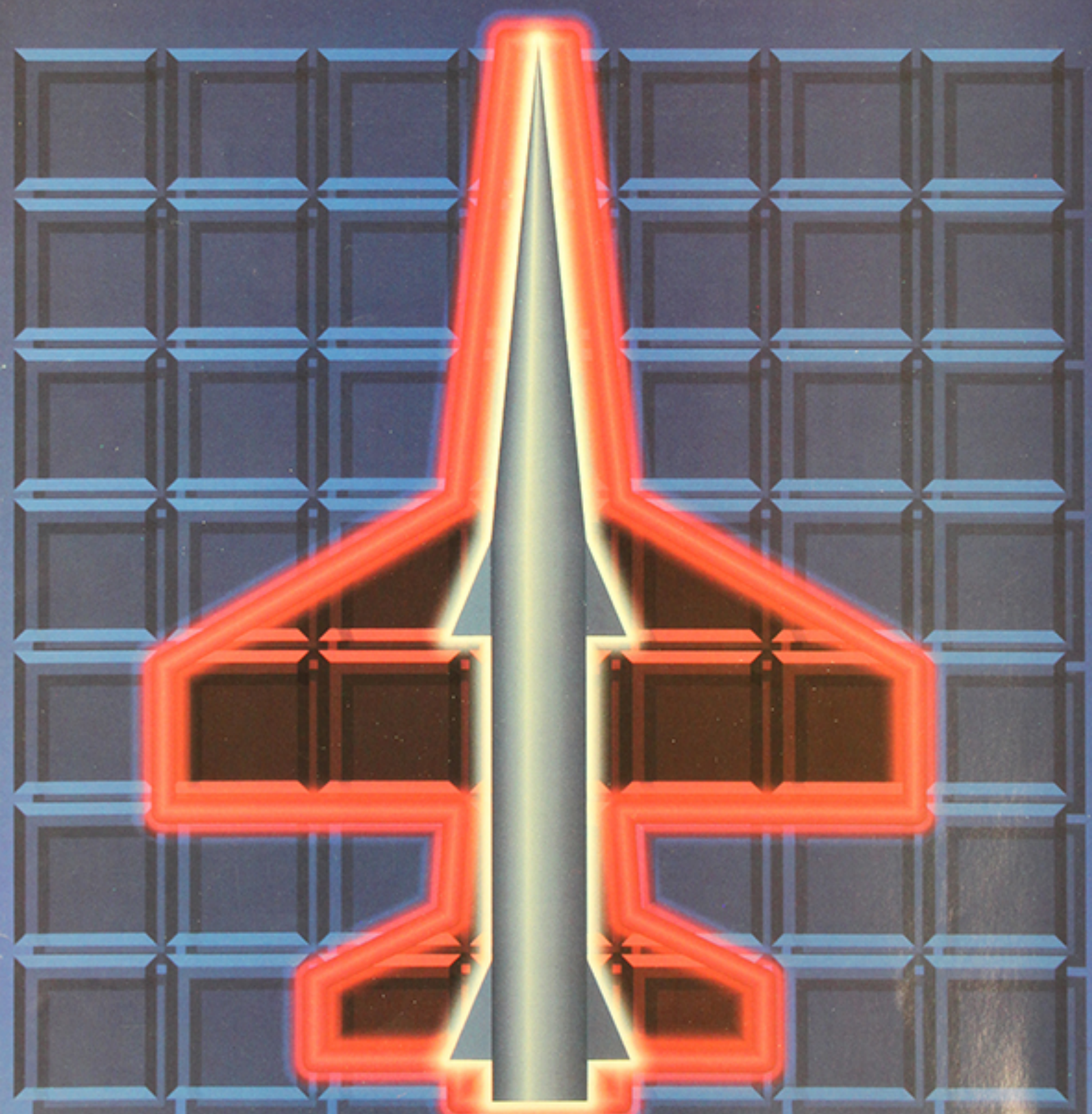
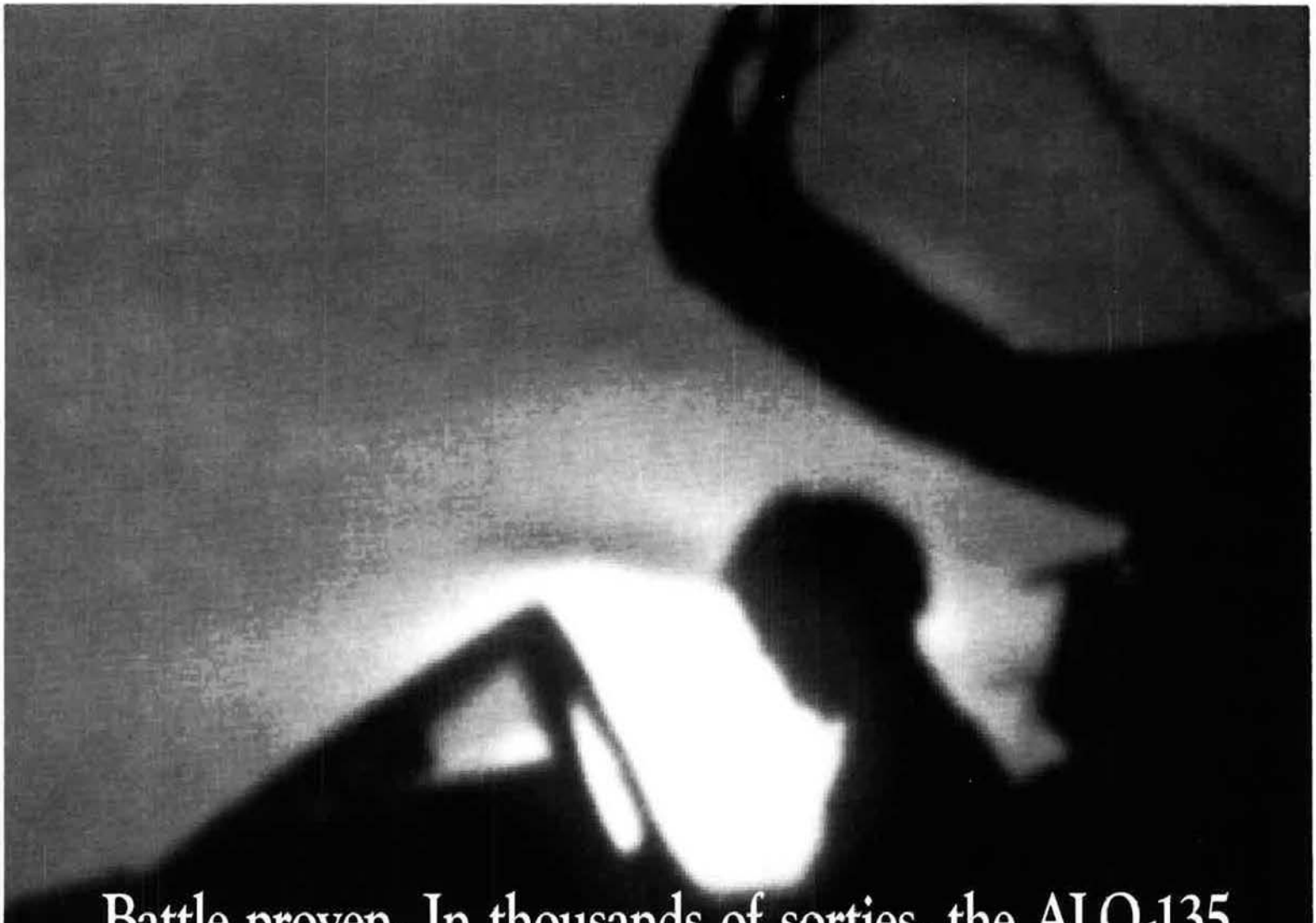
NOVEMBER 1991/$3

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Year of Victory—Year of Challenge





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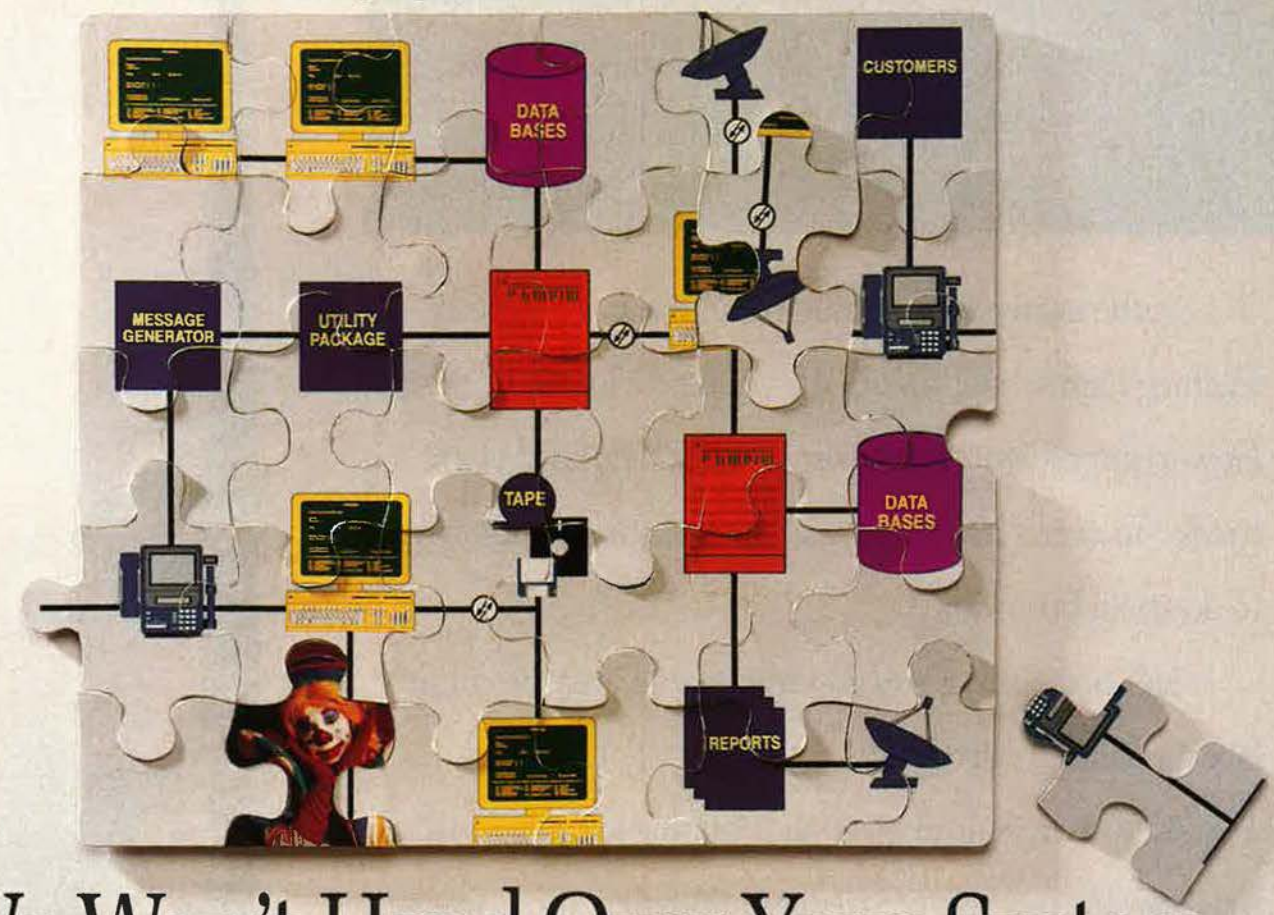

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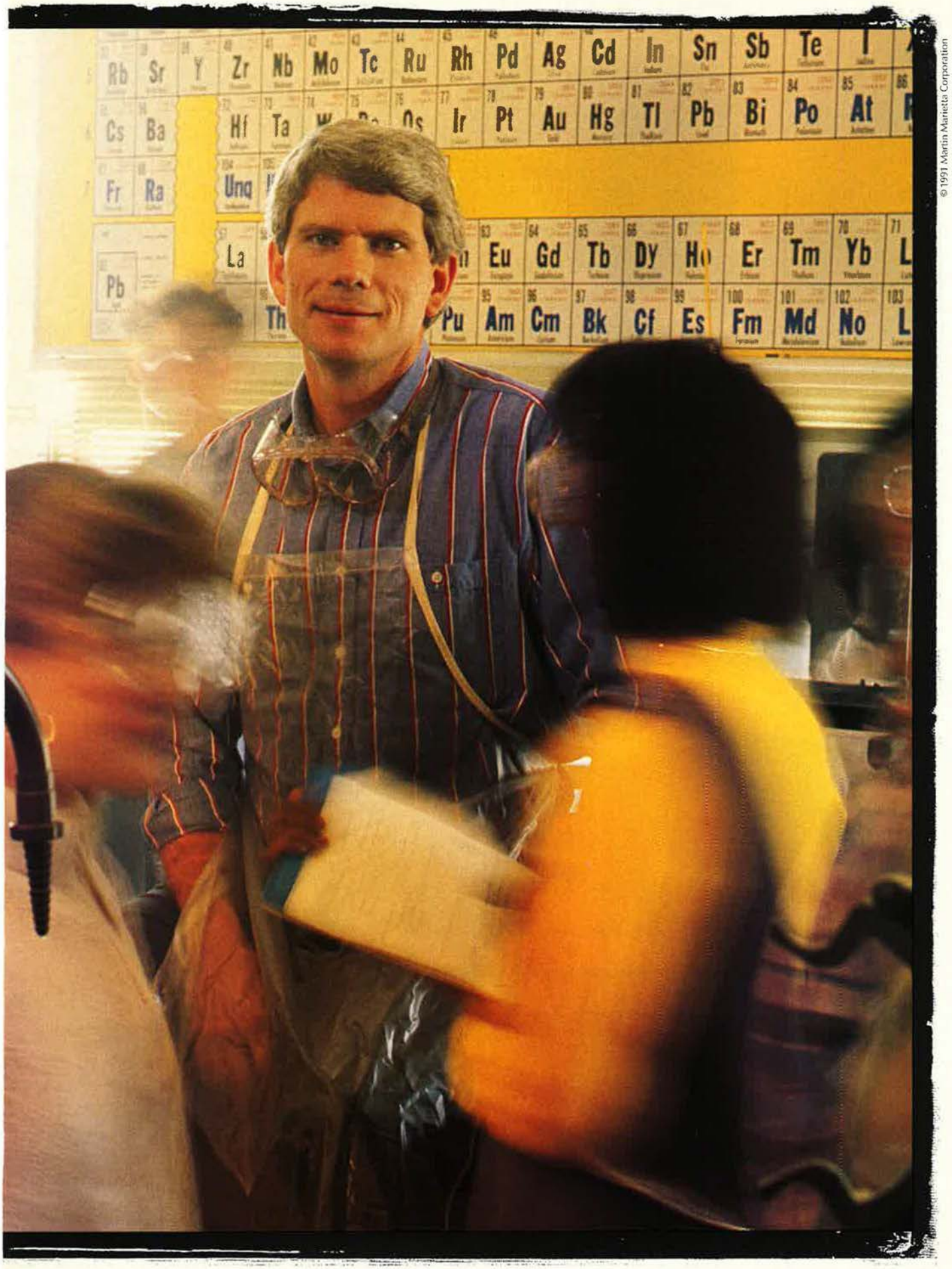

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November 1991, Vol. 74, No. 11

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Year of Victory, Year of Challenge

About the cover: The logo for the Aerospace Development Briefings and Displays held last September at AFA's National Convention in Washington, D. C., became a familiar sight to the 7,000 people who attended the forty-fifth annual event. Complete convention coverage begins on p. 74.

Convention '91

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Editorial

The 1991–92 Statement of Policy, adopted by delegates to AFA's National Convention on September 16, 1991.

Our Best Chance of Peace

THE AIR FORCE ASSOCIATION salutes the performance of US armed forces and their coalition allies in Operation Desert Shield/Desert Storm. We also salute the President of the United States for his leadership, courage, and steadfastness of purpose at a time of world crisis.

The Gulf War provided a convincing confirmation of US forces, weapons, and operational concepts and effectively repudiated the irresponsible criticisms of them heard so often in recent years. It is a matter of particular pride to us that airpower was the dominant factor and, most of the time, the decisive factor.

For the first time in its history, the nation fought a war with a military drawdown in progress. It was a victory achieved with forces, technology, and stock levels built in the 1980s. The Gulf crisis caught the world by surprise and the United States on the verge of a projected reduction of forces and defense budgets by twenty-five percent or more over the next five years.

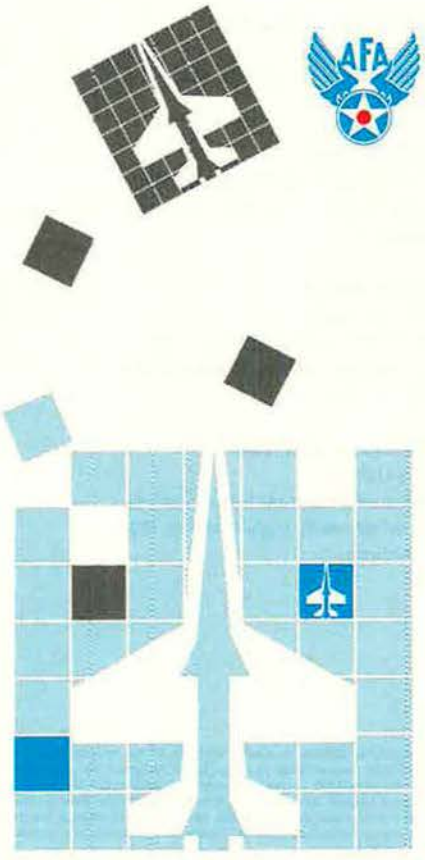
We share the belief of the Secretary of Defense, who says he is "absolutely certain" that "there will come another time when a President of the United States will have to send young Americans into combat some place in the world." When that time comes, our forces must take with them into battle the best preparation the nation can provide.

In their 1991 net assessment, the Joint Chiefs of Staff reported that the current US defense posture is one of "moderately high but acceptable risk" but warn that, for reasons ranging from shortfalls in sustainment and mobility to vulnerabilities in industrial preparedness, "we are moving rapidly toward unacceptable risk. How quickly we arrive will depend on how much of the defense program goes underfunded."

No one can predict exactly when, where, or why it may become necessary to defend our security or interests. The potential dangers have diminished in some respects, but, in others, they are increasing and diversifying.

The monolithic Soviet empire, which once stretched from the Elbe to the Pacific, is disintegrating. The Communist Party has been abolished. It is too soon to say what new concentrations of power may appear. Even with major reductions and reforms, the Soviet armed forces will almost surely rank as a military superpower, with an awesome, fully modernized strategic nuclear capability and well-equipped conventional forces numbering in the millions. So long as that is the case, unrestrained celebration is premature.

For reasons that include geography, population, natural resources, and the possession of military power, the Eurasian landmass will continue to be an important factor in world affairs. We share the hopes—but not the easy assumptions—of those who can imagine only a benign future arising from the present chaos.



The Air Force Association is concerned that the proliferation of technology, including aircraft, weapons, and electronics, is transforming Third World nations into formidable military threats. Furthermore, at least fifteen of those nations will have the ability to build ballistic missiles by the end of the decade. Eight will have or be near to having nuclear capabilities. About thirty nations will have chemical weapons. Ten will be able to deploy biological weapons.

The process of change and redistribution of power that began sweeping the globe in 1989 has not run its full course. A new world order is emerging, but the details of it are not yet clear. The international outlook is for deepening instability followed by great uncertainty.

The new US defense strategy, revealed in the past year, is based on a significantly smaller force structure and fewer forward deployments overseas. It prescribes a high-quality "base force" for response to the more probable forms of crisis but counts on increased warning time and reconstitution of forces in the event of major conflict. In the opinion of the Joint Chiefs of Staff, reconstitution may be the "linchpin of America's long-term security."

We find totally implausible the argument that the United States cannot afford a strong defense program. The present burden of the defense budget, 4.7 percent of the Gross National Product, is not unbearable, and defense expenditures will work even less hardship on the economy as they decline toward 3.6 percent of GNP.

Nevertheless, the campaign for ever-deeper cuts to defense goes on, employing claims of unaffordability and other tactics. A common technique in this regard is to single out high-visibility defense programs and attack them one by one.

The Air Force Association wishes to point out to the American public that, in their early stages of development, many of the systems that proved so spectacularly successful in the Gulf War came under similar attack from similar critics making similar asser-

tions. The pattern is a familiar one, and caution is advised about the credibility it deserves.

We repeat our conviction that the nation requires a balanced mix of land, sea, and air forces, prepared for action across the spectrum of conflict. As resources diminish, it will become increasingly difficult to maintain concurrent adequacy in force structure, force modernization, readiness, and sustainability, but it is vital that none of these be neglected.

In a restructuring of the magnitude envisioned, the impact is keenly felt by military members and the civilian employees who in actuality *are* the force. The Air Force Association's concern here is twofold: first, that every effort be made to minimize difficulties for both the individuals who will be leaving and those who will remain, and second, that, to the extent possible, the ability, experience, and quality of the force be preserved.

We are also concerned about the defense industrial base, which is in accelerated decline at a time when the emphasis on reconstitution of forces—which inherently requires industrial preparedness—is increasing. It appears to us that this is a weak point in the strategy.

Technological superiority, long the signature of US forces, figures to be even more important in the years ahead. We find it extremely disturbing that the Department of Defense sees an increasing risk that the United States may lose leadership in some key technologies regarded as essential to national security.

Our Association is aware, certainly, that evolution of the world order will bring opportunities for peace as well as dangers of war. We believe, however, that our best chance for peace is to maintain strength to deter war and discourage aggression.

We must temper optimism with reality and prudence and be willing to expend the efforts and resources necessary to keep risk to our security within tolerable bounds. We are a nation with both global interests and global responsibilities.

We cannot protect those interests or meet those responsibilities with wishful thinking and a bargain-basement defense program. It is imperative that the United States preserve the capabilities vital to a strong national defense and ensure that its armed forces are adequate in size, well equipped, properly supported, and second to none. ■

Letters

Sims Seconded

I applaud the letter by Capt. William Sims in the September 1991 issue *[see "Who's a Geek?", p. 11].* As a newly commissioned officer, I regarded his letter and that of Maj. Ray Castagnaro *[see "Dreaming Shoe Clerks," July issue, p. 10]* from the perspective of an AFROTC cadet as well as that of a nonpilot.

AIR FORCE Magazine is read regularly by many cadets, and seeing letters like Major Castagnaro's can be disheartening. From day one, cadets are taught to respect officers. Pilots seem to enjoy an extra measure of respect. Imagine freshmen or sophomore cadets with nontech slots who read that a respected officer and pilot seems to regard their chosen career fields as trivial. At such an early stage in a cadet's training, encouragement is essential. Teamwork receives a great deal of emphasis. All members of the team can and must contribute to the accomplishment of the mission. Recently, Operations Desert Shield and Desert Storm vividly demonstrated the value of teamwork among the behind-the-scenes people and the front-line people.

Except on MAC flights, most of us will never leave terra firma aboard an Air Force aircraft. The notion that nonflyers are unimportant is as offensive as it is erroneous. Not everyone can be a pilot, nor can everyone be an intelligence officer or an accounting and finance officer. Cadets are told they represent the future of the Air Force, and they especially need to feel that, regardless of their specialties, they will be a valued part of the team. This encouragement must not be left only to AFROTC and Academy instructors. All of us must provide it and the support necessary for them to excel as cadets and officers.

2d Lt. Douglas P. Brick,
AFRES
Pittsburgh, Pa.

Sims Disputed

Capt. William Sims drew some very wild conclusions from my July 1991 letter. He is way off base on this one.

First, who used the word "geek"? To paraphrase William Shakespeare: The Captain doth protest too much. I have no evidence of Capt. Sims's "geekdom." I'll just have to take his word for it.

Second, this "glamorous flyboy" may have the necessary attitude to be a fighter pilot (I've been saying for years that "fighter pilot" is more of an attitude or way of life than it is an Air Force Specialty Code), but I am, alas, an Air Liaison Officer (read: "redheaded stepchild," "bastard son," etc.) and was once a Weapon Systems Officer (read: same as above) in an F-4E Phantom II. My letter had nothing whatsoever to do with support officers, operations types (such as ALOs), or any other blue-suiter.

The man in the photograph that prompted my original letter was wearing a *business suit.* Did that strike anyone else as odd? It did me. That's why I wrote my harmless little observation.

I offer this to Captain Sims and other readers: I and many others have survived slanderous sobriquets and disparaging nicknames. Unlike certain shoe clerks (face it, the moniker is here to stay), WSOs accepted (dare I say embraced?) the names the nose gunners called us. That's because we had pride in what we did.

Even now, ALOs are so low in the pecking order that we don't even rate a real nickname. How insulting! But our lot did a fine job in the Persian Gulf War. Do you get the point? It's a pilot's Air Force, Captain Sims. Always has been, always will be. Either grow a thicker skin or join the Navy.

You're taking this all way too seriously. Pilots (and I include WSOs) trade jibes and insults to regain perspective and have a good time. Anyone who can't take it has a very serious self-esteem problem. . . .

Maj. Raymond J. Castagnaro,
N. C. ANG
Durham, N. C.

Valor at Kho Tang

John L. Frisbee's account of the *Mayaguez* incident *[see "Valor," September 1991 issue, p. 110]* should be well received by most of those who participated. He correctly gives much credit to the courage of the airmen and Marines involved. Unfortunately, he failed to mention one of the major players in the incident.

In the very early morning hours of May 13, an F-111A from the 347th Tactical Fighter Wing, based at Korat RTAFB, Thailand, and commanded by Col. Mo Seaver, located on radar and photographed the *Mayaguez* anchored near the small island of Kho Tang. Later that same morning, this sighting was confirmed by the Navy P-3. Throughout the operation, two F-111s were constantly on station over the area, each configured with four 2,000-pound bombs. While the other fighters were primarily engaged in supporting the ground operation, the F-111 mission evolved into interdiction of sea traffic between Kompong Som and Kho Tang. Throughout the next two days, any vessel that came out of the harbor was attacked, and several were destroyed. Long before the assault on Kho Tang began, traffic outside the harbor had been halted.

I was on station with my flight of two at dawn on May 15 when the USS *Holt* steamed into view. It quickly took control of the *Mayaguez.* At 0900 I saw a small vessel leave Kompong Som harbor. As I was short of fuel and my replacement flight had just arrived on the scene, I directed him to make an identification pass on the vessel, which he did. The Khmer Rouge had placed all of the hostage crew members on deck where they could easily be seen, and the rest is history.

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

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Letters

The press has always referred to this incident as the *Mayaguez* debacle, but as usual they miss the point. After years of the misuse of military power, our leadership finally did something right. They made the enemy pay for his criminal actions and got our crew and ship back in the process.

A case can be made that the assault on Kho Tang with its resulting casualties was unnecessary, but we proceeded on the best intelligence we had and acted accordingly. The loss of troops and airmen in combat is never pleasant, and the armchair experts can always come up with a better plan after the fact. Those of us who have served know that the acceptance of those risks is one of the reasons we are there in the first place.

Lt. Col. Edwin V. Wells,
USAF (Ret.)
Brentwood, Tenn.

It was refreshing to read John L. Frisbee's succinct account of American valor and determination to save the *Mayaguez* and its crew in May 1975. Colonel Frisbee is correct in stating that the action is largely ignored history, but it is also often misrepresented in basic textbooks.

Of the *Mayaguez* incident, one historian wrote that President Ford "promptly sent a military force to rescue the small crew. Although this action was widely acclaimed at the time as a positive assertion of America's will to defend its interests, critics saw it as an overreaction against a small, weak country that resulted in unnecessary loss of American lives."

The implication for American students is that big and strong America should not defend itself against "a small, weak country" and especially for only a "small crew."

J. Roger Osterholm
Ormond Beach, Fla.

"The *Mayaguez* Incident" closed by stating that the men who carried out the rescue deserve better than a footnote. I couldn't agree more. Reading that article after returning from my first visit to the Vietnam War Memorial really tugged at the heart. I don't know anything about Sergeant Harston, but I can fill your readers in on the others.

I had the honor of serving as a flight commander under Lt. Col. R. W. Purser when he was director of operations for the 33d Aerospace Rescue and Recovery Squadron at Kadena AB, Japan, in 1985. I think you may have spelled Rowland wrong, but I can't be sure. He always signed officer effectiveness reports R. "Wayne" Purser.

1st Lt. Don Backlund was killed in an A-10 crash at Gila Bend, Ariz., August 29, 1979.

1st Lt. Dick Brims (not "Brim" as stated in the article) was killed in a night HH-53 crash on the Nellis AFB, Nev., range May 21, 1986.

The pilot and copilot of the HH-53 that went down en route from Nakhon Phanom to the battle were Jim Kays and Larry Froelich. At that time, I was the copilot on the SAC HH-3 (dedicated to the Buffalo Hunter drone missions) that recovered the bodies and returned them to Nakhon Phanom.

Jim and Larry and the rest of their crew have a well-known footnote. It is forever etched into the black granite of the Vietnam wall, in the center just above the year 1975. Their ultimate contribution to our freedom is listed among the last to die in that conflict.

Lt. Col. John Bradford Shafer,
USAF
Beavercreek, Ohio

AFCC on the Move

Granted, Air Force Communications Command has done its share of traveling lately. AFCC recently moved from the front of the Major Command ranks to the files of the Field Operating Agencies. This was due to the Defense Management Report initiatives, which realigned AFCC's base-level units and division staffs under the Majcoms they served. When the dust settled, only the "Command" name and a little more than 8,000 people were left from the previous strength of 55,000.

Now, on p. 86 of the September 1991 issue, AFCC takes a new trip. Hq. AFCC has been relocated from Scott AFB, Ill., to Kelly AFB, Tex. Say it ain't so!

Capt. William A. Malec,
USAF
Hanscom AFB, Mass.

• *Hq. AFCC remains at Scott AFB, Ill.*
—THE EDITORS

More Than a Transit Point

"Aerospace World" in the September 1991 issue referred to Clark AB in the Philippines as a "transit point for special operations forces" *[see p. 24]*. Where have you people been? Clark AB has been home to the 353d Special Operations Wing since its activation in April 1989. Since 1981, it's been the home of the 1st Special Operations Squadron. These elite forces have responded to nearly every con-

tingency in the world during the last ten years. I believe their distinguished service to the United States and USAF deserves more recognition than as a "transit point."

Lt. Col. T. J. Doherty,
USAF (Ret.)
Fort Walton Beach, Fla.

Misplaced Museum Pieces

I have just finished reading the September 1991 edition of your magazine and enjoyed it very much, as usual.

In "Museum Pieces," the photograph on p. 102 depicting "ammo, patches, rations, matches, . . . and what-have-you" from the Korean War displays a patch with Snoopy on a doghouse—18th Division FAC. This patch was issued and used in Vietnam. I do not believe it was around in the 1950s. The patch should have been displayed with paraphernalia from the Vietnam War on p. 106. Right? Especially with "Curse You Charlie" on the patch.

MSgt. Kenneth C. Wilce,
USAF (Ret.)
Atwater, Calif.

Which Satellite?

I noticed that your photograph of the Delta II launch *[see "Aerospace World," September 1991 issue, p. 24]* didn't depict a Global Positioning System satellite, but rather the International Maritime Satellite (INMARSAT) that was launched on March 8, 1991. Upon closer inspection of the rocket in the photograph, you'll notice a "wave" decal that is associated with the INMARSAT community.

The eleventh GPS satellite was successfully supported and launched by members of McDonnell Douglas, Johnson Controls, and USAF on July 3, 1991.

Maj. Mark J. Taylor,
USAF
Cape Canaveral AFS, Fla.

Another Star in the Galaxy

I would like to provide a correction to "Valor: A Galaxy of Heroes" *[see August 1991 issue, p. 73]*. It was an excellent article and gave deserved recognition to the two pilots actively in command of the controls on the C-5A that fateful day. However, one glaring error is apparent to anyone familiar with the tragic accident. The actual date of the crash was April 4, 1975, not April 3, as you stated.

The two pilots were indeed heroes and were responsible for the large number of survivors. In addition to Captains Traynor and Harp, another pilot by the name of Capt. Keith D. Malone was of great assistance. He was in the jump seat running the radios, coordinating efforts of the rest of the crew, and fulfilling tasks that left the other two pilots free to concentrate solely on how to save the airplane, crew, and passengers. He has never received the credit he deserves.

I am very familiar with this accident since I was the chief loadmaster on board that day. I have not kept up with many of the survivors since, but I have kept in contact with Captain (now Colonel) Harp. Not only is he a superb pilot, he is also an outstanding officer and a good, decent human being. I am proud to have served, flown, and survived with him.

CMSgt. Ray Snedegar,
USAF (Ret.)
Waynesville, Ohio

CAP's Other Mission

"CAP's Half Century" *[see July 1991 issue, p. 41]* was well written and covers CAP's most important mission during World War II very well. I am speaking, of course, about the antisubmarine patrol mission. CAP had another important World War II mission: the CAP Cadet Program.

The CAP Cadet Program's purpose during World War II was to get teenaged boys and girls interested in flying. We wore a regulation Army uniform (purchased by us from a local Army/Navy surplus store) with a special CAP Cadet shoulder patch. We were taught drill and military courtesy and regulations. We also were given classroom training in navigation and meteorology and were taken up in such Army aircraft as the L-5 and B-24. We were taken to winter and summer encampments and given additional ground classroom training as well as more flights.

Arrangements were made for cadets to take the US Army Air Forces Cadet Pilot program physical once they turned seventeen. Upon graduation from high school and having passed the stringent flight physical, cadets were directed to report for USAAF pilot training. Most former CAP cadets excelled in the ground portion of the Cadet Pilot program.

Robert Beach
Kirkland, Wash.

Satellites Over the Gulf

"A Watershed in Space" *[see August 1991 issue, p. 32]* was excellent.

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8. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages or Other Securities *(If there are none, so state)*

Full Name	Complete Mailing Address
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9. For Completion by Nonprofit Organizations Authorized To Mail at Special Rates *(DMM Section 423.12 only)*
The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes *(Check one)*

(1) [X] Has Not Changed During Preceding 12 Months
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(If changed, publisher must submit explanation of change with this statement.)

10. Extent and Nature of Circulation *(See instructions on reverse side)*	Average No. Copies Each Issue During Preceding 12 Months	Actual No. Copies of Single Issue Published Nearest to Filing Date
A. Total No. Copies *(Net Press Run)*	216,171	211,715
B. Paid and/or Requested Circulation 1. Sales through dealers and carriers, street vendors and counter sales	972	158
2. Mail Subscription *(Paid and/or requested)*	204,057	201,647
C. Total Paid and/or Requested Circulation *(Sum of 10B1 and 10B2)*	205,029	201,805
D. Free Distribution by Mail, Carrier or Other Means Samples, Complimentary, and Other Free Copies	5,684	4,955
E. Total Distribution *(Sum of C and D)*	210,713	206,760
F. Copies Not Distributed 1. Office use, left over, unaccounted, spoiled after printing	5,458	4,955
2. Return from News Agents	- 0 -	- 0 -
G. TOTAL *(Sum of E, F1 and 2—should equal net press run shown in A)*	216,171	211,715

11. **I certify that the statements made by me above are correct and complete**

Signature and Title of Editor, Publisher, Business Manager, or Owner
EDITOR IN CHIEF

Being a satellite communications maintenance specialist and NCOIC of the Air Force Satellite Communications (AFSATCOM) Master Control Center, I was especially interested in the sections concerning satellite communications. I was upset, however, to find that AFSATCOM was almost entirely left out of the picture.

I am glad Mr. Canan thought that moving a DSCS II satellite was a historic event, but he failed to mention that AFSATCOM moved not one but two satellites in support of the war. Furthermore, the AFSATCOM Primary Control Centers contributed greatly to the war effort by doing a tremendous job reassigning users to various satellites in order to provide the greatest possible satellite coverage.

TSgt. Raymond E. Brant,
USAF
Offutt AFB, Neb.

Pucket at Ploesti

In reference to "Of Tradition and Valor" *[see July 1991 issue, p. 49]*, which related the story of Lt. Donald Pucket's Medal of Honor, I find this one very difficult to believe. Here is an officer who at one point in combat placed his entire crew in dire jeopardy and violated the integrity of the bomb group's formation by taking ten machine guns down to assist another aircraft (no doubt a friend) in trouble and under attack. For this he was awarded the Distinguished Flying Cross! Had he been in my group (the 96th), he would have been grounded forever and probably sent home to Mama.

Then, over Ploesti, he really came unraveled. He turned the damaged aircraft over to copilot Lt. Robert Jenkins and left the cockpit. When it finally occurred to Lieutenant Pucket that the B-24 was a lost cause and while still out of the cockpit, he ordered a bailout. Evidently the copilot was one of the first to go. A sound, undamaged B-24 was hard enough to fly; a B-24 with only two engines and battle damage was definitely a washout. Four good hands might have found a place to set her down. I was a flight engineer on both B-24s and B-17s, and I am aware of the shortcomings of the "Davis Wing" on the B-24.

The courage of Lieutenant Pucket is not questioned here. What is hard to understand is his lack of common sense and his superior's beliefs that he should be an aircraft commander.

SMSgt. Ernest P. Morgan,
USAF (Ret.)
Stone Mountain, Ga.

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Capitol Hill

By Brian Green, Congressional Editor

Three Views on Defense

Lawmakers turn up the pressure on the Pentagon's outyear budgets.

Rep. Les Aspin (D-Wis.), arguing that the US might now be able to let Pentagon budgets fall further than planned, reflected mounting "cut defense" sentiment in Congress in the wake of the hard-liners' failed coup attempt in the Soviet Union. The new mood threatens to scuttle a five-year budget agreement negotiated last year and has reignited controversy over how much military spending is enough.

Representative Aspin, chairman of the House Armed Services Committee, finds himself in the center of the controversy, and his position *[see box, p. 83]* stakes out the middle ground politically. Opinion on Capitol Hill falls into three groups:

- Those who want to restructure the US defense posture now and shift defense funds to domestic programs or deficit reduction.
- Those (like Representative Aspin) who believe that US military spending might safely be reduced beyond current plans, but only after Washington sees a further lessening of world tensions.
- Those who argue that current Pentagon plans to reduce spending and force structure by about twenty-five percent between 1990 and 1995 already cut deeply enough and should not be modified.

Some senators, including Budget Committee Chairman Jim Sasser (D-Tenn.) and Tom Harkin (D-Iowa), argue that now is the time to reduce defense spending. Senator Harkin, a candidate for the Democratic Presidential nomination, sponsored an amendment that would have moved $3.1 billion from the defense budget to domestic programs. Senator Harkin asserted that the cold war is over, that the Soviet military threat is significantly diminished, that his bill would transfer only about one-half of one percent of defense appropriations to domestic programs, and that defense spending is still very high. The Harkin amendment was defeated.

Sen. Brock Adams (D-Wash.) observed that "an educated, healthy, and productive citizenry is as crucial to our national defense as the Patriot missile." Another senior Democrat, Sen. Bill Bradley of New Jersey, proposed to cut some $80 billion out of the DoD budget over five years.

In line with these sentiments, Senator Sasser proposed to add to the Senate defense appropriations bill amendments that would terminate the B-2 Stealth bomber program, drastically reduce spending on the Strategic Defense Initiative program, cut Peacekeeper rail-garrison ICBM funding, and scoop $4 billion out of the Pentagon budget for return to the Treasury. The Sasser B-2 and SDI amendments went down to defeat in close votes.

Leading the opposition to these moves was Senate Armed Services Committee Chairman Sen. Sam Nunn (D-Ga.). He pointed out that the Pentagon is already reducing military spending sharply in response to a declining Soviet threat. He cited numerous force structure reductions that have been imposed or are in progress, as well as other cutbacks. "We have terminated twenty major defense programs in the last two years," said Senator Nunn. "The procurement budget has dropped twenty-seven percent in real terms in just two years. . . . Planned expenditures on twenty-five of our largest weapon systems, in terms of money for 1990 to 1995, have been . . . cut by fifty percent just in the past few years."

Senator Nunn concedes that the evolution of the Soviet military will require further review of US military strategy, but his approach is cautious: "We need to know more about the long-term composition of the Soviet Union [and] what its defense and foreign policy will look like before we begin, right in the middle of the process, to make dramatic changes in our own military strategy and our defense budget."

These remarks aligned Senator Nunn roughly with Secretary of Defense Dick Cheney, who maintains that congressional initiatives to cut defense further are misplaced. "They expect us to make long-term changes in national security based upon the events of the moment," says the Secretary. "We have an excellent strategy in place, and we ought to stick to it over the next several years."

Representative Aspin's position, laid out in a speech at the AFA National Convention in September, called for the government to take a close look at the level of defense spending in Fiscal 1993 and beyond. He argued that a new budget deal setting lower defense spending levels could be worked out, but only if changes in the Soviet Union yield "concrete, lasting changes in the threat on which we can base our decisions."

He laid out three key criteria: continuing favorable developments in the Baltics and Soviet-Cuban relations, reductions in the nuclear threat and clear indications that democratic forces hold sway over the military, and irreversible reduction of the Soviet military-industrial complex. If the three criteria are met, Representative Aspin believes, "we can look for a new budget deal."

Most political observers believe that, over the course of the decade, defense funding is likely to decline by even more than the planned twenty-five percent. Some congressional staff members already have begun to speculate that Pentagon budgets could be cut by one-third from 1990 levels.

Recent appropriations votes that protected defense in the short term often reflected extraneous concerns or declining support for defense programs. The Harkin amendment lost in part because of concern that transferring funds from defense accounts to domestic accounts would exceed the negotiated ceiling for domestic spending and thus trigger sequestration of all domestic accounts. The Sasser amendment failed to terminate the B-2 bomber program, although the 51-48 vote to save the stealth bomber showed considerable erosion of support in the Senate. ■

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The Chart Page

Edited by Colleen A. Nash, Associate Editor

Desert Storm's First Day

During the first twenty-four hours of air attacks on Baghdad, Iraq, coalition forces struck command-and-control centers, airfields, leadership strongholds, storage depots, and other high-priority targets. Almost immediately, Iraq was forced into a position that made a coherent response virtually impossible. The list of comparable targets in the Washington, D. C., area gives an idea how devastating these attacks were.

Targets in Baghdad, Iraq

1. Directorate of Military Intelligence
2, 5, 8, 13, 34. Telephone switching station
3. Ministry of Defense national computer complex
4. Electrical transfer station
6. Ministry of Defense headquarters
7. Ashudad highway bridge
9. Railroad yard
10. Muthena airfield (military section)
11. Air Force headquarters
12. Iraqi Intelligence Service
14. Secret Police complex
15. Army storage depot
16. Republican Guard headquarters
17. New Presidential Palace
18. Electrical power station
19. SRBM assembly factory (Scud)
20. Baath party headquarters
21. Government conference center
22. Ministry of Industry and Military Production
23. Ministry of Propaganda
24. TV transmitter
25, 31. Communications relay station
26. Jumhuriya highway bridge
27. Government Control Center South
28. Karada highway bridge (14th July bridge)
29. Presidential Palace command center
30. Presidential Palace command bunker
32. Secret Police headquarters
33. Iraqi Intelligence Service regional headquarters
35. National Air Defense Operations Center
36. Ad Dawrah oil refinery
37. Electrical powerplant

Comparable Targets in the Washington, D. C., Metropolitan Area

Andrews AFB, Md.
AT&T
Blair House (Presidential guest house)
Bolling AFB, D. C.
Camp David
Capitol
CIA Hq.
DIA Hq.
Executive Office Building
FBI Hq.
Federal Communications Center
Fort Belvoir (Army)
Fort McNair (Army)
Fort Myer (Army)
Fuel storage
MCI
Navy Annex
Navy Yard
Pentagon
Powerplants
Quantico (Marine Corps)
US Sprint
Suitland Federal Center
White House

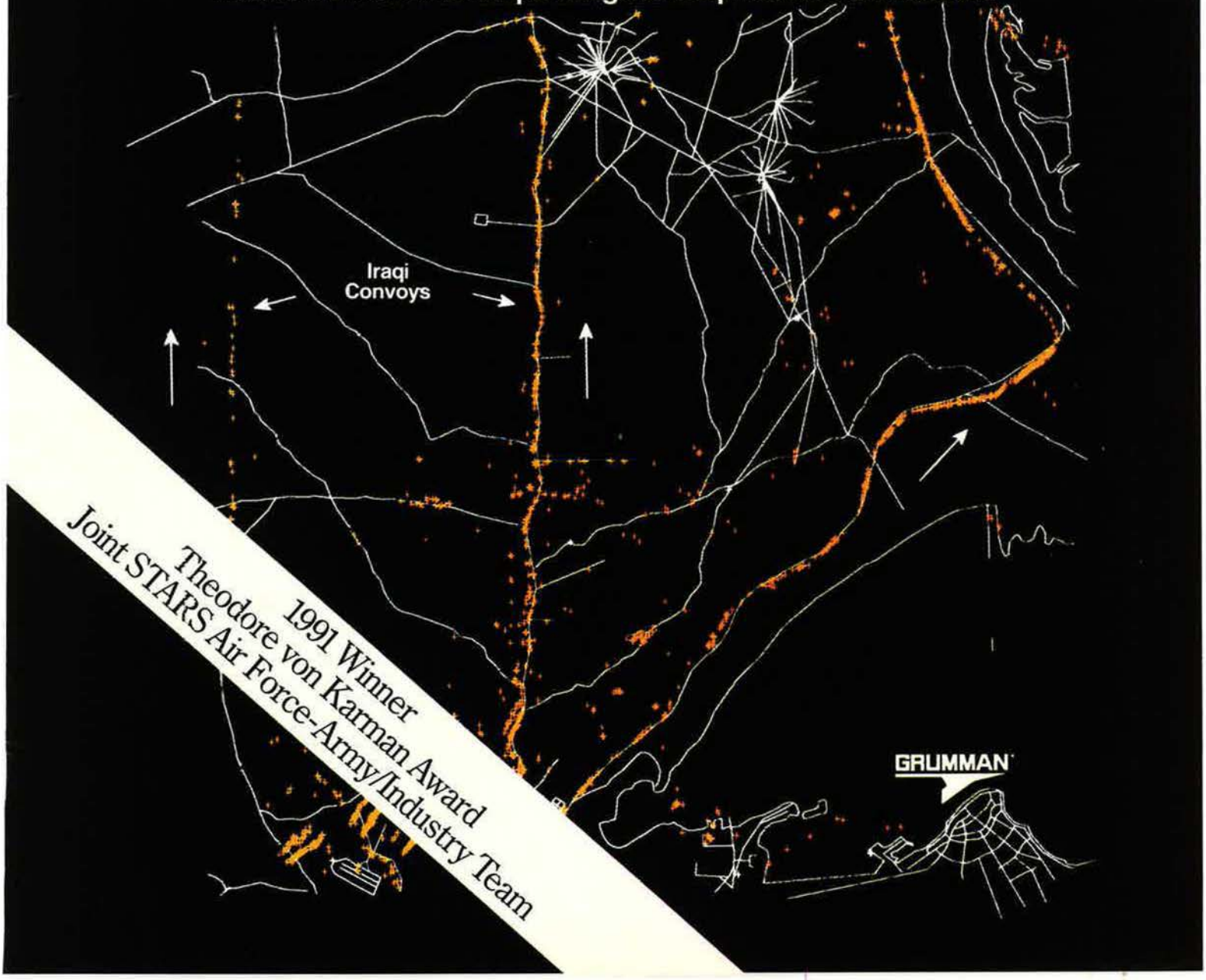
"Another war will not be fought without Joint STARS."

General Merrill A. McPeak
Chief of Staff
United States Air Force
TAC Symposium, Orlando, Florida
January 31, 1991

GRUMMAN

Grumman Melbourne Systems, Melbourne, Florida 32902

Actual Joint STARS scope image of Iraqi retreat from Kuwait.



1991 Winner
Theodore von Karman Award
Joint STARS Air Force-Army/Industry Team

Improvements in the Advanced Medium Range Air-to-Air Missile (AMRAAM) are now underway. They incorporate technological advances in aerodynamics, aircraft carriage, and guidance and signal processing, to counter future threats. AMRAAM's state-of-the-art radar enables pilots to launch and maneuver out of danger, while achieving multiple strikes per engagement. The 12-foot, 345 pound missile was developed by Hughes Aircraft Company to become the mainstay air-to-air missile for the Air Force's F-15 and F-16 fighters and the Navy's F-14 and F/A-18. Its deployment is also planned on the German F-4F and the UK's Sea Harrier and Tornado aircraft. Hughes will lead this product improvement program, with support from Raytheon.

Hughes technology protected the lives of civilian and military personnel in the Persian Gulf. Hughes' products included: infrared focal plane arrays used in defense systems for detecting Scud missile launches, fire suppression systems in the Army's M1 tanks and Bradley fighting vehicles, and target detection devices in precision missiles used by coalition forces. Hughes now intends to expand its diversification efforts, developing these and other state-of-the-art technologies for new, commercial markets.

Improvements in a Hughes software development process have been so dramatic, an independent review team has given a Hughes Software Engineering division the highest rating ever. The assessment, by Carnegie Mellon University's Software Engineering Institute, credits Hughes for its measured process of evaluating software development and feeding improvements back into the process while work is underway. It not only honors Hughes' predictable, risk-free software, but helps Hughes continue to identify new ways of lowering time, cost, and technical risks in its software development processes. This assessment marks an improvement over two years ago, when Hughes was already in the top 14% of all companies reviewed.

Hughes and Norway are building the world's first operational surface-to-air missile battery that uses new fire-and-forget Advanced Medium-Range Air-to-Air missiles (AMRAAM) in a ground-launch system. The missiles contain active radar and do not need an illuminator radar to guide them to the target. This prototype system, the second phase of the Norwegian Advanced Surface to Air Missile System (NASAMS), will include a Norwegian-built fire distribution system, Hughes-built three-dimensional TPQ-36A radar and off-the-shelf AMRAAM missiles, and a jointly-built ground AMRAAM launcher. The new missile system should help Norway cut its manpower requirements to meet its air defense needs.

A new solid-state broadband transmitter operates at considerably lower cost and reduced power consumption, while having performance equivalent to a 200-watt "brute force" system. This HIBT-118 — the latest in the Hughes family of AML® solid-state broadband transmitters — uses high-power FET amplifiers and unique microwave circuitry to achieve state-of-the-art performance in solid-state equipment. The inherent flexibility associated with its broadband 1-to-80 channel design, plus its increased power, provides for supertrunking applications well in excess of 20 miles.

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HUGHES

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Aerospace World

By Frank Oliveri, Associate Editor

—USAF photo by Sgt. Jerry E. Clemens, Jr.

The Air Force quickly implemented the President's order to stand down from alert the US strategic bomber fleet and Minuteman II ICBMs set for deactivation under the START Treaty. Among the Minuteman silos affected is Alfa -09, 10th Missile Squadron, Malmstrom AFB, Mont., which was activated during the 1962 Cuban missile crisis.

Nuclear Reductions

President Bush announced sweeping changes in the United States nuclear arsenal and challenged the Soviet Union to follow suit. Reaction from Moscow has been positive.

The President said that, in the aftermath of the failed coup in the Soviet Union last August, the time was ripe for Washington to propose unilateral reductions in the number of nuclear weapons on land, at sea, and in the air. While calling for reductions, the President also maintained in his September 27 announcement that the smaller US force of the future must be composed of highly capable systems and must promote stability.

"We must pursue vigorously those elements of our strategic modernization program that serve the same purpose," said the President. "We must fully fund the B-2 and SDI program."

In his address, the President outlined two chief proposals:

- Destruction of the worldwide inventory of theater nuclear weapons, nuclear artillery shells, and short-range ballistic missile warheads.
- Removal of all tactical nuclear weapons from surface ships and attack submarines and withdrawal of nuclear weapons associated with naval aircraft and nuclear cruise missiles. Many of the naval weapons will be destroyed. The weapons that remain will be stored in a central location in the US.

The President also announced, and USAF quickly implemented, an order to stand down from alert the US strategic bomber fleet and those Minuteman II intercontinental ballistic missiles (ICBMs) earmarked for deactivation under the Strategic Arms Reduction Talks (START) Treaty. Once the accord is ratified, the US will accelerate deactivation of those ICBMs.

The President also decided to terminate programs to develop the mobile portions of the Peacekeeper rail-garrison system and the Midgetman Small ICBM. Also canceled was the development of the Short-Range Attack Missile (SRAM) II, which would have been deployed on US bombers.

The President said the US will streamline command-and-control procedures, allowing for better management of nuclear forces. Land, sea, and air nuclear forces will come under a new, unified US Strategic Command.

President Bush called for the Soviet Union to work with the US to eliminate multiple-warhead missiles, generally regarded as "destabilizing" weapons.

C-17 Flies

The C-17 airlifter successfully flew for the first time on September 15. The aircraft took off from Long Beach Field in California and landed at nearby Edwards AFB two hours and twenty-three minutes later. The test aircraft reached a speed of 288 miles per hour and an altitude of 20,000 feet.

The success of the long-awaited flight provided a welcome bit of news to C-17 builder McDonnell Douglas Corp. and the Air Force. The flight may relieve some of the political pressure on the program, which missed several scheduled first-flight dates over the past year.

Controversy still swirls around the issue of the cost of developing the advanced airlifter. The Department of Defense has predicted that the C-17's development program could overrun its $6.7 billion contractual limit by as much as $2.6 billion. McDonnell Douglas, however, maintains that the program will exceec projections by only $390 million.

More B-2 Controversy

Disclosure of the results of some preliminary B-2 low-observable (LO) tests drew USAF's penetrating bomber into a fresh controversy. In September, the Pentagon and the Air Force confirmed news accounts that a B-2 had failed to demonstrate the expected a degree of stealthiness in a specific parameter. The event occurred during LO testing on July 26 at Edwards AFB. Technicians completed their analysis of test data in August and briefed top Air Force officials on the results. USAF, in turn, notified Deputy Defense Secretary Donald Atwood and Defense Secretary Dick Cheney, who notified Congress.

When word of the testing difficulties became public, Secretary Cheney and Donald B. Rice, the Secretary of the Air Force, rose to the defense of the bomber, which they described as "the most survivable aircraft in the world." Secretary Rice issued a statement claiming that "testing has confirmed the fundamental soundness of our [B-2] stealth design, a conclusion certified by the Defense Science Board and the OT&E [operational test and evaluation] community."

Information released by the Defense Department shows that, after reviewing data on B-2 LO testing to date, the DSB concluded there was "no justification for any change to the [B-2] program schedule." In fact, the DSB advised Secretary Cheney not to push for marginal stealth gains if doing so would bring about substantial cost increases.

In a September letter to Sen. Daniel Inouye, the Hawaii Democrat who chairs the Appropriations Committee's Defense Subcommittee, the Secretary of Defense said all new aircraft go through "a vigorous test and evaluation program in which problems are encountered and then solved. . . . The recent test results indicate that in one specific area of the radar low-observable features of the B-2, the projected level of performance was not met."

Secretary Cheney, who canceled the Navy's A-12 attack aircraft when it ran into major cost and performance problems, stated that he was willing to take such tough steps again with other programs if circumstances called for doing so. However, said Secretary Cheney, the data developed in the B-2 case show that such drastic action is not warranted. Secretary Rice explained that the Air Force will attempt to achieve a technical solution. If it does not work, he added, the Air Force will pursue other alternatives.

B-2 Deck Fixes

The Air Force says it will cost about $200 million to strengthen the aft decks of seventy-five B-2 bombers with stronger titanium, the goal being to repair and prevent cracks in that area. Only the first B-2 bomber suffered cracks in the aft deck area, but the problem was expected to crop up in other aircraft. The fix is being incorporated into aircraft now on the B-2 assembly line. Currently, fifteen B-2 bombers have been approved by Congress.

The cracks were discovered in mid-1990. Officials attribute the problem to thermal and noise stress in the aft deck of the aircraft. The fix will not affect B-2 stealth capabilities, according to the Air Force.

Stealth and the F-22

In order to make confident projections about the stealthiness of its next-generation air-superiority aircraft, the Air Force built a full-scale model of the F-22 Advanced Tactical Fighter before building the actual aircraft prototype. Thus, says the F-22 program manager, the Lockheed/Boeing/General Dynamics fighter is unlikely to run into the kind of testing surprise seen in the B-2 program.

Brig. Gen. (Maj. Gen. selectee) James A. Fain, Jr., in a briefing held September 16 at AFA's National Convention in Washington, D. C., said that the size of the B-2 aircraft made the creation of a full-scale model impractical and excessively expensive. That was not the case with the F-22. "We have a high degree of confidence" about the low-observable characteristics of the F-22, General Fain said. He explained that the F-22 full-scale model, "with panel gaps and cracks," underwent radar cross section testing and closely matched predictions. General Fain said the F-22's stealthiness would be in the "F-117 class."

General Fain said the production F-22 would exceed its original maximum-weight specification of 50,000 pounds by about 10,000 pounds. Production of a 50,000-pound ATF, he contended, "was a goal," and achieving it was never required. General Fain said that, as the F-22 design evolved, trade-offs had to be made. Compared to the prototype YF-22, the production F-22 is expected to use greater amounts of advanced thermoplastic and thermoset composites, which are much lighter than conventional metals.

General Fain confirmed that the first F-22s will not carry an infrared search and track (IRST) system. The fighter program will incorporate the capability in later models as a preplanned product improvement (P3I). The F-22 program manager attributed initial exclusion of IRST to the cost required to incorporate the system into the design while maintaining stealth and the ability to withstand the stresses of supercruise. The Martin Marietta–designed IRST system would cost about $1 million per air-

—USAF photo by SSgt. Rebecca Robison

Soviet Gen. Lt. Vladimir Medvedev, third from left, is briefed by 7th Wing Commander Col. Richard Szafranski (far left) and Maj. Gen. Robert W. Parker (right), director of the On-Site Inspection Agency. General Lieutenant Medvedev was the team chief for the Soviet START Exhibition Team that visited Carswell AFB, Tex., September 17–19 for a heavy bomber exhibition.

plane. While the currently planned system would work, General Fain said, the Air Force is looking to pay only half that amount for an IRST.

Defense Restructuring

At AFA's National Convention, Air Force officials disclosed a far-reaching plan to merge Strategic Air Command, Tactical Air Command, and Military Airlift Command into two new commands, and Rep. Les Aspin (D-Wis.), chairman of the House Armed Services Committee, laid out a possible roadmap for defense budget changes following the political collapse of the Soviet Union. *[See box on p. 83.]*

Further Cuts

Secretary Cheney mounted a campaign in early autumn against congressional moves to cut the defense budget even further than is called for in the current defense program. The lawmakers' efforts were sparked by the unraveling of Kremlin power and authority in the wake of the recent putsch and perhaps by President Bush's subsequent statements.

Not long after the collapse of the attempted coup, President Bush said that changed circumstances in the USSR might create "an opportunity for a vastly restructured national security posture." He hastened to add, however, that "it's way too early to get into that." In a joint statement with British Prime Minister John Major, the President indicated that the Soviet political situation would have to play out further before it would be prudent to undertake major changes in US defense posture.

Secretary Cheney took a stronger position, saying that his spending program devised last year and blessed by congressional and Administration leaders should continue through 1997 as planned, despite the Soviet Union's rejection of Communist rule. Secretary Cheney said his view on defense requirements does not clash with the President's words but capitalizes on those very statements.

Shaposhnikov to Head Soviet Forces

Marshal of Aviation Yevgeni Ivanovich Shaposhnikov became the new Soviet Defense Minister in late August. President Mikhail Gorbachev appointed Marshal Shaposhnikov to replace Marshal Dmitri Yazov, who took part in the failed coup attempt and is currently charged with treason. At forty-nine, Marshal Shaposhnikov is the youngest person ever named to the defense post. He also is the first Commander in Chief of the Soviet Air Forces to be named overall defense chief.

Marshal Shaposhnikov called for the formation of an all-volunteer military force to replace the Soviet Union's current conscription system. In addition, he announced a radical reorganization of the High Command in September. The Pentagon expressed satisfaction, welcoming the new Defense Minister's statements.

The Deputy Chairman of the Russian Parliament's foreign affairs and international relations committee, Yevgeni Ambartsumov, said in September that Russian President Boris Yeltsin wants a nuclear-free Russia.

Nuclear testing at the Semipalatinsk test site in Kazakhstan was also stopped, according to Kazakhstan President Nursultan Nazerbayev, while testing on the Arctic island of Novaya Zemyla will also be stopped. Russian and Kazakh officials called for the US also to halt nuclear testing.

In this country, the National Academy of Sciences (NAS) released a report maintaining that the US and Soviet Union could dramatically reduce their nuclear arsenals by the end of the century by improving their forces' survivability and, in the process, acquiring better C³I to link the forces.

The sixty-seven-page report, completed before the Soviet coup attempt, is titled "The Future of the U.S.-Soviet Nuclear Relationship." Its authors hold that phased reductions could be made to nuclear arsenals following START.

General Electric Sued

The Justice Department filed a lawsuit in August against General Electric Co. for allegedly defrauding the government of some $30 million. According to the government's petition, GE employees conspired with an Israeli Air Force officer, Gen. Rami Dotan, to file false claims for US funds to support Israel's purchase of 100 GE F110 engines.

A GE spokesman said the firm, once it learned of the scheme, cooperated fully with the government. The GE spokesman said that an employee, in violation of company policy, delayed notifying the firm of the alleged fraud.

The charges are the first against an American defense contractor in the case. General Dotan entered a plea of guilty to criminal charges in Israel.

Cohen Pleads Guilty

Victor D. Cohen, the former Air Force deputy assistant secretary for Tactical Warfare Systems, pleaded guilty in August to federal charges of agreeing to accept money and favors for illegally steering defense contracts to two defense firms.

Mr. Cohen was a prime target of the Ill Wind investigation, which has led to convictions or guilty pleas involving forty-five individuals and five firms to date. Mr. Cohen admitted to accepting gifts from representatives of Loral and Unisys. His plea follows that of former Navy Assistant Secretary Melvyn Paisley, also a major target of the Ill Wind investigation.

Unisys pleaded guilty in September to criminal charges, which will lead to fines totaling $190 million. Unisys Chairman and CEO James Unruh said the misconduct took place among a small group of people in parts of Sperry Corp. before that company became part of Unisys in 1986.

Pratt & Whitney IPEs

In August, South Korea chose Pratt & Whitney's F100-PW-229 Improved Performance Engine (IPE) to power new F-16s due to be built under the

—USAF photo by 148th FIG, Minn. ANG

An F-16 from the 148th Fighter Interceptor Group, Minnesota ANG, escorts a Soviet MiG-29 from an air show in Mankato, Minn., to one in Harrisburg, Pa., on September 10. A pair of MiG-29s were on an eight-stop US air show tour, where they sold flights in the fighters at a cost of $10,000 for a fifteen-minute flight.

Korean Fighter Program. The P&W engine won out over General Electric's F110-GE-129 IPE.

The award was not a big surprise to either engine firm, since P&W already powers thirty-six F-16A/Bs for South Korea. The contract will be worth more than $500 million. P&W will manufacture the first twelve engines for purchase under foreign military sales, then provide thirty-six engine kits for final assembly in Korea and provide a license for Samsung Aerospace Industries Ltd. to build the final seventy-two engines. The P&W IPE has about eighty percent commonality with the -220 engine currently used by South Korean F-16s.

Shortly after the Korean award, the Air Force grounded all aircraft using P&W IPEs because cracks were found in diffuser cases during routine manufacturing inspections.

P&W said that all the cracked diffuser cases appear to come from one manufacturing lot and that none of the cases was in the already deployed engines. However, the Air Force is requiring that all P&W IPEs be checked. Approximately sixty engines are outside the factory.

GE Wins Contract

In August, the Navy selected the General Electric Growth II Plus version of the F404 engine to power the proposed F/A-18E/F aircraft. GE was awarded a $15 million preengineering and manufacturing contract.

The F/A-18E/F version is expected to enter the force in the late 1990s to serve as an interim attack aircraft while the AX attack aircraft is being developed and built.

The Navy has not determined the number of F/A-18E/F aircraft it will procure but asked for pricing based on purchase of 500 airframes. The new engine would provide thirty-five percent more thrust than the 16,000-pound-class F404 engine now in service.

In late August, the Air Force temporarily barred use of afterburners on 850 F-16s fitted with the GE F110 engine, having discovered a problem with a sealant that has caused two burn-throughs. The fix could take up to six months, according to the service, and an additional 300 F-16s sold overseas will have to be inspected. The Air Force did not comment on the cost of the repairs.

Cheyenne Mountain in Operation

Phase II in the development of the Cheyenne Mountain Space Defense Operations Center at Cheyenne Mountain AFB, Colo., achieved initial operational capability in late July.

This gives Air Force Space Command the ability to maintain independently a catalog of 400 high-interest satellites in orbit. The system will detect maneuvers and resolve cross-tagging/position conflicts while processing space surveillance network data of up to 100,000 radar observations per day.

The program is one of six that make up the $1.6 billion effort to modernize Cheyenne's command, control, and communications systems.

Acquisition Reorganization

In a memo on August 12, Deputy Defense Secretary Donald Atwood formally notified defense agencies that he was increasing the authority of the Under Secretary of Defense for Acquisition and the Director of Defense Research and Engineering (DDR&E).

"As the reshaping of the US armed forces continues in light of changes in the world situation and constraints on available defense resources," the memo stated, DoD "must pursue aggressively the technologies needed for the nation's defenses and ensure maximum efficiency in the defense acquisition process."

The memorandum provides no new powers to those holding the Pentagon posts, but reasserts the powers of the two positions, giving them a stronger hand in future budget debates. Under Secretary of Defense for Acquisition Donald Yockey and acting DDR&E Charles Adolph will likely use that power in handling distribution of the large research and procurement budgets.

The memo grants significant power to Mr. Adolph by outlining his control over research efforts of all the services and government agencies, including the Defense Advanced Research Projects Agency. The DDR&E is under the control of the Under Secretary of Defense for Acquisition.

Under Secretary Yockey is given greater authority over how and if programs should proceed past milestones, as well as authority to review acquisition management in each department.

National Security Strategy

Stealth, space-based systems, sensors, precision weapons, and ad-

vanced training technologies will receive greater attention and focus as the US military force structure is reduced, President Bush said in the 1991 US National Security Strategy released in September.

The strategy calls for a viable industrial base that can support technology development and advanced production, in addition to assisting production surges in times of crisis.

News Notes

• Two Military Airlift Command wings at Kirtland AFB, N. M., merged into one wing last month as part of the Air Force plan to combine multiple wing bases into composite wings. The 1606th Air Base Wing and the 1550th Combat Crew Training Wing will combine to form the 542d Crew Training Wing.

• The Navy's high-energy laser beam system demonstrated improved tracking and pointing capabilities during a test in support of antisatellite efforts in August. The Army's Strategic Defense Command said the Mid-Infrared Advanced Chemical Laser/Sea Lite Beam Director (MIRACL/SLBD) focused a laser on a drone flying at 40,000 feet during a test at White Sands Missile Range, N. M.

• Israel increased defense spending for 1992 by $215 million to $4.5 billion after a prolonged Cabinet battle. There had been attempts to reduce defense spending by as much as $450 million.

• Japan's H-2 booster program suffered another setback in August with an explosion during engine component testing. The explosion damaged the manifold assembly and broke down the test chamber door, killing an engineer. Investigations are being conducted, with initial inspections revealing the failure of a weld rather than failure of the pipe. H-2 prototypes were to be launched in 1993 but are expected to be delayed. Original plans were for a first flight in 1992. Development of the 204,600-pound-thrust LE-7 engine began in 1983. To date the engine has suffered four fires and a hydrogen leak in addition to the explosion.

• A federal appeals court in San Francisco reinstated a lesbian's lawsuit challenging the legality of her discharge from the Army Reserve, a legal development that could clear the way for a renewed attack on the military's regulations banning homosexuals from active service. The appeals court said that social prejudice against homosexuals was no justification for the military's exclusionary policies. In July, Secretary Cheney called the issue of homosexuals' being a security risk "a bit of an old chestnut," but Pentagon officials recently defended the current policy.

• With $18.5 billion in arms sales in 1990, the US was the top arms seller to Third World nations, followed by the Soviet Union, which sold $12 billion in military goods. China ranked third with $2.5 billion.

• The failure of an Orbital Sciences Corp. rocket on a Strategic Defense Initiative mission was attributed to launch controllers who loaded the wrong computer program into the guidance unit of the rocket. It veered off course and was destroyed by range safety officials at Cape Canaveral AFS, Fla. The SDI experiment, Red Tigress, is a program to develop missile detecting sensors. The cost of the launch, excluding the experiment, was $5 million.

• Reforger 91, a joint service exercise designed to test rapid deployment of US combat forces from CONUS to Europe and back, began in late August and ran through October. The 1991 edition of Reforger (Return of Forces to Germany) was the twenty-

Five F-16 fighters are shown en route to Denmark in September to take part in Action Express, an eight-day exercise intended to test NATO's ability to defend northern Europe. Maine Air National Guard's 101st Air Refueling Wing, based in Bangor, refueled two dozen Europe-bound fighters in Operation Coronet Defender, one of the largest Air Guard operations in Air Force history. Tankers from ANG units in several states, including Arizona and Alaska, participated.

second such exercise. Reforger 91 and its follow-on exercise, Certain Shield, provided an opportunity for participating NATO nations to practice combined military operations. Belgian, German, Dutch, British, and US forces participated in this year's Certain Shield.

• Secretary Rice announced the establishment of the Office of Director, Test and Evaluation, in August. The new director will be responsible for development tests and evaluation as well as operational tests and evaluation oversight, policy and test resource management, and investment. The Air Force Chief of Staff will oversee the new office.

• The September 6 launch at Eglin AFB, Fla., of an air-to-ground AGM-65 Maverick missile guided autonomously by millimeter wave radar (MWR) marked a significant evolutionary step for smart weapons. The missile was programmed to spot an air defense unit amid an array of tanks and other armored vehicles. The MWR Maverick is undergoing demonstration/validation.

• The crash of a General Dynamics–built Advanced Cruise Missile in July was attributed to a bad circuit card. The missile crashed in Utah following a string of successful ACM tests. An Air Force investigation revealed that a circuit card in the lateral accelerometer failed, causing bad information to be passed to the guidance section. Testing of the ACM will continue, the Air Force said.

• General Dynamics received the lion's share of funding for the FY 1991 supplemental Navy buy of 278 Tomahawk missiles, with McDonnell Douglas building the rest. GD received $180.7 million to build 208 Tomahawk Block II Sea-Launched Cruise Missiles, with the option to upgrade them to Block III configuration. McDonnell Douglas will receive $104.4 million, with similar options.

• In September, the Army's Missile Command awarded a $114.3 million winner-take-all contract to General Dynamics for 4,413 Stinger reprogrammable microprocessor missiles, eliminating Raytheon as a second source for the antiaircraft missile. Raytheon was dropped because of delays in qualifying the firm for production. In addition, the Army set aside 2,700 future Stingers for General Dynamics prior to the competition, to allow for a fair competition. The cost of the additional missiles has not been set.

• Lockheed Missiles and Space Co., McDonnell Douglas Corp., and TRW will perform for NASA definition studies of the proposed National Launch System (NLS). Each company was awarded a $500,000 contract. The ten-month study will be based on the Shuttle-C and Advanced Launch System work carried out in the last few years. The NLS is expected to be a family of launch vehicles ranging in lift capability from 20,000 to 150,000 pounds. The NLS is to be a joint USAF-NASA program.

• The crash of the fifth Bell-Boeing V-22 tiltrotor aircraft in June was caused by an assembly error, according to DoD. A gyro-type device that feeds inputs to the flight-control system was faulted for the accident. V-22 test flights will continue.

• NASA's Ames Research Center is negotiating a contract with Rockwell International for a feasibility study of a hypersonic wave rider research vehicle, NASA said. Rockwell would be required to provide a readiness assessment of off-the-shelf technology to design, build, and test a hypersonic test vehicle. No due date was given.

• General Electric Aircraft Engines promised the Turkish government that it will maintain employment and work levels at the Tusas Engine Industries plant GE helped build in that country, the firm said in August. The pledge was made in Turkey by GE Aircraft Engines Vice President R. C. Turnbull. The announcement precedes Turkey's decision on the powerplant to be used for its order of eighty General Dynamics–built F-16s.

• NASA has created the positions of associate administrator for exploration and associate administrator for human resources and education in response to recommendations of the Advisory Committee on the Future of the US Space Program (the so-called Augustine Committee), NASA Administrator Richard Truly said in August. Michael Griffin, a former SDIO official, will head exploration, while retired Air Force Lt. Gen. Spence M. Armstrong, who served in the Synthesis Group, will head human resources and education.

• Boeing's Lightweight Exoatmospheric Projectiles (LEAP) demonstrated flight and lateral movement in August at the SDI National Hover Test Facility at Edwards AFB, Calif., according to SDIO. Hughes and Rockwell versions of LEAP have also completed hover tests. LEAP is designed to intercept and destroy a ballistic missile with kinetic energy.

• The Lockheed Aeronautical System Co.'s P-3 Orion assembly line opened in early August at the firm's Marietta, Ga., facility. Lockheed has a contract to produce eight P-3D Update Three models for South Korea, to be delivered in 1995. The P-3 line was formerly located in Burbank and Palmdale, Calif.

• NASA's F/A-18 High Angle of Attack (alpha) Research Vehicle,

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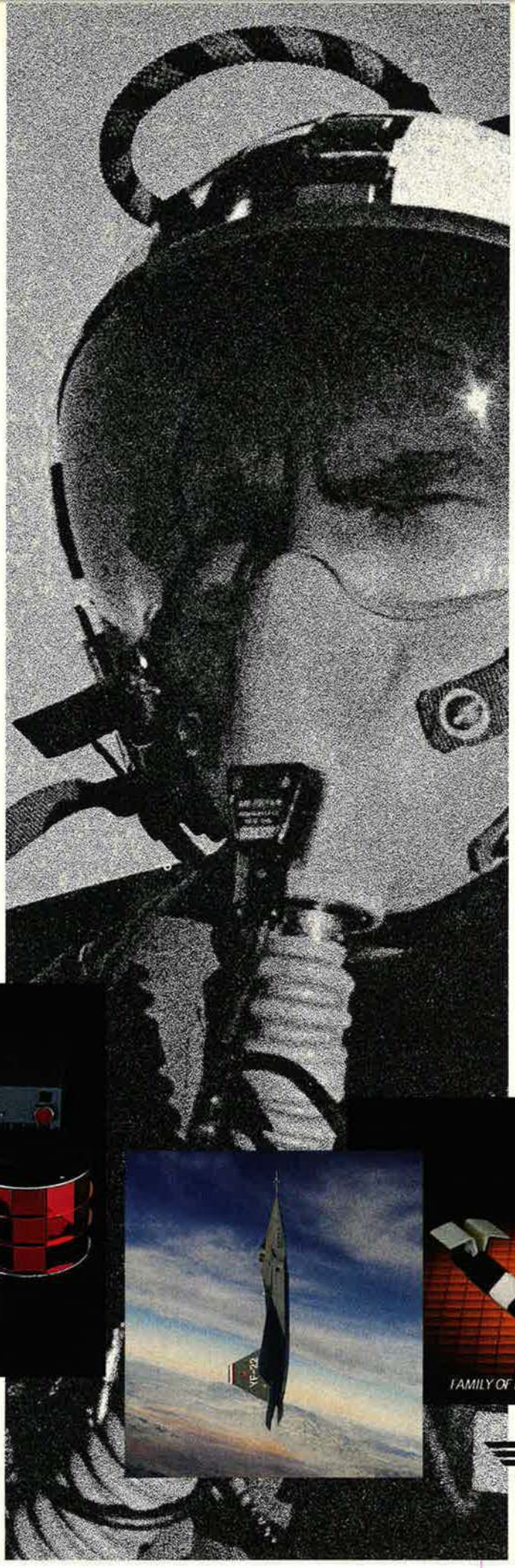
1500 closing.
No missile
threat."



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equipped with a thrust-vectoring system, flew for the first time in July. NASA is studying the ability of thrust vectoring to improve control while flying at high angles of attack. The flight test, conducted by the Dryden Flight Research Facility, lasted one hour with the thrust-vectoring system engaged for fifteen minutes. Two more flights took place later in the month.

• A round of tests on a fuselage/fuel tank section of the proposed X-30 National Aerospace Plane verified that the composite structures could withstand the mechanical and thermal loads they would face while ascending to orbit laden with cryogenic fuel. Work is being performed jointly by industry, DoD, and NASA.

• China announced in August that it plans to sign the Nuclear Nonproliferation Treaty unconditionally. The NPT requires that member nations not assist any other country in acquiring nuclear weapons.

• The French government announced in August that, for budgetary reasons, it was canceling a $183 million contract with Giat Industrie for upgrading ninety-two AMX-30 tanks and procurement of twenty-four new AMX-10P artillery observation vehicles, ten armored vehicles, and twenty towed TR 155-mm artillery pieces.

• In September, the British Ministry of Defence chose Westland and IBM to build forty-four Merlin antisubmarine warfare helicopters for $2.5 billion. The GEC–British Aerospace team was the loser in the competition.

Deliveries

McDonnell Douglas delivered in August the first two of twelve F-15C/Ds ordered by Saudi Arabia. The foreign military sales contract with the Air Force is worth $333.5 million and was struck prior to the Persian Gulf War. McDonnell Douglas will produce nine single-seat F-15Cs and three dual-seat F-15Ds at a rate of two per month.

Sikorsky Aircraft delivered the first production UH-60L Black Hawk capable of using the full output capacity of its General Electric T700-GE-701C powerplant in August. Prior to the delivery, UH-60Ls were unable to accommodate the power of the new engine because they lacked sufficiently robust mechanical flight controls. The adjustment will allow the aircraft to boost its lift capability from 7,000 to 8,000 pounds.

Honors

Phillips Laboratory recognized eight companies for "Outstanding Technical Achievement" in August. TRW, SAIC, W. J. Schafer Associates, and Logicon R&D Associates were honored for their work developing a space-based chemical laser called Alpha. Ball Aerospace Systems Group and Applied Technology Associates were cited for successes in fielding and testing an experiment that relayed a laser beam from one ground station to another via a satellite-based mirror. Assurance Technology Corp. was cited for a microelectronics experiment package developed for the Combined Release and Radiation Effects Satellite Experiment. Space Dynamics Laboratory of Utah State University was honored for its work with the design, construction, calibration, and flight support of a sensor system for a major experiment conducted aboard the space shuttle, titled the Cryogenic Infrared Radiance Instrumentation for Shuttle (CIRRIS).

A B-1B crew from Ellsworth AFB, S. D., received 8th Air Force's Gen. Ira Eaker Outstanding Airmanship Award for 1990 for successfully recovering their stricken Lancer at night after both forward windscreens had been shattered by multiple birdstrikes. The incident occurred September 19, 1990. The honor went to Capt. Paul Dow, aircraft commander; Maj. Thomas Owskey, instructor pilot; Maj. Thomas Dyer, instructor offensive

Senior Staff Changes

RETIREMENTS: M/G Thomas R. **Olsen;** M/G Richard A. **Pierson;** M/G Walter E. **Webb** III.

PROMOTIONS: To be **ANG Major General:** Michael **Adams;** Gary C. **Blair;** Allen C. **Pate;** David L. **Quinlan;** Edward V. **Richardson.**

To be **ANG Brigadier General:** Steffen P. **Christensen** III; Donald **Dalton;** Dan E. **Dennis;** Edmond W. **Doenisch,** Jr.; Peter L. **Drahn;** William D. **Lackey;** John M. **Lotz;** Roberta V. **Mills;** Paul A. **Pochmara;** Alan T. **Reid;** Kenneth L. **Ross;** Mason C. **Whitney;** George E. **Wynne;** Philip E. **Zongker.**

CHANGES: B/G Harold B. Adams, from Vice Dir., NORAD Combat Ops. Staff, NORAD, Cheyenne Mountain AFB, Colo., to Dir., NORAD Planning Staff, Hq. NORAD, Peterson AFB, Colo., replacing retired B/G James P. Ulm . . . **M/G Lester P. Brown, Jr.,** from Cmdr., USAF ADWC, TAC, Tyndall AFB, Fla., to Cmdr., 1st AF, TAC, and Cmdr., CONUS NORAD Region, Tyndall AFB, Fla., replacing retired M/G Richard A. Pierson . . . **B/G Frank Cardile,** from Vice Cmdr., 21st AF, MAC, McGuire AFB, N. J., to Cmdr., 438th MAW, MAC, McGuire AFB, N. J. . . . **M/G George B. Harrison,** from ACS/Studies and Analyses, Hq. USAF, Washington, D. C., to DCS/Ops., and Dep. Dir., Ops., EACOS, Hq. USAFE, Ramstein AB, Germany, replacing M/G James L. Jamerson.

M/G Harald G. Hermes, from Dep. Cmdr. and C/S, 4th ATAF, NATO, Heidelberg, Germany, to Vice Cmdr., 9th AF, TAC, and Dep. Cmdr., USCENTCOM Air Forces, Shaw AFB, S. C., replacing retired M/G Thomas R. Olsen . . . **M/G James L. Jamerson,** from DCS/Ops., and Dep. Dir., Ops., EACOS, Hq. USAFE, Ramstein AB, Germany, to ACS/Ops., SHAPE, NATO, Mons, Belgium, replacing M/G Alan V. Rogers . . . **M/G Donald L. Kaufman,** from Chief, US Mil. Training Mission to Saudi Arabia, USCENTCOM, Dhahran, Saudi Arabia, to Dep. Cmdr. and C/S, 4th ATAF, NATO, Heidelberg, Germany, replacing M/G Harald G. Hermes . . . **Col. (B/G selectee) Dwight M. Kealoha,** from Spec. Ass't to C/S, Hq. USAFE, Ramstein AB, Germany, to Cmdr., 375th MAW, MAC, Scott AFB, Ill., replacing Col. Robert J. Boots.

Col. (B/G selectee) John M. McBroom, from Spec. Ass't to DCS/Ops., Hq. TAC, Langley AFB, Va., to Dep. Dir., Ops., NMCC, Jt. Staff, J-3, Washington, D. C. . . . **B/G David W. McIlvoy,** from Mil. Ass't to the Sec'y of the Air Force, OSAF, Washington, D. C., to Cmdr., 319th Wing, SAC, Grand Forks AFB, N. D. . . . **M/G Alan V. Rogers,** from ACS/Ops., SHAPE, NATO, Mons, Belgium, to Dir., Operational Plans and Interoperability, Jt. Staff, J-7, Washington, D. C. . . . **B/G Arnold R. Thomas, Jr.,** from Command Dir., NORAD Combat Ops. Staff, NORAD, Cheyenne Mountain AFB, Colo., to Vice Dir., NORAD Combat Ops. Staff, NORAD, Cheyenne Mountain AFB, Colo., replacing B/G Harold B. Adams.

SENIOR EXECUTIVE SERVICE (SES) CHANGES: J B Cole, from Dep. Dir. for Construction, DCS/Logistics, Hq. USAF, Washington, D. C., to Dir., Air Force Center for Environmental Excellence, Brooks AFB, Tex. . . . **Marvin E. Smalling,** from Dir., Contract Clearance and Policy Development, DCS/Contracting, Hq. AFSC, Andrews AFB, Md., to Principal Ass't, DCS/Contracting, Hq. AFSC, Andrews AFB, Md., replacing Darleen A. Druyun. ■

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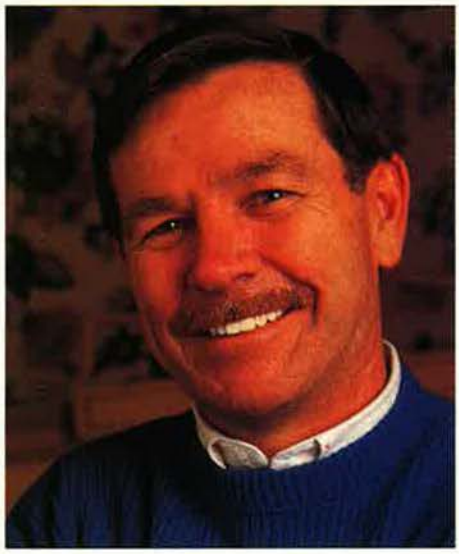

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U.S. Military (Ret.)

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systems officer; and Capt. Robert Distaolo, defensive systems officer.

Purchases

The Army awarded General Dynamics Land Systems Division a $767.9 million, firm, fixed-price contract for 641 M1A1 Abrams tanks. Expected completion: April 30, 1993.

The Air Force awarded McDonnell Douglas Corp., a $333.5 million, firm, fixed-price contract for the purchase of nine F-15C and three F-15D aircraft for the Peace Sun VI program. Expected completion: February 1992.

The Strategic Defense Initiative Organization awarded McDonnell Douglas Space Systems a $58.9 million contract for Phase II of the Single-Stage-to-Orbit program. Expected completion: 1993.

The Navy awarded Grumman Aerospace Corp. a $25 million order against a fixed-price contract to manufacture eighteen shipsets of wing center sections for the E-2C aircraft. Expected completion: October 1992.

The Navy awarded General Electric's Aircraft Engine Business Group a $22 million, latter contract for sixty-six T700-GE-401 engines for installation in the US Marine Corps AH-1W Cobra helicopters. Expected completion: December 1993.

The Air Force awarded McDonnell Douglas Space Systems Co. a $193 million, fixed-price, economic price adjustment/award fee with cost reimbursable line items contract for procurement of two Delta II launch vehicles and costs associated with launches planned for 1992, three launch vehicles and costs associated with launches planned for 1993, and advanced procurement of three launch vehicles planned for launch in 1994. Expected completion: December 1992.

The Army awarded Hughes Aircraft Co., a $6.3 million modification to a firm, fixed-price contract for 2,000 TOW-2A missiles. Expected completion: February 28, 1992.

Flight testing of the first EC-130V Airborne Early Warning aircraft began at General Dynamics Fort Worth Division in late July. The company installed the Navy E-2C Hawkeye Airborne Early Warning Radar System into the long-range C-130 airframe to provide extended patrol capability for the US Coast Guard.

Obituaries

Retired Air Force Maj. Gen. Leigh Wade, ninety-four, died of congestive heart failure on August 31. In 1924, Mr. Wade took part in the first around-the-world flight, a journey of 175 days that ended when engine trouble forced the pilot to ditch in the north Atlantic. General Wade was in the Army Air Corps when he and six other pilots were assigned the flight.

Astronaut James Benson Irwin, sixty-one, died of a heart attack in August. He was one of twelve men to walk on the moon and served as the lunar module pilot on Apollo 15 in 1971, the fourth successful manned lunar mission. Colonel Irwin was the first of the twelve moonwalkers to die.

Retired Air Force Maj. Gen. Charles C. Chauncey, 102, died in August. General Chauncey was a highly decorated World War II veteran. In 1944, he served in dual capacities as Eighth Air Force chief of staff and chief of staff for the US Army Air Forces in the United Kingdom. He later went on to command the Technical Training Air Force, a post he held until his retirement in 1951. ■

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Ten years before the F-22 deploys, the Air Force is already thinking about its successor.

Fighter 2020

By Larry Grossman

THOUGH the F-22 Advanced Tactical Fighter will not be deployed for a decade, the Air Force already is thinking about its successor.

Scientists working at Wright Laboratory, the research arm of Air Force Systems Command's Aeronautical Systems Division, now are identifying key technologies to serve as building blocks for an air-to-air fighter to follow the F-22, which goes into service in 2002.

Extrapolations from current development trends point to introduction of such an aircraft about two decades after the F-22 arrives. Hence the designation "Fighter 2020" used here.

Fighter 2020 is sure to be stealthy. It is likely to feature extraordinarily high angles of attack, Mach 2 supercruise, light-driven avionics, and flight controls that repair themselves. Its engines will be powerful but lightweight and efficient.

The Air Force is making a major new investment—$962 million this year—in technology now in the earliest stages of development at Wright-Patterson AFB, Ohio. In predicting future fighter development, technologies aren't the only factors to consider. However, each new military airplane must begin with an assessment of the technical possibilities.

Imagine a fighter with the ability to fly at virtually unlimited angles of attack. This may be made possible by future breakthroughs in composite fuselages and structures.

By embedding fiber optics and sensors in the skin and skeleton of a fighter, or even by taking advantage of "sensorial" qualities in composite materials themselves, aircraft designers may not need actuators as they are known today. Smart skin and smart structure will sense strains and stresses on the aircraft and will flex in response. Someday, even threats may be sensed by the smart plane's exterior.

Such smart components will be extremely complex, possibly very costly, and difficult to maintain. The benefits, however, are certain to be great. If it is possible to integrate the sensing of the structure with the flight controls of the plane—and Wright engineers think it is—then Fighter 2020 may be able to fly close to its physical limits without fear of

The tactical fighter to follow the F-22 ATF will have a dramatically different cockpit, incorporating technologies now in the early stages of development. The pilot will be aided by artificial intelligence systems like those being developed in the Pilot's Associate program to provide situation assessment and systems status reports and a phantom navigator that will display flight paths "in the sky" using liquid crystal displays.


MIG-31
90
S-20

structural failure. The result could be a far lighter structure, because many of the structural "margins" built into today's aircraft could be eliminated.

Ten-to-One Ratios

Shared situational and tactical information lies at the heart of the Integrated Control and Avionics for Air Superiority (ICAAS) system, one of Wright Laboratory's top priorities. The goal: Increase the expected kill ratio for fighters to an average of ten to one.

With a sophisticated data link, friendly fighters will be able to exchange information rapidly, provide mutual support, heighten situational awareness, maximize the performance of each weapon, and increase the survivability of each aircraft.

Pilots will use ICAAS to trade sensor and weapon information. ICAAS will then provide data to each pilot, individually tailored to his own perspective of the situation. Attack and defense capabilities will be completely integrated so that, as shooting opportunities against multiple targets are increased, the pilot's survival against a threat is also optimized. ICAAS will also calculate the best offensive and defensive tactics for a particular situation and make recommendations.

Because ICAAS is geared to use in beyond-visual-range situations, lead and wingman will no longer have to shadow each other. The data link will allow them to provide detached mutual support, providing pilots with a whole new bag of tricks.

For example, in a lead-trail, air-to-air combat formation, the first plane will be able to operate passively, with the more distant second aircraft acquiring tactical data using its active sensor suite to detect and lock on to a foe. That information would be handed off to the lead aircraft, which would launch its weapon and escape quickly, with the missile supported by the trailing aircraft.

"The idea of cooperative missile launch in this case is to get more separation between the threat and your aircraft when the missile arrives," says James Kocher, the ICAAS program manager.

Another program, the Integrated Tactical Aircraft Control (ITAC) system, embraces the same data-sharing concept for manned aircraft and lethal unmanned aerial vehicles (UAVs).

The UAVs will be capable of such missions as identifying relocatable targets. In air-to-air situations, lethal UAVs will be fused, so to speak, with the sensor and data systems of a piloted jet. This will increase fighter standoff ranges and lower the probability that an enemy will detect the plane.

The Air Force is working to develop a fighter engine with greater thrust, less weight, and greater fuel efficiency than its current state-of-the-art fighter engine. Possible applications include a supersonic vertical/short takeoff and landing fighter (here, the F-15 STOL/Maneuvering Technology Vehicle demonstrator).

UAVs may be used to mimic the signals emitted by the companion manned fighter—conducting, in effect, an electronic disinformation campaign. In another scenario, unmanned scouts may act covertly, working in close to a threat and allowing the manned fighter to stand off where it can safely launch a weapon. Conversely, the manned plane may do the target acquisition from a safe distance while the UAV moves in for the kill.

UAV size will determine the cost of the system and will be determined by weapons carriage requirements and recoverability and reuse needs.

ITAC will present serious command and control problems for combat air traffic controllers. Adding UAV flight management will mean yet another responsibility in the pilot's work load.

Avionics That Think

The sharing of signal and sensor information through new, advanced data links will be the basis of ASD's self-optimizing avionics program.

The system will rely heavily on massively parallel processing (many high-speed computers working simultaneously on various aspects of a problem) and artificial intelligence. This will allow an aircraft's controls, sensors, and weapons—and, in effect, the pilot—to be optimized automatically according to mission objectives.

Like ICAAS and ITAC, the self-optimizing avionics system will also look outside the cockpit and the plane's own systems for sources of information.

Say, for example, a pilot and his wingman have just fought their way out of a huge air-to-air engagement. The wingman has two air-to-air missiles left, but he has suffered damage that has knocked out his target acquisition radar. The leader's radar is in working order, but he has used all his weapons. Out of visual range, the leader's sensor suite picks up an enemy aircraft. Through their self-optimizing avionics systems, the leader can feed his target acquisition data to his wingman's fire-control system and, from his off-board position, launch the available missiles.

Wright Lab technologists also see prospects for adding a little autono-

my to flight controls. Wright Lab's flight-control directorate is developing a self-repairing flight-control system (SRFCS) for just that purpose.

The problem with current flight-control systems is that failures and battle damage to control surfaces, actuators, and hydraulics can significantly reduce the pilot's ability to control the plane. The SRFCS would allow swift reconfiguration of the system. The system would identify the faults and modify the positions of remaining functioning control surfaces to compensate for the failure, allowing the pilot to continue his mission.

In addition, SRFCS would improve the maintainability of flight-control systems. By examining system failure as it occurs, the system would analyze intermittent problems and would later feed the results to the ground crew, eliminating "cannot duplicate" or "retest OK" quandaries.

At Wright-Patterson, using a simulator to evaluate the effectiveness of pictorial presentation of information for use in the "cockpit of the future," pilots test displays giving information on flight control, navigation, weapons status, systems status, emergency procedures, and tactical situation.

Recognizing a Failure

SRFCS presents serious design and computational challenges to control experts, says John Perdzock, group leader of Wright Lab's flight-control division.

"The system is based on the idea of mathematically recognizing a failure, isolating it, and accommodating it," he says. "This is complex. An on-board computer has to continuously run a real-time mathematical model of the airplane."

The Pacir program, just formed by Wright Lab's flight dynamics directorate, will take the self-repairing controls program one step further, increasing allowable angles of attack. Taking F-22 technologies such as thrust-vectoring nozzles, flight engineers at Wright-Patterson hope to move from current capabilities of 20°, past the 70° that proved controllable in the X-29 test-bed, and on to an unlimited angle of attack position.

The increasing complexity of aerial combat is greatly affecting the shape of future avionics systems. Pave Pace, a major initiative at Wright Lab's avionics directorate, stems from the need to slash pilot work load by pushing for more sophisticated integration of data from all sources.

The first step in Pave Pace will be to develop a frequency multiplexed, multifunction array for radio frequency operations. This would enable a fighter's radar, electronic countermeasures, electronic support measures, and radar warning receivers to use common apertures as well as a common, integrated signal and data processor.

In the electro-optic range, the goal is to produce new or advanced forms of forward-looking infrared systems, laser radars, and forward-looking laser systems. These also would share integrated, multifunction apertures, with the information to be sorted and then fused by an integrated analog processor.

The act of processing at ultrahigh speeds will require a technological leap of great magnitude. Current state-of-the-art computers process three million instructions per second (MIPS). In Fighter 2020, however, computational power will be measured in *billions* of operations per second (BOPS). Because of tight volume and weight restraints in the fighter, the need to compress the size of the computer will be great.

Wright Laboratory's engineers describe their vision of future computers as "BOPS in a soup can."

The building blocks for this type of equipment include gallium arsenide wafers, as well as such new technologies as silicon germanium and silicon carbide.

Missile warning systems will need computers capable of three to four BOPS. So will automatic target recognition systems. New systems to perform integrated radio frequency signal processing will require no less than ten BOPS.

Getting from MIPS to BOPS will be a twenty-first-century necessity, driven by Fighter 2020's requirement for more computational capability. Digital radars (needed to counter the stealth qualities of future enemy aircraft), very-wide-area surveillance and automatic target recognition systems, and other advanced equipment will gobble up computational power at rates unimaginable today. All this, however, has to be balanced against cost, weight, volume, and power requirements.

Wright Lab's designers also are shooting for failure-free electronics. They are developing components able to go 20,000 hours between failures—in other words, for the life of the average system.

Stacks of Semiconductors

Designers at Wright Lab say future electronic systems will be aided by another promising development, heterojunction device technology.

This technology entails the use of thin layers of different types of semiconductors to construct devices of enormous complexity. The process provides the designer with

a much greater range of materials with which to optimize device performance. The designer can select a different material for each layer. Properties not occurring naturally in any one material will be attained by constructing "superlattices" of separate materials.

With this new technology, integration of electronics and optical devices—computers that run on photons (*i.e.*, particles of light) rather than on electrons—will for the first time become more than just a dream.

Keeping pilots from becoming overwhelmed by tens of BOPS of information will be the job of systems in a dramatically different cockpit.

Certain to be found is a variation of the so-called Pilot's Associate system, which has been on the drawing boards for some time. Engineers say this artificially intelligent helper will be fully matured in Fighter 2020. The Pilot's Associate will manage information and integrate it so it is meaningful to the pilot.

Mostly, the Pilot's Associate will provide situation assessment (analysis of the outside environment) and systems status (monitoring the aircraft and its accessories). All this information will then be fed to an on-board mission planner system, which will maintain or revise a flight plan, and an on-board tactics planner system, which will assess and then prioritize threats to the aircraft. The pilot will be able to tailor the system to his particular needs.

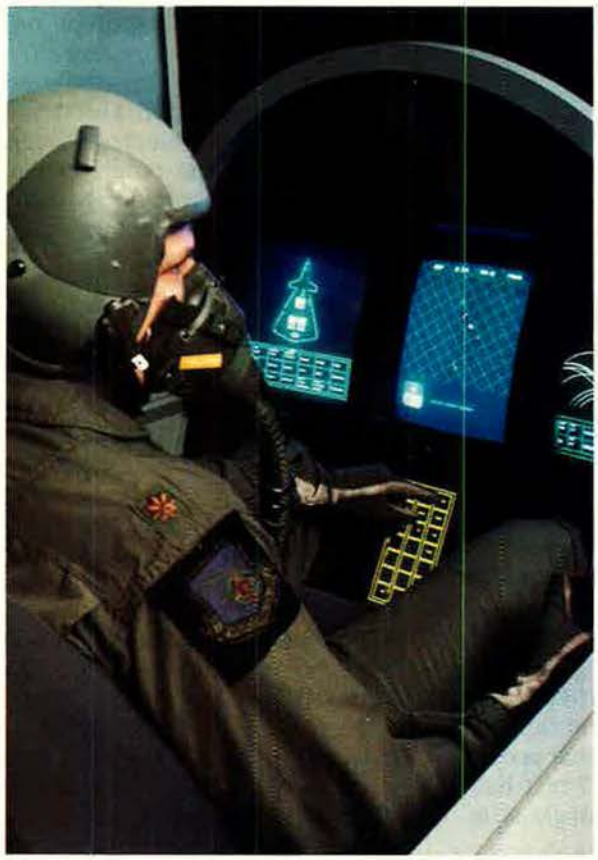
Says Lt. Alfonso Lapuma, a Pilot's Associate project engineer, "PA will let the pilot do things he does well—like thinking and flying —and let the computer do things like number crunching and correlation of data."

In another program, a kind of phantom navigator will be on hand to enhance the survivability of the aircraft and make it more likely to achieve success. The system, designed to help the pilot find the most secure routes into and out of a combat area, will rely on neural networks—computers able to "learn" like the human brain—that connect large, knowledge-based systems.

Though such systems will greatly assist pilots, pilots still will have to make decisions with lightning speed. In light of this need, Wright Laboratory engineers are virtually reinventing the cockpit. Several promising new generic systems are based on advanced technologies. One is called Pathway in the Sky. It presents an electronic picture of an undulating road in the sky: the pilot's mission path.

The Yellow Brick Road

The basis of the system is a 300-square-inch, active-matrix, liquid crystal display panel called the Panoramic Cockpit Control and Display System (PCCADS). The system will process and sythesize vast amounts of data into an animated picture. The picture will be projected in three dimensions by means of an autostereoscopic display that does not require use of polarizing glasses.



A pilot tests a fighter cockpit mockup, built by Lockheed, on a simulated mission over Germany. The screen on the left monitors aircraft and weapon systems; the middle screen is a detailed tactical display; the screen on the right shows the territory being overflown.

In practice, the pilot will follow a computerized lead airplane down a computerized "yellow brick road," the optimum route for the task at hand. As the pilot gets into a danger zone, a green stripe in the middle of the pathway turns yellow. In an extremely dangerous zone, the line turns red.

Engineers say the active-matrix, liquid crystal display technology being developed at Wright Lab may be the only way to present the integrated picture to the pilot because cathode ray tubes are too big and short-lived.

The beginnings of Fighter 2020's powerplant can be found at Wright Lab's aero propulsion and power directorate, where Integrated High-Performance Turbine Engine Technology (IHPTET) was born in 1982. The goal is to produce a fighter engine with twice the thrust of the ATF's state-of-the-art system, less weight, and greater fuel efficiency.

The program, a cooperative venture of DoD, NASA, and industry, aims to meet three fundamental performance goals.

First, it seeks to deliver higher combustion initiation temperatures —about 1,500° to 2,000° Fahrenheit —by creating higher pressure ratios or regeneration. Second, plans call for achieving higher maximum temperature tolerances, reaching up to 4,000°. Third, the program seeks to produce lighter-weight components for a thirty-five percent reduction in the ratio of weight to power.

IHPTET's powerplant should help the Air Force achieve, in a full-size fighter, Mach 3.5 top speed, Mach 2 supercruise (nonafterburner) capability, and a 1,000-nautical-mile mission range. It could also lead to development of a supersonic vertical/short takeoff and landing fighter the size of an F-15 with greater range-payload capability or a 100 percent increase in range-loiter-payload capability for an F-14-size aircraft.

The F-22 air-to-air fighter will go into service in 2002. Extrapolating from current development trends, the Air Force could introduce its successor about two decades later. Taking the F-22's technologies as a point of departure, flight engineers at Wright-Patterson are working on expanded fighter capabilities.

Search for "Unobtanium"

Achievement of the generic IHPTET will depend heavily on development of certain advanced composites that are both lighter in weight and able to withstand greater temperatures. Only half in jest, Program Manager Jim Petty calls the material that will allow him to achieve all of the stated IHPTET goals "unobtanium."

Mr. Petty says that no material in and of itself will ever be essential to his IHPTET program goals. At present, Wright Lab's materials experts are hard at work developing such new lightweight, ultrahigh-temperature composites as carbon-carbon substances and advanced metal-matrix composites for operations above 3,000° Fahrenheit.

Carbon-carbon substances, which are amalgams of carbon fibers glued in place with special resins, have been used in missile and rocket nose cones and exhaust nozzles for years. Jan Garrison, the program manager for advanced composite structures, says work on carbon-carbon has focused on two-dimensional nozzle structures for thrust vectoring and low-infrared signature requirements.

Carbon-carbon's shortcoming: It requires a special coating. This coating has a short life due to oxidization. Mr. Garrison says that the future of the material depends on solving the coating problem.

Metal-matrix composites, while capable of withstanding temperatures as high as carbon-carbon can and resistant to hydrogen degradation, are very brittle. A great deal of research remains to be done before they are applied to aircraft production, but they are seen as highly promising substances.

Advances in nonstructural materials, such as high-temperature liquid and solid lubricants, hydraulic fluids, seal materials, and thermal barrier coatings, will also be essential in reaching twenty-first-century powerplant requirements.

In the quest for better performance, scientists are at work on a new type of jet fuel, which is expected to take advantage of thirty years' worth of advances in refining technologies that have come into being since the current aviation fuels JP-4 and JP-8 were first produced.

Besides the power it produces, jet fuel plays another important role as coolant running throughout a plane to provide electronic subsystems hospitable living conditions. Because of the severely high temperatures generated by modern engines, contained jet fuel has to be used to cool the powerplant; using outside air would reduce the plane's stealthiness.

New JP-900 fuel will be able to sustain temperatures of 900° Fahrenheit, an increase over today's fuels' limits of 575°. Wright Lab's fuel research is also exploring development of advanced endothermic fuels, which will absorb much more heat than conventional fuels by using a catalytic heat exchanger reactor.

On current aircraft, many systems and components produce power unrelated to the plane's thrust. Hundreds of horsepower are transmitted through the plane to drive flight controls, cockpit environment controls, fire controls, avionics, and the like.

"Our vision is to replace all these power systems with a power-by-wire system for an all-electric jet using ultrareliable solid-state components," says Dick Quigley, power systems branch chief at Wright Laboratory. This would eliminate the need for a separate auxiliary power unit and emergency power unit, a major advantage for the fighter. On a two-engine fighter, the weight of internal power systems roughly equals that of a third engine, and eliminating them will bring greater range, maneuverability, and payload.

The Air Force's leadership has always pushed for the latest and best in advanced tactical combat aircraft. By all indications, the service's technological establishment will be able to meet this demand many decades into the future. ■

Larry Grossman, a free-lance writer in Washington, D. C., is a former associate editor of Military Forum *Magazine and staff member of the House Armed Services Committee. His most recent article for* Air Force *Magazine, "The Big Toxic Waste Cleanup," appeared in the October 1991 issue.*

Watch for a big leap in military information technology from the combination of electronics, superconductivity, and photonics.

Rome's Three Keys to the Future

By John Rhea

AT THE Air Force's Rome Laboratory, Griffiss AFB, N. Y., military information technology is in the throes of what may be its most significant change since introduction of the integrated circuit thirty-one years ago. Some claim that coming advances will make current electronic systems seem as archaic as the Civil War telegraph seems today.

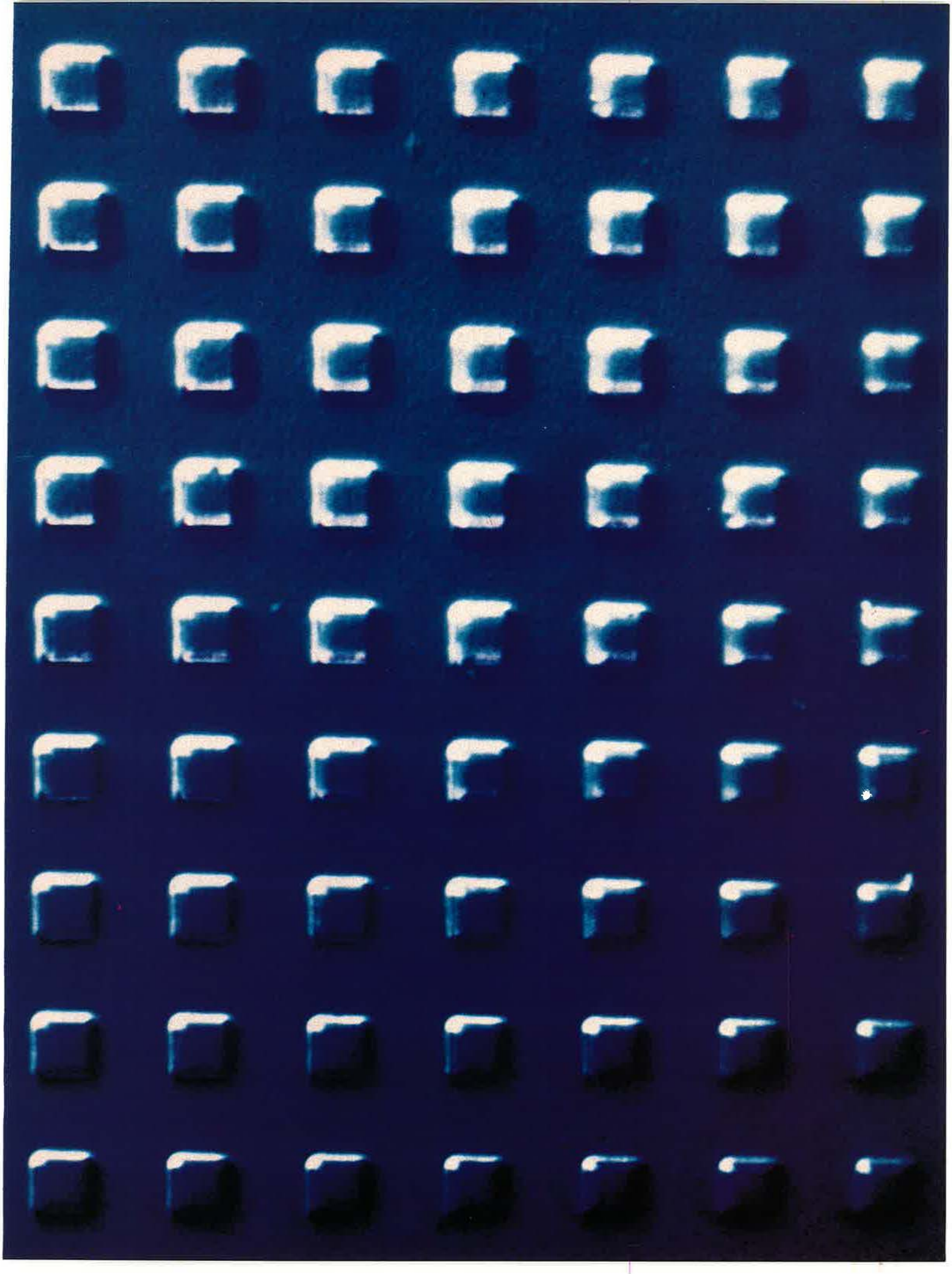
At the core of the change lie big improvements in standard electronic technologies, but that is not the whole story. Rome is also expanding its uses of the embryonic technologies of photonics and superconductivity.

Engineers working in photonics are making breakthroughs in developing devices that run on streams of minuscule particles of light—photons—rather than on electrons. With superconductivity, they are developing substances to virtually eliminate resistance to the flow of electrons. These basic research activities are feeding new technology into advanced development programs on a broad front.

Among these are the Advanced Tactical Surveillance Radar program, out of which may grow a new generation of mobile, jam-resistant tactical radars; the Advanced Airborne Surveillance Radar program, which is developing systems essential for use in conformal arrays, or "smart skins"; the Space-Based Radar program, aimed at producing surveillance equipment to track air-launched cruise missiles even against background clutter and countermeasures; and the Advanced On-Board Signal Processor program, an effort to develop computers powerful enough and small enough to meet the demanding requirements of the Strategic Defense Initiative.

In essence, Rome Lab is attempting to discover and refine new and

The transfer and processing of military information through photons (opposite, optical gates for a Cray supercomputer), rather than electrons, is one of the areas in which Rome Laboratory's engineers are making great research strides.



better ways to manage the flow of subatomic particles, whether they be electrons or photons. Transmission of these tiny bits of matter or energy is basic to communications.

Col. John M. Borky, commander of Rome Lab and holder of a doctorate in electrical engineering, sorts out which technologies can best perform which functions. Colonel Borky, who formerly was Air Force program manager for the Pentagon's very-high-speed integrated circuit (VHSIC) development program and avionics manager for the Advanced Tactical Fighter, believes electronics, superconductivity, and photonics will complement each other in the weapon systems the Air Force will field in the twenty-first century.

Conventional Electronics

Where do conventional electronic technologies figure into this equation? In many areas, Colonel Borky is quick to point out. He claims there is no end in sight to their pivotal role.

In an accounting of the most likely applications for continued, large-scale use of conventional electronics, perhaps in more exotic forms, Colonel Borky singles out what he calls the "more software-intensive," traditional data-processing functions.

Data processing is based on the retrieval of randomly stored and organized information, where high-volume "throughput" is not essential, and so is seen as the ideal area for electronics-based systems.

Colonel Borky contrasts this with signal processing, which is characterized by high-volume flows of information through a computer, repetitive functions, and a highly structured environment. Speed is critical, and speed is no longer the strong suit of electronics when compared with the new technologies.

Electronics is here to stay. As military challenges and systems have evolved, however, even its partisans have conceded that electronic technologies must struggle to keep pace. The need for further refinement of these technologies continues.

For example, electronic technologies based on silicon and even gallium arsenide will relatively soon be nearing their physical limits, as measured in terms of heat and power dissipation, and Rome Laboratory has become the focal point within the Air Force for the development of an even more powerful electronics technology based on indium phosphide.

Indium phosphide has higher electron mobility and greater resistance to nuclear radiation and electromagnetic interference. For these reasons, Rome engineers are working to make it possible to use this substance in future tactical devices, such as a phased-array radar capable of detecting stealthy targets.

Superconductive Electronics

One technology that might keep electronics progressing for a long time is superconductivity. It could drastically reduce electronics' heat and power-dissipation weaknesses.

Superconductivity describes the property found in a small number of substances that allows electrons to flow virtually unimpeded. Some metals exhibit near-zero resistance to an electric pulse when chilled to extremely low temperatures. Such low-impedance materials would make possible much greater efficiency in electronics.

Candidate systems include such microwave components as filters and resonators for antennas. In computers, electronics based on superconducting materials looms as the dual technology of choice to replace more-traditional analog functions. Analog computers operate with numbers represented by directly measurable quantities, such as rotations of a dial.

With superconductive devices, the requirement isn't so much overwhelming speed as it is connection of all components in a way that ensures overall system performance, according to Colonel Borky.

Colonel Borky points to the structure of the human brain as an example of what the Air Force is seeking. The brain, at the neuron level, has a switching speed of three-tenths of a millisecond—a plodding pace by the standard of modern computers. Each brain, however, has about ten trillion neurons organized in a highly parallel fashion, which more than compensates for the slowness of each switching operation.

Superconducting computers will have switching speeds measured in trillionths of a second. More important, these computers can be organized more like the human brain. Because the internal heat they produce is negligible, superconducting computers will have shorter signal paths because they can be packed more densely.

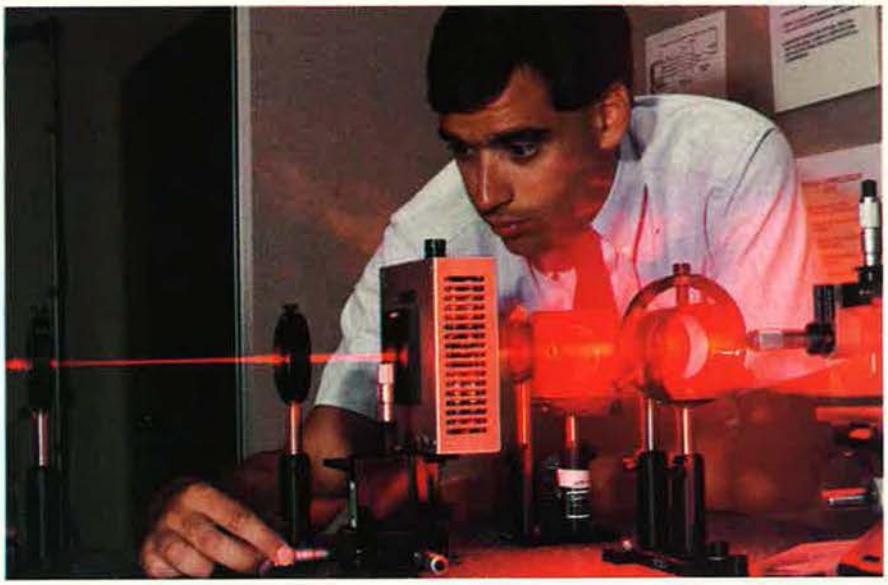
"Suddenly," says Colonel Borky, "the speed of the logic ceases to matter."

To unlock the full potential of superconductivity, engineers will

Electronic technologies are not being abandoned. Rome Laboratory is working on an indium phosphide–based technology that will increase electron mobility and resistance to radiation and electromagnetic interference—essential characteristics for such tactical devices as phased-array radar (above).

have to find substitutes for the extremely low-temperature superconducting substances in use today. These are niobium titanium and niobium tin, which superconduct at −459° Fahrenheit and require costly liquid helium cooling. New substances can operate at much higher temperatures (−320° F.) and be cooled to superconducting temperatures by using lower-cost liquid nitrogen cryocoolers. This will require basic research in new ceramic materials.

The Air Force, which has not yet deployed superconductive devices, is pressing to have prototypes ready by 1995. Rome Laboratory is in the lead, with USAF acting as part of a Defense Department effort to spur development of superconducting digital electronics. First use by the Air Force of a superconductive component probably will be in either a sensor or a microwave circuit.



Rome Laboratory's James Battiato uses lasers and beam splitters in a prototype all-optical digital processor. Photonic data-processing devices eliminate the problems of heat and power dissipation that make conventional electronics inappropriate for such high-speed, high-volume applications as signal processing.

The Rise of Photonics

While no one is writing off electronics, there is little doubt that photonic technologies will play a larger and larger role in the Air Force's communication and information systems.

Photonics refers to a cluster of technologies that the Air Force has identified as the logical successor to electronics for weapon systems of the twenty-first century. Photonics-based devices, by handling data traffic as photons, eliminate the heat and power-dissipation problems that bedevil electronic devices.

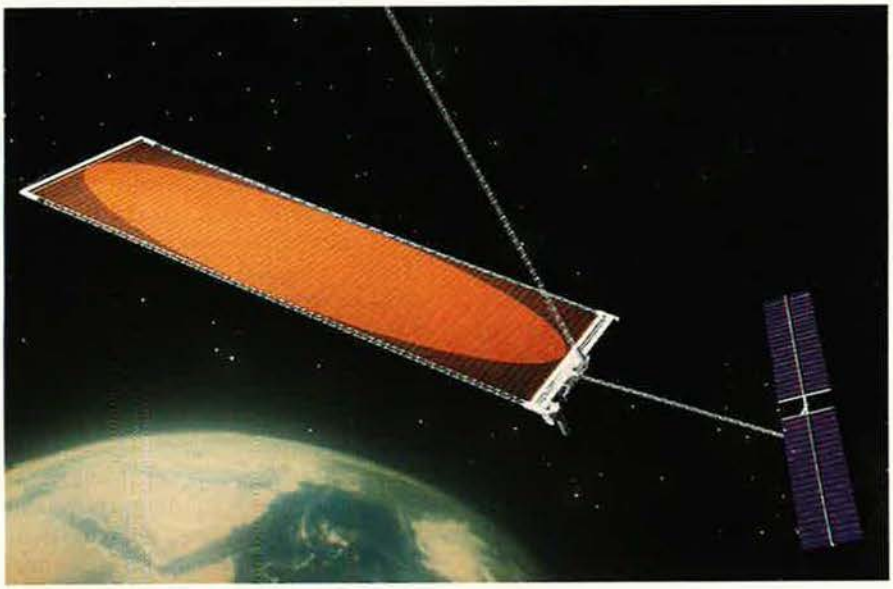
They also reduce vulnerability to electromagnetic interference and electromagnetic pulse. This makes them ideal for tactical aircraft threatened by enemy electronic countermeasures and for all types of command, control, communications, and intelligence (C^3I) systems.

The Air Force believes that photonics will be pervasive in future systems. Colonel Borky insists that Rome Laboratory does not seek indiscriminately to get rid of electronics in favor of the newer, more exotic photonics technologies. He is convinced, however, that the Air Force can soon begin to move these technologies "from the bench to packages"—that is, translate the work of engineering labs into actual components.

"It's fair to say we don't see any show-stoppers," says Colonel Borky. "In the next decade we'll get a handle on what we can and can't do."

Photonics is preferred for some functions and not for others, says the Rome Commander. "The great factor [favoring use of photonics] is speed, the ability to compress growing amounts of information onto light waves in a highly parallel fashion." Colonel Borky says that photonic principles, once perfected, will bring about nothing less than "a revolution in military hardware . . . particularly in the C^3I business, where the payoff in photonics is dramatic."

Among the most dramatic of the effects, says he, is that it will make workable systems possible for automatic target recognition and high-resolution radar images. Future applications could include spatial light modulators, which use tiny lasers to form the picture elements (pixels) of advanced displays. Moreover, says



Dramatic payoffs are expected from photonics research. Space-based surveillance systems incorporating radar satellites like this one could include such capabilities as automatic target recognition, ultrahigh-resolution radar imaging, improved C^3I antijam defenses, and wide-bandwidth photonic local area networks.

Advanced, real-time, three-dimensional displays, referred to in research circles as "virtual reality," would blend electronic technology for general-purpose data processing with highly parallel photonics to handle variable data. Such hybrid "god's-eye" systems would combine the best features of each technology.

Colonel Borky, photonics technology is best for operations requiring what he calls "more-structured logic." These operations include signal processing.

Optical Processing Research

Within Rome Laboratory's Surveillance and Photonics Directorate, engineers focus their efforts on three major research thrusts.

The first is optical processing for target recognition and improved C³I antijam capability. Norman Bernstein, of the optical processing and communications branch, is working on an integrated photonics-based system to replace electronic communications functions at microwave and millimeter-wave frequencies. The aim is to develop immense, jam-resistant, remote antennas. Mr. Bernstein calls this system "a five-kilometer-long black box," in which the traditional electronic communications are replaced by low-loss, fiber-optic communications.

Second is development of photonic feed systems for phased-array antennas and wide-bandwidth photonic local area networks. What makes this possible, Mr. Bernstein explains, is commercial availability of high-quality optical fibers at one dollar per meter of material. Mr. Bernstein expects the system to achieve data rates of up to 500 million cycles per second. Prototype hardware is due to begin tests early next year. Then the technology is to be used in operational C³I systems.

Finally, there is digital optical signal processing. Robert Kaminski, who is in charge of such efforts at Rome Lab, has begun to investigate surveillance, communications, and intelligence applications for photonics. The near-term goal is to develop a programmable central processing unit capable of performing one billion operations per second and achieving switching speeds measured in trillionths of seconds.

These are special-purpose optics, not replacements for existing chips, and are based on an optical programmed logic array. Instead of routing the signals electrically from one chip to another through external connections, the three-dimensional optoelectronic processor uses lasers to transfer the data directly via photons. The result is much higher densities of material on a chip.

Albert A. Jamberdino, who is in charge of the lab's work on optical memories, is working on a new device for sensor fusion applications. Data enter the system as electrons. Each bit is represented by an area of one square micron. Lasers switch the data to create a computer-generated hologram in which the data are stored.

In future systems, says Mr. Jamberdino, powerful memories will be needed to match the increasing speed of the computers. Computers capable of fifty billion operations per second, which will be used in the post-ATF generation of aerospace vehicles, would require memories capable of storing one-third of a trillion bits of data. Systems using only electronics would be so heavy that the vehicle wouldn't be able to take off.

Smart aircraft skins, a concept that originated in the Air Force's Project Forecast II studies completed five years ago, also have high priority in future air vehicles. These systems will require huge amounts of computing power, and there's only one way to get from here to there: photonics. High-speed, low-power, radiation-resistant optical computers will have to replace today's electronic data processors and signal processors.

Where Technologies Blend

One place where these technologies intermingle will be in advanced real-time, three-dimensional displays. These planned displays increasingly are described with the term "virtual reality." Colonel Borky calls this a "god's-eye view of the battlefield."

Traditional data-processing "logic engines" (using either conventional or superconductive electronics) would handle such general-purpose functions as scenes, angles, coordinates, and input/output. Highly parallel photonics coprocessors would be responsible for handling such variable data as intensity and color. The result would be a hybrid system combining the best features of each technology.

In the military's Integrated Communication, Navigation, Identification Avionics (ICNIA) system, the input and output functions are generally analog and can best be performed by electronic technologies optimized for those tasks. The internal processing, which is digital, is a logical candidate for photonics. ■

John Rhea is a free-lance writer who specializes in military technology issues. His most recent article for AIR FORCE *Magazine, "Seeking Heat," appeared in the April 1991 issue.*

C-17: Lifting America into the 21st century.

On September 15, 1991, four Pratt & Whitney F117 engines powered the C-17 on its first flight. At that moment, America moved closer to gaining the flexibility to meet its airlift challenges of the 21st century. We salute the United States Air Force and McDonnell Douglas for achieving a major aviation milestone. You asked for proven reliable engines for America's newest airlifter. We read you loud and clear.

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The government does not address the industrial base problem in a cohesive or comprehensive way.

Industrial Base Policy Adrift

By John T. Correll, Editor in Chief, and **Colleen A. Nash,** Associate Editor

This article is adapted from "Lifeline Adrift: The Defense Industrial Base in the 1990s." For a complete copy of the study, send $5.00 to the Aerospace Education Foundation, 1501 Lee Highway, Arlington, VA 22209-1198.

THE PENTAGON carries out a variety of defense industrial base programs, ranging from efforts to stimulate productivity to measures that authorize the government to direct the output of critical industries during wartime. However, Washington does *not* seek actually to control or to shape the defense industrial base except in marginal and indirect ways.

Indeed, when it comes to defense industrial matters, the nation's policy is being established largely by default. There seem to be two reasons for this.

The first reason is practical. With defense budgets dropping precipitously and with commercial demands overshadowing defense requirements in any case, the extent to which the problem can be controlled is not great. Without additional funding, the Pentagon can take action to preserve industrial infrastructure only at the expense of other priorities.

The other reason is political. The Bush Administration, which is not totally convinced that a problem exists, opposes the formulation of any kind of "industrial policy." In his signed preface to the most recent Economic Report of the President, President Bush stated the White House position clearly.

"Attempts to protect special interests by blocking the economy's natural, market-driven evolution—through regulation, subsidy, or protection from competition—reduce the economy's flexibility and impair its ability to grow and to create jobs," the President said. "Growth and prosperity are enhanced by strengthening and extending the scope of market forces, not by substituting government dictates for the free choices of workers, consumers, and businesses."

The White House Chief of Staff,

John H. Sununu, is among the most forceful and vocal opponents of industrial policy. "The last thing in the world you want," says he, "is either bureaucrats or a commission working with [other] bureaucrats to identify the winners and losers in the marketplace."

The "General Shakeout"

Statements by senior Pentagon officials are consistent with Administration policy. Fielding a question after a speech last spring, Secretary of Defense Dick Cheney laid out DoD's position:

"We're clearly interested in all of those [industrial base] concerns, but it runs smack up against the general shakeout that is occurring and will continue to occur in the aerospace and defense industries. . . . As we shrink down the total size of our activities, one of the things that develops is pressure on the industrial base and whether or not companies are able to continue to participate and do so profitably. We'll do our best to be sensitive to those concerns as we reduce, but there's no question . . . there will be firms that are doing business today in the defense area that will not be doing business a few years from now, once we've gone through this shrinking of the base."

Donald Rice, the Secretary of the Air Force, declares that industrial considerations did not figure in the selection of contractors for the Advanced Tactical Fighter (won by a team of Lockheed, Boeing, and General Dynamics over a team of Northrop and McDonnell Douglas). "There is still a substantial funding for the aircraft industry out there. Whether it will sustain the same number of companies as we've known in the past, I think we will simply have to leave to those market forces to determine over time."

Not everyone in government shares this faith in market forces, but dissent from today's orthodoxy has been muted if not silenced by a belief—which appears to have some basis in fact—that it can be hazardous to one's career to speak up in favor of anything that sounds remotely like industrial policy.

Privately, more than one bureaucrat concurs with Bernard L. Schwartz, chairman and CEO of Loral Corp., who takes quite a different view. "You can't afford to let the 'free market' dictate who will survive," Mr. Schwartz argues. "The reshaping of the industry must not be left to accidental market forces. Such realignment is not orderly and cannot be expected to proceed along [lines of] product or technological fit which, in the end, will better serve the DoD. Rather, free-market restructuring is often motivated by profit and return on capital considerations, with little regard for long-term investment or performance."

When it comes to defense industrial matters, the nation's policy is being established largely by default.

The Department of Defense does not exactly ignore the problem. Overall, however, it is working on the problem in narrow focus. It seems to lack a guiding concept of what it wants, needs, or expects from the industrial base.

For example, at a time when US defense industry is in accelerated decline, the US has adopted a new defense strategy that features smaller forces, reduced deployment of military units overseas, and heavier reliance on "reconstitution of forces." In fact, the Joint Chiefs of Staff say that the capability of this nation to actually conduct a "reconstitution" of larger forces "may well prove to be the linchpin of America's long-term security."

Yet, insofar as we have been able to determine, the new strategy and "reconstitution" concept were adopted before any real industrial planning for them had been done.

The Pentagon is belatedly turning to this task. A relatively new concept, rapidly gaining importance, is Graduated Mobilization Response (GMR). It envisions a process of steps the federal government can take, in somewhat flexible combination and order, to deal with "a spectrum of contingencies ranging from natural disasters to force reconstitution."

Too Rigid

GMR grew out of the earlier "Incon" concept, which proposed a series of "Industrial Conditions" corresponding to the "Defense Conditions" that US armed forces use in moving from one stage of alert and readiness to another. When forces went from "Defcon 4" to "Defcon 3," it was theorized, industry would go to "Incon 3."

That approach, however, was deemed too rigid to be practical. GMR, as one official explains it, does not require a straight-line march from one level to the next but rather allows the government, in the words of one observer, to "throw toggle switches Nine, Twelve, and Sixty-Four" or whichever ones the situation calls for.

The mix-and-match options in GMR incorporate numerous industrial resources, the Pentagon, and other federal agencies. It is seen as an alternative to "all or nothing" mobilization planning.

"Proponents argue that GMR would allow the United States to respond to a potential conflict by increasing production of spare parts for aircraft or activating selected munitions plants in advance of a general mobilization," says a February report of the congressional Office of Technology Assessment. "Selective defense-industrial mobilization might serve as a deterrent to aggression, while improving US force readiness should war break out."

OTA points out that some critics challenged the GMR concept, questioning whether timely mobilization decisions are possible in a democracy, whether such mobilization might be provocative in a crisis, and even whether the government could surmount environmental restrictions in order to open key munitions and other production facilities early in a conflict.

On a less philosophical level, GMR suffers from the lack of established specific objectives for the industrial base in force reconstitution. The result, say analysts, is that the program continues to drift.

Within limits of practicality and politics, the Pentagon is engaged in a number of industrial base programs. Prime cases are two highly regarded efforts launched in the early 1980s.

The Manufacturing Technology (MANTECH) program seeks to improve the productivity and responsiveness of the industrial base by funding research efforts to develop manufacturing technologies. There have been many MANTECH success stories, including development of a machine that now permits the repair of high-cost aircraft and missile hybrid circuits that previously were scrapped as defective. Typically, about 200 MANTECH projects are funded each year.

The Industrial Modernization Incentives Program, rather than focusing on development of manufacturing processes, has concentrated on modernization efforts aimed at improving productivity in existing facilities.

High-Profile Initiatives

In addition, DoD participates in various research consortiums such as SEMATECH, a semiconductor research organization based in Austin, Tex., and is placing greater emphasis on the future production base of new systems as they pass through the acquisition process.

The federal effort centers on two high-profile initiatives, both of which are getting a big push from Congress. One is an effort to identify critical technologies and promote US advances in those technological areas. The other is a concept described as "flexible manufacturing," which holds that distinctions between the defense industry and US industry as a whole are mostly artificial and should be eliminated.

The underlying message of both initiatives is that it is up to the Pentagon to adapt itself to commercial markets. Some officials state flatly that there is no *defense* industrial base, only an *industrial* base, for which defense is one customer.

Of these two initiatives, most attention and energy is devoted to critical technologies. The Departments of Defense and Commerce, several congressional committees, and a substantial body of task forces, think tanks, and private analysts are engaged on that front. It has been wryly noted by the business press that the selection of critical technologies unavoidably picks winners and losers and, thus, is a form of industrial policy. Despite that inconvenient fact, Administration support for the initiative continues.

Overlap among the Defense Department's "critical technologies," the Commerce Department's "emerging technologies," and the "national critical technologies" identified by the White House National Critical Technologies Panel (a group of senior federal officials and appointees from the private sector) points to vast opportunity for research cooperation between defense and other sectors.

As the initiative unfolds, however, the main orientation seems to be toward laboratory research, with less emphasis on production and deployment of new technologies. All signs are that this approach is not sufficient in itself to be the foundation for defense industrial base planning.

"Critical technologies" are not the same thing as "critical industries," which of course is the category wherein the problem is most pervasive. The US has long been very good at innovation but less successful in the efficient manufacture and competitive marketing of the things it invents. Japanese firms generally introduce products twice as fast as US firms do.

Awareness vs. Policy

In its recent reports, the Department of Defense shows a sober awareness of the link between technology and industrial capability. Whether that awareness will translate into active policies remains an open question.

Many experts caution that advocates of the "critical-technologies" solution tend to believe that it is sufficient *only* to perform research and development (and perhaps build a few prototypes), after which the results can be shelved, the technology left unproduced, and the products unmarketed. In the absence of production, unfortunately, the supporting supply chain and the manufacturing base wither away. Isolated R&D tends to lose touch with the real world. If the private sector is to lead (as market doctrine expects), sales and profits are essential to support and justify R&D. Moreover, private industry will not assign the best scientific and engineering talent to develop R&D for the shelf.

Leading-edge technology matures by evolution. It takes time and use to work the bugs out of systems. It is naïve to expect this maturation to occur in labs and on test benches.

Flexible manufacturing also has considerable merit, but it must be kept in perspective. The best statement of the concept appeared last spring in a report from the Center

The Data Controversy

In 1988, the Pentagon acknowledged that it had no adequate means of "maintaining awareness of either technology or industry trends, nor for understanding, analyzing, or assessing the national and international issues that surround the questions of American technological or industrial competitiveness."

Further, it said, "the Department of Defense does not know the extent to which foreign-sourced parts and components are incorporated into the systems it acquires" and thus had "no reliable system even to identify such dependencies, not to mention systems to minimize them."

Information has unquestionably improved since then, but officials are less inclined to confession than they were in 1988. Controversy continues over how much the Pentagon knows about the industrial base and about the kind of data system it needs.

A proposed federal law would mandate a defense industrial base information system. DoD opposes this proposal as difficult, expensive, and unnecessary. It would prefer to build on the existing Defense Industrial Network (DINET), production base analyses (which examine segments of the industrial base), and other tools.

The premier effort is DINET. It contains considerable information, but it will not be completed for another five years or so. In the meantime, parts of it now are in regular use.

Defense officials believe they have the dependency data problem in hand. "Our current DoD data system includes all direct DoD direct procurements over $25,000 from foreign sources," says Nicholas Torelli, deputy assistant secretary of defense for Production Resources. "Efforts are under way to identify and obtain access to other databases containing foreign sourcing information at lower production tiers."

for Strategic and International Studies (CSIS) in Washington, D. C. It explains that defense technology no longer is more advanced than commercial types. By perpetuating an artificial distinction, the argument goes, the military often pays more and gets less than the best.

CSIS declares that the integration of commercial and defense manufacturing is "stifled by a host of regulatory and legislative impediments (which themselves constitute an 'industrial policy,' albeit a negative one)."

In many procurements, including some high-technology types, it makes sense for DoD to shop in the commercial market rather than develop parallel products on its own. In fact, where it is possible to do so, the Pentagon appears to be making major progress in conversion to commercial specifications.

Though flexible manufacturing has obvious strong points, many see a risk in the assumption that commercial manufacturers will have both the versatility and the motivation to move back and forth nimbly between commercial and defense production. What guarantees that generic industries, engaged in "flexible manufacturing," will be responsive to defense needs? It is at least as likely that they will prefer to stick to the consumer market, where the sales are bigger, the profits better, and the aggravations fewer.

Moreover, there are complications in transforming the Department of Defense into a standard commercial customer—beginning with the fact that it is not a standard commercial customer.

Some military requirements are unique. Spinoff technology from the airlines, for example, never would have led to the early development of stealth properties, certain to be critical factors in the fighters of the future. The airlines have little need for tactical agility in aeronautics. So far, supersonic flight has been a commercial flop.

Unlike consumer products, military equipment may be called on to function in extreme heat, cold, or humidity, stand up to rugged handling on a battlefield, and operate for long periods without failure in locations ranging from polar ice packs to space.

A Reasonable Facsimile

Two years ago, some in the press ridiculed Air Force Systems Command's Electronic Systems Division for acquiring a costly facsimile transmission machine with specifications that appeared excessive to those expressing the ridicule. In the Persian Gulf War, however, that fax machine withstood blowing sand and kept transmitting target imagery as the searing desert heat melted the casings off its commercial counterparts. Demand for this type of fax spread throughout the combat zone and, by the end of the war, 105 of these faxes were in operation in the theater.

Year after year, the industrial base gets thinner and thinner and more vulnerable to failure.

Many of the government's initiatives are good, and some are very good. Taken together, however, they do not add up to a cohesive, comprehensive response to a defense industrial base problem that is steadily worsening.

Initiatives typically address isolated parts of the problem but not the overall problem. Even if narrow initiatives succeed, there is only a marginal effect on the problem.

The tendency to define away an identifiable "defense industrial base" has drawbacks. Defense needs may get lost in the macroeconomic scheme of broad industrial and trade issues. The 1991 report of the Council of Economic Advisors, for example, is so preoccupied with free trade and market forces that it has little concern to spare for other considerations.

Its perspective in a six-page section on the defense industry is that the decline of this sector will have no adverse effect on the economy as a whole, that the "resources will be able to move to alternative uses with little impediment," and that "government policy should seek to ensure that the transition occurs as smoothly as possible." It is only in a side observation, meriting a single sentence, that the Council acknowledges a "possible additional concern" about the "potential effect" of the decline on national defense.

Meanwhile, year after year, the American defense industrial base gets thinner and thinner—especially in the subtiers—and more vulnerable to failure.

The prospect of failure at critical nodes is especially high. Industrial base history is littered with instances when plans came a cropper because of a weak link that had previously escaped notice. Jacques Gansler, a veteran analyst of the US defense industry, recounts two examples.

In 1974, says Dr. Gansler, Congress authorized a doubling of tank production to replace tanks given to Israel to replace its losses in the October 1973 Arab-Israeli War. The M60 tank plant had excess capacity, and the Army believed that a rapid production increase was possible. However, only one armor-casting subcontractor firm remained, and it was running at capacity. It was a long time before tanks could be produced in increased quantities.

Dr. Gansler goes on to note that, in the 1970s, a surge study found it would take three years to increase F-16 fighter production significantly, although the plant was running only at one-third capacity. The reasons were (primarily) lead time for critical parts and (secondarily) production bottlenecks where a few very expensive machines were already being fully used three shifts a day and no additional machine was in the inventory.

Weaknesses in the defense industrial base have a perverse tendency to combine for a negative synergism. Fixing one problem may inadvertently set up a new one in a proximate sector.

Some years ago, the Air Force, in cooperation with the Commerce Department, sought to shore up a small electronic wire firm that had difficulty competing with foreign suppliers. The government arranged for advice by consultants, and in due time the small supplier got its price down.

How did it do so? In purchasing its raw materials, it moved from a domestic to a foreign source. ■

The Israeli Air Force, always good, has added some new wrinkles and now ranks with the best.

Israeli Airpower on the Rise

By Samuel M. Katz

—Biton Hoyl Ha Avir


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—Bilton Heyl Ha'Avir

F-16s like these, along with F-15s like those on the preceding pages, combine to give Israel a formidable range of options with which to confront its adversaries. Superbly trained Israeli Air Force pilots have had to go into action many times during the nation's brief history, often with stunning success.

SHOULD a major war again erupt in Lebanon or on the Golan Heights, the Israeli Air Force (IAF) likely will attempt to stage a kind of repeat performance of its devastating 1982 air assault on Syria's surface-to-air missile (SAM) sites in Lebanon's Bekaa Valley.

The IAF, if anything, is stronger than it was then. In light of the evolution of tactics and of the lessons gleaned from Desert Storm, the IAF might add some new twists to the attack.

With Iraq's defeat by the allied coalition, peace between Israel and Egypt, and a tacit understanding between Israel and Jordan, Syria remains the sole nation capable of engaging in full-scale war with Israel. For that reason, planning for large combat operations focuses on Syria.

The IAF also has a highly developed power to launch a single, swift strategic strike over great distances, a capability demonstrated time and again during recent years.

The IAF—in Hebrew, *Heyl Ha' Avir*—is the aerial arm of the *Tzava Haganah Le Yisrael,* or Israel Defense Force, responsible for all military air operations, including helicopter-borne transport of troops and air defense. The Patriot batteries that battled Iraqi Scud missiles early this year belonged to the IAF.

The IAF is officially tasked with preserving the "aerial integrity" of Israel, but the IAF has been the decisive offensive military factor in the wars fought between Arab nations and Israel.

Israel's attack on the network of Syrian SAMs in the Bekaa Valley on June 9, 1982, and subsequent destruction of much of the Syrian Air Force would serve as the exemplar for the IAF in any new conflict with Syria.

All-Inclusive Attack Strategy

Destruction of the Syrian SAM umbrella was crucial to the defense of ground troops advancing against Palestinian positions in Lebanon. In order to hinder the SAMs' ability to inflict damage—a major concern after the 1973 Arab-Israeli war —Israel developed an all-inclusive attack strategy.

The IAF's electronic countermeasure–electronic intelligence Boeing 707 flew over the southern stretch of the battle zone, providing standoff ECM to the air operations. So did a Grumman E-2C Hawkeye, the linchpin of the operation because it provided vast radar coverage and combat control. Flights of F-15s covered the invaluable E-2C and 707.

A fleet of remotely piloted vehicles (Tadiran Mastiff and Scout RPVs), with radar signatures similar to those of Israeli attack aircraft, were sent toward the SAM sites to trick the Syrians into turning on the "Straight Flush" fire-control radars in the missile batteries. Thinking that hostile aircraft were approaching, the Syrians—or their Soviet advisors—turned on the radar and began tracking the radar blips.

When the battlefield came alive, a flight of F-4 Phantoms, armed with Shrike or Standard antiradiation missiles, was called in by the Hawkeye to set up a racetrack at low level, using the terrain as cover. The planes used the pop-up tactic, wherein the flight circuit is broken up, temporarily allowing an electronics officer to detect any ground-based radar transmissions. Then the Phantoms launched their missiles quickly and headed for home.

Once the SAM radar had been destroyed, the Hawkeye called in multitudes of F-16s, F-4s, A-4s, and Kfir C-2 fighters to knock out the missiles and their support vehicles.

Syria had little choice but to put up its MiGs against Israel's fighters. The air war, fought by F-15s and F-16s guided by the Hawkeye, was one-sided. In a series of battles over several days, the IAF shot down ninety-two Syrian jets and suffered no losses.

Similar but Superior

The IAF of 1991 is similar but far superior to the force of pilots and aircraft that proved its mastery of the air in 1982.

The art of utilizing RPVs has been greatly expanded, and the IAF now deploys more advanced, longer lasting drones, such as the Mastiff 3, the advanced Scout, the Searcher, the Hellstar, and the Pioneer. New RPV/missiles, such as Israel Military Industries' "Samson" and "Delilah" systems, have been perfected for deployment on board F-4E "Sledgehammers," specially modified Phantoms.

In any future strike against missile installations or air defense radars, the IAF might take a page from the US operational book and punch holes in the enemy's defenses with missiles fired from attack helicopters.

The first US-made AH-64 Apaches landed in Israel a year ago. With their Hellfire missiles and night fighting systems, they have

become a potent first-strike addition to the IAF's order of battle. The Apache provides a virtual twenty-four-hour-a-day strike window.

Israel has never publicly disclosed the size and composition of its air force. According to foreign reports, the IAF deploys 655 front-line combat aircraft. These include A-4B/E/F/H Skyhawks, A-4N Skyhawk IIs, F-4E Phantoms, modified F-4E Sledgehammers, Kfir C-1/C-2/C-7s, F-15A/B/C/D Eagle IIs, and F-16A/B/C/Ds. Special operations, ECM, AWACS, long-range patrol, and C^3 aircraft include modified Boeing 707s, E-2C Hawkeyes, Grumman OV-lD Mohawks, and Israel Aircraft Industries' Sea Scan 1124N.

The IAF also deploys a fleet of attack helicopters that includes, in addition to the Apaches, AH-lG/S Cobras and Hughes 500MD Defenders. Transport aircraft include the Boeing 707 and the Lockheed C-130 Hercules.

In the next two years, the IAF will absorb sixty F-16C/D fighters, twenty F-15s, eighteen AH-64 helicopters, dozens of F-4 Phantom 2000s, and ten locally modified CH-53A "Sea Stallion 2000" helicopters.

Brig. Gen. Herzl Bodinger, soon to be the IAF commander and a veteran of the IAF's deep-penetration bombing runs against Luxor, Egypt, and H-3 in Iraq during the 1967 Six-Day War, was present when the IAF's Valley Squadron, based in northern Israel, received its first batch of F-16C/Ds last July. An unidentified squadron commander called the US-built warplanes "the most advanced combat aircraft in the region."

Israel may be looking for other advanced equipment. Before his retirement, IAF Commander Maj. Gen. Avihu Ben-Nun was able to test-fly the F-15E and F/A-18D while visiting Seymour Johnson AFB, N. C.

—IDF Spokesman

The IAF deploys a significant number of helicopters. Besides the CH-53, seen here unloading troops during maneuvers, the fleet includes AH-64 Apache, AH-1G/S Cobra, and Hughes 500MD Defender attack helicopters. The Cobras proved particularly potent during the 1982 campaign over the Golan Heights.

—Biton Heyl Ha'Avir

The deeds of the defenders of Metzada (Masada) still resonate as a symbol of Israel's resolve and defiant heroism. Here, three indigenously designed and built Kfirs, devastating ground-attack aircraft, fly over the fortress, where in A.D. 71 Jewish soldiers committed suicide rather than submit to their Roman besiegers.

Punitive Attack Capability

The IAF has a growing capability to conduct punitive attacks far beyond its own borders, a capability exercised frequently over the past decade.

On June 7, 1981, eight IAF F-16s escorted by six F-15s skirted western Saudi Arabia and eastern Jordan before entering Iraqi airspace. The raid, known as Operation Babylon, targeted the Osirak nuclear reactor near Baghdad. Flying at low altitude over Iraqi territory before rising and diving onto the target in a thirty-five-degree angle of attack, the F-16s dropped their ordnance directly on target, obliterating Iraq's nuclear potential for a decade.

The raid on Osirak was intended to send a signal to the world that Israel could reach quite far to deal with a threat to its survival. In fact, the lead pilot of the Osirak F-16 strike force was the commander of F-16Cs placed on alert for possible strikes on Iraq during the 1991 Gulf War.

On October 1, 1985, a flight of Israeli F-16s struck Tunis and shook the headquarters of the Palestine Liberation Organization with a precision bombing run. The raid was in

retaliation for the murder of three Israeli civilians in Cyprus two days earlier. To reach Tunis, the IAF had to overfly hostile nations and cross 3,000 miles of open sea.

Israel has proven that it is willing to take the political risks of authorizing long-range strikes, and the IAF has proven that it is willing to cross enormous stretches of territory—often at great risk—to execute missions deemed vital to Israeli national security.

The IAF has also demonstrated its ability to modify existing systems to cover great distances. In an interview with "Sixty Minutes," former IAF Maj. Gen. Aharon Lapiodot was asked about the IAF raid on PLO headquarters in Tunis. The combat veteran said, "We can travel much farther than Tunis!"

To bridge the gap between home base and distant targets, IAF Boeing 707s were modified by IAI to serve as midair refueling platforms. This was done after the United States balked at selling the IAF the KC-135 tanker. Several C-130 Hercules transports have also been "juiced," in the words of one IAF technical official, becoming airborne filling stations.

Such air-to-air refueling capability allows IAF operations planners to send aircraft over long ranges without fear that the target cannot be reached, or that it cannot be reached with sufficient fuel to fight. The IAF is capable of flying as far as its pilots and leaders are willing to strike, from the Tigris to Tunis and beyond.

C³ and ECM

Command, control, and communications (C³) on long-range operations present special problems owing to the vast distances involved and the need to maintain constant security. Problems also arise from the requirements of electronic countermeasures.

Special aircraft, such as a Boeing 707 C³ and ECM platform modified by IAI, have served the IAF well for more than a decade. That plane was first used as an airborne war room over Uganda during Operation Thunderball, the July 3–4, 1976, rescue raid on Entebbe.

Foreign commentators have maintained that the plane also was orbiting high above Tunis during the April 16, 1988, assassination of PLO Deputy Commander Abu Jihad.

A new IAI aircraft, the Phalcon, is an airborne early warning (AEW) system. It provides continuous fusion and cross correlation of data generated by four discrete sensors —one each for AEW, signal intelligence, tactical surveillance of air targets, and tactical surveillance of surface targets.

The whole package is housed in an IAI-modified Boeing 707 and staffed by seventeen console operators. These new aircraft are crucial to the success of long-range strikes. The aircraft's resemblance to those used for civilian purposes enhances the possibility of achieving tactical surprise.

Increasing the range of aircraft is crucial to long-range strikes. In this aspect, the IAF has proven masterful.

Fuel tanks carried on external pylons extend a fighter's range, but they make an aircraft slower and clumsier. A fighter must be able to climb, roll, and conduct evasive maneuvers against deadly concentrations of ground fire and SAM launches. To outlast SA-3, SA-5, SA-6, SA-8, SA-9, SA-10, and SA-11 missiles—the most prevalent air defense systems in Arab arsenals—IAF aircraft must be extremely agile.

The IAF has sought to install air-refueling capability in proven, paid-for fighter aircraft, such as the IAF's upgraded F-4E Sledgehammer.

Strict Security

When the IAF mounts a long-range strike, the human factor is vital. Pilots are briefed with the most up-to-date intelligence, and operational security must be strictly enforced.

For long-range operations, information is made available on a need-to-know basis. Fighter pilots do not ordinarily know at any given moment where the refueling aircraft are loitering. Ground crews do not know the aircraft's exact destination. Meteorologists are tasked with

—Bitton Heyl Ha'Avir

Israeli F-16s crossed hundreds of miles of open sea to deliver a blow to PLO headquarters in Tunis. The IAF's modification of C-130s and Boeing 707s for refueling duties gives it the ability to fly as far as its pilots and leaders are willing to strike.

providing weather reports for dozens of areas so they will not know the precise target area. Briefings are constantly interrupted by officers coming and going; each hears what is essential for his or her own mission. Pilots are briefed at the last moment and told only the bare essentials regarding their missions. These strict measures increase the chances of success.

Throughout the summer and early fall of 1991, countless reports in the foreign press pointed to the possibility of Israeli strikes against such diverse strategic targets as a Syrian germ warfare laboratory near Latakia and an array of nuclear reactors in nations from Algeria in the west to Pakistan in the east. All were rumored to be targeted for swift destruction.

The IAF's air-to-air capabilities have improved in recent years. One reason was the October 11, 1989, defection to Israel of a Syrian pilot in his MiG-23ML "Flogger-G" jet. The MiG, flown by Syrian Air Force Maj. Mohammed Bassem Adel, managed to land undetected and unmolested in a remote strip in northern Israel, exposing a weakness that has since been addressed.

Despite the IAF's embarrassment, the incident was of enormous intelligence value because the IAF was able to examine the most commonly seen fighter in the Arab order of battle from Iraq to Algeria. IAF technicians meticulously studied the Flogger, learning its secrets. On January 29, 1990, the IAF's chief test pilot flew the aircraft for the first time. Operational data on the strengths and weakness of the plane are now known to each IAF pilot. Such intimate knowledge of the Flogger-G is expected to have an incalculable impact on the outcome of the next conflict.

—Biton Heyl Ha'Avir

A ground mechanic and a Kfir pilot confer prior to a training mission. For operational missions, information is guarded tightly. Ground crews do not know the destination, and pilots are briefed at the last moment and told only the bare essentials. Even the location of loitering refueling aircraft is withheld.

Training Keeps the Edge

When Israel returned the last section of Israeli-occupied Sinai territory to Egypt in 1982, the invaluable real estate and airspace used for years as a gigantic air-to-air combat training ground were replaced by simulators and computers. Many feared that this shift might take the edge off IAF combat tactics and execution in wartime.

Time has disproven this theory. Today the IAF flyer is confident, even cocky, in the belief that his ability and equipment still are far superior to anything in the Arab air forces, from the Syrian flyer in a MiG-29 Fulcrum to the Jordanian pilot in a Mirage F1 or a Saudi Gulf War veteran flying an F-15.

Superb training has become an IAF strength. It begins the day the pilot arrives and does not end until he retires. Each pilot candidate undergoes an exhaustive screening process before even being allowed to volunteer for *Kurs Tayis,* the pilot's course. He then spends the remainder of a period that lasts nearly two years, from conscription to the awarding of wings, constantly proving his ability.

Competition is fierce. The attrition rate is well over ninety percent; a pilot candidate can be tossed from the course at any point, up to the day before graduation.

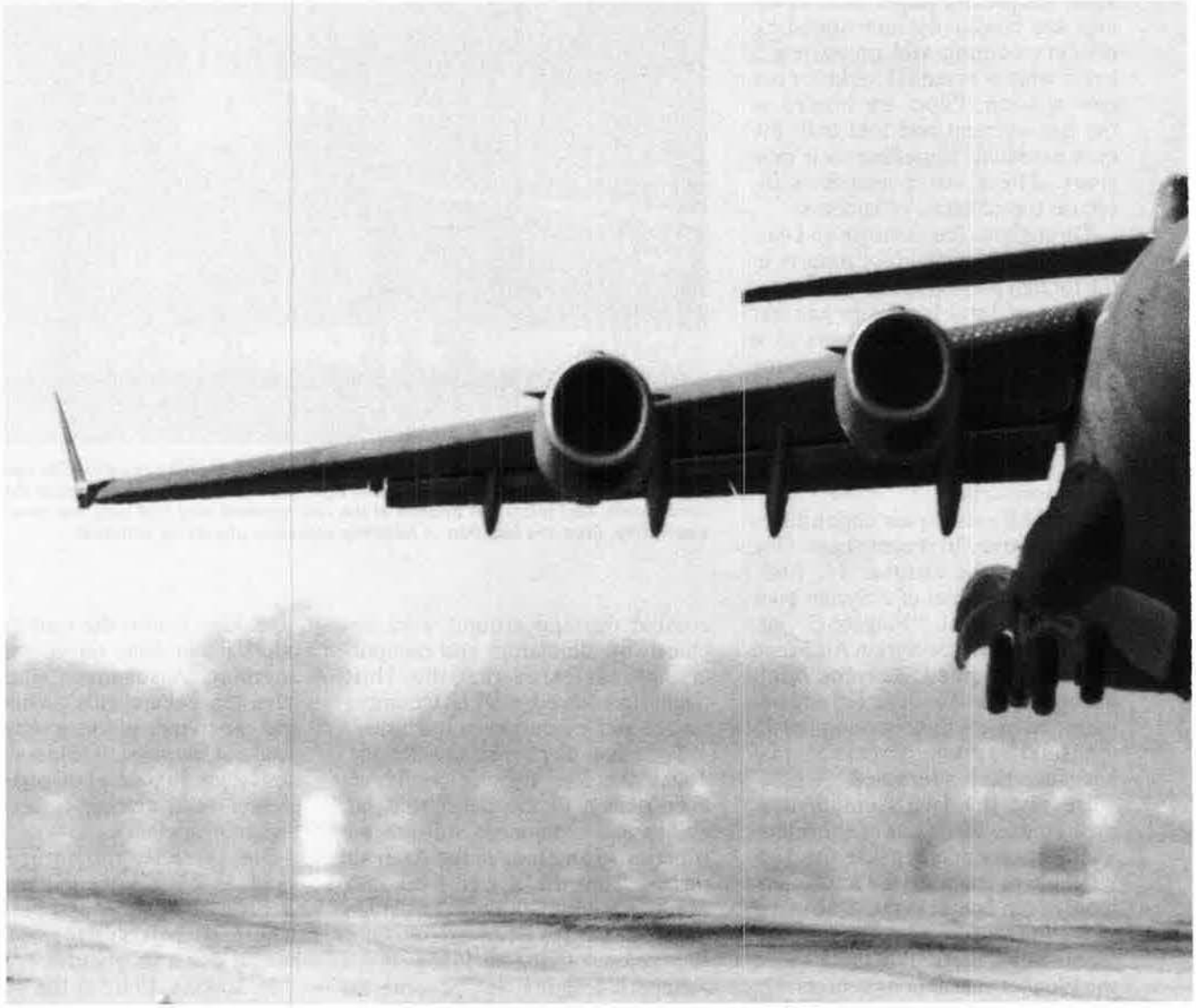
Making it into the ranks of IAF pilots is, in fact, no guarantee of anything. A squadron leader can have ten enemy kills to his credit and experience in three wars but be aced out for mission leadership by a newly graduated pilot possessing greater skill, quicker reflexes, and higher proficiency.

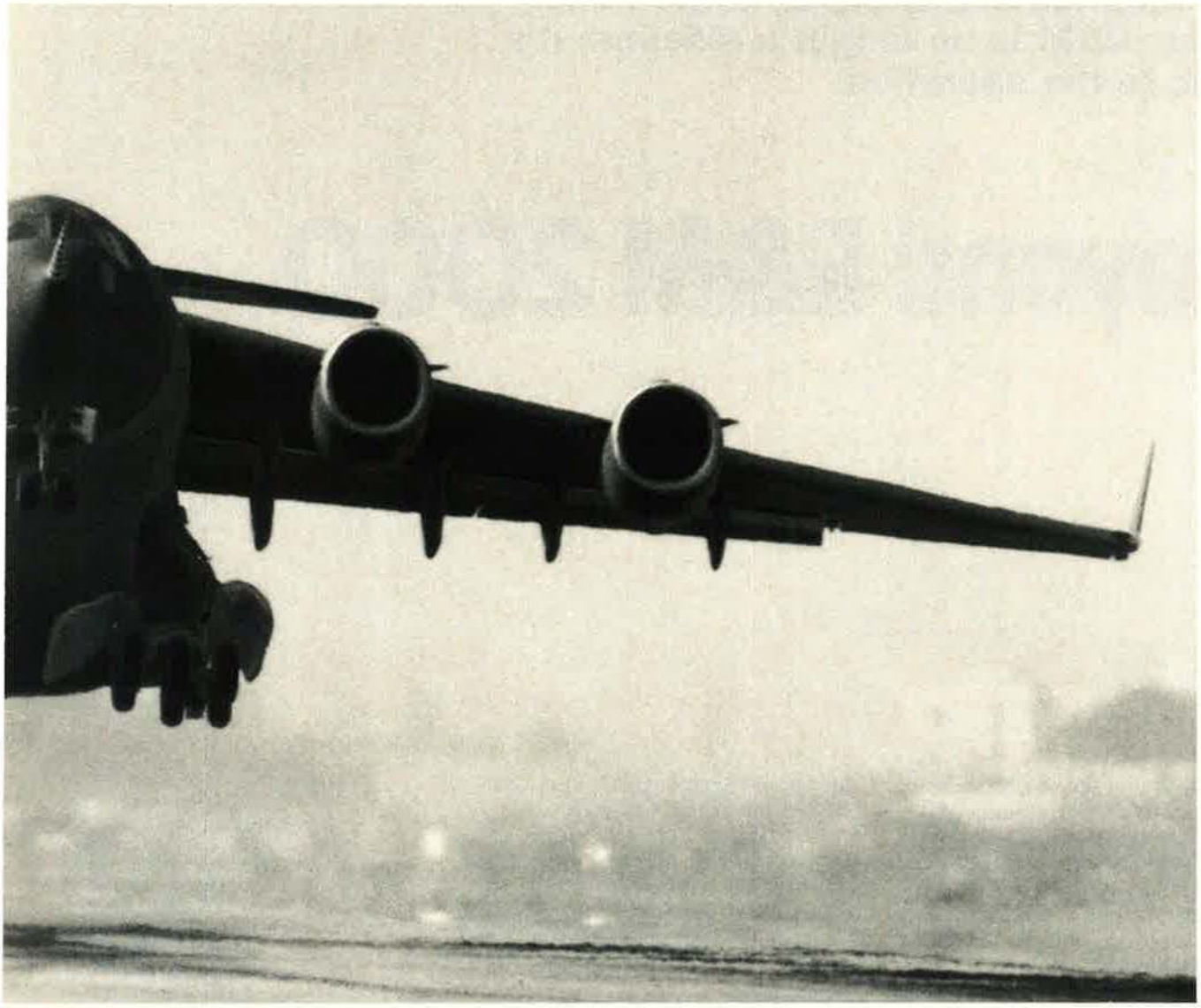
For Israelis, the future looks much as it has since independence in 1948: ambiguous and precarious at best. There is no sign that the IAF has let down its guard.

In January 1991, at the outset of the Gulf War, Israeli television broadcast an interview with the leader of the IAF, General Ben-Nun. He was filmed at an unidentified air base in Israel, standing in front of a fully armed, fully fueled F-16 parked inside its protective shelter. The F-16's pilot, in full nuclear-biological-chemical kit, had been sitting in the cockpit for eight hours, ready to surge into action on a moment's notice. The F-16 behind General Ben-Nun was carrying nearly 12,000 pounds of bombs on its pylons. So were many other F-16s, Phantoms, and Kfirs from attack squadrons throughout Israel. All were poised to scramble and strike Iraq.

That time, Israel's leaders did not order an attack, but no one doubts that, the next time the IAF goes into action, it will be prepared. ■

Samuel M. Katz is a free-lance writer specializing in the Israeli Defense Forces. He has written six books about Israeli military topics; the most recent, Israel's Air Force, *was published in October by Motorbooks. Mr. Katz served in the IDF during the war in Lebanon. This is his first article for* AIR FORCE *Magazine.*





Our First Flight Was So Impressive 10,000 New Airports Opened Up.

On September 15, 1991, America's newest airlifter flew for the first time. Because this efficient new transport lands on shorter runways and can maneuver on smaller airfields, the military now has access to 10,000 additional airfields around the globe. Whether delivering troops and military equipment or humanitarian aid, the C-17 will carry outsize payloads closer to the precise point they are needed than any transport aircraft in history. And once there, provide the flexibility needed to get any job done.

Thanks to the quality built in from day one, this was an impressive first flight—and just the beginning of a remarkable career for America's new C-17.

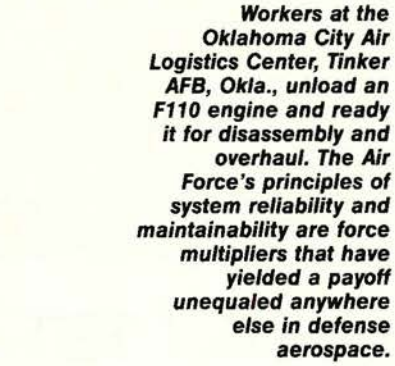
C-17

MCDONNELL DOUGLAS

The Air Force has closed its Reliability and Maintainability office in the Pentagon. R&M is no longer a sideline; it's basic to the operation.

Beyond R&M 2000

By Gen. Charles C. McDonald, USAF



—USAF photo by Ken Hackman

Workers at the Oklahoma City Air Logistics Center, Tinker AFB, Okla., unload an F110 engine and ready it for disassembly and overhaul. The Air Force's principles of system reliability and maintainability are force multipliers that have yielded a payoff unequaled anywhere else in defense aerospace.

DURING the cold war, the defense posture of the United States was based on a need to counter a numerically superior foe: the Soviet Union and its allies. Today that posture has taken on a new dimension. We must not only be able to counter superior numbers but also be flexible enough to reach quickly to any place in the world to respond to a regional crisis such as the one triggered by Iraq's August 1990 invasion of Kuwait.

One constant ingredient is required to win in either environment: highly reliable and maintainable weapon systems that afford us the ability to strike again and again. Reliable weapon systems provide increased combat capability and require fewer spare parts. Maintainable systems require fewer people and specialized skills and reduce maintenance time and costs.

In recent years, the Air Force's principles of system reliability and maintainability have become force multipliers of a high order, providing a payoff unequaled anywhere else in the defense aerospace industry. When a new system takes shape on the drawing board, "R&M" is no longer an afterthought. It is a major part of the design and planning.

R&M factors are taken into account each time an older system is upgraded or modified. In most cases, the Air Force inserts components and systems of increased reliability and with greater ease of maintenance.

For example, a major radar modification to the F-15 air-superiority fighter is under way at the Warner Robins Air Logistics Center (ALC), Robins AFB, Ga. The program, which aims to ensure the plane's long-term supportability, eliminates nine of the F-15's current Line Replaceable Units, or "black boxes," which are becoming unsupportable because some of their parts are becoming obsolete. Replacing these nine older LRUs will be six new, state-of-the-art units, all of which will be more reliable and easier to fix than their predecessors.

At the Oklahoma City ALC, Tinker AFB, Okla., each KC/C-135 shortly will undergo depot maintenance that will replace twenty percent of the plane's nearly nine miles of wiring. The new wiring will be more reliable. It will replace the

type that was installed between 1957 and 1966, during aircraft production.

An R&M Showcase

For further proof of the significant benefits provided by improved reliability and maintainability, one need look no further than Operation Desert Storm. Our aircraft flew 65,000 sorties during that campaign and maintained an average mission capable rate of ninety-two percent. *That* is R&M.

The Persian Gulf War was a virtual showcase of R&M successes. Examples large and small abound: F-15E fighters flew 2,200 sorties with a ninety-six percent mission capable rate. The commander of one F-111 wing reported that his unit flew 2,100 sorties without one aircraft exceeding its scheduled maintenance time. Despite their age, conventionally equipped B-52 bombers flew 1,600 sorties, turning in an average mission capable rate of eighty-one percent.

The benefits of increased R&M extend beyond the weapon platform itself. Improved R&M reduces dependence on large combat support structures, thus improving the survivability and sustainability of the fighting force. Good R&M has improved the mobility of our forces because fewer people and less support equipment and spares need to be transported.

Again, Desert Storm provides the evidence. With fewer pieces of equipment and support supplies to haul, the Air Force was able to deploy F-15s to Saudi Arabia and have them on alert, ready to fly defensive patrols 7,000 miles from home bases, within thirty-eight hours of notification to deploy.

It's getting better. Today the Air Force requires seventeen C-141A loads to deploy a twenty-four-plane squadron of F-15s to a distant site. To deploy a squadron of new F-22 fighters, however, the Air Force will need only eight planeloads. The total number of people needed to support the new F-22 will be fifteen, down from the twenty-five needed to support every F-15. Most important, however, we project that the F-22 will average 8.5 combat sorties between major maintenance actions, up significantly from the 5.4-sortie rate of the F-15.

The R&M Revolution

In only a few years, the push for improved R&M has been transformed from a commonsense, logical concept to a USAF-industry partnership that has made the Air Force the best supported, most reliable supplier of combat airpower in the world.

Prior to the "R&M revolution" of the mid- and late-1980s, the outlook was bleak. In the early 1980s, we were weighed down by a growing maintenance burden. More than one-third of Air Force manpower was devoted to maintenance. The Air Force treated R&M like optional equipment: nice to have, but secondary to the overall product.

Logisticians argued for a cultural change they hoped would make R&M an automatic aspect of our day-to-day business. This movement gained momentum in 1985 with the birth of the Air Force's R&M 2000 program.

The R&M 2000 effort had five simple goals:

- Increase combat capability.
- Lower the vulnerability of the combat support structure.
- Reduce mobility requirements per unit.
- Reduce manpower requirements per unit of output.
- Reduce costs.

To ensure that sound maintenance principles were built into the front of the acquisition process, the R&M 2000 charter stated that R&M would be deemed equal to cost, schedule, and performance requirements in the weapon system acquisition process.

Some of our first experiences with enforcing R&M 2000 were challenges. For example, when the LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) pods were tested in 1985, they performed well but were not sufficiently reliable. The Air Force went back to contractor officials and told them that the company needed to meet certain reliability goals before it could proceed to the next phase of the contract. Contractor workers went back to the drawing board and made some design changes; a few months later the program was back on track.

The move paid off. In Desert Storm, the seventy-two LANTIRN pods deployed to the theater had an amazing mission capable rate of ninety-eight percent.

A B-2 Success Story

The weapon systems in design and production today will be even greater R&M success stories. The stealthy B-2 bomber is a classic example. Throughout the design, development, and testing of the B-2, R&M factors have been as important to the program as the plane's composite material makeup and its

Air Force systems' performance in the Persian Gulf War demonstrated the significant benefits of improved R&M. F-15E Eagles deployed to the Gulf region, like this one from the 4th Tactical Fighter Wing, Seymour Johnson AFB, N. C., flew 2,200 sorties with a mission capable rate of ninety-six percent.

stealth capabilities. An aircraft's stealth technology is relatively ineffective if that aircraft is not maintainable and reliable when the time comes for it to perform its mission.

Early in the B-2 program, logisticians helped establish many maintainability design requirements, and contractors responded with products dedicated to the original R&M 2000 goals.

Aircrews and maintainers alike will appreciate the B-2's computerized on-board test system. This system monitors aircraft performance, detects and isolates component failures, and produces specific data on the failures. This means less need for technical data, maintenance training in lengthy diagnostic procedures, support equipment, and manpower.

Once totally dependent on traditional printed paper products, B-2 maintainers will have necessary information at their fingertips through the B-2's integrated technical data system. This handheld electronic device provides accurate and complete technical data with speed and mobility. No longer will maintainers have to lug around an armload of technical manuals or laboriously update them, page by page.

Even the simplest R&M ideas will save countless hours of maintenance. For example, B-2 components requiring frequent maintenance have been put in easily accessible places. Maintenance technicians will need to remove fewer parts in order to get to a problem part.

Throughout the design, development, and testing of the B-2, R&M factors have been as important as stealth capabilities. The bomber's computerized on-board test system and integrated technical data system will give aircrews and maintainers accurate and complete information efficiently.

Preliminary data show that, as a result of these and other steps, the B-2's maintenance man-hours per flight hour will be less than 34.5, far better than the original requirement of fifty.

Good Ideas

Emphasis on R&M is not limited to the weapon systems program offices and the production lines. Two joint Air Force Logistics Command–Systems Command offices at Wright-Patterson AFB, Ohio, are continually adding to the list of good R&M ideas.

First, the Productivity, Reliability, Availability, and Maintainability (PRAM) Program Office is responsible for inserting mature, off-the-shelf technology into existing weapon systems, support equipment, and maintenance depot operations. Second, the Reliability and Maintainability Technology Insertion Program (RAMTIP) Office focuses on emerging technologies that can be applied to both developing and existing systems.

One of PRAM's most recent successes is the fielding of a "video fax" machine that allows field maintenance technicians, when necessary, to relay video images via facsimile machine back to our depots where engineers can assess aircraft damage and quickly develop repair processes to get the aircraft flying again. This capability will save hours and even days in exchanging drawings and photographs explaining the extent of an aircraft's damage and the repairs needed.

Before the advent of the video fax, a unit would have to prepare a written message describing the damage. If the message could not adequately describe the damage, the depot would request photos and

A1C Jody Engstrom, an avionics specialist at Hill AFB, Utah, installs a part on an F-16 Fighting Falcon. The Air Force upgrades its weapon systems, support equipment, and maintenance depot operations with off-the-shelf technology and studies emerging technologies for both existing and developing systems.

—USAF photo by Ken Hackman

A C-5 cargo plane undergoes depot maintenance at the San Antonio Air Logistics Center, Kelly AFB, Tex. Each upgrade or modification includes steps to improve an aircraft's reliability and maintainability. Air Force Logistics Command manages its wealth of R&M information with the REMIS computer system.

X rays. If it still was unclear what repair steps should be taken, depot engineers would travel to the damaged aircraft to conduct an inspection. The process is time-consuming and costly. More important, it means that more aircraft are not ready to fly their missions.

Three video fax machines were deployed and operated in Saudi Arabia. Maintenance crews there were extremely pleased with this new capability.

Working with Warner Robins ALC, RAMTIP is developing a program for repairing aluminum aircraft structures with epoxy composite materials. The composites will prevent crack growth, require less repair time, and significantly reduce corrosion problems at the repair site. This process is expected to shorten repair time from six weeks to two weeks and increase aircraft availability. The composites will be used initially on the C-141 and C-130 and later on most aircraft in the Air Force inventory.

To manage the burgeoning wealth of R&M information, AFLC has developed the Reliability and Maintainability Information System (REMIS). REMIS is the standard Air Force computer system for collecting, processing, and analyzing R&M data. It will increase the readiness and sustainability of our weapon systems by improving the availability, accuracy, and flow of maintenance information. Computers at AFLC headquarters and each of our five depots will collect and organize maintenance information for every Air Force weapon system. The information will then be made available through REMIS to some 1,800 users worldwide.

Closing the Seams

Another Air Force initiative that will strengthen R&M is the integration of AFLC and AFSC to form the new Air Force Materiel Command. The cornerstone of the merger is integrated weapon system management. Under this cradle-to-grave management concept, a single system program office will be responsible for the entire life cycle of a weapon system. There will no longer be a "handing off" of a system from AFSC to AFLC at some point in its maturity.

This single-manager approach will strengthen our R&M initiatives by eliminating cultural differences that existed between the research and development and logistics communities in years past.

These disparities stemmed from differences in the very nature of the commands' missions. AFSC, with its research and development role, was at the leading edge of technology, designing the weapon systems of the future. AFLC, in its support role, was called on to use "less glamorous" but no less valuable technologies to sustain these weapon systems once they entered the inventory. Logistics principles were not always engineered into emerging systems.

With the formation of Air Force Materiel Command, we will have a "seamless" organization and a new outlook that ensures R&M will continue to be a top priority.

The principle of R&M also has made tremendous strides in academia. R&M is an important part of the curriculum for engineering students at the Air Force Institute of Technology at Wright-Patterson AFB and other Air Force educational facilities. The USAF engineers of tomorrow are leaving their classrooms with an appreciation for sound R&M basics.

Early in the R&M 2000 campaign, a major goal was to make the quest for R&M a permanent part of Air Force thinking. Brig. Gen. Frank S. Goodell, formerly special assistant for Reliability and Maintainability at Hq. USAF, said in 1986 that his role was to integrate R&M principles into the USAF "mindset" to the point that his organization at the Pentagon would go out of business.

His goal has been realized. His former office has been disbanded. Air Force leaders have declared victory in the effort to institutionalize R&M.

The examples in this article clearly illustrate the tremendous progress we have made in recent years. Our weapon systems are more reliable and maintainable today than at any time in history. The systems of tomorrow will be even more dependable. However, only when every one of our design engineers, scientists, logisticians, acquisition specialists, maintenance technicians, and system program managers has sound working knowledge of and appreciation for R&M, will it be truly institutionalized. Until that day arrives, we must continue to improve our processes, emphasize quality, and be creative at every level of our day-to-day business. ■

Gen. Charles C. McDonald, USAF, is commander of Air Force Logistics Command, headquartered at Wright-Patterson AFB, Ohio.

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With the F-16's targeting computer talking to other computers, the odds are right for a direct hit on the first pass.

—Staff photo by Guy Aceto

Cooperative **Attack**

By Jay C. Lowndes

The Automatic Target Handoff System allows F-16 pilots to get all the ground-targeting information they need in under thirty seconds, compared to the three or four minutes it takes today. The ATHS reduces voice communication, increases accuracy, and vastly improves coordination.

COOPERATIVE attack is emerging as the most promising approach yet to the task of firing precision guided munitions to protect ground troops. At the core of this tactic, which would apply to F-16s and other high-performance aircraft, lies the Automatic Target Handoff System (ATHS), which permits a fighter's targeting computer to "talk" directly to targeting computers in other planes or on the ground.

Eliminating pilot voice communication cuts down on confusion and makes tactical coordination virtually instantaneous. The payoff comes when a dozen or so participants in a battle help a close air support (CAS) aircraft pinpoint its target so precisely that a direct hit on the first pass is almost guaranteed.

"Ninety-five percent of the time it's right there" on the head-up display, says Lt. Col. Al Phillips, the ATHS project officer at the Air National Guard Test Center in Tucson, Ariz. "You don't ever have to look head-down to find the target."

Pinpointing a target and planning an attack used to take three to four minutes. An operations center officer or forward air controller (FAC) would dictate a nine-line brief with all pertinent information over the radio. Included were a designation code for the fixed initial point (IP); heading and distance from the IP to the target; the target's elevation, description, and coordinates; target marking, such as laser or smoke; location of surface-to-air threats; and friendly positions. The pilot would enter each item into his computer, then analyze the data to plan an attack.

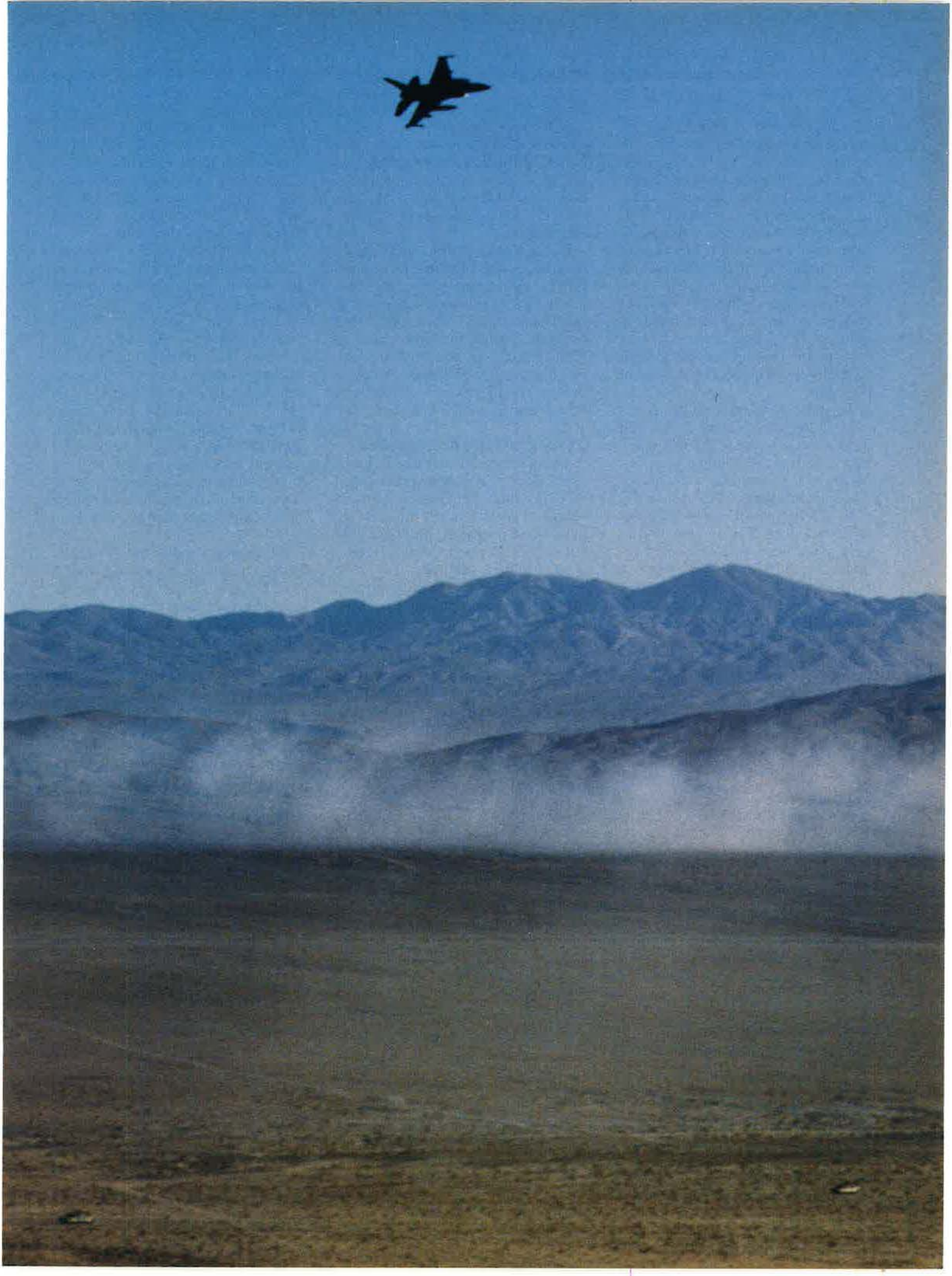
"We would have to orbit and make sure everybody understood each other," Colonel Phillips says. A FAC might ask, "Have you got it?" After a while, the pilot might answer, "Yeah, let's go," or "Say again?" Communicating target information this way all but ruled out cooperation among several combatants in order to bring off an attack. Coordination was just too slow.

Burst Transmissions

Colonel Phillips says that, with the ATHS, the nine pieces of targeting information now load directly into an F-16's computer in a fraction of a second in the form of a burst of digital information that is difficult to jam. Planning an attack takes no more than thirty seconds. "They'll 'burst' you another target as you come off the first," Colonel Phillips says. "You can strike again right away instead of going thirty miles back to orbit and keying in the second target."

Targeting accuracy used to be about 100 meters. Now, says Colonel Phillips, it is down to within ten meters. Updates on target location en route can further improve that accuracy, and these updates can come from just about anywhere.

Army units with air liaison officers have laptop computers hooked directly into the ATHS network. Demonstrations have proven that one F-16 can electronically hand off targeting data to another without voice communication between the pilots. Airborne tactical command and control aircraft such as the E-8 Joint STARS (Surveillance and Target Attack Radar System), scout helicopters, and remotely piloted vehicles are expected to go on the network. So are Navstar Global Positioning System (GPS) satellites, the ultimate electronic guidance



system, with differential processing that can pinpoint target location to within a few centimeters.

Improvements to the ATHS are now being tested at the Tucson facility. These include recognition of the Army's map reference points, selectable map coordinate systems to accommodate operations anywhere in the world, and a visual cue in the head-up display to alert a pilot when a burst of digital data has arrived and where to find it in computer storage on board. Colonel Phillips has put in several hundred hours of flight time testing ATHS-equipped F-16s and expects to have all the bugs worked out by the end of the year.

To understand what makes cooperative attack so attractive, one must go back to the mid-1970s when new, electronically guided weapons began to look accurate enough for close air support. CAS meant destruction of any adversary that US soldiers might face on the battlefield, including a single armored vehicle, a squad of enemy infantry in a fortified position, or a machine gun in a concrete bunker. Military doctrine called for attacking these targets with a relatively slow, damage-tolerant aircraft equipped with a big cannon and an armored pilot's compartment. The Fairchild Republic A-10 attack plane, fielded in the mid-1970s, was supposed to go in low and slow so pilots could eyeball smaller targets and destroy them by aiming the cannon manually. There was a clear distinction between small, CAS targets and those that higher-altitude bombers were assigned to destroy: columns of armored vehicles, bridges, storage bunkers, communication centers, and dams.

By the mid-1980s, advancing technology was blurring the distinction by putting more powerful ordnance on fighter aircraft and making guidance systems more and more accurate. When the time came to replace the A-10, the Air Force decided to avoid the high cost of developing a completely new aircraft and to use the F-16 airframe instead.

Immature Guidance Systems

Unfortunately, electronic guidance had not become so precise that an F-16 could hit dispersed armored vehicles, squads of enemy infantry in fortified positions, and hardened automatic weapon emplacements with sufficient accuracy. Yet these traditional CAS targets constituted the most immediate threat to ground troops.

The concept of cooperative attack, in which high-technology weapons would be used to perform CAS to the Army's satisfaction, could be the answer.

Work going on right now at the ANG Test Center and elsewhere may make the concept a reality. Colonel Phillips says he can hit single armored vehicles with elements of cooperative attack working through the ATHS and that things become routine when one element is the Pave Penny laser receiver. "When a laser spot hits the target. . . . Bingo! You're in there," he says.

Even with the ATHS, however, "there is no way" a pilot can hit an infantry emplacement without having a friendly ground unit designate the target with a laser, says Colonel Phillips. Other target-locating devices used by observers "lack the accuracy necessary to pinpoint small, highly mobile tactical targets," he says. "Maps using different types of grid systems are used. Inertial navigation systems used by current aircraft and helicopters have drift rates exceeding the accuracy needed in pinpointing their own location, let alone small tactical targets."

Allied forces did not have the benefit of the ATHS during Operation Desert Storm. Testing at the Tucson center indicates that cooperative attack could have been used to find and destroy mobile Scud launchers where conventional tactics failed. Colonel Phillips explains that the ATHS lets the on-board computer continuously compute impact points for guns or bombs and overlay those points on the ground for the pilot as he looks through the head-up display. However, says Colonel Phillips, it is the pilot's skill, not the computer, that actually aims the weapons.

Most of the ATHS improvements being tested at the center aim to provide older F-16A aircraft with the same computer power found in the newer F-16Cs. "We're doing a lot with an old system," Colonel Phillips says, "but this is about all we can get out of the A model."

The production block of F-16s scheduled to start rolling off the assembly line by February 1993 will have CAS capability. Planned retrofits will put 365 existing aircraft into the F/A-16 configuration, and the ongoing midlife upgrade program will add another 610.

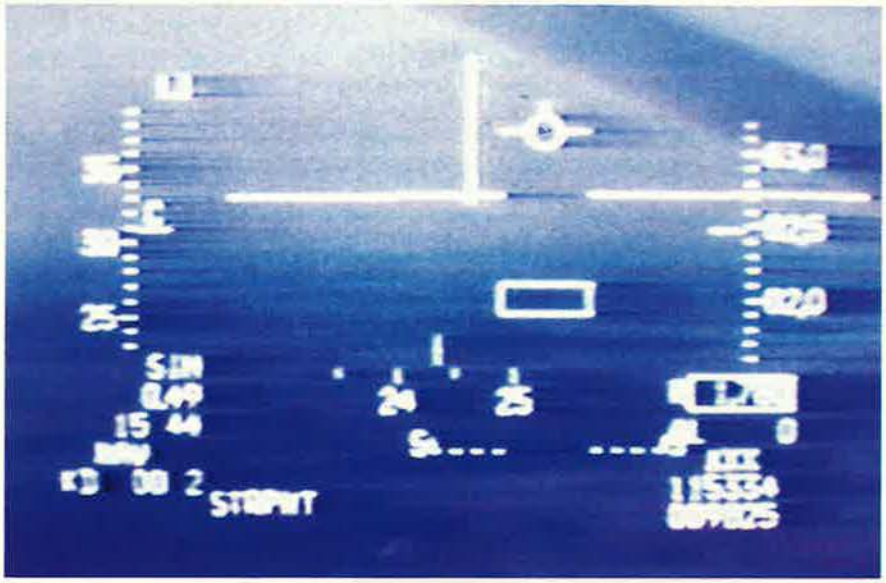
Incompatible Networks

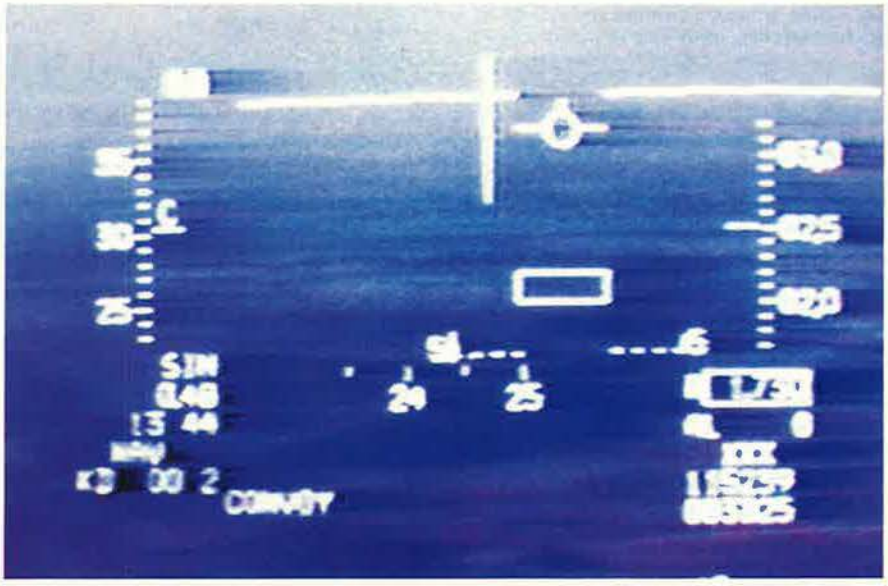
Another hurdle cooperative attack must clear is compatibility of

Army air liaison officers can give targeting information directly to F-16 pilots through the ATHS network. Computer compatibility problems have slowed coordination between USAF's Tactical Air Request Net and the Army's Tacfire network, but the needed modifications are under way.

the communications networks within which F-16s must operate along with other aircraft and ground units. "The Army's Tacfire net is digital and fully secure, extends down the chain of command to the company level, and is compatible with the ATHS and the digital message device [a laptop computer terminal] used by fire support teams, observers, and company commanders," Colonel Phillips says.

The Air Force's Tactical Air Request Net (TARN) parallels Tacfire. It is now "voice only" but is slated to get digital communications terminals. "The bad news is that the [digital terminals are] not compatible with the Army's digital Tacfire net," Colonel Phillips says, and needed





Targeting information is sent from the ground to the pilot's head-up display in a difficult-to-jam, nine-line burst. The pilot heads for the target area guided by a steer point (top). A split-second later the burst of information begins to appear on the display (above), letting the pilot know he is after a convoy. Eventually, all pilots on close air support missions will be able to get targeting information on their HUDs from the ground, other fighters, observation aircraft, and helicopters.

modification of the terminal code format is under way.

Compatibility is crucial because a ground battle commander has to go through a complex procedure to call in CAS. First, an observer detects a target and reports it to the unit. Next, the commander uses a voice link to inform the nearest tactical air control party, which relays the message to an air support operations center (ASOC) some distance back from the forward edge of the battle area. At the ASOC, the fighter duty officer gets approval for a strike from the senior ground force headquarters and then checks to be sure available aircraft are carrying proper ordnance for the target. "This is a sanity check," Colonel Phillips says. "Iron bombs wouldn't work too well against tanks."

Next, the fighter duty officer relays the request to a tactical air control center, which orders the wing operations center to scramble its fighters. Once en route, pilots must establish voice communication with various target-information sources such as Joint STARS planes, E-3 Airborne Warning and Control System aircraft, and FACs on the ground and in the air. The nine-line brief must be received and in the aircraft's fire-control computer by the time the pilot gets to the IP. Finally, FACs on the ground, in the OV-10 Bronco forward air control aircraft, or in helicopters control the attack until weapons are on the target.

Call and Shoot

Cooperative attack has made possible a new wrinkle that could help solve the CAS problem by bringing into play the best of two worlds: the accuracy and lethality of high technology and the simplicity and toughness of an aircraft designed just for this mission and under more direct control of ground troops. The A-10 now is to become the OA-10 forward air control aircraft. This will put a powerful CAS weapon in direct communication with ground commanders, give FACs a more capable platform, and put airborne FACs directly into the ATHS network. An OA-10 could attack a threat immediately with its cannon even as it is calling in an F/A-16 strike. When the time comes, automation might guide faster aircraft to targets without the FAC having to utter a word over the radio.

Lt. Col. Phil Hoffman, operations officer of the 138th Squadron of the New York Air National Guard's 174th Tactical Fighter Wing, is in charge of the ATHS testing and expects everything will come together

Much of the work in improving coordination between FACs and F-16s equipped with ATHS is being done by the 174th Tactical Fighter Wing, an ANG unit from Syracuse, N. Y. This 174th TFW F-16 deployed to the Persian Gulf, where, although the ATHS was not available, it would have come in handy for Scud-hunting and other chores.

next summer. "The last thing you want to do is hurt friendlies," Colonel Hoffman says. "If a FAC knows anything, he knows the grid coordinates of a target and the location of friendly forces."

Even satellite navigation will require some cooperation between aircraft and a ground unit with a GPS receiver at a fixed location to make differential calculations that cancel errors due to atmospheric signal attenuation and the drift of satellites in orbit.

The groundwork for cooperative attack was laid in the late 1980s by engineers at USAF's Flight Dynamics Laboratory, part of Air Force Systems Command's Aeronautical Systems Division, located at Wright-Patterson AFB, Ohio. (It is now called the Flight Dynamics Directorate of Wright Laboratory.) Their Advanced Fighter Technology Integration (AFTI)/F-16 demonstrated accurate target cuing and data-link operation with a FAC. Later, the aircraft went to Fort Hood, Tex., near its modification base at General Dynamics in Fort Worth, where it underwent extensive flight testing with an ATHS-equipped F-16B. The AFTI/F-16 used the digital network and a Pave Penny laser tracker to calculate and relay target coordinates to the F-16B for successful one- and two-ship attacks.

The tests proved that voice communication could be eliminated during all phases of air-support operations, according to Lt. Col. Ted Church, the AFTI/F-16 program manager.

The F-16 System Program Office (SPO) at Wright-Patterson paid about $10 million for engineering and integration of the Rockwell Collins CP-1516/ASQ ATHS to support testing by the New York Air National Guard. The SPO also is developing an advanced system called the improved data modem (IDM), which will be the version of ATHS that goes on production aircraft and most of the retrofits.

Capt. Bill Shelton, the IDM program manager, says the new device will have four simultaneous channels instead of one, will sustain a data rate of 16,000 bits per second instead of the current 1,200 bps, and will be reprogrammable through the F-16's military standard 1553 data bus. "You will be able to plug right into the port and field-load new software without taking the box out of the airplane," Captain Shelton says.

Ongoing work at the Naval Research Laboratory provided the basis for the IDM. "They had a system that did everything we required," Captain Shelton says, "so we have functioning IDMs now." Bench testing and integration now under way at General Dynamics is to be complete by Christmas, in time for a year of flight testing to begin January 1. Captain Shelton expects to award a production contract by next summer.

Plug In and Go

Captain Shelton thinks simultaneous operation of four channels will be a real help to FACs. The A-10, for example, has three radios, according to Captain Shelton. "We don't care if it's UHF or VHF," he says. "Just plug into existing radios and go."

The CAS upgrade will be part of the baseline F-16, so NATO interoperability will be a natural consequence of midlife upgrades going on all over the world, according to Captain Shelton. The Sacramento Air Logistics Center's OA-10 System Program Office at McClellan AFB, Calif., will get IDMs from the F-16 SPO, is participating in the various working groups, and is expected to start installing cooperative attack hardware the first of next year. The Army's Avionics Research and Development Activity at Fort Monmouth, N. J., is participating fully in F-16 SPO working groups, according to Captain Shelton, and is expected to start putting IDMs in the AH-64 Apache helicopter by early 1994. The Marine Corps Aviation Weapons Branch is working on putting cooperative attack hardware on the AV-8B Harrier, the F/A-18 strike fighter, and the AH-1 Cobra attack helicopter.

Slow progress in correcting the incompatibility of the Air Force's digital communications terminals with the Army's Tacfire network, identified by Colonel Phillips in a 1989 report, indicates that interservice cooperation is not all it could be. Another negative sign was Naval Air Systems Command's choosing a system for the Marine Corps other than the IDM developed by that service's own laboratory.

Even so, cooperative attack provides a real chance for the services to solve the close air support problem. The project has a good start already. ■

Jay C. Lowndes, a former engineering editor of Aviation Week & Space Technology *Magazine, is a free-lance writer and consultant in Washington, D. C. This is his first article for* Air Force *Magazine.*

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Eight years later, the Soviets disclose what really happened to the Korean airliner.

The Truth About KAL 007

By James Oberg

THE SOVIET destruction of Korean Air Lines Flight 007 on September 1, 1983, left many mysteries. Some were counterfeit, the creations of Soviet apologists. Others—the plane's true flight path, where it sank, the actions of US and Soviet forces—were of keen interest to the US but remained unsolved.

In a startling turn of events earlier this year, the newspaper *Izvestia* launched an independent investigation of the shootdown, spending thousands of hours on hundreds of interviews. Astonishingly, it managed to print the results. The new information demolishes the official Soviet version of events.

In the *Izvestia* articles, the Soviet pilot who fired the missiles that destroyed Flight 007, killing all 269 passengers and crew, admitted that the airliner was flying with proper lights on, that he never warned it on radio, and that he never fired tracer bursts as a warning. He maintained that Soviet authorities later ordered him to lie about each of these critical details.

Soviet undersea workers described to *Izvestia*'s journalists how they secretly located the airliner's wreckage and recovered the flight data recorders, items that would have helped establish the nature of the crew's actions in the critical hours before the plane was shot down. USSR officials have always denied possessing the recorders.

Before they were swept from power this summer, hard-liners in the Soviet military and KGB denounced the *Izvestia* probe. Yet the military newspaper *Krasnaya Zvezda,* even while attempting to justify the act, confirmed *Izvestia*'s most damning disclosures.

Determining the actual flight path of Flight 007 has always posed problems. From the time it left Alaskan airspace until its final minutes over Sakhalin Island, the airliner was out of range of US and other Western civilian and military radars.

The Korean pilot's reported positions clearly were wrong. He probably was misled by a malfunctioning navigation system.

Contemporary Soviet claims that the airliner took evasive action were self-serving and dubious. Many were based on workers' memories of unrecorded radar returns and on

momentary glimpses of the plane from maneuvering chase aircraft.

Early press accounts attempted to reconstruct the Korean aircraft's final flight direction by assuming that there was a late deviation in the mission. They thus introduced hypothetical turns first to the right and then to the left.

The result is a mishmash of proposed paths that cross over one another like spaghetti.

The Official Reports

Two "official" reports on the matter of the flight path appeared in late 1983. Jeane Kirkpatrick, the US ambassador to the United Nations, presented a US study to the Security Council. Soviet Marshal Peter Kirsanov gave the Kremlin's version to the International Civil Aviation Organization.

The accounts are almost identical —not surprising, since the US version is based on intercepted Soviet radar data. Both show that Flight 007 took an essentially straight flight path throughout its journey. The Soviet map, however, shows a slight jog around Sakhalinsk AB, a deviation that may have stemmed from a "slant range" error associated with the passage of the target over a radar.

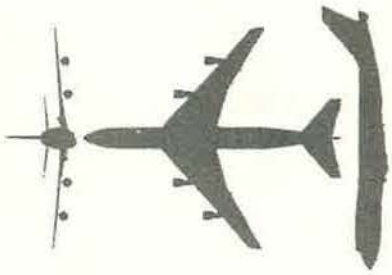
The *Izvestia* material corroborates these original maps and suggests that the airliner flew essentially straight for its entire passage through the region, until hit by the missiles. An official Soviet Defense Ministry map published in *Krasnaya Zvezda* confirmed this last July. The map was identical to Ambassador Kirkpatrick's original UN presentation—down to the removal of the small "jog" around Sakhalinsk AB.

Equally significant are *Izvestia*'s new disclosures regarding the actions of the VPVO, or Soviet Troops of Air Defense.

A Soviet rear admiral told *Izvestia* anonymously that he had been at the Kamchatka combat control center when Flight 007 began its perceived intrusion. He recalled observing at the same time a patrolling USAF EC-135. Later, Flight 007 was also observed by Soviet operators, but nothing seemed unusual. The assumption was that the aircraft was a refueling plane; it was given the target number 6065. Then Soviet operators saw that the airplane, rather than turning north, was continuing south.

At this point, continued the admiral, "the target suddenly disappeared from the radar altogether! The operational officer got frantic."

The military, as a precaution,



launched a pair of fighter-interceptors. They headed east, over the ocean.

Checks of the radar circuits allegedly showed that all was in order. This checking took time; meanwhile, the target was not being tracked. The admiral concluded that the target had deliberately descended below radar coverage—a sure sign of intentional penetration.

It wasn't until the airliner was halfway across Kamchatka (over the Kronotsky Nature Preserve) that it was seen again. By then, the first two interceptors were too far east.

A second pair of fighters was launched, but they got aloft too late to catch Flight 007 before it passed beyond a mountain range, which blocked further tracking.

Provoking Soviet Radars?

A former VPVO trooper named Alexei Kretinina, in an article first published in *Sibirskaya Gazeta* and reprinted in part by *Izvestia,* added further details to the picture. He attributed the initial confusion to the Soviets' assumption that the approaching plane was merely provoking Soviet radars and would turn away short of the border. The airplane, however, crossed the border at 5:33 a.m., local time. Soon after, the plane vanished from radar screens, not reappearing for thirteen minutes.

These and later "disappearances" of the airliner are more likely to have resulted from ground equipment malfunctions than from "active countermeasures" by a spy plane. Alexei Gordievsky, a Soviet intelligence defector, claims that, on the night of the overflight, "eight of the eleven tracking stations on the Kamchatka Peninsula and Sakhalin Island were not functioning properly."

Soviet military officials have always maintained that another set of interceptors (the third pair!) caught the Korean airliner as it crossed Kamchatka, observed that it was flying without lights, made warning maneuvers that were ignored, and then —incredibly—let it go on its way.

Shortly after the shootdown in 1983, Soviet television interviewed a man who described the incident in those exact terms. He claimed to be one of the pilots in the third set of fighters and was identified only as "Kazmin."

Izvestia's investigation located individuals on Kamchatka who told a far different tale. They said that the Soviet fighters from Kamchatka failed to get into the air fast enough and never caught the airliner. "Probably the pilot named Kazmin does not exist," *Izvestia* concluded. "He is a myth."

Having left Kamchatka behind, Flight 007 set out across the vast Sea of Okhotsk toward the Asian mainland. During its passage across the water, the airliner was flying beyond the range of VPVO radar. Forces on Sakhalin had been alerted, but they expected the intruder to turn south and escape over international waters. Suddenly, as the airliner approached Sakhalin, it appeared on Soviet radar screens. The surprised air defense radar observers were determined not to let it escape.

Earlier Incidents

Many of these Soviet military personnel, who spoke with *Izvestia* reporters, recalled how edgy they had become as a result of earlier incidents. One lieutenant colonel, who had been chief of a VPVO command post on Sakhalin the night of the shootdown, called to the newspaper's attention the overflights the Soviet Union had experienced the previous April, over the Kuril Islands.

US Navy planes from the carriers *Midway* and *Enterprise* had allegedly overflown Soviet territory.

In the course of one incident on April 4, 1983, Soviet commanders gave an order to intercept and fire on the US Navy jets.

Nothing happened. The Soviet fighter base nearest to the US intruders was fogged in. Interceptors at more distant bases did not have sufficient range because they were not equipped with drop tanks. Following the 1976 defection-by-air of MiG-25 pilot Victor Belenko, Soviet military aircraft on Sakhalin were never given enough fuel to fly to Japan as Belenko had done.

In the April 1983 incident, the US Navy planes were observed to make several "bombing runs" on one of the Kuril Islands, then fly off with impunity.

Soviet failure to get aircraft into the air resulted in reprimands, demotions, and transfers. "That is why, having behind us a successful penetration [by] an American into our airspace, we were in such a determined mood," one Soviet officer explained. "The Boeing [Flight 007] had to be destroyed."

Among those standing watch on the night that Flight 007 arrived off the Soviet coast was one of the very officers who had been on duty during the April 1983 incident. He had been severely reprimanded and ordered to take "resolute actions" in the event of a repetition. A recent report published in a Soviet military journal observed, "Had the situation in September 1983 been less tense, the information [that local] command post specialists possessed would have been perceived quite differently; the conclusions would have been different, and so would have been the result."

This comes close to an official admission of what many suspected: There were lots of hints at the time that the intruder was a lost civilian jet, but nobody dared take a chance on it.

One of the Soviets' targeting navigators was Sr. Lt. Vladimir Borisov. As the intercept began, he was ordered by the unit's deputy chief of staff for combat operations (Maj. Alexander Dovnarovich) to command the destruction of the intruder as soon as it crossed the border. Lieutenant Borisov was subsequently overruled, then again cleared to order the attack.

As Flight 007 neared Sakhalin, another pair of jets took off from Smirnykh but were unable to intercept the target. Yet another pair—one Su-15 and one MiG-23—took off from Sokol. Flying the Sukhoi was Lt. Col. Gennady Osipovich, the deputy regimental commander, who had just come back from leave.

A Sudden Order

Colonel Osipovich had received a telephone call at 4:30 a.m., local time. He had been ordered to get into his fighter.

His puzzlement grew after he saw a second aircraft being uncovered for flight. He remembers wondering what was going on: "The Americans usually started to make a commotion after 11:00; it was much too early for them now." At about 6:00, he was ordered to take off and head out to sea.

"For some reason," he recalled, "I was sure they had sent up a test target to check out the assets on call."

He was vectored onto a pursuit course and soon caught sight of Flight 007's flashing light. What was he thinking then? an *Izvestia* journalist asked.

"Nothing," he replied. "I was excited!"

Then he elaborated. "What is a fighter pilot? He is a kind of sheepdog that they are constantly sending off after strange things. I saw that what was ahead was something foreign. And I am not a state automobile inspector who can stop a violator and demand his documents!

"I moved in behind to intercept the flight. The first thing that I had to do was force it to land. And if he would not comply, then render him harmless at any cost. I simply did not have any other thoughts."

One Soviet military journalist who was with Colonel Osipovich after the shootdown told *Izvestia* there had been other thoughts in his head. This person said that Colonel Osipovich had been "most of all afraid of the slightest distraction from the instrumentation, of sliding into a hallucination, and losing sense of the spatial position of his plane."

In other words, there was no thrill of the chase for Colonel Osipovich, only anxiety—even fear—of not performing properly.

Flight 007's speed was "about 1,000 kph" (540 knots), and Colonel Osipovich took up a position about thirteen kilometers to the rear. Suddenly the controller began asking course and altitude questions. Both aircraft, Flight 007 and the Sukhoi, had dropped off the radar screen. Ground-radar equipment was again malfunctioning.

Here, the pilot's recorded air-to-ground conversation refers to turns by Flight 007. Colonel Osipovich was flying behind the target, on a heading of 240°. However, the ground controllers had clearly vectored the chase plane to the right, based on bad radar tracking data.

Colonel Osipovich could see the target and objected, "To the left surely, not to the right," but he was ordered to turn and took up a course of 260°.

Naturally, the line of sight to a target maintaining 240° would shift to the left, and this is exactly what Colonel Osipovich radioed a few moments later: "Affirmative, it has turned. The target is 80° to my left." It was he, not the target, who had turned, as the ground soon realized, and the ground controllers ordered a corrective course: 220°.

Within three minutes, the Soviet interceptor was again directly behind, and the pilot reported his course was again 240°, the same as it had been when the confusion had begun. In the *Izvestia* interviews, Colonel Osipovich never referred to these alleged target turns. They probably never happened.

First Lock-On

As the plane crossed the Sakhalin coast, Colonel Osipovich was ordered to destroy it. He went to afterburner and quickly reported that he had achieved a missile lock-on. Then, however, he received new orders: "Abort destruction! Match altitude with the target and force it to land."

The pilot recalled that he approached the target "from below" and "flashed him" (presumably with his landing lights) but got no response. He was then ordered to fire some warning bursts.

"What was the sense of that?" Colonel Osipovich asked. "I had armor-piercing rounds, not tracers. And it was hardly likely that anyone would see them."

He fired off several bursts without effect. Evidently, nobody saw him. But he believes that the Korean pilots had seen his flashing and "reacted unambiguously—they quickly reduced speed." For Colonel Osipovich and the ground controllers, this had all the appearances of a deliberate maneuver to cause him to overshoot and have to circle back. They thought the plane had ignored proper signals and was trying to escape.

What had really happened was a dreadful coincidence. As the end of the flight neared, Flight 007 radioed Tokyo Air Traffic Control Center for permission to climb from 33,000 to 35,000 feet (a standard fuel-economy technique once the airliner grew lighter). Tokyo radioed another aircraft on the same route, which had been assigned that flight level, to verify it had climbed to 37,000 feet as it had requested earlier. Once this was established, Tokyo cleared Flight 007 and the crew of the airliner replied that it was immediately beginning the climb. Its airspeed naturally chopped slightly during this maneuver. Flight 007 radioed Tokyo, "Leaving three-three-zero this time."

Moments later, Colonel Osipovich radioed excitedly, "The target is reducing speed." Fifteen seconds later, "I am going around. I am already moving in front of the target." A few seconds later, "It is decreasing speed."

"We had already flown past the island," Colonel Osipovich recalls, and were heading for international waters twelve nautical miles off the coast. "Only then was the command given to destroy the target."

At that point, Colonel Osipovich told *Izvestia,* he was above and approaching the target and had to drop back and maneuver to get missile lock-on. Western observers believe that, during those moments, the airliner may have passed out of Soviet airspace.

The order to destroy the target came from the unit's commanding officer, Colonel Kornukhov, at the Sokol command post. The commander of the Far Eastern Military District was at Khabarovsk on the mainland, but he reportedly only monitored the execution of preset orders.

According to the defector Gordievsky, Khabarovsk relayed reports to Moscow but the commander gave the Sakhalin units no specific instructions other than to follow the standing orders.

Aerial Combat?

Amid the confusion and garbled communications, another misunderstanding worried Colonel Osipovich. A second pursuing Soviet plane was asked about the intruder and Colonel Osipovich's aircraft. That pilot responded, "I'm observing both!"

Colonel Osipovich misperceived the Russian "uh-bo-EE-h" ("both") and thought he heard "bo-EE" ("battles"). Now he had to worry that aerial combat was in progress. Was someone shooting at him?

Colonel Osipovich felt insulted by the Western theory that he confused the Boeing 747 with an RC-135. He told *Izvestia,* "During ten years of service in the Far East I made more than 1,000 flights to intercept them. We knew the aircraft markings of the intruders, and they knew ours."

As for the target in front of him, Colonel Osipovich said, "it was larger than an Il-76 [transport] and its outline was something like a Tu-16 [bomber]. The trouble for all Soviet pilots is that we do not study civilian aircraft belonging to foreign companies. I knew all the military aircraft, all the reconnaissance aircraft, but this was not like any of them."

Colonel Osipovich's claim of ignorance is self-serving and implausible. At the time, he made no comment to the ground about the visual discrepancy between what may have been expected and what was actually there.

"The Target Is Destroyed"

Whatever it was, he was committed to destroying it. He fired off the first air-to-air missile, which hit near the tail. "There was a burst of yellow flame," said Colonel Osipovich. "The second took off half the left wing. The lights went out immediately."

He called back, "The target is destroyed."

Colonel Osipovich broke right and headed for home. The field was closed due to the morning sea fog, but he landed anyway. He received a joyous reception, but, "once back on the ground, I started to have a strange feeling."

Colonel Osipovich telephoned the unit commander, Colonel Kornukhov, and asked if the target had been "one of ours." No, it had been a foreigner, he was told.

A few days later, when the shock of realization settled in, Colonel Osipovich expressed the wish that he had shot down a Soviet strategic bomber instead. Even years later, he insisted to *Izvestia,* "I cannot really believe that there were passengers on board."

The stricken Korean airliner fell into the sea. *Izvestia* quoted a Soviet naval officer as saying that Flight 007 fell at a pitching angle of 70° to 80° from more than 30,000 feet. It disintegrated when it hit the water.

Testimony collected by *Izvestia* leaves no doubt that the aircraft's data recorders were recovered and sent to Moscow. Their contents were evidently not even shared with the military's special investigative commission.

Izvestia repeatedly tried to extract the recorder results from the Soviet Defense Ministry but failed. Last spring, the Ministry even defied orders from Soviet President Mikhail Gorbachev to turn the data over.

Soviet military officials may now be somewhat more cooperative, so additional insights may still be gained. ■

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Warrant officers rated a salute, were called "Mister," and were difficult to categorize.

The In-Betweeners

By Bruce D. Callander

WHEN the Army began graduating its physician's assistants with the rank of warrant officers, some Air Force PAs were irate. They were performing the same job —as noncoms. The Air Force sympathized, but it was not about to get back into the warrant officer business.

The service stopped making appointments to that rank in 1959. It spent another twenty-one years waiting for its last warrant officer to retire. When he did, the Air Force considered the subject closed.

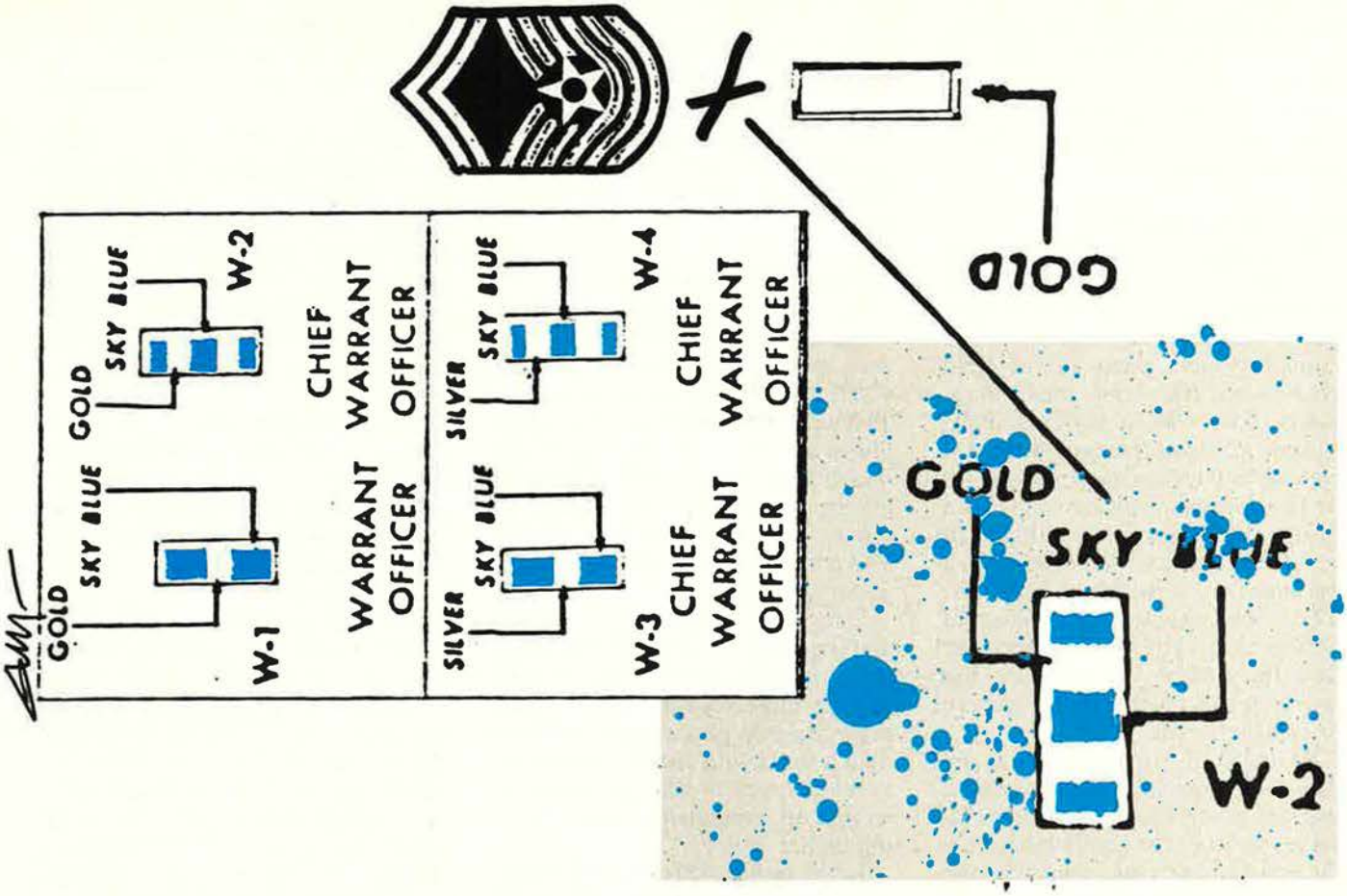
The Air Force's official position was that it had no place for another rank sandwiched between enlisted and commissioned officer levels. In fact, the service had never really decided how warrant officers fit into the scheme of things. They held jobs at the top of the enlisted career ladders but were counted as commissioned officers. They rated a salute from airmen but were outranked by second lieutenants young enough to be their sons. The only time the Air Force had made warrant officer appointments on a grand scale turned out to be a disaster.

The Army, too, had had trouble with its warrant officer program. By the late 1950s, it had spent forty years trying to find a role for WOs. Much of that time, it had used the rank to reward noncoms not qualified for commissions and to compensate former commissioned officers not needed in their old grades.

By the time the Army worked out an effective program for its warrant officers, the Air Force had given up.

Long before this country was founded, navies used warrant officers to handle technical operations aboard warships while the more aristocratic officers were "commissioned" to command them. In 1775, John Berriman, chief boatswain on the *Andrea Doria,* was appointed warrant officer in the Continental Navy. He probably was not the first American to hold the rank.

The Army gave a similar in-between grade to headquarters clerks in the late 1890s, but it did not use the warrant officer title until 1918, when it got its own little navy. In that year, Congress approved a seagoing Mine Planter Service for the Coast Artillery and authorized the use of warrant officers as masters, mates, and chief engineers.



Clerks and Bandleaders

By 1920, Congress allowed the Army up to 1,120 warrant officers, and the service was giving the rank not only to mine planters and headquarters clerks (now called field clerks) but also to quartermaster clerks and bandleaders.

That same year, Congress voted another provision that was to muddy the status of the grade for several decades. It allowed the Army to give warrants to long-service enlisted members and to former officers, including some Army Air Service pilots, who lost their commissions in the demobilization after World War I.

The use of the rank as a reward for some and a consolation prize for others worked against the Army's efforts to develop an effective career program for warrant officers. In the late 1930s, Army officials were still telling Congress that, except for these purposes, the rank did not meet any organizational needs and did not fit into the military system.

Then came World War II. US forces grew explosively. Old rank structures went by the boards. From 1938 to 1944, the strength of the Army Air Forces alone jumped from 21,000 to more than two million. Enlisted men added stripes every few months, and new officers were stamped out like aircraft parts.

To keep the force from getting impossibly top-heavy, the Army invented whole new categories of rank. One was a technician scheme under which enlisted specialists received the pay of noncoms without the corresponding rank. Another was a new type of flying warrant officer for the AAF.

Socially Unthinkable

When Congress created the flight officer rank in 1942, the plan was to give it to enlisted pilots and avoid the socially unthinkable prospect of having NCOs command aircraft on which commissioned officers served as crew members. During the war, however, thousands of aviation cadets who normally would have been commissioned were made flight officers instead. They served as pilots, bombardiers, navigators, flight engineers, and fire-control officers. Some 200,000 men were believed to have held the rank. Even the Pentagon lacks an exact count.

The rank was equivalent to that of Warrant Officer, junior grade, and carried the same pay ($150 per month), plus flight pay. Like more conventional warrant officers, flight officers were called "Mister." Both wore officer-style bars tinted with splashes of color (brown for WOs and blue for FOs). Both rated salutes from enlisted men, and both wore officer-style uniforms. Both ranked below all commissioned officers.

Unlike other warrant officers, however, flight officers were not tied to enlisted career fields. They filled the same crew positions as other officers, including aircraft commander. Some flew with commissioned copilots, and at least a few led major elements on missions. The Pentagon said they were to be treated "in the nature of third lieutenants . . . due all the customs and courtesies pertaining to commissioned officers."

The trouble was that no one, including the flight officers themselves, was quite sure what that meant. On the job, they performed

like any other officers, but, socially, many still felt like outcasts. Enough of the "Old Army" snobbery remained to remind them they were not viewed as the equivalent of commissioned officers.

Back on the Ground . . .

The status of more traditional warrant officers was often equally ambiguous. Many men who had held warrants before the war were commissioned, some in the field grades, but the Army made thousands of new WOs. Unfortunately, it gave major commands power to appoint and assign them and did little to standardize the process. As a result, the rank often continued to go to NCOs more as a reward than because their positions called for it. They were assigned to the Warrant Officer Corps and spread over more than forty occupational areas, but they still had no real career pattern to call their own.

Though the Army did little to define their position, some wartime warrant officers took it upon themselves to do so. In one bomb group, the enlisted line chief was given the rank. He went about his job, but he adopted a new image. Evidently using a British field marshal as his role model, he cultivated a handlebar mustache and carried a swagger stick.

He was the exception. Most warrant officers filled the essential clerical, administrative, and technical jobs with quiet efficiency and attracted little attention. Most were more experienced than the "ninety-day wonders" then being churned out by Officer Candidate Schools, and the rank gave them the clout that NCOs lacked. In fact, Congress provided that warrant officers in jobs normally filled by commissioned officers would have all powers of the commissioned ranks.

AAF veterans who passed through a certain flight training center in the American southwest may remember one warrant officer who used those powers to the fullest. Assigned to the headquarters staff, he was the person to whom incoming officers reported when the commander was absent. His favorite targets were crewmen returning from combat units, where discipline tended to be lax. If they were unimpressed by a mere warrant officer and failed to render a proper salute, he dismissed them like wayward cadets with orders to report again in the prescribed manner. Some questioned whether the commander's stand-in had that much authority, but few were tempted to test it.

The AAF Inheritance

When the war ended, the Army stopped appointing both flight officers and warrant officers, and most wartime appointees went home. Two years later, the Air Force began life as a separate service and inherited 305,000 former AAF members, among whom were 1,200 warrant officers. The service had no specific WO career plan, but it continued to appoint more.

Over the next decade, Congress and the Pentagon tried to sort things out, with limited success. The lawmakers gave warrant officers four separate pay grades but failed to match them with specific ranks. As a result, some warrant officers wound up supervising others drawing higher pay.

In the early 1950s, the Air Force tried to define the warrant officer by regulation. AFR 36-72 called him "a technical specialist with supervisory ability, who is appointed for duty in one superintendent Air Force specialty."

The regulation defined warrant positions as those in which supervision was limited to other warrant officers, enlisted members, and civilians; duties required more responsibility than was desirable for an NCO but greater specialization than was desirable for a junior officer; and duties could be handled by senior NCOs in the temporary absence of warrant officers.

The Air Force regulation also noted that putting this superintendent position at the top of the airman career ladder provided for the progression of outstanding airmen. By then, the Army had adopted a similar policy. This was intended to make the rank an incentive for outstanding enlisted performance rather than a reward for past service. In addition, however, the Air Force regulation allowed warrant officers to be used as technical assistants and advisors to staff officers and even as commanders of nontactical units.

Again, the Air Force seemed uncertain whether WOs should be used as superairmen or as substitute officers.

One warrant officer spent several years heading a major headquarters office normally run by a field grade officer. He had the specialized knowledge the job required and gave it more continuity than most commissioned officers' tours would have allowed. When he finally left the Pentagon, it was as a full colonel.

Such opportunities were rare, however. Bound as they were to the enlisted career fields, warrant officers normally could not expect career-broadening assignments of the types available to their commissioned counterparts.

Another problem was the small number of warrant officers. Though the Air Force made appointments well into the 1950s, peak strength never rose much above 4,500, or about one-half of one percent of the total active-duty force. There were not enough warrant officers to fill more than a handful of commissioned officer billets and far too few to occupy all of the superintendent-level slots in the enlisted fields. As a result, many master sergeants spent years in superintendent positions with little hope of winning warrants.

Nor was the Air Force likely to appoint more. From the early 1950s on, warrant officers were counted as commissioned officers for budgetary purposes. The Air Force was not eager to give up commissioned slots to add warrant officers, particularly if it meant taking them from the rated officer ranks.

To add still more confusion, a Defense Department study group took a long look at the program and recommended that all services replace their warrant officers with limited-duty officers. LDOs would hold commissioned ranks but be restricted to certain specialties, duties, and grades. The Air Force didn't see this as a workable solution and decided to keep its warrant program.

Second Thoughts

A few years later, some officials wondered if they had made the right decision. In 1955, a group of warrant officers formed an association.

The Air Force did not outlaw the organization as such but simply proscribed the joining of any group "devoted to the welfare of a single segment of the force." The Air Force Warrant Officers Association died aborning.

The move was questionable because commissioned officers already belonged to several rank-restricted associations. The handful of warrant officers was not the problem. The Pentagon was more worried about the much larger number of airmen who already were grumbling about pay, promotions, and personnel policies. USAF leaders feared that, if the warrant officers were allowed to organize, the airmen would follow and the service would have to deal with some kind of enlisted union.

(Ironically, some years afterward, a group of NCOs organized the Air Force Sergeants Association, which eventually won Air Force approval and support. The Army Warrant Officer Association, formed at about the time Air Force warrant officers were trying to organize, also survived and prospered.)

How much that experience with the Warrant Officers Association influenced the Air Force's attitude toward warrant officers is debatable. Clearly, it did nothing to tilt sentiment in their favor a few years later when the issue of the warrant program came to a head.

In 1958, Congress created two new enlisted grades, E-8 and E-9. The rationale was that enlisted members were reaching the top NCO grades midway in their careers and had no place to go from there. The services did not want to use officer authorizations to make more warrant appointments, so the solution seemed to be to add another tier to the enlisted ranks.

In 1959, the year that the Air Force promoted its first master sergeants to E-9, it also announced plans to phase out its warrant officer program. At the time, officials insisted there was no connection between the two moves, but the correlation is hard to ignore. The Air Force admitted that it had decided that warrant officers constituted an unnecessary layer of supervision between the commissioned and noncommissioned ranks. Some years later, officials concluded that the new senior noncoms were "capable of doing the same jobs as warrant officers."

Unlike warrant officers, the new NCOs were charged against enlisted strengths, and the services could afford more of them. The law allowed only three percent of all enlisted members to be in grades E-8 and E-9, but that was more than four times the number of warrant officers the Air Force had at the time.

Pentagon Foolishness

The advent of the supergrade NCO was not without its problems. In its first burst of enthusiasm, the Pentagon foolishly passed most of the new slots to major commands to fill as they saw fit. Many went to deserving master sergeants regardless of their specialties or positions. Commands again were using the appointments to reward individuals rather than to fill valid requirements. It took USAF several years to regain control over the supergrade program, define the superintendent slots, and begin to fill them by centralized promotions.

Meanwhile, the Air Force had to make use of those several thousand warrant officers who were left in the system. Most were assigned to commissioned officer positions. The service encouraged early retirement and, in some cases, forced attrition. It was not until 1980, however, that CWO James H. Long retired from the 438th Transportation Squadron at McGuire AFB, N. J., and the Air Force said good-bye to its last active-duty warrant officer.

While the Air Force was working warrant officers out of its ranks, the Army was finding a niche for them at last. In the late 1950s, it concluded that if the rank were to survive, it could not be used as a reward for enlisted members and a dumping ground for former commissioned officers. The Army combed its organizational tables for technical positions where warrants could be used to advantage. It found enough to continue the program and even to expand it.

One field in which the Army found warrant officers most useful was aviation. The new Air Force had taken most of its larger aircraft, but the Army still had some light planes and a variety of helicopters to use as "organic airpower." It wanted pilots with more rank than NCOs, but it did not want to spawn another big force of commissioned aviators. The highly specialized job fit neatly into the Army's new definition of a warrant position, and the flight officer idea that had bombed in the AAF soon boomed in the new Army.

Today almost fifteen percent of the Army's officers hold warrants rather than commissions. They continue to fill traditional slots in administration and marine operations and have moved into highly technical jobs in communications electronics, weapons maintenance, and health care.

Even in the Army, however, warrant officers continue to struggle for a better status. Their association has lobbied for higher pay, more commissioning opportunities, and special career legislation.

For all its problems, the WO idea continued to appeal to some Air Force NCOs. As the supergrades filled up and promotions slowed, they saw themselves doing officer-type jobs without having the opportunities of the Army NCOs to earn warrant appointments. The contrast was heightened by the creation of warrant slots for the Army's physician's assistants. Some Air Force PAs argued for a return to the warrant program or for adoption of a limited-duty officer plan.

Neither is likely to happen, particularly while strength cuts keep officer slots at a premium. The Air Force argues that such a move would only dilute the status of top airmen and would serve little purpose except to reward some NCOs and give surplus commissioned officers a place to serve their remaining time. It has been down that road before. ■

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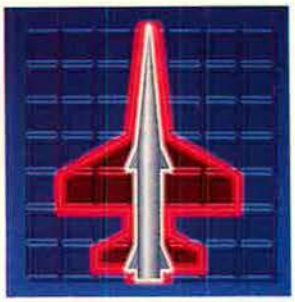


Industry Shows Its Stuff

By **Frank Oliveri,** Associate Editor

—Staff photos by Guy Aceto

Northrop's B-2 "glass cockpit" trainer (above) offered eight displays, each capable of providing a wealth of information, and stick-and-throttle controls. The briefings and displays drew crowds of active-duty visitors from all US services and many foreign militaries (opposite). More than 7,000 people attended this year's program, where aerospace companies emphasized systems of the future rather than resting on the laurels their products earned during the Persian Gulf War.

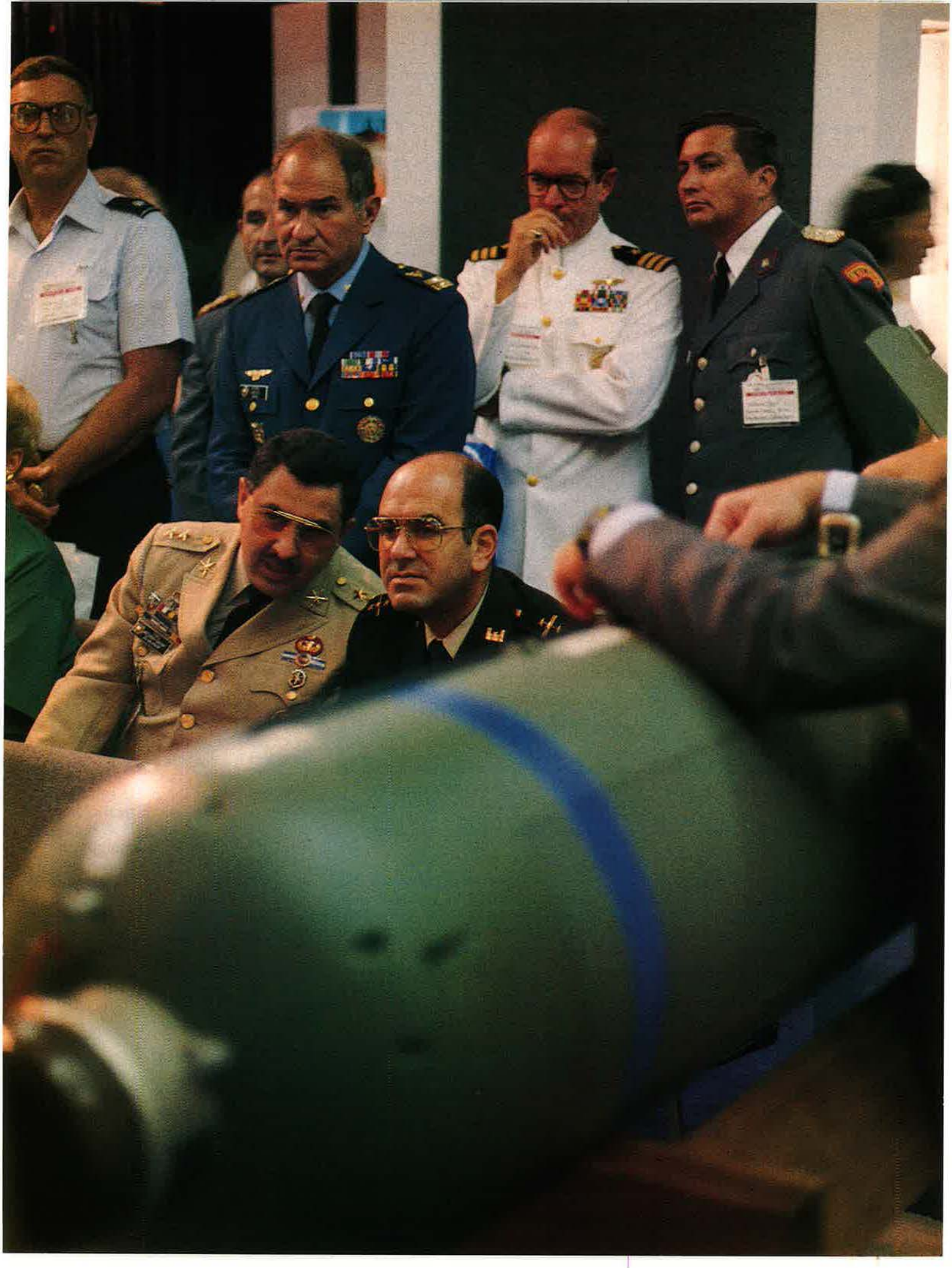
THOUGH it had been only a few months since the end of the Persian Gulf War, where many of their weapons turned in stellar performances, exhibitors at AFA's 1991 Aerospace Briefings and Displays tended to focus on the promise and prospects of their new-development systems. Older, combat-tested equipment figuratively took a backseat to the aerospace contractors' more exotic wares.

Northrop Corp., for example, gave great prominence to a mockup of its B-2 "glass cockpit" trainer. More than 7,000 visitors to the exhibition, held September 16–18 at the Sheraton Washington Hotel in Washington, D. C., were able to inspect the trainer's eight advanced displays and manipulate its numerous buttons, knobs, and dials. Would-be pilots seemed compelled to try almost every button and switch. Each control yielded some kind of response or useful information.

Northrop test pilot Wayne Staeley explained that classified functions of the cockpit were not a part of the software in the exhibit cockpit. However, bomb bay doors could be opened and closed when using the limited weapons functions.

The cockpit provides for a pilot and a mission commander. Both are trained to do either job. Each crew member sits before four cathode ray tube displays and has stick-and-throttle controls. Each may gain access to large volumes of information by calling up data on one of his CRTs.

The Northrop booth drew large crowds throughout the week of AFA's Convention, which also saw controversy erupt over the result of operational testing of the B-2 bomber's stealth capabilities and saw Secretary of the Air Force Donald Rice deliver a rebuttal to critics of the



new bomber *[see "Aerospace World," p. 20]*.

High-Profile Future Systems

Also on display at the show were various aspects of another high-profile system of the future: the Lockheed/Boeing/General Dynamics F-22 Advanced Tactical Fighter. F-22 technologies and systems were explained and displayed, not only by the prime contractors, but by the subcontractors as well.

In a specially prepared video about the new air-superiority fighter, Lockheed outlined some of the challenges coming up in the next phase of development. Lockheed Vice President James "Mickey" Blackwell, general manager of the F-22 program, and Brig. Gen. (Maj. Gen. selectee) James Fain, Jr., the Air Force's ATF program director, explained the importance of air superiority and the role that stealth, supercruise, and higher maneuverability will play in that mission. In addition, Mr. Blackwell described in basic terms the management plan for the aircraft program, calling the F-22 contractor team a "tight working group."

McDonnell Douglas Corp. drew much attention to its display with the cockpit trainer for its C-17 long-distance airlifter. Interest was further increased by the news that, on September 15, the Air Force's newest airlifter had flown for the first time, for two and a half hours. "We needed that [flight] badly," observed one McDonnell Douglas official, aware that a series of missed C-17 flight dates had left the program somewhat beleaguered politically.

Company officials showed a videotape of the first C-17 flight, which apparently took place without a hitch. The C-17 flew from Long Beach Field to Edwards AFB in the same general vicinity in southern California. The aircraft reached a target speed of 288 miles per hour and climbed to 20,000 feet.

With full deployment of the C-17, says McDonnell Douglas, US forces will be able to land at an additional 10,083 airfields around the world. The Air Force's earlier-generation airlifters, the C-5B and C-141, can use only 3,645 airfields because they require longer runways for takeoff and landing.

With about the same wingspan as the C-141, the C-17 can carry nearly twice the payload of that airlifter. The C-17's gross operating weight is 580,000 pounds, and its maximum speed at high altitude is Mach .875. The range with a 167,000-pound payload is 2,400 nautical miles. With that weight, it could land on a field 2,700 feet in length and take off with a payload of 81,078 pounds within 2,900 feet.

Little is currently known publicly of the requirements for the future USAF multirole fighter (MRF), the aircraft that the Air Force sees as the eventual replacement for the multipurpose F-16 fighter. However, McDonnell Douglas released a conceptual drawing of its MRF Concept 1006, which was designed for the old USAF Propulsion Integration of Aero-Control Nozzles (PIANO) program. The role of the aircraft would be battlefield air interdiction and defensive counterair. The aircraft design resembles the Northrop/McDonnell Douglas team's unsuccessful YF-23 ATF candidate, the principal difference being that the MRF version has one engine rather than two.

In a fact sheet released at the show, McDonnell Douglas maintained that the MRF was designed for maneuverability, great agility, and "balanced observables." Acquisition costs would be lowered through programs of size and weight reduction and by utilizing the ATF airframe, engine, and avionics technology.

McDonnell Douglas says it will study up to nine different designs for the MRF, with each making various trade-offs, ultimately leading to an affordable aircraft. The plane is expected to feature conformal carriage of weapons. It would be fifty-four feet in length and have a thirty-seven-foot wingspan.

Plans call for the plane to carry internally either two tactical munitions dispensers and a 25-mm gun with 250 rounds of ammunition or two AMRAAMs, two Infrared Air-to-Air Missiles, and a 25-mm gun with 250 rounds. Its propulsion would be in the 35,000-pound-thrust class, with the engine growing out of Phase II of the Air Force's Integrated High-Performance Turbine Engine Technology initiative. Its structure would be more than fifty percent composites.

JPATS Competitors

Competition is heating up for the Joint Primary Aircraft Training System (JPATS), with numerous contractors taking part. The principal mission of JPATS is to train entry-level USAF and Navy student pilots in primary flight instruction before

—Staff photo by Guy Aceto

Lockheed and Boeing, partners with General Dynamics on the F-22 Advanced Tactical Fighter, mounted popular displays. Lockheed outlined some of the coming ATF challenges in a video. Boeing, besides featuring the E-3 AWACS seen here, informed the public of its role in B-2 development, SRAM II, SRAM-T, and AIWS.

Aerospace Industry in Review

Companies represented at the 1991 Aerospace Development Briefings and Displays

Aerospatiale
French Aerospace and Defense Manufacturer's Products from Its Four Divisions: Tactical Missiles, Helicopters, Aircraft, and Space and Strategic Systems
AIL Systems Inc.
Self-Protection and Tactical Jamming Systems
Alliant Techsystems, Inc.
Conventional Munitions Such as the CBU-87 Combined Effects Munition and GAU-8/A Armor-Piercing 30-mm Ammunition for the A-10 "Warthog" and Future CEM Technologies
Allied-Signal Aerospace Co.
Latest Aircraft Equipment from Bendix, Bendix/King, Garrett, AiResearch
Bell/Boeing
V-22 Osprey Tiltrotor
Boeing Co., The
Advanced Tactical Fighter (ATF), B-2, and Short-Range Attack Missile (SRAM-T)
Brunswick Defense
Tactical Air-Launched Decoy/Family
CAE Link Corp.
Training Systems for the B-2 Stealth Bomber and the F-117A Stealth Fighter
Dassault Aviation
Full Range of French Aircraft and Aerospace Programs
Deutsche Aerospace
Military Aircraft Programs from German Aerospace and Defense Manufacturer's Two Divisions: MBB and Dornier
ESCO Electronics Corp.
Airborne Special Applications Radars and C³I Equipment
Evans & Sutherland
Visual Systems—The Force Multiplier in Combat Training
Grumman Corp.
Role in Desert Storm and Technologies That Make Sense Today
GTE Government Systems
Secure Information Services and C² Systems Software Modernization Services Through a Wide Range of IDIQ Contract Vehicles
Gulfstream Aerospace Corp.
C-20F Gulfstream for Special Air Missions (SAM)
Hercules Inc.
MMW Seekers, LADAR, and AWEST Technology
Hughes Aircraft Co.
Training Systems for Advanced Technology Aircraft
IBM Corp.
Applying Proven Military and Commercial Technologies and Products to Systems Solutions
Lear Astronics Corp.
Fly-by-Wire Flight Control and Vehicle Management Systems
Litton Systems, Data Systems Div.
MCE and Selected Tactical C² Equipment (ATS, TDC, and Digital Gateway)
Lockheed Corp.
The F-22: Fighter for the Twenty-First Century
Loral Corp.
Capabilities in Electronic Combat, Training and Simulation, Reconnaissance and Surveillance, Guidance, Tactical Munitions, and C³I
LTV Aerospace & Defense Co.
Pampa 2000 (JPATS)
Lucas Aerospace
Products of This International Aerospace, Subsystems, Components, and Equipment Manufacturer
Magnavox Government & Industrial Electronics Co.
Airborne, Ground, and Handheld Communications Systems; Electronic Combat Systems; and Global Positioning Systems
Martin Marietta Corp.
Update on LANTIRN Night Vision and Target System and Titan Launch Vehicles
McDonnell Douglas Corp.
C-17 Airlifter, F-15E, Training Delta Launch Vehicle, Missiles, and Electronics
NAVCOM Defense Electronics, Inc.
AN/UPM-155 IFF Radar Test Set
Northrop Corp.
USAF/Northrop B-2 Stealth Bomber
Raytheon Co.
Air-to-Air Missiles and Other USAF Programs
Rockwell International
Aerospace Operations: North American Aircraft, Rocketdyne, Space Systems
Technologies for the Enhancement of Air Force Capabilities in Aviation, Propulsion, and Space Systems Now and Into the Twenty-First Century
Collins Avionics & Communications Div.
Avionics Systems Solutions: Communication, Navigation, and Mission Management
Sabreliner
Training Systems Programs for USAF
Sextant Avionique
Technology Facilities for Liquid Crystal Cell Production and Display Systems
Smiths Industries
Overall Capabilities and Systems for USAF Applications
SNECMA
LARZAC Engine and CFM56 Engine
Sun Microsystems, Inc.
Tactical Air Forces Workstation Contract (308)
Sundstrand
Sundstrand Products for USAF Applications
Textron Defense Systems
Diversified Technology in the Strategic, Tactical, and Electronic Systems Business Areas
Thiokol Corp.
Solid Propulsion Applications—Strategic, Tactical, Space Programs
TRW Space & Defense
Multilevel Defense: The Space-to-Ground Connection
Vitro Corp.
Software Modifications/Reengineering—A Risk Reduction Process
Westinghouse Electronic Systems Group
Wide Range of Electronic Systems Products in Radars, ECM, Electro-Optical Imaging, and C³I

The following companies displayed but did not hold briefings.

Aerojet
Astra Holdings Corp.
AT&T, Federal Systems
Ball Aerospace Systems Group
Beech Aircraft Corp.
Bombardier Inc.
British Aerospace
Canadian Marconi Co.
Datatape Inc.
Delco Electronic Corp.
Dowty
Du Pont
E-Systems
ECC International Corp.
EDO Corp.
Fairchild Defense
GEC Aerospace, Inc.
General Atomics
General Dynamics Corp.
General Electric
  Aerospace
  Aircraft Engines
Harris Corp.
Honeywell Inc.
ITT Defense
Jane's Information Group
Litton Systems Inc.
  Aero Products Div.
  Applied Technology & Laser
  Guidance & Control Systems
Matra Defense Espace
Motorola Government Electronics
Recon/Optical Inc.
Rockwell International
  Autonetics Marine & Aircraft Systems Div.
  Autonetics Strategic Systems Div.
  Command & Control Systems Div.
  Tactical Systems Div.
Rolls-Royce Inc.
Space Applications Corp.
Standard Manufacturing Co., Inc.
Systems Research Laboratories, Inc.
Systron Donner
Technology Applications and Service Co.
Teledyne Electronics
Teledyne Power Systems
Texas Instruments Inc.
United Technologies Corp.
Williams International
Yugoslav Aerospace Industry

they move to advanced pilot training.

The Lockheed/Aermacchi/Rolls Royce T-Bird II team provided a fact sheet on its aircraft. The T-Bird II resembles the T-33A Shooting Star, which flew for the Air Force from 1947 until 1989. Combining the Lockheed T-33 design with Aermacchi's MB-326 and MB-339 led to the final design of the T-Bird II.

The Rockwell/Messerschmitt-Bölkow-Blohm/RFB team combined to propose the Fan Ranger for the JPATS competition. The team is proposing a modified fantrainer aircraft that includes a reconfigured fuselage incorporating a modern turbofan engine, new electronic flight instrumentation, and a pressurized cockpit.

Once again, the Bell/Boeing contractor team displayed a scale model of the V-22 Osprey and showed a video providing the latest news about development of this tiltrotor aircraft. US Defense Secretary Dick Cheney has attempted to cancel the program for the past two years, but Congress has managed to fund the program sufficiently to keep it on life support for possible future resuscitation. The Marine Corps needs a medium-lift transport to replace aging helicopters in its fleet. Bell/Boeing officials expressed confidence that Congress would again fund the Osprey in Fiscal 1992.

Missile Models on Display

Also prominent at the AFA exhibit were models of the world's most advanced, lethal, and sophisticated missiles.

The two major missile contractors, General Dynamics and McDonnell Douglas, displayed full-scale models of the Advanced Cruise Missile (ACM). The stealthy, nuclear cruise weapon is expected to improve the standoff lethality of US nuclear forces. Current plans call for carrying it aboard Strategic Air Command B-52H bombers. Each bomber can carry twelve ACMs.

Forward-swept wings, a needle-shaped nose, a unique tail and engine duct design, and a coating of elastometric radar-absorbing material all contribute to the stealthiness of this inherently low-observable missile. General Dynamic officials highlighted their first use of a CO_2 laser Doppler velocimeter, which gives the ACM the most advanced navigation system ever used on an unmanned aerial vehicle.

McDonnell Douglas also exhibited a full-scale model of its Have Slick missile, a large composite weapon that has been successfully launched in subsonic and supersonic flight from a modified F-111E. The missile can deliver submunitions or a unitary warhead.

The conformally carried Have Slick yields lower drag and extended mission range for advanced aircraft. Six test flights have been conducted with the missile. It is a fire-and-forget armament with a 2,000-pound launch weight. It has demonstrated a range of seven to

—Staff photo by Guy Aceto

IBM was on hand to demonstrate its computer-enhanced graphics and to show how its proven technologies could be applied to systems solutions. Here, industry representatives get a demonstration of IBM's advanced workstations.

—Staff photo by Guy Aceto

Flyers of yesteryear's transports can be forgiven if the C-17's cockpit reminds them more of Buck Rogers than it does the C-46s or C-47s they flew. McDonnell Douglas got a boost during the Convention from the new transport's first flight. With about the same wingspan as the C-141, the C-17 carries nearly twice the payload and will quadruple the number of airfields USAF's long-range transports can use.

nine nautical miles. McDonnell Douglas touted the missile's potential future use with the proposed new MRF aircraft.

Northrop displayed one of its so-called Brilliant Antiarmor Submunitions, called "Bat," which it unveiled for the first time early this year. Bat is to be used to locate, attack, and destroy moving tanks and other armored vehicles. It is carried into enemy territory by a delivery vehicle and then dispersed widely over the target area. Bat is thirty-six inches long and five and one-half inches in diameter. It weighs forty-four pounds and carries a tandem shaped-charge payload.

Bat is to be deployed from a variant of the Triservice Standoff Attack Missile (TSSAM) or the Army's Tactical Missile System. With respect to TSSAM, on September 16 the Air Force gave contractor Northrop a "cure notice"—in essence, an order to fix a defect in the weapon before proceeding. Pyrotechnic charges that blow off engine inlet covers and allow the weapon's wings to extend failed to work properly. Air Force officials say that, though the problem appears easy to fix, it may cause postponement of some TSSAM funding in Fiscal 1992.

—Staff photo by Guy Aceto

British Aerospace did not hold a briefing, but it brought along a flight simulator for the multinational Tornado, built in consortium with MBB of Germany and Aeritalia of Italy. In the background, Raytheon displays its AIM-9R air-to-air missile. The R model will have greater target acquisition range and better resistance to electronic countermeasures than earlier models of the missile.

—Staff photo by Guy Aceto

Besides the C-17, McDonnell Douglas's display featured the F-15E, Delta Launch vehicles, and its many missiles. The company also issued a concept for the multirole fighter of the future. Resembling the unsuccessful YF-23, the MRF Concept 1006 is McDonnell Douglas's candidate to replace the F-16. The concept calls for maneuverability, great agility, and "balanced observables."

Desert Storm Data

Though aerospace contractors chose not to emphasize the successes of their weapons in Operation Desert Storm, data on the value of the older, combat-proven weapon and surveillance systems was always close at hand should someone inquire.

Grumman Corp. prominently displayed a large-scale model of its revolutionary E-8 Joint Surveillance and Target Attack Radar System (Joint STARS) aircraft, which was deployed to the Persian Gulf while still in developmental stages and used with great effect in tracking Iraqi armor and other vehicles.

The model gave visitors an opportunity to view the inside of the aircraft, including its numerous workstations. In addition, color mapping displays revealed Joint STARS's ability to locate and track large Iraqi convoys during the war. Two E-8As were used in the Gulf, flying forty-nine combat sorties and supporting 100 percent of mission taskings with a system availability rate of eighty percent. Joint STARS aircraft logged 535 combat hours tracking and identifying targets for allied fighters, including fuel storage sites, Scud shelters and missiles, convoys, trucks, tanks, and SAM and artillery sites.

Joint STARS carries a complex, multimode radar that uses a so-called wide-area surveillance/moving target indicator; it locates and identifies slow-moving targets. The synthetic aperture radar/fixed target indicator produces a photographic-type image or map of selected geographic regions.

Despite the system's performance

in Desert Storm, the Air Force has no plans to accelerate the Joint STARS program; such a move would increase program risk and cost.

General Dynamics, McDonnell Douglas, and Lockheed provided videos that highlighted the Persian Gulf performances of their F-16, F-15, and F-117, respectively.

Extraordinary mission capable rates, numbers of sorties, and reliability were emphasized in the videos on the F-16 and F-15 fighters. General Dynamics noted the F-16's versatility, while McDonnell Douglas highlighted the strike ability of the F-15E and the F-15's undefeated air-to-air record.

The two US fighter engine builders were also out in force at this year's exhibition, displaying their Increased Performance Engines (IPEs) and other systems.

General Electric and Pratt & Whitney are locked in a tight competition to sell their IPEs abroad. The Air Force, cutting back on the size of its tactical fighter force, will need fewer engines. This will further increase the need of each engine house to expand its foreign sales. Each company boasts engines that produce nearly 30,000 pounds of thrust.

P&W displayed a full-scale model of its F119-PW-100 engine, chosen to power the supercruising F-22. The F119 was fitted with a two-dimensional, thrust-vectoring nozzle, which will also be installed on the production F-22.

General Electric provided fact sheets on its IPE and a Desert Storm fact sheet highlighting the numerous GE fighter and helicopter engines used in the Gulf. The paper claimed that GE engines powered more than half of the 110,000 allied sorties in the war, racking up mission capable rates of between eighty and 100 percent for each engine type.

—Photo by Paul Kennedy

McDonnell Douglas's Advanced Cruise Missile (top) will improve the standoff lethality of US nuclear forces. Its Standoff Land-Attack Missile (center) was a great success in the Gulf War. Its Have Slick (bottom) has been successfully launched from an F-111E at subsonic and supersonic speeds, can deliver a unitary warhead or submunitions, and is being proposed for use on the multirole fighter of the future.

Stealth, Decoys, Chips

In its exhibit, Boeing outlined the role it played in the development of the B-2 and the F-22, while also providing fact sheets on the Short-Range Attack Missile (SRAM) II, SRAM-T, and the Advanced Interdiction Weapon System (AIWS). SRAM II was designed primarily to beef up the striking power of the strategic bomber forces. Fighters were to carry the SRAM-T to bolster the nuclear strength of US and NATO theater nuclear deterrents. AIWS is a conventional standoff missile that may be deployed on tactical fighters.

Brunswick Defense held numerous briefings on the Tactical Air-Launched Decoy (TALD), which was used effectively in Desert Storm. TALDs are launched against enemy air defenses, forcing air defense teams to turn on their radar and fire SAMs at the decoys, thereby revealing not only air defense sites but also critical electronic emission frequencies and other vital data.

Hughes and Raytheon provided models of, and fact sheets about, the AIM-120A Advanced Medium-Range Air-to-Air Missile (AMRAAM). The AIM-120A, a lightweight, all-weather missile for the Air Force and Navy, is a true fire-and-forget missile. Many AMRAAMs can be fired in succession from one aircraft, with each destroying its target.

TRW briefed visitors on its SuperChip technology, which was developed as part of the Defense Department's Very-High-Speed Integrated Circuit (VHSIC) Phase 2 program. The SuperChip concept combines submicron device geometries (circuit line-widths of less than one micron) with wafer-scale integration, which will help to achieve high computational speeds. The SuperChip is little more than one inch square.

TRW also provided updated information on its Integrated Communication, Navigation, and Identification Avionics (ICNIA) program. The F-22 will feature avionics modules based on technologies developed in the ICNIA program. Modules like those in the ICNIA program will enable pilots to communicate with friendly forces, identify foes, navigate to and from targets, and detect and avoid threats.

Teledyne Electronics provided information to visitors about Identification Friend from Foe (IFF) systems, which received much attention after Desert Storm. Its PPX-3 and MAI-10 systems are known as interrogators, which are currently used in the Stinger and Chaparral missile systems and the Anglo-French SA 332 Gazelle helicopter. Transponders, which provide answers to the interrogators, include the multipurpose airborne transponder, the APX-108 (formerly deployed with the SR-71), the APX-109 used by F-16s, and the APX-110. Teledyne also provided information about test equipment for the systems. ■

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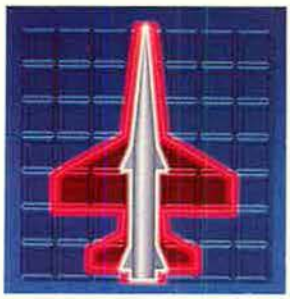


The "Back To Basics" Plan

By James W. Canan, Senior Editor

THE AIR FORCE, breaking with tradition, will merge its major strategic and tactical commands to integrate the strategic and tactical airpower that each has always called its own. USAF will also recast its airlift command under another name and devote it to long-distance, intertheater missions. Secretary of the Air Force Donald B. Rice announced those moves—the latest and boldest in a sweeping reorganization of the Air Force—at the Air Force Association's forty-fifth National Convention in Washington last September.

Dr. Rice declared, "We plan to restructure Tactical Air Command, Strategic Air Command, and Military Airlift Command into two commands. One will have the mission of air mobility—global reach. The other will focus on deterrence and air campaign operations—global power. They haven't been officially named, but for now they're called Air Mobility Command and Air Combat Command."

Addressing the AFA Convention, Air Force Chief of Staff Gen. Merrill A. McPeak explained how the rearranging of SAC, TAC, and MAC fits into the overall Air Force reorganization plan. He said it furthers the management and operational goals of that plan.

"This three-into-two [commands] idea is an example of streamlining and consolidating. It is also an example of . . . strengthening the chain of command," he said.

The Chief of Staff contended that he and Secretary Rice have presented "perhaps the most important set of reorganization initiatives—unusually far-reaching proposals—since the Air Force was established as a separate service."

Among those initiatives is the creation of composite wings with a variety of aircraft for different kinds of missions. General McPeak noted that the Air Force is taking steps to integrate strategic and tactical airpower in such wings. This sets the stage for integrating strategic and tactical commands in due course, he explained. "We see a continuing series of such steps leading to the eventual merger of SAC, TAC, and MAC into two successor commands notionally called Air Combat Command and Air Mobility Command."

The Line Disappears

The Chief of Staff declared, "The old arrangement that divides airpower into separate piles of strategic and tactical capabilities never was valid." He quoted "our first chief," Gen. "Tooey" Spaatz, as having said, "There is no line between strategic and tactical air forces. It is an overall effort uniting all kinds of aircraft."

At the AFA Convention, it was Secretary Rice who went into detail about the makeup of the proposed new commands. He described them as follows:

Air Combat Command (ACC) will consist of fighters, bombers, ICBMs, reconnaissance planes, aircraft for command, control, communications, and intelligence (C^3I), some tankers, and some C-130 tactical airlifters. Like MAC, Air Mobility Command (AMC) will enfold the entire intercontinental airlifter fleet now composed of C-5s and C-141s, but AMC's resemblance to MAC ends there. Unlike MAC, AMC will have charge of tankers that support global airlift and will not control tactical-range airlifters and tankers.

"Command of permanently forward-stationed tactical lift—C-130s—will transfer to theater commanders—PACAF [Pacific Air Forces] and USAFE [US Air Forces in Europe]—and some will be included in composite wings in the new Air Combat Command," Secretary Rice explained.

"For example, the twenty C-130s at Yokota [AB, Japan,] stay there but sport a PACAF patch [instead of a MAC patch]. . . . Forward-stationed tankers will be assigned to theater air forces, and some will join composite wings in Air Combat Command."

The Air Force put out a policy paper at the AFA Convention that explained what the reorganization is all about. It noted that Air Mobility Command "will include the bulk of airlift assets as well as a considerable portion of the tanker force." This "integration of lift with tankers" will enable the Air Force to respond more quickly to overseas contingencies and will "enhance our ability to operate with other services and nations." The document also discussed how the Air Force restructuring relates to theater operations. It noted that "many of our commands operate in theaters, not by function" and that "the paramount consideration is the theater commander's requirements, not an arbitrary functional division of labor."

The paper continued, "Overseas commanders will now command the assets they need to make airpower a unified whole within their theaters. The commanders of PACAF and USAFE will command the tankers, theater airlift, and reconnaissance assets that are stationed in their theaters, as well as their traditional combat assets."

It also noted that "this 'theater approach' is precisely the way we organized in World War II. Thus, the Majcom [Major Command] reorganization is another example of a return to basics."

Blurring the Distinction

Secretary Rice told his AFA audience that the decision to create Air Combat Command with dominion over all types of combat aircraft is in accord with "modern airpower theory, [which] blurs the distinction between strategic and tactical warfare and planes. It's how fighters and bombers are used in engagements that determines whether their effects are tactical or strategic."

He cited the Persian Gulf War as a vivid case in point. In that action, "F-117s and F-111s conducted strategic attack while B-52s went after tactical targets like troops and tanks," he recalled. Most of the time, "A-10s did no close air support"—their primary mission—but instead "suppressed enemy air defenses, hunted Scuds, and conducted battlefield interdiction," he said.

"To bring integrated airpower to bear in today's world, it is counterproductive to separate it into three commands [SAC, TAC, and MAC]," Dr. Rice asserted. He contended that, in makeup and missions, the two new commands will reflect the Air Force's "global reach, global power strategic planning framework" which represents "a renaissance in airpower thinking that began at the end of the cold war,

Moscow's "Most Important Test"

If the Soviet threat continues to diminish, the Bush Administration and Congress may be able to cut defense spending next year more sharply than planned.

Rep. Les Aspin (D-Wis.), chairman of the House Armed Services Committee, raised that possibility in a speech at the Air Force Association's forty-fifth National Convention in Washington last September.

Mr. Aspin noted that the Administration and Congress agreed last year on guidelines to cap defense spending at some $291 billion in Fiscal Years 1992 and 1993 while setting ceilings on the federal budget through FY 1995. However, he said, the failure of Soviet hard-liners to regain control of the Kremlin is an indication, among others, that the cap may have been set too high.

Mr. Aspin told his AFA audience, "If the reductions in the Soviet military threat are the right kind and can't be reversed, then we can safely reduce our defense spending. That means a new budget deal." He said it was too late to cut spending in the FY 1992 defense budget that went into effect October 1. The FY 1993 budget, up for consideration in 1992, may be a different story if Moscow makes good on peaceful intentions.

The Armed Services Committee Chairman hailed the Kremlin's approval of independence for the Baltic states and its move to withdraw troops from Cuba as "good signs" in that regard, but he said that Moscow's strategic and military-industrial policies and actions still bear watching.

Conciliatory changes in Soviet strategic policy and a significant drawdown of strategic forces "would signal an enormous loss of political clout by the military," Representative Aspin said. The "most important test" of Moscow's intentions is "what happens to the massive Soviet military-industrial complex," he declared. His committee learned in recent hearings that "this enormous structure of defense industry and ministries was getting more, not less, powerful," that it had supported the coup attempt of the hard-liners, and that it "was able to co-opt a defense conversion program intended to reform it."

"If this apparatus stays intact, it would enable some future hard-liner to attempt a resurrection of the Soviet military state," Mr. Aspin declared. "Conversely, its destruction would prevent that. If the military-industrial complex is dismantled, the decline in the Soviet threat will be irreversible, and we can act accordingly."

triumphed in the Gulf War, and matters more to the future each day."

At a joint press conference during the AFA Convention, Dr. Rice and General McPeak claimed that Air Mobility Command will fit at least as tidily as MAC did into the tri-service US Transportation Command. They affirmed that AMC's commander, like MAC's, will also command USTRANSCOM. Dr. Rice indicated that AMC, like MAC, will be headquartered at Scott AFB, Ill., along with USTRANSCOM.

The Air Force had not selected a headquarters base for either command by the time of the AFA Convention. "We're evaluating what the new commands will mean in terms of current headquarters at Langley, Offutt, and Scott [of TAC, SAC, and MAC, respectively]," Dr. Rice commented. "We don't have all the answers or timetables yet."

The unofficial word was that Langley AFB, Va., looked likely for ACC headquarters and that Offutt AFB, Neb., may well be named the headquarters of a new unified Strategic Command (STRATCOM) that the Defense Department was expected to form.

How long will it take to bring ACC and AMC into being? "Years, plural," replied Secretary Rice.

In his Convention speech, General McPeak said that those new commands will embody the "integrated airpower" that he has in mind for the remodeled Air Force.

Time to Catch Up

The Chief of Staff asserted, "Every actual combat application of airpower since World War II has shown us that airpower must be employed as a coherent whole . . . but we are organized in a command structure that disintegrates our capabilities. Whatever utility there once was in drawing a line and calling some capabilities 'tactical' and others 'strategic' has been overtaken by events. Our organization needs to catch up."

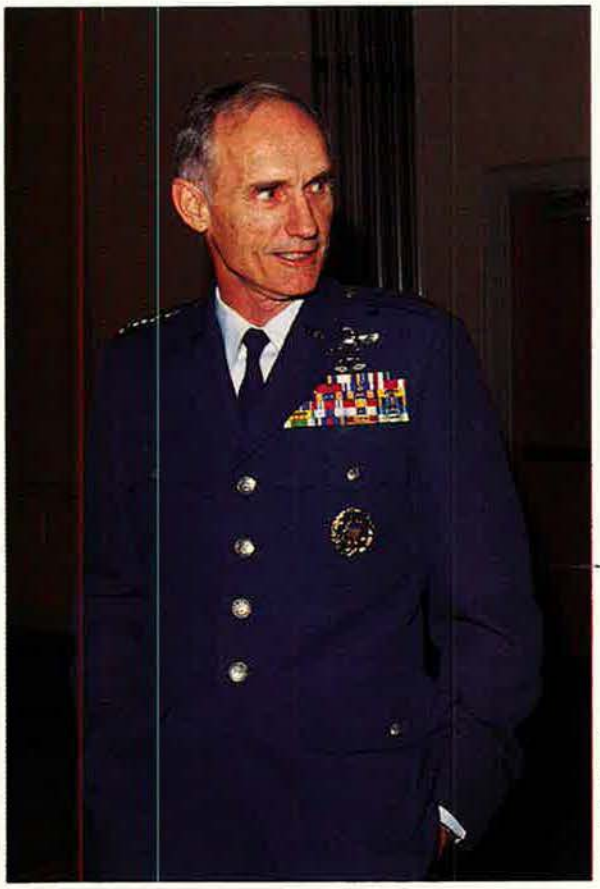
He made it clear that composite wings—"meaning simply that they operate more than one kind of airplane"—are central to the catching-up process. "We will end up with many such wings," he said.

The Chief of Staff noted that the new 4th (composite) Wing at Seymour Johnson AFB, N. C., melds the base's F-15E fighter wing and KC-10 refueling wing. The tankers "formerly belonged to SAC and are now part of TAC," he said. Another composite wing has been formed at Andrews AFB, Md., from the airlift wing and the base-operations wing previously in place, he said.

"Most of the composite wings that will be formed in the years ahead will be of exactly this type," General McPeak continued. "We will take existing composite operations that are already on the flight line—operations which we've already manned and for which we've already built facilities and bought spare parts—and consolidate them at the base level."

The Air Force should be able to save money in such circumstances, he claimed. He acknowledged that the service will incur "some additional costs" in building composite wings out of whole cloth, but he insisted that such costs "must be kept in perspective."

"We are building two new composite wings from the ground up," General McPeak said. "One will be at Mountain Home [AFB, Idaho], where F-15s, F-15Es, F-16s, tankers, and the AWACS will form a unit designed for quick air intervention anywhere in the world. At Pope AFB, [N. C.,] we will assemble a composite wing of A-10s, OA-10s, F-16s, and C-130s to build an air-land team with the 82d Airborne Division."



—Photo by Paul Kennedy

Air Force Chief of Staff Gen. Merrill A. McPeak: "We are organized in a command structure that disintegrates our capabilities. Whatever utility there once was in drawing a line and calling some capabilities 'tactical' and others 'strategic' has been overtaken by events."

He depicted the Mountain Home wing as "a global power wing, a wing that can launch from CONUS, go a long distance, do some damage, and come all the way back to CONUS if necessary." He said that "it will cost us something" to form that wing, but he claimed the costs will be offset by countervailing circumstances.

The Chief of Staff explained that the Air Force will centralize all F-111 wings, including the one now at Mountain Home and others overseas, at a base in New Mexico. "Therefore," he went on, "the mission at Mountain Home goes away, and we could close the base. If we did, it would cost us $50 million."

Keeping Mountain Home open and assembling a composite wing there should cost "a lot less than that," he claimed.

In most cases, forming composite wings will result in "net savings, not a net increase of costs," General McPeak said at the joint press conference. "Even for composite wings, we're not going to increase our flying-hours program. We're going to move some assets around, but there will be no increase in the number of aircraft the Air Force will operate to create a new composite wing."

De Facto Composite Wings

The Chief of Staff reminded his audience that the Air Force is no neophyte at building and operating composite wings. "The composite wing is by no means a new idea," he said. "For years, many SAC wings have been composite, operating both tankers and bombers. Others, such as the 52d Wing at Spangdahlem [AB, Germany], have been *de facto* composites for a long time."

He also emphasized that the Air Force will not run wild with composite wings, declaring, "Not all of our wings will become composite. Many will still be organized around a single mission and type of equipment, ready to go wherever necessary and be integrated with others at the point of use."

General McPeak stressed that a major goal of the Air Force restructuring is a "return to simplicity" of management and operations. He called his and Dr. Rice's proposals a "back to basics" plan to do such things as eliminate air divisions, rearrange and consolidate major commands, make support personnel and functions more directly accountable to operational commanders, and cut and recast the lineup of general officers.

The Air Force will scrap fifty-nine general officer slots. It will transfer many generals from staff jobs to operational jobs. Brigadier generals, rather than colonels, will command fifty-three air wings and their bases as well. A guiding principle in the reorganization of operational units is "one base, one wing, one boss," General McPeak said.

He said he will find enough generals to command wings by "liberating them" from the staffs of Air Force organizations destined for elimination, consolidation, or contraction. The reorganization will have many such outcomes. Air divisions will disappear. Numbered air forces will become operational echelons and will lose superfluous staff personnel. USAF will cut its thirteen major commands to ten and sharply shrink its Washington headquarters staff.

A major goal of all such reshaping and simplifying is to "increase accountability" throughout the operational command structure and to "strengthen the chain of command," General McPeak explained. "Our job is to make as few links in that chain as possible and to make sure each one is strong."

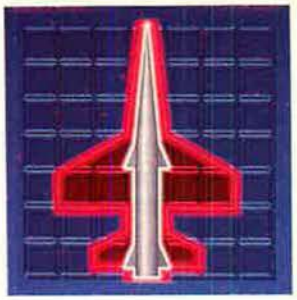
The Chief of Staff maintained that the Air Force must change, notwithstanding its demonstrably high quality and superb performance in the Persian Gulf War, in which "airpower came of age as a decisive element in combined arms operations." Dwindling resources and assets and the demands of a rapidly changing world "make change unavoidable," he said.

"The Air Force as a whole will get at least twenty-five percent smaller by 1995," the Chief of Staff predicted, "and cuts of this magnitude on top of those already taken rule out a business-as-usual approach. If nothing else makes us change, the resources slide will.

"Secretary Rice and I have absolutely no intention of presiding over the decline of the Air Force. Therefore, we will instead press for a top-to-bottom restructure as the best way to sustain our combat capability as we get smaller." ■

—Photo by Paul Kennedy

Air Force Secretary Donald B. Rice: "It is counterproductive to separate [integrated airpower] into three commands. The global reach, global power strategic planning framework [represents] a renaissance in airpower thinking that began at the end of the cold war, triumphed in the Gulf War, and matters more to the future each day."



Celebration and Challenge

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

ALMOST 1,000 US Air Force members were guests of honor at a special "victory celebration" at AFA's forty-fifth National Convention, held September 16–18 in Washington, D. C. That program and others highlighted the Convention theme, "Year of Victory—Year of Challenge," and the Association's salute to the armed forces for their performance in the Persian Gulf War.

Major evening events included a dinner honoring the twelve Outstanding Airmen of the Year and another dinner, at which the men and women of Operations Desert Shield and Desert Storm were honored. The Air Force Band and the Air Force Academy Cadet Chorale provided music for the dinners.

The fast-moving week saw major announcements about the future look of the Air Force *[see p. 82]*; appearances by senior defense leaders; release of a major Air Force Association report on the defense industrial base, published by the Aerospace Education Foundation; presentation of awards; and dozens of informative programs and presentations.

At this Convention, the Association also amended its constitution to eliminate restrictions on voting and holding of office in AFA by active-duty military members.

Election of Officers

O. R. Crawford of Austin, Tex., was reelected President of the Air Force Association. Jack C. Price of Clearfield, Utah, was reelected Chairman of the Board. Mary Ann Seibel of Saint Louis, Mo., was elected National Secretary, and William N. Webb of Midwest City, Okla., was reelected National Treasurer.

Gerald V. Hasler of Albany, N. Y., was reelected President of the Aerospace Education Foundation. James M. Keck of San Antonio, Tex., was reelected AEF Chairman of the Board. Thomas J. McKee of Fairfax Station, Va., was elected Vice President, John R. Alison of Washington, D. C., was reelected Treasurer, and Walter E. Scott of Dixon, Calif., was reelected Secretary.

For a complete list of AEF officers and trustees (as of September 15, 1991), see p. 96.

Elections and Activities

More than 7,000 attendees took part in one or more of the Convention-related activities at the Sheraton Washington Hotel. The 367 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, featured speeches, and social events. On hand to cover the Convention were more than 200 reporters and other news media representatives.

Meeting concurrently with the Convention were trustees of the Aerospace Education Foundation and USAF's command Senior Enlisted Advisors, as well as AFA's Air National Guard Council, Civilian Personnel Council, Enlisted Council, Junior Officer Advisory Council, Reserve Council, and Veterans/Retirees Council.

• *Resolutions and changes.* The Convention voted two additional significant changes to the Air Force Association's constitution and bylaws.

Beginning in January 1993, AFA's annual membership dues will increase from $21 to $25. Beginning in January next year, three-year membership dues will increase from $48 to $60 and life membership dues will increase from $300 to $400.

Kentucky state AFA was realigned with the Great Lakes Region. It had previously been aligned with the Central East Region.

• *Congressional activity.* Thirty-one state delegations sponsored congressional breakfasts on Tuesday and Wednesday of Convention week. More than sixty members of Congress participated. Among them were Sens. Sam Nunn (D-Ga.) and Timothy Wirth (D-Colo.) of the Senate Armed Services Committee and Sens. Jake Garn (R-Utah), Phil Gramm (R-Tex.), and Bob Kerrey (D-Neb.) of the Senate Appropriations Committee. Attending from the House Armed Services Committee were Reps. Herb Bateman (R-Va.), Charles Bennett (D-Fla.), Glen Browder (D-Ala.), Beverly Byron (D-Md.), Buddy Darden (D-Ga.), Chet Edwards (D-Tex.), James Hansen (R-Utah), Joel Hefley (R-Colo.), Earl Hutto (D-Fla.), Andy Ireland (R-Fla.), Jim McCrery (R-La.), Richard Ray (D-Ga.), Pat Schroeder (D-Colo.), and Curt Weldon (R-Pa.). Attending from the House Appropriations Committee were Reps. Chester Atkins (D-Mass.), Tom Bevill (D-Ala.), Jim Kolbe (R-Ariz.), Jerry Lewis (R-Calif.), John Murtha (D-Pa.), and Frank Wolf (R-Va.).

At the Virginia congressional breakfast, Air Force Chief of Staff Gen. Merrill A. McPeak presented Representative Bateman with a montage of photographs of the Desert Storm homecoming at Langley AFB, Va.

• *Other elections.* Four new National Vice Presidents were elected. They are Stanley V. Hood of the Southeast Region, Doyle E. Larson of the North Central Region, James M. McCoy of the Midwest Region, and Nuel E. Sanders of the Rocky Mountain Region.

Donald D. Adams of Omaha, Neb., Richard H. Becker of Oak Brook, Ill., John E. Kittelson of Sioux Falls, S. D., Bryan L. Murphy, Jr., of Fort Worth, Tex., Ellis T. Nottingham of McLean, Va., and Walter E. Scott of Dixon, Calif., were elected to the Board of Directors for three-year terms. Craig R. McKinley of Ponte Vedra Beach, Fla., was elected for a two-year term.

Three new Under-Forty Directors joining the AFA Board are Jesse D. Kinghorn, Jr., of Jacksonville, Fla., Stephen M. Mallon of Hampton, Va., and L. Elisabeth Root of Dallas, Tex.

For a complete list of National Vice Presidents and Directors, including those reelected, see "This Is AFA" on p. 99.

• *Membership report.* At a delegates' reception on Monday of Convention week, President Crawford announced that the number of life members and patrons increased by more than five percent.

• *Aerospace Education Foundation.* A video on "Our Best Community Service Project" won the Foundation's annual contest for presentations by Air Force Junior ROTC cadets. The winning entry was from John Jay High School, San Antonio, Tex. For next year's contest, cadets will submit a video on the same topic.

—Photo by Paul Kennedy

Capt. Richard Smith III, an F-16 pilot and veteran of Operation Desert Storm, accepts a plaque signifying his Life Membership in AFA from National President O. R. Crawford. At the opening ceremonies, Captain Smith narrated a video tribute to the men and women of Desert Storm.

Melba Iris Harris from Fort Payne, Ala., won the Christa McAuliffe Memorial Award for the year's outstanding math and science teacher. Jule Zumwalt of Sacramento, Calif., received the first Sam E. Keith, Jr., Aerospace Education Award of Excellence. The award is named in honor of the late AFA leader and former National President and Board Chairman from Fort Worth, Tex.

● *Acknowledgments.* Parliamentarian for the AFA National Convention was Martin H. Harris. William C. Rapp was Sergeant at Arms. Inspectors of Elections were Earl D. Clark, Jr. (Chairman), Craig R. McKinley, and Bruce Robin Stoddard. James M. McCoy chaired the Credentials Committee, serving with Cheryl Lynn Gary and James E. "Red" Smith.

The Association is particularly grateful to a corps of volunteers who assisted the staff in Convention support: Norm Aubuchon, 2d Lt. Scott Boyd, Terry Brady, Cecil Brendle, Evie Dunn, Cadet Ed Gray, Cadet George Loder, Cadet Kathleen Long, Charles and Mary Lucas, Cadet Jenifer Petrina, Cadet Richard Sugarman, Debbie and Gregg Snyder, Dana Steinhauser, Cadet Mike Vassilev, 2d Lt. C. G. Wander, and John Zipp.

The 1992 Convention will be held at the Sheraton Washington Hotel, Washington, D. C., on September 14–16. ■

—Photo by Paul Kennedy

Deputy Surgeon General of the Air Force Maj. Gen. James G. Sanders looks on as AFA National President O. R. Crawford presents the 1991 Paul W. Myers Award to Lt. Col. Ronald E. Persing from Keesler AFB, Miss. Colonel Persing was honored for his work as a clinician, educator, and innovator; for improving patients' access to care; and for increasing medical productivity.

Professional, Civilian, and Educational Awards

Award	Recipient
Stuart R. Reichart Award for Lawyers	Col. Dennis E. Kansala, Shaw AFB, S. C.
Paul W. Myers Award for Physicians	Lt. Col. Ronald E. Persing, Keesler AFB, Miss.
Personnel Manager of the Year Award	Col. Joseph A. Crozier Jr., Shaw AFB, S. C.
Crew Chief of the Year Award	SSgt. James J. Philhower, Rhein-Main AB, Germany
Civilian Wage Employee of the Year	Richard A. Myers, RAF Alconbury, United Kingdom
Civilian Program Specialist of the Year	Jane B. Ducane, United States Air Forces in Europe
Civilian Program Manager of the Year	Daniel Flynn, Eglin AFB, Fla.
Civilian Senior Manager of the Year	Dr. Jim Spain, Tyndall AFB, Fla.
Joan Orr Air Force Wife of the Year Award	Leigh P. Culver, Lackland AFB, Tex.
Outstanding AFROTC Cadet of the Year	Kimberly A. Moore, MIT, Cambridge, Mass.
CAP Aerospace Education Cadet of the Year	Christopher W. Leigeber, Middletown, Ohio
Diane O'Malley Angel of the Year Award	Karen Carter, University of Texas, San Antonio, Tex.
Juanita Redmond Award for Nursing	Capt. Judith M. Daly, 8th Aeromedical Evacuation Squadron, MAC

1991 Community Partner Membership Awards

These awards are presented to chapters with a significant outreach into the community and are based on March 31, 1991, chapter membership totals.

President's Award
This award recognizes 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 qualify.

Lloyd R. Leavitt, Jr., Mich.

Gold Awards
These awards recognize chapters that have 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.

Altus, Okla.
Anchorage, Alaska
Ark-La-Tex, La.
Barry Goldwater, Ariz.
Cape Fear, N. C.
Carl Vinson Memorial, Ga.
Cheyenne Cowboy, Wyo.
Cochise, Ariz.
Enid, Okla.
Fairbanks Midnight Sun, Alaska
General David C. Jones, N. D.
General Ira C. Eaker, Ark.
General Nathan F. Twining, Fla.
Green Valley, Ariz.
Guam–Arc Light, Guam
H. H. Arnold Memorial, Tenn.
Huron, Mich.
Joe Walker–Mon Valley, Pa.
Langley, Va.
Llano Estacado, N. M.
Lubbock, Tex.
Mobile, Ala.
Ogden, Utah
Paul Revere, Mass.
Pope, N. C.
Roanoke, Va.
Robert H. Goddard, Calif.
Scott Berkeley, N. C.
Tennesee Valley, Ala.
Tidewater, Va.
Total Force, Pa.
Tucson, Ariz.
Wright Memorial, Ohio

Achievement Awards
These awards recognize chapters that have a total number of Community Partners equal to or greater than one percent of their overall chapter membership. Chapters must have a minimum of five Community Partners to qualify.

Cape Canaveral, Fla.
Central Florida, Fla.
Charleston, S. C.
Dacotah, S. D.
Dale O. Smith, Nev.
Del Rio, Tex.
Delaware Galaxy, Del.
Eagle, Pa.
Florida Highlands, Fla.
Golden Triangle, Miss.
High Point, N. J.
John C. Stennis, Miss.
Major John S. Southrey, Mass.
Morgan S. Tyler, Fla.
Salt Lake City, Utah
Southwest Florida, Fla.
Tacoma, Wash.
Thomas B. McGuire, Jr., N. J.
Wichita Falls, Tex.

—Photo by Paul Kennedy

National Board Chairman Jack C. Price watches President Crawford give Man of the Year George M. Douglas his award. Mr. Douglas has chaired and served on every national AFA committee, including a stint as National President (1975–77). In 1991, he served on AFA's Industrial Task Force, determining the best way for AFA to serve its industrial partners, and is now helping the Association gear up for USAF's Golden Anniversary in 1997.

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 Award, made possible through a generous endowment to the Association by his son, Art Storz, Jr., has been awarded for membership excellence based on criteria approved by AFA's Board of Directors for the year ending March 31, 1991.

State Award
Presented to the AFA state organization that produces the highest number of new members during the twelve-month period ending March 31, 1991, as a percentage of total state membership as of March 31, 1990.

Massachusetts State AFA
David R. Cummock, President

Chapter Award
Presented to the AFA chapter that produces the greatest number of new members during the twelve-month period ending March 31, 1991 as a percentage of total chapter membership as of March 31, 1990.

Green Valley Chapter, Ariz.
Richard S. Reid, Sr., President

Individual Award
Presented to the AFA member who has done the most to promote AFA membership during 1990–91.

Richard S. Reid, Sr.

1991 Unit Activity Awards

Donald W. Steele, Sr., Memorial Award: AFA Unit of the Year
Paul Revere Chapter, Mass.

Outstanding State Organization
Florida State Organization

Outstanding Chapters
Central Florida, Fla. (more than 900 members)
Llano Estacado, N. M. (401–900 members)
Frank P. Lahm, Ohio (151–400 members)
Contrails, Kan. (20–150 members)

Exceptional Service Awards
General E. W. Rawlings Chapter, Minn. (Aerospace Education)
Florida Highlands Chapter, Fla. (Best Single Program)
Morgan S. Tyler Chapter, Fla. (Communications)
Green Valley Chapter, Ariz. (Community Relations)
Langley Chapter, Va. (Overall Programming)
Connecticut State Organization (Veteran's Affairs)

Management, Energy Conservation, and C⁴ Excellence Awards

Award	Recipient(s)
Logistics Management	
AFLC Executive Management Award	Col. Carl D. Portz, Kelly AFB, Tex.
AFLC Middle Management Award	Billie R. Campbell, Wright-Patterson AFB, Ohio
AFLC Junior Management Award	Robert T. Elliot, Hill AFB, Utah
Systems Management	
Distinguished Award for Management	Brig. Gen. (Maj. Gen. selectee) James A. Fain, Jr., Wright-Patterson AFB, Ohio
Meritorious Award for Program Management	Lt. Col. William L. Gotcher, Jr., Wright-Patterson AFB, Ohio
Meritorious Award for Support Management	Col. Robert C. Helt, Wright-Patterson AFB, Ohio
Energy Conservation	
Gen. Edwin W. Rawlings Award for Energy Conservation (Manager)	Craig D. Priest, Hill AFB, Utah
Gen. Edwin W. Rawlings Award for Energy Conservation (Technician)	SMSgt. Michael N. Fick, Ellsworth AFB, S. D.
C⁴ Excellence	
Gen. Billy Mitchell Award for C⁴ Excellence	Capt. Robert G. Dawson, Peterson AFB, Colo.

National Aerospace Awards

Award	Recipient(s)	Achievement	Accepted by
H. H. Arnold Award (AFA's highest honor in National Security to members of the armed forces)	Lt. Gen. Charles A. Horner, Commander, Central Command Air Forces, and Commander, 9th Air Force, Shaw AFB, S. C.	Extraordinary Leadership as Joint Force Air Component Commander in Operations Desert Shield and Desert Storm	
W. Stuart Symington Award (AFA's highest honor in National Security to a civilian)	Hon. George Bush, President of the United States	Courage, wisdom, and steadfastness of purpose in the Persian Gulf conflict	
David C. Schilling Award (for the outstanding contribution in Flight)	Air Force Men and Women of Operations Desert Shield and Desert Storm	Efficiency and precision in executing all aspects of the operations and effective integration with the other services	Gen. Merrill A. McPeak
Theodore von Kármán Award (for the outstanding contribution in Science and Engineering)	Joint STARS USAF/Industry Team	Exceptional development, integration, and operation of the new Joint STARS system	Col. Harry H. Heimple, USAF Martin E. Dandridge, Grumman Corp. Kenneth H. Meinelt, Norden Systems Inc. Erling E. Rasmussen, Motorola, Inc.
Gill Robb Wilson Award (for the outstanding contribution in Arts and Letters)	Col. Michael R. Gallagher, United States Air Forces in Europe	Professionalism as the public affairs officer directly responsible for US Central Command interaction with the worldwide media covering Desert Shield and Desert Storm	
Hoyt S. Vandenberg Award (for the outstanding contribution in Aerospace Education)	MSgt. William H. Moon, Presidio of Monterey, Calif.	Performance as an Arabic training specialist at the Defense Language Institute, which provided urgently needed military Arabic linguists in support of Deser: Storm	
Thomas P. Gerrity Award (for the outstanding contribution in Logistics)	Lt. Col. Bradley R. Busch, Shaw AFB, S. C.	Professionalism as Director of Contracting, US Central Command Air Forces	
Department of Veterans Affairs Employee of the Year Award	Joanne Messore, VA Medical Center, West Haven, Conn.	Consummate nursing efforts as Director of Home Care Services at the West Haven, Conn., VA Medical Center	

—Photo by Paul Kennedy

President Crawford congratulates Maj. Jack C. Gardner for winning one of only nine AFA Citations of Honor for 1991. Major Gardner, who works at the Defense Intelligence Agency, provided the coalition air forces of Desert Storm with combat target materials that some have termed "the best ever."

Citations of Honor

Recipient(s)	Achievement	Accepted by
Advanced Tactical Fighter Combined Test Force, Edwards AFB, Calif.	Development and execution of flight-test plans for the F-22 and F-23 ATFs, paving the way for successful development of an air-superiority fighter for the twenty-first century	Lt. Col. William Jay Jabour, Commander
Air Force Logistics Command, Wright-Patterson AFB, Ohio	Being the sole government entity to earn the President's Award for Quality in 1991, bestowed for AFLC's initiatives that supported Desert Storm flying units beyond all expectations	Gen. Charles C. McDonald, Commander
Maj. Jack C. Gardner, Jr., Defense Intelligence Agency, Washington, D. C.	Support of coalition forces in Desert Storm with timely combat target materials	
Milton G. Schellhase, Sacramento ALC, McClelland AFB, Calif.	Management of F-117 logistics, which enabled the F-117 to surpass all logistics and operational readiness goals during Desert Storm	
USAF Environmental Technical Applications Center, Scott AFB, Ill.	Climatological support during Desert Shield and Desert Storm and its record of environmental studies that help ensure the readiness of US forces worldwide	Lt. Col. Kenneth E. Eis, Commander
Col. Jay B. Welsh, Tactical Air Command, Langley AFB, Va.	Conceptualization and production of a videotape of the accomplishments of the USAF men and women of Desert Shield and Desert Storm	
56th Security Police Squadron, MacDill AFB, Fla.	Direct support of one major command and two unified commands, deploying in both Just Cause and Desert Storm, which garnered praise from Gen. H. Norman Schwarzkopf for providing "the best security" in southwest Asia	Lt. Col. David H. Donatelli, Commander
800th Civil Engineering Squadron, Whiteman AFB, Mo.	Supporting Minuteman II operations, building a solid foundation for a complex B-2 beddown, and deploying in Desert Shield and Desert Storm	Col. John A. Gillis, Commander
4440th Tactical Fighter Training Group, Red Flag, Nellis AFB, Nev.	Providing the most realistic combat training in the world to US and allied aircrews	Maj. Gen. Billy G. McCoy, Commander, USAF, TFWC

Air National Guard and Air Force Reserve Awards

Award	Recipient(s)	Achievement	Accepted by
Earl T. Ricks Award	1st Lt. Leonard W. Isabelle, Michigan Air National Guard	Outstanding airmanship in the Air National Guard	
Air National Guard Outstanding Unit Award	105th Military Airlift Group, Stewart ANGB, Newburgh, N. Y.	Outstanding ANG unit of the year	Col. Paul A. Weaver, Jr., Commander
Air Force Reserve Outstanding Unit Award	439th Military Airlift Wing, Westover AFB, Mass.	Outstanding Air Force Reserve Wing of the year	Brig. Gen. Frederick D. Walker, Commander
President's Award for the AFRES	A crew of the 512th Military Airlift Wing, Dover AFB, Del.	Top crew in the Air Force Reserve	Maj. John R. Haszard, Aircrew Commander

Special Citations and Other Awards

Award	Recipient(s)	Achievement	Accepted by
Gen. Curtis LeMay Award	Crew S-01, 7th BMW, Carswell AFB, Tex.	Best strategic aircrew	Maj. Stephen D. Schmidt, Commander
Gen. Thomas S. Power Award	Crew S-220, 91st SMW, Minot AFB, N. D.	Best strategic combat missile crew	Capt. Michael Fortney, Commander
Lt. Gen. William H. Tunner Award	Crew of the 63d MAW, Norton AFB, Calif.	Best Military Airlift Command aircrew	Capt. Ray R. Phillips, Commander
Lt. Gen. Claire Chennault Award	Maj. Jerry Leatherman, Command and General Staff College, Fort Leavenworth, Kan.	Outstanding aerial warfare tactician	
Gen. Jerome F. O'Malley Award	Capt. James C. Horton and Capt. Brian J. McNulty, 26th TRW, Zweibrücken AB, Germany	Best reconnaissance crew	
Best Space Operations Crew Award	Titan IV Launch Crew, Vandenberg AFB, Calif.	Best space operations crew	Capt. Brad Moore, Commander
CMSgt. Dick Red Award	CMSgt. Melvin E. Masters, Alaska ANG, Anchorage, Alaska	Outstanding aerospace maintenance by an enlisted member of ANG	
Verne Orr Award	401st Transportation Squadron, Torrejon AB, Spain	Most effective utilization of human resources within USAF	Maj. Nonie C. Cabana, Commander

—Photo by Robert L. Knudsen

The Gray Eagle now bears the name of Maj. Gen. Fred R. Nelson, commander of the Lowry Technical Training Center, Lowry AFB, Colo. The award goes to the most senior pilot on active duty. General Nelson earned his wings in 1957 and flew 100 combat missions over North Vietnam in F-105G Thunderchiefs.

1991 AFA Membership Awards

The following chapters have qualified for a membership award by showing a net chapter growth based on a comparison of chapter size at the beginning of the membership year, April 1, 1990, and chapter size at the end of the membership year, March 31, 1991. Chapters are listed in order of highest to lowest net growth.

Diamond Awards: 20% or greater net growth
Green Valley, Ariz.
Paul Revere, Mass.
General Charles A. Gabriel, Va.
Maui, Hawaii
Misawa, Japan
Eastern Carolina, N. C.
On Wings of Eagles, Fla.
Ocala, Fla.
Barry Goldwater, Ariz.
Cape Fear, N. C.
Foothills, N. C.
General E. W. Rawlings, Minn.
Danville, Va.
Gadsden, Ala.
Cochise, Ariz.
Bakersfield, Calif.
Rocky Mountain, Utah
Montgomery, Ala.
Maj. Gen. Robert M. White, Europe

Gold Awards: At least 10% net growth but less than 20%
Central Connecticut, Conn.
Jack Manch, Va.
Blue Hen, Del.
Enid, Okla.
Greater Rockford, Ill.
Llano Estacado, N. M.
Altus, Okla.
Ventura County, Calif.
Mid-Michigan, Mich.
Topeka, Kan.
Lawrence D. Bell Museum, Ind.
Lynchburg, Va.
Contrails, Kan.
Atlanta, Ga.
Alexandria, La.
Birmingham, Ala.
Tri-County, N. J.
Minuteman, Mass.
Flying Yankees, Conn.
Genesee Valley, N. Y.
Dacotah, S. D.
Lufbery-Campbell, Europe
Triad, N. C.
Pioneer Valley, Mass.
Richard I. Bong Minn.

Silver Awards: At least 5% net growth but less than 10%
Sal Capriglione, N. J.
Antelope Valley, Calif.
Metro Rhode Island, R. I.
Longs Peak, Colo.
Colin P. Kelly, N. Y.
Lloyd R. Leavitt, Jr., Mich.
Lawrence D. Bell, N. Y.
Thomas Watson, Sr., Memorial, N. Y.
Heart of the Hills, Tex.
First Connecticut, Conn.
Central Indiana, Ind.
Concho, Tex.
Eagle, Pa.
Madison, Wis.
Greater New Orleans, La.
Baltimore, Md.
Beaver Valley, Pa.
West Palm Beach, Fla.
Tennessee Valley, Ala.
Pocono Northeast, Pa.
PE-TO-SE-GA, Mich.
Central Maryland, Md.
Lt. Col. B. D. "Buzz" Wagner, Pa.
Richmond, Va.
Miami, Fla.
Hangar One, N. J.
General Nathan F. Twining, Fla.
Houston, Tex.
Badger State, Wis.
Flatirons, Colo.
Henlopen Area, Del.
Kalamazoo, Mich.
Dale O. Smith, Nev.
Ozark, Mo.
Aggieland, Tex.
Peace River, Fla.
Swamp Fox, S. C.
Gus Grissom, Ind.
General Robert E. Huyser, Colo.
Forrest L. Vosler, N. Y.
Worcester, Mass.
Coosa Valley, Ga.

Achievement Awards: At least 2% net growth but less than 5%
Albany, N. Y.
Freedom, Pa.
Gateway to Freedom, Europe
Central Missouri, Mo.
Lexington, Ky.
Everett R. Cook, Tenn.
Frank P. Lahm, Ohio
Steel Valley, Pa.
Tidewater, Va.
Mifflin County, Pa.
Carl Vinson Memorial, Ga.
Mercer County, N. J.
High Point, N. J.
Joe Walker–Mon Valley, Pa.
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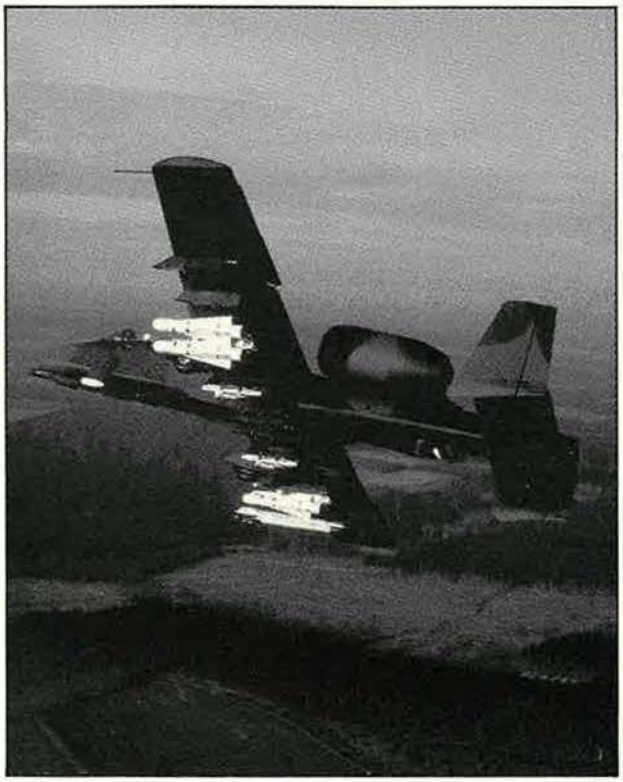

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AIR NATIONAL GUARD

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Janie Witt
Lt. Col. John H. Woolnough, USAF (Ret.)
Glennis Yeager

—Photo by Paul Kennedy

CMSAF Gary R. Pfingston stands with the twelve Outstanding Airmen of the Year. The twelve, who serve in fields as diverse as missile maintenance and medical administration, represent the best among the Air Force's enlisted ranks.

1991 Individual Activity Awards

Man of the Year
George M. Douglas

Special Awards
John R. Alison
Jack B. Gross
William W. Spruance
Air Force Band, Fiftieth Anniversary
Civil Air Patrol, Fiftieth Anniversary
Military Airlift Command, Fiftieth Anniversary

Presidential Citations
Robert L. Carr
John E. Kittelson
Doyle E. Larson
Alwyn T. Lloyd
Jack G. Powell
John P. Russell
Jack H. Steed
William L. Stone
Spann Watson
William G. Zavatson

Special Citations
Fred Eubanks
Nancy Gaisford
Capt. Richard D. Howell
Tony Kausal
William A. Lafferty
Maj. Gen. Raymond A. Matera, USAF (Ret.)
John T. McCarthy
Robert A. Munn
Dr. Glenn Overley
Maj. Gen. William J. Porter, USAF
Pat L. Schittulli
James J. Wagner
Donald O. Weckhorst
Emery S. "Scotty" Wetzel
Roy P. Whitton
Sherman W. Wilkins
Air Force Orientation Group, Ohio

Exceptional Service Awards
Jonny V. Antoline
Clower F. "Chick" Ashley
Christopher G. Bailey
Michael E. Bates
Clarence E. Becker
R. W. Beezley
Carrol D. Buford
Dr. Dan Callahan
Norfleet Callicott
William O. Christensen
Thomas Churan
Norman S. Collard
Robert C. Craig
William D. Croom, Jr.
James E. Cvik
Benjamin J. DeVane
Howard J. Eichner
Albert G. Elam
Georgia Franklin
Edmund J. Gagliardi
George D. Golden
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Robert C. Sorensen
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Albert E. Steensland
O. V. Stephenson
Charles X. Suraci
Arthur F. Trost
Marie M. Vanover
L. B. Webber
John R. White
Larry M. Williams
Kenneth O. Wofford
Jule Zumwalt

Jack B. Flaig Communications Award
William Solemene

The Medal of Merit
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Eugene A. Alfaro
Marge Allshouse
Richard W. Asbury
Capt. Kevin Ashley, USAF
1st Lt. John Ault, USAF
Harry H. Bailey
Arthur Beach
Richard E. Beach
Dennis M. Biggs
John J. Bily
Bernie Boeger
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—Photo by Paul Kennedy

AFA Executive Director Monroe W. Hatch, Jr., chats with TAC Commander Gen. John M. "Mike" Loh during the Convention. Mr. Hatch also serves as Executive Director of the Aerospace Education Foundation, which gave out twenty-four Barry Goldwater, Jimmy Doolittle, and Ira C. Eaker Fellowships at the Convention, representing $32,000 in contributions to AEF.

Aerospace Education Foundation Fellowships

Presented at September 16, 1991, luncheon; listed alphabetically

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Valor

By John L. Frisbee, Contributing Editor

Making the First Team

How a once-disdained aircraft and a valiant crew earned an honored place among aviation's elite.

FAIRCHILD'S C-119 Flying Boxcar was an aircraft not universally admired from the day of its debut as a Tactical Air Command troop carrier in 1947. This bulbous, twin-tailed apparition had a face and figure that only its designers could love and a temperament that didn't endear it to the maintenance fraternity.

During the Korean War, the C-119 was rejected as an air-evacuation plane because of the high noise level and hurricane-force drafts in its cargo compartment, and its payload was downgraded due to weak landing gear. Once it was barred from carrying passengers, the C-119 became principally a trash-hauler and qualifier of paratroopers for their jump pay, but it was there when needed.

Most of the C-119s found a home with Reserve troop carrier wings in those days when Guard and Reserve forces lived largely on hand-me-downs and castoffs. There they remained until given a new life by one of the most innovative and successful weapon developments of the Vietnam era. That development was the gunship, an Air Force concept pushed through by a group of imaginative blue-suiters.

The first Air Force gunship was the AC-47 "Spooky," used mostly for in-country area defense. It was followed by the AC-130 Spectre, a heavily-armed battle wagon that could do out-country interdiction. In early 1968, the Air Force saw the need to replace the AC-47 with a larger, more capable aircraft. There wasn't time to develop one from scratch, so DoD turned to the Reserve's C-119s. Two versions were equipped to find, fix, and fire on enemy targets at night: the AC-119G Shadow and the more sophisticated AC-119K Stinger, which was given two General Electric J85 jet engines hung outboard of its R-3350 radial engines. The first Gs went to Vietnam in December 1968, the first Ks in October 1969. This ugly duckling that had gone unhonored and unloved for twenty years rapidly gained a devoted following, especially among the grunts, many of whose names would be carved on The Wall today were it not for the Shadow and Stinger.

One of the most extraordinary Stinger missions took place on the night of May 8, 1970. Capt. Alan D. Milacek and his crew were on an armed reconnaissance mission near Ban Ban, Laos, where they destroyed two trucks with their four miniguns and two 20-mm cannon. The sensor operators, Capts. James Russell and Ronald Jones, picked up three more trucks, and Captain Milacek entered attack orbit at 3,500 feet above ground level when six enemy anti-aircraft positions opened fire. Copilot Capt. Brent O'Brien cleared their escort F-4s to silence the guns while Milacek nailed another truck.

Then a barrage of ground fire tore up the Stinger's right wing. The plane fell off in a steep dive to the right, losing 1,000 feet in a few seconds. It looked as though they were going in. Captain Milacek ordered the crew to prepare for bailout, but before anyone took to his parachute, Milacek and O'Brien muscled the plane out of its dive. Using full left rudder and aileron and maximum power on the two right engines, they were able to level the aircraft and turn toward friendly territory. Navigator Capt. Roger Clancy gave the pilots a heading for home base at Udorn RTAFB, Thailand, some 160 miles away. He reminded Captain Milacek that they were too low to clear the 7,000- to 9,000-foot peaks ahead.

The crew threw out everything that wasn't bolted down, and gradually the Stinger, with Milacek and O'Brien straining at the controls, climbed to 10,000 feet, staggering and skidding its way toward home. With Udorn in sight, Captain Milacek decided to land the damaged aircraft rather than have the crew bail out. Not knowing the extent of the damage, he would try a no-flap landing at 150 knots, more than thirty knots above normal approach speed. Still holding left rudder and aileron, he and Captain O'Brien managed to land. Safely on the ground, the crew found to their amazement that fifteen feet of the right wing, including the aileron, had been shot off.

When Air Force Chief of Staff Gen. Jack Ryan presented Captain Milacek and his crew the Mackay Trophy for "the most meritorious flight of 1970," he faced ten men who had come to love the old C-119 in its gunship transmutation. On the roster of Mackay Trophy winners, they joined such superstars as "Hap" Arnold, Eddie Rickenbacker, and Chuck Yeager. The AC-119, descendant of the disdained Flying Boxcar, would stand forever alongside the X-1, SR-71, and B-1. A crew and an airplane had made the first team. ■

Books

By Frank Oliveri, Associate Editor

Caged Dragons: An American POW in WW II Japan, by Robert E. Haney. This book is a firsthand account of the trials and horrors of forty-one months of captivity or "slavery" in World War II Japan. The author relates the shame he felt in being taken prisoner on Corregidor and the subsequent "degradation" that followed as a prisoner of war and touches on the brutality of imprisonment at the hands of Japan's military. Sabre Press, Ann Arbor, Mich., 1991. 267 pages with photos. $19.95.

The Certain Trumpet: Maxwell Taylor and the American Experience in Vietnam, by Douglas Kinnard. This book focuses on the Vietnam War through the eyes of Gen. Maxwell Taylor, who served as Army Chief of Staff and Chairman of the Joint Chiefs of Staff in the Kennedy Administration. Later, he became ambassador to Saigon and then a special consultant to President Johnson. General Taylor took part in nearly every major decision in the Vietnam War. Written from that perspective, Mr. Kinnard's book presents a unique history of the war. Brassey's Inc., New York, N. Y., 1991. 252 pages with photos. $22.95.

A German Odyssey: The Journal of a German Prisoner of War, by Helmut Horner, translated and edited by Allan Kent Powell. Mr. Horner offers insight into the life of a common German soldier during World War II who, near the end of the war, is taken prisoner by American troops. Mr. Horner was a prisoner in France for several months, then was transported to the US where he spent time in several camps. Fulcrum Publishing, Golden, Colo., 1991. 394 pages with photos and index. $23.95.

Haig's Command: A Reassessment, by Denis Winter. This "reassessment" looks at Gen. Sir Douglas Haig, British commander in chief during World War I, and largely contradicts official British history. The author, basing his work on key documents released in the 1960s, found "systematic falsification (of contemporary history) at the highest level." Mr. Winter accuses Haig of rewriting history and editing private papers to fit "his fictions."

"It demonstrates that Haig's rise owed everything to powerful patrons, little to professional expertise and nothing to battlefield performance," Mr. Winter states. Penguin Group, New York, N. Y., 1991. 362 pages with photos and index. $24.95.

Long Day's Journey Into War: December 7, 1941, by Stanley Weintraub. This reconstruction of key events leading to the Japanese attack on Pearl Harbor offers a worldwide perspective on events on and around December 7, 1941—from the activities of the US and Japanese governments to the battlefields of Russia, North Africa, and the Philippines. Anecdotal information from participants describes this pivotal time; December 7 could be seen as "a swath of time that was simultaneously the flood tide of Axis power and the beginning of its ebb." Truman Talley Books/Dutton, Penguin Group, Penguin Books USA Inc., New York, N. Y., 1991. 706 pages with photos and index. $26.95.

Peleliu, Tragic Triumph: The Untold Story of the Pacific War's Forgotten Battle, by Bill D. Ross. What was thought to be a battle that would last a few days became one of the more devastating battles of World War II's Pacific theater. After two months of bloody combat, the US lost 8,769 killed, wounded or missing, while Japan lost nearly everyone in its 13,000-man force. Now a little-known battle, the fight for Peleliu is documented with participant accounts and recollections of its effects on the Marines who fought it. Asserting that it was a battle that "need never have been waged," Mr. Ross maintains that its lasting meaning is its reinforcement for combat veterans of "the nightmarish memory of the awful, stupid horror they know war to be." Random House, Inc., New York, N. Y., 1991. 381 pages with photos, maps, and index. $22.00.

The Price of a Constitution: The Origin of Japan's Postwar Politics, by Tetsuya Kataoka. A comprehensive account of the origins of postwar Japanese policies and Tokyo's cold war relationship with the US, this book argues that Japan did not become a democracy because of a no-war constitution nor would militarism be revived if the constitution were revised. The author maintains that Japan originally accepted Gen. Douglas MacArthur's constitution to save the emperor and then retained it for foreign policy purposes. "Japan restored democracy and kept it for reasons that were independent of the constitution," he states. In addition, the Japanese chose economic development to "escape their inferior political status" compared to the US. Now, contends Mr. Kataoka, "Japan will be forced to choose between paying for American mercenaries or self-help" when a military crisis affecting Japan's interests occurs. He concludes that the US will reduce its military ties to Japan. Taylor & Francis New York Inc., New York, N. Y., 1991. 237 pages with index.

Other Titles of Note

Bataan And Beyond: Memories of an American POW, by John S. Coleman, Jr. The author's personal account of the surrender to the Japanese on Bataan, the subsequent "death march," and prison life under Japanese rule. Texas A&M University Press, College Station, Tex., 1978. 210 pages with photos, illustrations, and index. $12.95.

Battle of the Bismarck Sea, by Lex McAulay. A complete account of the destruction of a crucial Japanese reinforcement convoy to Lae, New Guinea, on March 2–4, 1943, told from the viewpoints of the Japanese on the ships and the attacking aircrews. St. Martin's Press, New York, N. Y., 1991. 226 pages with photos and index. $19.95.

Hell Divers: US Navy Dive-Bombers at War, by John F. Forsyth. A collection of combat stories from World War II naval air battles like Formosa, Leyte, and Luzon, filled with accounts of dogfighting, kamikaze attacks, and the sinking of ships. Motorbooks International Publishers & Wholesalers, Osceola, Wis., 1991. 160 pages with photos. $12.95.

Into the Guns of Ploesti: The Human Drama of the Bomber War for Hitler's Oil, 1942–1944, by Leroy W. Newby. Participant accounts of allied efforts to strike the oil fields of Ploesti, Romania, one of Germany's main sources of fuel during World War II. Motorbooks International Publishers & Wholesalers, Osceola, Wis., 1991. 192 pages with photos and index. $12.95.

Mates & Muchachos: Unit Cohesion in the Falklands/Malvinas War, by Nora Kinzer Stewart. An examination of morale, motivation, and unit performance of both sides in the Falkland Islands conflict, based on interviews with British and Argentinian officers, NCOs, and enlisted personnel. Brassey's Inc., New York, N. Y, 1991. 192 pages including index. $20.00.

Red Phoenix, The Rise of Soviet Air Power, 1941–1945, by Von Hardesty. The evolution of the Soviet Air Force during World War II, with detailed information on the German Luftwaffe. Smithsonian Institution Press, Washington, D. C., 1991. 288 pages with photos, illustrations, and index. $19.95.

Thunder in the Desert: The Strategy and Tactics of the Persian Gulf War, by Maj. James Blackwell, US Army (Ret.). From a CNN military affairs analyst, accounts of Persian Gulf War actions with emphasis on the strategy and tactics used in the campaign by all the services. Bantam Books, New York, N. Y., 1991. 252 pages with illustrations, photos, and index. $12.50. ■

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Bulletin Board

Seeking information on the **RAF Ornithological Society. Contact:** Lee Groom, P. O. Box 632, Grinnell, IA 50112.

Seeking the whereabouts of **Lt. Kenneth S. Sitton,** who served with the 531st Fighter Squadron in the south Pacific during World War II. **Contact:** Don L. Baker, 37 Fairview Blvd., Fort Myers Beach, FL 33931-1811.

Seeking to purchase a copy of ***History of Side-Firing Fixed-Wing Aircraft.*** **Contact:** Lt. Col. Jack Kalow, USAF (Ret.), P. O. Box 1771, Enid, OK 73702.

Seeking the whereabouts of **crew members of the B-29 *Z48*** with the 500th Bomb Group on Saipan from June through August 1945, including James Hackleman, Russell Herold, Bernard Hoffman, Chris Kandris, and Leonard McGarry. **Contact:** Ralph E. Smith, 526 Bender Rd., West Bend, WI 53095.

Seeking information on official and unofficial **nicknames** and slang phrases for USAF and USN squadrons and aircraft. **Contact:** D. J. Simonsen, PSC 80 Box 11227, APO AP 96367-1227.

Seeking the whereabouts of veterans of the **492d Bomb Group** who were stationed at North Pickenham, England, from April to August 1944. **Contact:** Willis H. Beasley, 1525 S. Garfield St., Denver, CO 80210-3022.

Seeking contact with veterans of the **196th Fighter Squadron** and **163d Fighter Group** of the California ANG, from 1946 to the present. **Contact:** CMSgt. James D. Rodgers, USAF (Ret.), 4710 Mt. Vernon Ave., Chino, CA 91710-3318.

Seeking information on the following officers whose names are printed on a 1930s-vintage **cloth pilot's helmet that belonged to Lt. A. W. Robertson:** Maj. C. B. Oldfield, Lts. J. R. Morgan, R. W. Harper, H. E. Rice, and B. M. Hovey. **Contact:** Col. William L. Evans, USAF (Ret.), 4390 N 125 W, Ogden, UT 84414.

Seeking information on **SSgt. Darrell (or Jerry) Roberts,** a B-29 flight crew member with the 444th, 462d, or 468th Bomb Group in the China-Burma-India theater during World War II. **Contact:** James E. Nunnally, 3500 Copeland Rd., Tyler, TX 75701.

Seeking contact with anyone who was **interned in Siberia** between April 1942 and September 1945. **Contacts:** H. J. Koepp, 2107 Parkview Blvd., Colorado Springs, CO 80906. A. T. Miller, 539B Keolu Dr., Kailua, HI 96734.

Seeking information on **TSgt. James B. Walker,** who served in the Australia–New Guinea area during World War II and was assigned to the 341st Fighter Squadron, 68th AACS Group, in 1943–44. **Contact:** MSgt. J. B. Walker, Jr., USAF (Ret.), 888 Woodhill Rd., Dayton, OH 45431.

Seeking contact with pilots and ground crews of the **F-86 Sabre** in the Air Force, Air National Guard, or foreign air forces. **Contact:** Rick Mitchell, 428 Madingley Rd., Linthicum, MD 21090.

Seeking information on the whereabouts of **George Stevens,** who served with USAF in Prestwick, Scotland, in 1966. **Contact:** Fiona Fallone, 177 Hillfoot Rd., Ayr 0292 289441, Scotland.

For a history of the 564th Strategic Missile Squadron, I am seeking a color photograph or drawing of the **564th Bomb Squadron patch.** Also seeking World War II nose art from the 564th Bomb Squadron. **Contact:** Capt. Steve Ray, 564th SMS, Malmstrom AFB, MT 59403.

Seeking the whereabouts of **Capt. Wade Brian Watts,** of Bedford, Mass., who was a member of the Renssalaer Polytechnic Institute AFROTC Class of 1982. **Contact:** Capt. Arthur C. Savignac, Anesthesia Dept., USA MEDDAC, Fort Benning, GA 31905-6100.

Seeking a **Stateside-style RED HORSE patch. Contact:** MSgt. James D. Gordon, USAF (Ret.), 766 E. Tabor #7, Fairfield, CA 94533.

Seeking **patches** from the 28th Bomb Squadron and 384th Air Refueling Squadron, both of McConnell AFB, Kan., and from the 602d Tactical Air Control Wing and 41st Electronic Combat Squadron, of Davis-Monthan AFB, Ariz. **Contact:** Jimmy Fallon, 3025 SE Burton St., Topeka, KS 66605.

Seeking information on the whereabouts of **Richard Ferris,** who was from either Massachusetts or Michigan and served at Udorn RTAFB, Thailand, in 1973–74. **Contact:** William R. Kemp, Rte. 3 Box 12, Middlesex, NC 27557.

The 126th Air Cadet Squadron of the Royal Canadian Air Cadets is seeking donations of photos, posters, books, and other **air history memorabilia. Contact:** Tony Power, Royal Canadian Air Cadets, Squadron 126, Niagara Falls, Ontario L2V 1W8, Canada.

Seeking information on the whereabouts of **Capt. Joseph E. DeDera,** USAAF, who served in England, Holland, and France in 1942–46. Also seeking contact with members of the 458th Service Squadron, 318th Service Group, stationed in England, Holland, and France in 1944–46. **Contact:** Arthur E. Froehlich, 3701 Lighthouse Way, Holiday, FL 34691.

Members of the 166th Tactical Airlift Group, Delaware ANG, believe they have the **first combat-qualified female C-130 flight engineer** in the Air Force, SSgt. Susan E. Wyrick, as of April 23, 1991. Anyone with knowledge to the contrary, please contact the address below. **Contact:**

If you need information on an individual, unit, or aircraft, or if you want to collect, donate, or trade USAF-related items, write to "Bulletin Board," Air Force Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Letters should be brief and typewritten. We cannot acknowledge receipt of letters to "Bulletin Board." We reserve the right to condense letters as necessary. Unsigned letters are not acceptable. Items or services for sale or otherwise intended to bring in money will not be used. Photographs cannot be used or returned.—THE EDITORS

Bulletin Board

Capt. Buckley Condie, 142 TAS/DOT, 12 Penns Way, Corporate Commons, New Castle, DE 19720-2495.

Seeking information on the whereabouts of **John Charles O'Reilly,** whose last known address, in 1989, was in Delaware where he was training on C-5As. **Contact:** John L. O'Reilly, 3900 Scotland St., Cocoa, FL 32927.

Historian seeks contact with **World War II veterans who served in France** and would be willing to answer a questionnaire on their impressions of the country and its people. **Contact:** Andrew A. Thomson, 19 Cranleigh Mead, Cranleigh, Surrey GU6 7JS, England.

Seeking information on a group of **Bell Aircraft, model YFM-1 "Airacudas,"** with both tricycle and conventional landing gear and pusher props, that were stationed at Chanute Field, Ill., in 1940–41 and later reassigned to Biloxi, Miss. **Contact:** Floyd M. Black, 1356 Skyridge Dr., Crystal Lake, IL 60014.

Seeking information on **Lt. Miles Bernard McDougal, Jr.,** who graduated from Williams AFB, Ariz., pilot class in 1944. He was shot down in the Pacific theater. **Contact:** Col. Cy Perkins, USAF (Ret.), 710 Middlebrook Cir., Tallahassee, FL 32312.

Seeking contact with former members of **USAF Air Resupply and Communications Service units** during the 1950s, in order to record the history of these units and their use of B-29s, SA-16s, C-119s, H-19s, C-123s, and any other aircraft. **Contact:** Maj. Bernard V. Moore II, USAF, 527-B 12th St., Maxwell AFB, AL 36113.

Collector seeks any and all **squadron patches,** including nonissued patches. **Contact:** 2d Lt. Drew L. Daugherty, USAF, 4000 Diamond Loch West, Fort Worth, TX 76180.

The Air Force Museum at Wright-Patterson AFB, Ohio, is seeking the loan of **photos of mascots** of any era, wartime or peacetime. **Contact:** Charles G. Worman, Chief, Research Division, USAF Museum, Wright-Patterson AFB, OH 45433-6518.

Seeking contact with World War II veterans who may have served under **Elwood "Pete" Quesada,** either when he was deputy commander of the North African Coastal Air Force or when he was commander of the IX Tactical Air Command in Ninth Air Force. **Contact:** Thomas Hughes, Dept. of History, University of Houston, Houston, TX 77204-3785.

Seeking contact with members of **Aviation Cadet Class 44-A** (at Cal-Aero Academy, Ontario, Calif.) that graduated as Class 44-B, Luke Field, Ariz. **Contact:** Richard H. Boehning, P. O. Box 31, Mill Spring, NC 28756.

Seeking information on the whereabouts of **William "Woody" Wood,** a pilot with the 42d Tactical Reconnaissance Squadron stationed at Spangdahlem AB, West Germany, in 1956–57. **Contact:** Frank Perri, 30 Aylesbury Cir., Madison, CT 06443.

Seeking **aerial photos of Udorn RTAFB,** Thailand, circa 1968. **Contact:** Chuck McCarn, 842 Ravenwood Ct., Biloxi, MS 39532.

Seeking color photos, slides, or negatives of the following **aircraft, circa 1953:** PA-18 and T-6G of Graham AFB, Fla.; T-28A and B-25J, L, or N of Vance AFB, Okla.; B-29A of Randolph AFB, Tex. Also seeking photos of SAC KC-97Gs, circa 1955. **Contact:** H. A. Frost, 10517 W. 92d Pl., Overland Park, KS 66214. ■

Unit Reunions

Atlantic City "Camp Boardwalk"
A fiftieth-anniversary reunion will be held May 31–June 1, 1992, for military and civilian personnel of all services who were stationed in Atlantic City, N. J., during World War II. Also invited are medical staff and patients who were hospitalized in the Thomas England General Hospital (now the Resorts International Hotel and Casino). **Contacts:** Lt. Col. Norman Shamberg, USAF (Ret.), 20 N. Gladstone Ave., Margate, NJ 08402. Michael Romancheck, 201 London Ct., Cardiff, NJ 08232.

Chambley AB
Military personnel, civilian, and dependents from Chambley AB, France, will hold a reunion May 22–25, 1992, at the Embassy Suites Hotel in Atlanta, Ga. **Contact:** Charles R. Timms, P. O. Box 6892, Marietta, GA 30065.

Flight Nurses
World War II flight nurses will hold a reunion June 17–21, 1992, in Louisville, Ky. **Contacts:** Mrs. Anthony G. Cerasale, 463 Port Royal Blvd., Satellite Beach, FL 32937. Phone: (407) 773-6173. Charles W. Arrington, 410 Oread Rd., Louisville, KY 40207. Phone: (502) 896-1554.

Mule Train
Project Mule Train veterans (C-123 squadron) who served in Vietnam in 1962 and 1963 will hold a reunion May 14–16, 1992, in Fayetteville, N. C. **Contacts:** Charles B. West, 429 Edinburg Dr., Fayetteville, NC 28303. Phone: (919) 864-2439. Col. Earl W. Strong, USAF, (Ret.), 1111 Hermosillo Glen, Escondido, CA 92026. Phone: (619) 745-1232.

Vietnam Veterans
L. Z. Bluegrass, Inc., is sponsoring a reunion for Vietnam veterans May 15–17, 1992, at the Holiday Inn Capital Plaza in Frankfort, Ky. The reunion is open to Vietnam veterans of all services. **Contacts:** L. Z. Bluegrass, Inc., P. O. Box 4884, Louisville, KY 40204. Phone: (502) 363-5550 (Pete Jakubiak). Cindy Dumas (502) 454-4981 or Bill Robinson (502) 363-5296.

40th ARRS/401st CES/FD
Members of the 40th Aerospace Rescue and Recovery Squadron and the 401st CES/FD are planning to hold a reunion May 22–24, 1992, at the Days Inn Hotel in Gatlinburg, Tenn. **Contact:** S. A. Bertch, 6915 Maplewood Ave., Sylvania, OH 43560. Phone: (419) 882-6929.

81st Tactical Fighter Squadron
Members of the 81st Tactical Fighter Squadron (formerly Fighter-Bomber Squadron) will hold its fiftieth-anniversary reunion January 15, 1992,

Readers wishing to submit reunion notices to "Unit Reunions" should mail their notices well in advance of the event to "Unit Reunions," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Please designate the unit holding the reunion, time, location, and a contact for more information.

at Spangdahlem AB, Germany. **Contact:** Capt. Steven Sokoly, Box 1746, APO NY 09123. Phone: (049) 6567-1226 or (049) 656561-6271.

301st Air Rescue Squadron
The 301st Air Rescue Squadron (formerly the 301st Aerospace Rescue and Recovery Squadron) from Homestead AFB, Fla., will hold a thirty-fifth-anniversary reunion November 16–17, 1991. **Contacts:** Brian Piper or Gail Hatter, 301st Air Rescue Squadron, AFRES, Homestead AFB, FL 33039-5000. Phone: (305) 257-7187. DSN: 791-7187.

321st Bomb Wing
The 321st Bomb Wing, a B-47 unit, will hold a reunion May 14–16, 1992, in Orlando, Fla. **Contact:** Col. Leslie E. Gaskins, USAF (Ret.), 2200 N. W. 21st St., Gainesville, FL 32605. Phone: (904) 377-6892.

394th Bomb/4th Recon Squadrons
Members of the 394th Bomb Squadron and 4th Reconnaissance Squadron, 5th Bomb Group, 13th Air Force (World War II), will hold a reunion April 30–May 2, 1992, at the Sheraton Crystal City Hotel in Arlington, Va. **Contact:** Ray Gaston, 1837 Eastern Hills Dr., Garland, TX 75043. Phone: (214) 240-2008.

475th/8th Fighter Wings
Members of the 475th/8th Fighter Wings and all attached and supporting units stationed at Itazuke AB, Japan (1947–53), will hold a reunion April 27–30, 1992. **Contact:** Col. Donald E. Miller, USAF (Ret.), 5221 Las Cruces Dr., Las Vegas, NV 89130. Phone: (702) 645-7552.

3785th Field Training Wing
The 3785th Field Training Wing (FLDTW) will hold its fiftieth-anniversary reunion banquet April 30, 1992. All past and present members, including the AAF Technical Training Command/ Mobile Training Unit (1942–45), 3718th AAFBU, 3499th MTG/TAW/FLDTW (1945–59), and 3785th FLDTG, are invited to attend. **Contacts:** Capt. Joyce Hand, USAF, or Nancy Wilson, 3785th Field Training Wing (ATC), Sheppard AFB, TX 76311-5424. Phone: (817) 676-4770. DSN: 736-4770.

Kindley AB
For the purpose of planning a reunion in 1992, I am seeking contact with members of all US Air Force units stationed at Kindley AB, Bermuda, between 1968 and 1970. **Contact:** William E. Aisenbrey, 1007 Ruby Pl., Sioux Falls, SD 57106-3449.

Minnesota CAP
Seeking former members and associates who served in the Minnesota Wing Civil Air Patrol between 1941 and 1991 who are interested in organizing a reunion in conjunction with the Wing's fiftieth-anniversary celebration in April 1992. **Contact:** Lt. Col. Thomas J. O'Connor, CAP, 16515 Frazer Way, Rosemount, MN 55068-1953. Phone: (612) 431-5396.

Weather Station Personnel
For a planned reunion in 1992, I am seeking contact with Weather Station personnel who served at Blytheville AAF, Ark., during World War II. **Contact:** William A. Jenner, 307 Alma St., O'Fallon, IL 62269.

Classes 52-18, 52-19, and 52-20
I would like to hear from navigator-bombardiers of Classes 52-18, 52-19, and 52-20 (Ellington AFB, Tex.) who served in Korea. **Contact:** John A. Sidirourgos, 3830 N. W. 102d Ave., Coral Springs, FL 33065. Phone: (305) 752-3330.

356th Tactical Fighter Squadron
I am seeking members of the 356th Tactical Fighter Squadron, 354th Tactical Fighter Wing, past and present who would be interested in holding a reunion in February or March 1992. **Contact:** Capt. James D. Reed, USAF, 356th TFS OPS, Myrtle Beach AFB, SC 29579.

358th Fighter Group
For the purpose of planning a reunion in 1992, I would like to hear from members of the 358th Fighter Group. **Contact:** L. H. Lok, 1907 Maple Rd., Effort, PA 18330.

421st Air Refueling Squadron
I am seeking contact with former members of the 421st Air Refueling Squadron to inform them of our squadron reunion, scheduled for April 23–25, 1992, in Orlando, Fla. **Contacts:** John A. Steele, 19 Dome Ln., Wantagh, NY 11793-1815. Phone: (516) 826-2519. Thomas L. Hattaway, 3612 Quando Dr., Orlando, FL 32802.

3626th Maintenance Squadron
For reunion planning, I am seeking information and contact with former members of the 3626th Maintenance Squadron who served at Tyndall AFB, Fla., between 1950 and 1953. **Contact:** Alex Sola, 466 A St., Colma, CA 94014. Phone: (415) 756-7765. ■

Bob Stevens'

"There I was..."

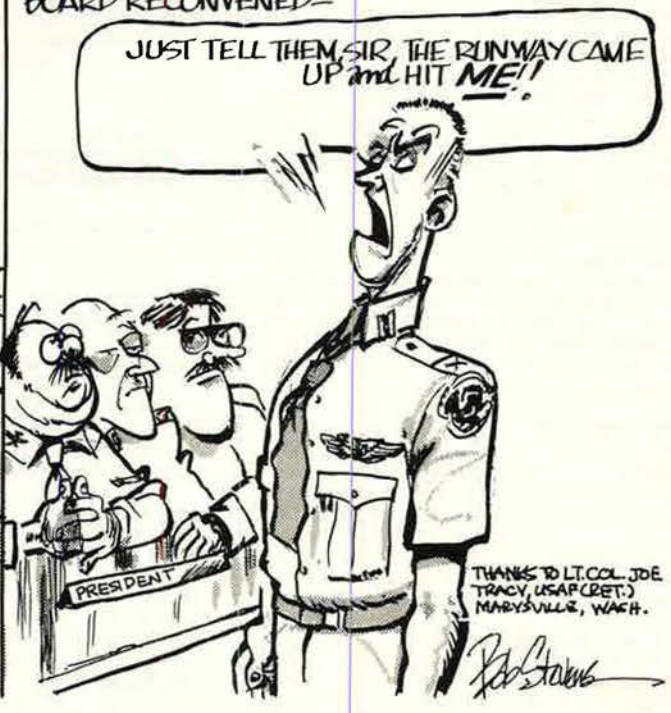
CLARK AB, THE PHILIPPINES, HAS BEEN IN THE NEWS LATELY BECAUSE OF LOCAL VOLCANIC ACTIVITY. THIS ISN'T THE FIRST TIME CLARK HAS RECEIVED BAD PRESS BECAUSE OF NATURE'S BEHAVIOR. IN THE SUMMER OF 1949 AN EARTHQUAKE OF CONSIDERABLE MAGNITUDE HIT THE BASE and CAUSED A LOT OF COLLATERAL DAMAGE. THIS CERTIFIABLY TRUE STORY OF AN F-80 TRYING TO LAND WHEN THE TEMBLOR HIT IS AN EXAMPLE OF "COLLATERAL" DAMAGE-

THE '80 WAS FLARED FOR TOUCHDOWN WHEN AN UNDULATING RUNWAY SLAPPED THE BIRD BACK IN THE AIR!

THE POOR JOCK TRIED TO SPIKE IT, BUT GOT TO PORPOISING UNTIL THINGS GOT OUT OF CONTROL. PIECES CAME OFF, and THE GEAR FOLDED.

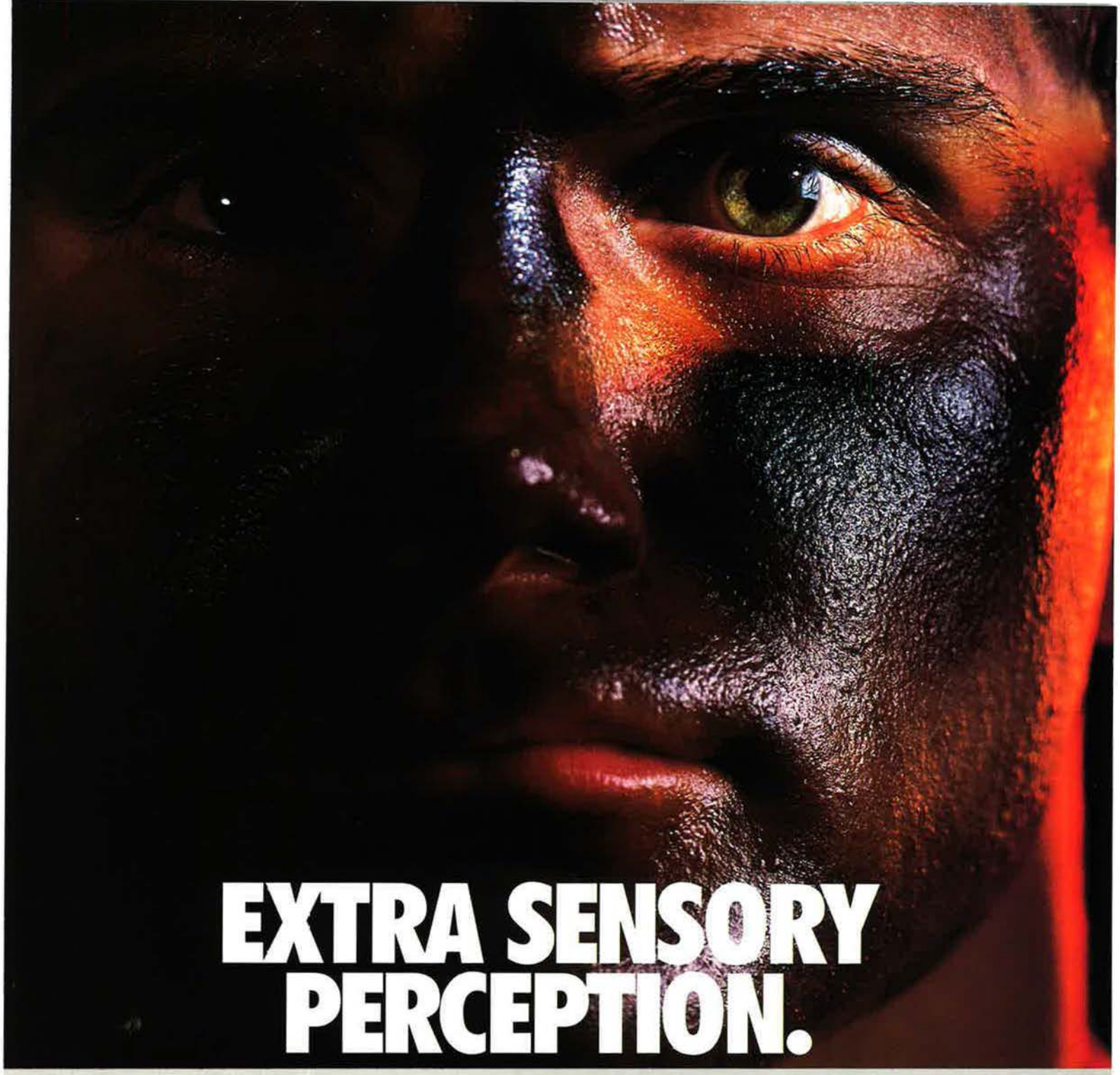
AFTER SLIDING TO A STOP ACROSS A PERIMETER ROAD, THE PILOT EXITED UNHARMED-

THE ACCIDENT REPORT BOUNCED, TOO, BECAUSE HQ USAF IG WOULDN'T BUY "EARTHQUAKE" AS THE CAUSE FACTOR. FINALLY, THE LOCAL ACCIDENT BOARD RECONVENED-



THANKS TO LT. COL. JOE TRACY, USAF (RET.) MARYSVILLE, WASH.

Bob Stevens



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