misawa AB, Japan, have been converted from the F-16A model to the more advanced F-16C, which has more powerful engines and better avionics. In May, PACAF completed a similar conversion at the 8th TFW located at Kunsan AB, Korea, exchanging its forty-eight F-16A aircraft for an equal number of F-16Cs.

This comes on the heels of the earlier deployment of USAF's premier air-to-air fighter, the sleek F-15, into the Pacific in large numbers. Three squadrons of the advanced F-15C model, totaling seventy-two aircraft, now are on hand at Kadena AB on the Japanese island of Okinawa.

Also available are twenty-four tank-killing A-10 jets in Korea, twelve F-4G Wild Weasel planes in the Philippines, and eighteen RF-4C reconnaissance craft in Japan.

Much is yet to come. For one thing, there will be more F-16Cs to replace the seventy remaining F-4E fighters in the inventory. The 51st TFW at Osan, Korea, will trade its twenty-four Phantoms for twenty-four F-16Cs early next year. Similar changeouts will take place elsewhere in PACAF over the next five years. The biggest advance, however, will be the appearance of the new F-15E strike fighter.

The F-15E, with unparalleled ground attack prowess, will go far toward supplying the long-range interdiction power that PACAF has been sorely lacking. Says General Kerby: "That's an ideal piece of equipment for this part of the world."

Two other forthcoming systems will help magnify the power of the tactical fighter wings in PACAF. They are the Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system—it enables jets to fly low-level attack missions in darkness and poor weather—and the AIM-120A advanced medium-range air-to-air missile.

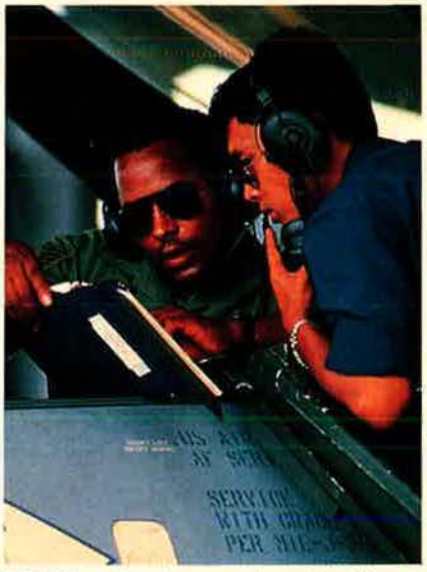
High Mission-Capable Rates

At least as impressive as the sophistication of PACAF's modern fighters are their high mission-capable rates, which PACAF reports to be higher than at any time in recent years. Typical of the situation throughout PACAF are the mission-capable reports from one recent month: Of all units, only one failed to meet PACAF's operational-readiness standard.

The situation stems from a number of factors. A major one is increased reliability of PACAF's F-16Cs and F-15s over the planes that they have replaced. Break rates and maintenance hours are down.

Equally important are strides that the command has made in providing the spare parts, repair equipment, and supplies necessary to maintain advanced aircraft in top shape. Fatter budgets in the first part of the 1980s had helped fill some parts bins. Officers report that PACAF is benefiting from USAF's Critical Item Program, which identifies items contributing to high mission capability and moves them swiftly through the system. Under the Combat-Oriented Supply Organization system, established at seven bases, spares and war-readiness stocks are located closer to users.

The biggest contributing factor, however, may be the higher caliber of worker maintaining PACAF aircraft. PACAF's enlisted force, officers make clear, is in great shape. Virtually all first-termers in the ranks hold high school degrees and



—USAF photo by SSgt. Val Gempis

PACAF's extensive exercise schedule keeps air and ground crews in constant interaction with allies and other US services throughout the Pacific. Above, USAF TSgt. Robert Burleson, crew chief from the 14th Tactical Fighter Squadron based in Japan, and a Royal Thai Air Force counterpart go over an F-16C postflight checklist during Cobra Gold '88, a combined exercise held in Thailand. USAF and Thai pilots and crews (right) operating out of Don Muaung RTAFB prepare to fly another mission during this year's Cobra Gold.

—USAF photo by Sgt. Dean Wagner

are eminently trainable. What's more, the force is older and more mature than that of previous years. Of all PACAF enlisted personnel completing first tours of duty thus far in 1988, nearly seventy percent elected to reenlist. In 1980, the rate was forty-seven percent. The result, in maintenance no less than in other areas, is more experience on the job.

Equally important in US preparations for combat, Pacific style, is the heavy emphasis that PACAF places on training throughout the command.

Execution of intricate wartime operations in the theater, involving repeated midair refueling, coordinated strikes, marshaling of forces, and the like, would require great skill and expertise. As a result, PACAF forces train incessantly in air-combat operations.

One measure of the activity is the high number of flying hours attributed to PACAF. In Fiscal Year 1987, the most recent for which statistics are available, pilots in the Pacific wrung out a total of 105,792 flying hours from 77,150 sorties. This year, despite the fact that PACAF's operations and maintenance budget was slashed by eleven percent, the command was able to protect its flying program from deep cuts. Individual PACAF crews are flying virtually the same number of sorties per month as in 1987. The level of activity remains higher than it was in the early 1980s.

Awesome Exercise Schedule

PACAF's exercise schedule is awesome. Each year, PACAF forces take part in sixty field training and command post exercises. More than sixty percent of these involve operations with Pacific allied air forces. Ninety percent include US Navy or US Army units. Some are huge.

Team Spirit, a large-scale field training exercise held every year in Korea, regularly employs up to 17,000 USAF personnel and all types of planes. Probably the biggest exercise of its kind outside the Warsaw Pact, Team Spirit brings together air, land, and sea forces of the US and Korea.

There are others. Orient Shield, held annually in Japan, has brought USAF A-10s from Korea to participate in close air support drills. PACAF F-16s participate in Cobra Gold, an exercise designed to enhance cooperation of US and Thai air forces. Cope Max, held twice a year in the Pacific, helps PACAF train to launch, assemble, and direct very large packages of aircraft for theater war.

PACAF's most realistic exercise is the Cope Thunder sequence, held in the Philippines. If today's PACAF crews are better trained than ever in peacetime history—and senior officers insist that that is the case—Cope Thunder probably is the biggest reason.

The exercise is held seven times each year at the sprawling Crow Valley range near Clark AB—each session lasting two weeks. Aircrews, flying against dedicated "aggressor" planes, are presented with every combat situation that the imagination of a planner can devise. What's more, Navy and Marine Corps crews take part, as do pilots from Thailand, Australia, the Philippines, and other allies and friends in the region. When the intense exercise is over, participants have flown a combined total of some 1,000 combat sorties and picked up a great deal of experience. PACAF's goal, crimped somewhat by budget constraints, is to put each of its crews through ten Cope Thunder sorties each year.

Ground crews are also kept in constant motion. Before 1985, PACAF logistics units carried out peacetime operations while the fighter forces trained for war. No longer. For the past three years, logistics outfits have been put to the test in Cope Thunder and other exercises. They are called on to conduct aircraft battle-damage repair on the spot, rearm and refuel aircraft, reprogram aircraft software, and carry out rapid maintenance and checkout procedures.

As part of its strenuous exercising, PACAF is now paying serious attention to cooperation with the US Navy. The Pacific Fleet's 300 warships, including seven aircraft carriers, make it an imposing military force in the region. PACAF is sharpening its ability to conduct maritime operations. Moreover, the degree of cooperation between the services in strike planning is probably unprecedented.

"We do an awful lot of exercising with the Navy," says General Kerby. "In the Pacific, we can't operate effectively without the Navy, and they can't function without us. That's why we are working as hard as we can to equip F-16s and B-52 conventional launch platforms with a Harpoon [antiship missile] capability. Flying Air Force missions in support of maritime operations is a necessity in the Pacific."

Mushrooming Joint Efforts

Exactly six years ago, in October 1982, Navy and Air Force leaders approved a memorandum of agreement aimed at expanding interservice cooperation. Since then, joint efforts have mushroomed.

Use of AWACS surveillance planes and land-based F-15 and F-16 fighters, service leaders maintain, could make a big difference in defense of US carriers from Soviet bomber and cruise missile attack. They also look for Air Force help in the form of early warning, command and control, electronic warfare, and aerial refueling.

PACAF planners look to combine Navy and Air Force strike and defensive operations. USAF Wild Weasels might support Navy strikes. Air Force tankers would support Navy aircraft. AWACS will work with Navy aircraft.

Apart from top-flight weapons and well-trained crews, another major PACAF priority focuses on bringing its logistics support up to the standard required for war in the Pacific environment.

Logistics support is viewed as the cornerstone of a credible deterrent force in the Pacific. Without it, the fighting power of PACAF units would be sapped by shortages of everything from replacement bombs to aircraft maintenance. Initiatives are many and varied.

To ease pressure on airlift, PACAF has prepositioned munitions in Japan to support US-based forces that would deploy to forward operating locations. About 711 short tons of USAF weapons—equivalent to twenty-eight C-141 sorties—are in storage at the US Army's Akizuki munitions complex in Japan.

Introduction of the Rapid Assembly Munitions System (RAMS) gives arms technicians a system on

which to assemble large quantities of weapons for high-rate sortie generation. The system consists of two gantries, four ten-foot-long assembly conveyors, hoists, an air compressor, and a lighting system. Each RAMS will produce, every hour, at least sixty Mk 82 GP bombs, twenty Mk 84 GP bombs, thirty cluster bombs, and eight guided bombs.

PACAF does not have to go it alone. Under a formal wartime support program, Korea is pledged to provide PACAF with the use of civilian airliners, storage facilities, maintenance shops, and surface transport vehicles. The US and Thailand have begun preparations for stockpiling war reserve materiel in that Southeast Asian nation.

To improve the survivability of intermediate-level aircraft maintenance, PACAF is decentralizing functions of its Pacific Logistics Support Center (PLSC) at Kadena AB. The deployment of long-range Soviet bombers in the theater makes concentration of such a critical operation in one place too risky. Plans call for each flying organization to provide its own intermediate-level maintenance next year. Osan AB, Korea, and Misawa AB, Japan, each will receive two F-16 avionics shops, while Kunsan AB, Korea, and an unspecified location will each receive one. With jet-engine shops, the story is the same. PLSC's A-10 engine shop goes to Suwon AB, Korea. All F-16 engine shops will eventually move to the F-16 wings.

Stepped-Up Survivability

PACAF's stepped-up survivability efforts extend to its fighter bases, too. The command's Air Base Operability program, part of a broad campaign being pushed throughout USAF, is making progress. On tap are more extensive active and passive defenses of base infrastructure, chemical-warfare protection, and wartime base recovery measures.

Ferret robots are now in use by PACAF's explosive-ordnance disposal units. In PACAF's projected funding for Fiscal Years 1989 through 1994, $205 million is allocated for the hardening of aircraft shelters, command posts, and operations centers, among other projects.

For Pacific operations planners, however, the gut issue remains the staying power of the thinly supplied tactical units. They say that no matter how effectively PACAF fighters and crews perform in combat they eventually will run out of the munitions, parts, and fuel that are needed to keep them in action.

The current stockpiles are inadequate—especially war munitions. That was made plain in a report issued by Adm. Ronald Hays shortly before he retired from the post of Commander in Chief of the US Pacific Command (PACOM). Admiral Hays notes that, across the various service components of PACOM, the average fill rate for PACOM-preferred munitions—such as Maverick missiles and the I-2000 bombs—reaches twenty-eight percent of objective.

"We need good standoff conventional munitions, and we don't have those," adds one Pacific planner. "There's not a lot of prospect [for our getting them] in the near time frame. It makes our assets more vulnerable because we have to stick our neck out further to get to the objectives."

The situation would be even worse were it not for large improvements in combat sustainability brought about by heavy outlays on these items in the early and mid-1980s. Admiral Hays points out that, due to substantial investment in spare-parts supplies, there has been a steady improvement in the number of days for which supplies would be available. At present, Pacific Air Forces has eighty-three percent of theater stock requirements.

Storage for 13,000,000 gallons of jet fuel and 3,000,000 gallons of truck fuel was added to the Pacific Command's fuel reserves last year. Over the past five years, the Pentagon has purchased 5,400,000 barrels of bulk petroleum war reserves for PACOM.

Overall, however, the sustainability picture is not good. From Admiral Hays comes this assessment: "The Pacific strategy needs ready forces that can sustain a fight. Today our forces are ready, [but] not sustainable to the degree that I would like to see."

Given the current level of budget-cutting fervor in Congress, PACAF will be hard pressed to maintain its current strength—much less expand it. The Air Force already has lost a total of $20 billion from the budgets it had expected to have in 1988 and 1989. More cutting is sure to come.

The impact on combat sustainability could be great, particularly in stockpiles of spare parts. The problem has not yet materialized because the tactical wings are living off prior investments. "However," warns one PACAF report, "as we start to feel the effects of funding constraints, we can expect spares support to deteriorate in the near future with long-term effects." For example, projected funding for War Readiness Spares Kits and Base-Level Self-Sufficiency Supply kits war-reserve materiel is "practically nonexistent."

Belt-Tightening Ahead

Nor will PACAF training and exercises be fully protected from the budget-cutting axe. Admiral Hays points out that, even though PACAF makes a major effort to protect its flying program, some exercises have been curtailed or canceled. PACAF's FY '89 operations and maintenance account will bring about even greater belt-tightening.

Unless the Air Force sees noticeable improvement in military compensation—an unlikely event in light of budget stringency—manpower problems are sure to emerge. The impact, say PACAF officers, would be felt most swiftly in the form of lower retention rates of personnel working in critical specialty areas.

PACAF, like every other combat command, sees its biggest problem in the potential exodus of pilots in the years ahead. Pilot retention for the Air Force as a whole has plummeted to forty-eight percent of those eligible—down from seventy-two percent only four years ago. As matters stand, the deficit of pilots could reach nearly 2,500 early in the next decade. The scarcity will be allocated evenly throughout the tactical air forces.

In this situation, PACAF's task in the years to come will go beyond conquering the Pacific's vast open spaces. It will also have to conduct a damage-control operation to prevent serious decline of its own military forces. ■

Davis-Monthan puts aircraft and parts back into service, giving the government $12 worth of products for every dollar it spends.

Look What They've Done to the Boneyard

BY JEFFREY P. RHODES, AERONAUTICS EDITOR

STAFF PHOTOS BY GUY ACETO, ART DIRECTOR

"BEFORE I got here, I thought all AMARC did was store old airplanes and nothing more," said Col. Larry Jones, who is the Commander of the Aerospace Maintenance and Regeneration Center at Davis-Monthan AFB, Ariz. "I was wrong."

Since 1946, when the Army began storing B-29s and C-47s there, Davis-Monthan has carried the image of a desert boneyard where old airplanes faded away. Even the previous name of the place—"Military Aircraft Storage and Disposition Center"—reinforced that impression.

AMARC has changed more than its name. Since 1985, it has returned nearly 575 aircraft to service. Last year, almost 114,000 parts valued at $72.2 million were removed from stored aircraft and processed to fill current needs. In FY '87, the Center returned about $12 worth of materiel to the government for every dollar it spent in its $22.7 million budget.

That isn't all. Ground-launched cruise missiles will be destroyed at Davis-Monthan under the terms of the Intermediate-range Nuclear Forces (INF) Treaty. The Center is now doing "minidepot-level" work on OA-37s. It is also modifying weapons pylons and reclaiming parts from ex-commercial airliners.

The primary purpose of AMARC, though, is storing airplanes. Davis-Monthan is the single storage area for all Department of Defense aircraft, taking in about 300 aircraft a year. The Center now stores just over 2,600 aircraft.

The 2,262-acre site was chosen mainly for its dryness (less than eleven inches of rain a year) and low humidity, factors that minimize corrosion. The alkaline soil, containing a very hard substance known as caliche, allows aircraft to be parked in the desert without concrete or steel ramps.

The Other Mission

In wartime, AMARC would increase its priority parts removal by up to 200 percent. "We also have a formal tasking from the Army and Navy for taking aircraft out of storage," said Col. Frank Broadhurst, one of twelve Air Force Reservists

The main purpose of the Aerospace Maintenance and Regeneration Center at Davis-Monthan AFB, Ariz., is storing some 2,600 aircraft of all types. Shown at right are early-model B-52s with a row of F-106s and T-39s in the background. Storage is job one at AMARC, but each year a number of aircraft are returned to service. Above, Lt. Col. Gene Gaddis goes through his preflight checks before flying an F-100 slated for target duties.


U.S. AIR FORCE

who would help the Center move to a double-shift, round-the-clock operation in wartime. The Air Force is currently developing a contingency removal plan.

The Army's mobility plan calls for removing certain helicopters from storage, transporting them to a contractor for modification and upgrade, and using them for surge training.

A small number of Navy aircraft (mostly late-model McDonnell Douglas F-4 aircraft) are kept near flight-readiness for rapid withdrawal in a contingency. These mobility aircraft also provide excellent training for the AMARC technicians by keeping their withdrawal techniques up to par.

"The aircraft in the plan change from time to time," said C. C. Flick, the civilian head of the Navy detachment at AMARC. "As the aircraft are phased out, the expertise to work on them in the field fades out, too. That is the driving force behind deciding which aircraft are involved." Several years ago early model Grumman E-2 Hawkeyes were part of the contingency operation, but because of technological advances, all of those Hawkeyes are now in long-term storage.

AMARC also stores tooling for such aircraft as the Fairchild A-10 and the Rockwell B-1B, both now out of production. In wartime, the Center would ship the tooling to a contractor, who could reestablish parts or production lines.

The basic mission of storing and maintaining aircraft is performed by 600 Logistics Command civilians and three active-duty officers.

The basic process for putting aircraft into long-term storage is pretty much the same for all, but the time required varies by type. It takes approximately 250 man-hours to prepare an F-4, the most common type currently coming into the Center.

First, an aircraft is safed (all explosive ejection seat cartridges and the like are removed), an inventory of accountable equipment is taken and recorded on computer, and the plane is washed. An E&E team (Examination and Evaluation) takes off the panels and makes detailed notes on corrosion, missing items, or discrepancies with the technical order.

Before the aircraft are taken out to the desert for storage, they undergo a thorough preservation process. In AMARC's 600-foot-long reclamation shelter, technicians seal a plane's canopies, radomes, and most of the openings and seams with barrier paper, tape, and a material called Spraylat. Here, George Foss, a storage servicer, puts a final coat of white Spraylat on a Navy A-7.

The aircraft goes next to the Preservation Section (the "Flush Farm") where it is defueled. Its system is filled with a 10-10-weight lubricating oil, and the engines are rotated. After several minutes of runup, the aircraft is shut down and the oil is drained through a filtering system back into a 50,000-gallon storage tank for reuse later. This process leaves a thin, preservative oil film in the aircraft's system and engines. Oxygen, hydraulic, and pneumatic systems are also preserved.

At the large reclamation hangar, all of the openings and seams on the upper part of the plane's fuselage, wings, and empennage, as well as canopies, windows, and radomes, are covered with barrier paper and tape. The bottom openings are left uncovered to permit air circulation and evaporation of moisture.

A heavy black plastic coating called Spraylat is then applied with a spraygun to papered areas. A thin coat of white Spraylat goes on top of that. This keeps the interior of the aircraft within ten to fifteen degrees of the outside temperature and protects the canopies and radomes from sun and heat damage. Finally, the aircraft is towed to the desert.

Condition of the aircraft is checked frequently, and every four years the aircraft is removed from storage and represerved. "With the tight budget situation, we only take off the Spraylat that has deteriorated," said Dan Woodard, acting chief of AMARC's planning section. "We were taking it all off before, but now we just do what is necessary."

Spraylat costs $24 a gallon, so the Center's materials laboratory is examining other options. One method is shrink-wrapping the entire plane. This is relatively inexpensive (a 200-foot-by-fifteen-foot sheet costs $65), but the technique has met with only limited success so far.

AMARC is also testing wrap-around plastic "bags" on forty-eight aircraft of various types, including the Navy mobility aircraft. The planes are sheathed in gray plastic "bags," providing overall protection loose enough to allow air to circulate.

AMARC's wealth of airplanes makes it a perfect place for some specialized training. Air Training Command has set up its main Aircraft Battle-Damage Repair

(ABDR) school there. Crash-recovery teams frequently come to AMARC to practice aircraft retrieval with heavy-lift helicopters.

Out of Storage

Some airframe carcasses that have been stripped of small parts are kept in the Reclamation Insurance Type (for structural members) area (or "RIT" for short). These aircraft—or what's left of them—are valuable for such main structural components as wings and radomes.

When an aircraft is deemed completely surplus, the Defense Logistics Agency gets it to sell for scrap. These transfers happen less frequently today than in the 1950s, when more than 6,000 aircraft were stored at the Center. In FY '87, only twelve aircraft were sent to DLA for disposition.

What mainly goes out of AMARC, though, is parts.

Priority removals—those performed to get a specific operational aircraft back flying when a part is not in normal supply channels—are increasing. These normally take three days to accomplish. About 21,000 parts were shipped out in FY '87, and almost 65,000 priority removals have been done since FY '85.

After an airplane is thoroughly examined and washed, it is defueled, and its fuel system is refilled with a lightweight lubricating oil. After several minutes of engine runup, the oil is drained, leaving a thin, preservative oil film in the aircraft's engines and systems. Shown undergoing this preservation step is a Navy F-4S, one of several versions of the venerable Phantom II now coming into the Center.

"We use a negative inventory system that tracks what has been removed from each aircraft," said Jerry Mullins, the Center's administrator. "That helps us avoid wasting a lot of time. We know right where to go."

AMARC's biggest removal effort is the F-100 drone program. The aircraft, some of which have been stored for up to thirteen years, are disassembled, checked, and put back together. It takes roughly 1,900 man-hours to bring the F-100s back up to flight status, as Willard Wilkinson is doing here. Once completed, the aircraft are flown to Mojave, Calif., where they are converted into drones.

Routine removals are done to replenish parts stocks. One current program is the B-52F reclamation. The B-52s in storage are systematically brought through the reclamation hangar for 200 parts. On the J57 engine reclamation effort, 180 parts are removed from each Pratt & Whitney engine. With approximately 500 engines, each one providing parts worth up to $100,000, the project saves $50 million and keeps parts available for the B-52G fleet.

Another program pulls Boeing 707 airliner parts for use by Air National Guard and Air Force Reserve KC-135s. This project works well because of the commonality between the 707 and KC-135, although they are different aircraft.

Boeing bought 150 707s for the Air Force, mainly to get the Pratt & Whitney JT3D turbofan engines. AMARC removed the engines and ninety-eight other items (ranging from cockpit displays to horizontal stabilizers), which Boeing uses to upgrade both Guard and Reserve KC-135As to the KC-135E standard. This program has led to savings of $650 million from a $130 million investment.

Many parts must be certified as serviceable before they are shipped. Avionics and radio equipment have to be bench-tested, and structural

AMARC technicians have prepared almost 260 F-100s for conversion into drones since 1982. Four times a month, an F-100 is prepped for a final flight out of AMARC (above). Some of the aircraft in storage have colorful histories. The F-4 shown below shot down a North Vietnamese MiG-17 in 1967.

or mechanical parts have to be cleaned and X-rayed. AMARC has recently installed a new X-ray machine that is saving money and time. Before, it took three people a day and a half to X-ray an F-100 stabilizer. Now, the same ninety shots can be taken by two people in six hours.

Shipping parts is an art in itself. "Nothing is standard here," said Alfredo Soza, the Center's chief carpenter. "We have to design many of the specialized containers." Indeed, much of the woodmill's work is done by the TLAR ("That Looks About Right") method because of the odd shapes and sizes of the parts. "Many times we just have to build around a part," added Mr. Soza. The woodmill spent approximately $350,000 on lumber last year.

Some "parts," on the other hand, go out as complete airplanes. Earlier this year, AMARC completed a five-year program ahead of schedule and under budget, through which thirty-five Navy A-6 Intruders were brought out of storage for Grumman to refit and return to service.

Other aircraft are sold or transferred to non-DoD agencies and foreign countries. Seven C-130As are now being reworked to serve as fire bombers in California.

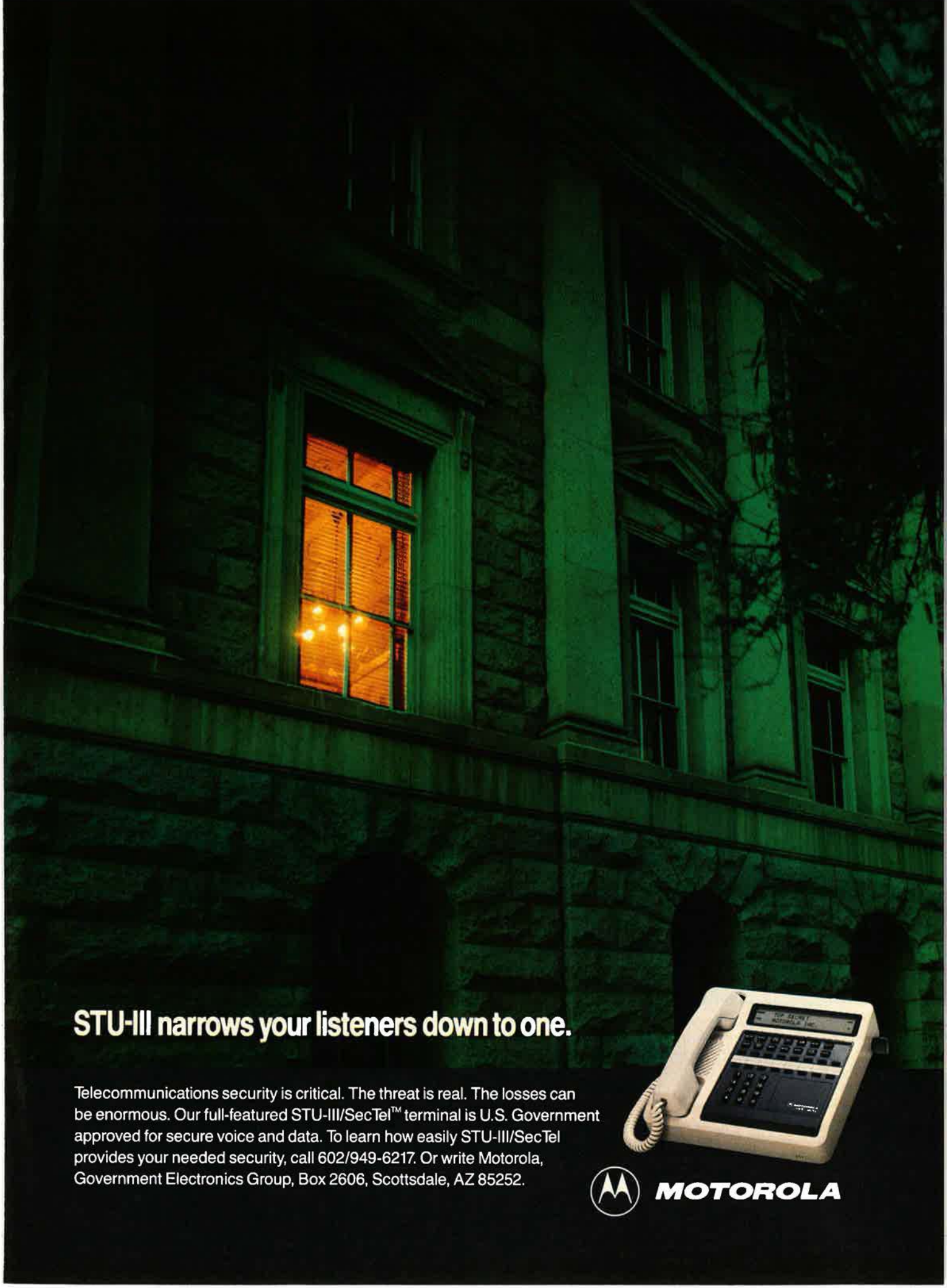
The biggest removal effort, though, is the F-100 drone program. Since 1982, almost 260 North American F-100s stored for as long as thirteen years have been returned to flight status as remote-controlled drones for missile tests. There is a similar program for Navy F-4Ns.

Each of the Super Sabres requires about 1,900 man-hours of work to bring it up to par. After ground tests, the planes are put through a functional check flight.

"You have to kick the tires on these planes more than once," said Lt. Col. Gene Gaddis, AMARC's lone pilot and one of a handful of people getting F-100 time in the 1980s. "The ground crews are very cautious about their work. They are experienced, though, and that is very reassuring."

Four or five times a month, Colonel Gaddis flies the F-100s to Mojave, Calif., where Tracor Flight Systems, Inc., converts them into QF-100s. The last thirty-five F-100Fs will be delivered by January 1990.

A program to convert Convair F-106s into drones will begin next spring. "The F-106s are a little more difficult to convert," said Ray Manus, chief of the aircraft branch. "However, we had a huge learning curve with the F-100s, and I anticipate we'll knock 500 or 600 man-hours off the time needed to work the F-106s within the first five or six aircraft we do." The first F-106 is scheduled to leave AMARC next June.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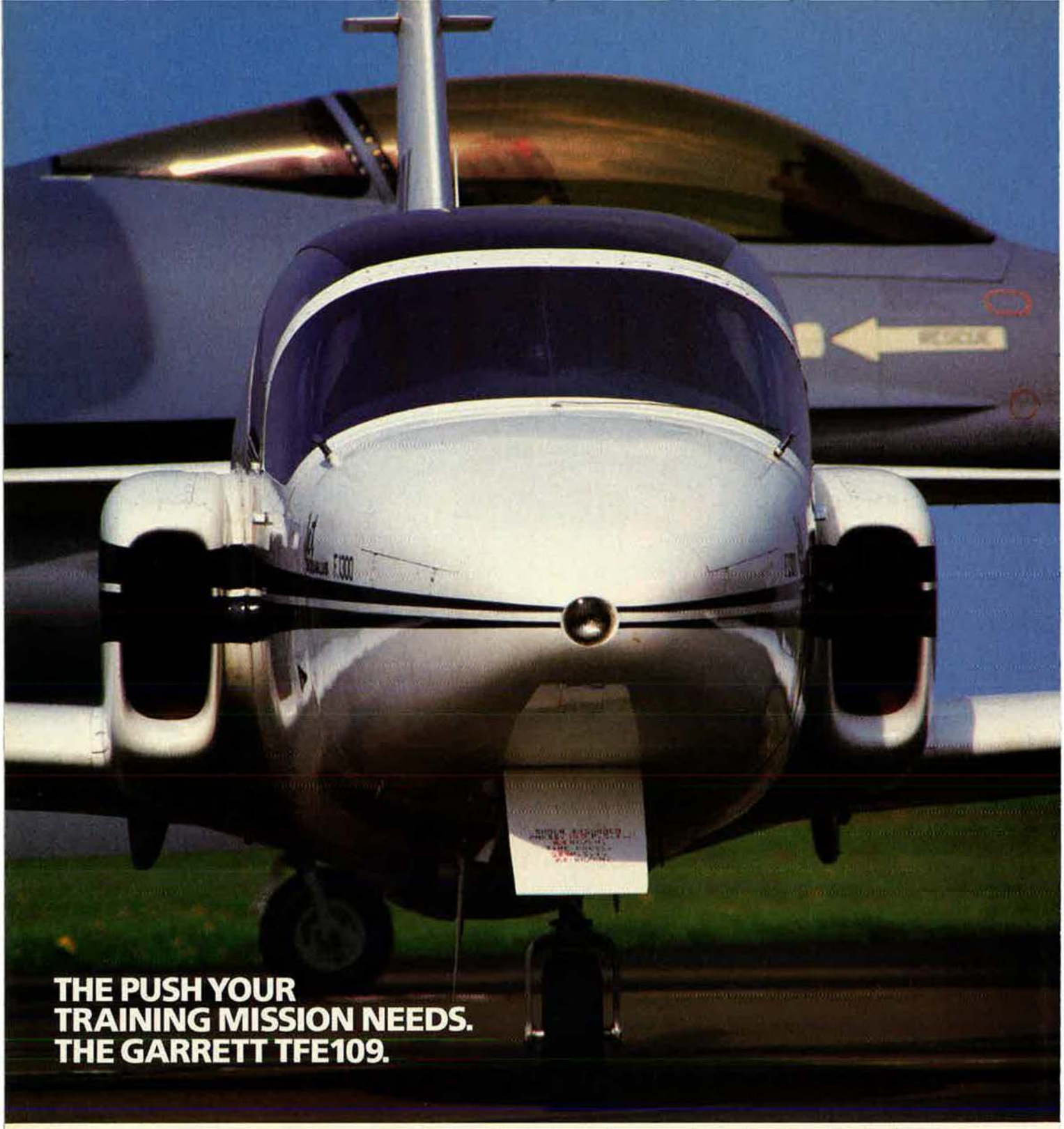

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Other Jobs

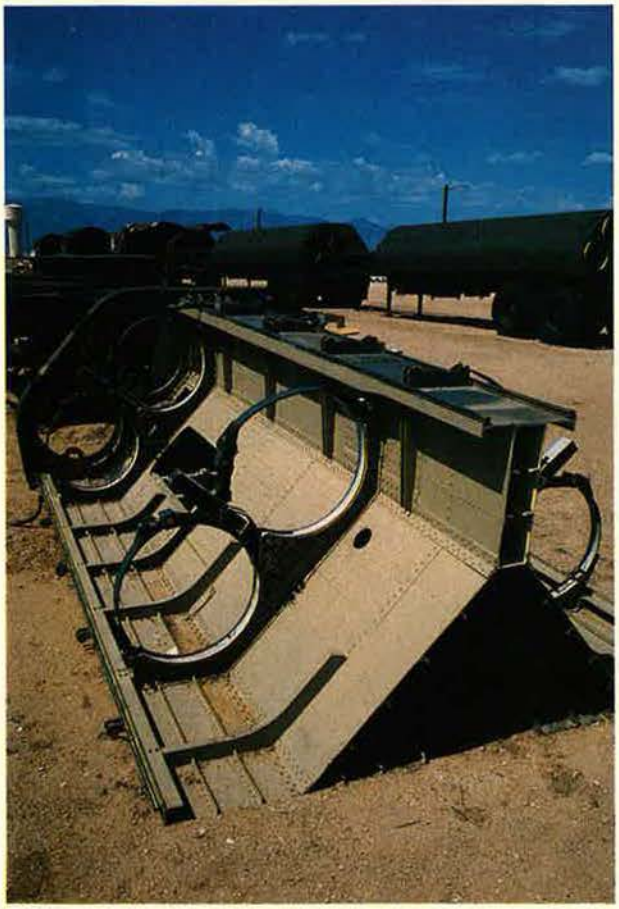
The AMARC technicians are also modifying pylons that were used to carry AGM-86 air-launched cruise missiles (ALCMs) on B-52s. When finished, the pylons (and the pylon load adapters) will fit the new, stealthy AGM-129 Advanced Cruise Missile (ACM) and other munitions. The reclamation teams are converting about four pylons a month.

AMARC can also do small, depot-size projects. The first effort of this type is the Cessna OA-37 Analytical Condition Inspection/Modification (ACI/MOD) for the ninety Dragonflys still operating in the US.

The new activity attracting the greatest attention, however, is destruction of the BGM-109 ground-launched cruise missiles as part of the INF accords. This will be done in a restricted-access, 300-foot-by-600-foot, fenced area near the flight line. In the compound are two trailers, one for the Soviet observers and one for the US team. There are three work pads, separated by six-foot-high berms. There is also a storage area.

To minimize the time the Soviets must spend at Davis-Monthan, two flights (each consisting of sixteen missiles, four transporter/erector/launchers, and four spare missiles) will be destroyed during each visit. The treaty is very specific as to how the missiles must be destroyed.

AMARC's materials laboratory is always looking for better and less expensive ways to do things. The F-4 in the background has been "bagged"—an alternative preservation method now under study. The F-4 in the foreground has been preserved with Spraylat.



One of AMARC's most important tasks over the next few years will be the destruction of BGM-109 ground-launched cruise missiles and support equipment under the terms of the Intermediate-range Nuclear Forces Treaty. These transporter/erector/launchers are waiting to be cut up when the Soviets make one of their periodic visits.

Before the missiles (officially called Gryphons, although the name never caught on) arrive at AMARC, their W84 nuclear warheads will be removed. On the first pad, the missiles will be taken out of their launch canisters and the rocket booster will be removed. The boosters will be destroyed off site. The guidance set and jet engine, however, can be reused in the Navy's Tomahawk sea-launched cruise missiles (SLCMs).

On Pad 2, the missiles will be defueled. The $14-a-gallon fuel will be saved and reused. On Pad 3, the missiles will be destroyed using a rescue saw with a carbide blade. A plasma arc torch will cut the interior bulkheads. The missiles must be cut lengthwise (to prevent rewelding), and the wings and fins have to be cut in a nonjoint area. The whole cutting process takes about an hour.

"It's a simple site and a simple plan," said Ray Roden, AMARC's chief of plans and engineering. "It complies with the protocols, and it doesn't require much manpower. We'll just use technicians from the reclamation and welding shops."

"AMARC is a valuable resource," concluded Colonel Jones. "With the reductions in funding, the Air Force will be relying more and more on parts support out of AMARC. You add the small work loads that can be done here, and the potential to grow is great." ■

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18. Hawk 200 single-seat fighter
19. Tornado Air Defence Variant
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22. Skynet military communications satellite

BRITISH AEROSPACE

British Aerospace plc, 11 Strand, London.

The spotlight was on the MiG-29, but behind the scenes the talk at the air show was about emerging realities in the world aerospace market.

Farnborough's Star Attraction

BY JAMES W. CANAN, SENIOR EDITOR

THE Soviet MiG-29 Fulcrum was the only newcomer—and the star attraction—among military aircraft from many nations at this year's Farnborough International Air Show in England. Showing clean lines and looking like a smaller version of the USAF F-15 Eagle, the twin-tailed, twin-engine MiG-29 did just fine in the air throughout the eight days of the show.

Two variants—a single-seat fighter and a two-seat trainer—were flown on alternate days. They earned the respect, if not the awe, of critically inclined Western observers.

Especially noteworthy among the Fulcrums' feats of flying were their high-G turns, nose-high attitude on low-speed passes, tail-slide maneuvers under no-thrust control at the top of steep climbs to about 3,000 feet, and low-level, knife-edge passes over the length of the runway.

Some observers speculated that the engine thrust of the Soviet fighter may not be quite up to the standard of the best of the West. The MiG-29 also got low marks for eating up a whole lot of runway, needing to deploy a drag chute on landing, and having smoky engines.

Its flight-control avionics are also, to all appearances, somewhat behind the times.

Despite its drawbacks, the Fulcrum's flight characteristics and handling qualities are impressive, as seen at Farnborough, and the pilots clearly got the most out of their aircraft.

As the air show narrator noted each time the Fulcrums flew, they do not sport the computer-managed, quick-acting, fly-by-wire flight controls that have become commonplace in the latest of the free world's first-line fighters.

The advent of such controls, courtesy of advances in microelectronics, made it possible to design and produce fighters that are aerodynamically unstable and thus highly maneuverable—yet eminently flyable as well.

The General Dynamics F-16 and McDonnell Douglas F/A-18, both of which showed their stuff at Farnborough, are just such fighters. So are current-generation fighters from other Western nations that performed at the air show.

A Soviet MiG-29 fighter begins a steep climb, heading for a breathtaking "tail-slide" maneuver at this year's Farnborough Air Show, an international aerospace extravaganza.

Soviet officials at Farnborough made no apologies for the comparative backwardness of the MiG-29's flight-control avionics and cockpit technologies, which were exemplified by a welter of old-style switches and dials and an absence of new-style TV-type displays.

On the contrary, those officials expressed pride in the MiG-29's maneuverability despite all that. They assured observers that the Fulcrum is a fearsome weapon system featuring look-down/shoot-down radar, a laser ranger, an electro-optical system including infrared search and track (IRST), and a helmet-mounted sight.

Much-Coveted Quality

The MiG-29 has another much-coveted quality as well. It can operate amid debris. Its engine-inlet system is uniquely designed to prevent the powerplants from sucking in stones and other foreign objects that might abound on airfields in wartime conditions.

The MiG-29 went into service with the Soviet Air Forces early in 1985, and the West was given a peek at it in 1986 in Finland, which may yet buy it. Since then it has sold fairly well in military markets that are part of the Soviet bloc or that come under Soviet influence in the Third World.

By the time of the Farnborough Air Show, the Soviets had sold MiG-29s to North Korea, India, Iraq, Syria, and Yugoslavia. They were said to be looking to East Germany, Hungary, Nigeria, Austria, and Algeria as near-term customers.

The Soviets clearly are out to sell the MiG-29 worldwide. Their willingness to reveal the worst of it as well as the best at Farnborough stands as perhaps the best testimony to date of General Secretary Gorbachev's *glasnost* going global.

Indeed, Farnborough marked the first time ever that the Kremlin has used an international air show to market a combat aircraft, in the best capitalist tradition, by showing prospective buyers what it is made of and what it can do.

As he tries to restructure the Soviet economy, Gorbachev acknowledges that he must devote more national treasure to domestic needs and less to the defense sector. So he finds himself in a dilemma, the same one that besets the nations of the West—tighter defense budgets make it much tougher to produce high-cost fighters. As free-world marketeers are well aware, one way to bring down the unit costs of aircraft is to sell them abroad and thereby raise their production rates to achieve affordable economies of scale.

Interviewed separately in their companies' chalets at Farnborough, two US aerospace industry executives agreed that the MiG-29 may well become a formidable competitor to US and European fighters in free-for-all foreign-sales markets.

They also agreed, given what they had seen of the MiG-29, that it would probably do better against Western fighters in the marketplace than in the air. This sentiment was said to be widespread in aerospace circles at the air show.

Giving the Fighter Its Due

Air Force Chief of Staff Gen. Larry D. Welch inspected the MiG-29 on the ground, saw it fly, and talked with Soviet officials shepherding its two variants at Farnborough. He reportedly gave the fighter its due and by no means denigrated it.

But General Welch also noted that the Fulcrum's hydromechanical flight controls would put it at a disadvantage in any match of maneuverability against a fly-by-wire fighter of the sort that USAF currently flies.

The USAF Chief of Staff reportedly attributed the Kremlin's "surprising" decision to display the MiG-29 at Farnborough to the "very large marketing effort" that Moscow is making on behalf of the fighter.

Marketing is, of course, what Farnborough is all about. Some 650 companies from all over the world were on hand to indulge in it. They occupied more space in the show's vast exhibit halls and operated from a greater number of chalets than was the case at the last gathering at Farnborough two years ago.

Some US companies, including aerospace giants Lockheed, Northrop, and Grumman, were no-shows. They were said to be marking time in overseas markets and to be concentrating instead on selling to the Pentagon. It may or may not be coincidence in this regard that Lockheed and Northrop are the leaders of the two teams in competition to develop and produce the US Air Force's Advanced Tactical Fighter (ATF).

The companies can't say much about what they are doing in the ATF program, a great deal of which is under wraps, and their work in it has no bearing on their foreign sales prospects just yet. In consequence, they may see international air shows as uninviting just now.

Norman Augustine, chairman and chief executive officer of Martin Marietta Corp., said at Farnborough that the air show reflected the realities of the aerospace world in its accent on "product-improved airplanes" rather than on new ones.

Among combat aircraft flying at the show, the only one that might have qualified as "new" was the French Avions Marcel Dassault (AMD) prototype of the next-generation Rafale fighter. Also relatively new were trainers built by Promavia, Shorts, British Aerospace, CASA, and others.

On the commercial side, the newest of the new was the McDonnell Douglas experimental MD-81, which has a 16,000-pound-thrust GE ultrahigh bypass engine mounted on the aft fuselage.

British Aerospace, Fokker, Dornier, and the multinational Airbus Industrie consortium also weighed in with nifty-flying modern airliners of various sizes, including the fly-by-wire Airbus 320.

Gulfstream Aerospace created a stir at the show by announcing its interest in building a supersonic business jet for ten to twelve passengers. The first-of-its-kind aircraft would cruise at 50,000 to 60,000 feet, have a range of 3,500 nautical miles, and cost $30 million to $50 million.

Taken altogether, however, Farnborough showed that the worldwide aerospace industry is putting a bigger premium on improving existing airplanes than on building brand-new ones.

Becoming an Electronics Show?

In Mr. Augustine's view—one that is widely shared—Farnborough and all other air shows are "moving from being airplane shows to becoming electronics shows." This,

he said, is in keeping with his oft-expressed judgment that "the modern airplane is really a lot of electronic components flying in close formation and held together with software."

Mr. Augustine also regarded this year's Farnborough as renewed evidence of the tendency of European companies to team up in joint ventures and of US companies to try to beat them or join them on their own continental turf. Farnborough had some prime cases in point.

McDonnell Douglas underscored its efforts to persuade the French Navy to buy the Hornet 2000, an updated variant of the company's F/A-18, as a stopgap fighter until the naval variant of the new Rafale becomes available in the 1990s.

General Dynamics was hard at work marketing its Agile Falcon, a derivative of its F-16 Fighting Falcon, to European nations that would seem to be in line to buy the multinational Eurofighter consortium's EFA (European Fighter Aircraft) in the coming decade.

The McDonnell Douglas and General Dynamics marketing moves have caused concern in European aerospace industry circles. They are seen there as long-term threats to the Rafale and EFA programs if the Hornet 2000 and the Agile Falcon are permitted to gain footholds.

Marketing in Europe has become a must for US companies—not just the airframe primes, but also the companies that build the avionics, radars, engines, and other major subsystems for the primes.

These companies include Westinghouse, Hughes, Pratt & Whitney, General Electric, ITT, Texas Instruments, TRW, Honeywell, Control Data, Allied-Signal, Martin Marietta, and many other stars on the US aerospace stage—all represented in force at Farnborough.

All have ever-higher stakes in the foreign sales of US military aircraft, for the simple reason that the US market for such aircraft is shrinking fast and may crowd them out.

Fighters make the point. The US Air Force is near the end of its long run of F-15s and is well along in its production of F-16s. The US Navy is in a comparable situation with its F-14s and F/A-18s.

After these fighters, the only new ones that can be expected in the air-superiority and surface-attack categories for a long time to come are the Air Force Advanced Tactical Fighter and the Navy Advanced Tactical Aircraft, designated A-12.

Each of the two services is expected to buy the other's airplane in the end.

This means that the US companies losing out in the ATF and A-12 programs will probably have nowhere to turn but overseas for fighter markets in the coming century, short of becoming junior producers in the two big US programs or simply going out of the fighter business.

Spectators flock to the MiG-29 at Farnborough to inspect and get photos of a Soviet fighter on unprecedented display in the West. The Kremlin is marketing the MiG-29 worldwide as an affordable air-superiority fighter that will more than hold its own. The fighter's performance at Farnborough was a big part of such marketing.

High-Performance Fighters

This is why so many US companies had so much interest in the good fortunes of the General Dynamics F-16 and the McDonnell Douglas CF-18 at Farnborough—and these aircraft did not let them down. Both flew in fine style. So did the high-performance fighters of Britain, France, and the multinational Panavia and Embraer companies, enfolding West Germany, Italy, and Brazil as well.

The BAe European Aircraft Program (EAP) demonstrator aircraft did not fly at Farnborough this year. It had served its purpose at previous international air shows as the precursor of the European Fighter Aircraft. Now that the EFA program is a going concern, the Eurofighter consortium no longer considers the EAP to be representative of the ac-

tual EFA in the making, and the consortium has left off showing it as such.

Britain, West Germany, and Italy put the long-planned EFA program into full swing earlier this year and were awaiting Spain's official participation at the time of the Farnborough Air Show. At a press conference there on September 6, Gerrie Willox, Eurofighter's managing director, declared:

"We are sure that the EFA weapon system will perform to the satisfaction of the Air Forces of the four [Eurofighter] nations, and we believe that many other nations currently studying the project will eventually conclude that it is the most cost-effective air-superiority fighter for their Air Forces as well."

Several such other nations are being targeted by General Dynamics and McDonnell Douglas for sales of their fighters. Belgium, for one, is also interested in the Rafale, even though it coproduces the F-16.

Eurofighter officials also confirmed at Farnborough that the first two EFA prototypes will be powered by Rolls-Royce engines. The remaining six prototypes will carry EJ200 advanced-technology engines being developed by the Eurojet engine consortium of Rolls-Royce of Britain, MTU of West Germany, Fiat of Italy, and Sener of Spain.

Production of the Eurofighter will be shared by Britain's BAe, West Germany's Messerschmitt-Bölkow-Blohm, Italy's Aeritalia, and Spain's CASA (Construcciones Aeronauticas SA), assuming Spain's expected participation in the program.

Many of the EFA's unproven technologies will be tested in the EAP demonstrator aircraft. They are not expected to be as advanced, on the whole, as the technologies of the US ATF and A-12 aircraft. This is said to be especially true of their low-observable (or stealth) technologies.

Even so, Eurofighter officials are convinced that EFA technologies will be good enough—and will cost less and be more marketable than those of the next-generation US combat aircraft.

The US tried to thwart the Eurofighter program. It offered prospective European partners a sixty percent share in the development of a new fighter to be marketed in Europe, the US, and around the world, a fighter that would cost only about one-third as much as the EFA and only half as much as the Rafale.

But the Europeans didn't go for it. They claimed that such wholesale transatlantic collaboration on a fighter program would inevitably lead to US predominance and, in consequence, to the drying up of European fighter design and production capabilities.

What About EFA's Radar?

A major decision in the EFA program remained to be made as the Farnborough Air Show ended on September 11. It had to do with the fighter's radar, the focus of acrimonious industrial infighting on both sides of the Atlantic.

The stakes are high. Officials estimate that there will be a market for more than 1,000 EFA radars in contracts valued on the whole at nearly $2 billion over the years to come.

Two European multinational industrial teams are competing for EFA radar work. One includes Britain's Marconi, West Germany's AEG, Italy's Fiar, and Spain's Insel. It proposes using the technology of the Hughes APG-65 fire-control radar in the US Navy F/A-18 as the basis of the MSD-2000 radar, which it is offering for the Eurofighter.

The other European team includes Britain's Ferranti, along with Fiar and Insel, two companies that can't lose no matter which team is selected.

The Ferranti-led "Euroradar" consortium proposes to equip the Eurofighter with the ECR-90 radar, an outgrowth of the Ferrari Blue Vixen radar in the British Sea Harrier—an aircraft that put on a crowd-pleasing combat-style flight demonstration at Farnborough in concert with British troop and assault helicopters.

The show also featured the McDonnell Douglas/BAe AV-8B now being bought by the US Marine Corps as a versatile attack fighter.

Amid all the uproar surrounding the EFA radar program, Westinghouse, the prime supplier of radars for USAF fighters, would seem to be out of the running. But the company has not given up hope.

At Farnborough, Westinghouse displayed its APG-68 radar now being deployed in USAF F-16C/D fighters and talked it up as one that the Eurofighter consortium would do well to consider, even at this late date. Westinghouse promoted the APG-68 as being half the size and half the weight of the two EFA front runners.

"Those two may offer better logistics [as European products], but ours is lighter, and that means it will cost less," a Westinghouse official declared.

From all appearances at Farnborough, it seems to be getting harder and harder for US electronics to make their way into the Eurofighter.

For example, the Airborne Self-Protection Jammer (ASPJ), jointly developed by ITT and Westinghouse and now in production for US combat aircraft, was once considered a likely candidate for the Eurofighter. Now the Europeans seem to be moving to rule out US participation in the fighter's defensive avionics. They have formed a multinational, but totally European, consortium called EuroDASS—European defensive aids subsystem—for the EFA. It includes West Germany's AEG, Britain's Marconi, Italy's Elettronica SpA, and Spain's Ensa and Insel.

EuroDASS intends to integrate the Eurofighter's defensive avionics somewhat in the manner of the Integrated Electronic Warfare System (INEWS) being readied for USAF's Advanced Tactical Fighter—but with technologies developed only in Europe.

Fears for Eurofighter

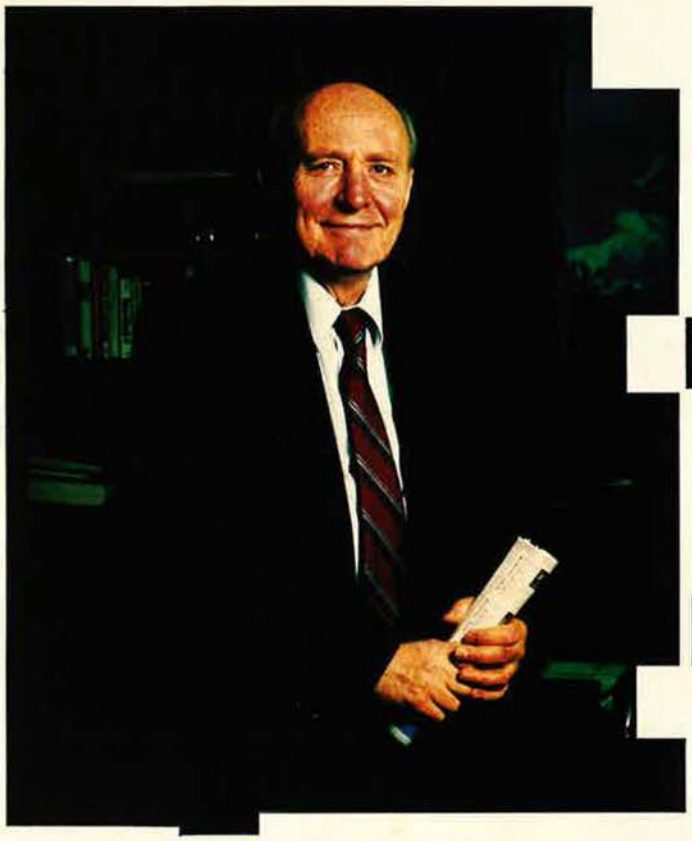
The Europeans fear that the incorporation of too much US high technology in the Eurofighter would give Washington too much of a say about where the aircraft could be marketed outside of NATO.

Westinghouse is still smarting from policies—or the lack of them—on technology transfer that the company believes may have put it at a big disadvantage in the Eurofighter radar sweepstakes.

The Air Force kept Westinghouse on a tight leash in the company's dealings with the Europeans on its fighter radar technologies. The Navy, on the other hand, pretty much gave Hughes its head in such transatlantic discussions.

At Farnborough, Hughes made much of the success of its radars

technology



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in Harriers. And Westinghouse claimed that its radars in British Hawks have helped win foreign customers for the aircraft, which can be used as trainers or as combat planes.

Like the Harriers, the Hawks were a big hit at Farnborough. BAe showed off its Hawk 200 single-seat combat aircraft and its two-seat Hawk T. Mk 1 trainer. The famed Royal Air Force Red Arrows aerobatic display team did its stuff at the show in Hawks as well.

The US Navy has ordered 300 T-45 Goshawk variants of the aircraft to train more than 600 pilots a year. BAe and McDonnell Douglas are jointly manufacturing the planes. The first flew last April.

Three months later, Saudi Arabia ordered Hawks, Tornados, and other BAe aircraft, along with British Westland helicopters and British-built minesweepers, in a deal involving an estimated ten billion pounds sterling (or about $17 billion) for undisclosed quantities of aircraft and other systems. No wonder British aerospace officials seemed so upbeat at Farnborough. Of course, they were right at home.

The show's main themes of international marketing and product improvement were exemplified by Westinghouse. "Our emphasis here is on upgrades of our radars for international markets," explained Jim Holthaus, marketing manager for aerospace with Westinghouse Electronic Systems Group.

"We have a big international push going on right now," he added, "because we've moved into good position with our tactical fighter radars. For the international market, we're modifying our baseline radars that we made primarily for F-16s."

Marketing the Pathfinder

Among the many other companies that struck the same themes, Martin Marietta was busy marketing its Pathfinder night navigation system for attack aircraft.

Pathfinder is a scaled-down variant of the highly sophisticated LANTIRN (low-altitude navigation and targeting infrared for night) system, which Martin Marietta is producing for USAF.

Lacking LANTIRN's precision-targeting capability, the Pathfinder forward-looking infrared (FLIR) system nonetheless gives attack aircraft the wherewithal to do many things at night that they cannot currently do. Martin Marietta is optimistic about the system's foreign sales prospects.

USAF will equip many of its F-16Cs with LANTIRN, so Martin Marietta hopes to find a home for Pathfinder in foreign air forces that fly F-16s but are denied the full-up LANTIRN system by US export policies.

The Farnborough show featured all manner of missiles and other kinds of combat equipment quite aside from aircraft. There were jamming pods, towed targets, aerial gun targets, aerial target tow reels, chaff dispensers, laser designator pods, missile simulators, space systems—you name it.

There were too many examples of industrial teaming and product upgrades to list all of them here. Some were:

- McDonnell Douglas, Messerschmitt-Bölkow-Blohm, and Hughes joined forces to upgrade 250 F-4Es now being flown by Egypt, Greece, Turkey, and Korea.
- Rockwell teamed with BAe to compete in USAF's Tanker Transport Training System (TTTS) aircraft program for Air Training Command.
- Texas Instruments and MBB joined to develop submunitions for attacking aircraft shelters and are working the US and West German markets for such.
- ITT teamed with Plessey Avionics of Britain to produce and market receivers and modules for the US Air Force Global Positioning System (GPS) navigation satellite program.
- Ferranti and Sanders Canada are collaborating in building test equipment for Canadian Air Force CF-18s.
- Aérospatiale Helicopter Corp. has joined with LTV and LHTEC, a joint-venture company of General Motors and Garrett, to market an Aérospatiale helicopter containing LHTEC engines originally designed for the US LHX military helicopter.
- McDonnell Douglas and Bell Helicopter Textron are teamed in opposition to Boeing and Sikorsky for the LHX award, one that could turn out to be especially lucrative.

Those companies promoted their LHX work at Farnborough as part of their campaigns to convince customers of their expertise in contemporary military choppers across the board.

Apache's Eye-Popping Display

A McDonnell Douglas Apache attack helicopter put on an eye-popping display of adventuresome airworthiness at Farnborough. The company followed through with one of the show's most intense international marketing efforts.

McDonnell Douglas dearly wants to sell the Apache to NATO armies. It made a big point of the contract that it had just been awarded by the US Army to give the attack helicopter air-to-air capability with Stinger missiles.

The company also tried to make everyone aware of a statement by the British House of Commons Defence Committee last June:

"The US AH-64 Apache is an obvious choice to fulfill this nation's light-attack antitank helicopter requirements."

At the show, Rockwell International and General Dynamics took note of their leadership of transatlantic consortia in competition to produce modular standoff weapons (MSOW) for NATO forces.

Such weapons may well be the wave of the future, and transatlantic teams are becoming more fashionable all the while.

One such team, off and running, is developing the multiple launch rocket system (MLRS) for NATO armies. Led by LTV, it includes Martin Marietta, West Germany's Diehl GmbH, France's Thomson-CSF, and Britain's Thorn EMI Electronics.

All these companies were especially active at Farnborough in promoting their wide ranges of electronic and aeronautical systems and gear.

Many US companies seem fairly confident about their ability to win and sustain international business in years to come. One is Texas Instruments. At the air show, William Mitchell, TI executive vice president for defense systems and electronics, noted that success in the international arena can be had by operating "on a businesslike basis" and by being "good partners," much as his company has done. ■

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As Veterans Day approaches, they move through their paces with a little more snap, reflecting a touch more pride.

With Dignity and Honor

BY MSGT. ALAN PROCHOROFF, USAF (RET.)

IF YOU spend much time around Washington, D. C., you'll see Air Force Honor Guardsmen serving at change of command ceremonies, performing at White House arrivals, laying wreaths at the Tomb of the Unknowns at Arlington National Cemetery, welcoming visiting dignitaries, and honoring former members of the Air Force at funerals.

On Veterans Day, though, you'll find members of the elite unit rendering honors with just a little more snap, reflecting a touch more pride in what they do.

"Veterans Day is one of two very special times of the year for us," said Capt. Steven Benton, officer in charge of the Air Force Honor Guard's ceremonial flight. "We honor individuals who have given a part of their lives—sometimes the greater portion of their lives—to their country.

"But at this time of the year, and on Memorial Day, we're not just honoring individuals. We're paying tribute to all who have served."

On Veterans Day, the Honor Guard will take part in a joint-service ceremony with the Secretary of Defense at the Tomb of the Unknowns at Arlington Cemetery. The holiday observance is just part of their job of representing USAF at ceremonies in Washington. Last year, the Honor Guard proudly rendered honors on more than 2,200 occasions in the nation's capital.

In 1987, they served at 666 military funerals, including those of retired Air Force Gen. Ira C. Eaker and retired Army Gen. Maxwell Taylor, former chairman of the Joint Chiefs of Staff. They opened the Air Force Association convention in September and presided over the retirement ceremonies of numerous Air Force members in the Washington area.

The Honor Guard saluted former Sen. Barry Goldwater of Arizona; outgoing Secretary of Defense Caspar Weinberger; Frank Carlucci, the current Secretary; and other national and foreign dignitaries. It rendered the proper military honors on Bolling's Ceremonial Lawn, at the White House, and in the Pentagon. It marched in Washington's Cherry Blossom Parade and in Philadelphia's parade celebrating the bicentennial of the signing of the Constitution.

Representing the Force

Whatever the occasion, the intent of the Honor Guard is the same: to

Below: With an appropriate backdrop, A1C Jason Blanton, front, and A1C Chad Taylor exemplify the USAF Honor Guard. The photo at the right says it all about standing tall.

—USAF photos by SSgt. Brigitte C. Wright


USAF HONOR GUARD

represent the Air Force proudly, with honor and dignity. It's an important mission, but one that's sometimes not fully understood.

"On behalf of the Air Force, we pay respect and tribute to those who have served their country," said Maj. John Ufford, who commanded the Honor Guard until this past July. "But just as important, we represent the Air Force as it should be represented—as the most professional military organization in the world.

"That's important, particularly when we're being seen by officials from other countries. Their opinions of the US military can be formed by one impression, the one they get when they see us."

That sentiment was echoed by SSgt. Walter Payne, NCO in charge of the Honor Guard's training flight. "Whether we're at the White House, at Arlington National Cemetery, or anywhere else, we want to leave a strong, lasting impression. That's important to us, because we're not just representing the Air Force Honor Guard. We're representing everyone in the Air Force."

—USAF photos by SSgt. Keith Walker

USAF Honor Guardsmen do their stuff at variegated ceremonies. Veterans Day and Memorial Day are special. Here, fellow Guardsmen help each other get ready for an honors presentation.

Air Force Honor Guardsman Sgt. Steve Collier, closest to camera, is part of a multiservice team at an Arlington National Cemetery service.

For many who aren't associated with the Honor Guard, the job of Air Force representative seems easy enough: stand at attention and look good while you're doing it. It looks simple to the untrained eye. But there's a lot more to it: learning the Honor Guard way to walk, learning the Honor Guard way to talk, and cultivating the Honor Guard look.

Standards Are High

First, you've got to be in the Honor Guard, and just the initial requirements can be an insurmountable obstacle for many applicants. Men must be at least five feet ten inches tall and women—they've served in the Honor Guard since 1976—must be no shorter than five feet six inches. That's so all the armed forces can present a uniform appearance.

Applicants must be in excellent physical condition, have smooth complexions, be United States citizens, and be willing to maintain an exceptional appearance. And that's just to have your record considered. It must, of course, be perfect in every way.

"We'll only look at applications that are superior," said MSgt. Ken Mitchell, the Honor Guard superintendent. "We want top quality, so we also take a hard look at what their reporting officials have to say, their letters of recommendation, their full-length photograph, their medical history, and a security questionnaire that's needed to apply for a presidential support security clearance."

Why the strict requirements? "It's not an easy job," said Sergeant Mitchell. "If it were, anyone could do it. But everyone can't."

Even so, there's no shortage of volunteers. The reasons for wanting to join are as varied as the members themselves. For some it's the glamour. For others it's the chance to serve their country in a different but meaningful way.

Sergeant Mitchell felt the initial urge to be a part of the Honor Guard in November 1963 as he watched the funeral of President John F. Kennedy on television.

"I saw the Guard of Honor standing over his casket as it lay in state at the Capitol," he recalled. "I decided then that I wanted to be a part of that." With the exception of one four-year break and a six-month overseas remote tour, Sergeant Mitchell has been with the Honor Guard continuously since 1974, serving in a variety of assignments.

Photos in his office corroborate what's said about the fifteen-year veteran—that he probably knows more about drill and ceremonies than anyone in the force. One faded photograph shows a youthful Sgt. Ken Mitchell ramrod straight as a member of the ceremonial flight. Another is of him at the White House during President Gerald Ford's state dinner for King Juan Carlos of Spain.

The Ultimate Honors

But the event of which he is most proud to have taken part—The Ultimate Honors, in his words—was serving as part of the Guard of Honor during interment ceremonies honoring the Unknown Serviceman of the Vietnam Conflict. "That was top duty—ahead of inaugurals, parades, and everything else," he said of the once-in-a-lifetime experience.

Sergeant Mitchell led one of the joint service honor guard teams who stood the Death Watch at Travis AFB, Calif., when the public was allowed to visit and pay their respects.

"People would come to the chapel and wait until the team was led by a member from a particular service. That was usually because of the service they or a relative or a friend had belonged to. Some of them waited for hours," he said. "So when I stood my tours and saw someone from the Air Force paying their respects, I'd try to stand a little taller, be a little more proud for them."

The attitude of excellence, which is sometimes hidden but always there, is evident when the Honor Guard buries the not-so-famous, too. SSgt. David Imming remembers a funeral for someone who'd served with the Honor Guard during the 1950s.

"We'd already folded the flag, and I was standing with it until I could present it at the end of the graveside services," he recalled. "Everyone was pretty emotional, and I was starting to get that way, too. But I stood tight, thinking of the image this man would have presented thirty years ago in the same situation. I thought he deserved nothing less."

That's the kind of a job well done that's not often observed by the public. Nor do outsiders often see, or appreciate, members of the Honor Guard who stand for hours in near-freezing weather. That's what Sergeant Imming and others did so they could render honors for a few minutes during the arrival and departure ceremonies at the White House for Soviet leader Mikhail Gorbachev. Such hardships are the price Honor Guardsmen pay every day, but it all comes with the territory, Sergeant Imming said, brushing aside any complaint.

—USAF photo by SSgt. Keith Walker

This color guard team lives up to the intent of the USAF Honor Guard—to represent the Air Force proudly, with honor and dignity. Left to right: SrA. Marcus James, Sgt. Michael Dunning, A1C Patrick Culver, and A1C Mark Lollar.

All in a Day's Work

Nicks, cuts, bumps, and bruises come with the territory, too, for members of the crack Honor Guard Drill Team. "The team assists Air Force recruiters and represents the Air Force in civilian communities that have limited exposure to the military," explained 1st Lt. Mark Hobson, a former leader of the Drill Team.

The twenty-member Drill Team performs an eighteen-minute routine designed to display the coordination, professionalism, teamwork, and discipline of Air Force members. The standard performance consists of precise movements with M1 rifles and fixed bayonets, including a series of complex tosses and exchanges. The show-stopping highlight is a three-minute routine, during which the drill commander stands at attention while four team members simultaneously hurl their bayoneted weapons over, under, around—but not through—him.

How impressive is the show? Drill Team members tell of recruiters who've filled six-month quotas within thirty days of an exhibition. Others talk about people who joined the Air Force solely on the basis of a Drill Team show.

Those results—and the glory of being in the spotlight—don't come without a price. The Drill Team spends 180 days a year on the road, and many of its members sport nicks, cuts, and scars like those on A1C Kenneth Shako's elbows, hands, and fingers.

That's evidence of a very real danger. The Drill Team's closest call probably came during a performance at Sea World in Florida when a tossed rifle went awry, cutting A1C Troy Benge just below his eye. Bleeding from the wound, he continued with the show.

That left quite an impression. But as any Honor Guardsman will tell you, it was all in a day's work of representing the Air Force. ■

MSgt. Alan Prochoroff, USAF (Ret.), is a free-lance writer in the Washington, D. C., area. Before his October 1 retirement, he was Public Affairs Superintendent at the Public Affairs Office at the Air Force District of Washington, Bolling AFB, D. C.

The defense industrial base problem spreads across industry, labor, education, and several branches of government. The recovery must be national in scope—and a Presidential commission should plan it.

Lifeline in Danger

BY JOHN T. CORRELL, EDITOR IN CHIEF

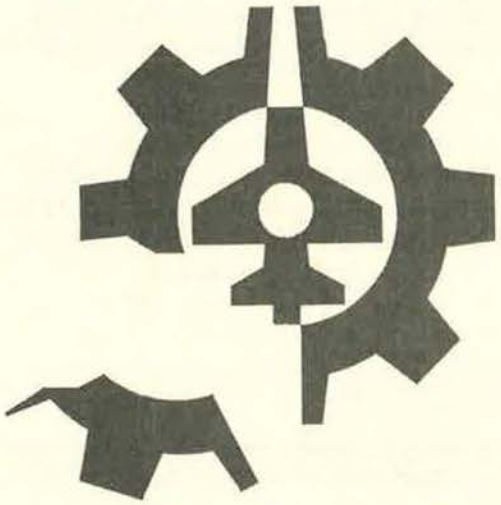
THE US defense industry in 1988 bears little resemblance to the "Arsenal of Democracy" that turned out tanks and airplanes in legendary numbers during World War II. American industry today cannot meet surge or wartime mobilization needs. It even has difficulty with peacetime defense requirements.

The armed forces depend increasingly on foreign suppliers for high-technology weapon system components. Overseas firms, often backed by strong support from their governments, are aggressively penetrating US markets. Domestic industry lags behind in manufacturing and productivity improvements. Although the United States is still ahead in the international balance of military trade, its relative advantage is slipping fast.

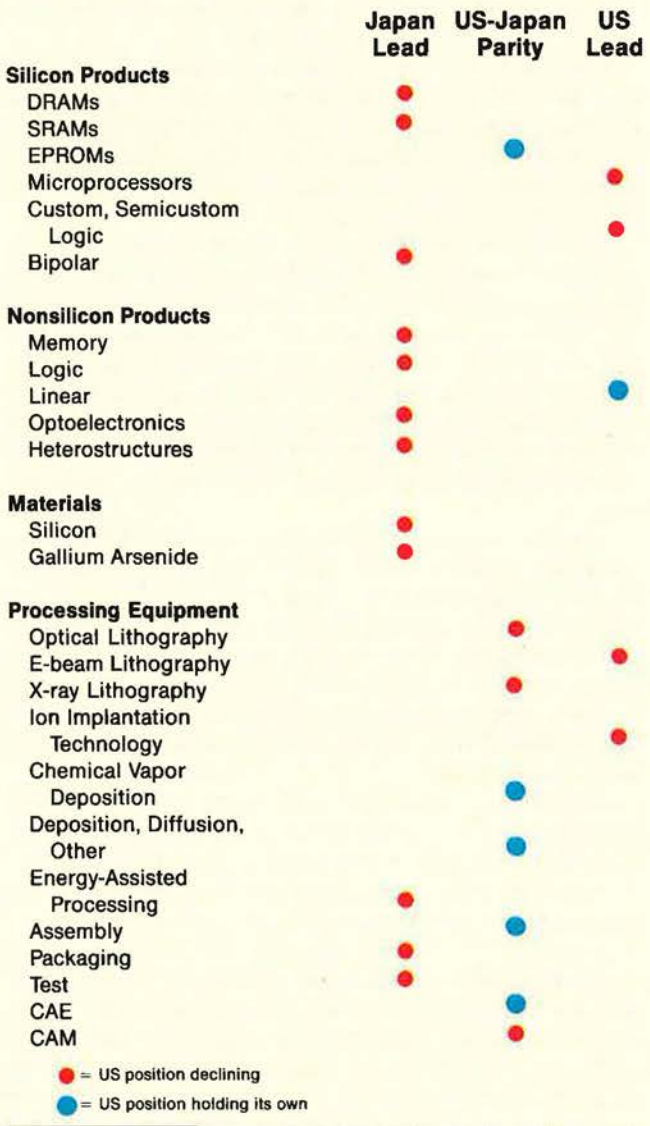
"Continuing on its present course, this nation faces the real possibility of becoming a second-rank manufacturing and technology power," the Air Force Association and the USNI Military Database concluded in a lengthy report on the defense industrial base published September 20.

The two organizations called for the appointment of a White House commission—comparable to the Packard Commission on defense management and the Scowcroft Commission on strategic modernization—to devise a recovery plan. The problem affects and is affected by government, industry, labor, and educational systems at the high school and college levels, the report said, so any possible solutions will have to be national in scope.

The decline of the US semiconductor industry *(see chart on next page)* has attracted considerable public attention, but other segments of the defense industrial base are hurting, too.



The Shift in Semiconductor Technology



Source: *Defense Science Board, Report of the Defense Science Board Task Force on Semiconductor Dependency (Washington, D. C.: Office of the Under Secretary of Defense for Acquisition, February 1987), p. 58.*

Although highly subjective and undoubtedly subject to debate, one recent study conducted by the US government's Interagency Working Group on Semiconductor Technology reveals an unmistakable trend in leadership relating to key semiconductor technologies. Note that the US position is not improving in any of the categories reported here and is holding its own in relatively few.

Even in peacetime, for example, defense consumes a fourth of the output of the machine tool industry. A shortage of machine tools was the biggest barrier to expanding weapon production in the two World Wars and the Korean conflict. Twenty-five percent of the US machine toolmakers in business in 1983 have since closed, been bought out by other concerns, or moved their operations offshore. The foreign share of the US machine tool market, only seventeen percent so recently as 1977, had grown to nearly half by 1986.

If the United States could pull its act together on modernization of plants, equipment, and manufacturing processes and somehow manage to coordinate its teamwork, an additional hitch would still remain: American schools and colleges do not produce enough technically prepared people to keep pace with the demand. Ironically, foreign students account for eighty-five percent of the recent growth in technical education at US graduate schools.

Reasons for the Decline

The report cites multiple and interlocking reasons for the decline of the defense industrial base. US military budgets, no longer so ample as they once were, fluctuate wildly from year to year. This creates instability and uncertainty for the supporting industry. Industry is reluctant to commit long-range capital to improve productivity.

Defense has become a rather small customer in the high-technology market, which is now driven by commercial product lines. Many of the firms that were doing defense business twenty years ago have either closed

No Choice but Foreign Chips

Global Positioning System (satellites)
Integrated Underwater Surveillance System
Defense Satellite Communications System
Fleet Satellite Communications Systems
AN-53B SSQ Sonobuoy
F-16 Fighting Falcon
AIM-7 Sparrow Air-to-Air Missile
AM-6988 Poet Decoy (expendable jammer)
Army Helicopter Improvement Program (OH-58 Kiowa)
APG-63 Airborne Radar (for the F-15 Eagle)
M1 Abrams Tank
F/A-18 Hornet

Source: *Defense Science Board, Report for the Defense Science Board Task Force on Semiconductor Dependency (Washington, D. C.: Office of the Under Secretary of Defense for Acquisition, February 1987), p. 64.*

This is a sampling of US military systems containing semiconductors that are available only from foreign sources.

their doors or moved to other markets. The decline has been sharpest among small companies in the industrial subtiers that subcontract work and supply components to the prime defense contractors.

The strong trend in the world economy is toward internationalization. American industry, preoccupied with quarterly profits and insufficiently attentive to quality, no longer holds the uncontested leadership. More and more, hard-charging foreign competitors are on the heels of US industry and, in some cases, have overtaken it.

In addition, foreign firms are achieving roundabout penetration of US markets through "offset" concessions that their governments demand as a condition when they buy US military products. *(See "You Scratch My Export and I'll Scratch Yours," p. 128, September '88 issue.)* These are side arrangements, perhaps unrelated to the main sale, that require some industrial or commercial compensation as a part of the deal. In a typical instance, the offset will call for the US seller to purchase military components from firms in the customer's country. One result of offsets is that American component makers lose business and grow weaker.

Whereas foreign firms usually have the enthusiastic support of their governments, US industry and government are squared off in a withering adversarial relationship. "American industry deserves better support than it has been getting from American government," the report said. "It's an open question whether the United States is ready for a Japanese-style Ministry of International Trade and Industry or even a British-style Defence Export Services Organization. Clearly, though, the US can do more than it does—and it should do more."

The problem is compounded, the report said, by "a tangle of laws, regulations, and requirements that often work at cross-purposes . . . and frequently achieve results opposite of those intended. There is no coherent relationship among tax laws, incentives and disincentives in the systems procurement process, environmental and trade policies, and other aspects of government regulation."

Partners or Adversaries?

The popular perception that arms makers and the Department of Defense are united in a powerful "military-industrial complex" is wrong, according to the report. In fact, government and industry too often behave as adversaries rather than as partners. The relationship has been strained to the limit in the past few years.

Part of the rift is about money. In the name of procurement reform—and to keep its own spending down—the Defense Department began requiring contractors to shoulder heavy R&D costs on high-risk developments, even though other contractors might get the production contracts or the systems might never be built. The government also cut progress payments to contractors, stopped covering expenses that had been reimbursable before, and eliminated tax deferrals.

More recently, the Pentagon has backed away from rigid use of fixed-price contracts on risky ventures and no longer expects industry to pay so much of the cost on speculative developments. One reason for this change of heart is that contractors balked at bidding on jobs that looked like losing propositions.

The defense industry, citing its own figures and the findings of independent financial analysts, claims that its profits are comparable to or lower than those of commercial firms. As recently as a few months ago, the Pentagon was still contending that profits in the defense industry are equal to or higher than the US average. (AIR FORCE Magazine asked the Department of Defense for the data on which it based that conclusion, but was told that the information was not available for public release.)

Another source of bad feeling has been the zealous campaign against "waste, fraud, and abuse" during the Reagan Administration. Since 1982, the Defense Department has increased its force of fraud investigators by 147 percent and its number of auditors by forty-six percent. It has installed fraud hotlines and told federal workers to be on the lookout for possible fraud. Suspension and debarment actions against defense contractors have risen tenfold.

Contractors, the report said, "claim auditors are encouraged to find problems and are seizing upon any irregularity, no matter how small, to make their 'quota.' In addition, contractors argue that they are denied due process of law by the government's contract debarment procedures. . . . Federal law does not require the government to tell contractors that they are being considered for debarment until the decision has been made. Moreover, the government is not required to state specifically the evidence used against the contractor. Only after the proceedings have run their course can the company argue its case before the agency, and then only under a set of rules established by the agency itself, in essence making it legislature, judge, and jury."

The Department of Defense, having weighed the industrial base problem for more than a year, said in July that the adversarial relationship has been a major cause of declining American industrial competitiveness and that DoD will put a high priority on forging better relations with industry.

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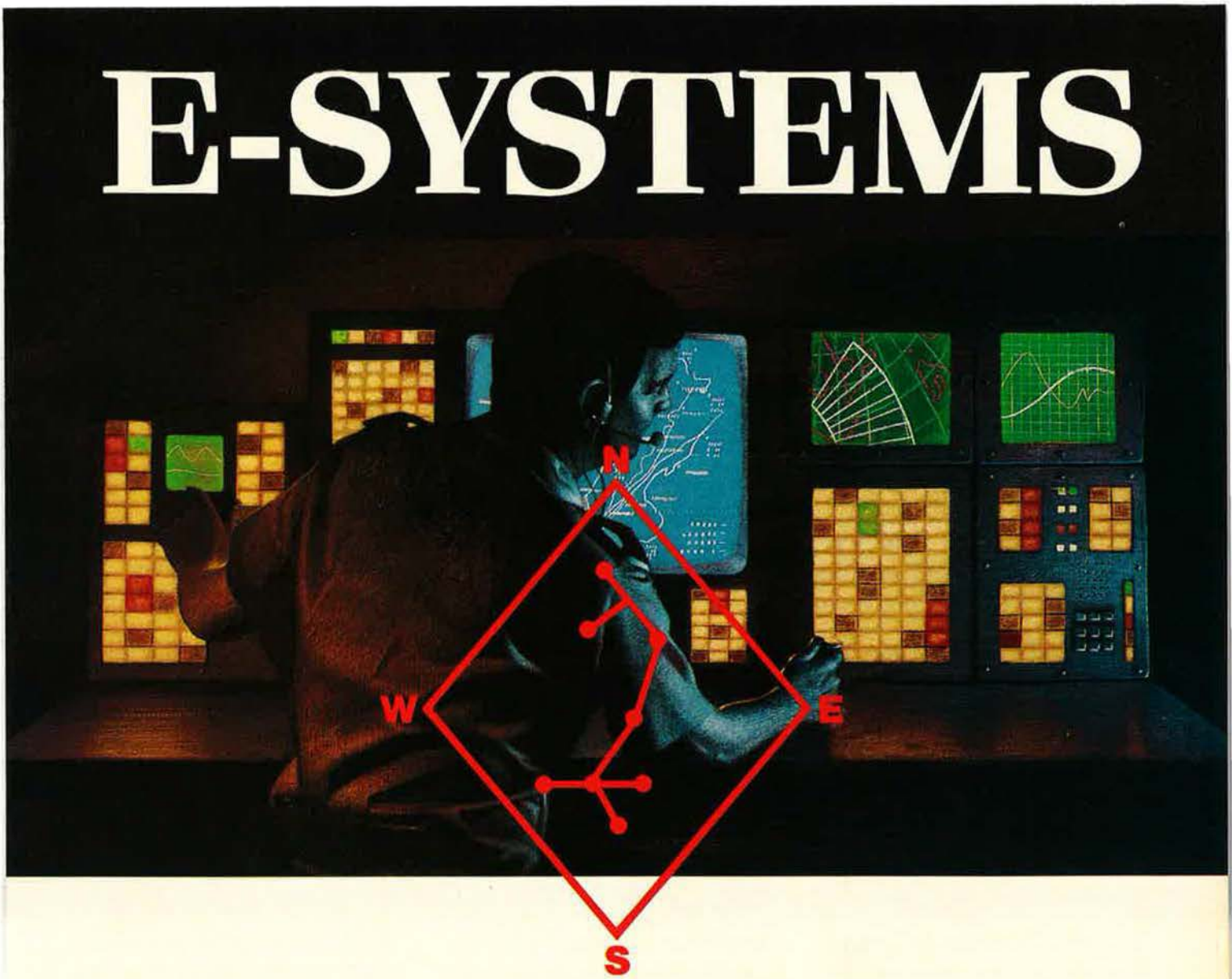

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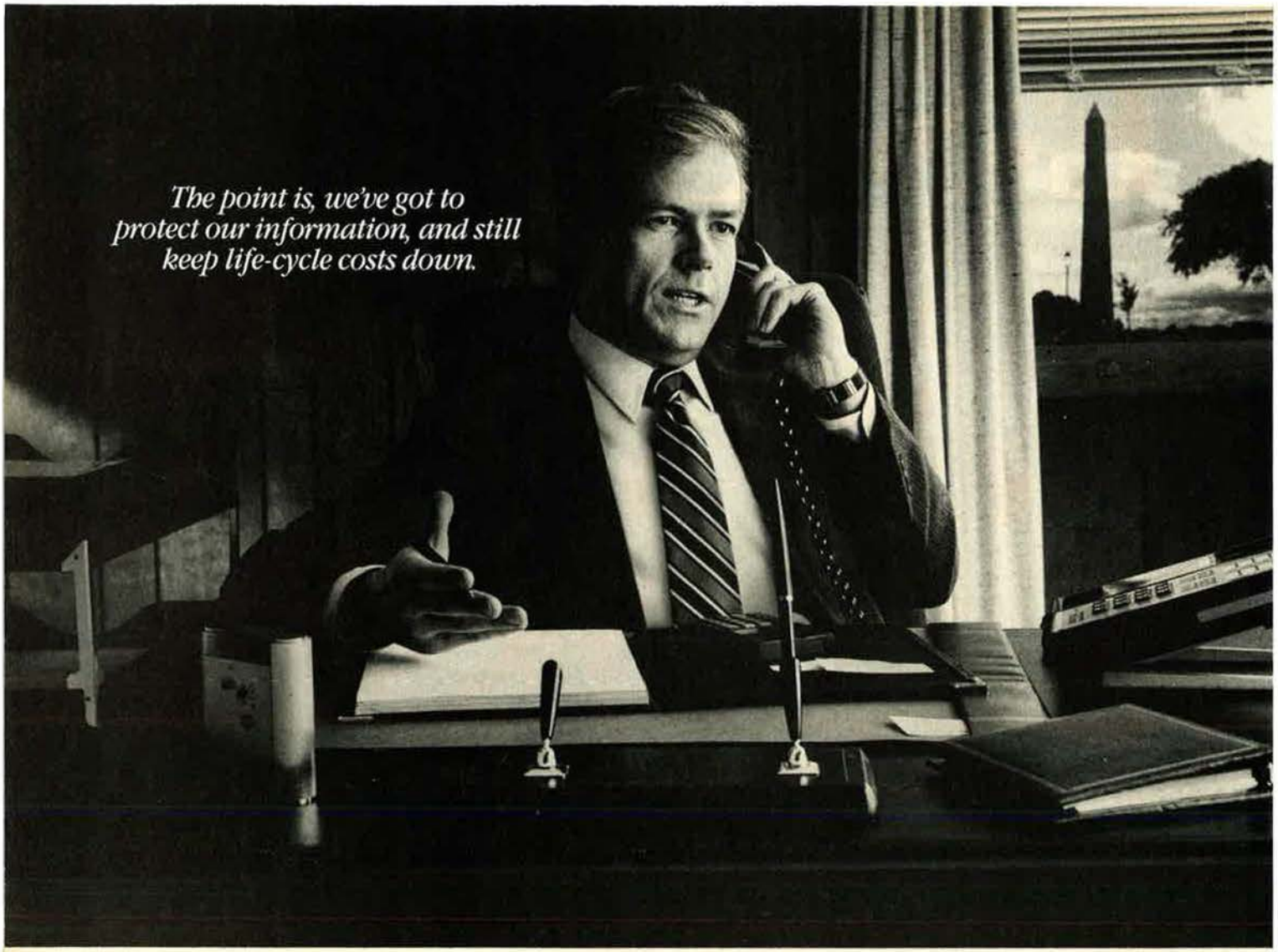

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Solutions and Non-Solutions

With federal budgets that allocate less than six percent of GNP to defense, it is pointless to talk about rebuilding the Arsenal of Democracy, the report said. In any case, it concluded, "It would be a mistake for the United States to seek complete independence for its defense industrial base. For many reasons, led by financial ones, this is impossible. This nation does not envision a single-handed defense of either the European or Pacific theaters of operation. In any such conflict, it is committed to fighting alongside its allies. A reasonable degree of interdependence and interoperability is logical under those circumstances.

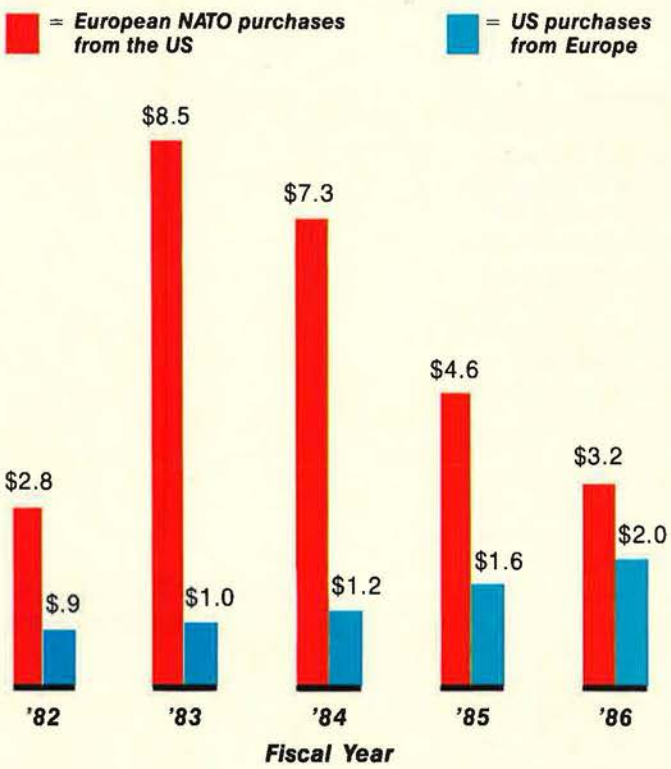
"At the same time, it would be foolish in the extreme for the United States to ignore critical vulnerabilities and foreign dependencies. Advanced semiconductors, pervasively used and pivotal in weapons quality, are an example of such a dependency. It would be irresponsible to rely on uncertain sources offshore for such items."

The report also cautioned against hasty legislation aimed at correcting pieces of the problem without taking the entire problem into account. "We urge Congress to legislate with economy, and in all cases, to consider the impact of the laws it makes," the report said. "It was hasty, *ad hoc* legislation that created the tangle [that presently exists]."

The two organizations said that the Defense Department should begin the difficult process of gathering crucial information that it does not have now: "It must identify, all the way to the end of the supplier and subcontractor chain, the foreign dependencies involved for critical weapons and components. Thereafter, it must continue to monitor and report such dependencies. It must also discover the overlaps for sources, foreign and domestic, in surge production requirements for those critical weapons and components. This will be a major task and an expensive one, but until it is done, the nation is planning in the dark."

The Defense Trade Balance

(billions of dollars, rounded)



Source: *Department of Defense.*

This chart shows the ratios between European NATO purchases from the US and US purchases from Europe since FY '82. Since that year, the ratios have been 3:1, 8:1, 6:1, 3:1, and 3:2.

"The Arsenal of Democracy"

(US industrial output between 1940 and 1945)

Aircraft:	296,000
Heavy Bombers	34,400
Medium Bombers	55,500
Fighters	98,700
Major Naval Vessels	1,201
Landing Vessels	64,546
Tanks	86,333
Small-arms Ammunition (million rounds)	41,585

Source: *Wartime Production Achievements and Reconversion Outlook: Report of the Chairman, War Production Board, October 9, 1945 (US GPO, pp. 106–109).*

War materiel production by US industry from July 1, 1940, to July 31, 1945. This was the legendary "Arsenal of Democracy" that supported and sustained the World War II fighting forces.

Finding the Focus

"The defense industrial base is not just the prime contractors," the report said. "Many of the shortfalls and critical problems are concentrated at the subcontractor and supplier levels. As one of its major recommendations, the study appealed to prime contractors to adopt, as a major initiative, the nurturing and shoring up of the supplier-subcontractor base."

It also said that "the United States must think of commercial vendors as part of the defense industrial base, too. Such diverse groups as researchers in academia and those who mine critical minerals are important as well."

The report assessed the state of the defense industrial base in 1988 this way: "Some industries are doing well and look ahead to a bright future. Another group, not threatened at present, is concerned about the future. A third group, which is quite large, is just getting by and scrambling to stay in business. This final group consists [mainly] of the small subcontractors and suppliers who furnish specialty products to the prime defense contractors. Federal programs to assist these industries exist, but they are frequently insufficient and underfunded."

For all of the bad news in their report, AFA and the USNI Military Database reached one upbeat conclusion.

"The United States should approach the problem with humility, but not be abject about it. We can and should learn from other nations, but should not always assume that the best answers inevitably lie abroad. We aren't the underdog yet, although our relative advantage is declining. The defense systems that set the standard for the world are American systems." ■

An Aerospace Education Foundation roundtable analyzes what happened to the defense industrial base, and why it happened.

Industry's Long Slide

BY JOHN T. CORRELL
EDITOR IN CHIEF

THE United States never made a conscious decision to abandon its defense industrial base. It certainly did not intend to allow its leadership in high-technology manufacturing to slip away.

The nation was simply preoccupied with other concerns and failed to recognize that its industrial base was gradually sinking. Even now, few Americans are fully aware of what has happened, although certain side effects—such as a loss of business and jobs to foreign competitors—have begun to seize their attention.

Speakers at an Aerospace Education Foundation roundtable held on September 21 analyzed the decline of the industrial base, amplifying a report published the previous day by the Air Force Association and the USNI Military Database. *(See "Lifeline in Danger," p. 74.)*

The long, steady slide was caused by the convergence of several trends that, given the hindsight of history, are easily seen as related. The relationship was not so apparent in the years when the trends were first gathering steam.

In the 1950s, the panel said, defense concepts were dominated by the existence of nuclear weapons. Most strategists believed that any future conflict would be apocalyptic and short. A strong industrial base to sustain conventional forces in wartime no longer seemed important. When national policy turned, finally, from nuclear brinksmanship and massive retaliation toward flexible response and a range of options, the neglect of the industrial base continued.

The defense share of the federal budget decreased. Production rates for military goods fell. The nation, which had taken major mobilization actions for both World Wars and the Korean conflict, chose to fight the Vietnam War from a peacetime industrial footing. As the unpopular war dragged on, the public came to regard the defense establishment and the defense industry with disfavor.

Challenge From Abroad

Year by year, the ranks of US defense contractors thinned. Industry, reluctant to invest because of unpredictable defense budgets and procurements, did little to improve its plants and manufacturing processes. Concurrently, the foreign competition got tougher. The newcomers from abroad knew how to make products efficiently and market them aggressively.

Gen. John R. Guthrie, USA (Ret.), a roundtable panelist and former Commander of the Army's Materiel Command, recalled that it was difficult for Americans to believe that the foreigners were really catching up. At one point in the 1970s, he was sent to discover why the Army had heard nothing from the Japanese about eleven data-exchange agreements. The reason, he found, was that "Japan was ahead of US technology in all eleven cases."

Foreign penetration of US markets began small, said panelist Martin H. Harris, an executive with

Martin Marietta International and, at the time of the roundtable, chairman of AFA's Board of Directors. Major US contractors, he said, went originally to foreign suppliers as second sources, backups for US suppliers. They found that the quality of components from abroad was generally better and that the prices were lower. Soon, other nations were demanding reciprocal purchases or concessions from the US as a condition of US military sales to them. Sometimes the "offset" demanded was an infusion of US technology, which added to the strength of firms in the gaining country.

A disturbing aspect of the industrial base problem is the prospect of "the technology overseas, the production overseas, and eventually, the brains overseas," said Foundation President James M. Keck, moderator of the roundtable.

Foreign dependency is most pervasive at the level of weapon system components rather than at the level of finished systems, but there are some striking voids in the ability of the US industrial base to produce larger items. "We no longer have the capability of casting tank hulls or turrets in this country," General Guthrie said.

The defense industry has no real capacity for surge production, Gen. Robert T. Marsh, retired Commander of Air Force Systems Command and chairman of AFA's Science and Technology Committee, said at the roundtable. About all that's possible, he added, is "to up your rates a little bit for things that were already in the pipeline" and then wait for eighteen months to two years for industry to build up. The nation needs an industrial base that can respond much faster than that to a call for mobilization or surge production.

White House Commission

The panelists agreed with the conclusion of the AFA-USNI Military Database study that a Presidential Commission should be appointed to plan a long-term *national* recovery. The problem spreads over so many governmental agencies and aspects of the economy that only a task force with a national charter can tackle it properly.

Before the Commission begins work, General Marsh said, the Defense Department should start gathering data to "calibrate the problem," identifying all the various mobilization and surge dependencies, an unknown number of which overlap. The Pentagon today has no idea what these dependencies are and has no reliable means of finding out.

The panel also liked a proposal made in the study for a command post exercise to be conducted by the federal government to diagnose and demonstrate the condition of the industrial base. As a model, the study cited "Nifty Nugget," a 1978 exercise that tested the ability of the armed forces to mobilize and deploy for a major conflict.

General Guthrie said that such exercises often reveal important information. For example, the Army learned from Nifty Nugget that it did not have enough rifles—and could not acquire enough—to support a mobilization. Another significant discovery was that in 1978, the US had no way to provide fresh water for forces in the Persian Gulf area.

Broadening the Base

Mr. Harris predicted that industry would be willing to invest in quality and productivity improvements if defense budgets were less subject to sudden swings and turns. Watching the instability that has prevailed up to now, contractors are cautious and reluctant to make long-term commitments.

The panelists believed that the defense industrial base must be broader—more firms producing goods that the armed forces can use—as well as stronger. If the government structures its incentives properly, it can make defense business more attractive to potential vendors. The fundamental reality, however, is that military requirements constitute only a small part of the technology product market, and this is not likely to change. In the years ahead, the armed forces will have to design their systems around commercial components whenever they can. Military designers are already moving in that direction, but Mr. Harris said that the complexity of military component specifications still severely limits the ability of prime contractors to buy parts from commercial suppliers.

The panel explored other adjustments that might ease the supply-source problem and cut the time required for mobilization or surge production. Mr. Harris pointed out, for example, that redundant testing of components takes place at each sequential step of system assembly. This, he contended, is a major limitation on industry's ability to surge its production. "We've found that if we could eliminate some of this [redundant testing], we could just about halve the time [it takes] to double the production."

Streamlining for a Surge

Dr. Scott C. Truver, one of the study's authors and a panelist at the roundtable, said that the complexity of modern military systems constrains surge production in other ways, too. Some design features, such as those that provide for an extended shelf life of the product, might be waived during a surge, when the expectation would be that the product would be used soon after its manufacture.

General Marsh agreed that under surge conditions it might make sense to streamline or eliminate some specifications, such as redundant testing and shelf-life features, but warned against the notion—popular in defense "reform" circles—that the United States should shift its design philosophy to "simpler" systems because they are easier and cheaper to produce.

Modern weapons are complex because the tasks they must perform and the adversaries they must defeat are complex, too. General Marsh said that there are valid reasons for the capabilities designed into US weapon systems and added, "I don't want to blacken the skies with a lot of [Korean War vintage] F-86-type aircraft only to make a bunch of Soviet aces."

The roundtable panelists further concurred with the study's conclusion that there is no quick and easy solution to the defense industrial base problem. They specifically cautioned against attempts to correct the damage with hasty legislation.

It took the nation thirty years to build the problem, General Marsh said. Recovery will require a sustained effort, perhaps a decade of it, before the job is done. ■

WAR GAMING AND OPERATIONAL READINESS

SYSCON and the Joint Staff is working together to apply state-of-the-art technology to all aspects of the war planning process.

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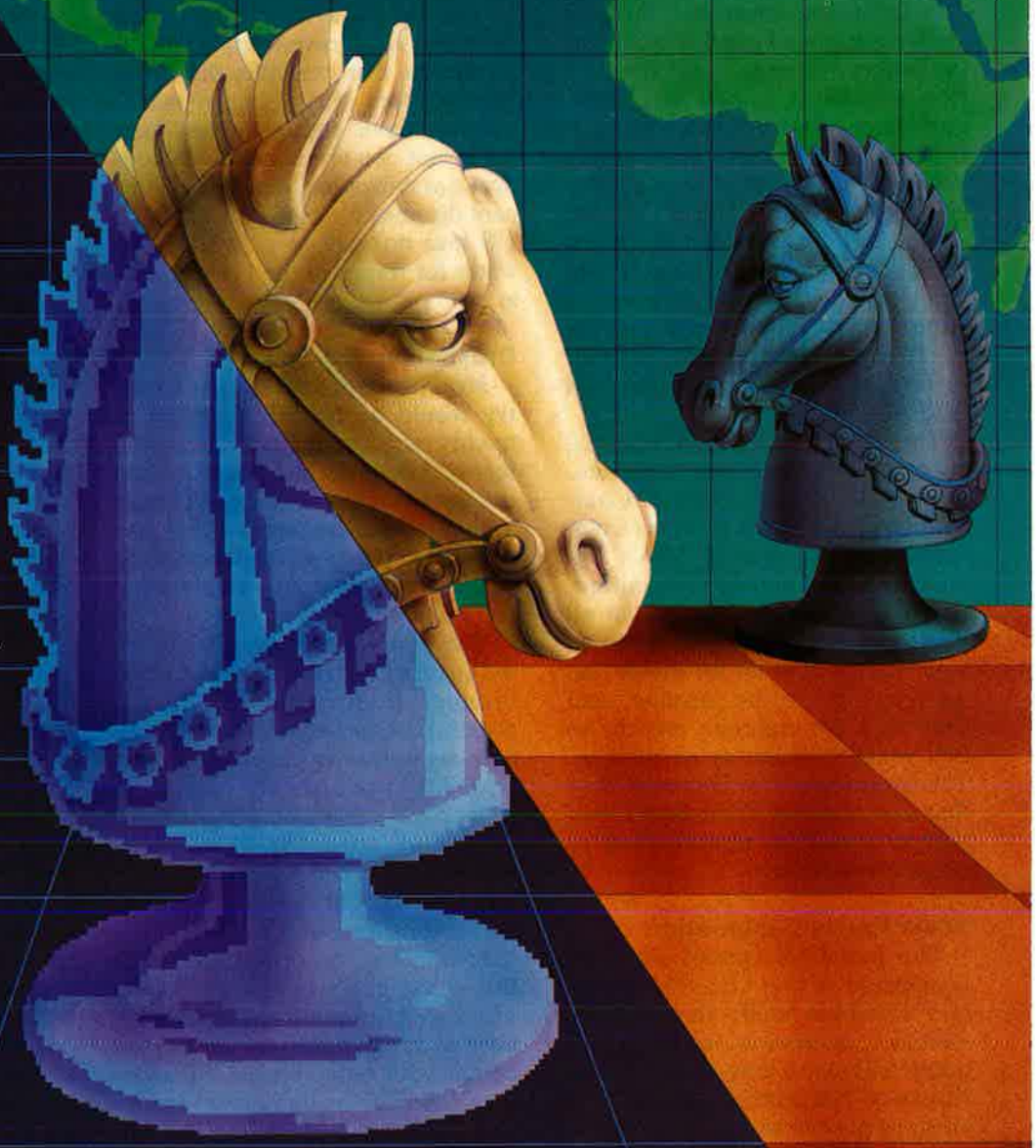
SYSCON is working with the Joint Staff developing computer based decision support tools under the Automated Force Generator Program, the prototype models for the next generation war planning information system.



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Gallery of West European Airpower

BY JOHN W. R. TAYLOR, EDITOR IN CHIEF, JANE'S ALL THE WORLD'S AIRCRAFT

Bombers and Maritime

MIRAGE IV-P

Eighteen Mirage IV-Ps of the French Air Force represent the only genuine strategic bomber force operated by any nation of Western Europe. They originated in the 1956 decision that, like the US and USSR, France should adopt a nuclear deterrent policy based on a triad of manned bombers, and silo based and submarine launched ballistic missiles. Using a minimum of imported equipment, Dassault scaled up its delta-wing Mirage III fighter airframe, installed tandem seats for a two-man crew, a large circular radome under the centre fuselage, and a pair of uprated Atar turbojets. The prototype, which flew on 17 June 1959, was followed by three slightly larger pre-series aircraft and 62 production Mirage IV-A bombers, which achieved initial operational capability in October 1964.

They were deployed in three wings, each comprising three four-aircraft squadrons, dispersed at a total of nine bases and with an underground HQ at Taverny near Paris. One aircraft at each base was held at permanent alert, ready to fly within 15 minutes of an order to go. They were kept in shelters from which they could emerge with engines running at full power. JATO rockets could be used to shorten the take-off run. Sorties were intended to be flown at high altitude, with up to 45 minutes at Mach 1.7, combat radius being extended by in-flight refuelling from Boeing C-135F tankers. This eventually gave way to a low-level penetration role, and between 1976 and 1983 the force was reduced to two wings with 34 first-line Mirage IV-As and ten reserves. Twelve aircraft were modified to carry a 2,200 lb reconnaissance pod instead of the standard AN 22 parachute retarded 60–70kT nuclear free-fall weapon.

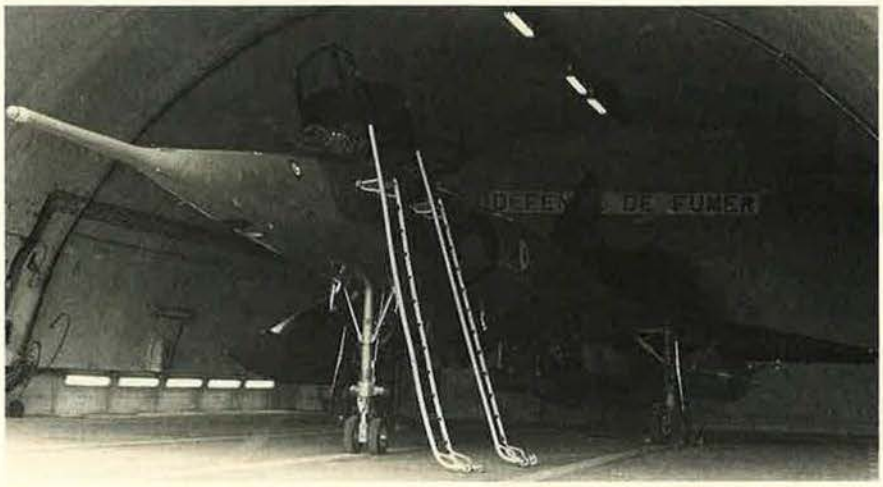
It was intended originally to retire the Mirage strategic bombers by 1985. Instead, 18 were upgraded to Mirage IV-P (for Penetration) standard as carriers for the far more potent ASMP supersonic thermonuclear missile. Navigation and targeting capabilities are improved by installation of a Thomson-CSF Arcana pulse-Doppler radar and dual inertial systems. Uprated EW equipment includes, typically, a Thomson-CSF Barem self-protection jamming pod and a Philips BOZ-100 chaff/flare pod on underwing pylons, plus two 436 or 660 gallon external fuel tanks. Thomson-CSF Serval radar warning receivers are standard. The Mirage IV-P became operational with Squadron 1/91 *Gascogne* at Mont-de-Marsan on 1 May 1986, followed by 2/91 *Marne* at St Dizier. A few aircraft are allocated to the OCU, CIFAS 328 *Aquitaine*, at Bordeaux.

Contractor: Avions Marcel Dassault-Breguet Aviation, France.
Power Plant: two SNECMA Atar 9K afterburning turbojets; each 15,400 lb st. Provision for 12 JATO rockets; total 11,000 lb st.
Dimensions: span 38 ft 10½ in, length 76 ft 5½ in, height 17 ft 8½ in.
Weights (approx): empty 31,965 lb, gross 70,550 lb.
Performance: max speed Mach 2 at high altitude, 745 mph IAS at low altitude, service ceiling 59,000 ft, radius of action 930 miles unrefuelled.
Accommodation: crew of two.
Armament: one ASMP thermonuclear missile.

ALBATROSS (HU-16B)

First flown on 24 October 1947, the Albatross was ordered initially as a utility transport amphibian for the US Navy, and for search and rescue duties with USAF. In 1961, Grumman developed a special version of the larger-span HU-16B for anti-submarine missions, with a nose radome, retractable MAD tail 'sting', ECM equipment on the wing, an underwing searchlight, and provision for carrying depth charges. The Hellenic (Greek) Air Force continues to operate a single anti-submarine warfare squadron with eight of these aircraft, acquired from Norway in 1969.

Contractor: Grumman Aircraft Engineering Corporation, USA.
Power Plant: two Wright R-1820-76A piston engines; each 1,425 hp.
Dimensions: span 96 ft 8 in, length 62 ft 10 in, height 25 ft 10 in.
Weight: gross 37,500 lb.
Performance: max speed 236 mph at S/L, service ceiling 21,500 ft, max range 2,850 miles.
Accommodation: crew of five.
Armament and Operational Equipment: four underwing pylons for torpedoes, rockets, depth charges, and other stores; sonobuoys, marine markers, and depth charges in fuselage.



Mirage IV-P of the French Air Force in its quick reaction shelter (SIRPA "AIR")

HU-16B Albatross, Hellenic Air Force (Stephen P. Peltz)

Atlantic, Italian Air Force

ATLANTIC

Twenty-five entries were received from manufacturers in several countries when NATO held a design competition for an anti-submarine aircraft to replace the Lockheed Neptune. Breguet's Br 1150 Atlantic was declared the winner, and two prototypes were ordered in December 1959. The first of these flew on 21 October 1961. Breguet then built 40 production Atlantics for the French Navy and 20 for the West German Navy, of which five were modified subsequently for ECM duties. Italy purchased 18 which, being operated by the 86th and 88th *Gruppi* of the Italian Air Force, qualify for inclusion in this Gallery.

Production of the Atlantic was undertaken by a consortium of companies in France, Germany, Belgium, Italy, and the Netherlands, with landing gears built in Spain, some avionics from the UK and USA, and turboprop engines manufactured by a French/Belgian/German/Italian/UK team. Most of the airframe is skinned in metal honeycomb sandwich, and the upper deck of the 'double-bubble' fuselage is both pressurised and roomy. A relief crew can be carried on long missions, in addition to the normal two pilots, flight engineer, three observers, radio navigator, ESM/ECM/MAD operator, radar/IFF operator, tactical co-ordinator, and two acoustic sensor operators. Equipment includes a retractable CSF radar, MAD tailboom, and an ECM pod at the top of the tail fin. The radar was claimed to detect a submarine snorkel at up to 46 miles range, even in rough seas. The whole of the upper and lower rear fuselage provides storage for sonobuoys and marker flares.

A much improved version, known as the Atlantique 2 (ATL2), is currently in production for the French Navy.

Contractor: Breguet-Aviation, France.
Power Plant: two Rolls-Royce Tyne RTy 20 Mk 21 turboprops; each 6,106 ehp.
Dimensions: span 119 ft 1 in, length 104 ft 2 in, height 37 ft 2 in.
Weights: empty 52,900 lb, gross 95,900 lb.
Performance: max speed 409 mph at height, service ceiling 32,800 ft, range 5,590 miles.
Accommodation: crew of 12. Provision for 12 other personnel.

Armament: internal weapons bay accommodates all standard NATO bombs, 385 lb depth charges, four homing or nine acoustic torpedoes. Underwing pylons for four nuclear or conventional missiles.

AVIOCAR (C-212)

CASA has developed versions of its C-212 Aviocar STOL utility transport equipped for specialised military duties. Nine Srs 100/200s were ordered by the Spanish Air Force for search and rescue missions, three by the Spanish Ministry of Finance, one ASW version by the Swedish Navy, two for maritime patrol (with SLAR and IR/UV search equipment) by the Swedish Coastguard, and 17 others by Mexico, Sudan, Uruguay, and Venezuela. Operational equipment can include a nose mounted AN/APS-128 search radar with 270° scan, searchlight, FLIR, smoke markers, and camera in the maritime patrol version; an underfuselage radar with 360° scan, ESM, sonobuoy processing system, OTPI, MAD, tactical processing system, IFF/SIF transponder, sonobuoy and smoke marker launcher, and weapons in the ASW version. *(Data for Srs 200.)*

Contractor: Construcciones Aeronauticas SA, Spain.
Power Plant: two Garrett TPE331-10R-511C turboprops; each 900 shp.
Dimensions: span 62 ft 4 in, length 49 ft 8½ in, height 20 ft 8 in.
Weight (ASW version): gross 18,519 lb.
Performance: max cruising speed 219 mph, loiter speed 121 mph at 1,500 ft, service ceiling 24,000 ft, range 1,898 miles.
Accommodation: crew of five (ASW and maritime patrol versions).
Armament: provisions for carrying torpedoes such as Mk 46 and Sting Ray, unguided rockets, and air-to-surface missiles such as Sea Skua and AS 15TT.

BUCCANEER

Like America's F-4 Phantom II, the Buccaneer began life as a naval aircraft and has gone on to achieve outstanding success in air force service. Its clearly area ruled form reflected the fact that it was the first aircraft designed specifically to exploit the vulnerable gap beneath hostile radar defences, by delivering its nuclear weapon at speeds above Mach 0.9 at extremely low altitude. The prototype flew for the first time on 30 April 1958, only 33 months after it had been ordered. It had two 7,100 lb st Gyron Junior turbojets, as did pre-series aircraft and the first production batch of Buccaneer S. Mk 1s for the Royal Navy. The switch to Rolls-Royce Speys offered a 30 percent increase in thrust and reduced fuel consumption, and these engines became standard in all subsequent production Buccaneers, designated S. Mk 2, for the Royal Navy and Royal Air Force.

The Royal Navy lost the last of its Buccaneers when its large carriers were retired in the 1970s. The budget cuts that restricted the first-line Fleet Air Arm to helicopters and V/STOL aircraft also cost the Royal Air Force its eagerly awaited TSR.2 supersonic attack aircraft, and then the F-111Ks and Anglo-French variable-geometry aircraft that were to take its place. Instead, the RAF got 43 Buccaneer S. Mk 2Bs, with a 425 gallon fuel tank in the bomb bay, strengthened landing gear, and provision for Martel missiles. About 60 ex-Navy aircraft were converted to S. Mk 2A standard for RAF use, without Martel capability.

Today, Buccaneers equip Nos. 12 and 208 Squadrons of Strike Command, operating in a maritime strike and reconnaissance role from RAF Lossiemouth in Scotland. Sixty of the RAF S. Mk 2s are being updated by British Aerospace to enhance their Blue Parrot attack radar and radar warning/ESM suite, install Ferranti FIN 1063 INS, and enable them to carry both TV guided Martel and Sea Eagle anti-ship missiles.

Contractor: Hawker Siddeley Aviation Ltd, UK.
Power Plant: two Rolls-Royce RB168 Spey Mk 101 turbofans; each 11,100 lb st.
Dimensions: span 44 ft 0 in, length 63 ft 5 in, height 16 ft 3 in.
Weights: empty 29,980 lb, gross 62,000 lb.
Performance: max speed Mach 0.92 (690 mph) at S/L, service ceiling over 40,000 ft, tactical radius 500–600 miles on hi-lo-hi mission.
Accommodation: crew of two, in tandem.
Armament: max weapon load 16,000 lb, inside ventral bomb bay and on underwing pylons, including nuclear bombs.

Search and rescue Aviocar, Spanish Air Force

Buccaneer S. Mk 2s, Royal Air Force

F27 Maritime (D.2), Spanish Air Force

Gulfstream SMA-3, Royal Danish Air Force (Paul Jackson)

F27 MARITIME

The islands of the Canary Archipelago, being more than 800 miles from the Spanish mainland, have their own mini air force in the form of MACAN, Canaries Command of the Spanish Air Force. Its three squadrons, based at Gando, Las Palmas, include No. 802 maritime surveillance and search and rescue Squadron, equipped with four Super Puma helicopters and three F27 Maritimes (Spanish designation D.2). The F27 Maritime is generally similar to the basic F27 twin-turboprop transport (which see). Unarmed, it carries a crew of up to six persons, and has a Litton 360° search radar in a ventral radome. Its standard fuel gives it an endurance of 10–12 hours or range of up to 3,107 miles.

Contractor: Fokker BV, Netherlands.

GULFSTREAM SMA-3

In 1981–82 the Royal Danish Air Force took delivery of three SMA-3 special missions aircraft, adapted from the Gulfstream III executive transport to meet the difficult requirements of Denmark's fishery patrols. These have to cover an area of more than 212,000 sq miles around Greenland and 112,700 sq miles around the Faeroe Islands. Bad weather can prevent landing at either place, necessitating a 920 mile diversion to an alternate. In addition, the aircraft had to be suitable for airdrop, medevac (including airborne surgery), SAR, tactical air transport, and VIP transportation for members of the nation's Royal Family. Allocated to No. 721 Squadron, they are based at Vaerløse, near Copenhagen, and detach in rotation for duty at Søndrestrøm AB, Greenland. Special features include a cargo door on the starboard side, forward of the wing, Texas Instruments APS-127 sea surveillance radar, and Litton 72R INS.

Contractor: Gulfstream Aerospace Corporation, USA.
Power Plant: two Rolls-Royce Spey Mk 511-8 turbofans, each 11,400 lb st.
Dimensions: span 77 ft 10 in, length 83 ft 1 in, height 24 ft 4½ in.
Weights: empty 36,173 lb, gross 69,700 lb.
Performance: max cruising speed Mach 0.85, service ceiling 45,000 ft, range with VFR reserves 4,537 miles.
Accommodation: crew of seven.
Armament: none.

NIMROD MR. Mk 2

Four squadrons of No. 18 Group of Royal Air Force Strike Command are equipped with this maritime patrol aircraft. Of these, No. 42 is based at St Mawgan in Cornwall, England. Nos. 120, 201, and 206 are at Kinloss and Lossiemouth in Scotland. The airframe is based substantially on that of Britain's pioneer Comet 4C jetliner, with an unpressurised pannier for operational equipment and weapons added under the fuselage. Spey turbofans replace the Comet's Avon turbojets. The tail unit is entirely reconfigured, with a large dorsal fin, an ESM pod on top of the fin, an MAD tailboom, and, on current aircraft, a small ventral fin, and finlets on the tailplane leading-edges.

Forty-six of the original Nimrod MR. Mk 1 version were built, with deliveries beginning in 1969. Thirty-five have been uprated to the current MR. Mk 2 operational standard, with Thorn EMI Searchwater long-range surface vessel detection radar, GEC Avionics AQS 901 acoustics processing system compatible with a wide range of passive and active sonobuoys, and Loral EWSM in wingtip pods. As a result of experience in the Falklands campaign in 1982, all Nimrod MR. 2s now have provision for in-flight refuelling probes, and for carrying Sidewinder and Harpoon missiles.

Contractor: British Aerospace plc, UK.
Power Plant: four Rolls-Royce RB168-20 Spey Mk 250 turbofans; each 12,140 lb st.
Dimensions: span 114 ft 10 in, length with refuelling probe 129 ft 1 in, height 29 ft 8½ in.

Nimrod MR. Mk 2, Royal Air Force (Sgt Jerry Chance)

Weights (approx): empty 86,000 lb, normal gross 177,500 lb.
Performance: max speed 575 mph, typical low-level patrol speed 230 mph, service ceiling 42,000 ft, typical endurance 12 hours.
Accommodation: crew of 12.
Armament: up to nine torpedoes and bombs in weapons bay; two underwing pylons for Sidewinder or Harpoon missiles, rocket or cannon pods, or mines.

ORION (P-3) and AURORA (CP-140)

Standard shore-based anti-submarine and maritime patrol aircraft of the US Navy since 1962, the P-3 flies in the insignia of five other NATO nations, including those of the Canadian, Norwegian, Portuguese, and Spanish Air Forces. The original P-3A Orion was based on the airframe of the Lockheed Electra airliner, with 4,500 ehp Allison T56-A-10W turboprops, APS-80 radar, ASQ-10 MAD in a tailboom, and an ASR-3 sensor to sniff the exhaust of submerged diesel-powered submarines. Mines, nuclear or conventional depth bombs, and torpedoes were carried in a weapons bay forward of the wings. Ten underwing pylons could carry more torpedoes, mines, or rockets, as well as a searchlight. Sonobuoys and acoustic devices were launched from the cabin.

Six P-3As transferred from the US Navy (Spanish designation P.3) equip No. 221 Squadron of the Spanish Air Force at Jerez, but are being replaced by five of the seven P-3Bs operated by No. 333 Squadron of the Royal Norwegian Air Force. Based at Andøya, in the far north of Norway, these P-3Bs made news in 1987 by obtaining the first good photographs of Soviet Su-27 'Flanker' fighters operating from the Kola Peninsula. Their primary task is to detect Soviet submarines leaving Northern Fleet bases in the Murmansk area, for which the two remaining P-3Bs will be supplemented next year by four of the latest Update III P-3Cs. These have much improved avionics, including an IBM Proteus acoustic processor to analyse signals picked up from the sea, and a new sonobuoy receiver, as well as a Texas Instruments AAS-36 undernose IR detection set, and Harpoon missile capability. The Portuguese Air Force has bought six P-3Bs from Australia, and is having them updated before they enter service. The 18 CP-140 Auroras operated by the Canadian Forces since 1980 combine the P-3C airframe with the avionics and data processing system of the US Navy's S-3A Viking, including APS-116 search radar, ASQ-501 MAD, and AYK-10 computer. *(Data for P-3C.)*
Contractor: Lockheed Aeronautical Systems Company, USA.
Power Plant: four Allison T56-A-14 turboprops; each 4,910 ehp.
Dimensions: span 99 ft 8 in, length 116 ft 10 in, height 33 ft 8½ in.
Weights: empty 61,491 lb, normal gross 135,000 lb.
Performance: max speed at 15,000 ft 473 mph, patrol speed at 1,500 ft 237 mph, service ceiling 28,300 ft, mission radius (3 hours on station) 1,550 miles.
Accommodation: crew of ten.
Armament: max expendable load of 20,000 lb, including 500/1,000/2,000 lb mines, Mk 54/57 depth bombs, Mk 101 nuclear depth bombs, Mk 43/44/46 torpedoes, Harpoon missiles, sonobuoys, marine markers, acoustic sensors, and parachute flares.

TRACKER (S-2 and CP-121)

First flown in XS2F-1 prototype form on 4 December 1952, this veteran piston-engined aircraft continues to perform important shore-based maritime duties with two NATO air forces. About 15 S-2A/E Trackers are operated on anti-submarine patrol by No. 103 Squadron of the Turkish Air Force, with joint Air Force/Navy crews, from Topel on the Black Sea. Canadian Forces Maritime Command has 20 CP-121s, basically similar to the US Navy's S-2A, which were built by Canadian manufacturers in the late 1950s, under licence from Grumman. In the 1970s, after the RCN had retired its last carrier, the CP-121s' ASW equipment was replaced by a Litton APS-504 search radar, Marconi Omega navigation system, cameras, and provision for 2.75 in rocket pods for armed reconnaissance. The naval arrester hook and MAD boom were removed, but the 85 million candlepower steerable searchlight under the starboard wing was retained. Today, the CP-121s are operated primarily by MR-880 Squadron, which shares its aircraft with personnel of No. 420 (Air Reserve) Squadron, at CFB Summerside on Prince Edward Island. Three other CP-121s are flown from CFB Comox on Canada's west coast by VU-33 (Utility) Squadron. Primary mission for all of these aircraft is coastal surveillance, including fisheries protection and pollution control, with a secondary search and rescue role carrying parachute flares and a SKAD (Survival Kit Air Droppable) underwing.
Prime Contractor: de Havilland Aircraft of Canada Limited, Canada.
Power Plant: two Wright 983C9HE1 (R-1820) piston engines; each 1,525 hp.
Dimensions: span 69 ft 8 in, length 42 ft 3 in, height 16 ft 3½ in.
Weights: empty 17,500 lb, gross 26,055 lb.

P-3A Orion, Spanish Air Force

CP-121 Tracker, Canadian Forces (Cpl N.C. Levesque)

Performance: max speed 258 mph, search speed 161 mph, service ceiling 24,000 ft, range 1,150 miles.
Accommodation: crew of three.
Armament: 2.75 in rocket packs, depth bombs, and bombs.

Fighters

F-4 PHANTOM II

Five NATO air forces in Europe continue to deploy the 30 year old Phantom II as first-line combat equipment. The Royal Air Force has six full air defence squadrons, all but one under NATO command. Nos. 43 and 111, based at Leuchars in Scotland, have Phantom FG. Mk 1s (F-4Ks). No. 56 at Wattisham in England, and Nos. 19 and 92 at Wildenrath in Germany, have FGR. Mk 2s (F-4Ms). Both versions are comparable to US Navy F-4Js, except for having Rolls-Royce Spey engines. No. 74 Squadron, at Wattisham, has ex-USN F-4Js with J79 turbojets. Additionally, four FGR. Mk 2s serve with No. 23 Squadron for air defence of the Falkland Islands.

The German Air Force has eight squadrons of F-4Fs in two fighter-bomber wings (JBG 35 and 36) and two air defence wings (JG 71 and 74). It is planned to upgrade 110 of these aircraft, primarily from the air defence wings, to give them a lookdown/shootdown capability against multiple targets. MBB is prime contractor for the programme, known as ICE (Improved Combat Effectiveness), which will replace the existing Westinghouse APQ-120 radar with an all-digital multimode Hughes APG-65 embodying advanced ECCM. The cockpit will be updated; new equipment will include a Litef digital fire control computer, Honeywell laser INS, GEC digital air data computer, improved IFF, and provisions for four AMRAAM missiles. A further 40 F-4Fs, serving in the fighter-bomber role, are undergoing partial update.

Spain has two squadrons of F-4Cs (known as C.12s) with 12 Wing of Air Combat Command (MACOM) at Torrejón AB. These are scheduled for replacement with EF-18s by 1990. The two remaining Phantom operators have F-4Es, of which three squadrons (337, 338, and 339) serve with the Hellenic Air Force, and five squadrons (111, 112, 171, 172, and 173) with the Turkish Air Force. *(Data for FGR. Mk 2.)*
Contractor: McDonnell Douglas Corporation, USA.
Power Plant: two Rolls-Royce RB168-25R Spey 202 afterburning turbofans; each 20,515 lb st.
Dimensions: span 38 ft 4¾ in, length 58 ft 3 in, height 16 ft 3 in.
Weights: empty 31,000 lb, gross 58,000 lb.
Performance: max speed at 40,000 ft Mach 2.1, at 1,000 ft Mach 1.15; service ceiling 58,050 ft, max range 1,750 miles.
Accommodation: crew of two in tandem.
Armament: one 20 mm M61 multi-barrel gun; four Sky Flash or Sparrow air-to-air missiles and four Sidewinders. Provision for eleven 1,000 lb bombs, 126 SNEB 68 mm rockets, and external fuel tanks.

F-5 and CF-5

In 1954, Northrop decided to develop a low-cost lightweight supersonic fighter, at a period when aircraft like USAF's F-100 and F-105 were becoming increasingly heavy and expensive. The prototype, known as the N-156F, flew on 30 July 1959. Impressed by its potential for economical foreign military aid/sales, DoD ordered into production single-seat F-5A and two-seat F-5B versions. They were acquired eventually by 17 foreign air forces, and are still assigned to fighter ground attack duties by six non-US NATO air forces. On NATO's southern flank they are flown by Squadrons 341 and 343 of the Hellenic Air Force, and Squadrons 151 and 152 of the Turkish Air Force. The last two Canadian squadrons (Nos. 433 and 434) of Canadair-built CF-5s (single-seat CF-116As and two-seat CF-116Ds) are being replaced progressively by CF-18s. The Royal Netherlands Air Force now has only two squadrons (Nos. 314 and 316) of Canadian-built NF-5As, others having re-equipped with F-16s. Norway's No. 336 Squadron operates as an OCU for its four squadrons of F-16s. The two squadrons of CASA-built SF-5As (A.9s) and SF-5Bs (AE.9s) operated by Tactical Command of the Spanish Air Force (Nos. 211 and 212) are being updated with laser rangers and improved avionics, including a head-up display. *(Data for F-5A.)*
Contractor: Northrop Corporation, USA.
Power Plant: two General Electric J85-GE-13 afterburning turbojets; each 4,080 lb st.
Dimensions: span over tiptanks 25 ft 10 in, length 47 ft 2 in, height 13 ft 2 in.

F-4K Phantom FG. Mk 1, Royal Air Force

CF-116A (CF-5), Canadian Forces

F-16A Fighting Falcon, Royal Netherlands Air Force

Weights: empty 7,860 lb, gross 20,040 lb.
Performance: max speed at 36,000 ft Mach 1.4, service ceiling over 50,000 ft, max range 1,750 miles, range with max weapons 368 miles.
Accommodation: pilot only.
Armament: two 20 mm M39A2 guns in nose; Sidewinder missile on each wingtip; centreline pylon and two under each wing for about 4,400 lb of air-to-air or air-to-surface missiles, rocket packs, gun pods, bombs, or fuel tanks.

F-16 FIGHTING FALCON

On 7 June 1975, less than five months after USAF's decision to order the F-16, the Governments of four European NATO nations announced their selection of this aircraft to replace their F-104s. Final assembly lines for single-seat F-16As and two-seat F-16Bs were established in Belgium and the Netherlands, to which components, avionics, and equipment were supplied by about 30 European companies. With follow-on contracts, orders to date total 160 F-16s for the Belgian Air Force, 70 for the Royal Danish Air Force, 213 for the Royal Netherlands Air Force, and 72 for the Royal Norwegian Air Force. All are similar to basic USAF F-16As and Bs, with some equipment changes. Belgian aircraft are intended to have Rapport ECM in an extended fin root fairing; those for Norway, and current RNethAF production aircraft, have a brake-chute in this location. The 23,830 lb st Pratt & Whitney F100-PW-200 afterburning turbofan and Westinghouse APG-66 radar are standard in all of these aircraft. Currently, they equip Squadrons 23, 31, 349, and 350 of the BAF; 723, 726, 727, and 730 of the RDAF; 311, 312, 313, 315, 322, and 323 of the RNethAF, with 316 forming; and 331, 332, 334, and 338 of the RNorAF.

When Turkey and Greece joined the steadily growing list of F-16 operators, they both opted for the uprated F-16C/D versions, with a 27,600 lb st General Electric F110-GE-100 engine and APG-68 radar. Deliveries of the 40 Greek aircraft have started, as have the 160 for Turkey, most of which are being built in Turkey by Tusas Aerospace Industries. *(Data for F-16C.)*
Contractor: General Dynamics Corporation, USA.
Power Plant: one General Electric F110-GE-100 afterburning turbofan; 27,600 lb st.
Dimensions: span over missiles 32 ft 9¾ in, length 49 ft 4 in, height 16 ft 8½ in.
Weights: empty 19,100 lb, gross 42,300 lb.
Performance: max speed at 40,000 ft above Mach 2, service ceiling above 50,000 ft, radius of action more than 575 miles.
Accommodation: pilot only.
Armament: one 20 mm M61A1 multi-barrel gun in port side wing/body fairing; Sidewinder missile on each wingtip; centreline hardpoint and three under each wing for total 12,000 lb of stores, including air-to-surface missiles (Penguin Mk 3 on Norwegian aircraft), single or cluster bombs, rocket packs, ECM packs, and fuel tanks. Internal chaff/flare dispensers.

F/A-18 HORNET

Two non-US NATO air forces have, so far, preferred the US Navy's twin-engined F/A-18 to the competing single-engined USAF F-16. The Canadian Forces placed their initial order for 98 CF-18A single-seaters and 40 CF-18B two-seaters in April 1980, and are believed currently to require 25 more to offset attrition to the year 2010. By comparison with the Navy versions, the CF-18s have a different ILS and an added spotlight on the port side of the fuselage for night identification of other aircraft in flight. Unique is the canopy shape painted on the underside of the front fuselage, which is intended to confuse hostile pilots during combat manoeuvres. CF-18s have replaced CF-5s in Nos. 409, 421, and 439 Squadrons of No. 1 Canadian Air Group based at Söllingen, West Germany. Four squadrons of CF-18s (Nos. 416, 425, 433, and 441), plus an OCU (No. 410), have replaced other CF-5s and the CF-101F Voodoos that contributed to North American air defence. Two of them are allocated to support Canada's NATO force in Europe in an emergency.

CF-18 Hornet, Canadian Forces (WO Vic Johnson)

Canadian-built CF-104G Starfighter, Turkish Air Force (Paul Jackson)

Hawk T. Mk 1A, Royal Air Force

Mirage IIIE with AN 52 nuclear bomb, French Air Force (SIRPA "AIR")

The Spanish Air Force ordered 72 EF-18s in May 1983, with an option on 12 more, designating the single-seaters C.15 and the two-seaters CE.15. Deliveries to equip two squadrons of Air Combat Command (MACOM) 15 Wing, at Zaragoza AB, began in 1986. By 1990 the two Phantom squadrons of 12 Wing, at Torrejón AB will also fly EF-18s. (Data for CF-18A.)
Contractor: McDonnell Douglas Corporation, USA.
Power Plant: two General Electric F404-GE-400 augmented turbofans; each 16,000 lb st.
Dimensions: span over missiles 40 ft 4¾ in, length 56 ft 0 in, height 15 ft 3½ in.
Weights: empty 23,050 lb, gross (fighter escort mission) 37,175 lb.
Performance: max speed Mach 1.8, combat ceiling approx 50,000 ft, combat radius 660 miles.
Accommodation: pilot only.
Armament: one 20 mm M61 multi-barrel gun in nose; Sidewinder missile on each wingtip; centreline pylon and three under each wing for Sparrow air-to-air missiles, rocket packs, bombs, ECM pods, etc. Max external stores load 17,000 lb.

F-104 STARFIGHTER

Greece and Turkey have maintained large inventories of F-104s by acquiring surplus aircraft from other NATO air forces that have re-equipped. The Hellenic Air Force is believed to have three fighter-bomber squadrons of F-104Gs at Araxos. The Turkish Air Force has up to ten squadrons of F-104Gs and two-seat TF-104s, plus two air defence squadrons of F-104Ss bought from Italy. The 'S' model was the final version of the Starfighter, developed by Aeritalia at Turin for the Italian Air Force, which bought 205 to equip its Nos. 4, 5, 6, 9, 36, 51, and 53 Wings, three of which were assigned to air defence and the others to a joint interceptor/strike role. Three squadrons have since re-equipped with Tornados, but 160 Italian Air Force F-104s have been undergoing a major weapons system update since 1982, bringing them up to F-104S ASA *(Aggiornamento Sistemi d'Arma)* standard. This includes installation of a Fiar R21G/M1 Setter look-down/shootdown radar, advanced ECM, improved IFF and altitude reporting system, improved electrical generation and distribution, an armament computer and time delay unit for improved weapons delivery, and a new automatic pitch control computer. Selenia's Aspide medium-range air-to-air missile is now standard, as an alternative to the Sparrows which accounted for the 'S' in the aircraft's designation. *(Data for F-104S.)*
Contractor: Aeritalia SpA, Italy, under licence from Lockheed.
Power Plant: one General Electric J79-GE-19 afterburning turbojet; 17,900 lb st.
Dimensions: span without tiptanks 21 ft 11 in, length 54 ft 9 in, height 13 ft 6 in.
Weights: empty 14,900 lb, gross 31,000 lb.
Performance: max speed at 36,000 ft Mach 2.2, at S/L Mach 1.2; service ceiling 58,000 ft, max combat radius 775 miles.
Accommodation: pilot only.
Armament: AIM-9L Sidewinder on each wingtip; seven pylons under fuselage and wings for bombs, rocket packs, fuel tanks, and air-to-air missiles, including two Aspides or Sparrow IIIs. Max external stores load 7,500 lb.

HAWK T. Mk 1A

A total of 88 Hawk trainers of Nos. 1 and 2 Tactical Weapons Units of the Royal Air Force, and of its Red Arrows aerobatic team, have been wired for carriage of two AIM-9L Sidewinder air-to-air missiles on their inboard underwing pylons, and for activation of the previously unused outer wing hardpoints. Seventy-two of these redesignated Hawk T. Mk 1As are declared to NATO for point defence and participation in the RAF's Mixed Fighter Force, in which they would accompany radar equipped Phantoms and Tornado ADVs on medium-range air defence sorties. They retain their underfuselage 30 mm Aden gun pod.
Contractor: British Aerospace plc, UK.
Power Plant: one Rolls-Royce Turbomeca RT172-06-11 Adour 151 turbofan; 5,340 lb st.
Dimensions: span 30 ft 9¾ in, length, excluding probe, 36 ft 7¾ in, height 13 ft 5 in.
Weights: empty 8,040 lb, gross 17,097 lb.
Performance: max speed approx 560 mph, service ceiling 48,000 ft, max range with external tanks 1,923 miles.
Accommodation: crew of two in tandem.
Armament: one 30 mm Aden gun pack under fuselage; AIM-9L Sidewinder air-to-air missile on each inboard underwing pylon.

MIRAGE III

Thirty-two years after the first flight of the Mirage III prototype on 17 November 1956, this elegant delta-wing fighter remains in first-line service with the Air Forces of France and Spain, for both air defence and fighter-bomber duties. The Mirage IIIE is operated by Squadrons

1/3 *Navarre*, 2/3 *Champagne*, 3/3 *Ardennes*, 2/4 *La Fayette*, and 1/13 *Artois* of the French Tactical Air Force (FATAC). This version originated as an all-weather low-altitude attack fighter with CSF Cyrano II fire control and ground mapping radar, Marconi Doppler, navigation and bombing computers, but is equally effective for interception of Mach 2 targets in all weathers. Standard weapons include an AN 52 nuclear bomb. The Mirage IIIEEs flown by two squadrons of Air Combat Command (MACOM) 11 Wing of the Spanish Air Force, from Manises AB, are similar except for having no nuclear capability. Their Spanish designation is C.11. *(Data for Mirage IIIE.)*

Contractor: Avions Marcel Dassault-Breguet Aviation, France.

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

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

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

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

Accommodation: pilot only.

Armament: one Matra R.530 air-to-air missile under fuselage, and two Matra Magic missiles under wings, for interception missions. One AN 52 nuclear bomb, one AS 30 air-to-surface missile, or one Martel antiradar missile under fuselage, bombs or rocket packs underwing, for ground attack missions. Provision for two 30 mm DEFA 552 guns in fuselage.

MIRAGE F1

Unique in three decades of Dassault products for the French Air Force, the Mirage F1 reverted to sweptwing, rather than delta, configuration. The basic F1-C, first flown in prototype form on 23 December 1966, is intended primarily as an all-weather, all-altitude interceptor, but is also suitable for visual ground attack missions. Its fuselage and weapon systems are generally similar to those of the Mirage IIIE, but an uprated turbojet helps it to take off in under 2,000 ft on air defence missions, armed with air-to-air missiles. Its initial rate of climb is 41,930 ft/min, with a stabilised ceiling of 52,500 ft at supersonic speed. Automatic leading-edge flaps give it outstanding manoeuvrability in combat, matched by great stability at high speeds close to the ground. Standard equipment now includes a HUD and Cyrano IV-M multifunction radar with a high degree of resistance to ECM. In addition, many F1-Cs have been fitted with an in-flight refuelling probe, under the new designation F1-C-200. Using this capability, four of them flew nonstop 3,100 miles from Solenzara, Corsica, to Djibouti, East Africa, in six hours in 1960. Squadrons equipped currently with F1-Cs are 2/5 *Ile de France* at Orange; 1/12 *Cambrésis*, 2/12 *Picardie*, and 3/12 *Cornouaille* at Cambrai; and 1/30 *Valois*, 2/30 *Normandie Niemen*, and 3/30 *Lorraine* at Reims. One further squadron, 4/30 *Vexin*, is based in Djibouti; and there are a few F1-Cs with the two-seat F1-Bs of 3/5 *Comtat Venaissin*, the OCU at Orange.

The Hellenic Air Force has two squadrons of Mirage F1-CGs, Nos. 334 *Thalos* and 342 *Sparta*, at Tanagra. Air Combat Command 14 Wing of the Spanish Air Force at Albacete AB has two squadrons of F1-CEs (known as C.14As). In addition, a single squadron of multirole Mirage F1-EEs (C.14Bs), with INS, nav/attack computer, and HUD, serves with No. 46 Wing of Canaries Command (MACAN) at Gando AB, Las Palmas. *(Data for Mirage F1-C.)*

Contractor: Avions Marcel Dassault-Breguet Aviation, France.

Power Plant: one SNECMA Atar 9K-50 afterburning turbojet; 15,873 lb st.

Dimensions: span over missiles 30 ft 6¾ in, length 49 ft 11¾ in, height 14 ft 9 in.

Weights: empty 16,314 lb, gross 35,715 lb.

Performance: max speed at height Mach 2.2, at S/L Mach 1.2; service ceiling 65,600 ft; combat air patrol endurance 2 h 15 min; attack radius, depending on flight profile and weapon load, 265–863 miles.

Accommodation: pilot only.

Armament: two 30 mm DEFA 553 guns in fuselage; seven hardpoints for practical external load of 8,818 lb: two Matra Super 530 air-to-air missiles, a Matra Magic or Sidewinder missile on each wingtip, and chaff/flare dispensers for interception mission; or fourteen 250 kg bombs, 30 anti-runway bombs, 144 rockets, an ARMAT antiradar missile, AM 39 Exocet antiship missile, or laser guided weapons and designator pod for ground attack missions.

MIRAGE 2000

The Mirage 2000 was selected on 18 December 1975 as the primary combat aircraft of the French Air Force from the mid-1980s. Under French Government contract, it was developed initially as an interceptor and air superiority fighter, powered by a single 19,850 lb st SNECMA M53-5 turbofan and with Thomson-CSF RDM multimode Doppler radar. The Mirage 2000 is equally suitable for reconnaissance, close support, and low altitude attack missions in areas to the rear of a battlefield. Orders for the French Air Force total 239 to date, excluding prototypes. Of these, 123 are air superiority Mirage 2000Cs, which, from airframe No. 38, have a more powerful M53-P2 engine and RDI pulse-Doppler radar. Deliveries began in 1983, and Mirage 2000Cs now equip Squadrons 1/2 *Cigognes*, 2/2 *Côte d'Or*, and 3/2 *Alsace* at Dijon. Squadron 2/5 *Ile de France* at Orange has begun exchanging its Mirage F1-Cs for Mirage 2000Cs with M53-P2 and RDI. The designation 2000DA *(Défense Aérienne)* is used in collective reference to Mirage 2000Cs and two-seat 2000Bs.

RDI radar has an operating range of 62 miles. Other equipment on the Mirage 2000C includes Sagem Uliss 52 INS, Thomson-CSF head-up and head-down displays, Thomson-CSF/ESD ECM jammers and chaff/flare dispenser, Matra Spirale passive countermeasures, and Thomson-CSF Serval radar warning receivers. Control is fly-by-wire. The standard detachable in-flight refuelling probe enabled two Mirage 2000s of 2 Wing to fly nonstop more than 3,400 miles from Djibouti to Dijon on 6 February 1988, in 6 h 40 min, each refuelled three times by a C-135FR tanker. Performance in air defence configuration includes the ability to attain a speed of Mach 2.26 at a height of 39,350 ft within 2½ min of leaving the runway. Minimum speed in stable flight is 115 mph.

Delivery to the Hellenic Air Force of 36 multirole Mirage 2000EGMs, plus four 2000BGM two-seaters, began in March of this year. *(Data for Mirage 2000C.)*

Contractor: Avions Marcel Dassault-Breguet Aviation, France.

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

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

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

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

Accommodation: pilot only.

Armament: two 30 mm DEFA 554 guns in fuselage; five hardpoints under fuselage and two under each wing for max external stores load of 13,890 lb. Two Matra Super 530 and two Matra Magic air-to-air missiles for interceptor mission. Ground attack weapons include eighteen 250 kg retarded bombs or BAP 100 antirunway bombs, 16 Durandal penetration bombs, two 1,000 kg laser guided bombs, six Belouga cluster bombs, two AS 30L or AM39 Exocet air-to-surface missiles, two ARMAT antiradar missiles, four packs of eighteen 68 mm rockets, two packs of 100 mm rockets, or a twin 30 mm gun pod.

Mirage F1-C, armed with Magic and Super 530 F missiles (SIRPA "AIR")

Mirage 2000C, with M53-P2 engine and RDI radar (SIRPA "AIR")

TORNADO ADV

Full-scale development of this air defence variant (ADV) of the Tornado IDS was authorised by the UK Government in March 1976. Airframe modifications involved primarily an increase in fuselage length forward of the front cockpit, to accommodate the longer radome of the GEC Avionics AI-24 Foxhunter multimode pulse-Doppler radar, and a small 'stretch' aft of the rear cockpit to allow four Sky Flash missiles to be carried in tandem pairs under the fuselage. Together with an increase in wingroot chord, these changes reduced drag, especially at supersonic speed, and allowed a 10 percent increase in internal fuel capacity. One of the two guns was deleted, and RAF ADVs use only the two inboard underwing pylons.

Tornado F. Mk 3, Royal Air Force (Flt Lt T. Paxton)

A total of 165 Tornado ADVs was ordered for the Royal Air Force, of which the first 18 were built as Tornado F. Mk 2s, with 16,920 lb st RB199 Mk 103 engines. Most of these are being kept in store until the early 1990s, when they will be upgraded to F. Mk 2A standard, equivalent to F. Mk 3 except that they will retain their Mk 103 engines. All subsequent ADVs have been built to F. Mk 3 standard, with uprated RB199 Mk 104 turbofans, a retractable in-flight refuelling probe, added head-down display for the pilot, a second INS, new IFF, automatic wing sweep, and other changes. The first F. Mk 3 flew on 20 November 1985, and deliveries to No. 229 OCU (No. 65 Squadron) began in July 1986. Other units currently operational include Nos. 5 and 29 Squadrons at Coningsby, with No. 11 at Leeming scheduled to follow this month. Seven squadrons will eventually fly ADVs, including the two currently equipped with Phantoms at Leuchars.

On 24 September 1987, a Tornado F. Mk 3 made the first unrefuelled transatlantic crossing by a British fighter, flying 2,530 miles from Goose Bay, Canada, to Warton, England, in 4 h 45 min. *(Data for F.Mk 3.)*

Contractor: Panavia Aircraft GmbH, a UK/German/Italian consortium.

Power Plant: two Turbo-Union RB199-34R Mk 104 afterburning turbofans; each approx 18,100 lb st.

Dimensions: span 45 ft 7½ in spread, 28 ft 2½ in swept; length 59 ft 3¾ in, height 19 ft 6¼ in.

Weights: empty 31,970 lb, gross 61,700 lb.

Performance: max speed at height (clean) Mach 2.2, service ceiling 70,000 ft, intercept radius more than 345 miles supersonic, 1,150 miles subsonic.

Accommodation: crew of two in tandem.

Armament: one 27 mm IWKA-Mauser gun in fuselage; four Sky Flash air-to-air missiles under fuselage, four AIM-9L Sidewinders under wings. Provision for AMRAAM and ASRAAM.

Attack Aircraft

ALPHA JET

In parallel with production of the advanced trainer/light attack version of the Alpha Jet for the French and other air forces, 175 close support variants (formerly Alpha Jet A) were ordered for the German Air Force. They were delivered in 1979–83 for JBG 41, 43, and 49 and now equip seven fighter-bomber squadrons. An update programme, due to be implemented in 1989–92, will include improved instruments, navigation, and air data sensors; a stall warning indicator; improved wheel/tyre/brake cooling; a three-axis damping system; and provision for two AIM-9L Sidewinder missiles and a jettisonable pod containing a 27 mm Mauser gun. This is expected to permit the Alpha Jets to operate effectively in anti-helicopter and point defence roles until the mid-1990s. Retrofit has replaced the original Larzac 04-C6 turbofans with 04-C20s.

Contractors: Avions Marcel Dassault-Breguet Aviation, France, and Dornier GmbH, Germany.
Power Plant: two SNECMA/Turbomeca Larzac 04-C20 turbofans; each 3,175 lb st.
Dimensions: span 29 ft 10¾ in, length 43 ft 5 in, height 13 ft 9 in.
Weights: empty 7,749 lb, gross 17,637 lb.
Performance: max speed Mach 0.86, service ceiling 48,000 ft, max mission radius, hi-lo-hi 668 miles.
Accommodation: crew of two in tandem.
Armament: hardpoint under fuselage and two under each wing for up to 5,510 lb of stores, including gun pods, bombs, rocket packs, cluster bombs, missiles, and fuel tanks.

CORSAIR II (A-7H and A-7P)

Sixty land-based A-7H Corsair IIs were delivered to the Hellenic Air Force in 1975–77 to replace F-84F Thunderstreaks for tactical support of maritime operations. Equipping No. 347 Squadron at Lárisa, and Nos. 340 and 345 at Soúda, they retain the folding wings and 15,000 lb st non-afterburning Allison TF41 (Spey) turbofan of the US Navy's A-7E on which they are based, but have no in-flight refuelling capability.

The 43 A-7Ps delivered to the Portuguese Air Force since 1981 are refurbished USN A-7As, with TF30-P-408 engine, a mix of A-7D and A-7E standard avionics, and ability to carry a Northrop ALQ-171(V) ECM pod. They equip Nos. 302 and 303 Squadrons for ground attack missions. *(Data for A-7P.)*

Contractor: Vought Corporation, USA.
Power Plant: one Pratt & Whitney TF30-P-408 non-afterburning turbofan; 13,400 lb st.
Dimensions: span 38 ft 9 in, length 46 ft 1½ in, height 16 ft 0¾ in.
Weights: empty 16,175 lb, gross 42,000 lb.
Performance: max speed at S/L 697 mph, service ceiling 41,000 ft, combat radius 675 miles.
Accommodation: pilot only.
Armament: two 20 mm Mk 12 guns; two pylons under fuselage and three under each wing for up to 15,000 lb of Sidewinder air-to-air missiles, Maverick and Shrike air-to-surface missiles, bombs, rocket packs, mines, 30 mm Mk 4 gun pods, ECM pods, sonobuoys, and flares.

DRAKEN (F-35)

In 1968–69 the Danish Defence Ministry ordered for the Royal Danish Air Force a total of 46 Saab 35XDs, comprising 20 fighter-bombers which it designated F-35, 20 RF-35 reconnaissance fighters, and 6 TF-35 fighter trainers. Externally, the 35XD was similar to the Swedish Air Force's J 35F supersonic all-weather fighter, but with greatly increased attack capability. Its then-unique double-delta configuration and afterburning Avon turbojet enabled it to take off in 4,030 ft carrying nine 1,000 lb bombs. In Swedish Air Force service, Drakens landed and took off regularly on auxiliary airstrips formed by sections of the country's main roads. An update programme in the first half of the 1980s added a Lear Siegler nav/attack computer, Singer Kearfott INS, Ferranti laser ranger, improved gunsight, and head-up display, giving the Danish Drakens an attack capability equal to that of the F-16A. The F-35s equip No. 725 Squadron at Karup, in a dual air defence/attack role.

Contractor: Saab-Scania Aktiebolag, Sweden.
Power Plant: one Volvo Flygmotor (Rolls-Royce) RM6C (Avon 300-series) afterburning turbojet; 17,650 lb st.
Dimensions: span 30 ft 10 in, length 50 ft 4 in, height 12 ft 9 in.
Weight: gross 33,070 lb.
Performance: max speed at 36,000 ft Mach 2, service ceiling 65,000 ft, combat radius (hi-lo-hi) with two 1,000 lb bombs and two drop tanks 623 miles.
Accommodation: pilot only.
Armament: nine hardpoints under wings and fuselage for four Sidewinder air-to-air missiles, or up to 9,000 lb of bombs, rockets, and fuel tanks.

Alpha Jet, German Air Force

A-7H Corsair II, Hellenic Air Force

F-35 Draken, Royal Danish Air Force

G91R, Portuguese Air Force

G91R and G91Y

Having won an internationally contested NATO design competition, it was expected that the Fiat (now Aeritalia) G91 would become the standardised light strike fighter of NATO air forces. In fact, it was ordered only by Italy and Germany, with assembly lines in both countries. Except for a small pre-series batch, all single-seaters built up to May 1966 were G91Rs, with a single 5,000 lb st Bristol Siddeley Orpheus 803 turbojet, and three Vinten 70 mm cameras in a glass panelled nosecone to give them a dual strike/reconnaissance capability. The Italian Air Force continues to operate two Squadrons (Nos. 14 and 103) of G91R/1 series aircraft. Many of the G91R/3s and 4s built for the German Air Force, with improved avionics and two 30 mm guns instead of the four 0.50 in guns of the G91R/1s, were transferred to the Portuguese Air Force between 1965 and 1980. The R/3s now equip attack Squadron 301 at Montijo, with limited interception capability since they were retrofitted with a Saab RGS 2 sighting system and Sidewinder air-to-air missiles. The R/4s are operated from Lajes by attack Squadron 303.

A version known as the G91Y, with the larger wing of the G91T trainer, and two 4,080 lb st General Electric J85 afterburning turbojets replacing the single Orpheus, flew for the first time on 27 December 1966. Over the next ten years, 20 pre-series and 45 production G91Ys were built for the Italian Air Force. They currently equip Squadrons 101 and 13, the latter with a secondary anti-shipping role from Brindisi. All Italian G91s will be replaced eventually by the AMX aircraft now being developed and produced as a joint Italian/Brazilian programme. *(Data for G91R/3.)*

Contractors: Fiat SpA, Italy, and ARGE-91 consortium, Germany.
Power Plant: one Fiat-built Orpheus 803 non-afterburning turbojet; 5,000 lb st.
Dimensions: span 28 ft 1 in, length 33 ft 9½ in, height 13 ft 1½ in.
Weights: empty 8,130 lb, gross 12,125 lb.
Performance: max speed 650 mph, service ceiling 40,000 ft, combat radius 196 miles.
Accommodation: pilot only.
Armament: two 30 mm DEFA 552 guns in fuselage; four underwing pylons for up to 1,000 lb of bombs, rocket packs, or Sidewinder missiles.

HARRIER GR. Mk 3

The Harrier was the world's first operational fixed-wing V/STOL combat aircraft, owing its success to use of a single vectored-thrust turbofan for both lift and forward thrust. The first prototype flew on 31 August 1966. Deliveries of production Harriers to the Royal Air Force's No. 233 OCU at Wittering in the UK began in April 1969, and No. 1 Squadron formed at the same base three months later. A total of 118 production aircraft were built for the RAF, of which 14 took part in the Falklands Campaign in 1982, with considerable success. Four of them were flown from the UK to Ascension Island, in mid-Atlantic, using in-flight refuelling from Victor tankers for the nonstop 4,000 mile flight of 9 h 15 min. They then flew directly to land on the carrier HMS *Hermes*, making a total of 8,000 miles into a combat zone in some 18 flying hours, with one intermediate stop. Others have since crossed the Atlantic for deployment to Belize in Central America for operational duty.

Harriers in current service with No. 1 squadron at Wittering, and with Nos. 3 and 4 squadrons of RAF Germany at Gutersloh, are to GR. Mk 3 standard with a Pegasus 103 engine. Equipment includes a Ferranti FE 541 inertial navigation and attack system, Cossor IFF, Smiths electronic head-up display, Marconi radar warning re-

Harrier GR. Mk 3, Royal Air Force

ceiver, a weapon aiming computer, and a Ferranti Type 106 laser ranger and marked target seeker in a lengthened nosecone.
Contractor: British Aerospace plc, UK.
Power Plant: one Rolls-Royce Pegasus Mk 103 vectored-thrust turbofan; 21,500 lb st.
Dimensions: span 25 ft 3 in, length 46 ft 10 in, height 11 ft 11 in.
Weights: empty 13,535 lb, gross 25,200 lb.
Performance: max speed in a dive at height Mach 1.3, in level flight at S/L 730 mph; service ceiling 51,200 ft; range with 4,400 lb external load, hi-lo-hi 414 miles, lo-lo-lo 230 miles.
Accommodation: pilot only.
Armament: typical load comprises two 30 mm Aden gun pods under fuselage, combat tank or 1,000 lb bomb on each inboard underwing hardpoint, Hunting BL755 cluster bomb on each outboard pylon. Some aircraft carry Sidewinder air-to-air missiles and a Tracor ALE-40 chaff/flare dispenser.

HARRIER GR. Mk 5

To meet US Marine Corps requirements for an improved version of the Harrier, which they had operated under the designations AV-8A/C, McDonnell Douglas and British Aerospace developed jointly the AV-8B Harrier II. This retains the basic Harrier/AV-8A fuselage, but with a raised cockpit similar to that of the Royal Navy's Sea Harrier, and with lift improvement devices under the fuselage. The all-new wing has a supercritical section and is made largely of carbonfibre and other composites. Compared with the wing of the original Harrier/AV-8A, it has greater span and area, and 10° less sweep. To give the Marines the 'bomb truck' they wanted, there are six underwing pylons, and the AV-8B can lift an external load of 9,200 lb at its max STOL weight. Equipment includes a Hughes Angle Rate Bombing Set with TV/laser target seeker/tracker, working in conjunction with a mission computer.

Two AV-8As were modified as YAV-8B aerodynamic prototypes. The first of four genuine full-scale development AV-8Bs flew on 5 November 1981, by which time it had already been decided to put the aircraft into production for the Marines and the Royal Air Force. McDonnell Douglas manufactures all wings; sections of the fuselage, and other components, are produced by one or other of the British and US contractors, with an assembly line in each country. Delivery of the 94 Harriers ordered to date for the RAF began in July 1987, the first unit being No. 233 OCU at Wittering. By 1991, Nos. 1, 3, and 4 Squadrons in the UK and Germany should all be re-equipped with Harrier IIs. The last 34 of these RAF aircraft will be built to 'night attack' standard, probably with the designation GR. Mk 7. Their equipment will include GEC Avionics FLIR, new Smiths head-up and head-down displays, and cockpits compatible with night vision goggles. When they have been completed, the first 41 RAF aircraft, known initially as Harrier GR. Mk 5s, will be retrofitted to the same standard, followed by Nos. 42-60 (which meanwhile will have been completed to an interim specification). *(Data for Harrier GR. Mk 5.)*
Contractors: British Aerospace plc, UK, and McDonnell Douglas Corporation, USA.
Power Plant: one Rolls-Royce Pegasus Mk 105 vectored-thrust turbofan; 21,750 lb st.
Dimensions: span 30 ft 4 in, length 46 ft 4 in, height 11 ft 7¾ in.
Weights: empty 13,984 lb; gross for VTO 18,950 lb, for STO 31,000 lb.
Performance: max speed at height Mach 0.91, at S/L 661 mph; STOL T-O run 1,330 ft; combat radius (hi-lo-hi) with 4,000 lb weapon load 553 miles.
Accommodation: pilot only.
Armament: two 25 mm gun pods under fuselage; four hardpoints under each wing for Sidewinder air-to-air missiles, air-to-surface missiles, 12 cluster bombs, 10 Paveway laser guided bombs, eight fire bombs, 10 rocket packs, two additional gun pods, sixteen 500 lb bombs, or fuel tanks. Marconi Zeus internal ECM. Provision for nose mounted IR reconnaissance sensor.

JAGUAR

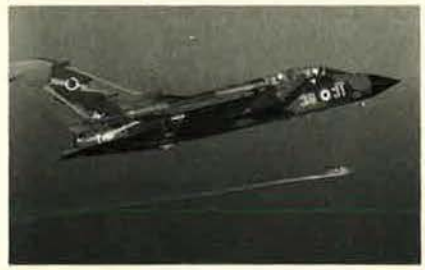
Four versions of the Jaguar were developed and manufactured by the Anglo-French SEPECAT Consortium (British Aerospace and Dassault-Breguet) for the French and British air forces. The Royal Air Force took delivery of 165 single-seat Jaguar GR. Mk 1s and 38 two-seat Jaguar T. Mk 2s, which were delivered between 1973 and 1982 in parallel with 160 single-seat Jaguar As and 40 two-seat Jaguar Es for the French Air Force. These aircraft were all completed with 7,305 lb st Adour Mk 102 afterburning turbofans. Between 1978 and 1984, RAF Jaguars were retrofitted with 7,900 lb st Adour Mk 104s. Most have also had their original NAVWASS nav/attack equipment replaced by the more compact and capable Ferranti FIN 1064 INS, leading to a change of designation to GR. Mk 1A. Many Jaguar squadrons have converted to Tornados, leaving only Nos. 6 and 54 at Coltishall in the UK in the tactical support and ground attack roles. The French Air Force has a total of seven squadrons of Jaguar

Harrier GR. Mk 5, Royal Air Force

Jaguar As, French Air Force (SIRPA "AIR")

Mirage 5F, French Air Force (SIRPA "AIR")

Mirage 2000N, French Air Force (Paul Jackson)



Tornado IDS, Italian Air Force

As in No. 7 Wing at St Dizier, and No. 11 Wing at Toul, with Jaguar Es in Squadron 2/7, the OCU. No. 7 Wing is assigned to what are called 'pre-strategic' missions, carrying AN 52 nuclear bombs. No. 11 Wing is intended primarily for close support duties in Europe and for rapid deployment overseas. Jaguar As have seen action in Mauritania, Chad, and Lebanon, and have crossed the Atlantic with the aid of in-flight refuelling to participate in Red Flag training at Nellis AFB, Nev. *(Data for Jaguar A.)*
Contractor: SEPECAT Consortium, France and UK.
Power Plant: two Rolls-Royce Turbomeca Adour Mk 102 afterburning turbofans; each 7,305 lb st.
Dimensions: span 28 ft 6 in, length 55 ft 2½ in, height 15 ft 9½ in.
Weights: empty 15,432 lb, gross 34,612 lb.
Performance: max speed at height Mach 1.3, at S/L Mach 1.1; service ceiling 45,000 ft, typical attack radius, hi-lo-hi 875 miles, lo-lo-lo 570 miles.
Accommodation: pilot only.
Armament: two 30 mm DEFA 553 guns in fuselage; centreline pylon and two under each wing for 10,000 lb of stores, including AN 52 nuclear bomb, eight 1,000 lb bombs, laser guided and cluster bombs, anti-runway weapons, rocket packs, and fuel tanks.

MIRAGE 5

The Mirage 5F entered service with the French Air Force in April 1972 and is currently operational with Squadrons 2/13 *Alpes* and 3/13 *Auvergne*. Its basic airframe, power plant, and gross weight are identical with those of the Mirage IIIE. By simplifying the avionics and other systems, Dassault was able to increase the internal fuel capacity by 132 gallons, and the external stores load to 8,820 lb on seven wing and fuselage hardpoints. Combat radius with a 2,000 lb bomb load is 808 miles hi-lo-hi, or 404 miles lo-lo-lo.

MIRAGE 2000N

This tandem two-seat attack aircraft is entering service with Squadron 1/4 *Dauphiné*, at Luxeuil, and will eventually replace both Mirage IIIE squadrons of No. 4 Wing and the three Jaguar squadrons of No. 7 Wing that have been responsible for 'pre-strategic' missions carrying AN 52 tactical nuclear bombs. By comparison with the Mirage 2000C, the 2000N has a strengthened airframe for flight at a typical 690 mph at 200 ft above the terrain. Its primary weapon, like the Mirage IV-P strategic bomber, is the new ASMP medium-range air-to-surface nuclear missile. Equipment includes ESD Antilope V terrain following radar, two Sagem inertial platforms, improved TRT radio altimeter, Thomson-CSF colour CRT, an Omera vertical camera, special ECM, and two Magic air-to-air missiles for self-defence. Specification is generally similar to that of the Mirage 2000C, except for a length of 47 ft 9 in.

TORNADO IDS

The capabilities of this tri-nation interdictor/strike aircraft were demonstrated when RAF Tornados crossed the Atlantic, with the aid of in-flight refuelling by Victor tankers, to win major trophies at USAF's strategic and tactical bombing competitions in 1984 and 1985. Operational since June 1982, Tornado GR. Mk 1s equip Nos. 27 and 617 Squadrons of RAF Strike Command, at Marham in the UK, Nos. 15, 16, and 20 with RAF Germany at Laarbruch, and Nos. 9, 14, 17, and 31, also with RAF Germany at Brüggen. Their equipment includes a Texas Instruments multimode ground mapping radar, Ferranti FIN 1010 digital INS, Decca Doppler, HUD, and laser rangefinder and marked target seeker in an undernose pod. Weapons include nuclear bombs and anti-airfield JP233s.

German Air Force Tornados equip eight squadrons, two each with JBG 31, 32, 33, and 34, with ability to carry MW-1 weapon dispensers. The IDS version also equips Nos. 154, 155, and 156 Squadrons of the Italian Air Force. Current development includes integration of HARM, ALARM, Kormoran and Maverick missiles, and a night vision FLIR system into the IDS, of which more than 700 have been ordered to date by five air forces and the German Navy.
Contractor: Panavia Aircraft GmbH (BAe, UK; MBB, Germany; Aeritalia, Italy).
Power Plant: two Turbo-Union RB199-34R Mk 101 afterburning turbofans; each more than 16,000 lb st.
Dimensions: as Tornado ADV, except length 54 ft 10¼ in.
Weights: empty 31,065 lb, gross 60,000 lb.
Performance: max speed at height Mach 2.2 clean, Mach 0.92 with external stores; radius of action, hi-lo-hi 863 miles.
Accommodation: crew of two in tandem.
Armament: two 27 mm IWKA-Mauser guns in fuselage; seven fuselage and wing hardpoints for 19,840 lb of external stores, including air-to-air, air-to-surface, and anti-radiation missiles; cluster bombs; napalm; 'smart', retarded, and conventional bombs; rocket packs; flare bombs; jamming/deception and chaff/flare ECM pods; and fuel tanks.

REIMS-CESSNA FTB 337 G

The Portuguese Air Force operates 32 of these militarised versions of Cessna's 'push and pull' twin-engined light aircraft, for counter-insurgency, training, and utility duties. They embody STOL modifications in the form of high-lift flaps, and can carry gun pods, rocket launchers, or bombs on underwing pylons.
Contractor: Reims Aviation SA, France.
Power Plant: two Continental TSIO-360-D turbocharged piston engines; each 225 hp.
Dimensions: span 39 ft 8½ in, length 29 ft 9 in, height 9 ft 4 in.
Weights: empty 3,206 lb, gross 4,630 lb.
Performance: max speed 236 mph, service ceiling 23,950 ft, range 1,325 miles.
Accommodation: pilot and up to five passengers, two stretchers, or cargo on non-combat missions.

Reconnaissance and Special Mission Aircraft

AVIOCAR (C-212)

Two C-212 Aviocars operated by the Portuguese Air Force have been modified for electronic intelligence/ ECM duties. They now carry equipment for automatic signal interception, classification, and identification in dense signal environments, data enabling a map to be drawn plotting the position and characteristics of hostile radars. Jamming emitters are also carried. No. 408 Flight of the Spanish Air Force has two C-212s (designated TR.12D), with blunt radome and fin-tip pod, for ECM duties. Both the Spanish and Portuguese Air Forces also have a few Aviocars fitted with Wild RC-10 cameras for survey work. *(Data generally as for C-212 transport.)*

ECM version of C-212 Aviocar, Portuguese Air Force (Ivo Sturzenegger)

C-135FR of French Air Force preparing to refuel a Mirage IV-P (SIRPA "AIR")

BRONCO (OV-10B/Z)

Rockwell OV-10B/Z twin-turboprop target towing aircraft are operated by a commercial company on behalf of the German Air Force. They are generally similar to the OV-10As flown by USAF, but have a 2,950 lb st General Electric J85-GE-4 auxiliary turbojet added above the central nacelle.

BOEING C-135FR

Like the KC-135 Stratotankers of SAC, the eleven C-135FRs of the French Air Force have had their lower wing skin renewed to make possible another 25,000 flying hours. This justified re-engining them with CFM56 turbofans, and the last updated aircraft rejoined the three squadrons of the 93rd flight refuelling Wing in April of this year. All C-135FRs are equipped for both flying-boom and probe-and-drogue refuelling, enabling them to service all types of combat aircraft flown by the French Air Force, over a range of nearly 3,400 miles. In their other role, as transports, each can carry 75 fully equipped troops on sidewall seating, or 77,000 lb of freight over a range of 2,235 miles, or 44 stretchers and 54 other persons in a medevac mission.

Contractor: Boeing Military Airplanes, USA.
Power Plant: four CFM56-2 turbofans; each 22,000 lb st.
Dimensions: span 130 ft 10 in, length 136 ft 3 in, height 42 ft 0 in.
Weights: empty 110,230 lb, gross 319,665 lb.
Performance: max speed 560 mph, service ceiling 50,000 ft.
Accommodation: crew of four.

CANBERRA

Of more than 780 Canberras built to fly with bomber, intruder, and photographic reconnaissance squadrons of the Royal Air Force, only a handful remain in service in the UK. A few Canberra PR. Mk 9s of No. 1 PRU, with cameras in their belly, form the only dedicated strategic photo reconnaissance unit in the RAF in 1988. Examples of several other variants provide target facilities under the banner of No. 100 Squadron, with TT. Mk 18s towing targets for live fire, and others simulating low-level, high-speed attackers against ships or land targets. A few bulbous-nosed Canberra T. Mk 17s of 360 Squadron provide specialised electronic countermeasures training by transmitting radio interference, and using jammers and wingtip chaff dispensers. *(Data for Canberra PR. Mk 9.)*

Contractor: English Electric Co Ltd/Short Brothers and Harland Ltd, UK.

Canberra PR. Mk 9, Royal Air Force

CL-215, Spanish Air Force

RF-35 Draken, Royal Danish Air Force (Martin Fricke)

Power Plant: two Rolls-Royce Avon 206 turbojets; each 10,050 lb st.
Dimensions: span 69 ft 5 in, length 66 ft 8 in, height 15 ft 7 in.
Weight: gross 57,500 lb.
Performance: max speed at height 560 mph, service ceiling 70,000 ft, max range 4,000 miles.
Accommodation: crew of two.
Armament: none.

CHALLENGER (EW VERSIONS)

Seven Canadair Challenger 600s are employed on electronic support and training missions by No. 414 Squadron of the Canadian Forces. An eighth was delivered to the Aeronautical Engineering and Test Establishment at Cold Lake, Alberta, as a testbed for developing such future military applications as maritime reconnaissance. Canadian Forces designation is CC-144A.

Contractor: Canadair Inc, Canada.
Power Plant: two Textron Lycoming ALF 502L turbofans; each 7,500 lb st.
Dimensions: span 61 ft 10 in, length 68 ft 5 in, height 20 ft 8 in.
Weights: empty approx 23,300 lb, gross 41,100 lb.
Performance: max cruising speed 529 mph, service ceiling 41,000 ft, range 3,220 miles.
Accommodation: crew of four and up to 12 passengers in transport role; wide variety of electronic warfare equipment in 414 Squadron aircraft.

CL-215

Some air forces are responsible for civilian tasks such as firefighting. The Hellenic Air Force has taken delivery of 15 CL-215 amphibian water-bombers for this purpose, and the Spanish Air Force has received 20. All are capable of other tasks, and eight of the Spanish aircraft are equipped for search and rescue, and coastal patrol. Each air force has lost aircraft during firefighting operations, but results have been encouraging. Single CL-215s have frequently made more than 100 drops, totalling more than 141,230 gallons, in one day. Full loads of water have been scooped up from the Mediterranean by the amphibians in wave heights up to 6 ft.

Contractor: Canadair Inc, Canada.
Power Plant: two Pratt & Whitney R-2800-CA3 piston engines; each 2,100 hp.
Dimensions: span 93 ft 10 in, length 65 ft 0¼ in, height 29 ft 5½ in.
Weights: empty 28,082 lb, gross 43,500 lb.
Performance: max cruising speed 181 mph, max range 1,301 miles.
Accommodation: crew of two; payload of 12,000 lb for water-bomber, 8,518 lb for utility version. Crew of six in patrol and SAR versions, with provision for additional seats and stretchers.

DHC-8 DASH 8M (CT-142)

The Canadian Dept. of National Defence operates four Dash 8M-100s as CT-142 navigation trainers with an extended nose. Basically similar to the standard Dash 8 transport, these aircraft have long-range fuel tanks, rough-field landing gear, high-strength floors, and mission-related avionics.

Contractor: Boeing of Canada Ltd (de Havilland Division), Canada.
Power Plant: two Pratt & Whitney Canada PW120A turboprops; each 2,000 shp.
Dimensions: span 85 ft 0 in, length 73 ft 0 in, height 24 ft 7 in.
Weights: empty 22,000 lb, gross 34,700 lb.
Performance: max speed 310 mph, service ceiling 25,000 ft, range 575 miles.
Accommodation: crew of two; four students and two instructor navigators.

DRAKEN (RF-35)

No. 729 Squadron of the Royal Danish Air Force is equipped with Saab S 35XD Drakens, which operate from Karup under the designation RF-35. Equipped initially with cameras for daylight reconnaissance only, these aircraft have been able to operate round the clock since 1975 when Red Baron infra-red pods were bought from Sweden. *(Data as for F-35 Draken.)*

E-3A SENTRY

NATO operates 18 airborne warning and control system (AWACS) aircraft equipped to the original standard of USAF E-3A Sentry Nos. 27 to 35. Much of the avionics was produced in West Germany, with Dornier as systems integrator. NATO funded a third HF radio, to cover the maritime environment; a new data analysis and programming group; underwing hardpoints on which optional ECM pods could be attached; and a radio teletype to link the aircraft with NATO maritime forces and commands. The 18 aircraft were delivered between January 1982 and April 1985 and are the only operational military aircraft to bear the insignia of Luxembourg on their fin. They have Luxembourg/US registrations, comprising their US military serial number prefixed by LX-N. This

satisfies international legal requirements, as NATO has no national identity. Main operating base for the NATO E-3As is at Geilenkirchen in Germany. Forward operating bases are at Oerland, Norway; Konya, Turkey; Preveza, Greece; and Trapani, Italy.

Seven E-3s have been ordered for the Royal Air Force and four for the French Air Force, all with CFM56 turbofans. *(Data for NATO E-3A.)*

Contractor: Boeing Aerospace, USA.
Power Plant: four Pratt & Whitney TF33-PW-100/100A turbofans; each 21,000 lb st.
Dimensions: span 145 ft 9 in, length 152 ft 11 in, height 41 ft 9 in.
Weight: gross 325,000 lb.
Performance: max speed 530 mph, service ceiling over 29,000 ft, max unrefuelled endurance more than 11 hours.
Accommodation: basic crew of 20, including 16 AWACS specialists.
Armament: none.

F-16A(R) FIGHTING FALCON

The aircraft of No. 306 Squadron of the Royal Netherlands Air Force are assigned to reconnaissance duties, with the designation F-16A(R). They carry on their centreline pylon an Oude Delft Orpheus pod of the type fitted to the RF-104G Starfighters that they replaced.

G222GE and G222RM

The Italian Air Force has two G222GEs for electronic warfare duties with the 71st Squadron *(Guerra Elettronica)* at Pratica di Mare. Carrying a pilot, co-pilot, and up to ten systems operators, this version has a modified cabin fitted with racks and consoles for detection, signal processing, and data recording equipment, with an electrical system providing up to 40kW of power for its operation. It is externally distinguishable by a small thimble radome beneath the nose, and a larger 'doughnut' radome at the tip of the tail fin. Four G222RMs are used by the Italian Air Force for in-flight calibration of ground radio nav/com facilities. *(Data as for G222 transport.)*

HANSA JET

No. 3 Squadron of JBG 32 Tornado Wing operates seven distinctive sweptforward wing Hansa Jets for ECM training. Features include a cylindrical nose radome and a boat shape fairing under the rear fuselage.

Contractor: Messerschmitt-Bölkow-Blohm GmbH, Germany.
Power Plant: two General Electric CJ610-9 turbojets; each 3,100 lb st.
Dimensions: span 47 ft 6 in, length (excl radome) 54 ft 6 in, height 16 ft 2 in.
Weight: gross 20,280 lb.
Performance: max speed at 25,000 ft 513 mph, service ceiling 40,000 ft, range 1,472 miles.

HERCULES C. Mk 1 ELINT

An accompanying photograph shows a Royal Air Force Hercules C. Mk 1P from RAF Lyneham that has been fitted with an elint/sigint pod under each wingtip. The installation has been seen on various Mk 1 aircraft, but no details are available.

JAGUAR GR. Mk 1A (RECONNAISSANCE)

The Jaguar GR. Mk 1As of No. 41 Squadron of RAF Strike Command in the UK, and of No. 2 Squadron of RAF Germany, are assigned to tactical reconnaissance missions. Standard equipment is a large centreline pod containing cameras and a British Aerospace 401 infrared linescan system. No. 2 Squadron will begin converting to Tornado GR. Mk 1s in January 1989.

MB-339RM

Another type of aircraft used by the Italian Air Force for in-flight calibration of ground radio communications and navigation aids is the MB-339RM *(radiomisure)*, based on that Air Force's MB-339A jet trainer. Four MB-339RMs are flown by No. 8 Squadron of 14 Wing at Pratica di Mare. *(Data for MB-339A.)*

Contractor: Aermacchi SpA.
Power Plant: one Rolls-Royce Viper Mk 632-43 turbojet; 4,000 lb st.
Dimensions: span over tiptanks 35 ft 7½ in, length 36 ft 0 in, height 13 ft 1¼ in.
Weights: empty 6,889 lb, gross 13,000 lb.
Performance: max speed at 30,000 ft 508 mph, service ceiling 48,000 ft, range, clean, 1,094 miles.
Accommodation: crew of two in tandem.

MIRAGE IV-A (RECONNAISSANCE)

Twelve of the original Mirage IV-A strategic bombers of the French Air Force were modified to carry a 2,200 lb reconnaissance pod for long-range surveillance missions. Four of them are based currently with the Mirage IV-P OCU at Bordeaux.

NATO E-3A Sentry (S.G. Richards)

G222GE, Italian Air Force

MIRAGE F1-CR-200

All three tactical reconnaissance squadrons of the French Air Force (1/33 *Belfort*, 2/33 *Savoie*, and 3/33 *Moselle*) are now equipped with Mirage F1-CRs. Full designation of these aircraft is F1-CR-200, implying that they have a fixed in-flight refuelling probe. They differ from the basic F1-C fighter in being fitted with the IVMR model of Cyrano radar (with additional ground mapping, contour mapping, air-to-ground ranging, and blind let-down modes), a Sagem Uliss 47 inertial platform, and ESD 182 navigation computer. An SAT SCM2400 Super Cyclope infrared linescan reconnaissance system replaces the starboard gun, and an undernose bay houses either a 75 mm Omera 40 panoramic camera or a 150 mm Omera 33 vertical camera. F1-CR-200s have a secondary ground attack role and can also carry a centreline podded sensor in the form of a Thomson Raphaël TH SLAR or a Thomson-CSF Astac electronic reconnaissance system for detecting ground radars. ECM pods can be carried underwing, together with two Magic air-to-air missiles for self-defence. *(Data as for Mirage F1-C, except length 50 ft 2½ in.)*

MYSTÈRE-FALCON 20

The Canadian, French, and Norwegian Air Forces all use small numbers of Mystère-Falcon twin-jet transports modified for ECM training and combat area duties. The Norwegian aircraft, and the EW-117 Falcons of No. 414 Squadron in Canada, are equipped for radar and communications intelligence and jamming duties. The Mystère-Falcons of the French Centre de Prédiction et d'Instruction Radar 339 at Luxeuil, are fitted with the combat radar and navigation systems of various Mirage types for training interceptor, strike, and reconnaissance pilots.

Contractor: Avions Marcel Dassault-Breguet Aviation, France.
Power Plant: two General Electric CF700-2D2 turbofans; each 4,500 lb st.
Dimensions: span 53 ft 6 in, length 56 ft 3 in, height 17 ft 6¾ in.
Weights: empty 16,600 lb, gross 28,660 lb.
Performance: max cruising speed 490 mph at 40,000 ft, service ceiling 42,000 ft, range 2,180 miles.
Accommodation: flight crew of two; up to ten other persons or 3,750 lb of equipment or cargo according to role.

Hercules C. Mk 1 elint version, Royal Air Force (Paul Jackson)

Mirage F1-CR-200, carrying Magic missiles and countermeasures pods, being flight refuelled (SIRPA "AIR")

Nimrod R. Mk 1, Royal Air Force (Ivo Sturzenegger)

MIRAGE 5BR

The Belgian Air Force's tactical reconnaissance unit is No. 42 Squadron, equipped with licence-built Mirage 5BR aircraft. Except for their camera-carrying nose, these are similar to the Mirage 5 fighter.

NIMROD R. Mk 1 and 1P

Three Nimrod R. Mk 1s, delivered to No. 51 Squadron of RAF Strike Command, at RAF Wyton, are specially equipped for electronic intelligence missions. They can be identified by the short tailcone that replaces the MR. Mk 2's MAD boom, and by modifications to the port wing leading-edge pod. When an in-flight refuelling probe is fitted, the designation is changed to Mk 1P. *(Data generally as for MR. Mk 2.)*

PD-808ECM and RM

Together with its PD-808VIP and TA light jet transports, the Italian Air Force acquired six PD-808ECMs for electronic warfare training, and four PD-808RMs for navaid calibration and other duties, in the 1970s. Except for their specialised role equipment, they are similar to the PD-808TA for which data follow:

Contractor: Rinaldo Piaggio SpA, Italy.
Power Plant: two Rolls-Royce Viper Mk 526 turbojets; each 3,360 lb st.
Dimensions: span over tiptanks 43 ft 3½ in, length 42 ft 2 in, height 15 ft 9 in.

Weights: empty 10,650 lb, gross 18,000 lb.
Performance: max speed at 19,500 ft 529 mph, service ceiling 45,000 ft, range 1,322 miles.
Accommodation: flight crew of two; up to nine other persons or 1,600 lb of equipment according to role.

RF-4 PHANTOM II

Four of America's European allies continue to operate reconnaissance versions of the Phantom. The German Air Force has four squadrons of RF-4Es in AG 51 and 52 Wings at Bremgarten and Leck, respectively. The Hellenic Air Force operates a few similar aircraft alongside the F-4Es of 110 Wing, and the Turkish Air Force also has RF-4Es in No. 113 Squadron. The few RF-4Cs (CR.12s) serving in 12 Wing of the Spanish Air Force may join the Turkish Es when the Wing re-equips with Hornets. *(Data generally as for F-4 Phantom II.)*

RF-5A

No. 184 Squadron of the Turkish Air Force is the largest NATO operator of reconnaissance RF-5As, with up to 20 aircraft at Diyarbakir. The Hellenic Air Force is believed to have eight in No. 349 Squadron. Spain has 13 (designated AR.9) alongside the F-5As of Nos. 211 and 212 Squadrons in 21 Wing. Original standard equipment of the RF-5A comprised four KS-92 cameras in a modified nosecone. *(Data generally as for F-5A.)*

RF-104G STARFIGHTER

Based at Villafranca-Verona, the 3rd Reconnaissance Fighter Wing of the Italian Air Force comprises No. 28 Squadron with RF-104Gs and No. 132 Squadron with F-104Gs, all equipped to carry Oude Delft Orpheus pods bought from the Netherlands since 1977.

SHACKLETON AEW. Mk 2

The few surviving Shackletons of the RAF's No. 8 Squadron, based at Lossiemouth in Scotland, must continue to provide vital airborne early warning coverage for UK airspace until replaced by E-3A Sentrys in the early 1990s. The first of 12 Shackleton AEW. Mk 2s flew on 30 September 1971. All were conversions of MR. Mk 2 maritime reconnaissance aircraft, which were themselves developments of the wartime Lancaster/Lincoln bomber line. Despite their longevity, they have given good service, with all their former armament replaced by a variety of new equipment. This includes AN/APS-20(F) search radar (transferred from retired Royal Navy Gannets) in an underbelly radome, Orange Harvest wideband passive ECM, APX7 IFF, Doppler nav, and an airborne moving target indicator.
Contractor: A.V. Roe & Co Ltd, UK.
Power Plant: four Rolls-Royce Griffon 57A piston engines; each 2,455 hp.
Dimensions: span 119 ft 10 in, length 92 ft 6 in, height 16 ft 9 in.
Weight: gross 98,000 lb.
Performance: max speed 260 mph, endurance up to 10 hours.
Accommodation: crew of ten.
Armament: none.

TORNADO (RECONNAISSANCE)

Scheduled to form in January, the RAF's No. 2 Squadron will be the first to equip with a camera-less reconnaissance version of the Tornado IDS. Identifiable by a small underbelly blister fairing, to the rear of the laser rangefinder pod, this aircraft will be equipped with a BAe sideways looking IR system, BAe Linescan 4000 IR surveillance system, and Computing Devices signal processing and video recording system.

The German Air Force will receive 35 specially developed Tornado ECR (electronic combat and reconnaissance) versions of the Tornado IDS, to equip JBG 32 and JBG 38 in 1989–91. Retaining its air-to-surface role, except for removal of its guns, the ECR will be fitted with a ground emitter locator, a Honeywell/Sondertechnik IR linescan, FLIR, onboard systems for processing, storing, and transmitting reconnaissance data, and advanced tactical displays for the pilot and weapons officer. It will normally be configured to carry two HARM anti-radiation missiles, two Sidewinders, an active ECM pod, chaff/flare dispenser pod, and two underwing 396 gallon fuel tanks. A Mk 105 version of the RB199 engine will provide about 10 percent more thrust than the IDS's Mk 103. *(Data generally as for Tornado IDS.)*

RF-4E, West German Air Force

Shackleton AEW. Mk 2, Royal Air Force (Paul Jackson)

TriStar tanker, Royal Air Force (Paul Jackson)

VC10 K. Mk 2, Royal Air Force

Victor K. Mk 2 of the Royal Air Force refuelling a Tornado GR. Mk 1

TRANSALL ASTARTÉ and GABRIEL

Four of the second-series Transall C-160s built for the French Air Force are equipped as communications relay aircraft on behalf of the nation's nuclear deterrent forces. Designated Astarté *(Avion STAtion Relais de Transmissions Exceptionelles)*, and operated under the Ramses *(Réseau Amont Maillé Stratégique Et de Survie)* programme, each is equipped with a Collins VLF system of the kind fitted to US Navy Tacamo aircraft. To ensure maximum survivability and effectiveness in a nuclear combat environment, they are able to operate as in-flight refuelling tanker/receivers.

Two other Transalls are equipped as elint/ESM aircraft, and are designated Gabriel. Also equipped as tanker/receivers, they have a row of large blade antennae above the forward fuselage, a retractable ventral Thomson-CSF radome, and slender wingtip pods with UHF/DF blade antennae. *(Data as for Transall C-160 transport.)*

TRISTAR TANKERS

To meet a growing Royal Air Force requirement for in-flight refuelling tanker support, Marshall of Cambridge is converting to this role six Lockheed L-1011-500 TriStar airliners purchased from British Airways and three more purchased from Pan Am. The first four aircraft are to TriStar K. Mk 1 tanker/transport standard, with an increased max T-O weight of 540,000 lb. Each has twin Flight Refuelling Mk 17T hose drums, and seven tanks in the baggage compartments, raising total fuel capacity to 300,000 lb. Features include a refuelling receiver probe over the flight deck, a crew rest area for non-operating personnel on long missions, and closed-circuit TV to monitor all refuelling operations. Two other aircraft are being converted to KC. Mk 1 tanker/freighter role, with a large cargo door, strengthened cabin floor, and cargo handling system. The three ex-Pan Am aircraft will become TriStar K. Mk 2 tanker/passenger transports, with 290,000 lb of fuel. All nine aircraft will eventually have an additional Flight Refuelling Mk 32 pod under each wing, and AN/ALR-66 radar warning receivers. They are operated by No. 216 Squadron.
Contractor: Lockheed Aircraft Corporation, USA.
Power Plant: three Rolls-Royce RB211-254B4 turbofans; each 50,000 lb st.
Dimensions: span 164 ft 6 in, length 164 ft 2½ in, height 55 ft 4 in.
Weights: empty 242,864 lb, gross 540,000 lb.
Performance: max speed 545 mph at 30,000 ft, service ceiling 43,500 ft, range with max payload 4,310 miles.
Accommodation: crew of three.

VC10 TANKERS

No. 101 Squadron of the Royal Air Force has five VC10 K. Mk 2 in-flight refuelling tankers, converted by British Aerospace from ex-BOAC Model 1101s, and four VC10 K. Mk 3s converted from East African Airways Super VC10 Model 1154s. Each has a flight refuelling Mk 17B hose drum in the rear fuselage, and a Mk 32 pod under each wing, plus a receiver probe on its nose, and closed circuit TV to monitor refuelling operations. Fuel tanks in the cabin give the K. Mk 2 a total capacity of 24,904 gallons, and the K. Mk 3 a capacity of 27,152 gallons. Data are generally as for the RAF's VC10 C. Mk 1 transports, except that the K. Mk 2 is 166 ft 1 in long, and the K. Mk 3 is 179 ft 1 in long.

VICTOR K. Mk 2

Sole survivors of the RAF's once-mighty fleet of four-jet nuclear V-bombers, the Victor K. Mk 2 in-flight refuelling tankers of No. 55 Squadron were converted from operational B. Mk 2s and SR. Mk 2s in the early 1970s. Like the VC10s of 101 Squadron, they are able to refuel three aircraft simultaneously. During the Falklands Campaign in 1982, they flew 600 refuelling sorties in support of Harriers, Hercules, Nimrods, and Vulcans.
Contractor: Handley Page Ltd, UK.
Power Plant: four Rolls-Royce Conway RCo 17 Mk 201 turbofans, each 20,600 lb st.
Dimensions: span 117 ft 0 in, length 114 ft 11 in, height 30 ft 1½ in.
Weight: gross 223,000 lb.
Performance: max speed over 600 mph at 40,000 ft, service ceiling over 60,000 ft, max range 4,600 miles.
Accommodation: crew of five.

Tactical and Strategic Transports

ANDOVER/HS 748

The Belgian Air Force has three HS 748 Srs 2A tactical transports, with side freight door, in its No. 21 Transport Squadron at Melsbroek. Conventional Andover CC. Mk

2s, and C. Mk 1s with an upswept tail and rear loading ramp, continue in Royal Air Force use, for a variety of tasks. The six E. Mk 3s of No. 115 Squadron are C. Mk 1s modified for radar calibration and special duties. *(Data for Andover C. Mk 1.)*

Contractor: Hawker Siddeley Aviation Ltd, UK.

Power Plant: two Rolls-Royce Dart RDa 12 Mk 301 turboprops; each 3,245 ehp.

Dimensions: span 98 ft 3 in, length 78 ft 0 in, height 30 ft 1 in.

Weights: empty 27,709 lb, gross 50,000 lb.

Performance: max speed 302 mph, service ceiling 23,800 ft, range with 8,530 lb payload 1,158 miles.

Accommodation: crew of two or three; up to 44 troops, 18 stretchers and eight seated passengers, or 14,000 lb of freight.

AVIOCAR (C-212)

More than 50 Aviocars equip No. 35 Transport Wing of the Spanish Air Force and No. 461 Squadron of its Canaries Command, under the designations T.12B/C. Each aircraft can accommodate up to 18 troops, 15 paratroops and a jumpmaster, or 4,410 lb of freight, including light vehicles, loaded via the rear ramp. Two medevac conversions (D.3As) can each carry up to 18 stretcher patients. Squadrons 502 and 503 of the Portuguese Air Force fly standard C-212 tactical transports. Data are generally as for the maritime version, except for operational equipment.

BOEING 707

Boeing 707s serve in military roles with three NATO air forces besides USAF. Those of the Canadian Forces include two tanker/transports that were modified to support CF-5s. Spain will base two similar tankers at Zaragoza to refuel its EF-18 Hornets. Four 707s handle VIP and support flights with the German Air Force's Special Missions Squadron at Köln/Bonn. Dornier of Germany heads a team that is modifying three 707-320Cs as trainer cargo aircraft (TCA), with cockpits similar to those of the E-3A, for training of NATO AWACS flight crews and to provide NATO with air transport capability. These aircraft have an in-flight refuelling system installed.

BUFFALO (CC-115)

Fifteen Buffalo medium transports were acquired for the Canadian Forces in 1967–68, for their ability to operate under all weather conditions in areas where short, rough, unprepared strips provide the only take-off and landing surface. About 11 Buffalos are assigned primarily to search and rescue missions, together with helicopters, in No. 442 Squadron at Comox on Canada's west coast, No. 413 at Summerside on the east coast, and No. 424 at Trenton, Ontario.

Contractor: The de Havilland Aircraft of Canada Ltd, Canada.

Power Plant: two General Electric CT64-820-3 turboprops; each 3,060 shp.

Dimensions: span 96 ft 0 in, length 79 ft 0 in, height 28 ft 8 in.

Weights: empty 24,500 lb, gross 41,000 lb.

Performance: max cruising speed 260 mph, service ceiling 25,000 ft, range 1,400 miles.

Accommodation: crew of three; up to 41 troops, 24 stretchers and six seated persons, or freight.

C-130 HERCULES

Except for Germany and the Netherlands, all NATO air forces operate transport versions of this classic aircraft, which first flew in prototype form 34 years ago. Canada has mainly C-130Es, with 4,050 ehp T56-A-7 engines, plus a few more powerful C-130Hs. Designated CC-130 by Canadian Forces, these aircraft are used for strategic airlift, tactical airdrop/airlift, search and rescue from Edmonton, and air navigation training from Winnipeg. Belgium, Denmark, Greece, Italy, Norway, Portugal, Spain, and Turkey all have small numbers of C-130Hs. Six C-130Hs were delivered to France during the past year, and are being followed by a few 'stretched' C-130H-30s. The Royal Air Force acquired 66 C-130Ks, basically 'Hs' with UK equipment, as Hercules C. Mk 1s. Six were converted into C. Mk 1K in-flight refuelling tanker/receivers by Marshall of Cambridge, with four fuel tanks and a hose-drum unit in the cabin. Thirty have been lengthened to C-130H-30 standard, as Hercules C. Mk 3s, able to carry seven cargo pallets instead of five, or four Land Rovers and trailers, or 128 troops, 92 paratroops, or 97 stretcher patients. When fitted with an in-flight refuelling probe, they become C. Mk 1Ps and 3Ps. RAF Hercules equip Squadrons 24, 30, 47, and 70 of Strike Command, and No. 1312 Flight in the Falkland Islands. *(Data for C-130H.)*

Contractor: Lockheed Aeronautical Systems Company, Georgia Division, USA.

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

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

Andover C. Mk 1, Royal Air Force

Aviocar (T.12B), Spanish Air Force

CC-137 Boeing 707, Canadian Forces

CC-115 Buffalo, Canadian Forces (Sgt Margaret Reid)

Weights: empty 76,469 lb, gross 175,000 lb.

Performance: max cruising speed at 20,000 ft 374 mph, service ceiling 23,000 ft, range with max payload 2,356 miles.

Accommodation: crew of five; up to 92 troops, 64 paratroops, 74 stretcher patients, or five 463L freight pallets.

CARIBOU (T.9)

Two squadrons of the Spanish Air Force, Nos. 371 and 372 of 37 Wing, are equipped with Caribou (Spanish designation T.9), many of which were acquired as USAF/ANG surplus.

Contractor: The de Havilland Aircraft of Canada Ltd, Canada.

Power Plant: two Pratt & Whitney R-2000-7M2 piston engines; each 1,450 hp.

Dimensions: span 95 ft 7½ in, length 72 ft 7 in, height 31 ft 9 in.

Weights: empty 18,260 lb, gross 28,500 lb.

Performance: max speed 216 mph, service ceiling 24,800 ft, range with max payload 242 miles.

Accommodation: crew of two; up to 32 troops, 22 stretchers and eight seated persons, or three tons of freight.

F27 and F27M TROOPSHIP

The Royal Netherlands Air Force has only one transport squadron, No. 334 at Soesterberg, equipped with three standard F27-100 Friendships and nine F27M Troopships with a large parachuting door on each side in addition to the freight loading door. *(Data for Troopship.)*

Contractor: Royal Netherlands Aircraft Factories Fokker, Netherlands.

Power Plant: two Rolls-Royce Dart RDa.7 Mk 532-7R turboprops; each 2,140 ehp.

Dimensions: span 95 ft 2 in, length 77 ft 3½ in, height 27 ft 11 in.

Weight: gross 45,000 lb.

Performance: cruising speed at 20,000 ft 298 mph, service ceiling 30,000 ft, max range with freight 2,727 miles.

Accommodation: crew of two or three; 45 paratroops, 24 stretchers and nine seated persons, or 13,283 lb of freight.

G222

Two of the three transport squadrons of the Italian Air Force are equipped with these general purpose transports. Six quick-change kits are also held, for in-the-field conversion to aeromedical configuration. The Italian Air Force has eight of the G222SAA firefighting version of the aircraft, with a modular palletised pack carrying 1,585 gallons of water and retardant. These have been used extensively and successfully in many parts of Italy. *(Data for G222.)*

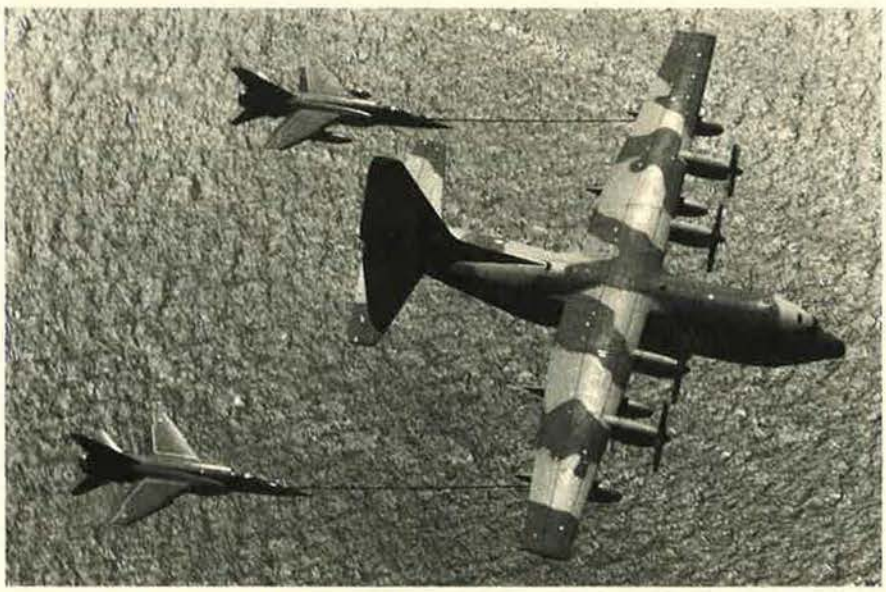
Contractor: Aeritalia SpA, Italy.

Power Plant: two General Electric T64-GE-P4D turboprops; each 3,400 shp.

Dimensions: span 94 ft 2 in, length 74 ft 5½ in, height 32 ft 1¾ in.

Weights: empty 33,950 lb, gross 61,730 lb.

Performance: max speed 336 mph, service ceiling 25,000 ft, range with max payload 852 miles.



Hercules tanker (T. 10) of Spanish Air Force refuelling two Mirage F1s (C.14s)

Accommodation: crew of three; 53 troops, 40 paratroops, 36 stretchers and four attendants, or 19,840 lb of freight, vehicles, and guns.

TRANSALL C-160

The French Air Force received 50, and the German Air Force 90, of the original C-160s, of which production ended in 1972. A second series was authorised in 1977, with updated avionics and an optional additional centre-section fuel tank. Of 29 built for the French Air Force, eight are standard transports, ten are equipped as probe-and-drogue in-flight refuelling tankers, five others have provision for rapid conversion to tankers, and six are Astarté/Gabriel special missions aircraft (which see). All have an in-flight refuelling receiver boom. Five squadrons of the French Air Force, and three squadrons of the German Air Force, fly C-160s. In addition, first-series C-160s equip a single squadron of the Turkish Air Force.

Contractor: Arbeitsgemeinschaft Transall (Aérospatiale and MBB); France and Germany.

Power Plant: two Rolls-Royce Tyne RTy.20 Mk 22 turboprops; each 6,100 ehp.

Dimensions: span 131 ft 3 in, length, excluding probe, 106 ft 3½ in, height 38 ft 2¾ in.

Weights: empty 63,935 lb, gross 112,435 lb.

Performance: max speed at 16,000 ft 319 mph, service ceiling 27,000 ft, range with max payload 1,151 miles.

Accommodation: crew of three; 93 troops, 61–88 paratroops, 62 stretchers and four attendants, tanks, vehicles, or up to 35,275 lb of freight.

VC10 C. Mk 1

No. 10 Squadron of the Royal Air Force has VC10 transports for long-range strategic operations. Although dimensionally similar to the commercial standard VC10 airliner, these were built with uprated engines, additional fuel tankage in the tail fin, a side freight door, reinforced cabin floor, rearward facing seats, an in-flight refuelling probe, an APU in the tailcone, and autoland blind-landing system.

Contractor: British Aircraft Corporation, UK.

Power Plant: four Rolls-Royce Conway 301 turbofans; each 22,500 lb st.

Dimensions: span 146 ft 2 in, length, excluding probe, 158 ft 8 in, height 39 ft 6 in.

Weights: empty 146,000 lb, gross 323,000 lb.

Performance: max speed at 30,000 ft 580 mph, service ceiling 42,000 ft, range with 24,000 lb payload 5,370 miles.

Accommodation: crew of four; 150 passengers, 76 stretcher patients and six attendants, or 57,400 lb of freight.

Helicopters

ALOUETTE II

Twenty-two nations operated military versions of the Alouette II, which continues to fly with the air forces of Belgium, France, and Portugal. Initial major production version was the SE 313B, with an Artouste turboshaft. It was followed by the SA 318C, with an Astazou IIA engine of the same power. *(Data for SE 313B.)*

Contractor: Sud-Aviation SNCA, France.

Power Plant: one Turbomeca Artouste II C 6 turboshaft; derated to 360 shp.

Dimensions: rotor diameter 33 ft 5¾ in, length of fuselage 31 ft 10 in, height 9 ft 0 in.

Weights: empty 1,973 lb, gross 3,527 lb.

Performance: max speed 115 mph, service ceiling 7,050 ft, range with max payload 62 miles, with max fuel 350 miles.

French Air Force Transall engaged on relief work in Africa (SIRPA "AIR")

Accommodation: pilot and four passengers or two stretcher patients and attendant.

ALOUETTE III

Like the Alouette II, the Alouette III was produced first with an Artouste turboshaft, as the SA 316B, and then with an Astazou, as the SA 319B. Both versions continue in NATO service, with the air forces of France, the Netherlands, Portugal, and Spain. Main uses are now light transport, search and rescue, and training, although a wide variety of armament could be carried. *(Data for SA 319B.)*

Contractor: SNI Aérospatiale, France.

Power Plant: one Turbomeca Astazou XIV turboshaft; derated to 600 shp.

Dimensions: rotor diameter 36 ft 1¾ in, length of fuselage 32 ft 10¾ in, height 9 ft 10 in.

Weights: empty 2,527 lb, gross 4,960 lb.

Performance: max speed 136 mph, range with max payload 375 miles.

Accommodation: pilot and six passengers or two stretchers and two attendants.

BELL 47

An early version of the Bell Model 47 was the first helicopter certificated for commercial use, in 1946. Later versions entered worldwide civil and military service, and the 47G and 47J variants were produced under licence by Agusta, in Italy, until 1976. Both remain in service with the Italian Air Force, mainly for training. The Hellenic Air Force uses a few 'Gs' for cropspraying on behalf of civil authorities. *(Data for 47G-3B-2A.)*

Contractor: Costruzioni Aeronautiche Giovanni Agusta SpA, Italy.

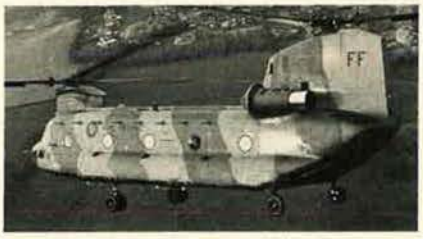
Power Plant: one Lycoming TVO-435-F1A piston engine; 280 hp.

Dimensions: rotor diameter 37 ft 1½ in, length of fuselage 31 ft 7 in, height 9 ft 3¾ in.

Weights: empty 1,893 lb, gross 2,950 lb.

Performance: max speed 105 mph, service ceiling 19,000 ft, range 247 miles.

Accommodation: three persons side-by-side; provision for two external stretchers, or 1,000 lb slung load.



Chinook HC. Mk 1, Royal Air Force

CH-113 Labrador, Canadian Forces (WO Vic Johnson)

Alouette IIIs, Royal Netherlands Air Force

BO 105 CB

The Royal Netherlands Army owns the BO 105 CB helicopters of No. 299 Squadron, and the SA 316B Alouette IIIs of Nos. 298 and 300 Squadrons, but they are flown and maintained by the Royal Netherlands Air Force. Duties are light transport, observation, and forward air control on behalf of the Army. No armament is fitted, but the BO 105 CBs are equipped for operation at night and in adverse weather.

Contractor: Messerschmitt-Bölkow-Blohm GmbH, Germany.

Power Plant: two Allison 250-C20B turboshafts; each 420 shp.

Dimensions: rotor diameter 32 ft 3½ in, length of fuselage 28 ft 1 in, height 9 ft 10 in.

Weights: empty 2,813 lb, gross 5,511 lb.

Performance: max cruising speed 150 mph, service ceiling 17,000 ft, range with max payload 408 miles.

Accommodation: up to five persons; rear bench seat removable to permit carriage of two stretcher patients or equivalent freight.

CH-113 LABRADOR

Together with fixed-wing Buffalos, CH-113 Labrador helicopters form the mainstay of Canada's coastal and inland search and rescue units. Each has a 900 gallon fuel capacity for relatively long-range missions, an 11,000 lb cargo hook for external loads, a rear ramp for easy loading, a watertight hull for landing on water, a rescue hoist, a scoopnet for retrieving survivors from the water, and Stokes litters. Under an upgrade programme, the entire fleet has been fitted with improved avionics and a high powered searchlight.

Contractor: The Boeing Company, Vertol Division, USA.

Power Plant: two General Electric T58-GE-8F turboshafts; each 1,350 shp.

Dimensions: rotor diameter each 50 ft 0 in, length of fuselage 44 ft 7 in, height 16 ft 10 in.

Weights: empty 11,532 lb, gross 21,400 lb.

Performance: max speed 170 mph, service ceiling 13,700 ft, range 690 miles.

Accommodation: crew of three; provision for up to 20 survivors.

CHINOOK (CH-47)

The UK, Canada, and Greece operate Chinook helicopters similar to the US Army's CH-47s. Those of the Hellenic Air Force are CH-47Cs built in Italy by Agusta. Chinooks with uprated engines and other improvements are used by Canadian Forces under the designation CH-147, and by the Royal Air Force as Chinook HC. Mk 1s. The latter have an autoflight control and stability augmentation system and operate at a much greater gross weight than US Army CH-47Cs, including 28,000 lb loads on a triple cargo hook. Squadrons 7, 18, and 78 are based in the UK, Germany, and the Falklands respectively. *(Data for Chinook HC. Mk 1.)*

Contractor: Boeing Vertol Company, USA.

Power Plant: two Avco Lycoming T55-L-712 turboshafts; each 3,750 shp.

Dimensions: rotor diameter each 60 ft 0 in, length of fuselage 51 ft 0 in, height 18 ft, 7¾ in.

Weights: empty 20,547 lb, gross 50,000 lb.

Performance: max speed 180 mph, service ceiling 15,000 ft, mission radius 115 miles with 14,728 lb payload.

Accommodation: crew of four; up to 44 troops, or 24 stretcher patients, or internal or external freight.

Armament: one machine-gun in forward hatchway.

ECUREUIL 2

The French Air Force is acquiring 50 of these twin-turbine light helicopters for surveillance of strategic military bases and other support duties. The first ten are AS $355F_1$s, as described below. The remainder will be AS 355Ns, with 456 shp Turbomeca TM 319 turboshafts.

Contractor: Aérospatiale SNI, France.

Power Plant: two Allison 250-C20F turboshafts; each 425 shp.

Dimensions: rotor diameter 35 ft 0¾ in, length of fuselage 35 ft 9½ in, height 10 ft 4 in.
Weights: empty 2,840 lb, gross 5,511 lb with slung load.
Performance: max cruising speed 143 mph, service ceiling 12,140 ft, range 447 miles.
Accommodation: pilot and up to five passengers.
Armament: provision for carrying Mistral missiles.

GAZELLE

The 34 Gazelles supplied to the Royal Air Force have been used mainly for training at No. 2 FTS, and at the Central Flying School, under the designation HT. Mk 3. A few Gazelle HCC. Mk 4s are used by No. 32 Communications Squadron.
Contractors: Westland Helicopters Ltd, UK, and SNI Aérospatiale, France.
Power Plant: one Turbomeca Astazou IIIA turboshaft; 590 shp.
Dimensions: rotor diameter 34 ft 5½ in, length of fuselage 31 ft 3¼ in, height 10 ft 2¾ in.
Weights: empty 1,874 lb, gross 3,970 lb.
Performance: max cruising speed 164 mph, service ceiling 16,400 ft, range 416 miles.
Accommodation: pilot and up to four other persons.

HH-3F

Agusta of Italy began licence production of this Sikorsky multi-purpose search and rescue helicopter in 1974, and has since received orders for 35 for the Italian Air Force. They equip No. 15 Wing, with 85 Squadron at Ciampino (Rome Airport) and detachments at Trapani, Rimini-Miramare, and Brindisi.
Contractor: Costruzioni Aeronautiche Giovanni Agusta SpA, Italy.
Power Plant: two General Electric T58-GE-100 turboshafts; each 1,500 shp.
Dimensions: rotor diameter 62 ft 0 in, length of fuselage 57 ft 3 in, height 18 ft 1 in.
Weights: empty 13,255 lb, gross 22,050 lb.
Performance: max speed 162 mph, service ceiling 11,100 ft, range 886 miles.
Accommodation: crew of two or three; six stretchers and 10 seated persons, or 26 troops, or 15 stretchers and two attendants, or equivalent freight.

HUGHES 300

The Hellenic and Spanish Air Forces both utilise small numbers of Hughes 300C light helicopters for training. The Greek aircraft were built under licence in Italy by BredaNardi as NH-300Cs.
Contractor: Hughes Helicopters Inc, USA.
Power Plant: one Avco Lycoming HIO-360-D1A piston engine; derated to 190 hp.
Dimensions: rotor diameter 26 ft 10 in, length overall 30 ft 10 in, height 8 ft 9 in.
Weights: empty 1,100 lb, gross 2,050 lb.
Performance: max cruising speed 94 mph, service ceiling 10,200 ft, range 232 miles.
Accommodation: pilot and two other persons.

KIOWA and AB-206A

Seventy-four Bell COH-58As, generally similar to the US Army's OH-58A Kiowa, were delivered to the Canadian Forces to fill the roles of observation, reconnaissance, command and liaison, target acquisition, and fire adjustment. Known in Canada as CH-136s, they were supplemented by 14 Bell 206B JetRanger IIIs (CH-139s) for pilot training, from 1981. The Hellenic Air Force uses similar Agusta-Bell 206As for transport tasks. *(Data for CH-136 Kiowa.)*
Contractor: Bell Helicopter Company, USA.
Power Plant: one Allison T63-A-700 turboshaft; 317 shp.
Dimensions: rotor diameter 35 ft 4 in, length of fuselage 32 ft 7 in, height 9 ft 6½ in.
Weights: empty 1,797 lb, gross 3,000 lb.
Performance: max speed 140 mph, service ceiling 10,000 ft (restriction, as oxygen not available), range 230 miles.
Accommodation: crew of two.
Armament: one 7.62 mm Minigun, or 2.75 in rockets.

PUMA

One of the major successes of the French helicopter industry, the Puma serves in Europe with the Royal Air Force and the Air Forces of France, Portugal, and Spain. The basic SA 330 was produced under a joint Anglo-French programme that included the Gazelle and Lynx. French Air Force version is the SA 330B; RAF version is the SA 330E. Both have Turmo $IIIC_4$ engines, and are used primarily as military assault helicopters. RAF Puma HC. Mk 1s also have a rescue hoist and cargo hook as standard equipment. They equip No. 33 Squadron in the UK, No. 230 with RAF Germany, and No. 1563 Flight in Belize.
Contractors: Westland Helicopters Ltd, UK, and SNI Aérospatiale, France.
Power Plant: two Turbomeca Turmo $IIIC_4$ turboshafts; each 1,435 shp.
Dimensions: rotor diameter 49 ft 2½ in, length of fuselage 46 ft 1½ in, height 16 ft 10½ in.

Gazelle HCC. Mk 4, Royal Air Force

CH-136 Kiowa, Canadian Forces (WO Vic Johnson)

SA 330 Puma, Portuguese Air Force

Sea King Mk 48, Belgian Air Force

AS 332 M_1 Super Puma demonstrator

Weights: empty 7,403 lb, gross 14,110 lb.
Performance: max speed 174 mph, service ceiling 15,100 ft, range 390 miles.
Accommodation: crew of two; up to 16 troops, six stretchers and four seated persons, or internal or external freight.
Armament: two 7.62 mm machine-guns; other weapons optional.

SEA KING

Under an agreement signed in 1959, Westland was enabled to utilise the airframe and rotor system of Sikorsky's SH-3 helicopter, with extensive changes to the power plant and specialised equipment, to meet a Royal Navy requirement for an advanced anti-submarine helicopter with prolonged endurance. The resulting Westland Sea King can undertake other roles, such as search and rescue, tactical troop transport, medevac, and cargo carrying. The Royal Air Force uses Sea King HAR. Mk 3s to equip Flights of No. 202 (SAR) Squadron throughout the UK, and (with Chinooks) No. 78 Squadron in the Falklands. Equipment of the HAR. Mk 3 includes MEL radar, and a Decca TANS F computer, accepting inputs from a Mk 19 Decca nav receiver and Type 71 Doppler. Sea King Mks. 43 and 48 are similar SAR versions used by the Norwegian and Belgian Air Forces respectively. Denmark has Sikorsky-built S-61As for search and rescue. Canadian Forces deploy CH-124As on board ships for ASW duties, and for search and rescue, passenger transport, and carriage of slung loads; these are generally identical to the USN's SH-3A Sea Kings, with General Electric T58-GE-8D turboshafts. *(Data for Sea King HAR. Mk 3.)*
Contractor: Westland Helicopters Ltd, UK.
Power Plant: two Rolls-Royce Gnome H 1400-1 turboshafts; each 1,660 shp.
Dimensions: rotor diameter 62 ft 0 in, length of fuselage 55 ft 9¾ in, height 15 ft 11 in.
Weights: empty 13,672 lb, gross 21,400 lb.
Performance: max speed 131 mph, service ceiling 14,000 ft, range 690 miles.
Accommodation: crew of four; six stretchers, or two stretchers and 11 seated persons, or 19 passengers.

SUPER PUMA

The French Air Force uses three of these AS 332 developments of the original Puma for support duties at nuclear firing ranges in the Pacific. The Spanish Air Force acquired ten for search and rescue missions from bases in Madrid, Seville, Gando in the Canaries, and Palma de Mallorca. Two more operate alongside Pumas on VIP duties with No. 402 Squadron from Cuatro Vientos Airport, Madrid. Spanish designations are HD.21 (SAR) and HT.21 (VIP).
Contractor: Aérospatiale SNI, France.
Power Plant: two Turbomeca Makila IA1 turboshafts; each 1,877 shp.
Dimensions: rotor diameter 51 ft 2¼ in, length of fuselage 50 ft 11½ in, height 16 ft 1¾ in.
Weights: empty 9,458 lb, gross 19,841 lb.
Performance: cruising speed 163 mph, service ceiling 13,450 ft, range with standard fuel 384 miles.
Accommodation: crew of two or three; up to 21 passengers, or six stretchers and 11 seated persons, or nine stretchers and three seated, or internal freight, or 9,920 lb slung load.

UH-1 (single-engine)

Variants of the single-engine Bell UH-1 Iroquois serve with seven non-US NATO air forces. Those operated by Canada and Turkey were built in the US; the German aircraft were manufactured under licence by Dornier; those flown by Greece, Italy, Norway, and Spain came from Agusta licence production in Italy. Canada uses its CH-118s (UH-1Hs) for transport and base rescue. Germany's large force of UH-1Ds is intended for liaison, with

four assigned to the Air Force's special missions wing. Greece has Agusta-Bell 205As (UH-1D/H series) for light transport and SAR. AB-204Bs are used by Italy for training, and by the Royal Norwegian Air Force for army support and SAR. Spain's AB-205s are assigned primarily to SAR. The Turkish UH-1Hs are used for army support, liaison, and training. *(Data for CH-118.)*

Contractor: Bell Helicopter Company, USA.
Power Plant: one Avco Lycoming T53-L-13 turboshaft; 1,400 shp.
Dimensions: rotor diameter 48 ft 0 in, length of fuselage 41 ft 10¾ in, height 14 ft 8 in.
Weights: empty 4,800 lb, gross 9,620 lb.
Performance: max speed 140 mph, service ceiling 10,000 ft (restriction, as no oxygen available), range 360 miles.
Accommodation: two crew and 11 other persons, or up to 4,000 lb of slung cargo.

UH-1 (twin-engine) AND MODELS 212/412

The Bell Model 212 was developed, with Canadian Government approval, as a twin-engine version of the Iroquois utilising a Canadian-built power plant. Canada placed the first order, for 50, as CUH-1Ns. Now designated CH-135, they are intended as combat area transports, able to carry 12 troops with weapons only, ten with packs in summer, eight with packs in winter, or six stretcher patients. Options include various types of armament, or a rescue hoist for SAR operations. Italy uses Agusta-built AB-212s for SAR. Greece has a few for transport duties; and Norway will have 18 of the developed Model 412SPs, with a new four-blade advanced technology rotor and improved performance. Seventeen of these will be assembled in Norway, to replace UH-1Bs of Nos. 339 and 720 Squadrons of the Royal Norwegian Air Force. *(Data for 412SP.)*

Contractor: Bell Helicopter Textron, Canada.
Power Plant: one Pratt & Whitney Canada PT6T-3B-1 Turbo Twin Pac; 1,400 shp.
Dimensions: rotor diameter 46 ft 0 in, length of fuselage 42 ft 4¾ in, height 14 ft 2¼ in.
Weights: empty 6,470 lb, gross 11,900 lb.
Performance: max cruising speed 143 mph, service ceiling 16,300 ft, range with max payload 432 miles.
Accommodation: pilot and up to 14 passengers.

WESSEX

Three versions of this turbine powered development of the Sikorsky S-58 remain in service with the Royal Air Force. Wessex HC. Mk 2 tactical transports equip No. 72 Squadron at Aldergrove, in support of the Northern Ireland garrison, No. 28 in Hong Kong, and No. 22 for SAR missions throughout the UK. Two Wessex HCC. Mk 4s wear the red and blue livery of The Queen's Flight. Ex-Royal Navy Wessex HU. Mk 5Cs of No. 84 Squadron provide SAR and United Nations support from Akrotiri, Cyprus. *(Data for HC. Mk 2.)*

Contractor: Westland Aircraft Ltd, UK.
Power Plant: two coupled Rolls-Royce Bristol Gnome Mk 110/111 turboshafts; each 1,350 shp.
Dimensions: rotor diameter 56 ft 0 in, length of fuselage 48 ft 4½ in, height 14 ft 5 in.
Weights: empty 8,304 lb, gross 13,500 lb.
Performance: max speed 132 mph, service ceiling 12,000 ft, range 478 miles.
Accommodation: crew of two or three; 16 troops, seven stretcher patients, or 4,000 lb of freight.
Armament: provision for air-to-surface missiles, rocket packs, or machine-guns.

S3D nuclear missile in its silo (SIRPA "AIR")

CH-118 (UH-1H), Canadian Forces (WO Vic Johnson)

CH-135, Canadian Forces

Wessex HC. Mk 2, Royal Air Force

Strategic Missiles

S3D (SSBS)

Second element of France's Forces Aériennes Stratégiques (FAS), after its Mirage IV-P bombers, is the 1st Groupement of S3D *sol-sol balistique stratégique* (SSBS) missiles based in hardened silos throughout 385 sq miles of the Plateau d'Albion, east of Avignon. Each of the two groups of nine S3D second-generation missiles has its own fire control centre, with No. 1 PCT (Poste Centrale de Tir) at Rustrel, and No. 2 at Reilhannette. Reaction time for the S3D is reported to be about 3½ minutes. Its silo is claimed to be able to survive a nuclear first strike. *(Data are provisional.)*

Contractor: Aérospatiale SNI, Space and Strategic Systems Division, France.
Propulsion: first stage: SEP Type 902 solid-propellant motor; 99,200 lb thrust for 76 seconds. Second stage: SEP Rita II solid-propellant motor; 70,550 lb thrust for 52 seconds.
Guidance: inertial.
Warhead: thermonuclear (1.2 mT). Re-entry vehicle is hardened against the effects of a high-altitude nuclear explosion by an ABM and carries penetration aids.
Dimensions: length overall 45 ft 11 in, diameter of first stage 5 ft 0 in.
Weight: 56,880 lb.
Performance: range over 2,175 miles.

Air-Launched Missiles

ALARM

ALARM (Air Launched AntiRadiation Missile) is being developed for use by Harrier, Jaguar, and Tornado IDS aircraft against hostile gun and missile radars. Sufficiently small and lightweight to be carried also by aircraft as small as the Hawk, and military helicopters, it has several operational modes. These include direct attack, and a loiter mode in which the missile climbs to height and deploys a parachute, from which it remains suspended until a suitable target has been identified. The parachute is then released, and the missile falls on to the target.

Contractor: British Aerospace plc, UK.
Propulsion: solid-propellant rocket motor.
Guidance: passive homing, using Marconi seeker that homes on hostile radar emissions.
Warhead: high-explosive type, by MBB, with Thorn EMI proximity fuze.
Dimensions: length 13 ft 0 in, body diameter 9 in, wing span 2 ft 5 in.
Weight: 617 lb, incl launcher.

AS 12

The Turkish Air Force still has AS 12 air-to-surface missiles in its inventory. The armour piercing version will penetrate more than 1½ inches of steel armour. Alternatives include an anti-tank shaped charge and a pre-fragmented anti-personnel type.

Contractor: Nord-Aviation/Aérospatiale, France.
Propulsion: two-stage solid-propellant rocket motor.
Guidance: Wire-guided, under manual control.
Warhead: high-explosive type; weight 62.6 lb.
Dimensions: length 6 ft 2 in, body diameter 7 in, wing span 2 ft 1½ in.
Weight: 170 lb.
Performance: speed at impact 210 mph, max range 19,685 ft.

AS 30 L

The AS 30 L (for laser) supersonic air-to-surface missile is intended for use against hardened and heavily defended targets on land and at sea, normally in conjunction wih a Thomson-CSF Atlis 2 target illuminating pod carried by the launch aircraft. The guidance system is claimed to provide the optimum standoff distance for direct target acquisition. The warhead's hard steel casing allows penetration of more than 6 ft of concrete before detonation, using a delayed fuze. The AS 30 L replaced the earlier, radio command, AS 30 in production, and is carried by French Air Force Jaguars. It has been exported to operators of the Mirage F1, and is compatible with such types as the Mirage 2000, AMX, Tornado, F-15, and F-16.

Contractor: Aérospatiale SNI, Division Engins Tactiques, France.
Propulsion: two-stage solid-propellant rocket motor.
Guidance: pre-guidance phase on gyro reference, followed by semi-active laser terminal homing using a Thomson-CSF Ariel seeker.

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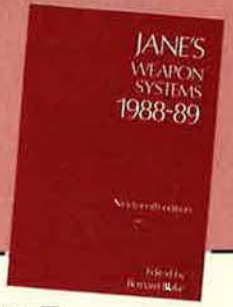

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Warhead: high-explosive type; weight 529 lb.
Dimensions: length 11 ft 11¾ in, body diameter 1 ft 1½ in, wing span 3 ft 3¼ in.
Weight: 1,146 lb.
Performance: speed at impact above Mach 1.32, range 1.8–6.2 miles.

ASMP

The ASMP (Air-Sol Moyenne Portée) was developed as primary armament of the French Air Force's Mirage IV-P strategic bomber and Mirage 2000N attack aircraft, and to replace AN 52 nuclear bombs on Super Étendard fighters of the French Navy. It is powered in supersonic cruising flight by a kerosene-burning ramjet, supplied with air by a pair of two-dimensional side intakes that also provide lift. Intended targets are airfields, command communications centres, and other heavily defended sites, from standoff range.
Contractor: Aérospatiale SNI, Division Engins Tactiques, France.
Propulsion: SNPE solid-propellant booster is integrated in the combustion chamber of a kerosene-burning ramjet, forming a two-stage rocket-ramjet.
Guidance: Sagem pre-programmed inertial system, with terrain following capability.
Warhead: nuclear type; yield 150 kT.
Dimensions: length 17 ft 8 in, body diameter 1 ft 3 in, wing span 3 ft 1¾ in.
Weight: estimated at 1,985 lb.
Performance: cruising speed Mach 2 at low altitude, Mach 3 at high altitude; range 50 miles after low-altitude launch, 155 miles after high-altitude launch.

ASPIDE

Aspide is interchangeable with the externally similar Sparrow on F-104S ASA Starfighters of the Italian Air Force. It is an all-weather, all-aspect, air-to-air and surface-to-air weapon, suitable for air-launch at very low altitudes and offering multiple target engagement and resistance to advanced ECM. A fully automatic "fire and forget" guidance system is expected to be available for Aspide in the early 1990s.
Contractor: Selenia Industrie Elettroniche Associate SpA, Italy.
Propulsion: single-stage solid-propellant rocket motor.
Guidance: semi-active CW radar guidance, employing monopulse techniques.
Warhead: high-explosive type; weight 73 lb.
Dimensions: length 12 ft 1½ in, body diameter 8 in, wing span 3 ft 3¼ in.
Weight: 485 lb.
Performance: cruising speed Mach 2 + speed of launch platform, range 22–37 miles.

BULLPUP (AGM-12B)

Developed originally for the US Navy, Bullpup began as a simple weapon built around a standard 250 lb bomb. The pilot steered it in flight by radio command, via a hand switch in the cockpit, using tracking flares above and below the rocket nozzle to keep Bullpup on a line of sight path to the target. Licence manufacture in Europe was undertaken by a consortium led by Kongsberg Vaapenfabrikk of Norway, whose production rounds are still available to the Air Forces of Denmark, Norway, and Turkey.
Prime Contractor: Kongsberg Vaapenfabrikk, Norway.
Propulsion: Thiokol LR58-2 storable liquid-propellant rocket motor; 12,000 lb st.
Guidance: radio command.
Warhead: high-explosive type; weight 250 lb.
Dimensions: length 10 ft 6 in, body diameter 1 ft 0 in, wing span 3 ft 1½ in.
Weight: 569 lb.
Performance: cruising speed Mach 1.8, max range 7 miles.

HARM (AGM-88A)

America's HARM (High-speed AntiRadiation Missile) has been ordered by the German Air Force, to equip its Tornados, and by the Spanish Air Force. It was developed on the basis of experience in Vietnam, where Soviet-built radars often detected approaching first-generation anti-radiation weapons such as Shrike, and shut down before the missile could home on their emissions. HARM offers both higher performance and coverage of a wide range of frequencies, through the use of programmable digital processors in the launch aircraft's avionics and the missile. It can be launched at heights from sea level to 40,000 ft.
Contractor: Texas Instruments, Inc, USA.
Propulsion: Thiokol smokeless dual-thrust solid-propellant rocket motor. Hercules second source.
Guidance: passive homing, using seeker that homes on hostile radar emissions.
Warhead: high-explosive type; weight 145 lb.
Dimensions: length 13 ft 8½ in, body diameter 10 in, wing span 3 ft 8½ in.
Weight: 807 lb.
Performance: cruising speed supersonic, range more than 10 miles.

ASMP and two Magic missiles on Mirage 2000N (SIRPA "AIR")

Harpoon antiship missile

AS 37 Martel antiradiation missile

HARPOON (AGM-84A)

Some Nimrod maritime patrol aircraft of the Royal Air Force were fitted with Sidewinder air-to-air missiles for self-defence and were given an attack capability with bombs, Sting Ray torpedoes, and, later, during the Falklands campaign in 1982, Harpoon antiship missiles. Provisions for carrying Sidewinders and Harpoons were installed subsequently on all other Nimrod MR. Mk 2s. The Harpoons are similar to those carried by USAF B-52Gs. They follow a sea-skimming path after launch and are able to perform high-g manoeuvres when operating against fast manoeuvring targets. Counter-countermeasures are installed.
Contractor: McDonnell Douglas Astronautics Company, USA.
Propulsion: Teledyne CAE J402-CA-400 turbojet; 660 lb st.
Guidance: sea-skimming cruise monitored by radar altimeter; active radar terminal homing.
Warhead: penetration high-explosive blast type; weight 488 lb.
Dimensions: length 12 ft 7½ in, body diameter 1 ft 1½ in, wing span 3 ft 0 in.
Weight: 1,145 lb.
Performance: cruising speed high subsonic, range more than 57 miles.

KORMORAN

The basic Kormoran 1 version of this rail-launched sea-skimming antiship missile can be carried by any aircraft that is able to maintain a speed between Mach 0.6 and 0.95 during the attack and that is equipped with target acquisition radar and an autonomous navigation system such as an inertial platform. On modern aircraft like the Tornados of the German and Italian Air Forces, the Kormoran system requires a minimum of special equipment for signal adaptation and missile control. A Kormoran launcher provides the mechanical interface between a standard 30 in pylon and the missile, and houses missile related electric interface units. Launch information is received from the aircraft's radar and navigation system. The missile can be operated in range-and-bearing and bearing-only modes, the latter being used when firing optically without use of radar.

Kormoran is designed for maximum effectiveness against ships up to destroyer size and is immune to a high degree to all contemporary types of ECM. An improved Kormoran 2 is under development, with a new radar seeker, a strapdown INS, and digital signal processing. Interchangeable with Kormoran 1 on the Tornado, it will offer improved target engagement capability, advanced ECCM, a longer range, better penetration capability, and increased warhead weight. *(Data for Kormoran 1.)*
Contractor: Messerschmitt-Bölkow-Blohm GmbH, Germany.
Propulsion: two built-in boosters, and solid-propellant sustainer rocket motor.
Guidance: "fire and forget" type, employing inertial mid-course guidance and radar terminal homing.
Warhead: high-explosive type; weight 352 lb.
Dimensions: length 14 ft 5 in, body diameter 1 ft 1½ in, wing span 3 ft 3¼ in.
Weight: 1,320 lb.
Performance: cruising speed Mach 0.9, max range 23 miles.

MAGIC (R.550)

The basic version of this highly manoeuvrable short/medium-range dogfight missile can be launched at ranges between 1,640 ft and 4.35 miles in the hemisphere behind the target, is stressed for 50*g* manoeuvres, and can be fired from an aircraft in a 7*g* turn, singly or at one second interval between rounds. There is no minimum launch speed; maximum is more than 805 mph IAS.

A Magic 2 all-sector version is now operational on Mirage 2000 aircraft of the French and Hellenic Air Forces. It has a new infrared seeker with a multi-element cell and great sensitivity, and can be slaved to the launch aircraft's AI radar as an alternative to autonomous operation. Many thousands of Magics have been sold, 75 percent of them for export. They have been adapted to A-4 Skyhawk, Alpha Jet, F-8E(FN) Crusader, Jaguar, MB-339, MiG-21, MiG-23, Mirage III, Mirage 5, Mirage F1, Mirage 2000, Super Étendard, Sea Harrier, and other types. *(Data for basic Magic.)*
Contractor: SA Matra, France.
Propulsion: single-stage solid-propellant rocket motor.
Guidance: infrared homing.
Warhead: high-explosive type; weight 27.5 lb. Impact and infrared proximity fuzes.
Dimensions: length 9 ft 0¼ in, body diameter 6½ in, wing span 1 ft 6 in.
Weight: 196 lb.
Performance: cruising speed above Mach 2, range 1,640 ft to 4.35 miles.

MARTEL (AS 37)

Martel (Missile AntiRadar and TELevision) was developed in two forms, as a joint Anglo-French programme. The command guided AJ.168 has been superseded by Sea Eagle. The all-weather antiradiation AS 37 continues

in use on Mirage IIIEs and Jaguars of the French Air Force and on Royal Air Force Buccaneers.
Contractors: SA Matra, France, and British Aerospace, UK.
Propulsion: solid-propellant rocket motors by Aérospatiale and Hotchkiss-Brandt.
Guidance: AS 37 has passive seeker that homes on hostile radar emissions.
Warhead: high-explosive type; weight 330 lb. Proximity fuze.
Dimensions: length 13 ft 6¼ in, body diameter 1 ft 3¾ in, wing span 3 ft 11¼ in.
Weight: 1,168 lb.
Performance: cruising speed subsonic, range 18.5 miles.

MAVERICK (AGM-65)

The Air Forces of Germany, Greece, and Spain are European operators of this familiar launch-and-leave TV-guided air-to-surface missile. The version bought by Germany is the AGM-65B, with a "scene magnification" seeker that enables the pilot to identify and lock on to smaller or more distant targets than with the original AGM-65A. *(Data for AGM-65B.)*
Contractor: GM-Hughes, Missile Systems Group, USA.
Propulsion: Thiokol TX-481 solid-propellant rocket motor.
Guidance: self-homing electro-optical guidance system.
Warhead: high-explosive type, shaped charge; weight 125 lb.
Dimensions: length 8 ft 2 in, body diameter 1 ft 0 in, wing span 2 ft 4½ in.
Weight: 462 lb.
Performance: range 0.6–14 miles.

PENGUIN

The air-launched Penguin Mk 3 antiship missile has been selected as armament of F-16s of the Royal Norwegian Air Force. It can be carried by aircraft flying at speeds up to Mach 1.2 and launched at any height between 150 and 30,000 ft. Target acquisition can be via the launch aircraft's radar or in a completely passive mode using the head-up display. It is claimed to be immune to ECM and able to discriminate between real targets and decoys.
Contractor: Norsk Forsvarsteknologi A/S, Norway.
Propulsion: two-stage solid-propellant rocket motor.
Guidance: programmed inertial midcourse guidance; infrared terminal homing.
Warhead: high-explosive armour-piercing type; weight 265 lb.
Dimensions: length 10 ft 4¾ in, body diameter 11 in, wing span 3 ft 3¼ in.
Weight: 820 lb.
Performance: cruising speed above Mach 0.9, range over 25 miles.

R.530 and SUPER 530

The R.530 all-weather air-to-air missile was built in two forms, with alternative semi-active radar and infrared homing heads. It is carried under the fuselage of Mirage III interceptors and under the wings of Mirage F1s, and it can be launched at any altitude between sea level and 69,000 ft. Operators include the French and Spanish Air Forces.

The Super 530 is an all-sector development of the R.530, able to attack targets flying 29,500 ft higher or lower than the launch aircraft. It is fitted with advanced ECM antijamming circuits. The basic Super 530 F is deployed on Mirage F1 interceptors. The Mirage 2000 is armed with the Super 530 D, compatible with its Doppler radar, and able to attack targets flying at speeds up to Mach 3 and heights from sea level to 80,000 ft. *(Data for Super 530 D.)*
Contractor: SA Matra, France.
Propulsion: dual-thrust solid-propellant rocket motor, by Thomson-Brandt.
Guidance: semi-active pulse-radar homing, by Electronique Serge Dassault.

Two Magic and two Super 530 D air-to-air missiles on Mirage 2000C (SIRPA "AIR")

Mockup Sea Eagle antiship missile

AIM-9L Sidewinder air-to-air missile

Sidewinders on a Hawk T. Mk 1A flying in company with a Tornado F. Mk 3 armed with Sky Flash missiles

Warhead: fragmenting high-explosive type; weight 66 lb. Electromagnetic proximity fuze.
Dimensions: length 12 ft 5½ in, body diameter 10¼ in, wing span 2 ft 1¼ in.
Weight: 584 lb.
Performance: cruising speed Mach 4.5, range more than 25 miles.

SEA EAGLE

Sea Eagle is an all-weather, day and night, 'fire and forget' antiship missile. Its turbojet engine gives it a longer range than that of the rocket powered AJ.168 Martel, which it has replaced. Prior to launch, the onboard microprocessor is supplied with target positional information from the carrier aircraft. The computer controls the flight path of Sea Eagle until the target is acquired by the radar seeker during the final sea-skimming phase of attack. The missile can discriminate between several potential targets and is designed to destroy or disable targets protected by sophisticated ECM and decoys, including heavy cruisers and aircraft carriers. A helicopter launched version has a small additional boost motor. Sea Eagle equips Royal Air Force Buccaneers.
Contractor: British Aerospace plc, UK.
Propulsion: Microturbo TRI-60 turbojet; 787 lb st.
Guidance: inertial navigation, with active radar terminal homing.
Warhead: high-explosive type; weight more than 507 lb.
Dimensions: length 13 ft 7 in, body diameter 1 ft 3¾ in, wing span 3 ft 11¼ in.
Weight: approx 1,280 lb.
Performance: cruising speed Mach 0.85, range more than 68 miles.

SIDEWINDER (AIM-9)

This pioneer infrared homing air-to-air missile is used by all NATO air forces except that of France. Versions in service include the AIM-9B and AIM-9P, but the major current model in Europe is the third-generation AIM-9L, which is manufactured by a consortium of British, Italian, Norwegian, and German companies, under the leadership of Bodenseewerk. About to enter production is an improved version designated AIM-9L/I. *(Data for AIM-9L.)*
Contractor: Bodenseewerk Gerätetechnik GmbH, Germany.
Propulsion: Mk 36 Mod 7/8 solid-propellant rocket motor.
Guidance: infrared homing, with AM/FM conical scan and active IR proximity fuze.
Warhead: annular blast fragmentation high-explosive; weight 20.8 lb.
Dimensions: length 9 ft 5 in, body diameter 5 in, fin span 2 ft 1 in.
Weight: 191 lb.
Performance: cruising speed above Mach 2, range more than 10 miles.

SKY FLASH

The "boost and coast" Sky Flash all-weather air-to-air missile has the same general configuration and dimensions as the AIM-7E Sparrow, but is fitted with a British semi-active radar homing head of inverse monopulse design. The advanced radar proximity fuze is claimed to offer a high single-shot kill capability against targets flying at subsonic and supersonic speeds, singly and in formation, at high, medium, and low (250 ft) altitudes, in severe ECM environments. Sky Flash is the primary weapon of the RAF's Tornado ADV.
Contractor: British Aerospace plc, UK.
Propulsion: Aerojet Mk 52 Mod 2 solid-propellant rocket motor.
Guidance: semi-active radar homing, by Marconi Defence Systems.
Warhead: high-explosive type; weight 66 lb. Thorn EMI radar proximity fuze.
Dimensions: length 12 ft 0 in, body diameter 8 in, wing span 3 ft 4 in.
Weight: 425 lb.
Performance: cruising speed above Mach 2, range 31 miles.

SPARROW (AIM-7)

Sparrow is in service with the air forces of Canada, Greece, Italy, Spain, Turkey, and the UK. Most widely used version is the AIM-7E, which was also manufactured in Italy by Selenia; but the Spanish Air Force has AIM-7Ds and Fs, and the latest AIM-7M serves with the Canadian and Hellenic Air Forces. *(Data for AIM-7E.)*
Contractor: Raytheon Company, USA.
Propulsion: Rocketdyne Mk 38 Mod 2 solid-propellant rocket motor.
Guidance: semi-active CW radar homing.
Warhead: high-explosive type; weight 68 lb.
Dimensions: length 12 ft 0 in, body diameter 8 in, wing span 3 ft 4 in.
Weight: 450 lb.
Performance: cruising speed above Mach 3.5, range 20 miles.

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Much of the improvement in international affairs is the result of the resurgent strength of the United States. Speakers at the AFA Convention warn against relaxing the approach that has been so manifestly successful.

A Strategy That Works

BY JAMES W. CANAN, SENIOR EDITOR

THE resurgent strength of the United States forced the Soviet Union to let up on foreign adventurism, become more cooperative in arms control, and face up to and acknowledge internal problems.

Now the US must remain strong in order to continue pressing the Kremlin. It must not misread the changes in the Soviet Union and in Soviet policies as evidence that the Kremlin has gone soft.

In one form or another, this message was conveyed by the principal speakers at the Air Force Association's forty-second National Convention last September in Washington.

Those speakers were Air Force Chief of Staff Gen. Larry D. Welch; Secretary of the Air Force Edward C. "Pete" Aldridge, Jr.; Lt. Gen. Colin L. Powell, Assistant to the President for National Security Affairs; and Michael H. Armacost, Under Secretary of State for Political Affairs.

General Welch told his convention audience: "It is the strength of the free world that brings the Soviets to the arms-negotiation table. It is the success of our system of alliances and the strategy of deterrence that leads the Soviets to conclude they cannot afford to build the military forces needed to impose their will on the free world.

"And it is the success of the free world's economic and political systems that drives the Soviets to new and less threatening behavior."

The USAF Chief of Staff acknowledged that "national security doesn't come from military power alone" and that "economic strength and political will are also required."

"But I'm not in that business," he added. "For the military forces, our contribution must be in providing the taxpayer an affordable defense that is worth every dime we pay for it. Within the financial planning constraints, your Air Force is intensely focused on doing just that."

The theme of this year's AFA convention was "A Creed to Believe—Freedom." Picking up on this, General Powell described the theme of his speech as "providing for the common defense," adding:

"The two themes are inseparable. You can't have the first without the second—and the second without the first is called tyranny."

The General told his AFA audi-

"The American people will not accept...the decline of America's standing in the world community. Americans want a strong defense at a reasonable price."

ence that "America is the strongest player on the world stage today because of our economic strength, our political strength, our systemic strength—values, creed, moral position, and yes, because we are militarily strong once again.

"Over the past ten years, it has become clear that the American people will not accept military weakness, timidity in the protection of our national interests, or the decline of America's standing in the world community. Americans want a strong defense at a reasonable price."

Secretary Aldridge expressed "great pride in telling you that after eight years of hard work and sound fiscal planning, the legacy we will leave is much better than [the one] we inherited. . . . We have restored the combat capability of the United States Air Force."

He also noted: "We are fielding a new generation of systems that will underwrite our nation's deterrent strategy across the spectrum of potential conflict. We have provided the necessary training and equipment for our personnel to achieve an all-time high in the combat readiness of the Air Force."

Effective Global Diplomacy

Under Secretary of State Armacost claimed that the Reagan Administration "restored our military strength" and thereby "enhanced our ability to employ forces in support of US interests abroad."

Crediting the Air Force with having contributed heavily to "the military strength that makes possible an effective global diplomacy for the United States," Mr. Armacost brought up "the essential relationship between military strength and effective diplomacy" and continued:

"We have learned through hard experience that a world in which disputes are settled peacefully—a world of law, comity, and human rights—cannot be created by goodwill and idealism alone. Since 1945, every President has recognized that, to maintain the peace, we must preserve our strength and, more than that, we have to be willing to *use* our strength."

Taking note of "a number of global trends favorable to US interests," Mr. Armacost opined that the US enjoys "promising prospects for the future," but warned that the nation "should not be complacent."

He declared: "As we face the future, we need to pay careful attention to new challenges posed by a changing security environment and by trends that bear on our ability to acquire and use military power."

All the AFA convention speakers discussed just such challenges and trends. General Welch, for one, dealt with them in the contexts of "concern over the shift in national priorities that has produced a declining defense budget for the past three years," of "national and international perceptions of change within the Soviet Union," and of "the Air Force approach to providing an affordable defense in the face of [downward] priority and budget trends."

"It would be ironic...if the very effectiveness of our national security policies undercut the popular support essential for their continued success."

As to the last point, the Chief of Staff expressed an upbeat—"mostly good news"—attitude "in spite of the challenges" involved. He was also at pains to emphasize that "it is not my purpose to complain about the facts of life" or to "criticize the results of the democratic process," but rather "to contribute what I can to assuring that national priorities are influenced by a realistic view of the national security aspects of the world we live in."

Withal, General Welch called the latter-day buffeting of the defense budget "bad news" because it "illustrates, once again, that it has never been possible to build any kind of lasting national consensus on the priority we should assign to national defense. The result is the roller-coaster approach to funding national defense."

In this, the Chief of Staff reminded his audience of the damage that inconsistent defense budgeting and planning do to the development and production of weapon systems.

"It means," said General Welch, "that we frequently find ourselves successfully completing the development of a new capability needed to meet the threat, only to find that the budget dictates we buy the systems at less-than-economical production rates or cancel needed programs—sending the R&D investment down the drain.

"The inefficiency associated with this lack of stable financial planning absolutely dwarfs all other causes of inefficiency reported with such relish by the news media. In my view, US national security is far too important for such a haphazard financial approach, and you ought to demand a change."

General Welch noted that the federal deficit now seems to be "at the top of many lists of national concerns" and that "a smaller defense budget is seen by some as a major means of reducing that deficit."

However, he declared, "neither facts nor logic leads to a conclusion that the deficit is caused by increases in defense spending or is likely to be cured by decreases in defense spending."

Perception of the Threat

He took note too of "a changing public perception of the threat," a perception involving "arms negotiations and Soviet peace offensives," as a probable cause of the American public's apparent willingness to spend less on defense than it had previously.

General Welch called US relations with the Soviet Union "a powerful driver of both the need for national defense and the public willingness to support that need." In this regard, his message to the AFA convention audience was, in the main, a cautionary one.

"I would agree," said the Chief of Staff, "that there are important forces at work within the Soviet Union that can eventually have profound effects on the relationship and all that grows out of the relationship. But so far, we have lots of words and few deeds and no evidence of any fundamental change in Soviet objectives."

He said the Soviets agreed to the

Intermediate-range Nuclear Forces (INF) Treaty because they had been faced down by the resolve of the US and its NATO allies to deploy and sustain such weapons.

As to the "surprising developments in Soviet political and economic approaches," General Welch said the West must bear in mind that the success of such approaches can only strengthen the Soviet Union, to the likely detriment of the US in the long run.

Also: "We have before us a Soviet declaration that they have shifted to a purely defensive military strategy. But we have seen no change in Soviet forces. They continue to produce weapons of all kinds at far greater rates than does the United States."

General Powell claimed that US successes in economic, geopolitical, and military spheres have swung the world to the ways of the West, on the whole, and have diminished Soviet and Communist influence around the globe.

"Today," he said, "we see Gorbachev's bold leadership examining the nation's past practices because of the dismal Soviet record of chronic economic failures and foreign policy setbacks." He described General Secretary Gorbachev's policies of *glasnost* and *perestroika*—"openness" and "restructuring"—as "efforts to make the Soviets more formidable competitors for the long haul and to place the regime and its economic underpinnings on a more stable, enduring basis.

"Gorbachev is very clear on this," General Powell said. "He seeks no fundamental alteration of the Soviet single-party dictatorship. That dictatorship permits no organized political opposition and . . . wholly lacks the institutional checks and balances that, in our democracy, are the institutional guarantees of individual freedom."

General Powell warned against slippage of "America's strategic position in the world," a position that resulted from "the restoration of a domestic consensus in the early 1980s" in favor of a strong national defense and that made "peace through strength a vision that has become a fundamental reality."

Declared the President's national security advisor: "The question now is: Has this consensus retained its vitality, or have the successes it has brought in the last few years diminished its importance in the eyes of the American people? It would be ironic, indeed, if the very effectiveness of our national security policies undercut the popular support essential for their continued success."

Incorrect Perception?

He described any perception that "all is well" with the US as "an incorrect and potentially dangerous one," asserting:

"We must continue to provide for the common defense. We cannot allow further erosion of our military power without putting at serious risk our ability to execute the national-security strategy that has succeeded so remarkably over the past seven years in keeping the peace, supporting realistic arms control, restoring America's strength and prestige, reinforcing the cohesion of our alliances, encouraging freedom, and providing a solid foundation for our diplomacy around the world."

"Launch is only one part of assuring space-mission operations. What we do when we get there is just as vital."

The relationship between military power and diplomacy was the stuff of Mr. Armacost's address to the AFA national convention. The State Department official noted that such power is by no means the only component of effective diplomacy, others being "skill, intelligence, patience, the right policies, and a strong economy."

Even so, he said, "maintaining the military balance of power is crucial to diplomatic success. In the decade of the 1970s we lost sight of this fact, and we paid the price."

Mr. Armacost recounted the Reagan Administration's moves to mount greater military power, among them its strategic modernization program and, "despite what some are now saying, beefing up our conventional forces as well." He also stressed the Administration's willingness to use such power.

For example: "I think it fair to say that the designers of the FB-111 never imagined that this strategic aircraft would find service in operation against terrorist bases. But the real significance of the strike against Libya, as with Grenada and the [Persian] Gulf, is that we gave renewed credibility to our *will* to engage in the measured and judicious use of force in pursuit of our security interests. Such credibility gives greater weight to our diplomacy and will hopefully reduce prospects of having to employ force in the future."

In discussing new weapons introduced or brought along by the Reagan Administration, Secretary Aldridge spoke out against "critics who wish to engage in political football and question the mission capability of the B-1B bomber because of a single, slow-maturing component." Such critics, said the Secretary, "lack an understanding of the B-1B's primary mission—deterrence."

He was referring to the bomber's defensive avionics. He described the electronic countermeasures system at the core of such avionics as but one element among many making up the B-1B's "deterrent value" as seen and rated by the Soviet leadership.

"The Soviets know," said Secretary Aldridge, "that the B-1 is capable of flying low, avoiding defenses, penetrating at long ranges into Soviet territory, and holding at risk all categories of targets with its gravity and standoff weapons.

"In spite of the rhetoric from some congressional critics, the Soviets know the B-1 is a fully mission-ready aircraft, currently on day-to-day alert and capable of rapid generation in time of crisis."

USAF Doing Well

Despite the downturn of the defense budget and the continuing attacks of critics, the Air Force is doing well, "continuing to modernize, although somewhat more slowly than we would like," Secretary Aldridge said. "Our mission-capa-

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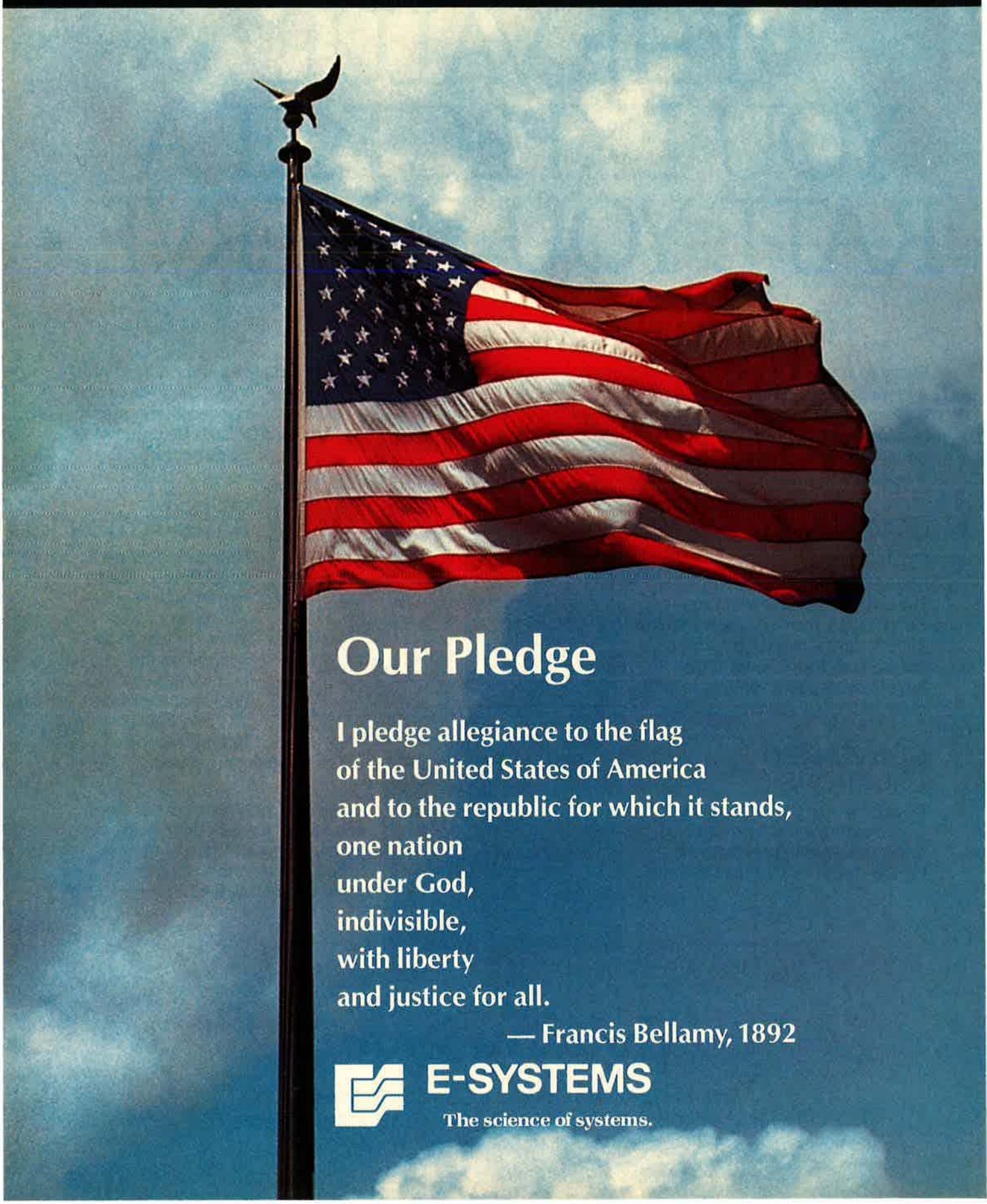

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ble rates remain at an all-time high, quality people continue to enter and stay in the Air Force, and our technological progress will ensure an impressive future combat capability."

The Air Force of tomorrow looks good, too, he said, citing the Advanced Tactical Fighter and the B-2 "Stealth" bomber as bellwether systems to be anticipated.

In keeping with his stewardship of USAF's space mission and capabilities during his term in office, Secretary Aldridge emphasized to his AFA audience how well the Air Force has rebuilt its space-launch capability following the Space Shuttle *Challenger* disaster of January 1986.

"We are back," he said. "But launch is only one part of assuring space-mission operations. What we do when we get there is just as vital. We must put a large part of our investment into the packages our launch systems deliver—into the satellites that meet mission needs today and tomorrow."

Looking ahead to his fairly imminent departure from the Pentagon and the end of the Reagan Administration as well, Secretary Aldridge declared: "We have turned things around. The Air Force is stronger in all mission areas today than ever before in our history. Overall, we leave you the best Air Force in the world."

Secretary Aldridge recited a number of challenges that the Air Force leadership will have to meet. Among these are maintaining the quality of Air Force people, overcoming the increasing tendency of Congress to micromanage Air Force and other defense programs, counteracting and surmounting the venality of a relative handful of people doing business in and with the Pentagon, maintaining the US technological edge, and continuing, amid all this, to "maintain the combat capability of our forces." ■

Awards at the 1988 Air Force Association National Convention

AFA'S NATIONAL AEROSPACE AWARDS

The H. H. Arnold Award (AFA's highest honor to members of the armed forces in the field of National Security)—to the **Air Force Ground-Launched Cruise Missile (GLCM) Team,** Los Angeles AFB, Calif., for its hard work, technical expertise, and operational proficiency, which brought about the tremendously successful GLCM development and deployment, immeasurably improving US and European security. *(Accepted by Gen. Larry D. Welch, Chief of Staff, USAF.)*

The W. Stuart Symington Award (AFA's highest honor to a civilian in the field of National Security)—To the **Hon. George P. Shultz,** Secretary of State, Washington, D. C., for his contributions to national security through a period of unprecedented developments in US-Soviet relations and for his foresight in seizing opportunities to reduce the conflict and instability that can lead to military aggression.

The David C. Schilling Award ("The most outstanding contribution in the field of Flight")—To the **Strategic Air Command Alert Force,** Offutt AFB, Neb., for its diligence, professionalism, patriotism, and vigilance in serving as the cutting edge of America's strategic forces. *(Accepted by Gen. John T. Chain, Jr., Commander in Chief, SAC.)*

The Theodore von Kármán Award ("The most outstanding contribution in the field of Science and Engineering")—To **Bernard Louis Koff,** West Palm Beach, Fla., for his extraordinary technical insight, dynamic innovations, and pioneering work in design and development, which have revolutionized gas turbine propulsion technology and the performance of military and civilian jet engines.

The Gill Robb Wilson Award ("The most outstanding contribution in the field of Arts and Letters")—To **William Randolph Hearst, Jr.,** of New York, N. Y., for his keen insight into the complexities of national security and foreign policy. His nationally syndicated editorials have greatly improved the public's understanding of defense and foreign policy issues.

—Photo by Eddie McCrossan

Gen. John T. Chain, Jr., Commander in Chief, SAC (center), accepts the David C. Schilling Award on behalf of the SAC Alert Force, Offutt AFB, Neb. Maj. Francis Bott (left) and Lt. Sandra Petrie are members of the Alert Force.

The Hoyt S. Vandenberg Award ("The most outstanding contribution in the field of Aerospace Education")—To the **Douglas Community Partnership Council,** Ellsworth AFB, S. D., for rallying community and business support for the Douglas County school district. The Council's aerospace education program is the first of its kind to address the educational needs of Air Force dependents. *(Accepted by Col. Robert E. Roberts, Commander, 812th Combat Support Group.)*

The Thomas P. Gerrity Award ("The most outstanding contribution in the field of Logistics")—to **Lt. Col. Mary B. Hamlin,** 12th Organizational Maintenance Squadron, 12th Flying Training Wing, Randolph AFB, Tex., for her unparalleled professionalism, management initiatives, and innovation as Squadron Commander.

—Photo by Eddie McCrossan

From left to right: AFA Chairman of the Board (then President) Sam E. Keith, Jr., presents The Veterans Administration Employee of the Year Award to Colorado recreation therapist Santo F. Trombetta. Thomas K. Turnage and Martin H. Harris offer their congratulations.

The Veterans Administration Employee of the Year Award—to **Santo F. Trombetta,** recreation therapist, Veterans Administration Medical Center, Grand Junction, Colo., for his vision of a National Winter Sports Clinic for disabled veterans and his enthusiastic dedication in making it a reality.

The Juanita Redmond Award for Nursing—to **1st Lt. Laurie J. McMullan,** 13th Air Force Medical Center, Clark AB, the Philippines, for sustained professional excellence in all aspects of her nursing duties, which frequently include managing complex patient treatment in the Special Care Unit.

The General Edwin W. Rawlings Award for Energy Conservation (Manager)—To **Harold E. Bargar,** Eielson AFB, Alaska, for outstanding achievements in energy conservation within the United States Air Force.

The General Edwin W. Rawlings Award for Energy Conservation (Technician)—To **Johann Krones,** Bitburg AB, West Germany, for outstanding achievements in energy conservation within the United States Air Force.

AFA CITATIONS OF HONOR

The **8th Civil Engineering Squadron,** Kunsan AB, Republic of Korea, for providing outstanding combat support with enthusiasm and dedication. It also has been designated Best Civil Engineering Squadron in Pacific Air Forces. *(Accepted by Maj. Gregory S. Griffin, Squadron Commander.)*

The **21st Tactical Fighter Wing,** Elmendorf AFB, Alaska, for outstanding maintenance effectiveness while significantly reducing expenditures. The military and civilian men and women of the 21st were directly responsible for fifty-six successful F-16 intercepts of Soviet aircraft. Working in temperatures as low as fifty-five degrees below zero, they supported more than 8,000 sorties without a single aircraft incident. *(Accepted by Col. James D. Ferry, Deputy Commander for Maintenance.)*

—Photo by Eddie McCrossan

On behalf of the US Department of Defense, Secretary of Defense Frank C. Carlucci accepts an AFA Citation of Honor. The Department's annual print and videotape public information package, "Soviet Military Power," earned it the award.

The **374th Aerial Port Squadron,** Clark AB, the Philippines, for its rapid response to worldwide emergencies under adverse conditions. The 374th has kept essential troops and cargo on the move and made possible the effective support of US national policy in the Persian Gulf. *(Accepted by Lt. Col. Robert S. Wells, Jr., Squadron Commander.)*

The **1827th Electronics Installation Squadron,** Kelly AFB, Tex., for successfully completing more than 200 electronics installations annually in support of Department of Defense units worldwide, in spite of severe budget cuts, world political tensions, and unprecedented communications systems growth. *(Accepted by Lt. Col. Finch M. Jones, Jr., Squadron Commander.)*

Air Force Chaplain Service, Bolling AFB, D. C., for a successful twelve-month program that communicated the theme "Seek Peace and Pursue It" to many military and civilian audiences and emphasized the role of the peacemaker as a necessary ingredient of national security. *(Accepted by Maj. Gen. Stuart E. Barstad, Chief of Air Force Chaplains.)*

Elmond E. Decker, Foreign Technology Division, Wright-Patterson AFB, Ohio, for his design and development of a radar-decoy configuration that promises to be far superior to existing systems in its ability to attract radar-guided missiles and thus enhance the survivability of our ships at sea.

The **Department of Defense,** Washington, D. C., for increasing public understanding of global military power imbalances and the need for a vigilant and strong US military force by annually developing and publishing print and videotape versions of "Soviet Military Power." *(Accepted by the Hon. Frank C. Carlucci, Secretary of Defense.)*

The **Deputate for Launch Systems,** Los Angeles AFB, Calif., for developing rigorous, state-of-the-art measures to assure the quality and reliability of current launch vehicles and for initiating procurement of a new generation of launch vehicles that will give the nation uninterrupted access to space while saving millions of dollars. *(Accepted by Lt. Gen. Donald L. Cromer, Space Division Commander.)*

SMSgt. Robert L. Gilbert, Hq. Twenty-First Air Force, McGuire AFB, N. J., for designing, developing, and building a prototype air-transportable, rapidly deployable cart that allows transfer of fuel directly from the internal tanks of fixed-wing aircraft into helicopters. This "hot refueling" concept, now being evaluated by the Air Force, is expected not only to improve combat efficiency but also to increase safety, and it promises far-reaching military and civilian applications.

SSgt. Mark E. Hallstein, 41st Electronic Combat Squadron, Davis-Monthan AFB, Ariz., for his creativity as an aircraft maintenance technician. His uncanny ability to visualize the impact of new equipment and his technical expertise in designing and building such equipment have significantly increased the combat effectiveness of his unit.

SSgt. Michael B. Hughes, 416th Organizational Maintenance Squadron, Griffiss AFB, N. Y., for developing several electronic devices and modifying the B-52 Steerable Television. His efforts are estimated to have saved millions of dollars and thousands of maintenance hours.

The **Mathematics, Engineering, Science Achievement (MESA) Program,** San Francisco/Oakland, Calif., for promoting minority participation and achievement in mathematics and science, for promoting educational opportunities in these key academic areas, and for tapping valuable but underutilized human resources that are essential to continued US technical advances. *(Accepted by Wilfred O. Easter, MESA Statewide Director.)*

Capt. Robert W. McAllister, Det. 8, 1361st Audiovisual Squadron, Hurlburt Field, Fla., for directing and producing the "Air Force Now" film series. His initiative, ingenuity, and creativity have earned the series several national and international awards and have given audiences new insights into Air Force missions.

Capt. Susan E. Strednansky, SAF/PATT, Hq. USAF, Washington, D. C., for superb leadership in international public affairs. Her accomplishments in media relations, internal information, and community relations have won her the CINCUSAFE Trophy for the best Public Affairs program in the US Air Forces in Europe and have disseminated a more favorable image of the US and the Air Force.

United States Air Force Academy Airmanship Programs, for generating and maintaining an emphasis on flight throughout USAF Academy cadet training. Basic flight procedures, soaring, parachuting, and other flight-related activities motivate cadets toward flying careers, develop leadership skills, and enhance the aerospace education of future Air Force leaders. *(Accepted by Brig. Gen. Sam W. Westbrook III, Commandant.)*

AFA MANAGEMENT AWARDS FOR LOGISTICS

AFA Executive Management Award—To **Col. Philip H. Ferro,** former Chief, International Logistics Div., Directorate of Materiel Management, San Antonio Air Logistics Center, Kelly AFB, Tex., for outstanding contribution to management while assigned to Air Force Logistics Command.

AFA Middle Management Award—To **Lt. Col. Phillip E. Jung,** Chief, Transportation Operations Division, San Antonio Air Logistics Center, Kelly AFB, Tex., for outstanding contribution to management while assigned to Air Force Logistics Command.

AFA Junior Management Award—To **1st Lt. Drew A. Karnick,** Reliability and Maintainability Special Projects Engineer, Warner Robins Air Logistics Center, Robins AFB, Ga., for outstanding contribution to management while assigned to Air Force Logistics Command.

AFA MANAGEMENT AWARDS FOR SYSTEMS

AFA Distinguished Award for Management—To **Brig. Gen. Kenneth E. Staten,** former Deputy Commander for Tactical Systems, JTIDS and AWACS, Electronic Systems Division, Hanscom AFB, Mass., for outstanding contribution to management while assigned to Air Force Systems Command.

AFA Meritorious Award for Program Management—To **Col. James E. Lee, USAF (Ret.),** former Deputy for Strategic Systems, Electronic Systems Division, Hanscom AFB, Mass., for outstanding contribution to management while assigned to Air Force Systems Command.

AFA Meritorious Award for Support Management—To **James F. Setchell,** former Technical Advisor, Ballistic Systems Division, Foreign Technology Division, Wright-Patterson AFB, Ohio., for outstanding contribution to management while assigned to Air Force Systems Command.

AIR NATIONAL GUARD AND AIR FORCE RESERVE AWARDS

The Earl T. Ricks Award—To a **C-130A Crew of the 118th Tactical Airlift Wing,** Tennessee ANG, Nashville Metropolitan Airport, for outstanding airmanship and the highest degree of crew coordination and courage while flying a C-130A over Tennessee. In spite of catastrophic failure of all hydraulic systems, which degraded aircraft controllability and filled the cargo compartment with highly flammable fluid, the crew, with three crew members at the controls and one attempting to contain the hazard, made a successful landing. *(Accepted by Maj. John R. Cole, Commander.)*

—Photo by Eddie McCrossan

CMSAF James C. Binnicker (left) congratulates TSgt. Timothy P. Carroll on receiving an AFA Special Citation as Outstanding Crew Chief of the Year.

The Air National Guard Outstanding Unit Award for 1988—To the **161st Air Refueling Group,** Phoenix, Ariz., as outstanding Air National Guard Unit of the Year. *(Accepted by Col. William R. Sherer, Air Commander.)*

The Air Force Reserve Outstanding Unit Award for 1988—To the **315th Military Airlift Wing,** Charleston AFB, S. C., as outstanding Air Force Reserve Wing of the Year. *(Accepted by Col. Michael J. Peters, Wing Commander.)*

The President's Award for the Air Force Reserve—To an **HC-130N crew of the 305th Aerospace Rescue and Recovery Squadron,** Selfridge ANGB, Mich., as outstanding Air Force Reserve Flight Crew of the Year. *(Accepted by Maj. Oral W. Carper, Aircraft Commander.)*

SPECIAL CITATIONS AND OTHER AWARDS

The General Curtis E. LeMay Strategic Aircrew Award—To **Crew S-01, 42d Bombardment Wing,** Loring AFB, Me., as the best overall (B-52) aircrew in Strategic Air Command. *(Accepted by Lt. Col. Charles H. Patrum, Commander.)*

The General Thomas S. Power Strategic Combat Missile Crew Award—To **Capt. Stephen G. Cullen and 1st Lt. Rodney L. Holder,** who make up **Senior Peacekeeper Standardization and Evaluation Crew S241A,** 90th Strategic Missile Wing, F. E. Warren AFB, Wyo., as the best overall combat missile crew in Strategic Air Command. *(Accepted by Capt. Stephen G. Cullen, Commander.)*

The Lieutenant General William H. Tunner Aircrew Award—To a **crew of the 20th Special Operations Squadron,** 1st Special Operations Wing, Hurlburt Field, Fla., as the best overall aircrew in Military Airlift Command. *(Accepted by Capt. Paul R. Schumacher, Aircraft Commander.)*

The Lieutenant General Claire Lee Chennault Award—To **Maj. Steven W. Rapp,** Chief, F-15 Tactics and Test Division, 57th Fighter Weapons Wing, Nellis AFB, Nev., as the outstanding aerial warfare tactician.

The General Jerome F. O'Malley Award—To an **RF-4C aircrew of the 12th Tactical Reconnaissance Squadron,** 67th Tactical Reconnaissance Wing, Bergstrom AFB, Tex., as the best reconnaissance crew in the Air Force. *(Accepted by Capt. Victor L. Hnatiuk, Aircraft Commander.)*

The Chief Master Sergeant Dick Red Award—To **MSgt. Gary D. Cole,** 118th Consolidated Aircraft Maintenance Squadron, Tennessee ANG, Berry Field, Nashville, Tenn., for outstanding Air National Guard aerospace maintenance.

The Stuart R. Reichart Award for Lawyers—To **Col. William R. Elliott, Jr.,** Yokota AB, Japan, for outstanding achievements in the field of law within the United States Air Force.

The Paul W. Myers Award for Physicians—To **Lt. Col. David G. Young III,** DCS/Medical Services and Training, Randolph AFB, Tex., for excellence as an officer, a physician, and a medical leader. As Chief, Clinical Medicine Division, DCS/Medical Services and Training, ATC, he has improved the quality of health care and stimulated active participation by other medical officers within the Air Force. As medical consultant to the ATC Physical Standards Section, he has improved the overall quality of entrants to the Air Force.

Outstanding USAF Personnel Manager of the Year Award—To **Maj. David E. Edwards,** Air Command and Staff College, Maxwell AFB, Ala.

Outstanding Crew Chief of the Year Award—To **TSgt. Timothy P. Carroll,** 2d Bombardment Wing, Barksdale AFB, La.

The Verne Orr Award—To the **319th Organizational Maintenance Squadron,** Grand Forks AFB, N. D., for the most effective utilization of human resources within the United States Air Force. *(Accepted by Lt. Col. Maurice C. Hatfield, Commander.)*

The Joan Orr Award—To **Linda S. Allen,** Eielson AFB, Alaska, as the Air Force Wife of the Year.

The Outstanding AFROTC Cadet of the Year Award—To **Elizabeth A. Lutes,** Duke University, Durham, N. C.

The Outstanding CAP Aerospace Education Cadet of the Year Award—To **Lt. Patricia L. Gilbert,** Elkton, Md.

The Diane O'Malley Outstanding Angel Award—To **Andrea Lea Setser,** University of Oklahoma, Norman, Okla.

The Aerospace Briefings and Displays at AFA's National Convention cover 1.3 acres. Visitors come by the thousands to see the latest in defense developments and technology.

State of the Systems Art

More than 100 firms participated in this year's program, fifty of them conducting formal briefings at their exhibits. Some 8,000 people attended. Among them were congressmen and cadets, military members and Convention delegates, senior government officials, allied officers, reporters, and others with an interest in defense R&D.

Secretary of the Air Force Edward C. Aldridge, Jr., accompanied by his wife, pauses on his tour of the displays to inspect Boeing's Seek Spinner drone.

—Photos by Eddie McCrossan

Aerospace Development Briefings & Displays

Mockups and hardware often give a perspective that's lacking when dealing with systems on paper. At the McDonnell Douglas exhibit, an officer checks out the cockpit of the new C-17 airlifter.

—Photos by Eddie McCrossan

Not all the uniforms at the briefings were blue. The program is increasingly popular with military people from other services and other nations. This Army officer hears about the latest in engine development from United Technologies.

Jack Katzen, Assistant Secretary of Defense for Production and Logistics, was among the senior Pentagon officials in attendance.

—Photo by Robert Knudsen

At the Link Flight Simulation booth, Gen. Larry D. Welch, USAF Chief of Staff, talks with John Barainca, recipient of this year's Christa McAuliffe Award from the Aerospace Education Foundation. Later in Convention week, General Welch accepted AFA's H. H. Arnold Award on behalf of the Ground-Launched Cruise Missile team.

—Photos by Eddie McCrossan

Junior AFROTC cadets Susan Pittman and Joanne Ulery of Anchorage, Alaska, try their hands at designing a fighter with Northrop's interactive video demonstration.

AEROSPACE INDUSTRY IN REVIEW

Companies Represented at the 1988 Aerospace Development Briefings and Displays

Allied Signal Aerospace Co.
Bendix-Garrett-Bendix/King
Display of Aircraft Equipment, Including Sophisticated Systems, Subsystems, and Components
AT&T Federal Systems
AT&T Technology for Secure Computing and Communications
Bell Helicopter Textron/Boeing Helicopters
Special Operations—"The Osprey Way"
Boeing Co., The
Strategic Missile Modernization, Strategic Aircraft Modernization, Tactical Forces Modernization
British Aerospace
International Collaborative Aerospace Programs—Eurofighter, T45A/Hawk, ALARM, TERPROM, and Air Combat Simulator
Brunswick Corp.
Air-Launched Standoff Flight Systems
Computer Sciences Corp.
Digital Document Storage and Retrieval
Control Data Corp.
Tactical Air Reconnaissance and Command and Control System Software Development
Emerson Electric Co.
The Microwave Landing System, Special Applications, Radars, and C^3I Equipment
E-Systems
The Vital Link—High Technology Electronics
Ford Aerospace Corp.
Defense, Space, and Communications Systems
General Dynamics Corp.
F-16 Fighting Falcon
General Motors Defense, Delco Electronics Corp., Delco Systems
Allison Gas Turbine Div.
Space and Guidance Systems from Delco and Allison's T-406 Engine
Grumman Corp.
Depot Maintenance Management Information System (DMMIS), EF-111 System Improvement Program
GTE Government Systems
C^3 Systems and Integration
Gulfstream Aerospace Corp.
C-20 Applicatons within USAF
Harris Corp.
Harris's Sophisticated Communication and Information Processing Systems for the US Air Force
Hercules Aerospace Co.
Pegasus,™ A Revolutionary Winged Space Booster
Honeywell
Helping You Control Your Mission
Hughes Aircraft Co.
Advanced Test and Training Technology
IBM Corp.
Systems Integration/Advanced Technology
ITT Defense Technology Corp.
Advanced Systems for an Advanced Air Force
Litton, Itek Optical Systems
Electro-Optics in Action
Lear Astronics Corp.
Innovative Products from Advanced Technology
Learjet Corp.
Learjet's Multi-Purpose Mission Aircraft
Link Flight Simulation Division
USAF Training for the 1990s
Lockheed Corp.
ATF Into the 21st Century
Loral Corp.
ALR 56(C)(M) Radar Warning Receiver and F-15 Simulation
LTV Aerospace and Defense Co.
YA-7F
Magnavox Government and Industrial Electronics Co.
Antijam Communications
Martin Marietta Corp.
Update on Current Air Force Programs
MBB of America, Inc.
MBB's Military Technology Programs
McDonnell Douglas Corp.
McDonnell Douglas—The Corporation's Role in the Multi-Dimensional Air Force of Today and Tomorrow
Motorola Government Electronics
Involvement in Advanced USAF Electronic Programs
Northrop Corp.
Aircraft Manufacturing: The Next Generation
Raytheon Co.
Air-to-Air Missiles
Rockwell International
Autonetics Electronics Systems
Peacekeeper, Minuteman, Small ICBM
Collins Government Avionics Div.
Advanced Military Aircraft Avionics
North American Aircraft
North American Aircraft Meets the Challenge
Space Transportation Systems Div., Satellite and Space Electronics Div., Rocketdyne Div.
Space Report '88
Sundstrand Corp.
Sundstrand Products for USAF Applications
Teledyne, Inc.
The Turbine Engine Story
Textron, Inc.
Tactical Weapons Systems
Thomson-CSF, Inc.
New Concepts for Combat and Ground Attack, Aircraft Cockpit Displays, and Weapon Systems
Tracor, Inc., A Westmark Company
Countermeasures Systems, Expendables, EW Training Systems, Aircraft Modification, Flight Services
TRW Space & Defense
Long-Lived Satellites: The "Freesat" Fleet
Unisys
Unisys Programs for Airspace Development
United Technologies Corp.
F100-PW-229 and JT15D Engines and Advanced Tactical Fighter (ATF) and C-17 Programs
Vitro Corp.
Applying the Vitro Method for Systems Integration and Software Engineering
Williams International
Advanced Gas Turbine Engines

—Photo by Robert Knudsen

Sen. Edward M. Kennedy (D-Mass.) took a special interest in systems produced in his home state. Here he gets a briefing from the General Electric Aircraft Engine Group.

The following companies displayed, but did not hold briefings.

AAI Corp.
Development and Production in Training and Simulation, Automatic Test Equipment, Ordnance, Mechanical Support Equipment, Combat Vehicle Systems, Missiles, and Robotics

Aerojet General
Front-Line Technology in Defense Electronics, Propulsion, and Ordnance

Aérospatiale, Inc.
Tactical Missiles, Aircraft, Helicopters, and Space and Strategic Systems

Aero Systems Engineering, Inc.
ASE Designs, Manufactures, and Supports Gas Turbine Engine Test Facilities

Astra Holdings Corporation

Accudyne
Fuzes, Components, and Subsystems

E. Walters and Co.
Metal Parts for Defense Industry

Kilgore Corp.
Infrared Decoy Flares

Astra Canada Ltd.
Pyrotechnic Devices [for DoD]

Astronautics Corp. of America
High-Performance Instruments, Displays, and Computers for Aircraft

Ball, Aerospace Systems Division
Design and Building Products for Space Applications

Bell Aerospace Textron
Military Landing Systems, Inertial Products and Systems, and Strategic Communications Products

Canadair Inc.
CL-227 Sentinel Remotely Piloted Vehicle

Canadian Marconi Co.
Wide Range of Avionic Equipment Developments

Cleveland Pneumatic Co./Abex Aerospace
Design and Production of Landing Gear, Flight Controls, Hydraulic Subsystems, and Ground Power Converters

Compudyne Corp.
EWI Division: Telemetry Systems and Radio Direction Finders
Vega Division: Portable Radar Tracking and Control Systems for RPVs and Target Drones

Contel
Overview of the Telecommunications and Information Systems and Services Contel Federal Systems Supplies to Government Agencies throughout the World

Deere and Co.
Products Applicable to Air Base Survivability or General Military Use

Dowty
Flight Controls, Polymers for Stealth Applications, and Other Systems for USAF

Eastman Kodak Co.
Infrared-Sensitive Silicide Array and Its Beryllium Optic Processing Facility

Eaton Corp.
Eaton's Advanced Electronic Warfare Systems for USAF

ECC International Corp.
Design and Development of Maintenance and Operator Training Systems

EDO Corp.
Updated Bomb Release Units (BRUs), Ejection Release Units (ERUs) for ATF and CAS Aircraft, and Command and Control Systems

Electronic Data Systems Corp.
Total Systems Integration Approach to Implementing and Managing Information Systems

Evans & Sutherland Computer Corp.
The Simulation Division of Evans & Sutherland Designs and Manufactures Special Purpose Computer Image Generation (CIG) Systems

Fairchild Aircraft Corp.
Merlin and Metro Series of Pressurized Twin-Engine Turboprop Aircraft

Fairchild Industries, Inc.
Automated Military Aircraft Mission Planning System

Fairchild Weston Systems Inc.
Reconnaissance Systems, Digital Cassette Recording Systems, Electro-Optical Camera Systems, Mini-Electronic Countermeasures Jamming Equipment, and ECCM Training Systems

Ferranti International Signal
Providing Applied Technology to the Future

FlightSafety Services Corp.
Total Training System Approach to Aircrew Training and Its Support of the C-5 and C-17 USAF Aircrew Training Programs

GEC Avionics Ltd.
Communications and Navigation Systems, NAV Attack FLIR, SCADC, HUDs, and Related Products

General Atomics
High-Technology Research on Energy and Power System Development

General Electric

Aerospace Group
Spacecraft, Automated Test Equipment, Air Defense Radar, Communications Systems, Reentry Systems, Infrared Search and Track, Simulation and Training Systems, and Gatling-Type Guns

Aircraft Engine Group
F110 Engine and Unducted Fan Technology

Israel Aircraft Industries Ltd.
Aerospace Capabilities

Jane's Information Group
Jane's Yearbooks and Reviews

Kollsman
P-4A Airborne Instrumentation Telemetry Pod

Litton Systems, Inc.

Applied Technology
ALR-74 Advanced Threat Warning Systems

Litton Aero Products
Inertial, Omega, and GPS Navigation Systems

Litton Data Systems
Modular Control Equipment (MCE) AN/TYQ-23 and Advanced Tracking System (ATS) AN/GYQ-51

Litton Guidance and Control Systems
Inertial Navigation Systems and Attitude and Heading Reference Systems

Lucas Aerospace
Engine Accessory Drive Gear Boxes and Actuators, Ejector Designs for Weapon Carriage and Release, Missile Launch and Fin Actuators, and Emergency Power Equipment

Martin-Baker Aircraft Co., Ltd.
MK-14 Electronically Controlled Ejection Seat

Morton Thiokol, Inc.
Space Shuttle and Ballistic Missile Solid Propulsion Systems

Planning Research Corp.
Full Range of Systems Integration and ADP Services, Including the Design, Development, Implementation, and Operation of Advanced Information Handling Systems

Recon/Optical, Inc.
Development and Manufacture of Reconnaissance and Electro-Optical Equipment, Subsystems, and Components

Rolls-Royce, Ltd.
Aircraft Engines for Military Applications

Schwem Technology
Image Stabilizing Lens and Camera Platforms and Camera Stabilizing Systems

Short Brothers, plc
Shorts C-23 Sherpa Transport Aircraft and Shorts Tucano Primary Trainer Aircraft

Smiths Industries
Aircraft Instrumentation and Controls

Snap-On Tools Corp.
Professional Hand Tools and Related Equipment

Standard Manufacturing Co., Inc.
Bomb Loading and Ground Support Equipment and Trailing Arm Drive (TAD) All-Terrain Vehicles

Systron Donner
Components for Aircraft FIRE AND OVERHEAT Detection and Suppression Systems

Texas Instruments
Systems for Future Air Force Requirements—ATF, Recce, SOF, CAS, and Interdiction

Westinghouse Electronic Systems Group
Technologies for ATF, F-16, B-1B, and E-3 AWACS, Ground-Based Sensor Systems, and Missile Launch and Handling Systems

More than 8,000 people—including delegates, members of Congress, award winners, military members, and government officials—were there for AFA's forty-second National Convention.

Convention '88

SPECIAL REPORTS COMPILED BY THE STAFF

CONVENTION PHOTOS BY EDDIE McCROSSAN

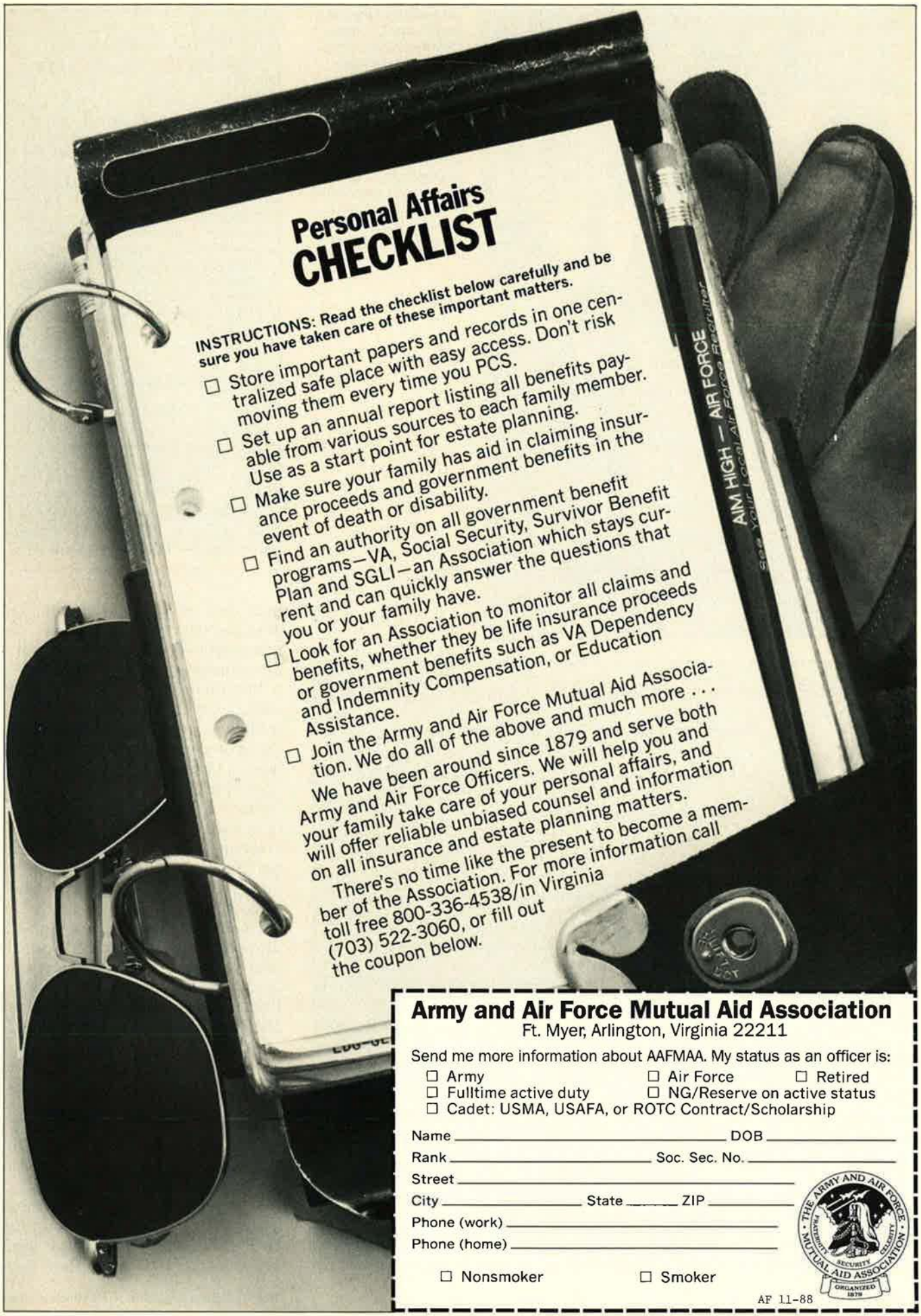
At AFA's annual Opening and Awards Ceremony, Charles G. Durazo (right) is presented with the Man of the Year award, the highest of AFA's Individual Activity awards, by outgoing Board Chairman Martin H. Harris. Mr. Durazo also received an AEF Jimmy Doolittle Fellowship at the annual AEF luncheon.

JACK C. Price of Clearfield, Utah, was elected President of the Air Force Association at AFA's forty-second National Convention in Washington, D. C., September 19–22. The theme of the Convention was "A Creed to Believe—Freedom."

Sam E. Keith, Jr., of Fort Worth, Tex., was elected Chairman of the Board. Thomas J. McKee of Bethpage, N. Y., was reelected National Secretary, and William N. Webb of Midwest City, Okla., was reelected National Treasurer.

Outgoing AFA Chairman of the Board Martin H. Harris received the AFA Gold Life Membership Card at the AFA Opening and Awards Ceremony on Monday of Convention week. The Card is the Association's highest tribute to an AFA leader.

More than 8,000 people took part in one or more of the Convention-related activities at the Sheraton Washington Hotel. The 377 registered delegates—representing forty-six states and the District of Columbia—were joined by a host of others, including senior military and government officials, for the Aerospace Development Briefings and Displays program, featured



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Phone (home) _____

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AF 11-88

On behalf of the General David C. Jones Chapter, N. D., Chapter President Mike Fedorchak (right) accepts the Donald W. Steele, Sr., Memorial Award for AFA Unit of the Year, presented by former USAF Chief of Staff and former Chairman of the Joint Chiefs of Staff Gen. David C. Jones, the Chapter's namesake.

Arthur C. Storz, Sr. Membership Awards

AFA's most prestigious membership awards are named after Arthur C. Storz, Sr., a former permanent AFA National Director, Life Member, and principal founder of Omaha's Ak-Sar-Ben Chapter. The Storz Membership Awards, made possible through a generous endowment to the Association by his son, Art Storz, Jr., are awarded each year for membership excellence based on criteria approved by AFA's Board of Directors for the year ending June 30, 1988.

Storz Individual Award

Helen Haaland

Storz Chapter Award

Del Rio Chapter
Del Rio, Texas
President: Larry E. Martwig

Air Force Association's 1988 Unit Activity Awards

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

General David C. Jones Chapter, North Dakota

Outstanding State Organizations

Florida State Organization
Texas State Organization

Outstanding Chapters

Carl Vinson Memorial Chapter, Georgia (more than 900 members)
Del Rio Chapter, Texas, and Paul Revere Chapter, Massachusetts (401–900 members)
Major John S. Southrey Chapter, Massachusetts (151–400 members)
William A. Jones III Chapter, Virginia (20–150 members)

Exceptional Service Awards

Nation's Capital Chapter, Washington, D. C. (Aerospace Education)
Central Florida Chapter, Florida (Best Single Program)
Alamo Chapter, Texas (Communications)
Brooklyn "Key" Chapter, New York (Community Relations)
Charles A. Lindbergh Chapter, Connecticut (Overall Programming)

Special Awards

Arkansas State Organization
Iron Gate Chapter, New York
Langley Chapter, Virginia

speeches, and social events. On hand to cover the Convention were more than 300 reporters and other news media representatives.

President Ronald Reagan sent AFA a letter expressing his best wishes for a "memorable and productive convention." The President, a Charter Life Member of the Association, noted that AFA has "helped us to maintain a high level of defense preparedness and to develop the kind of scientific and technological leadership necessary to keep our nation strong for decades to come."

Evening highlights included a dinner honoring the Air Force's twelve Outstanding Airmen of the Year. The Air Force Anniversary Dinner Dance featured entertainer Mitch Miller and the USAF Band.

Meeting concurrently with the Convention were trustees of the Aerospace Education Foundation and USAF's command senior enlisted advisors, as well as AFA's Junior Officer Advisory Council, Enlisted Council, and Civilian Personnel Council.

• *Congressional Activity.* Several members of Congress, including Rep. Bill Chappell (D-Fla.), Sen. Ted Kennedy (D-Mass.), Rep. Den-

Named in Memorial Tribute

These are the names of the USAF and AFA leaders and supporters and aviation pioneers who died during the last year: Rear Adm. Frank **Akers,** USN (Ret.); Luis **Alvarez;** SMSgt. Ronald J. **Amitei;** Maj. Gen. Earl O. **Anderson,** USAF (Ret.); Noel H. **Assink;** Martin L. **Blatt;** Col. Max B. **Boyd,** USAF (Ret.); Col. Gregory "Pappy" **Boyington,** USMC (Ret.); Brig. Gen. Charles D. **Briggs,** USAF (Ret.); TSgt. David R. **Brown;** TSgt. Charles A. **Bruce;** Mayor Richard S. **Caliguiri;** Mrs. Esther "Bunny" **Caniff;** Milton A. **Caniff;** Thomas E. **Cindric;** SSgt. Kathy A. **Clark;** MSgt. Lee M. **Cothran;** Maj. Gen. Richard C. Coupland, USAF (Ret.); CMSgt. John **Delaney;** Col. Merlyn H. **Dethlefsen,** USAF (Ret.); Brig. Gen. James P. S. **Devereux,** USMC (Ret.); The Hon. James H. **Douglas,** Jr.; Maj. Gen. John P. **Doyle,** USAF (Ret.); Donn F. **Eisele;** TSgt. David E. **Frazier;** Bob **Gohn;** Maj. Gen. Donald L. **Hardy,** USAF (Ret.); Brig. Gen. Harold R. **Harris,** USAAF (Ret.); Maj. Gen. Victor R. **Haugen,** USAF (Ret.); Robert A. **Heinlein;** Maj. Gen. John H. **Herring,** Jr., USAF (Ret.); SSgt. Patricia A. **Hitt;** TSgt. Donald J. **Hughes;** MSgt. Craig L. **Jones;** Maj. Gen. Lester T. **Kearney,** Jr., USAF (Ret.); Richard J. **Keegan;** Thomas G. **Lanphier,** Jr.; Roger **Lewis;** Lt. Col. Maurice L. **Lien,** USAF (Ret.); Col. Edward M. **Lightfoot,** USAF (Ret.); The Hon. Clare Boothe **Luce;** Arley **McQueen,** Jr.; Lt. Gen. Troup **Miller,** Jr., USAF (Ret.); Lt. Gen. Richard M. **Montgomery,** USAF (Ret.); James G. **Murdock;** Charles J. V. **Murphy;** Monsignor Francis X. **Murphy;** Mrs. Mildred **Nelder;** Lloyd **Norman;** Gen. Lauris C. **Norstad,** USAF (Ret.); Lt. Gen. Donald G. **Nunn,** USAF (Ret.); Col. Donald W. **Paffel,** USAF (Ret.); Col. Joseph C. **Pica,** USAF (Ret.); Kenneth Lee **Porter;** Maj. Gen. Kenneth R. **Powell,** USAF (Ret.); Maj. Gen. Paul T. **Preuss,** USAF (Ret.); Rep. Melvin **Price;** Maj. Gen. Robert E. **Sadler,** USAF, (Ret.); Maj. Gen. Pete C. **Sianis,** USAF (Ret.); Brig. Gen. Turner A. **Sims,** Jr., USAF (Ret.); Col. William L. **Sklar,** USAF (Ret.); Chaplain (Maj. Gen.) Roy M. **Terry,** USAF (Ret.); Dr. Robert M. **Tirman;** Robert **Todd;** Col. Raymond **Towne,** USAF (Ret.); Andrew W. **Trushaw;** Maj. Gen. Arthur W. **Vanaman,** USAF (Ret.); William O. **Wissman; Col. Bruce D. Witwer,** USAF (Ret.); Brig. Gen. Clair L. **Wood,** USAF (Ret.); George **Wunder;** John K. **York;** Carroll L. **Zimmerman,** Sr.; Col. Donald D. **Zurawski,** USAF (Ret.).

Air Force Association's 1988 Community Partner Membership Awards

Special Award

This one-time-only (1988) award was created to recognize chapters that have recruited 100 or more Community Partners as of June 30, 1988.

Carl Vinson Memorial Chapter, Georgia
General David C. Jones Chapter, North Dakota

President's Award

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

Mobile Chapter, Alabama

Gold Awards

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

Admiral Charles E. Rosendahl Chapter, New Jersey
Ak-Sar-Ben Chapter, Nebraska
Ark-La-Tex Chapter, Louisiana
Blytheville Chapter, Arkansas
Boise Valley Chapter, Idaho
Enid Chapter, Oklahoma
Fairbanks Midnight Sun Chapter, Alaska
Florida Highlands Chapter, Florida
Joe Walker Chapter, Pennsylvania
Langley Chapter, Virginia
Lloyd R. Leavitt, Jr., Chapter, Michigan
Pope Chapter, North Carolina
Roanoke Chapter, Virginia
Scott Berkeley Chapter, North Carolina
Tallahassee Chapter, Florida

ny Smith (R-Ore.), Sen. Ted Stevens (R-Alaska), and Sen. Steven Symms (R-Idaho), participated in various Convention activities.

Fifteen state delegations sponsored breakfasts at AFA's Congressional Breakfast program on Tuesday and Wednesday of Convention week. Several Senators and members of the House of Representatives participated. Among these were Sen. Sam Nunn (D-Ga.), Sen. J. James Exon (D-Neb.), and Sen. John Warner (R-Va.) of the Senate Armed Services Committee; Rep. Jon Kyl (R-Ariz.) of the House Armed Services Committee; and Reps. Lindy Boggs (D-La.) and Frank Wolf (R-Va.) of the House Appropriations Committee.

● *Resolutions and Changes.* The Convention voted two significant changes to the AFA constitution and bylaws.

Beginning next year, eighteen AFA National Directors will be elected. Six will serve three-year terms, six will serve two-year terms, and the remaining six will serve one-year terms. At the end of their three-year terms, those National Directors will be ineligible for reelection for one year. A total of nine years as a National Director, instead of ten years, is now required to become a permanent National Director. After the 1989 transition year, only six National Directors will be elected annually for single three-year terms; they will not be eligible for reelection for a one-year period.

Also to be implemented in 1989 is a change affecting Under-40 Directors. No more than three Under-40 Directors may be elected in each year for a period of two years. Under-40 Directors may serve only a single two-year term.

The Convention passed a resolution calling for the issuance of a commemorative stamp honoring World War I ace Capt. Edward V. Rickenbacker. The Convention passed another resolution in support of President Reagan's initiatives calling for the full accounting of POW/MIAs in Vietnam and any other wars, including future ones.

● *New in Office.* Six new National Vice Presidents were elected at the first AFA business session during the Convention. They are Gerald S. Chapman (Far West Region),

Air Force Association's 1988 Individual Activity Awards

AFA Man of the Year

Charles G. Durazo

Presidential Citations

Aaron C. Burleson
Joseph R. Falcone
Edward J. Fox
William J. Gibson
Gerald V. Hasler
David L. Jannetta
Irene G. Johnigan
Jan M. Laitos
James P. LeBlanc
Bud A. Walters

Special Citations

Oliver R. Crawford
C. J. Tippett
Walter G. Vartan
Roy P. Whitton
Minot AFB (North Dakota)
Francis E. Warren AFB (Wyoming)

Exceptional Service Awards

Richard D. Anderson
John L. Beringer
Kaye H. Biggar
William A. Bingham, Jr.
Gary L. Brinner
Gerald S. Chapman
S. Ron Chromulak
Horace W. Cook
Frank M. Coorsen
Phillips J. Copeland
Dr. Kenneth Daly
Harry E. Davis
Toby J. duCellier
George Estrella
Fred E. Eubanks
Frank Gallagher
Jack K. Gamble
Robert W. Gates
John R. Gilchrist
Robie Hackworth
M. N. Dan Heth
Victor R. Hollandsworth
Cecil H. Hopper
Paul J. Johnston
Glenn A. Jones
Kathleen L. Landis
Virginia M. Leitch
J. Rilee Lindquist
James C. Lloyd
Capt. Steven F. Maurmann
John T. McCarthy
George W. McKay
Thomas J. McKee
Daniel E. McPherson
Robert A. Munn
CMSgt. Norman T. Parnes
Raymond W. Peterman
Corrina L. Petrella
Jack G. Powell
Ronald E. Resh
John P. Russell
William J. Schaff
William A. Solemene
Everett E. Stevenson
Tommy Sylvester
Charles D. Taylor
James R. Temple
Dennis Theriault
Muriel Tierney
Betty Lou Warren
Dorothy L. Welker
Emery S. Wetzel, Jr.
Marcus C. Williams
Edwin S. Wittbrodt
William G. Zavatson

Medals of Merit

Duane A. Aamont
Joseph H. Allen, Jr.
Cecelia F. Andretta
Richard W. Asbury
Marilyn Ashley
Warren D. Barter
Bruce F. Bauer
Carl E. Beck
Vivian M. Benson
Robert Berglund
Faye Beringer
William P. Binks, Jr.
Keith M. Bischoff
Eric C. Blazi
Capt. Reb Byrne
C. Wayne Calhoun
Kenneth W. Calhoun
Joe M. Campbell
C.N. Chamberlain
Eugene S. Chaney
Kenneth B. Chase
Lt. Robert T. Childress
Dan D. Clinton, Jr.
Martin G. Colladay
Carol Comeau
Oliver J. Cook, Jr.
David D. Cooper
Robert E. Copley
Robert C. Craig
William D. Croom, Jr.
David R. Cummock
John Cutney
James E. Cvik
William B. Daly
Wesley A. Davis
Bradley Day
Lawrence F. DePaulo, Jr.
Denton D. Diestler
Robert J. Dingle, Jr.
Eric S. Doten
Vincent duCellier
Paul Dudley
Laura E. Dumez
Marshall N. Dunbar, Jr.
Donald N. Edmunds, Jr.
Glen Edwards
Howard J. Eichner
William H. Ernst
John Everhard
Michael Farren
Michael J. Fedorchak
Johnny C. Fender
Stephen E. Finney
Thomas M. Fitzgerald
Henry A. Garcia
Patricia Gardner
Capt. Marianne Germann
Capt. (Dr.) William J. Germann
Jack Gilpin
Herbert Goodman
Ralph R. Goss
Ken Grant
Esther F. Gregory
Robert W. Gregory
Helen Haaland
Joseph L. Hardy
Tommy G. Harrison
Andrew H. Heath
Daniel C. Hendrickson
Ellen Hertlein
Gloria M. Hicks
Howard B. Hitchens
Allen C. Hoffman
Fred Hollowell
Stanley J. Hryn
Ken Huey, Jr.
Francis E. Jeffery
Theron L. Jenne
Frederick B. Jones
Paul D. Kiddon
Mary E. Kilgore
Dewey King
Robert H. Krumpe
Richard E. Kyle
Peter B. Lane
James E. Laney
Hal Langerud
Joseph E. Lanser
Guy W. Leach
Al Leferink, Jr.
David W. Lepori
Robert J. Lilljedahl
2d Lt. Thomas Looby
Dennis Love
John H. Loyd
John Lynch
Otis M. Lytle, Jr.
Linn E. Mann
William A. Mann, Jr.
Maurice E. Marler
Robert W. Marsh, Jr.
Larry E. Martwig
Noboru Masuoka
Capt. Joel R. Maynard
Capt. Michael J. McGrevey
Brig. Gen. Joel McKean
Shirley L. Miles
Dee Dee Millican
Richard C. Milnes
Richard B. Moffatt
A. J. Monroe
Carrol J. Moore
Clement P. Moore
Alvin R. Moorman
James L. Murphy
John S. Murphy
Dorothy E. Myers
E. G. Myers
Richard L. Neal
Glen O. Neely
Robert C. Newman, Jr.
George Nicklaus
James E. Nolen, Jr.
James P. Nowlin
Clifford E. O'Neal
Richard L. Peluso
Col. David S. Penniman
John Petrovich
Thomas E. Pierce
Floyd H. Pinkston
Bill Powell
Roland P. Powell
Ronald I. Powell
Oscar I. Rearick
Nima Reavis
H. Thomas Reed
David F. Reese
Raymond Restagno
Maureen G. Reyling
John A. Root
Robert Rutledge
David Sanderson III
Richard J. Saucier
Pat L. Schittulli
Jean Schobert
Helen S. Seidel
Robert S. Seidel
Andrew E. Sentgeorge
Elroy D. Simnacher
William L. Skliar *(posthumous)*
Barry L. Smith
Clair J. Smith
Frank L. Smith
Jane A. Snow
Robert C. Sorensen
Michael E. Stansell
John H. Stein
O. V. Stephenson
Brig. Gen. Wilbur T. Stewart
Roger Stiles
Harold Strack
John D. Strauss
Richard Strelka
Harry R. Sunderland
Kenneth L. Tallman
Roger Tierney
H. L. Tower
Charles G. Treser
Maj. Fran Tunstall
John E. Turner
2d Lt. Michael R. Underwood
Delores Vallone
Ken Waits
June V. Wallin
Terry G. Warren
William J. Warren
Frank R. Watkins
Wayne E. Whitlatch
Paul A. Willard III
Gene F. Williams
Harry Williams
Lucien D. Wise
Larry Yanotti
John K. York *(posthumous)*
Marylyn V. Zywan

Advising newly elected AFA President Jack C. Price (second from left) are (left to right) National Director Judge John G. Brosky, permanent National Director Martin H. Harris, and National Director and former President Gerald V. Hasler.

AEF officers plan the Foundation's 1988–89 activities. From left: John R. Alison, Treasurer; George D. Hardy, Chairman of the Board; James M. Keck, President; Edward M. Crane, Jr., Vice President; and Walter E. Scott, Secretary.

1988 AFA Membership Achievement Awards

AFA Membership Achievement Awards are presented to those AFA chapters, states, and regions that achieve certain new membership goals as established by AFA's Membership Committee. The following units achieved these objectives for the year ending June 30, 1988. AFA salutes them as pacesetters in the important work of enlarging and strengthening the Association.

State	President
Nevada	Emery S. Wetzel, Jr.
Chapters	**Presidents**
Alexandria, Louisiana	Harmon A. Dungan, Jr.
Bozeman, Montana	Ronald R. Glock
Charles A. Lindbergh, Connecticut	Richard C. Anderson
Citrus Belt, Florida	Samuel J. Hardin
Cochise, Arizona	Thomas A. Shtogren
Eagle, Pennsylvania	Raymond J. Restagno
Gainesville, Florida	Curtis A. Nolen
General Bennie L. Davis, Connecticut	Lily Tata
General David C. Jones, North Dakota	Michael J. Fedorchak
General James R. McCarthy, Florida	William L. Sparks
Golden Triangle, Mississippi	James E. Nolen, Jr.
High Point, New Jersey	Dolores Vallone
Joe Walker, Pennsylvania	James M. Cain
Mercer County, New Jersey	Allen C. Hoffman
Mid-Ohio, Ohio	Robert Lovett
Panama City, Florida	James F. Fantaski
Paul Revere, Massachusetts	Lyle T. Niswander
Peace River, Florida	Joseph Musil
Quad Cities, Illinois	Benjamin F. Schneider
Thunderbird, Nevada	Juan B. Sotomayor
Weld County, Colorado	Robert S. Zimmerman
West Suburban, Illinois	Donald D. Clark
William A. Jones III, Virginia	Robert E. Frazier

John E. Kittelson (North Central Region), Jack G. Powell (Rocky Mountain Region), Everett E. Stevenson (South Central Region), Kenneth C. Thayer (Northeast Region), and Joe Zaranka (New England Region).

Six new National Directors—including several who have served in years past—will take their place at the next meeting of the AFA Board. They are Joseph R. Falcone of Rockville, Conn., Jack B. Flaig of Lemont, Pa., William J. Gibson of Ogden, Utah, David Graham of Laguna Niguel, Calif., Thomas J. Hanlon of Buffalo, N. Y., and H. B. Henderson of San Diego, Calif. Outgoing Chairman of the Board Martin H. Harris of Winter Park, Fla., resumes his Board status as permanent National Director.

Five new Under-40 Directors joining the AFA Board are Richard S. Cain of Hopkins, S. C., Cheryl L. Gary of Redlands, Calif., Mary K. Readly of Grand Forks, N. D., Michael E. Stansell of Heath, Ohio, and Bruce R. Stoddard of Tucson, Ariz.

For a complete list of National Vice Presidents and Directors, including those reelected, see "This Is AFA" on page 121.

• *Membership Report.* At a reception for delegates on Sunday of Convention week, then AFA National President Sam E. Keith, Jr., announced that the number of AFA Life Members and patrons grew by more than eight percent this year.

• *Aerospace Education Foundation.* James M. Keck of San Antonio, Tex., was reelected President of the Aerospace Education Foundation. George D. Hardy of Hyattsville, Md., was reelected AEF Chairman of the Board. Edward M. Crane, Jr., of New York, N. Y., was elected Vice President, John R. Alison of Arlington, Va., was reelected Treasurer, and Walter E. Scott of Dixon, Calif., was reelected Secretary.

For a complete list of AEF officers and trustees, see the accompanying box.

A sound/slide entry on "Aerospace Heroes of Today" won the Foundation's annual contest for presentations by Air Force Junior ROTC cadets. The winning entry was from West Anchorage High School, Anchorage, Alaska. The theme for next year's contest is "Why We Serve."

John Barainca, an aerospace science teacher at Brighton High School in Salt Lake City, Utah, was presented the third annual Christa McAuliffe Memorial Award at the AEF luncheon on Monday of Convention week.

• *Acknowledgments.* Parliamentarian for the AFA National Convention was Edward J. Monaghan. Edward A. Stearn was Sergeant at Arms. Inspectors of Elections were David L. Blankenship, Chairman; Earl D. Clark, Jr.; and James E. "Red" Smith. Bryan L. Murphy, Jr., chaired the Credentials Committee, serving with Donald D. Adams and Herbert M. West, Jr.

The Association is particularly grateful to a corps of volunteers who assisted the staff in Convention support: Norm Aubuchon, Cecil Brendle, Frank Bricel, Chris Coffelt, Evie Dunn, Chuck Forth, Kenneth Griffin, Chuck Lucas, Mary Lucas, P. Oury, Ken Wilson, and John Zipp.

The 1989 Convention will be held at the Sheraton Washington Hotel, Washington, D. C., on September 18–21. ■

(More coverage on p. 122.)

This Is the Aerospace Education Foundation

Chairmen Emeriti
Gen. James H. Doolittle, USAF (Ret.)
Hon. Barry Goldwater

Chairman of the Board
George D. Hardy

President
James M. Keck

Vice President
Edward M. Crane, Jr.

Treasurer
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Secretary
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Executive Director
Charles L. Donnelly, Jr.

Deputy Executive Director
Kenneth A. Goss

Director
Emilio G. Tavernise

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Edward A. Stearn
James H. Straubel
Mrs. Henry H. Timken, Jr.
George A. Vaughn
William N. Webb
John W. Williams
(Vacancies yet to be filled)

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Russell E. Dougherty
Charles A. Gabriel
Jan Laitos
Frank M. Lugo
Hans Mark
Jack Powell
Kenneth A. Rowe
Lawrence Skantze
Harold A. Strack
Dorothy Welker
Harry Wugalter

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John G. Brosky
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Jack B. Flaig
Don C. Garrison
Jack B. Gross
Gerald V. Hasler
Leonard W. Isabelle
William V. McBride
William C. Rapp
Sherman W. Wilkins

Aerospace Education Foundation Fellowships

(Presented at September 19 Luncheon, Listed Alphabetically)

Individual Jimmy Doolittle Fellows	Sponsors
Earl D. Clark, Jr.	Midwest Region
Robert Collings	Paul Revere Chapter
Charles G. Durazo	Central East Region
Emlyn I. Griffith	Colin P. Kelly Chapter
Clement P. Moore	Langley Chapter
Hon. H. James Saxton	New Jersey State AFA
Robert S. Seidel	Texas State AFA
Joel T. Wareing	Air Force Association and the Aerospace Education Foundation
Brig. Gen. John W. Williams, USAF (Ret.)	Brig. Gen. William W. Spruance, USAF (Ret.)
Donald E. Zweifel	Vietnam Veterans Historical Association

Individual Ira Eaker Fellows	Sponsors
Maj. Gen. William S. Chairsell, USAF (Ret.)	Nevada State, Thunderbird, and Dale O. Smith Chapters
Harriet Helen Ostrander Johnson *(in memoriam)*	Lt. Col. Marjorie O. Hunt, USAF (Ret.)
James and Teddy LeBlanc	South Central Region
Col. Dick Paul, USAF	Paul Revere Chapter
Mrs. Margaret D. Strack	Brig. Gen. Harold A. Strack, USAF (Ret.)

This Is AFA

The Air Force Association is an independent, nonprofit, aerospace organization serving no personal, political, or commercial interests; established January 26, 1946; incorporated February 4, 1946.

OBJECTIVES: The Association provides an organization through which we as a free people may unite to address the defense responsibilities of our nation imposed by the dramatic advance of aerospace technology; to educate the members and the public at large in what that technology can contribute to the security of free people and the betterment of mankind; and to advocate military preparedness of the United States and its allies adequate to maintain the security of the United States and the free world.

PRESIDENT
Jack C. Price
Clearfield, Utah

BOARD CHAIRMAN
Sam E. Keith, Jr.
Fort Worth, Tex.

SECRETARY
Thomas J. McKee
Bethpage, N. Y.

TREASURER
William N. Webb
Midwest City, Okla.

NATIONAL VICE PRESIDENTS

Information regarding AFA activity within a particular state may be obtained from the Vice President of the Region in which the state is located.

Donald D. Adams
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1701 FirsTier Bank Building
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(408) 943-6058 or 6976

Far West Region
California, Nevada, Arizona, Hawaii, Guam

Oliver R. Crawford
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Austin, Tex. 78720
(512) 331-5367

Southwest Region
Oklahoma, Texas, New Mexico

Charles G. Durazo
P. O. Box 7367
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North Central Region
Minnesota, North Dakota, South Dakota

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Northwest Region
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Jack G. Powell
1750 S. Ironton
Aurora, Colo. 80012
(303) 370-4787

Rocky Mountain Region
Colorado, Wyoming, Utah

James E. "Red" Smith
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Princeton, N. C. 27569
(919) 936-9361

Southeast Region
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(901) 454-2484

South Central Region
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Northeast Region
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Chicago, Ill. 60610
(312) 644-8216

Great Lakes Region
Michigan, Wisconsin, Illinois, Ohio, Indiana

Joseph A. Zaranka
9 S. Barn Hill Rd.
Bloomfield, Conn. 06002
(203) 236-6077

New England Region
Maine, New Hampshire, Massachusetts, Vermont, Connecticut, Rhode Island

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Redlands, Calif.

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Nathan H. Mazer
Roy, Utah

William V. McBride
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Ponte Vedra Beach, Fla.

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Bryan L. Murphy, Jr.
Fort Worth, Tex.

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J. Gilbert Nettleton, Jr.
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Ellis T. Nottingham
Atlanta, Ga.

Sam E. Parish
Mount Airy, Md.

J. Michael Phillips
Grand Forks, N. D.

William C. Rapp
Williamsville, N. Y.

Mary K. Readly
Grand Forks, N. D.

Julian B. Rosenthal
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Pinehurst, N. C.

Walter E. Scott
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Los Angeles, Calif.

William W. Spruance
Marathon, Fla.

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Edward A. Stearn
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James H. Straubel
Fairfax Station, Va.

Harold C. Stuart
Tulsa, Okla.

James M. Trail
Oro Valley, Ariz.

A. A. West
Hayes, Va.

Herbert M. West
Tallahassee, Fla.

Sherman W. Wilkins
Bellevue, Wash.

Charles L. Donnelly, Jr.
(ex officio)
Executive Director
Air Force Association
Arlington, Va.

Rev. Richard Carr
(ex officio)
National Chaplain
Springfield, Va.

Capt. Joel Maynard
(ex officio)
Chairman, Junior Officer Advisory Council
Scott AFB, Ill.

CMSgt. Norman T. Parnes
(ex officio)
Chairman
Enlisted Council
Washington, D. C.

Scott E. Boyd
(ex officio)
National Commander
Arnold Air Society
University Park, Pa.

USAF Chief of Staff Gen. Larry D. Welch congratulates H. R. "Bobby" Case, President of the Mobile, Ala., Chapter, which won AFA's President's Community Partner Membership Award.

AFA Enlisted Council member MSgt. James H. Daniels, one of 1987's Outstanding Airmen of the Year, attends the Enlisted Council meeting during Convention week.

Discussing policy at the AFA Convention are George D. Hardy, AEF Chairman of the Board; Rep. Bill Chappell (D-Fla.); and Under Secretary of the Air Force James F. McGovern.

Gen. R. E. "Dutch" Huyser, USAF (Ret.), autographs copies of his book, Mission to Tehran, *at the Aerospace Education Foundation booth during the Convention.*

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Airman's Bookshelf

The Fly Guys

Test Pilots—The Frontiersmen of Flight (Revised Edition), by Richard P. Hallion. Foreword by Michael Collins. Smithsonian Institution Press, Washington, D. C., 1988. 359 pages with photos, appendix, notes, bibliography, and index. $17.50 paperback.

Test pilots are a unique breed. Always have been and always will be. Richard Hallion traces the history of the breed from Eilmer, the Benedictine monk who, in the year 1000, leapt off Malmesbury Abbey in England in a homemade hang glider, to Dick Rutan and Jeana Yeager, who, in 1986, flew around the world in a homemade airplane nonstop on a single tank of gas. Almost every other notable test pilot who flew in between is included.

Far from a mere *Who's Who* of test pilots, this book is an instructional text as well as a history of flight. Throughout the book, author Hallion simplifies such complex aerodynamic concepts as inertia coupling and the workings of supercritical wings, rendering them comprehensible to all readers. An understanding of these concepts helps to show why flight test went in certain directions at certain times.

Test Pilots breaks aviation down by periods. The first deals with the quest for flight from Otto Lilienthal and Octave Chanute to the Wright brothers. The second period could best be described as a time of, "We've got the airplane, now what do we do with it?" People such as Roland Rolfs, Jimmy Doolittle, Wiley Post, and Eddie Allen took the torch from the Wrights and carried aviation out to the frontier.

The 1950s and 1960s were probably the heyday of flight testing. First jets (Tony LeVier), breaking the sound barrier (Chuck Yeager), vertical flight (pilots like "Skeets" Coleman and Pete Girard), and travel to the edge of space (Scott Crossfield, Joe Walker, and others) and finally to the moon (Neil Armstrong and "Buzz" Aldrin) all happened in those years.

Today, aviation and space may not be making the huge technological leaps of twenty years ago, but that doesn't mean that nothing exciting is going on. Perfecting fly-by-wire, control-configured vehicles, propfans, and the like promises great rewards in the future.

Along with the ages of aviation came the evolution of the test pilot. Famed Boeing test pilot Eddie Allen described it as a three-step process, from the "Here Goes Nothing" period when willingness to take risks bordered on the foolhardy, to the day of "the type of pilot who was bent on reducing his risks and . . . who [planned] for every emergency." In the final stage, Allen writes, "there . . . emerges a new attitude . . . away from chance-taking altogether and toward a complete analysis of each problem that can be met prior to flight." He says that the third period had been reached by the 1930s.

For all its glamour and excitement, flight test also has its grim side. Many pilots, like Mel Apt and Milo Burcham, were killed during flight test, while others like Joe Walker and Iven Kincheloe were killed during routine flights. Mechanical problems were the cause of many deaths, but just as many pilots died from split-second lapses in concentration.

To combat this reality, the pilots turned to humor. Author Hallion relates a number of stories like that of Jack Woolams, the Bell test pilot, who startled a group of Army pilots not only by flying a plane without a propeller (America's first jet, the P-59), but also by wearing a gorilla mask and smoking a cigar in the cockpit.

The author also uses humor to speed along the narrative. He writes that "Icarus . . . exceeded his craft's thermal limits, inducing structural failure with subsequent loss of control." He also notes that "the French balloonist Jean Pierre Blanchard actually dropped animals with parachutes from his balloon in 1785 to entertain watching crowds, something the Society for the Prevention of Cruelty to Animals would certainly not condone today!"

Hallion frequently lets his subjects do the talking. One of the most riveting passages comes from Jimmy Collins, a test pilot and a reporter for the New York *Daily News.* Collins had a premonition that it was time to leave the test flying game, and he wrote a column entitled "I Am Dead" that only appeared in his autobiography after he was indeed killed on a test flight. In it he wrote, "The cold but vibrant fuselage was the last thing to feel my warm and vibrant flesh." Powerful stuff.

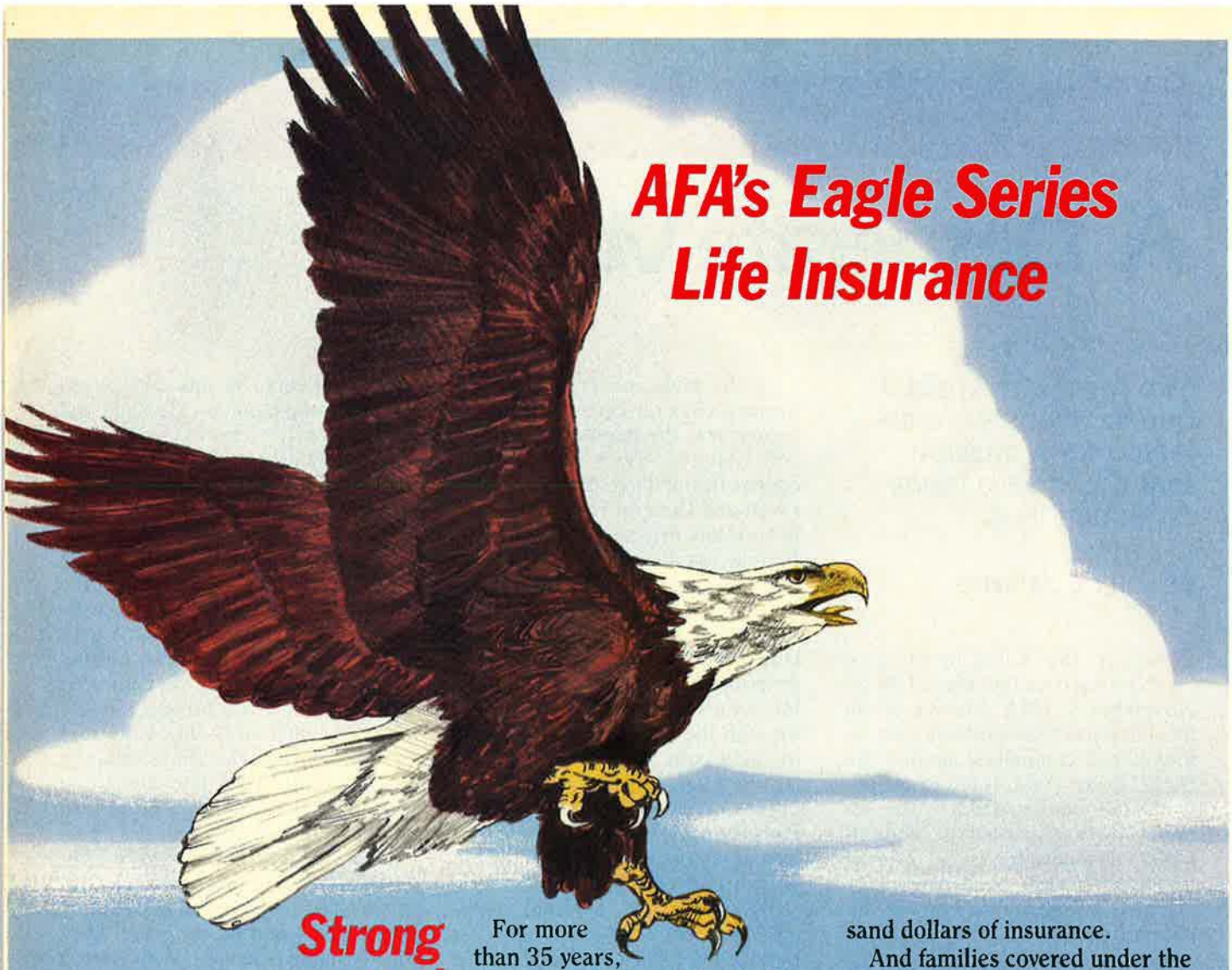
Test Pilots is a well done book. The story is detailed enough for technical readers and historians (examples include exact dates for famous flights), but it moves quickly enough for the reader who is only mildly interested in the subject matter. As a concise history, it is first rate, and it is even a good reference book.

—Reviewed by Jeffrey P. Rhodes, Aeronautics Editor.

New Books in Brief

Vietnam: The Heartland Remembers, by Stanley W. Beesley. This unique book provides a voice for thirty-three Oklahomans who fought the war, waited behind, or are still waiting for family members to return. While the book's focus may be too narrow for some, the vignettes (none is longer than twelve pages) of these people—medics, wives, helicopter pilots, and everyone in between—make for a powerful read.

Two of the author's own tales (an Army Ranger, he was twice awarded the Bronze Star) are included, but he mostly lets the people tell their stories. The book is divided into four sections, each showing a different aspect of how the war affected these people—why they went, fighting the war, what else went on, and what they found when they got back. While the stories center on Oklahomans, many of the pieces have universal meaning. An interesting book. The University of Oklahoma Press, Norman, Okla., 1988. 216 pages, with map, glossary, biographical sketches, and index. $7.95 paperback.



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A Desperate Venture

Two men with special qualifications were selected for a mission that could save many American lives.

BY JOHN L. FRISBEE

TORCH, the Allied invasion of North Africa that kicked off on November 8, 1942, was one of the most important but perhaps least remembered campaigns against the Berlin-Rome Axis. It led to the defeat of Germany's Afrika Korps, secured North Africa and the Mediterranean as a base for the invasion of Southern Europe, and temporarily placated Joseph Stalin, who was impatiently demanding the opening of a second front.

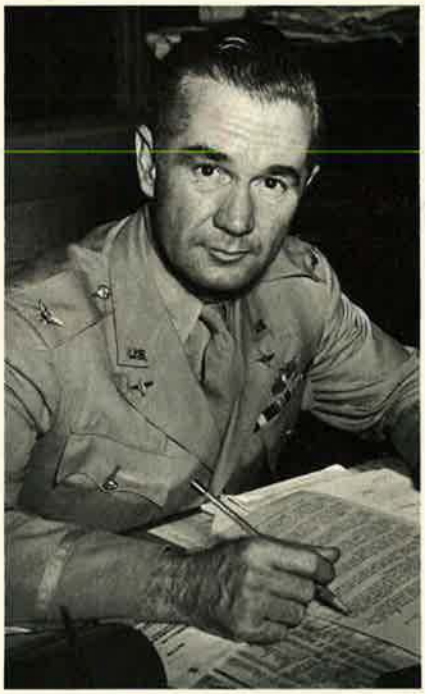
The plan called for landings by British and American forces near Oran and Algiers on Algeria's Mediterranean coast and by American troops under Maj. Gen. George Patton at three sites near Casablanca on Morocco's Atlantic coast. The defenders in all areas were French troops under commanders who had given their oaths of loyalty to Marshal Pétain's Vichy government, which was collaborating to varying degrees with the Germans. The strongest opposition was expected in Morocco, where Patton's 37,000 men would face about 55,000 French troops supported by 130 combat aircraft, several naval vessels, and many shore batteries.

Most important of Patton's three landing beaches was Mehdia, about eighty miles north of Casablanca. Troops landing there at 0400 hours were to seize the airfield at Port Lyautey, a short distance up the Sebou River. Until the field was secure, air suppport would be provided by US Navy carrier aircraft.

Of the many uncertainties confronting General Patton, most worrisome was the degree of intensity with which the Vichy French would oppose the landings. President Roosevelt and General Eisenhower had broadcast messages urging the French not to resist, but had the messages been received? Would they be heeded? Brig. Gen. Lucian Truscott, commander of the Mehdia landing force, decided on what he described as "a desperate venture." He would send two emissaries through the French lines to locate the area commander and persuade him to cooperate. From many volunteers, Truscott selected Maj. Pierpont Morgan Hamilton and Col. Demas "Nick" Craw, the commander of his air contingent.

Why these two? Harvard graduate Pete Hamilton had been an Air Service pilot in World War I. In the interwar years, he was engaged in international banking. He had lived in France for several years and spoke fluent French. He was serving as General Truscott's intelligence chief. Colonel Craw, a 1924 graduate of West Point, had commanded pursuit units before serving as Military Air Observer with the RAF in Egypt and as a military attaché in Greece and Turkey. A man of persuasive personality, he had many friends among foreign officers, including the French.

At first light on D-Day, Craw and Hamilton headed for shore aboard a landing craft. They intended to go as far up the Sebou River toward Port Lyautey as possible, then proceed in a light truck driven by Pfc. Orris Corey, but heavy artillery fire from shore batteries prevented them from entering the river. They finally made a landing on the beach



The daring truce mission of Maj. Pete Hamilton (left) and Col. Nick Craw saved hundreds of American lives in French Morocco in World War II. They were the first AAF recipients of the Medal of Honor in the European-Mediterranean theater and the only airmen to receive the Medal for valor not involving air combat.

at Mehdia at 0720 hours. After being pinned down by repeated attacks from strafing French fighters, they worked their way across the beach, only to be pinned down again by friendly naval gunfire and French artillery. When the bombardment lifted, they passed through two French formations. The truck bore American and French flags and a flag of truce.

As the truck passed over a slight rise, a machine gun opened fire at close range, killing Colonel Craw, who was seated between Corey and Hamilton. The two survivors were taken prisoner and driven to the French headquarters. The local commander refused to order a cease-fire, but agreed to pass the message Major Hamilton was carrying to Major General Mathenet, commander of the North Morocco area. Hamilton was not allowed to contact his headquarters by radio or to meet with other American prisoners. The French feared American reprisals for having killed an officer traveling under a flag of truce.

On the evening of November 10, after two days of often heated discussions, General Mathenet agreed to capitulate. The following morning, Marshal Pétain's deputy, French Admiral Jean Darlan, who was in Morocco, ordered all French troops in North Africa to cease resistance. The formal surrender took place at a meeting arranged by Major Hamilton.

On the recommendations of Generals Truscott, Patton, and Eisenhower, the Medal of Honor was awarded to Major Hamilton and posthumously to Colonel Craw for a daring mission that contributed to saving many American lives. They were the first Army Air Forces recipients of the Medal in the European-Mediterranean theater of World War II and the only airmen to be awarded that decoration for valor not involving air combat.

After the war, Pete Hamilton served as a military-political officer in Washington and Europe and at many international conferences. He retired as a major general in the Air Force Reserve, and died at his home in Santa Barbara in 1982. ■

Thanks to Lt. Col. Raymond Fredette and the Office of Air Force History for making available his research on this mission.

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Intercom

By John R. "Doc" McCauslin, CHIEF, FIELD ORGANIZATION DIVISION

Dinners Here and There

AFA's Ogden (Utah) Chapter displayed its support of AFROTC cadets by sponsoring "ROTC Dining Out" for cadets from Brigham Young (Provo), Utah State University (Logan), and the University of Utah (Provo). AFA members, community business partners, and people from the Hill AFB area expressed their support for the guests of honor, future Air Force leaders. Guest speaker for this special event was the USAF "Top Gun 1988," Maj. Danny Hamilton from the 419th Tactical Fighter Wing at Hill AFB.

AFA National recently hosted a reception and dinner meeting for the top USAF enlisted leadership. Sam Keith, who was then National President but who has since been elected Chairman of the Board, and Executive Director Chuck Donnelly met with **CMSAF James C. Binnicker and all of the former Chief Master Sergeants of the Air Force** (except CMSAF Richard D. Kisling, who died November 3, 1985) to elicit ideas and seek their continued support of AFA. Following the meeting, President Keith acknowledged the important role the CMSAFs play and expressed appreciation for the tremendous job that each CMSAF has done for the Air Force and AFA. All of the CMSAFs are members of AFA.

John R. "Doc" McCauslin, new Chief of AFA's Field Organization Division, now compiles "Intercom." A retired chief master sergeant, "Doc" served two tours in Vietnam and has held executive posts with the Air Force Sergeants' Association and at air bases in Germany, Japan, Taiwan, Korea, and Hawaii.

AFA across the generations: Founder Gen. Jimmy Doolittle meets Patron Member Christopher Hernandez of Morgan Hill, Calif., at a recent luncheon hosted by the Monterey Bay Area, Calif., Chapter. The Chapter presented General Doolittle with a Barry Goldwater Fellowship.

The **Iron Gate (N. Y.) Chapter** held a reception to recognize the fourteen corporations that have supported the National Air Force Salute since its inception. Recipients of Iron Gate Certificates of Appreciation included Alan Chase, Lockheed Corp.; Hans Driessnack, United Technologies; John Flanigan, ITT Defense Communications Division; Ken Goss, AFA; John Hilton, Fairchild Weston Systems; Walter Jordan, Unisys Corp.; Dan McGrath, Northrop Corp.; Thomas McKee, Grumman Corp.; Special USAF Guest Lt. Gen. George L. Monahan, Jr., Principal Deputy Assistant Secretary of the Air Force for Acquisition; E. Archie NeSmith, Jr., Allied Signal Aerospace; Lawrence Ryan, Bell Aerospace Textron; Duane Semcken, General Electric-Long Island; Denny Sharon, McDonnell Douglas Corp.; and John Stirk, General Dynamics.

At the semiannual awards banquet of the **Red River Valley Chapter** in Grand Forks, N. D., CINCSAC Gen. John T. Chain was guest speaker. Several Grand Forks AFB units received awards during the event, which attracted more than 300 members. Chapter President DaLonna R. Bjorge presented General Chain with an AFA emblem in stained glass for his support of AFA and the awards program at Grand Forks.

In California, the **Monterey Bay Area Chapter** hosted a luncheon to continue its active support of youth participation and presented Gen. Jimmy Doolittle, USAF (Ret.), with a Barry Goldwater Fellowship Award.

New Chapter Chartered

Former USAF Chief of Staff Gen. Charles A. Gabriel, USAF (Ret.), recently assisted in the chartering of AFA's newest chapter. The **General Charles A. Gabriel Chapter,** formed in Tysons Corner, Va., was named

Chartering the new Gen. Charles A. Gabriel Chapter of Tysons Corner, Va., are (left to right) Heikki Joonsar, second vice president of the new chapter; Chuck Durazo, AFA Vice President, Central East Region; General Gabriel; Owen Wormser, president of the new chapter; and Richard Ensign, first vice president.

after the former Chief of Staff to honor his leadership and efforts in telling the Air Force story to Congress, the American public, and the Department of Defense. The first chapter meeting attracted numerous retired military and civic business leaders interested in fostering AFA goals in the Dulles Airport corridor.

New SEAs

Congratulations are in order for several **recently selected Senior Enlisted Advisors.** Chief Master Sergeants selected for SEA duties include CMSgt. Richard Allen, 343th Tactical Fighter Wing, Eielson AFB, Alaska; CMSgt. Charles Blackburn, 305th Aerial Refueling Wing, Grissom AFB, Ind.; CMSgt. Robert Farrell, 72d Flying Training Wing, Vance AFB, Okla.; CMSgt. Thomas J. Lustik, 377th Combat Support Wing, Ramstein AB, Germany; CMSgt. George Moriarty, Fifth Air Force, Yokota AB, Japan; CMSgt. Eddie Ollie, 374th Tactical Airlift Wing, Clark AB, the Philippines; CMSgt. Robert Pulliam, 50th Tactical Fighter Wing, Hahn AB, Germany; and CMSgt. Terry Trivett, 507th Tactical Air Control Wing, Shaw AFB, S. C.

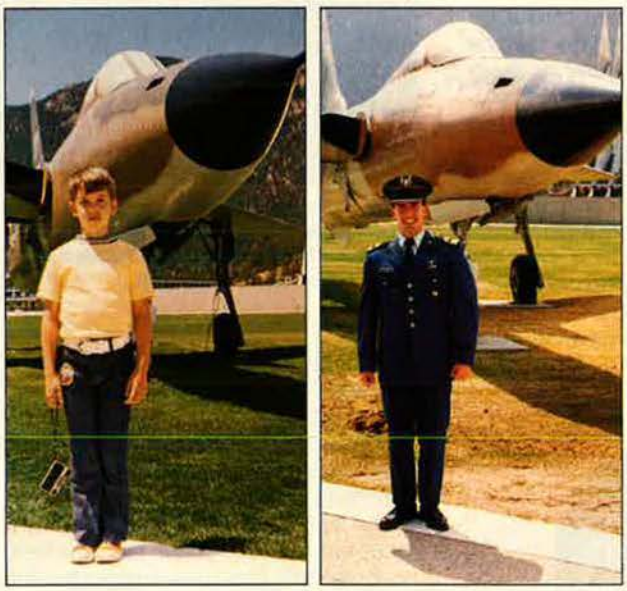
Florida and Utah

Special guest speaker at the **Florida State AFA Convention** was Royal Air Force Group Capt. Peter G. Johnson, OBE, Assistant Air Attaché at the British Embassy in Washington, D. C. Captain Johnson traced the history of close cooperation between USAF and the RAF since World War I and described joint operations in many fields.

The **Utah State AFA Convention** in Ogden was the scene of numerous awards presented with the assistance of Maj. Gen. Robert P. McCoy, Commander of the Ogden ALC. A special presentation was given by Allan J. McDonald, Vice President, Engineering for Space Operations, Morton Thiokol, concerning the status of the Space Shuttle program and solid-fuel rocket engines.

In the Field

The **Robert H. Goddard Chapter** at Vandenberg AFB, Calif., recently donated the flagpole for the American flag at the Western Spaceport Museum and Space Center (WSMSC) in Lompoc, Calif. At the flag-dedication ceremony, a memorial wall donated by local businesses and individuals was also dedicated. Secretary of the



Carl J. Long II, age nine in 1976, stands in front of an F-105 Thunderchief at the USAF Academy in Colorado. Cadet Long, today a Flight Commander in the Academy's Blackjack Squadron #21, is shown in front of the same aircraft twelve years later.

Progress Report: AFA Life Member Directory

Verification of the Air Force Association Directory of Life Members is under way. Most Life Members have already received telephone calls from the Harris Publishing Co., publishers of the official AFA Directory of Life Members. Harris representatives are calling to verify that the information members provided on their directory questionnaires (or on membership records if no questionnaire was returned) is accurate and up-to-date. At the same time, the Harris callers are inviting members to purchase personal copies of the AFA Directory. Scheduled for release in February 1989, the AFA Directory will be a definitive listing of AFA's leaders and aerospace proponents. If you are interested in ordering your own copy and have not previously requested one, you may contact the publisher directly at the following address:

Customer Service Dept.
Bernard C. Harris Publishing Co., Inc.
3 Barker Ave.
White Plains, N. Y. 10601

AFA State Contacts

Following each state name are the names of the communities in which AFA chapters are located. Information regarding these chapters or any of AFA's activities within the state may be obtained from the appropriate contact.

ALABAMA (Birmingham, Gadsden, Huntsville, Mobile, Montgomery, Selma): **H. R. Case,** P. O. Box 16625, Mobile, Ala. 36616 (phone 205-639-0168).

ALASKA (Anchorage, Fairbanks): **Theron L. Jenne,** 2501 Banbury Dr., Anchorage, Alaska 99504 (phone 907-337-3360).

ARIZONA (Green Valley, Phoenix, Sedona, Sierra Vista, Sun City, Tucson): **Robert A. Munn,** 7042 Calle Bellatrix, Tucson, Ariz. 85710 (phone 602-747-9649).

ARKANSAS (Blytheville, Fayetteville, Fort Smith, Hot Springs, Little Rock): **Bud A. Walters,** 903 Dixie Dr., Blytheville, Ark. 72315 (phone 501-763-1825).

CALIFORNIA (Apple Valley, Camarillo, Edwards, Fairfield, Fresno, Los Angeles, Merced, Monterey, Novato, Orange County, Pasadena, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, Sunnyvale, Vandenberg AFB, Yuba City): **Harold Strack,** 28063 Lobrook Dr., Rancho Palos Verdes, Calif. 90274 (phone 213-541-6226).

COLORADO (Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Littleton, Pueblo): **Jack G. Powell,** 1750 S. Ironton, Aurora, Colo. 80012 (phone 303-370-4787).

CONNECTICUT (Brookfield, East Hartford, Middletown, Storrs, Stratford, Torrington, Waterbury, Westport, Windsor Locks): **Joseph Zaranka,** 9 S. Barn Hill Rd., Bloomfield, Conn. 06002 (phone 203-242-2092).

DELAWARE (Dover, Milford, Newark, Rehoboth Beach, Wilmington): **Horace W. Cook,** 112 Foxhall Dr., Dover, Del. 19901 (phone 302-674-1051).

DISTRICT OF COLUMBIA (Washington, D. C.): **Denny Sharon,** 1501 Lee Highway, Arlington, Va. 22209-1198 (phone 703-247-5820).

FLORIDA (Avon Park, Broward County, Cape Coral, Daytona Beach, Fort Walton Beach, Gainesville, Homestead, Jacksonville, Leesburg, Miami, New Port Richey, Ocala, Orlando, Palm Harbor, Panama City, Patrick AFB, Port Charlotte, Redington Beach, Sarasota, Spring Hill, Tallahassee, Tampa, Vero Beach, West Palm Beach, Winter Haven): **Roy P. Whitton,** P. O. Box 1706, Lake Placid, Fla. 33852 (phone 813-465-7048).

GEORGIA (Athens, Atlanta, Columbus, Dobbins AFB, Rome, Savannah, St. Simons Island, Valdosta, Warner Robins): **Robert W. Marsh, Jr.,** P. O. Box 542, Springfield, Ga. 31329 (phone 912-964-1941, ext. 206).

GUAM (Agana): **Michael C. Wilkins,** Box CV, Agana, Guam 96910 (phone 671-646-5259).

HAWAII (Honolulu, Puunene): **Don J. Daley,** P. O. Box 3200, Honolulu, Hawaii 96847 (phone 808-525-6296).

IDAHO (Boise, Mountain Home, Twin Falls): **Chester A. Walborn,** P. O. Box 729, Mountain Home, Idaho 83647 (phone 208-587-7185).

ILLINOIS (Belleville, Champaign, Chicago, Elmhurst, Moline, Peoria, Rockford, Springfield-Decatur): **Glen W. Wensch,** R. R. #1, Box 54, Champaign, Ill. 61821 (phone 217-352-2777).

INDIANA (Bloomfield, Fort Wayne, Grissom AFB, Indianapolis, Lafayette, Marion, Mentone, South Bend, Terre Haute): **Don McKellar,** 2324 Pinehurst Lane, Kokomo, Ind. 46902 (phone 317-455-0933).

IOWA (Des Moines, Sioux City): **Carl B. Zimmerman,** 608 Waterloo Bldg., Waterloo, Iowa 50701 (phone 319-232-2650).

KANSAS (Garden City, Topeka, Wichita): **Cletus J. Pottebaum,** 6503 E. Murdock, Wichita, Kan. 67206 (phone 316-683-3963).

KENTUCKY (Lexington, Louisville): **Jo Brendel,** 726 Fairhill Dr., Louisville, Ky. 40207 (phone 502-897-7647).

LOUISIANA (Alexandria, Baton Rouge, New Orleans, Shreveport): **Paul J. Johnston,** 1703 W. Medalist Dr., Pineville, La. 71360 (phone 318-640-3135).

MAINE (Bangor, Loring AFB, North Berwick): **Richard F. Streika,** 54 Country Rd., Caribou, Me. 04736 (phone 207-492-4381).

MARYLAND (Andrews AFB area, Baltimore, Rockville): **Vince duCellier,** 6650 Chesapeake Terrace, Dunkirk, Md. 20754 (phone 301-855-5978).

MASSACHUSETTS (Bedford, Boston, East Longmeadow, Falmouth, Florence, Hanscom AFB, Lexington, Taunton, Worcester): **William J. Lewis,** 36 Francis Wyman Rd., Burlington, Mass. 01803 (phone 617-863-8254).

MICHIGAN (Alpena, Battle Creek, Calumet, Detroit, East Lansing, Kalamazoo, Marquette, Mount Clemens, Oscoda, Petoskey, Southfield): **William Stone,** 7357 Lakewood Dr., Oscoda, Mich. 48750 (phone 517-724-6266).

MINNESOTA (Duluth, Minneapolis-St. Paul): **Doyle E. Larson,** 13509 York Ave., South, Burnsville, Minn. 55337 (phone 218-890-9140).

MISSISSIPPI (Biloxi, Columbus, Jackson): **Henry W. Boardman,** 10 Bayou Pl., Gulfport, Miss. 39503 (phone 601-896-8836).

MISSOURI (Kansas City, Richards-Gebaur AFB, Springfield, St. Louis, Whiteman AFB): **Raymond W. Peterman,** P. O. Box 9605, Kansas City, Mo. 64134 (phone 816-761-7453).

MONTANA (Bozeman, Great Falls): **Ronald Glock,** 321 N. 17th, Bozeman, Mont. 59715 (phone 406-586-5455).

NEBRASKA (Lincoln, Omaha): **Ralph Bradley,** 3902 Davenport, Omaha, Neb. 68131 (phone 402-554-6220).

NEVADA (Las Vegas, Reno): **Emery S. Wetzel, Jr.,** 2938 S. Duneville St., Las Vegas, Nev. 89102 (phone 702-362-1767).

NEW HAMPSHIRE (Manchester, Pease AFB): **Robert N. McChesney,** Scruton Pond Rd., Barrington, N. H. 03825 (phone 603-664-5090).

NEW JERSEY (Andover, Atlantic City, Belleville, Camden, Chatham, Cherry Hill, Forked River, Fort Monmouth, Jersey City, McGuire AFB, Middlesex County, Newark, Old Bridge, Trenton, Wallington, West Orange, Whitehouse Station): **Robert Gregory,** R. D. #2, Box 216, Wrightstown, N. J. 08562 (phone 609-758-2973).

NEW MEXICO (Alamogordo, Albuquerque, Clovis): **Louie T. Evers,** P. O. Box 1946, Clovis, N. M. 88101 (phone 505-762-1798).

NEW YORK (Albany, Bethpage, Brooklyn, Buffalo, Chautauqua, Griffiss AFB, Hudson Valley, Nassau County, New York City, Niagara Falls, Patchogue, Plattsburgh, Queens, Rochester, Rome/Utica, Suffolk County, Syosset, Syracuse, Westchester, Westhampton Beach, White Plains): **Gerald V. Hasler,** P. O. Box 5254, Albany, N. Y. 12205 (phone 518-785-5020).

NORTH CAROLINA (Asheville, Charlotte, Fayetteville, Goldsboro, Greensboro, Greenville, Havelock, Kitty Hawk, Littleton, Raleigh, Wilmington): **Robert C. Newman, Jr.,** 3037 Truitt Dr., Burlington, N. C. 27215 (phone 919-584-7069).

NORTH DAKOTA (Concrete, Fargo, Grand Forks, Minot): **Ralph Ehlers,** 1207 Glacial Dr., Minot, N. D. 58701 (phone 701-852-3221).

OHIO (Akron, Cincinnati, Cleveland, Columbus, Dayton, Mansfield, Newark, Youngstown): **Cecil H. Hopper,** 537 Granville St., Newark, Ohio 43055 (phone 614-344-7694).

OKLAHOMA (Altus, Enid, Oklahoma City, Tulsa): **Aaron C. Burleson,** P. O. Box 757, Altus, Okla. 73522-0757 (phone 405-482-0005).

OREGON (Eugene, Klamath Falls, Portland): **Hal Langerud,** 10515 S. W. Clydesdale Terrace, Beaverton, Ore. 97005 (phone 503-644-0645).

PENNSYLVANIA (Allentown, Altoona, Beaver Falls, Bensalem, Coraopolis, Drexel Hill, Erie, Harrisburg, Homestead, Indiana, Johnstown, Lewistown, Mon Valley, Philadelphia, Pittsburgh, Scranton, Shiremanstown, State College, Willow Grove, York): **S. Ronald Chromulak,** 126 Phillips St., Charleroi, Pa. 15022 (phone 412-864-7220).

PUERTO RICO (San Juan): **Fred Brown,** 1991 Jose F. Diaz, Rio Piedras, P. R. 00928 (phone 809-790-5288).

RHODE ISLAND (Warwick): **Thomas R. Portesi,** 102d Tactical Control Squadron, North Smithfield ANG Station, Slatersville, R. I. 02889 (phone 401-762-9100).

SOUTH CAROLINA (Charleston, Clemson, Columbia, Myrtle Beach, Sumter): **George J. Thom,** 25 Calhoun Dr., Sumter, S. C. 29150-4738 (phone 803-748-8754).

SOUTH DAKOTA (Belle Fourche, Rapid City, Sioux Falls): **John Kittelson,** 141 N. Main, Suite 308, Sioux Falls, S. D. 57102 (phone 605-336-2498).

TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tri-Cities Area, Tullahoma): **Everett E. Stevenson,** 4792 Cole Rd., Memphis, Tenn. 38117 (phone 901-767-1315).

TEXAS (Abilene, Amarillo, Austin, Big Spring, College Station, Commerce, Corpus Christi, Dallas, Del Rio, Denton, El Paso, Fort Worth, Harlingen, Houston, Kerrville, Lubbock, San Angelo, San Antonio, Waco, Wichita Falls): **M. N. Dan Heth,** P. O. Box 748, MZ 9377, Fort Worth, Tex. 76101 (phone 817-882-5398).

UTAH (Bountiful, Clearfield, Ogden, Salt Lake City): **Glenn M. Lusk,** 2144 West 4000 South, Roy, Utah 84067 (phone 801-731-3366).

VERMONT (Burlington): **Ralph R. Goss,** 8 Summit Circle, Shelburn, Vt. 05482 (phone 802-985-2257).

VIRGINIA (Alexandria, Charlottesville, Danville, Harrisonburg, Langley AFB, Lynchburg, McLean, Norfolk, Petersburg, Richmond, Roanoke): **Don Anderson,** Box 54, 2101 Executive Dr., Hampton, Va. 23666 (phone 804-868-8756).

WASHINGTON (Seattle, Spokane, Tacoma, Yakima): **Alwyn T. Lloyd,** P. O. Box 24271, M/S 6A-30, Seattle, Wash. 98124 (phone 206-234-8027).

WEST VIRGINIA (Huntington): **Ron Harmon,** 1933 Ohio Ave., Parkersburg, W. Va. 26101 (phone 304-485-2088).

WISCONSIN (Madison, Milwaukee, Mitchell Field): **Gilbert Kwiatkowski,** 8260 W. Sheridan Ave., Milwaukee, Wis. 53218 (phone 414-463-1849).

WYOMING (Cheyenne): **Irene G. Johnigan,** 503 Notre Dame Court, Cheyenne, Wyo. 82009 (phone 307-775-3641).

Air Force Edward "Pete" Aldridge formally dedicated the first "milestone" to be made part of the Center.

Cadet Carl J. Long II epitomizes the theme of last July's Pennsylvania State AFA Convention, "Our Youth of Today Are Our Leaders of Tomorrow." Cadet Long has been placed on the Air Force Academy's Superintendent's List for academic and military excellence and was awarded a summer scholarship at the Institute on Comparative Political and Economic Systems, sponsored by Henry Kissinger's Fund for National Security Affairs. Cadet Long's father, Carl J. Long, is an AFA National Director and Life Member in the Greater Pittsburgh Chapter.

AFA National Chairman of the Board (then President) Sam Keith visited **Wueschheim AB, Germany,** immediately following a visit by the Soviet INF Treaty inspectors to that ground-launched cruise missile (GLCM) installation. Mr. Keith observed a "hands-on" demonstration by Charlie Flight personnel and took part in discussions about the GLCM and supporting programs. ■

During his visit to Wueschheim AB, Germany, AFA Chairman of the Board (then President) Sam Keith takes aim with an M-203 grenade launcher used by GLCM dispersal teams for ground defense. Members of the 89th Tactical Missile Squadron look on.

Unit Reunions

Foster/Aloe Fields

Military and civilian personnel stationed at Foster and Aloe Fields (Matagorda Gunnery Range/Matagorda Peninsula) during the 1940s and 1950s will hold a reunion June 2–4, 1989, in Victoria, Tex. **Contact:** Paul A. Kneblick, 601 Cambridge, Rte. 6, Victoria, Tex. 77901. Phone: (512) 575-5840 or (512) 575-7560 (Helen K. Welch).

Thunderbirds Alumni Ass'n

Members of the Thunderbirds Alumni Association will hold their reunion on November 17–20, 1988, at the Aladdin Hotel/Casino in Las Vegas, Nev. **Contact:** Denny Weddle, P. O. Box 14000, Las Vegas, Nev. 89156. Phone: (702) 791-4285.

1st Air Commando Ass'n

Veterans of the 1st Air Commandos will hold a reunion on April 13–16, 1989, in San Diego, Calif. **Contact:** Lt. Col. Robert E. Moist, USAF (Ret.), P. O. Box 466, Broderick, Calif. 95605.

1st PennANG

Members of the 1st PennANG, including the 103d Squadron and the 111th Tactical Air Support Group, will hold a reunion on November 11–12, 1988, in Willow Grove, Pa. **Contact:** Harry Hollenbach, 2002 Bensalem Blvd., Bensalem, Pa. 19020. Phone: (215) 757-6943 or (215) 757-3883. Norman Pinney, 435 Honeysuckle Ct., Montgomery, Ala. 36109. Phone: (205) 272-0274.

B-24 Liberator Club

The International B-24 Liberator Club will hold two reunions next year to celebrate the fiftieth anniversary of the B-24 Liberator. The first will be May 17–21, 1989 in Fort Worth, Tex., and the other Septem-

ber 20–24, 1989, in San Diego, Calif. **Contact:** Bob McGuire, P. O. Box 841, San Diego, Calif. 92112. Phone: (619) 582-5445.

47th Troop Carrier Squadron

The 47th Troop Carrier Squadron will hold a reunion in October 1989, in San Antonio, Tex. **Contact:** Charles F. Goodenough, Box A 39D, Rte. 2, Medina, Tex. 78055. Phone: (512) 589-2685.

F-84F

The F-84F "Hog Drivers" stationed at MacDill AFB, Fla., from 1962 through 1964 will hold a reunion on November 11–13, 1988, at the Sheraton Grand Hotel in Tampa, Fla. **Contact:** Leo Jacobs, 6200 Country Estates Dr., Tipp City, Ohio 45371. Phone: (513) 667-5210.

100th Bomb Wing

The 100th Bomb Wing (Pease AFB, N. H.) will hold a reunion on March 1–2, 1989, in Las Vegas, Nev. **Contact:** Bucky Freeman, 420 W. Santa Inez Ave., Hillsborough, Calif. 94010. Phone: (415) 348-2120.

7025th Air Postal Group

Members of the 2d, 3d, 8th, and 12th Air Postal Squadrons and Group Headquarters will hold a reunion in the summer of 1989 at Maxwell AFB, Ala. **Contact:** Maj. James K. Foshee, USAF (Ret.), 3509 Deer Trail, Temple, Tex. 76504. Phone: (817) 774-7303.

Fifth Air Force Memorial Foundation

The Fifth Air Force Memorial Foundation committee would like to hear from groups or squadrons who served in Fifth Air Force regarding future reunion dates and persons to contact.

Please contact the address below.

Jules Teck
1601 Cabana Dr.
Lake Havasu City, Ariz. 86403-1033
Phone: (602) 855-1776

Class 43-F

A reunion is in the planning stages for Class 43-F cadets who trained at Blackland, Perrin, and Stamford AAFs, Tex.

Please contact the address below.

Col. Clyde W. Bradley, Jr., USAF (Ret.)
1704 Gatsby Dr.
Montgomery, Ala. 36106
Phone: (205) 265-5323

Class 45-C

I would like to hear from members of Class 45-C who would be interested in holding a reunion.

Please contact the address below.

Robert L. Tank
204 Waterman Circle
Danville, Calif. 94526

Class 63-B

I would like to hear from members of Class 63-B (Williams AFB, Ariz.) for the purpose of organizing a reunion in the Phoenix, Ariz., area in mid-1989.

Please contact the address below.

Lewis Aaronson
5022 Cascade Ct.
Culver City, Calif. 90230-4243
Phone: (213) 836-9260

87th/512th Fighter Interceptor Squadrons

A reunion is in the planning stages for veterans who served in the 87th and 512th Fighter Interceptor Squadrons from December 1954 through March 1958.

Please contact the address below.

Jerry White
10620 W. 76th Dr.
Arvado, Colo. 80025
Phone: (303) 425-0134

3704th BMTS/Flight 323

I am looking for members of the 3704th BMTS/Flight 323 who were in flight training at McConnell AFB, Kan., from March 26 to May 7, 1982. I would like to keep in touch with this unit and possibly organize a reunion.

Please contact the address below.

SSgt. Kirk Perry
28th Bomb Squadron
McConnell AFB, Kan. 67221-5000

Reunion Notices

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, a time and location, and a contact for more information.

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Bob Stevens

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