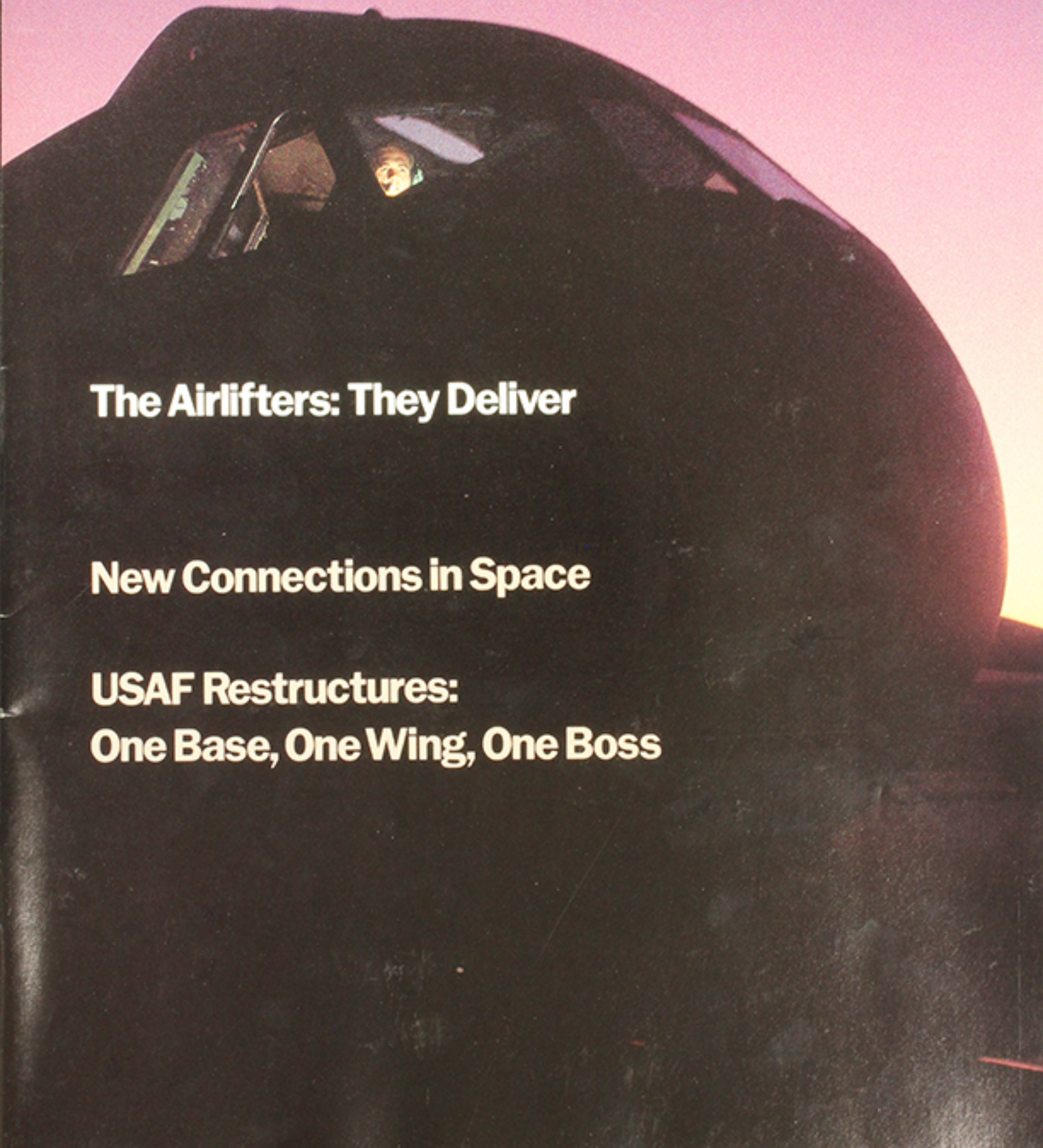
AUGUST 1991/$3

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION



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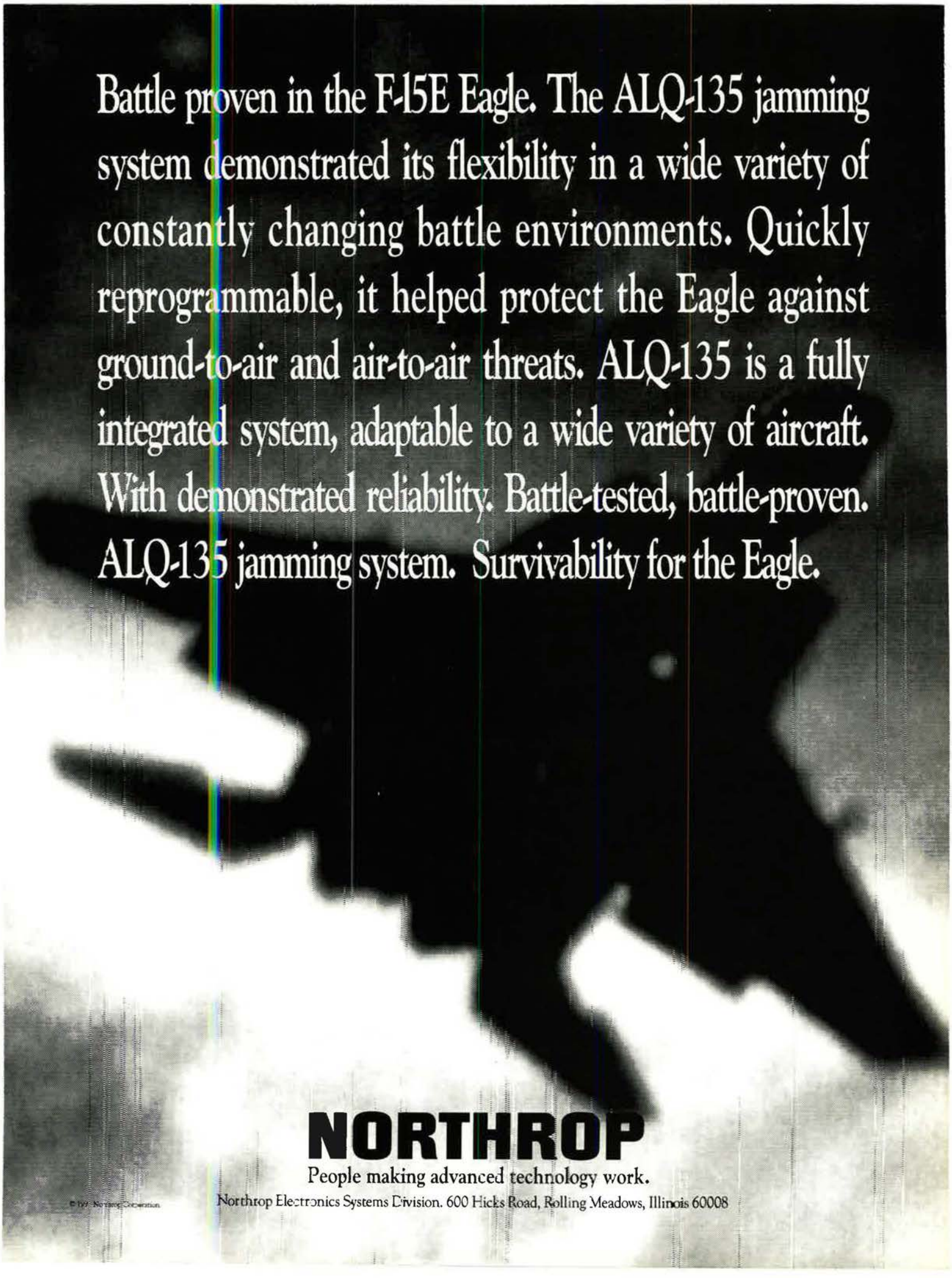
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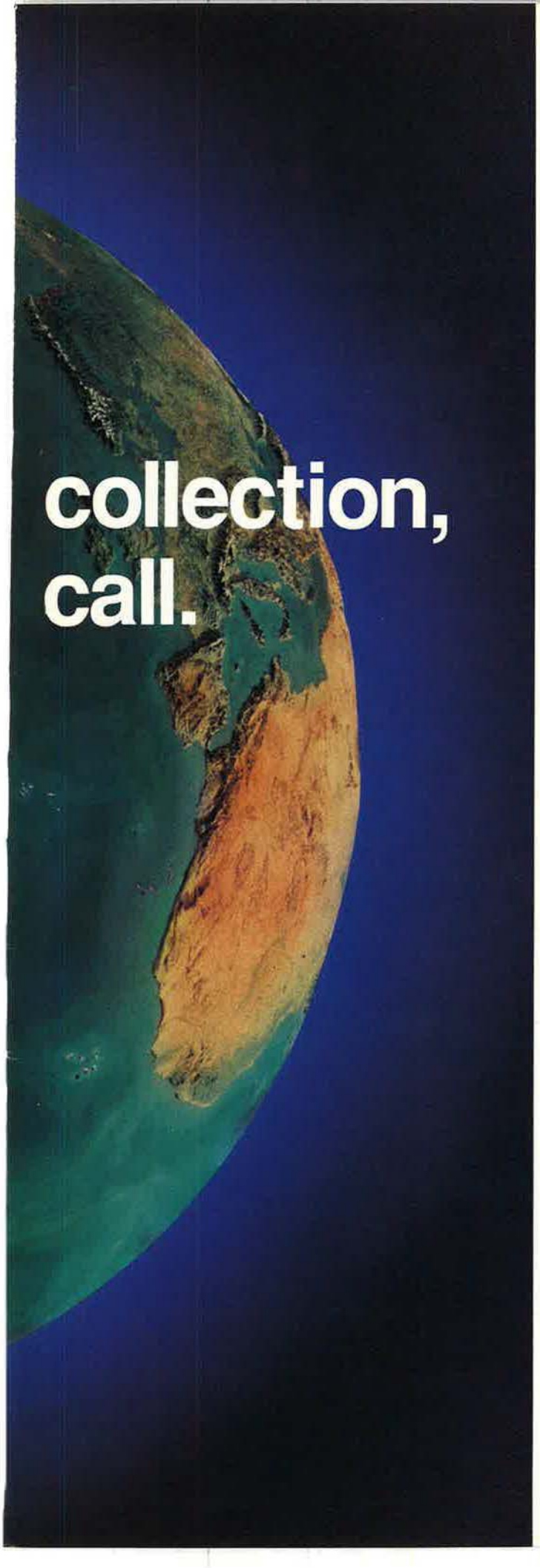

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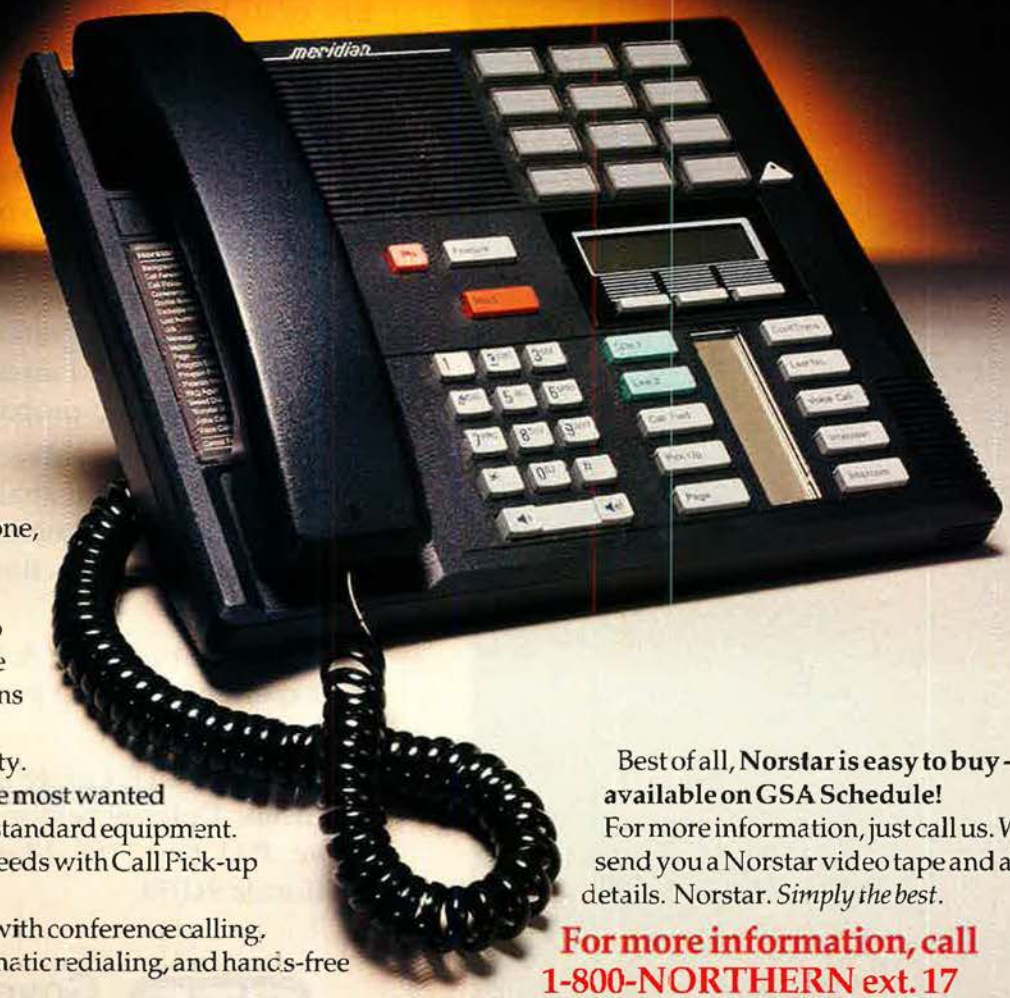

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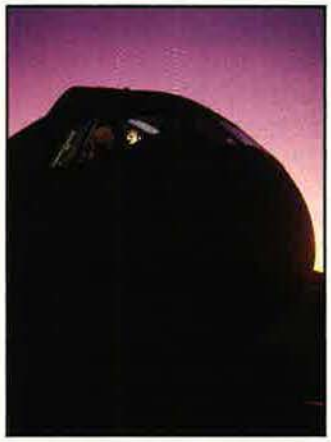

About the cover: 1st Lt. Robert G. Shular, a copi ot with the 86th Military Airlift Squadron, Travis AFB, Calif., prepares for a night mission in a C-141B Star-Lifter. For a tribute to fifty years of airlift operations, see "They Deliver," p. 50. USAF photo by TSgt. David McLeod.

Space and Strategic Systems

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Editorial

By John T. Correll, Editor in Chief

Let's Hear It for the Loggies

TEN years ago, the Air Force did not have enough spare parts to sustain wartime operations. In fact, 7.4 percent of the fleet was grounded by supply shortages in peacetime. The maintenance troops dug routinely into war reserve kits and borrowed parts off one airplane to get another one fixed. The wheezy old data system could not even forecast the spare parts requirement.

Given that state of affairs, there was some smirking in 1983 when Air Force Logistics Command announced it was switching emphasis from peacetime efficiency to wartime effectiveness and that it had a plan to fix the spares shortage, the grounded airplanes, and the data management system.

Nobody is smirking now. When Operation Desert Storm opened last August, the Air Force's wartime readiness kits and operating stocks were in excellent shape. Logistics Command accelerated the repair of some 80,000 critical parts and expedited the overhaul of seventy aircraft. Returning these aircraft to operation ahead of schedule gave the Air Force a cumulative 931 days of additional flying service.

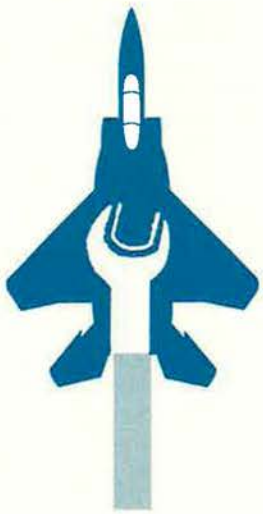
Oklahoma City Air Logistics Center (ALC) became the second largest aerial port operation in the United States as cargo volume increased from sixty tons to 300 tons a day. San Antonio ALC surged and shipped 539,183 propulsion parts and accelerated the overhaul of forty-five jet engines.

Flying units in Saudi Arabia were so well-stocked with spares that readiness rates for many systems were better than at home in peacetime. Depot maintenance teams went to the war zone to repair battle damage on the spot. The list could go on and on.

In May, the Federal Quality Institute presented Air Force Logistics Command the 1991 President's Award for Quality. It was an honor richly deserved.

Logistics excellence is not all wartime surge and excitement. It depends in great part on careful attention to details and everyday persistence. Is the part that's supposed to be in the warehouse actually there? Is it really the part showing on the inventory?

The AFLC work force (which is ninety percent civilian) demonstrates an impressive sense of purpose. A "Quality Bill of Rights" entitles anyone in the command to challenge procedures and expect quality to be put ahead of production.



As the Gulf War demonstrated, combat logistics is more than a slogan. These people had their act together.

Wayne Hayes, a sheet metal mechanic on the F-15 repair line at Sacramento ALC, had occasion to discover how sincere that policy is. Mr. Hayes, working with parts from a repair kit, was not satisfied with the fit of a cap on the aircraft's vertical stabilizer. He exercised his quality rights and stopped the F-15 repair line. The commander backed him and sustained a nine-day shutdown until the problem was corrected.

Gen. Charles C. McDonald, AFLC commander, told the Senate Armed Services Subcommittee on Readiness, Sustainability, and Support that the transition to wartime operations last August was "almost transparent" because the command was already attuned and geared to support combat.

In July, just days before Iraq invaded Kuwait, AFLC planners had completed one of the computerized logistics exercises they run regularly. This one, by coincidence, had a Middle East scenario, so the system was primed even more than usual when Saddam Hussein made his move in August.

The loggies are living up to the promises made in 1983. Even the new data systems, which looked to be the hardest part of the task, are working out well. Nine projects, known collectively as the Logistics Management System, are coming on line gradually. Some proved their value in the Gulf War.

The Weapon System Management Information System (WSMIS), for example, tracked each unit's thirty-day combat capability and impending parts problems. The ALCs then used this information to expedite repair or procurement of critical items. The system, General McDonald told the Senate, was spotting weapon system support problems in one to seven days. Previously, identification of the same problems would have taken sixty to ninety days.

In the aftermath of the Gulf War, the loggies have a big job on their hands. Aircraft and engines were flown near or beyond their limits. There is battle damage to repair. Regular depot maintenance, sidetracked to support the war effort, awaits completion.

A leading concern is the spare parts and other stocks that were expended in combat. Operation Desert Storm was fought on the strength of war readiness kits and spares funded between 1984 and 1987. Since then, budgets for these items have been cut sharply.

Like the rest of the Air Force, the loggies are searching for ways to preserve their effectiveness while absorbing the reductions that have already begun. It is some comfort to know that they approach the lean years with their priorities straight, their data systems in good order, and a tradition of quality established. ■

Letters

May Issue Miscues

I noticed that Air Weather Service (AWS) was not mentioned in the "Report from the FOAs" section of the May 1991 issue. AWS separated from Military Airlift Command (MAC) and became a Field Operating Agency (FOA) under Hq. USAF on April 1, 1991. Additional changes are under way that will transfer field weather units to the Major Commands they support. As an FOA, AWS will continue to provide centralized weather support to the Air Force and Army as the USAF center of weather technology and standardization.

The organizational change began February 5, 1991, with the establishment of a Directorate of Weather on the Air Staff. The final portion of the command's restructure is now being implemented. It will give Major Command operational commanders control and ownership of their dedicated weather resources. After it is restructured, AWS will provide centralized weather support and services to the Air Force and Army. It will be responsible for fielding standard weather systems and new technology to meet the needs of today and tomorrow. It will also help to ensure that the Air Force has a standardized, interoperable, and high-quality weather support system.

As they did during the forty-five years AWS was associated with MAC and its predecessors, USAF weather personnel will observe and forecast for those who fly and fight. Although operational commanders will now own their dedicated weather units, AWS (as an FOA) will continue to fill a key role in operational support to the Air Force, Army, designated unified and specified commands, and other agencies. . . .

Col. George L. Frederick, Jr., USAF
AWS Commander
Scott AFB, Ill.

You have my curiosity aroused to a point where I must ask your help to satisfy it.

In 1990, AIR FORCE Magazine ran an advertisement for a replica World War II leather flight jacket described as the "Capt. James Goodson series." The photograph in this advertisement showed a pilot sitting in a World War II fighter cockpit, and there was a square of swastikas indicating thirty German aircraft shot down. I had seen lists of World War II aces often in the past and certainly did not recall anyone with my surname on any of them.

When the May 1991 issue came out, I looked for James Goodson on the list of World War II aces. He wasn't there. If he indeed had thirty kills, he should have been.

On p. 78 of the June 1991 issue, there is James Goodson again, this time a lieutenant.

So I must ask you, "Who in blazes is James Goodson?" "What is his claim to fame?" And, "Why does he warrant so much recent coverage in your magazine?"—especially since I have never before encountered his name during my forty-five years of interest in aviation and the US Air Force.

Donald W. Goodson
Ridgecrest, Calif.

• *James Goodson was many things: Eagle Squadron member, 336th Squadron commander, USAAF ace, and industry executive. One thing he wasn't, unfortunately, was pictured on p. 78 of the June issue. As several readers pointed out, the man identified as Goodson was in fact Capt. John Godfrey, credited with 16.33 victories in the European theater. Pictured with Captain Godfrey was Capt. Don Gentile, who was credited with 19.83 victories. Goodson, who retired as a colonel, scored fourteen victories, just missing the May issue cutoff point of 14.5. The thirty swastikas could have stood for unconfirmed victories, Eagle Squadron victories, or even aircraft destroyed on the ground.*—THE EDITORS.

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

Thanks for the Almanac section, "Understanding the Designation System" *[see May issue, p. 58]*. I hope our leaders in the Pentagon and in Congress read it and understand just how the designation system works before they talk about new systems. Unfortunately, there have been several unofficial designations applied to aircraft programs by leaders in and around Washington that are inconsistent with the DoD designation system adopted in 1962. These Potomac MDSs have a habit of sticking with a program once they have appeared in the press, becoming a nightmare down the road for logistics support folks and historians alike.

One common type of "misnomenclature" is the duplication of used designations, such as AV-8, F-4G, T-1A, and EC-137D. Of more serious concern to the designation system's integrity, however, is an apparent lack of understanding that there is a "hard" hyphen linking the basic mission designator and the design number to identify a specific aircraft design. Problems start to occur when those who do not understand the system incorrectly assume that it prescribes A-16 as the designation for the attack version of the F-16. By this logic, it would follow that the B-47 was the bomber version of the C-47 transport, whose helicopter derivative was the CH-47, all of which evolved from the P-47 fighter of World War II. Thank goodness today's nomenclature abusers in Washington were doing something else when all of these aircraft were flying.

The question now is how to identify the attack version of the F-16 fighter. The F/A-16 designation widely reported in recent months by many, including AIR FORCE Magazine, doesn't comply with the DoD designation system. One may ask, why does the Navy fly a bird designated F/A-18? Hard to say,

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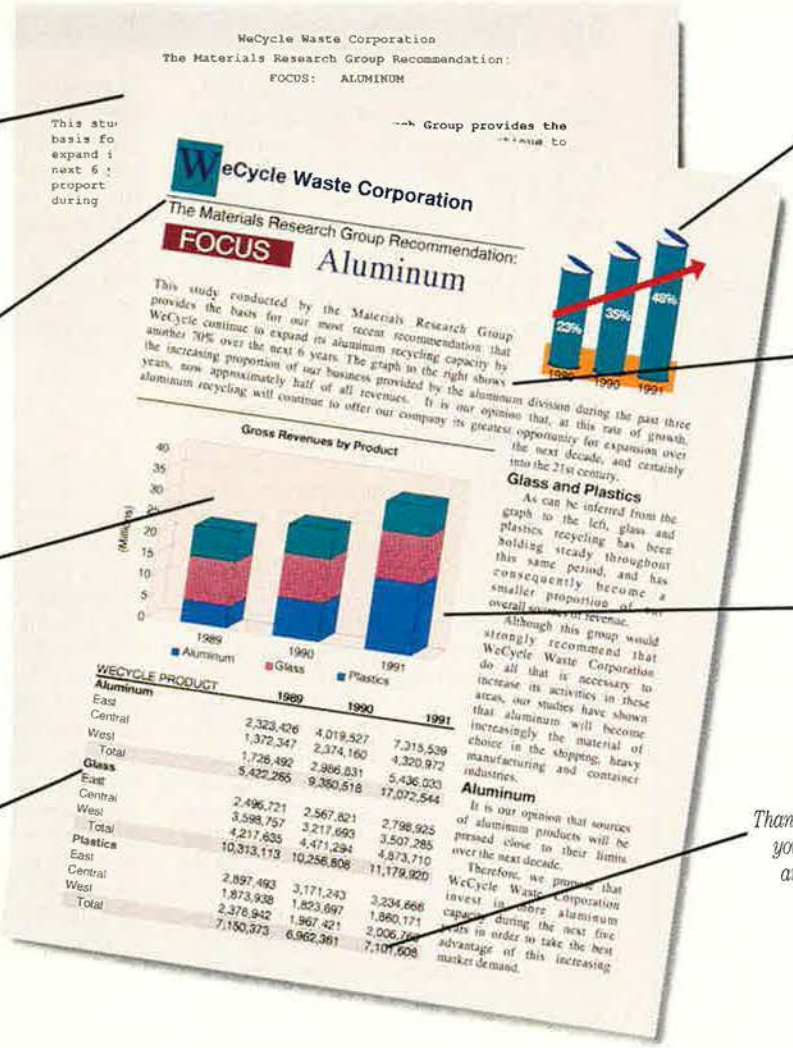

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Letters

but it's possible that the admirals, fearing that the AF-1E fighter designation retroactively applied to their FJ Fury series fighters conjured up images of the Navy's using an Air Force fighter, just wouldn't stand for such bad public relations for their latest carrier jet. (The F/A-18 was in fact derived from the USAF/Northrop YF-17 prototype.) Its proper designation should be AF-18, F-18, or A-(whatever number was next in 1976).

What would be a proper designation for an attack version of the F-16C/D? The attack version of the F-15—the F-15E—illustrates the most common Air Force practice. The attack version of the F-16C/D could well be the F-16F/G (F-16E having already been assigned). Alternatively, AF-16C/D modified mission designators may be preferable for aircraft that are to be modified rather than built as new. If a pure attack designator is preferred, then A-13 (let's not be superstitious) is the next MDS number in line. These designations all comply with the DoD directive and conform to accepted practice. One difference here is that the "AF" designation should be no affront to the Air Force.

If we must go with an "A-16" designation for political or whatever reasons, we should give serious thought to changing the DoD designation system so that each design number will be unique in itself. Then we can let the status prefixes, modified mission designators, and basic mission designators vary all over the place, and the B-47 will properly be the bomber version of the C-47, and so on.

Col. Jack D. Morris,
USAF (Ret.)
Dayton, Ohio

On p. 165 of the May 1991 issue, there is an editorial comment that I feel is completely out of character for the magazine. In discussing the power requirements for the F-16C Fighting Falcon, you refer to Pratt & Whitney as a "secondary supplier" of engines for this aircraft. That is absolutely not true. More than seventy percent of the world's F-16s are powered by our F100 engines. In the most recently completed annual fighter engine competition, we were awarded fifty percent of the engines to power the FY 1992 F-16 buy. As a result of this latest award, our engines will be powering more than seventy percent of USAF F-16s. Powering a majority of an aircraft fleet certainly cannot be considered secondary.

I think your wording is backward and really should have said "with Pratt & Whitney as the preferred supplier with its F100-PW-229 IPE engine." Also in error are the "Gallery" entry on the C-17A, which incorrectly states that the powerplant for later aircraft will be open for competition, and the F-15 entry, which incorrectly lists a GE powerplant as optional. I hope you will correct these grave misconceptions your publication has created.

Robert G. H. Carroll III
Pratt & Whitney
West Palm Beach, Fla.

The May 1991 issue appears to be seriously lacking in one important aspect of the Air Force. Minimal words are used to discuss the leg of the strategic triad with the best alert rate—missiles. Only in the Strategic Air Command report and the "Gallery of USAF Weapons" are missiles mentioned. I realize that the B-2 is an important political issue in the world today and that without the bombers and tankers, the war in the Persian Gulf may not have been as successful, but what about the men and women who pulled their alert and maintained the missiles so the bombers could be relieved of their Single Integrated Operational Plan requirements?

According to SAC Commander in Chief Gen. George L. Butler during his talk at the 1991 Olympic Arena (SAC's annual Missile Combat Competition), the only reason he could send the number of bombers and tankers to support Operation Desert Shield was because of the alert rate and accuracy of SAC's deployed missile forces.

The missileers of SAC are used to being the silent warriors, but enough is enough. In the report from SAC and in the organizational charts of 15th Air Force, the Strategic Missile Center was not mentioned. The Strategic Missile Center is the mother organization of all missileers. It has two very significant missions.

The first mission is training. The only initial combat crew missile training in USAF takes place at Vandenberg AFB, Calif., in the 4315th Combat Crew Training Squadron (CCTS). Besides Undergraduate Missile Training, 4315th CCTS provides refresher and requalification training for wing and headquarters staff personnel as well as training for all missile instructors.

The second part of the Strategic Missile Center's unique mission is the operational test launch program for the Minuteman and Peacekeeper weapon systems. It is the only organization designed to position, maintain, launch,

and analyze the launch of an operational missile.

The Strategic Missile Center is, as you state, host to Olympic Arena. This competition determines which strategic missile wing can be called the best overall for the year. The 1991 competition was again won by the 341st SMW from Malmstrom AFB, Mont., the only wing to win the trophy back-to-back. . . .

Thank you for the opportunity to express my concerns, and I would appreciate some mention every now and then of missiles and the people who support them.

Maj. David C. Sharp,
USAF
Vandenberg AFB, Calif.

In the May issue's section on the Gunsmoke competition *[see p. 157]*, the winner for 1954 is listed as "Unknown." The first team to fly for the Vandenberg trophy during the worldwide fighter gunnery meet (Gunsmoke) held at Nellis AFB, Nev., in 1954 was from the 3595th TFW. This trophy has been used for a number of years, adding the top gun winner's name each year.

After the 1954 meet, the six team members listed on the first shield of the Vandenberg trophy were Col. George Jones (leader) and James Kassler, Robert Latshaw, Warren Rice, William Wescott, and myself. I was the overall individual high scorer during the meet as a member of the Nellis AFB team flying in an F-86 from the 3595th TFW.

I am surprised that your research for this article did not reveal this information. However, I am also aware that the price of a cup of coffee won't change either way.

I am very respectful of those individuals listed because I have flown many hours with several of them—they are great aviators, one and all.

Col. Charles C. Carr,
USAF (Ret.)
Dallas, Tex.

With regard to the "Anniversaries" section of the May 1991 "Aerospace World" *[see p. 30]*, I was pleased to see the mention of the May 21, 1956, hydrogen bomb drop over Bikini Atoll. As a result of the success of that operation, the development of smaller, more efficient weapons proceeded smartly, leading to a better deterrent against enemy attack.

My quarrel is with the misspelling of my name. It is Critchlow, a family name listed in the military in every American war before and since the American Revolution. The tradition continues with my sons.

In spite of the minor irritation caused by seeing my name misspelled, I remain a booster of the armed forces and your superlative magazine.

Col. David M. Critchlow,
USAF (Ret.)
Redlands, Calif.

I would like to provide a correction to your list of leading aces of World War II on p. 68 of the May 1991 issue.

Five of these men were part of the 357th Fighter Group, 8th Air Force. You list four of them correctly, but Clarence E. Anderson, Jr., with 16.25 victories is shown with the wrong first name.

You list him as Lawrence E. Anderson; his first name is Clarence.

MSgt. Merle C. Olmsted,
USAF (Ret.)
Paradise, Calif.

Reviewing the "Awards and Decorations" section, I find that the Berlin Airlift device was omitted. This device, a miniature gold C-54, was awarded to thousands of Air Force personnel who served honorably during the Berlin Airlift.

I suggest that next time it be included.

Col. Kenneth Herman,
USAF (Ret.)
San Bernardino, Calif.

The May 1991 issue's section on "Awards and Decorations" *[see p. 43]* has the American Campaign Medal ribbon upside down. The correct sequence of middle stripes is blue, white, and red.

Lt. Col. Andrew Jones,
AFRES
Arlington, Va.

"Forgotten Firsts" in the May 1991 issue *[see "Valor," p. 181]* contains a major error.

The first AAF unit to bomb a target in Europe to earn "a unique but sometimes forgotten place in Air Force history" was the HALPRO Detachment, *not* Major Kegelman's A-20s of the 15th Bomb Squadron.

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Convention	352,361	403,071
Data Processing Services	47,716	37,700
Industrial Associates	178,100	194,368
Insurance Programs	2,789,811	3,418,715
Investment	505,335	1,221,108
Land Rental	—	96,568
Magazine	2,497,241	2,862,002
Membership	3,090,915	3,107,445
Patrons	241,988	236,641
Other	619,229	605,252
Total Revenue	12,292,990	13,523,199
Expenses[1]		
Aerospace Development Briefings	588,458	505,032
Building Operations	855,896	650,777
Convention	829,766	738,245
Data Processing Service	140,137	90,949
Industrial Associate Program	120,719	111,000
Insurance Programs	3,712,065	3,387,509
Magazine	2,363,584	2,448,695
Membership	3,640,129	3,372,503
Patronship	253,118	239,187
Total Expenses	12,503,872	11,543,897
Excess (Deficit) of Revenue over Expenses	**$ (210,882)**	**$ 1,979,302**
Life Membership Fund		
Revenue from Investments	598,988	601,424
Less: Transfer to General Fund for annual dues and other costs	605,747	580,496
Net Income (Loss), Life Membership Fund	**$ (6,759)**	**$ 20,928**

Treasurer's Note: The figures presented herein have been extracted from audited financial statements submitted previously to the Board of Directors of the Air Force Association.

[1]Expenses include chapter commissions, state commissions, and other direct support for field units totaling $582,722 in 1990 and $602,233 in 1989.

Thirteen HALPRO B-24s, launched from Egypt, attacked Ploesti June 12, 1942, before Kegelman's June 29th mission.

HALPRO was the parent organization of the 376th Bomb Group (H)—the *first*, and probably only, heavy AAF bomb group born in combat overseas.

Brig. Gen. Richard Fellows, USAF (Ret.)
Riverside, Calif.

I don't think you will get any dispute that there were a lot of different units deployed in support of Desert Shield and Desert Storm. You will get even less of an argument that there were many different kinds of equipment sent over to fight the Iraqis. Everyone who has a job associated with a weapon system likes to see his plane or tank in the news saying that it is the best, did the best, did the most. . . .

It does, however, get to be infuriating to see article after article telling bits of information about a certain aspect of the war and seeing a major weapon system omitted almost every time. The way the press has acted, it's almost as if the F-111 played no part in the war at all.

In the May issue, Colleen Nash presented two pages of charts showing how various airplanes performed during the war on mission capable rates, utilization rates, and average sortie duration. I challenge her to use the same kind of charts for the F-111, including number of targets destroyed vs. number of aircraft deployed (there was only one F-111 wing deployed to Saudi Arabia). I think the public will be amazed to find out that a twenty-year-old fighter-bomber did so much. You might also look at how many laser-guided bombs were dropped in the war and see who dropped the most (and hit the most targets).

The thrust of almost every article I see these days is, "Gee, look how all these brand-new weapons did in the war." Let's look at who pulled the weight in target destruction, too. I think you will be surprised to find which plane is on top.

Capt. Steven M. Nitz, USAF
RAF Lakenheath, UK

• *The omission was by no means intentional. The May 1991 "Chart Page" was prepared in March, using the most current and comprehensive information available from the Air Force at that time. Later, an April USAF white paper provided more detail. It said that the F-111 flew more than 4,000 sorties, achieving a mission capable rate of more than eighty-five percent—approximately eight percent higher than peacetime rates. The venerable B-52, which was also not covered by the charts, had a mission capable rate of more than eighty-one percent—two percent higher that its peacetime rate. The white paper stated further that US pilots used 7,400 tons of precision munitions with "deadly effectiveness" and some ninety percent were dropped by the Air Force. We would like to point out that the F-111 received extensive coverage in the June and July "Aerospace World" departments and that the commander of the 48th TFW was quoted in "Voices From the War" in the April issue, p. 42.*—THE EDITORS

Having participated in Desert Shield and Desert Storm, I am greatly disappointed with the lack of press coverage of the KC-135 Stratotanker. This aircraft along with hundreds of its crews flew round-the-clock missions, making sure that the planes that needed gas got it. Many times did our aircraft venture into Iraq to refuel fuel-starved aircraft, yet it seems time and time again we receive no recognition despite the danger involved.

If you want to talk about workhorses of the war, check the figures on the mission capable rate of the KC-135 (which was not listed in the summary in the June 1991 "Aerospace World" department), a thirty-year-old airplane doing the job like it has never been done before. Many people talk about the fighters and bombers, and rightly so, but all we ask is to have a little recognition sent our way for the major role we played in Operations Desert Shield and Desert Storm.

Lt. Dennis J. Smith, USAF
Plattsburgh AFB, N. Y.

AIR FORCE ASSOCIATION BALANCE SHEET

	December 31, 1990			December 31, 1989		
Assets	**General Fund**	**Life Membership Fund**	**Total**	**General Fund**	**Life Membership Fund**	**Total**
Current Assets						
Cash plus marketable securities at lower of cost or market	$ 4,251,429	$8,274,308	$12,525,737	$ 4,622,610	$7,683,983	$12,306,593
Receivables, prepaid expenses, etc.	1,311,335	485,332	1,796,667	1,752,449	556,766	2,309,215
Fixed assets (land, building, etc.)	12,825,106		12,825,106	13,143,376		13,143,376
Funds on Deposit and Other Assets	4,580,724		4,580,724	4,584,901		4,584,901
Total Assets	**$22,968,594**	**8,759,640**	**31,728,234**	**$24,103,336**	**$8,240,749**	**$32,344,085**
Liabilities and Fund Balances						
Current Liabilities (including payables, accrued expenses, etc.)	$ 3,050,060		3,050,060	$ 3,439,859		$ 3,439,859
Deferred Revenue (including advance membership dues and magazine subscriptions)	1,363,315		1,363,315	1,623,126		1,623,126
Long-Term Debt	6,242,500		6,242,500	6,535,000		6,535,000
Fund Balance						
Unrestricted	10,854,204		10,854,204	10,873,698		10,873,698
Designated	1,458,515		1,458,515	1,631,653		1,631,653
Restricted		8,759,640	8,759,640		$8,240,749	8,240,749
Total Liabilities and Fund Balances	**$22,968,594**	**$8,759,640**	**$31,728,234**	**$24,103,336**	**$8,240,749**	**$32,344,085**

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Capitol Hill

By Brian Green, Congressional Editor

Fifty Percent Down

Noting the drop in procurement funding since 1985, the House Appropriations panel expresses concern about the industrial base and defense technology.

House versions of the new defense authorization and appropriations bills reflect mounting unease that contraction of the US defense industrial base and weakening of the technology base could hamper efforts to maintain top-flight forces.

The House Appropriations Committee noted that the Fiscal Year 1992 arms procurement request marks a decline in value, since Fiscal 1985, of fifty percent and comes in at a level fourteen percent below the pre-Reagan, Fiscal 1981 level, expressed in terms of constant, noninflated dollars. As a result, said members of the panel, "the Committee [is] concerned about . . . maintaining an adequate industrial base for the defense industry."

The authorization and appropriations bills, which must be reconciled with Senate versions and signed by President Bush, include a number of initiatives designed to protect the nation's ability to produce weapons and technology. These include:

- Extended production of the F-16 fighter. The House resisted USAF plans to end its F-16 buys after Fiscal 1993. The Air Force argues that there is no room to absorb new F-16s in a shrinking force structure. The House Armed Services Committee (HASC) expressed concern that termination would "leave the Air Force with no warm production base for fighter aircraft after Fiscal Year 1993" and at least a five-year gap in fighter production.
- Elimination of funding ceilings for independent research and development (IR&D) conducted by contractors. The authorization report took note of "numerous and dramatic advances" that grew out of IR&D work. It recommended setting a policy of granting full "allowability" for reimbursement of contractor IR&D and bid and proposal expenses.
- Increased R&D funding for DoD and the Air Force. The House authorization bill would add $632 million to the DoD R&D request of $40.1 billion (up from $34.5 billion in FY 1991) and $305 million to the Air Force request of $15 billion (up from $11.7 billion). The appropriations bill would cut the overall requests by about $2 billion, but would still provide a large increase over FY 1991.
- More money for the technology base. The House's authorization bill would provide an additional $516 million for basic research and exploratory development, while the appropriations bill would add $222 million.

Strategic Priorities

Secretary of the Air Force Donald B. Rice and Gen. Merrill A. McPeak, USAF Chief of Staff, testified before the Senate Armed Services Committee that the B-2 bomber and SDI are their top strategic priorities, but that the fifteen B-2s currently authorized would not constitute a viable combat force.

HASC Chairman Rep. Les Aspin (D-Wis.) has been an avowed B-2 opponent for most of the past year. However, he has signaled that he is moderating his position. In a recent speech, he conceded that "the Air Force may well be right" that the B-2 would be effective as a conventional bomber, though he argued that a total of ten operational B-2s would be sufficient to handle the conventional mission.

Secretary Rice told Senators that he could "not imagine . . . that ten aircraft would be enough for any credible operational force." He preferred to "put the emphasis on . . . [Representative Aspin's] public recognition of the value of the B-2 in a conventional role."

Secretary Rice indicated that the new bomber would be qualified for both conventional and nuclear missions around 1995. "Baseline capabilities provided for in the bomber give it a full range of capabilities to deal with a wide range of target sets for both precision and more massive deliveries," said the Secretary. Modifications to provide a wider range of precision capabilities for the B-2 are being explored. Laser-guided munitions (like those carried by the F-117) would involve some cost, but other options are not expensive, he said.

Secretary Rice argued that, while the Air Force does not manage the SDI program, "we need to be marching down the path to effective defenses against ballistic missiles . . . I think we have been very clear . . . about the top priority of SDI and the B-2." General McPeak stated, "I believe strongly in the idea that we ought to try to defend the United States from ballistic missile attack."

The House appropriations bill zeroed B-2 procurement to remain consistent with the authorization bill. However, Rep. John Murtha (D-Pa.), chairman of the Appropriations Defense Subcommittee, is a B-2 supporter and may be willing to restore procurement funds in the House-Senate conference.

Women Fighter Pilots

The House authorization bill would permit female military pilots to fly combat missions.

The House language would not require the services to place women in combat roles but would lift the statutory ban regarding combat aircraft. The Army is not restricted by current law but, as a matter of policy, bars women from "direct combat" assignments.

General McPeak testified before the Senate that he was reluctant to put Air Force women in "greater jeopardy." He said, however, that if Congress changed the law, he would recommend that Air Force regulations be changed to allow women to fill any role for which they qualify. Currently, Air Force female officers are excluded from fighters, bombers, forward air control aircraft, most helicopters, and some reconnaissance aircraft. Enlisted women are excluded from careers in pararescue, defense aerial gunner, combat control, and tactical air command and control. The House bill would open all the officer slots and most of the enlisted career fields to women. ■

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Washington Watch

By James W. Canan, Senior Editor

One Base, One Wing, One Boss

After restructuring, the Air Force will have less headquarters overhead and a more operational look. "Stovepipe" support organizations will be out of fashion.

- New composite wings combining different kinds of airplanes and assorted squadrons under a single commander for a variety of missions.
- Brigadier generals instead of colonels commanding forty-five wings, composite or not.
- Wing commanders owning more assets on their bases and taking command of the installation as well—under the motto "one base, one wing, one boss."
- Much broader responsibility for squadron commanders.

These are just some ingredients of a major structural makeover that Gen. Merrill A. McPeak has in mind for the Air Force. On becoming Chief of Staff late last year, he declared that "reorganization is a very high priority." Now he is moving to make good on his word.

General McPeak proposes sweeping changes to streamline management, stimulate leadership, strengthen operations, and save money at all levels of the Air Force, from flight lines to headquarters at the Pentagon. He is intent on husbanding dwindling monetary and manpower resources, but that's only part of it. Those most familiar with his program call it the most fundamental set of changes since the Air Force was established.

The Chief of Staff's main goal is to make the Air Force even more potent than it proved to be in the Gulf War, which was plenty. He asserts that "combat capability is the measure of merit" in all his moves. Thus he has set out to "strengthen that noble concept, the chain of command;" to "combine authority and responsibility, so that we have true accountability for performance at every level;" and to "open the gates to leadership" for greater numbers of deserving air warriors.

Air wings, the essence of the warfighting Air Force, are in for a big shot of change. It has long been standard practice for colonels to command these wings. General McPeak proposes a drastic departure. In his reorganization plan, brigadier generals would command wings on USAF's forty-five largest bases—those with 4,000 or more personnel.

The Chief of Staff also proposes to remove any ambiguity about whether the wing commander or the base commander is actually in charge of the installation. In his plan, wing commanders gain rank and managerial stature while retaining responsibility as combat leaders. They will fly unit missions and make important decisions on the combat battle staff, but they will have to balance their time between these duties and those of running a major Air Force installation.

Other changes flow from the one at the top of the wing. All raise questions. Why make big changes in air wings when they work well now? Indeed, why go to great lengths to fix an Air Force that clearly, as they say, "ain't broke"?

General McPeak admits that those questions seem to be good ones, but he maintains that they miss the point, which is that the Air Force has no choice but to change. This is also the viewpoint of Air Force Secretary Donald B. Rice.

Ever-tighter budgets compel USAF to trim down, tone up, and operate with utmost efficiency. It is faced with the need to stay in fighting trim even as it loses personnel, airplanes, and installations. It will shrink by one-fourth or more in all those respects in the years ahead.

General McPeak declares, "Our resource base is shrinking and the projection is pretty bleak, but Secretary Rice and I have no intention of presiding over the decline of the US Air Force." To avert such a decline, "we must change the way we do business, whether we want to or not," he insists.

Dwindling resources are not the whole story behind the reorganization. Keeping up from an operational standpoint has at least as much to do with it. General McPeak contends that USAF cannot stand pat. He wants it to stay ahead of the game in making changes to counter diverse and deadly threats around the globe.

"It doesn't make any difference that we are the world's best air force or that we demonstrated in the Gulf War just how good we are," the Chief of Staff asserts. "We are going to have to change because our competition will change and so will our position relative to that competition. I'm dedicated to making sure that we control the change, that we change because it makes good operational sense to us."

His move to redo air wings makes the point. He sees the restructuring as a means of reducing overhead and of complying with the cost-cutting recommendations of the Defense Management Review of 1989, a Defense Department–wide study that spurred big changes throughout DoD to cut costs and personnel while safeguarding national security. But money and manpower are secondary considerations. Combat capability comes first.

For air wings, the Chief of Staff proposes "a series of reforms that are aimed not so much at reducing costs as they are at streamlining operations and making them more combat-effective."

General McPeak is scheduled to retire on October 1, 1994. He is determined to leave the Air Force even more competent and reliable than it was when he took charge of it. He will not ease up in his efforts to reorganize it, his associates say.

His game plan also puts composite wings into play. That concept has been around for a while but has never been instituted and exploited. USAF's great success at coordinating the logistics, missions, and sorties of all sorts of aircraft in the Gulf War did a great deal to cinch the credibility of the mixed-planes composite-wing concept.

Such wings are now being formed at Andrews AFB, Md., and at Seymour Johnson AFB, N. C., but those are relatively narrow in scope. At Andrews, the 89th Airlift Wing will combine two wings—an airlift wing whose mission is Presidential support and an air base wing that now exists only to run the base. At Seymour Johnson, the new 4th Wing—with no "Tactical Fighter" or "Air Refueling" modifiers—draws together a wing of F-15Es and a wing of KC-10s. It is a flexible arrangement from an operational standpoint. SAC headquarters at Offutt AFB, Neb., retains control of the wing's KC-10s for worldwide tanker scheduling.

A composite wing on a much grander scale is slated for Mountain Home AFB, Idaho. It will feature a rich assortment of aircraft—F-15Cs, F-15Es, B-52s, KC-10s, E-3 AWACS planes, and possibly others. General McPeak calls it an "intervention wing" and says there will be others like it to come.

He explains: "We'll have some composite wings, like the one at Mountain Home, that are built up around Secretary Rice's concept of global reach, global power. Those wings are designed to go somewhere and do some damage—quickly."

General McPeak points out that USAF already runs "many composite operations" at overseas bases. He cites Kadena AB, Okinawa, Japan, as "the perfect example, with a large number of different kinds of airplanes operating there."

Those airplanes—air-to-air fighters, tankers, and AWACS planes, among others—will come together under one commander, a brigadier general, in the reorganized 18th Wing, a prototypical composite wing.

In remaking wings and commands—and in many other respects—the McPeak plan bucks tradition, topples empires, and raises fears for careers here and there. Thus its champions anticipated stiff resistance, even rebellion, in some Air Force circles.

It didn't happen. The Chief of Staff's fellow four-stars reportedly gave his plan a favorable reception when briefed on it at a mid-June Corona meeting, and it seems to be catching on across the Air Force without a lot of hiccups.

Changes in the makeup of wings and in the ranks and responsibilities of their leaders may be the biggest attention-getters in the reorganization plan. But there are many other elements, some of which were announced by Air Force headquarters late last year and earlier this year. The plan also calls for:

- Rearranging the lineup of Major Commands. Air Force Communications Command becomes a Field Operating Agency, with its field communicators transferring to their host wings. Air Force Intelligence Command comes into being *[see "Aerospace World," p. 26]*. Air Force Systems Command and Air Force Logistics Command merge to form the new Air Force Materiel Command already being established at Wright-Patterson AFB, Ohio *[see "Curtain Up on Materiel Command," p. 66]*.
- Dispensing with Air Divisions and transforming USAF's fourteen numbered air forces from administrative units into operational echelons led by three-star generals whose workaday uniforms are flight suits instead of blue suits. They will also have much slimmer staffs.
- Eliminating Separate Operating Agencies and funneling their functions into newly fashioned Field Operating Agencies. FOAs are expected to be more responsive to Air Force headquarters and to operational demands.

In this as in all things, General McPeak aims for closer ties and clearer lines of authority between operations elements and support elements throughout the Air Force. His blueprint for a better Air Force reaffirms the primacy of the operational side of the service in all such linkages. It breaks up the autonomous, "stovepipe" organizations that provide operational units with such support services as maintenance, weather forecasting, and communications. It transfers the control of support services from those who generate the services to those who make use of them.

Air wings are in for a big shot of change as part of General McPeak's plan to reorganize the Air Force.

For example, wing weather shops formerly run by Air Weather Service out of Military Airlift Command headquarters now belong to the operational commanders whom they serve.

General McPeak declares that "stovepipes will be out of fashion" in support organizations. "Maintenance, weather, and communications people, and most other support personnel, will be directly responsible to combat commanders, not to a functional chain. Airplanes will belong to flying squadron commanders, not to the maintenance world."

The Chief of Staff does not intend his reorganization plan as a put-down of support organizations and functions; rather, as the means of making them more effective from an operational perspective. In some ways, in fact, the support infrastructure gains influence in blue-suit circles at the Pentagon. The McPeak plan creates general officer slots on the Air Staff for "functional chiefs" of supply, transportation, maintenance, safety, security police, and weather, for example, thus "letting people [in those fields] know that they have a daddy rabbit in Washington," General McPeak explains.

The way he sees it, though, there will be far fewer big bosses in blue suits in Washington. The Air Force must lose fifty-nine general officers between now and 1995—from 338 down to 279. This includes a loss of forty-two "line" general officers—from 270 down to 228. Air Force headquarters will take a net loss of fourteen such line generals. Jobs currently filled by twenty-one of them, including three deputy directors and five assistant deputy directors, will disappear. But seven slots will be added—directors of requirements, weather, intelligence, communications, and supply and chiefs of safety and security police.

Rearrangements of general officer ranks and responsibilities, amid net reductions, will hold true throughout the Air Force. All such moves are in tune with the findings of the Defense Management Review and the Goldwater-Nichols defense reform act of 1986.

A major aim of the reorganization is to clarify roles and responsibilities in and between the Air Staff and the Air Force Secretariat. One such responsibility is that of establishing requirements for new weapons and other major systems. It gravitated from the Air Staff to the civilian-run Secretariat in recent years as part of the overall reform of the acquisition process. Now General McPeak proposes restoring the requirements-setting responsibility "to the military side" of headquarters where, he believes, it properly belongs.

The McPeak plan also transfers the supervision of flight safety and security functions from the Secretariat back to the Air Staff where they once

resided. "The Secretary and I agree that these are essentially military functions and that they belong in the Air Staff," explains General McPeak.

On the military side, there is nothing more important than air wings. They are what the Air Force is all about, and they will have a much different look when the Chief of Staff gets through with them.

As it stands, a typical air wing is commanded by a full colonel and includes several others of that rank, among them the vice commander; deputy commanders for operations, maintenance, and resource management; and the combat support group commander.

In the McPeak format, much of this changes. The wing commander is a brigadier general, the vice commander a colonel. The wing is made up of an operations group, a logistics group, and a support group, each under a colonel whose title is group commander.

General McPeak proposes to delegate staff functions within each group to enable group commanders to concentrate on their principal purpose: keeping fit for flying and fighting. Thus each "ops group" will consist of a number of operations squadrons and an operations support squadron. Ops support squadrons will provide services now managed by the staffs of wing directors of operations—weapons and tactics, analysis, scheduling, and operations training—and will also be responsible for weather forecasting, air traffic control, and base operations.

The ops group commander envisioned in the reorganization plan is a warrior all the way. "He's not a staff officer, he's a commander, a walking-around leader who doesn't have to sit in his office supervising staff activities," General McPeak explains.

Lieutenant colonels will command the flying squadrons in each operations group. Just as now, each squadron commander will have an operations officer and a complement of pilots. But in the new setup, each will also have a maintenance officer, will oversee the flight-line maintenance personnel assigned to the squadron's airplanes, and will be responsible for the squadron's sortie-generation and sortie-support activities.

Given their broader command responsibilities, squadron commanders will have "a much different challenge of leadership" than they do now, General McPeak declares. "They will be well trained for the next step up the rung and beyond, because they'll be getting a much bigger picture of how the Air Force actually runs."

The restructured air wing exemplifies the "skip-echelon" pattern of staffing—lean staffs at management echelons, leaner staffs at echelons more intensely involved with operations—that General McPeak is shooting for throughout the Air Force. For example, in his plan, commanders of major air commands require more functional staff support than do commanders of numbered air forces, which are newly designated as operational echelons. Thus Majcom commanders are slated for lean staffs, numbered air force commanders for leaner staffs.

The restructuring will strengthen the chain of command and open the gates to leadership all around.

The same skip-echelon sequence holds true for staff support within a wing—from wing commander (lean) to group commander (leaner) to squadron commander (lean).

Like his operations group counterpart, the colonel in command of the logistics group in each reconstituted air wing will be an on-the-go leader who leaves most management details to his squadron commanders.

"The logistics group commander comes to work in fatigues," declares General McPeak. "The only function under his direct supervision is quality assurance. He walks around those shops making sure that quality is what it ought to be. His squadron commanders do all the former maintenance and resource management staff functions."

The logistics group of each remolded air wing will be responsible for wing intermediate-level maintenance away from the flight line and will incorporate a maintenance squadron to do the job.

General McPeak expects that intermediate-level maintenance will vary from base to base. "Some bases will have an engine shop and an avionics shop and other I-level maintenance activities, but others will not," he says.

The Chief of Staff also expects that maintenance squadrons and some I-level maintenance facilities, such as battery shops, machine shops, and wheel and tire shops, will be required on air bases for some time to come. But the tide may be running against them.

"The Secretary and I want to see I-level maintenance and that maintenance squadron shrivel and shrink wherever possible," asserts the architect of the wing restructuring plan. "As we get better reliability and maintainability in our equipment, we want to move toward two-level [flight line and depot] maintenance."

In addition to a maintenance squadron, each logistics group in an air wing will also include supply, transportation, and logistics support squadrons. Each wing's support group will include a mission support squadron, a security police squadron, a civil engineering squadron, a morale, welfare, and recreation squadron, and a base communications squadron.

The Air Force will find enough one-star slots for air wings among those taken from other organizations. Only the wing level will show a gain of general officers, from two to forty-five. The number of general officers at Air Force headquarters will drop from fifty-eight to forty-four, in major command headquarters from sixty-four to forty-seven, in numbered air force and equivalent headquarters from fifty-nine to thirty-three, and in air divisions from seventeen to two.

For the most part, the reorganization "forces generals out of office staff jobs and into jobs running big pieces of Air Force business on bases," says General McPeak. "At the same time, it opens up or creates a lot of important staff jobs for colonels. So it does not have a bad side so far as I can tell. It has all the redeeming features you look for in a management initiative."

The plan "opens the gates to leadership" all around, General McPeak claims. Group commanders who do well will move on to senior service school and to follow-on assignment to a joint or headquarters staff. Then comes promotion to brigadier general and wider opportunities for command at the general officer level.

Successful wing commanders will move up to command numbered air forces. "They'll be back in the combat business again, wearing a flight suit every day, doing what they love," explains the Chief of Staff. Ditto for the best of the operations squadron commanders, who will pin on eagles, put aside memo pads, and take command of groups.

"I'm very excited and optimistic about the personnel dynamics of the wing restructuring," General McPeak declares. "It creates very attractive career tracks for everybody, with a good mix of management and leadership along the way." ■

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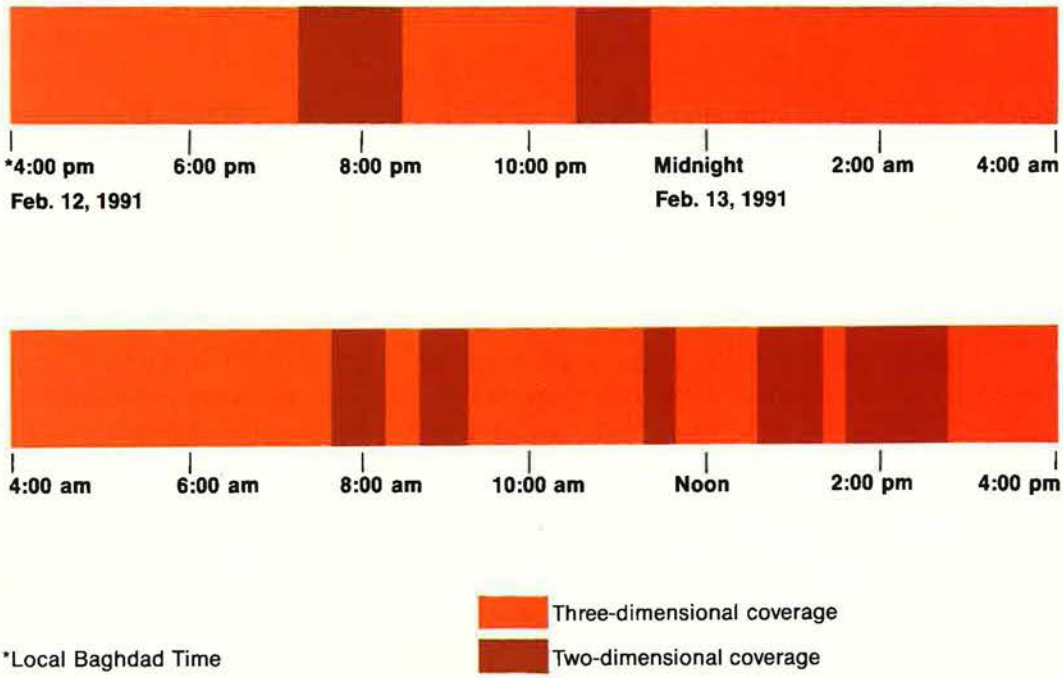
The F-16. For 18 nations, it not only protects, it saves.

GENERAL DYNAMICS
A Strong Company For A Strong Country

The Chart Page

Edited by Colleen A. Nash, Associate Editor

GPS Success in Desert Storm



*Local Baghdad Time

When the Navstar Global Positioning System (GPS) is fully deployed in 1993, the twenty-one-satellite constellation will give military users worldwide position fixes in three dimensions—latitude, longitude, and altitude—to within sixteen meters, twenty-four hours a day. The partial constellation of sixteen GPS satellites performed better than USAF expected in Operation Desert Storm. During this particular twenty-four-hour period of intense bombing in February, the interim system's positional accuracy averaged 7.5 meters. Moreover, the three-dimensional coverage was available for some twenty hours. With two dimensions of coverage, operators must manually enter an altitude value. For more on GPS, see "A Watershed in Space," p.32.

Source: Air Force Space Command

The Comeback in Space

The space-launch recovery plan devised by the Air Force after the 1986 *Challenger* accident ensured that high-priority payloads, such as those carrying the Navstar Global Positioning System satellites, got off the ground. As of June 12, 1991, there have been fifteen space launches from the Eastern Space and Missile Center and three from the Western Space and Missile Center. Totals include DoD, NASA, and commercial space launches.

SPACE LAUNCHES			
Fiscal Year	**Eastern Space and Missile Center, Fla.**	**Western Space and Missile Center, Calif.**	**Total**
1986	7	4	11*
1987	4	5	9**
1988	4	7	11
1989	13	2	15
1990	20	4	24
1991 (projected)	22	7	29

*Includes three failures
**Includes one failure

Source: Air Force Space Command

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

A new antenna with an integral high-speed computer helps an airborne radar system achieve higher resolution ground maps. The radar, designed and built by Hughes for the U.S. Air Force, uses a phased-array Electronically Scanning Antenna (ESA) and a Beam Steering Computer (BSC) to create the wide instantaneous bandwidth necessary for distinguishing between closely-spaced targets. When the BSC is commanded by the flight's mission computer to scan a certain area, the BSC moves the radar beam by computing new settings for the electronic phase shifters several million times a second.

In a major breakthrough in integrated circuit technology, Hughes has developed a technique for producing distinct lines approximately one three-millionth of an inch in width on semiconductor chips. These ultrasmall features, which are 100 times smaller than those of most commerical integrated circuits, will play a vital role in an emerging integrated circuit technology based on quantum physics. Rather than using electron beams, they were created with a focused ion beam since features in resist material can be defined much more accurately using ions. Scientists predict these semiconductor chips will operate 10 times faster than conventional circuits.

A rocket engine less than an inch long and weighing only 3.5 grams (about a tenth of an ounce) will control a space intercept vehicle. The engine was designed for the Lightweight Exo-Atmospheric Projectile (LEAP), a state-of-the-art intercept device under development by Hughes for the U.S. Army. The miniature LEAP rocket produces one pound of thrust by expelling hot gas, produced in a gas generator, in small pulses less than a millisecond in duration. The projectile also includes a long-range imaging infrared seeker and a 4.2 million instructions per-second computer that weighs less than an ounce. The LEAP vehicle, which has no warhead, is the smallest and lightest-weight intercept technology being developed for defensive applications.

A microprocessor simplifies complex welding procedures in a new welding controller.
The programmable AC welding controller, developed and built by Hughes and designated the Model HAC-1000, is a microprocessor-based system designed to control complex welding functions via simple walk-through programming. A HELP key provides a built-in operation manual and an OPTIONS key prompts operators through a variety of functions. Four different weld schedules may be pre-programmed, and each sequence may be activated by pressing a button on the front panel. For automated applications, programs may be selected or altered through an RS-232 interface.

For more information write to: P.O. Box 45068, Los Angeles, CA 90045-0068 USA

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Aerospace World

★ Calling the early hours of January 17 "some of the most nervous moments of my life," Operation Desert Storm air commander Lt. Gen. Charles A. Horner gave a detailed, command-bunker view of the air war in extensive Senate testimony. Hundreds of allied aircraft attacked along four major avenues, he explained, three leading into Iraq and one into Kuwait. The route farthest west was cleared when Army AH-64 Apache helicopters struck radars inside Iraq at 2:38 a.m., followed by F-117 Stealth planes that hit more radars located deep inside Iraq. Through that corridor in the radar coverage stormed additional F-111s, A-7s, Tornados, and F-14 fighters.

Punching through the next avenue to the east were USAF F-15Cs, F-4Gs, EF-111s, and Navy EA-6Bs. Flooding into Iraq just to the west of Kuwait in the next corridor were Air Force heavy, long-range B-52 bombers and Tornado GR Mk. 1s. Striking along the avenue farthest east, into Kuwait, were US Navy and Marine Corps F/A-18s and A-6s. The fighter and bomber aircraft were supported by aerial tankers, E-3 Airborne Warning and Control System (AWACS) planes, and carrier-based Navy F-14s flying combat patrol in the Persian Gulf.

Thus, said General Horner, the war began with an "unbelievably complex" first air strike. It included, all told, some 500 aircraft attacking with split-second timing, General Horner told the Armed Services Committee. The massive raid—Iraq was hit by roughly 300 fighter and strike aircraft supported by 160 or so tankers—aimed to "bore holes in [Saddam Hussein's] defenses, blind him, and also strike" Scud missile sites and other targets that might allow Iraq to mount a counterstrike.

Highlighting an emerging ability to react almost instantly to new intelligence, General Horner in his May 22 appearance on Capitol Hill told of several last-minute changes to air missions. Some pilots were actually halted on the flight line and given photos of new targets. In another instance, General Horner's command learned late in the afternoon that the Iraqis at Al Taqaddum airfield near Baghdad were loading several medium-range bombers with what were thought to be chemical munitions. The command found some F-117 fighters that had planned intensively for another mission that night, gave them rough coordinates for the targets, and diverted them to attack the suspect aircraft. "We nailed six of those airplanes on the ground before they could be launched against us," General Horner testified.

—US Army photo by Major Kuenning

Army AH-64 Apache helicopters like this one fired the first shots of Operation Desert Storm when they struck Iraqi radars at 2:38 a.m. January 17. Lt. Gen. Charles A. Horner told the Senate that the Apaches were followed by F-117A Stealth fighters, which attacked radars and hit other targets even deeper in Iraq.

★ After a major eruption of Mount Pinatubo in the Philippines blanketed Clark AB with six to twelve inches of volcanic ash, the United States on June 21 began pulling out 4,500 "nonessential" Air Force personnel from the country. Withdrawal of the personnel will leave roughly 2,500 Air Force members still assigned to Clark, though only a few hundred are actually staying on the base. Most of those are security guards.

More than 18,000 service members and dependents were already evacuated due to the threat. The last of forty-eight F-4E Phantom fighters were withdrawn from the base before the volcano erupted. All remaining transport aircraft and helicopters were evacuated when Pinatubo began showing signs of activity. The base is unusable for air operations, and US officials were unsure of the extent of damage or possible cost of reconstruction.

While US officials promised to press ahead with difficult negotiations over a new basing agreement for Clark and for Subic Bay naval base, the natural disaster has severely complicated the issue. "If there is a lot of reconstruction that has to be done . . . you have to look at that vs. the amount of time that the base contract will run for," said Pentagon spokesman Pete Williams.

★ During Desert Shield and Desert Storm, Air Force Logistics Command (AFLC) had to rely on foreign suppliers of parts and subassemblies forty-two times. Noting that the command was awarding approximately 12,000 contracts a week during the war,

Anniversaries

- *August 2, 1911:* Harriet Quimby becomes the first woman pilot in the US to obtain an FAI certificate. She receives certificate #37 at Mineola, N. Y.
- *August 2–3, 1916:* The German Army airship *Schütte-Lanz* SL11 is shot down over London by a BE2C piloted by Lt. William Leefe Robinson, who was awarded the Victoria Cross for this on September 5, 1916. The downing of the airship demoralized airship crews and helped prevent the expected large-scale raid on London.
- *August 29, 1916:* The first US Coast Guard Aviation Division is authorized, although no funds are appropriated until 1926.
- *August 1, 1921:* The first Vickers Vernon troop-carrying biplane, the first aircraft specifically designed as a troop carrier, is delivered to the RAF.
- *August 10, 1921:* The US Navy Bureau of Aeronautics is formed, with Rear Adm. William A. Moffett in charge.
- *August 1, 1941:* The US bans the export of aviation fuel except to the UK and unoccupied nations resisting the Nazis. This is a severe blow to Japan, which is at war with China, and hastens its decision to join the Axis powers in war against the Allies.
- *August 2, 1946:* The National Air Museum is established as part of the Smithsonian Institution.
- *August 17, 1946:* Sgt. Lawrence Lambert, USAAF, of Wright Field, Ohio, makes the first US test of a manned ejection seat, from a Northrop P-61 Black Widow flying at 302 mph at 7,800 feet.
- *August 1, 1951:* Canada and the US ratify an agreement to cooperate in the development and construction of an early warning defense system.
- *August 15, 1951:* Maj. William Bridgeman flies a Navy D-558-2 Douglas Skyrocket to the highest altitude ever reached by a human being, 79,494 feet, at Muroc Field, Calif. That same day he also sets a world speed record of 1,238 mph.
- *August 24, 1951:* Maj. Louis J. Sebille is posthumously awarded the Medal of Honor for continuing to attack Communist troops in his damaged plane until it crashed near Hamchang, Korea, on August 5, 1950. He is the first Air Force Medal of Honor recipient of the Korean War.
- *August 10, 1966:* Air Training Command's Officer Training School graduates its 20,000th second lieutenant.
- *August 6, 1971:* An Air Force Atlas rocket is launched from Vandenberg AFB, Calif. It places nine experiments into three different orbits.
- *August 25, 1981:* NASA's Voyager 2 spacecraft makes its closest approach to Saturn, returning spectacular pictures of its moons and rings.
- *August 26, 1981:* First flight of the first McDonnell Douglas F-15J Eagle assembled by Mitsubishi in Japan from US-built components.

AFLC Commander Gen. Charles C. McDonald called the level of foreign dependency relatively small.

However, General McDonald added a warning. In three of the forty-two cases, he said, no alternative supplier existed and the US faced a sole-source situation. "Foreign dependency was not a problem," said General McDonald, "but if the coalition had been different, it might have been. If the foreign suppliers had chosen to cut us off for political reasons in those few cases where they were the sole source, we might have had trouble recovering."

★ Two F-117 pilots who flew combat missions in the Gulf War told members of the Senate Armed Services Committee that they and other pilots devised maneuvers and tactics to optimize the plane's low-observable characteristics. "I think it's important to remember that the F-117 is a low-observable airplane, rather than a no-observable airplane," said Lt. Col. Ralph Getchell, an F-117 squadron commander. "We're aware very precisely what its characteristics are, and we planned our missions to take advantage of those characteristics." When the aircraft were briefly visible to Iraqi radar, Colonel Getchell said, they would "change altitude, change heading, and disappear again."

The Fiscal Year 1992 defense authorization bill approved by the House includes $83 million for modifications to upgrade the performance of the F-117A fighter. Lockheed officials said that the Senate agrees in principle to the improvement package, which was "fully coordinated" with the Air Force. The package includes upgrading the mission planning system's user interface; adding Global Positioning System capability; adding low-probability-of-intercept, aircraft-to-aircraft communications; and giving the aircraft all-weather capability. It would cost roughly $500 million to upgrade the entire fleet of fifty-six airplanes over several years, say Lockheed officials.

Seven F-117s have already undergone the Offensive Capability Improvement Program, which includes upgraded mission computers and installation of Digital Tactical Displays and automatic throttles for cruise control. The House also authorized $140 million for the start of research on an F-117A+ derivative. It suggested installing into the F-117A the engine that had been planned for use in

—Photo by Paul Kennedy

Although famed for its low-observable properties, the F-117 is not "a no-observable airplane," Squadron Commander Lt. Col. Ralph Getchell told the Senate Armed Services Committee. He explained that pilots devised tactics to make the most of the plane's characteristics. Here, he answers questions at the Paris Air Show.

the now-defunct Navy A-12 attack jet. According to the Air Force, that would increase the aircraft's combat range by twenty-one percent, from 600 nautical miles to 728, and reduce its takeoff distance by thirteen percent.

★ The Synthesis Group appointed by NASA to study ways to pursue President Bush's Space Exploration Initiative (SEI) issued its blueprint for a permanent return to the moon and a landing on Mars by 2019. Chaired by retired Air Force Lt. Gen. Thomas P. Stafford, the group of senior aerospace experts sifted through some 2,500 ideas during a ten-month national outreach program. The result was a 180-page report supported by sixty volumes of backup material.

The group's recommendations centered on four separate exploration architectures based on varying goals. The approaches included Mars exploration alone, with moon visits used for testing; detailed exploration of both the moon and Mars; permanent human settlement on the moon to support Mars exploration; and use of resources found on the moon, Mars, and a near-Earth asteroid.

Each proposal would require significant technological advances, but the group emphasized its preference for incremental approaches, building on technologies used in earlier manned and unmanned space efforts. For example, the members strongly endorsed nuclear thermal propulsion of the kind developed in the Nuclear Engine for Rocket Vehicle Application (NERVA) program in the 1960s and 1970s. This could also apply to the problem of how best to get large payloads out of Earth's gravity. The group echoed a suggestion made by the Johnson Space Center that the US return to the liquid oxygen/kerosene combination used in the Saturn V F1 engines developed in the 1960s.

Beyond propulsion, the architectures would require advances in at least eleven other areas, from nuclear powerplants for moon and Mars surface operations and automated docking for large spacecraft to zero-gravity countermeasures and closed-loop life support. Conspicuously absent from the report was any estimate of cost for the proposals. Stafford emphasized that existing federal research programs in NASA, DoD, and the Energy Department could be focused on the long-term SEI goals.

The first step toward the goals outlined in SEI is scheduled to take place in late 1992 or early 1993 with the launch of the Mars Observer to gather data on atmospheric and surface conditions. The Synthesis Group recommended two Mars orbiters with a similar mission in the 1998 time frame to scout landing sites.

★ Pelted with questions after the Air Force alluded in congressional testimony to a secret standoff conventional weapon in development for the B-2 bomber, the Pentagon on June 6 revealed the existence of the Tri-Service Standoff Attack Missile (TSSAM). The Air Force is leading the joint-service effort, now in full-scale development, to produce a 2,300-pound stealthy missile with ranges under 600 kilometers for the air-launched version (AGM-137) and 500 kilometers for the ground-launched variant (MGM-137).

The Pentagon selected Northrop to develop the weapon, with Boeing named as the second source. The program is to produce 8,650 missiles by 1999 at an inflation-adjusted cost of $15.1 billion, or $1.7 million each. The Air Force has told Congress that the B-2 will be able to carry eight

TSSAMs, and the weapon will also equip the B-52 bomber, F-16 fighter, and the Navy's A-6 strike aircraft and F/A-18 attack plane. The Army will fire a variant of it from the Multiple Launch Rocket System. Initial operating capability for the subsonic TSSAM is expected in the mid-1990s.

★ **NEWS NOTES**—Trying to land after its first flight on June 11, **the fifth Bell-Boeing V-22 Osprey tilt-rotor aircraft crashed** on its back on the runway at the New Castle County airport in Wilmington, Del., near Boeing's suburban Philadelphia facility. According to a contractor statement, the Osprey's left engine initially struck the ground in the attempted landing, and the aircraft subsequently lifted off, rolled to the left, and flipped onto its back. The Navy has launched an investigation into the incident. The V-22 flight testing has been temporarily suspended.

Advancing the wave of consolidations sweeping through the defense establishment, **the Air Force** announced that it **is forming the Air Force Intelligence Command,** with activation scheduled for **October 1 at Kelly AFB,** Tex. The new AFIC will consolidate the personnel and missions of the Air Force Foreign Technology Division, Wright-Patterson AFB, Ohio; the Air Force Special Activities Center, Fort Belvoir, Va.; elements of the Air Force Intelligence Agency, Washington, D. C.; and the Electronic Security Command at Kelly. Approximately 17,000 people will be assigned to the new command, which will offer theater commanders a single focal point for support that encompasses all intelligence disciplines.

In early June, aerospace giants **General Dynamics and McDonnell Douglas filed suit to overturn the Defense Department's A-12 default termination** and seek a determination that the huge contract was canceled for the convenience of the government. The difference in wording is important; under a convenience-of-the-government cancellation, the contractors would have significantly lower financial exposure than is the case today.

The companies charged that the Navy misled them about the risks associated with service performance targets and never reduced those risks sufficiently to justify a fixed-price development program under Pentagon rules and federal law. The suit claims that the Navy also cut back so severely on the demonstration and validation phase that they couldn't perform studies essential to reducing the risk in the development program.

Much of the team's suit seems to rest on statutes that bar DoD from spending appropriated funds on fixed-price contracts to develop a major system "unless the Under Secretary of Defense for Acquisition (USDA) determined that program risk had been reduced to the extent that realistic pricing could occur." The companies claim that the USDA never did that.

On June 6, after an aggressive campaign by the White House to save the space station, **the House of Representatives voted to keep the orbital laboratory** as the centerpiece of future US space exploration. The action came in direct response to an Appropriations Committee vote to kill the project. Under the rescue amendment approved by the House, most of NASA's 1992 budget would be frozen

Avionics Integration General Manager Ed Bailey of Douglas Aircraft Co. works the controls of the C-17 airlifter's flight-hardware simulator, which is used to verify the integration of all C-17 flight control and avionics hardware and software. The cockpit features stick instead of yoke controls and a head-up display similar to those in fighter aircraft. The C-17 is scheduled for its first flight this summer.

at 1991 levels in order to provide $1.9 billion for the space station. NASA officials said they hope to restore balance to the space program by recovering some money for other space programs in the Senate.

Former Navy research chief Melvyn Paisley pleaded guilty in federal court to three charges of conspiracy, bribery, and conversion in connection with the Justice Department's Ill Wind probe of defense contractor abuses. The former Assistant Secretary of the Navy for Research, Engineering, and Systems, who served during the years of the massive fleet and naval aircraft buildup in the era of Navy Secretary John F. Lehman, Jr., thus became the highest-ranking former government employee convicted in the investigation so far.

Congressional investigators concluded that the Air Force's method for choosing fourteen bases it plans to close was essentially sound. According to the General Accounting Office, the "Air Force's process of evaluating installations was a generally reasonable approach to identify potential closure or realignment candidates for the Secretary of Defense."

A Pentagon investigation found no evidence to support charges **of stalling and cover-up in its handling of reports on US prisoners or troops missing in action since the Vietnam War,** and DoD officials said no further action is required. The original charges were made in March by Army Col. Millard Peck, who quit after eight months as chief of the Defense Intelligence Agency's Special Office for Prisoners of War and Missing in Action. A highly decorated veteran, Colonel Peck claimed that most analysis by the office was directed at finding fault with the sources who reported sightings of some of the more than 2,000 Americans still listed as MIA or unaccounted-for in Vietnam.

★ MILESTONES—The Advanced Medium-Range Air-to-Air Missile (AMRAAM) **passed Air Force tests** to confirm the validity of various fire and flight characteristics. One missile was fired from an F-15 over the Gulf of Mexico and passed within lethal range of its target in a test of AMRAAM's fire-and-forget capability. Another missile was fired over Eglin AFB, Fla., to validate its launch characteristics when fired from a high-speed, turning F-16.

In test firings on June 6 at the Army's Redstone Arsenal, Ala., Martin Marietta and E&S Corp. conducted the **first successful demonstration of the multiple launch and guidance of two TOW missiles against separate targets.** According to a statement issued by the companies, the two missiles were launched less than two seconds apart and scored bull's-eyes on two targets.

The **Advanced Antitank Weapon System-Medium (AAWS-M) completed its second guided flight test** May 15 when it was fired from a gunner in the prone position, flew a top-attack trajectory, and struck a Soviet T-62 tank. The test was conducted at night to evaluate the missile's night tracking capability, according to Texas Instruments. AAWS-M is scheduled to complete its flight test program in early 1993.

A Hawk air defense system destroyed a short-range tactical ballistic missile in flight in the latest series of tests conducted by the Army. It was the third such test associated with the Army's Patriot/Hawk interoperability program. Under the program, target tracking data acquired by the Patriot

A TAV-8B Harrier II with Italian Navy markings flies over Missouri during a test by McDonnell Aircraft. It is one of two going to the carrier Giuseppe Garibaldi *to train Italian Navy pilots for the Harrier II Plus, whose radar integration and production is a collaborative program by the US, Spain, and Italy.*

The Panther 800 helicopter reached a milestone recently when it was moved from LTV Aerospace and Defense in Dallas to Aerospatiale's facilities in Grand Prairie, Tex. LTV designed the hardware and installation systems. Now Aerospatiale will install the T800 engines and cockpit. LTV, Aerospatiale, LHTEC, and IBM will offer the Panther 800 to the US Army as an off-the-shelf replacement for the UH-1 in the light helicopter utility role.

Senior Staff Changes

RETIREMENTS: B/G Edward N. **Brya;** B/G Jimmy L. **Cash;** B/G Charles E. **Fox,** Jr.; B/G Joel T. **Hall;** B/G Grover E. **Jackson;** L/G Monte B. **Miller;** B/G Erlind G. **Royer;** B/G Hanson L. **Scott.**

PROMOTIONS: To be **Lieutenant General:** Robert M. **Alexander;** Richard E. **Hawley;** Gary H. **Mears.**

To be **Brigadier General:** Ruben A. **Cubero.**

CHANGES: M/G (L/G selectee) Robert M. Alexander, from Dir., Plans, DCS/P&O, Hq. USAF, Washington, D. C., to Dep. Ass't Sec'y of Def. for Military Manpower and Personnel Policy . . . **M/G Marcus A. Anderson,** from Cmdr., 3d AF, USAFE, RAF Mildenhall, England, to Cmdr., AFOTEC, Kirtland AFB, N. M., replacing M/G Peter D. Robinson . . . **M/G Lawrence E. Boese,** from DCS/P&P, and Dep. Dir., Plans & Prgms., EACOS, Hq. USAFE, Ramstein AB, Germany, to DCS/Ops., and Dep. Dir., Ops., TACOS, Hq. TAC, Langley AFB, Va., replacing M/G Michael E. Ryan . . . **B/G Roy D. Bridges, Jr.,** from DCS/Test & Resources, Hq. AFSC, Andrews AFB, Md., to Cmdr., AFFTC, AFSC, Edwards AFB, Calif., replacing retiring M/G John P. Schoeppner, Jr.

B/G Frank Cardile, from Vice Cmdr., ESD, AFSC, Hanscom AFB, Mass., to Vice Cmdr., 21st AF, MAC, McGuire AFB, N. J., replacing B/G Fredric N. Buckingham . . . **B/G Jeffrey G. Cliver,** from Ass't DCS/Ops., Hq. USAFE, Ramstein AB, Germany, to Vice Cmdr., 7th AF, PACAF; C/S ROK/US Air Comp. Cmd., CFC; and Vice Cmdr., US Air Forces Korea, Osan AB, Korea, replacing retired B/G Jimmy L. Cash . . . **B/G Stewart E. Cranston,** from Vice Cmdr., ASD, AFSC, Wright-Patterson AFB, Ohio, to DCS/Test & Resources, Hq. AFSC, Andrews AFB, Md., replacing B/G Roy D. Bridges, Jr. . . . **Col. (B/G selectee) Ruben A. Cubero,** from Permanent Professor and Dept. Head of Foreign Languages, USAFA, Colorado Springs, Colo., to Dean of Faculty, USAFA, Colorado Springs, Colo., replacing retired B/G Erlind G. Royer.

B/G Gary L. Curtin, from JCS Rep. for START, Jt. Staff, Washington, D. C., to Ass't Dep. Dir., Int'l Negotiations, J-5, Jt. Staff, Washington, D. C. . . . **M/G Howell M. Estes III,** from DCS/Ops., and Dep. Dir., Ops., STRACOS, Hq. SAC, Offutt AFB, Neb., to Dir., Plans, DCS/P&O, Hq. USAF, Washington, D. C., replacing M/G (L/G selectee) Robert M. Alexander . . . **B/G Phillip J. Ford,** from Cmdr., AC&SC, Hq. AU, Maxwell AFB, Ala., to DCS/Ops., and Dep. Dir., Ops., STRACOS, Hq. SAC, Offutt AFB, Neb., replacing M/G Howell M. Estes III . . . **B/G Carl E. Franklin,** from ACS/P&P, UK Air Forces, NATO, RAF High Wycombe, England, to DCS/P&P and Dep. Dir., Plans & Prgms., EACOS, Hq. USAFE, Ramstein AB, Germany, replacing M/G Lawrence E. Boese.

B/G Travis E. Harrell, from Cmdr., 833d AD, TAC, Holloman AFB, N. M. to ACS/P&P, UK Air Forces, NATO, RAF High Wycombe, England, replacing B/G Carl E. Franklin . . . **M/G (L/G selectee) Richard E. Hawley,** from Dir., Ops., DCS/P&O, Hq. USAF, Washington, D. C., to Cmdr., US Forces Japan, and Cmdr., 5th AF, PACAF, Yokota AB, Japan, replacing L/G (Gen. selectee) James B. Davis . . . **B/G C. Jerome Jones,** from Dep. Dir., Strategy & Policy, J-5, Jt. Staff, Washington, D. C., to Vice Cmdr., AFSOC, and Vice Cmdr., AF Comp. Cmd., USSOCOM, Hq. AFSOC, Hurlburt Field, Fla., replacing B/G Dale E. Stovall . . . **M/G Walter Kross,** from Dir., Ops. & Log., J-3/J-4, Hq. USTRANSCOM, Scott AFB, Ill., to Dir., Ops., DCS/P&O, Hq. USAF, Washington, D. C., replacing M/G (L/G selectee) Richard E. Hawley.

M/G Charles D. Link, from Cmdt., Air War College, and Vice Cmdr., Hq. AU, Maxwell AFB, Ala., to Cmdr., 3d AF, USAFE, RAF Mildenhall, England, replacing M/G Marcus A. Anderson . . . **M/G (L/G selectee) Gary H. Mears,** from Vice Dir., Log., and Dep. Dir., Strat. Mobility & Resources, J-4, Jt. Staff, Washington, D. C., to Dir., Log., J-4, Jt. Staff, Washington, D. C. . . . **B/G Teddy E. Rinebarger** from Cmdr., 40th AD, SAC, Malmstrom AFB, Mont., to JCS Rep. to the Def. and Space Talks, Jt. Staff, Washington, D. C., replacing B/G Joseph C. Wilson, Jr. . . . **M/G Peter D. Robinson,** from Cmdr., AFOTEC, Kirtland AFB, N. M., to Cmdt., Air War College, and Vice Cmdr., Hq. AU Maxwell AFB, Ala., replacing M/G Charles D. Link.

M/G Michael E. Ryan, from DCS/Ops., and Dep. Dir., Ops., TACOS, Hq. TAC, Langley AFB, Va., to Vice Dir., Strat. Plans & Policy, J-5, Jt. Staff, Washington, D. C. . . . **B/G James S. Savarda,** from IG, Hq. SAC, and Vice Cmdr., Survivable, Endurable Cmd. Ctr., Hq. SAC, Offutt AFB, Neb., to Cmdt., AC&SC, Hq. AU, Maxwell AFB, Ala., replacing B/G Phillip J. Ford . . . **B/G Dale E. Stovall,** from Vice Cmdr., AFSOC, and Vice Cmdr., AF Comp. Cmd., USSOCOM, Hq. AFSOC, Hurlburt Field, Fla., to Dep. Commanding Gen., JSOC, USSOCOM, Fort Bragg, N. C. . . . **B/G (M/G selectee) Edwin E. Tenoso,** from Vice Cmdr., 22d AF, MAC, Travis AFB, Calif., to Dir., Ops. & Log., J-3/J-4, Hq. USTRANSCOM, Scott AFB, Ill., replacing M/G Walter Kross.

B/G Michael G. Vergamini, from Dir., J-1, Jt. Staff, Washington, D. C., to Cmdr., USAF Recruiting Service, and DCS/Recruiting Service and Commissioning Prgms., Hq. ATC, Randolph AFB, Tex., replacing retiring B/G John J. Salvadore . . . **B/G Lester J. Weber,** from Cmdr., Comp. Sys. Div., AFCC, Gunter AFB, Ala., to DCS/Comm. Comp. Sys., Hq. SAC, Offutt AFB, Neb. . . . **B/G Joseph C. Wilson, Jr.,** from JCS Rep. to the Def. and Space Talks, Jt. Staff, Washington, D. C., to JCS Rep. for START, Jt. Staff, Washington, D. C., replacing B/G Gary L. Curtin . . . **B/G Frederick A. Zehrer III,** from Vice Cmdr., AFCC, and Cmdr., Tech. Integration Ctr., Hq. AFCC, Scott AFB, Ill., to Cmdr., Comp. Sys. Div., AFCC, Gunter AFB, Ala., replacing B/G Lester J. Weber.

SENIOR EXECUTIVE SERVICE (SES) CHANGES: Dr. George R. Abrahamson, to Chief Scientist of the Air Force, Hq. USAF, Washington, D. C., replacing Dr. Robert W. Selden . . . **Dr. R. Earl Good,** from Dir., Optical and Infrared Technology, Geophysics Directorate, Phillips Lab, SSD, AFSC, Hanscom AFB, Mass., to Dir., Geophysics Directorate, Phillips Lab, SSD, AFSC, Hanscom AFB, Mass. . . . **Thomas Ylum,** from Dir., System Integration Office, Hq. AFSPACECOM, Peterson AFB, Colo., to Chief Scientist, Directorate of Operations, Hq. USAFE, Ramstein AB, Germany, replacing Dr. Joseph R. Ryan. ■

air defense system is conveyed to the Hawk. Hawk and Patriot system software then controls the interception of the target missile by the Hawk.

On May 29, **Military Airlift Command celebrated its fiftieth anniversary** as an organization. *[See "They Deliver," p. 50.]* The earliest progenitor of MAC was Army Air Corps Ferrying Command, organized in 1941.

★ **DELIVERIES—LTV Aerospace and Defense delivered the first full-scale production Army's Tactical Missile System** (ATACMS) missile to the Army **five months ahead of schedule.** Under a $132 million, November 1990 contract, the Army ordered 318 of the conventional warhead missiles, each of which has a sixty-mile range and contains 950 M74 high-explosive bomblets. LTV had accelerated production of the missiles for the Gulf War.

The **Ohio Air National Guard took delivery of its first C-130H** transport aircraft in ceremonies at Mansfield Lahm Airport, Ohio. Assigned to the 179th Tactical Airlift Group, the aircraft are scheduled to replace C-130Bs that the unit has operated since 1976.

★ **PURCHASES—The Air Force awarded Pratt & Whitney and General Electric contracts with a combined worth of more than $660 million for Alternate Fighter Engine production.** Pratt & Whitney received $317.1 million for eighty-eight F100-229s for F-15s and F-16s, and $19.2 million for long-lead items on twenty-four engines in FY 1992. General Electric received $285.9 million for additional FY 1991 production of F110-129 engines for F-16 aircraft, and $44.6 million in long-lead funding for a buy in FY 1992.

Hughes Aircraft Co. and Raytheon received almost $400 million in contracts from the Air Force **for AMRAAM Lot IV missile production.** Hughes received $229.6 million for long-lead on 450 AMRAAMs, and Raytheon $160.1 million for long-lead on 450 missiles.

The **Air Force awarded GenCorp's Aerojet Ordnance Div. a $28 million contract to make more than three million 30-mm, depleted-uranium cannon shells** for the A-10 aircraft's GAU-8 gun, the first such contract for the company since Aerojet stopped making the shells in 1989. Though Aerojet originally designed and developed the rounds, the Air Force purchased recent batches from Alliant Techsystems.

NASA chose IBM to provide mainframe computer systems for Space Station mission control and training

Air National Guard technicians perform a cable sweep on an F-15 at Otis ANGB, Mass., using the Radio Frequency Transmission Line Test Set developed by Lockheed Sanders. Sanders has received contract awards totaling $30.1 million from the San Antonio Air Logistics Center, Kelly AFB, Tex., for production of 290 of these test sets for the Air Force.

facilities operations at Johnson Space Center and chose PacifiCorp Capital to provide IBM-compatible subsystems, in contracts that could be worth $245 million if all options are exercised.

The **Army awarded Hughes Aircraft Co. $199 million in contracts to continue production of the TOW antiarmor missile.** Included in the contract was production of 8,404 TOW-2Bs, designed to fly over their targets and drop two warheads on the relatively weak top portion of tanks. Initial deliveries are slated for late this year.

Raytheon received a $17.7 million increase to an Army contract to enhance the Patriot missile's antitactical ballistic missile capability. By extending the Patriot's ground-based phased-array radar, the upgrades are expected to allow the Patriot to engage other missiles at higher altitudes farther away from population centers.

The **Air Force awarded a $107 million contract to Raytheon's Electromagnetic Systems Division for additional ALQ-184 countermeasure pods and related equipment.** The award follows the recent certification by the Air Force Operational Test and Evaluation Center that the equipment had met all operational requirements.

Aerospace World

★ **HONORS—Air Force Logistics Command (AFLC) was named the national winner of the 1991 President's Award for Quality.** *[See "Let's Hear It for the Loggies," p. 7.]* The award, the federal equivalent of the prestigious Malcolm Baldrige Award for quality in private industry, is given to government agencies that exhibit great progress in quality. AFLC was chosen by the Federal Quality Institute for its implementation and practice of Total Quality Management principles.

The **58th Tactical Fighter Squadron,** Eglin AFB, Fla., **won the 1990 Hughes Achievement Award,** which recognizes the outstanding Air Force air-to-air squadron. During the period covered by the award, the 58th flew 5,722 accident-free sorties while sustaining an eighty-six percent mission capable rate. The 58th was also picked as the first operational unit to carry AMRAAM.

Capt. John Roush of the 95th Reconnaissance Wing at RAF Alconbury, England, **earned the 1990 Cheney Award** for risking his life to help find a downed German pilot. Captain Roush was on a nine-hour operational mission aboard his TR-1 aircraft on March 13, 1990, when he experienced a loss of his full-pressure-suit cooling system. Despite the life-threatening failure, he responded to an immediate call for assistance in locating a German Air Force Alpha Jet pilot with engine trouble. Though he could have been killed by heat stress, Roush located the German jet, enabling search-and-rescue teams to recover the pilot from the North Sea. He then returned to base and safely landed his aircraft.

SSgt. William F. Kramer, a production control clerk in the Computer Systems Division at the Field Command, Defense Nuclear Agency, Kirtland AFB, N. M., **was selected as Headquarters Outstanding Enlisted Person of the Year.** In addition to the award, Sergeant Kramer was selected as Field Command's Noncommissioned Officer of the Fourth Quarter of 1990.

Col. Philip G. Stowell, deputy chief of staff for Engineering Services, Strategic Air Command, **received the 1990 Gold Medal for Distinguished Service from the Society of American Military Engineers,** a national organization with more than 29,000 military and civilian members. The Gold Medal is the most prestigious of the fifteen individual awards that the society presents each year.

Air Force Reserve Officer Training Corps **Cadet Kimberly A. Moore was selected as the Air Force Association Outstanding Cadet of the Year** from among 1,985 eligible cadets. Cadet Moore was first selected as the award winner for her unit, the Air Force ROTC Det. 365, Massachusetts Institute of Technology. To be eligible for the award, a cadet must rank in the upper five percent of his or her Aerospace Studies 300 class and rank in the upper ten percent of his or her academic class. ■

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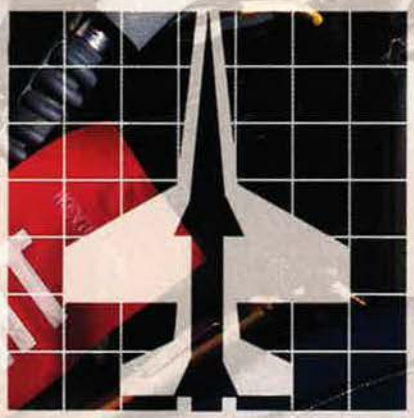

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For the first time, space systems were integral and crucial to the war below.

A Watershed in Space

By James W. Canan, Senior Editor

THE Gulf War demonstrated once and for all that space systems are indispensable tools of modern combat. Satellites never planned a sortie, dropped a bomb, executed a flanking maneuver, or fired a shot, but they might as well have. Their contributions to all such endeavors were central to the success of US-led coalition forces in outwitting and outgunning the enemy.

Lt. Gen. Thomas S. Moorman, Jr., commander of Air Force Space Command, calls Desert Storm "a watershed event in military space applications because, for the first time, space systems were an integral part of terrestrial conflict and were crucial to its outcome."

Space systems will pay a price for success. Now that they have shown what they can do, they will be expected to do even better. As combat commanders learned to appreciate the advantages of having space assets at their disposal, they also became sufficiently savvy about space operations and infrastructures to spot and critique shortcomings.

Martin C. Faga, Assistant Secretary of the Air Force for Space, asserts that "Desert Storm was the first large-scale opportunity for our forces in the field to understand that space systems are vital to their success." This will make the warfighting commands "tougher customers" for the services of such systems in the future, he contends.

Mr. Faga makes the point that it is second nature for USAF's operational commands to set standards for new airplanes because they know airplanes inside out, are experienced at using them, and require certain things from them. Those commands, he says, "haven't been as familiar with space systems, so their requirements [for those systems] haven't been as firm. Now, this will change."

Desert Storm was an eye-opener for the combat arms of all the services on the importance of space as a force multiplier. In all comparisons of allied and Iraqi forces, "one thing that stood out was that we had space systems," Mr. Faga declares. "We had information, and Saddam Hussein did not. We could see, hear, and talk all through the war. After a few hours, he could not."

Air Force Space Command (AFSPACECOM), USAF's warfighting

The weather over Iraq and Kuwait was the worst in many years during the early days of the Gulf War. That's why pictures such as this one of cloud patterns over the region, as seen from space, were crucial to the success of allied air forces. The Air Force quickly developed and deployed to the Gulf weather satellite receiver stations (inset) that, unlike old models, can be toted on trucks.

Officers of the 2d Space Wing at Falcon AFB, Colo., communicate with a satellite via computer. In such fashion, AFSPACECOM revived a navigation satellite and repositioned a communications satellite to give allied forces better service from space. The Gulf War was a showcase for all sorts of space systems.

command for space, did some extraordinary things to ensure such advantages for allied forces. It repositioned a communications satellite on orbit, resuscitated a navigation satellite, and expedited the "replenishment launch" of a weather satellite—all with a winning touch.

In the Gulf War, "communications were used to an unprecedented extent" and "satellite communications were absolutely crucial," General Moorman declares.

The Channel Crunch

Making it happen took some doing. Not long after setting up shop in Saudi Arabia, US Central Command and its air component, Central Air Forces, were faced with a potentially deadly problem—a shortage of communications channels. The problem steadily worsened as more and more units deployed to the region, topping off at a half-million troops, through the five and a half months of Operation Desert Shield.

Space was the natural medium for long-haul communications into and out of the war zone. The traffic was so heavy that it overwhelmed military satellites. Half of it had to be routed via commercial satellites.

Air Force Space Command went into action. At Falcon AFB, Colo., AFSPACECOM blue-suiters got in touch with a Defense Satellite Communications System (DSCS) II satellite being held in reserve in geostationary orbit 22,300 miles above the Pacific Ocean. Via computer, they turned on its motor, propelled it westward along the so-called geosynchronous belt, and brought it to a stop at a fixed point above the Indian Ocean.

It took several days for the satellite to travel to its new station. Once in operation there, it shared the load of military messages with another DSCS II satellite and a DSCS III satellite already serving coalition forces.

The feat was historic—the first-ever repositioning of a satellite to support US combat operations.

"With three DSCS satellites, the Defense Communications Agency was able to allocate sufficient channels and bandwidths to support [all] tactical terminals for the duration of the conflict," General Moorman explains.

Desert Storm demonstrated the flexibility as well as the mobility of the DSCS constellation. US warplanners had counted on DSCS extremely high-frequency (EHF) satellites primarily for intercontinental communications and on assorted ultrahigh-frequency (UHF) systems for short-range intratheater communications. It did not turn out that way. DSCS satellites relayed most messages within the region—wing to wing, battalion to battalion, for example—plus those to and from faraway places.

"For the first time, satellites were the primary means for intratheater communications—eighty-five percent of them—as well as for all intertheater communications," General Moorman declares.

In the opinion of Gen. Colin Powell, Chairman of the Joint Chiefs of Staff, "satellites were the single most important factor that enabled us to build our command, control, and communications network."

Unprecedented Precision

Satellites were also the great navigators of the Gulf War. Incessant streams of signals from a constellation of Navstar Global Positioning System (GPS) satellites enabled coalition forces to fire and move with unprecedented precision and accuracy.

The GPS constellation will consist of twenty-four satellites—twenty-one operational and three spares—once the last one goes into space in 1993. With all its satellites in orbit, teaming up to cover the globe with crisscrossing signals, the constellation will be able to provide position fixes in three dimensions—latitude, longitude, and altitude—for anyone with a GPS receiver terminal anywhere in the world at any time.

Not yet, though. The GPS constellation in space when Operation Desert Shield deployments began a year ago was incapable of all that. It comprised only sixteen satellites, five short of the number needed for full global coverage. A few were real old-timers, having been launched more than a decade ago as experimental satellites, and were well past their prime.

Even so, the partial constellation was expected to do an adequate job for allied forces around the Gulf—provided that all GPS satellites in position to transmit signals into the war zone kept operating.

One did not. A GPS satellite launched on April 26, 1980, during the program's experimental phase, gave out just a few weeks before the Gulf War began. It was critical for providing three-dimensional coverage. Its failure was bad news for troops facing combat on and above a vast, featureless desert with shifting sands and with landmarks few and

far between—a setting that cried out for navigation signals from space, the more the better.

Air Force Space Command's GPS operators at Falcon AFB came to the rescue at their computer consoles.

"They did a magnificent job of recovering a satellite that we had given up for dead," General Moorman asserts. "They created software routines to stabilize it. It had been in the wrong attitude. They were able to right it, conserve its capability, and make it useful whenever it was within range over the theater of operations."

Allied air operations had the most to gain from the feat at Falcon. Adding the recovered satellite's position-fixing signals to those of other GPS satellites simultaneously orbiting over the region "increased the amount of three-dimensional coverage we had there," says General Moorman. "We had twenty-four hours a day of two-dimensional coverage and about sixteen hours of three-dimensional coverage.

"Two dimensions are generally satisfactory for ground operations, but the third dimension is crucial for air operations."

The Critical Edge

US forces pounced on GPS. General Moorman claims that the space-based system "performed magnificently—even better than expected—and really came of age" in Desert Storm. It was "critical to the victory," he contends.

Air Force Special Operations Forces "used GPS in all their aircraft to give them the passive, silent navigation that was crucial to their survival," he says. The superaccurate system also gave SOF aircrews a sure sense of direction, plus the confidence that goes with it, on risky missions into and back from enemy territory.

SOF MH-53J Pave Low helicopters equipped with GPS terminals teamed with Army AH-64A Apache attack helicopters armed with Hellfire missiles to do more early damage than was generally recognized, destroying two key Iraqi early warning sites and opening a hole in Iraqi air defenses.

Air Force F-16s used GPS to great advantage in navigating to initial points on bombing runs and then, at night, letting the LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) system take them the rest of the way. Navy pilots relied on GPS to put their planes in the right places to launch standoff land-attack missiles. Once launched, those long-range SLAMs steered themselves by means of signals from GPS satellites.

Says General Moorman, "One SLAM would open a hole in a target and the next SLAM would go through the hole and blow up the target. GPS was a big reason for their accuracy. It's built into the missiles to give them midcourse updates."

The Navy is now turning to GPS to navigate its Tomahawks, the ship-launched cruise missiles that were the first US weapons to strike Baghdad. Future Tomahawks will come equipped with GPS, not with the terrain-contour-mapping navigation system characteristic of all preceding Tomahawks.

GPS was a godsend for ground troops traversing the desert, especially in the frequent sandstorms that made finding their way all the more difficult. Tank crews and drivers of all sorts of vehicles swore by the system. Meal trucks were equipped with GPS receivers to enable drivers to find and feed soldiers of front-line units widely dispersed among the dunes. Engineers located water wells in the desert by following goat tracks, then used GPS to pinpoint them on maps for future reference.

Minesweeping specialists staked their lives on GPS. They used navigation signals from space to follow—or to draw—maps through minefields, changing direction and marking waypoints up to a dozen times across a half-mile field.

Passing the Hat for GPS

Small, lightweight GPS receivers called "sluggers" (SLGRs), made by Trimble Navigation Inc. and Magellan Systems Corp., both of California, were all the rage. The ground services ordered them by the thousands. Soldiers and Marines sometimes passed the hat for money to buy terminals for their companies and platoons. Rockwell Collins also stepped up its production of GPS terminals—larger than SLGRs but small enough to be carried in backpacks—for ground troops.

From the beginning of the allied buildup to the end of the war, the number of GPS receivers in the theater increased from a few hundred to 4,500, with 4,000 more on order.

The need for Defense Meteorological Satellite Program (DMSP) terminals also turned out to be direr than anticipated, because "How's the weather?" was no idle question around the Gulf.

—US Navy photo by PH1 Dewayne B. Smith

An M1A1 tank roars across the desert during Operation Desert Storm. Drivers of tanks and other vehicles, including meal trucks, used signals from the Global Positioning System (GPS) constellation of satellites to find their way around the featureless sands. GPS satellites were the great navigators of the Gulf War.

During the allied buildup, the Air Force decided to expedite its long-planned "replenishment launch" of a DMSP satellite to augment two others on orbit. The third bird boomed into polar orbit out of Vandenberg AFB, Calif., just six weeks before the war began—and a good thing it did.

Each of the polar-orbiting DMSP satellites passed over the region twice a day on its hour-and-a-half revolution around the Earth. Thus the three satellites in succession transmitted meteorological data to CENTAF in real time every four hours, or six times a day. Transmissions would have been more widely spaced—at six-hour intervals, four times a day—had only two satellites been transiting the Earth.

The difference turned out to be huge. CENTAF headquarters and units needed all the weather pictures and data they could get, because the weather went sour over Iraq and Kuwait almost as soon as the war began. Old hands called it the worst weather the region had seen in fourteen years. It threatened to shut down allied air operations and let Iraq bounce back from the heavy blows of initial bombardments.

No such thing. The weather impeded but did not stop the allied air onslaught. CENTAF was able to work around and through it and keep the pressure on.

"Understanding the vagaries of the weather quickly became crucial to air operations," General Moorman declares. "The three DMSP satellites provided an unprecedented volume of data to our forces."

Those satellites were star players in CENTAF's game plans. Their images of cloud cover and other weather conditions greatly influenced the planning and flying of sorties, plus the selection of weapons to be taken along.

"Satellite weather data was very important to weapons loading at the wing level," General Moorman explains. "For laser-designated [precision guided munitions] to work, there has to be a clear view of the target. Our wings knew which targets were clear and which were covered, and they were able to optimize their weapons loading. Very few sorties resulted in bombs not dropped."

Instead of sitting tight until the weather cleared, aircrews were able to press the attack through gaps in cloud formations seen by satellites. On at least one occasion, for example, an attack on Baghdad was called off and an attack on Basra was reordered because the weather satellites had kept watch. One saw Baghdad open and Basra under cloud cover, but the next one saw the situation reversed.

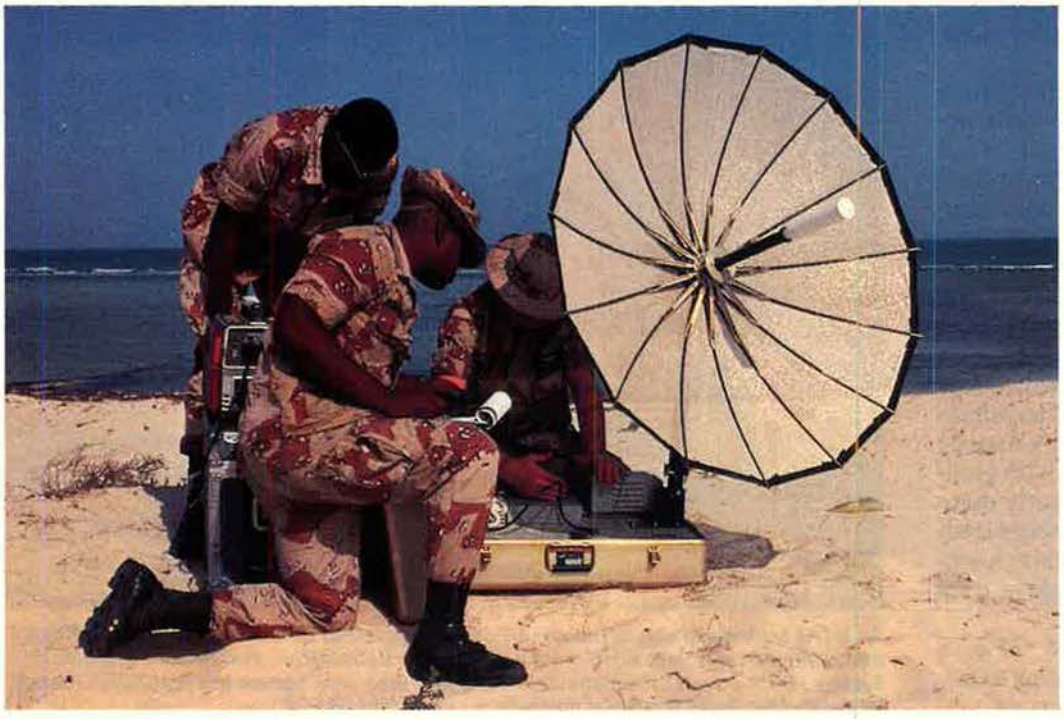
Lightening Up

DMSP satellites transmitted images to a terminal in an isoshelter-type van at CENTAF, to aircraft carriers, and to Army and Marine aviation units. Weighing 26,000 pounds and measuring 1,280 square feet, the DMSP van proved burdensome for airlifting.

Urgently hunting for something smaller and lighter, Air Force Space Systems Division placed rush orders with Harris Corp. and Sea Space last November for prototype rapid deployment imagery terminals that would fit in the back of an Army "Humvee" (high-mobility multipurpose vehicle). Those RDIT prototypes went into wartime service in Saudi Arabia only three months later, in time to support the allied ground offensive. After the war, one was airlifted to Turkey for use in the Kurdish relief effort.

An Air Force Defense Support Program (DSP) early warning satellite apparently had more to do with the victorious outcome of Desert Storm than may ever be known. It appears that the satellite, perched in geostationary orbit above the Indian Ocean on the lookout for launches of ICBMs, managed to spot Scud launches on the side.

—USAF photo by TSgt. Rose Reynolds



Crew of a joint combat camera section set up a station for transmitting still video images from a forward-deployed position to the Pentagon. All sorts of ground stations were Gulf War staples, and US forces learned a lot about the nature, uses, and availability of space resources.

There is no official confirmation of the DSP satellite's role. General Moorman discussed the subject only in general terms, noting that "space and terrestrial [warning] systems were enormously important in Desert Storm" and that "their full contribution remains sensitive."

He declares, "Being able to warn of impending Scud attacks had phenomenal psychological and political importance, as well as military importance, not only to the United States but also to our allies and to civilians in Saudi Arabia and Israel. The warning systems served to contain the conflict, and they clearly enhanced our Patriot missile defense."

Their lifesaving performance is seen as a boon to USAF's high-priority plan for a future constellation of satellites dubbed FEWS—for Follow-On Early Warning System—and designed to detect the launches of tactical ballistic missiles as well as strategic ballistic missiles all over the world. FEWS satellites would be at least as capable and much more versatile than DSP satellites. But they would be less capable—and cost less—than the elaborate warning-and-targeting satellites formerly envisioned in the Strategic Defense Initiative.

Desert Storm's heavy demands on communications satellites should translate into increased military and political backing for USAF's Milstar (Military Strategic and Tactical Relay) communications satellite program. USAF designed Milstar more than a decade ago as a virtually indestructible, exceptionally capable system of crosslinked satellites that would hold up during nuclear war.

A Change in Milstar

Says General Moorman, "Milstar was designed to survive everything you could think of—jamming, nuclear air bursts, laser scintillation, everything—and it was focused strictly on the strategic problem. We are making it into a less heroically survivable system and replacing survivability features with extra bandwidths to better serve tactical users."

Retailoring Milstar more to the requirements of tactical warfare also will result in smaller, cheaper, more mobile ground terminals.

Defense Meteorological Satellite Program (DMSP) satellites, such as the one in this artist's rendering, made a big difference in the Gulf War. During the prewar buildup, AFSPACECOM expedited its launch of a DMSP satellite to join two others on transpolar orbits. The trio provided "an unprecedented volume" of weather data.

Operation Desert Storm had minuses as well as pluses in the space arena. It quickly became obvious to military space officials that US forces arriving in the war zone had a lot to learn about the nature, uses, and availability of space resources that they might draw on.

"Operational planning for the use of space systems was not well developed when Iraq invaded Kuwait," General Moorman asserts. "We were fortunate to have had five months to get ready. If this had been a come-as-you-are war, we would not have been well-prepared to use space systems. We are still relatively unsophisticated about integrating space into our routine operational planning."

The war also underlined a point that Air Force Space Command has been making for several years—that the US space-launch infrastructure is not set up to stay on top of wartime demands.

Desert Storm's heavy drain on communications satellites makes the point. "We were able to offset our lack of a responsive launch system by moving the DSCS," notes General Moorman. "Fortunately, we had a [DSCS] constellation that was robust enough to let us do that. But we need more. What we need is the flexibility not only to move satellites but also to launch them responsively."

Mr. Faga agrees. He also notes that military space systems "did not give the warfighters everything they wanted. In many cases, they wanted better performance, or they wanted more [of the] product."

For some jobs in space, there were not enough military satellites to go around. For others, there were none.

As an example, the Army used a variety of civil satellites and, in fact, a Soviet Meteor system satellite to collect weather information. Central Command headquarters used US Landsat satellites and/or France's SPOT satellites to obtain multispectral images of the war zone for tactical planning and mapmaking. The Air Force aspires to a multispectral imaging satellite of its own.

Mr. Faga contends that the US military space community is entitled to take "great pride" in its Desert Storm accomplishments but must also be "mindful of the many lessons" to be had from that war. He also insists on keeping things in perspective.

"Our military space systems and their crews have shown the whole world that space is fundamental to modern war and to national security," Mr. Faga asserts. "But space systems didn't win the war by themselves. They were vital to the victory, but only one element in it. We can always do better." ■

USAF Space Systems Checklist

Compiled with the assistance of Space Systems Division and Phillips Laboratory, Air Force Systems Command.

Atlas Launch Vehicles System Program Office

Atlas E
Primarily used to support DMSP and NOAA satellites. Launches of five remaining refurbished Atlas E boosters will be from Vandenberg AFB, Calif. **Contractor:** General Dynamics. **Status:** Operational.

Atlas II
Development, acquisition, and launch of a medium launch vehicle. Initially to be used for communications satellite launches, such as SATCOM, and other payloads. **Contractor:** General Dynamics. **Status:** Production.

Brilliant Eyes System Program Office

Brilliant Eyes System
BE is a space-based surveillance system using state-of-the-art technology to track space objects. It is a key element in the Theater Missile Defense (TMD) System and the Global Protection Against Limited Strike (GPALS) System. BE provides tracking during the critical boost, postboost, and midcourse flight phases of hostile ballistic missiles, a process critical to the successful employment of ground- and space-based weapons designed to negate these targets. **Contractors:** Source selection. **Status:** Development.

Brilliant Pebbles System Program Office

Brilliant Pebbles/Space-Based Interceptor
Both Brilliant Pebbles and Space-Based Interceptor (SBI) programs are designed to intercept and destroy ICBMs before the warheads become active or reenter the atmosphere during a nuclear attack. Both programs are similar, with SBI being a somewhat larger vehicle. SBI is being phased out with SDIO's choice of Brilliant Pebbles as the primary system. **Contractors:** Various. **Status:** Operational.

Defense Meteorological Satellite System Program Office

Defense Meteorological Satellite Program
DMSP spacecraft provide meteorological, oceanographic, and solar-geophysical weather data for DoD operations and high-priority programs. The data are transmitted to fixed and mobile receiving terminals worldwide. **Contractors:** General Electric (GE), Westinghouse, Hughes, Aerojet, Harris, and Lockheed. **Status:** Operational.

Defense Satellite Communications System Program Office

Air Force Satellite Communications System
AFSAT provides high-priority command and control communications for US strategic forces. System is integrated into other spacecraft. **Contractor:** Classified. **Status:** Operational.

Defense Satellite Communications System
DSCS is a worldwide satellite network providing survivable, antijam, secure voice, and high-data-rate communications for DoD, State Department, and other US government users. DSCS III satellites provide increased capability and longer on-orbit life spans. **Contractors:** GE, TRW, and Aerospace Corp. **Status:** Operational.

NATO III
System provides military and diplomatic communications for ground, airborne, and shipborne NATO European and North Atlantic forces through satellites that are interoperable with DSCS. **Contractors:** Loral and Aerospace Corp. **Status:** Operational.

Defense Support System Program Office

Defense Support Program
DSP is a surveillance satellite designed to provide early warning of ICBM launches. **Contractors:** TRW, Aerospace Electro Systems, and IBM. **Status:** Operational.

Delta Launch Vehicles System Program Office

Delta II
Acquisition and launch support of medium launch vehicle. Currently used for launching Navstar GPS, SDIO experimental payloads, NASA scientific payloads, and commercial payloads. **Contractor:** McDonnell Douglas. **Status:** Operational.

Follow-On Early Warning System Program Office

Follow-On Early Warning System
FEWS is a space-based sensor system being developed to replace the Defense Support Program (DSP). The FEWS mission is to detect, track, count, and identify the type of individual, worldwide, ballistic missile launches. **Contractor:** None. **Status:** Demonstration/validation.

Milstar Joint System Program Office

Milstar
The next generation of military satellite communications to provide worldwide, jam-resistant, survivable communications capability for national command authorities and US military forces using EHF, SHF, and UHF systems.

Contractors: Lockheed Missiles and Space Co., TRW, and Hughes. **Status:** Development.

National Launch Development Program Office

National Launch System
NLS, formerly Advanced Launch Development Program or Advanced Launch System (ALS), is designing an evolutionary approach for the development of a family of launch vehicles and infrastructure with the capability to place a wide range of payload weights into orbit at a fraction of current costs. NLS is looking at ways to make the launch business as routine as that of a long-haul trucking company. **Contractors:** Various. **Status:** Research.

Navstar GPS Joint System Program Office

Navstar GPS
Navstar Global Positioning System (GPS) will provide twenty-four-hour, all-weather, worldwide, space-based radio navigation capabilities. GPS will provide military and civilian users with extremely accurate three-dimensional position information. Military users will be able to get position information accurate to within sixteen meters, civilians to within 100 meters. **Contractors:** Rockwell International (Block I & II), GE (Block IIR), and IBM. **Status:** Fully operational in mid-1993.

Small Launch Vehicles System Program Office

Pegasus
Acquisition of a small launch vehicle. Pegasus uses a unique air-launched concept to double the effective payload-to-orbit capability over a comparable ground-launched system. Primarily used to deliver experimental low-Earth-orbit satellites. First flight occurred in April 1990 under a DARPA development program. **Contractors:** Orbital Sciences Corp. (OSC) and Hercules. **Status:** Production.

Taurus
DARPA development of a Standard Small Launch Vehicle (SSLV) based on the Pegasus with the addition of a Peacekeeper first stage. Taurus will be ground-launched and will demonstrate the rapid establishment of a transportable launch capability. **Contractor:** OSC. **Status:** Development.

Space Test and Transportation System Program Office

Space Test and Transportation Program
STTP sponsors spaceflights for DoD experimental payloads that do not have dedicated spacecraft. Experiments may be flown on small boosters or the shuttle. STTP also manages DoD-dedicated payloads aboard NASA's shuttle. STTP has cooperative programs with both NASA and DARPA. **Contractors:** Various. **Status:** Research.

Titan System Program Office

Centaur
The Titan IV/Centaur upper stage is a modified Centaur-G Prime with high-energy cryogenic propellants and multiple restart capability. It will be the most powerful upper stage in the US inventory. **Contractors:** Martin Marietta and General Dynamics. **Status:** Development.

Titan II
Modification of Titan II ICBMs into expendable launch vehicles. Initial conversion contracts for fourteen Titan IIs. The first two have been launched successfully. The Titan II was also used for the NASA Gemini program. **Contractor:** Martin Marietta. **Status:** Production.

Titan IV
Development and acquisition of the Air Force's heavy-lift launch vehicle for shuttle-class payloads. Launch sites at Cape Canaveral AFS, Fla., and Vandenberg AFB, Calif., will provide launch capability of eight launches per year. First launch occurred June 14, 1989. **Contractor:** Martin Marietta. **Status:** Production.

Upper Stages System Program Office

Inertial Upper Stage
IUS was developed to provide highly reliable two-stage vehicles to boost satellites into geosynchronous orbits. Used for military and NASA payloads, including Magellan, Galileo, and Ulysses interplanetary missions for NASA. **Contractors:** Boeing Aerospace and United Technologies Chemical Systems Division. **Status:** Operational.

Phillips Laboratory: Geophysics Directorate

Combined Release and Radiation Effects Satellite
Comprehensive effort to specify radiation environment and to test operational hardware components of future satellites in the hazardous space environment, and to provide Air Force systems designers with specific information for improving and forecasting satellite survivability. **Contractors:** Many. **Status:** Analyzing space radiation data.

Cryogenic Infrared Radiance Instrumentation for Shuttle
CIRRIS-1A experiment to collect simultaneous high-resolution spectral and spatial measurements of the natural Earth background in the 2.5 and twenty-five micrometer region over altitudes ranging from the surface of the Earth to 260 kilometers. **Contractors:** Utah State Univ., Boston College, and Orbital Sciences. **Status:** Data processing and analysis.

Global, Real-Time Ionospheric and Neutral Atmospheric Models for Air Weather Service
Real-time ionospheric model will provide electron density profiles, globally, from ninety to 1,000 kilometers for AWS high-priority customers while the neutral atmospheric model will specify neutral densities and winds from ninety to 500 kilometers. **Contractors:** Computational Physics, Inc., and Univ. of Michigan. **Status:** Advanced research and development.

High-Frequency Active Auroral Research Program
Joint USAF/Navy program to investigate the potential of initiating and controlling processes in the ionosphere via ground-based, high-power, high-frequency radio waves. The heart of the program will be the development of a unique ionospheric heating instrument in Alaska. **Contractors:** Raytheon, Arco Power Technologies, Inc., Univ. of Alaska, and Pennsylvania State Univ. **Status:** Research and exploratory development.

Nuclear Test Ban Treaty Verification
Comprehensive seismic research and development program designed to study physical properties and behavior of the Earth's interior as they pertain to monitoring underground nuclear tests. **Contractors:** Seventy (universities and industry). **Status:** Research and exploratory development.

Photovoltaic Array Spacepower Plus Diagnostics
Research to determine the environmental effects of space on the operation and lifetime of photovoltaic spacepower systems. Joint development program among Phillips Laboratory, Wright Laboratory, and NASA. Insertion/demonstration window begins in 1992 with launch on Pegasus. **Contractors:** Many. **Status:** Integration and flight hardware testing.

Smart Weapons Performance Prediction Techniques
Investigation of the weather sensitivities of smart weapon systems to develop techniques to measure the required parameters in the battlefield and to use this information to predict the effectiveness of smart weapon systems. **Contractors:** STX, STC Batelle Memorial Institute, and Georgia Tech Research Corp. **Status:** Advanced development.

Superconducting Inertial Sensors
Development of revolutionary new technology for ultraprecise measurement of inertial acceleration and rotation, exploiting advantages of cryogenic temperatures, superconductivity, and superfluidity. **Contractors:** Univ. of Maryland and Univ. of California at Berkeley. **Status:** Research and exploratory development.

Totally Integrated Payload Attitude Control Tester
Development of a device to suspend a mass in such a way that it may be rotated about each of three orthogonal axes simultaneously with virtually no friction or suspension resistance. May be used to support a spacecraft so that it may be maneuvered in attitude as if it were in zero gravity. **Contractor:** In-house. **Status:** Exploratory development.

Weather Sensing Technology
Program to develop remote sensing tools to measure atmospheric parameters required to assess system development planning and to provide operational weather support. Techniques being developed and evaluated include satellite systems and ground-based systems ranging from the visible through the infrared and into the microwave portions of the spectrum. **Contractors:** STX, Atmospheric Environmental Research Co., Univ. of Wisconsin, and Univ. of Utah. **Status:** Basic research, exploratory development, advanced development.

Phillips Laboratory: Rocket Propulsion Directorate

Advanced ICBM Technologies
Effort to identify, design, and develop advanced solid rocket motor technol-

ogies for a next-generation ICBM. These technologies include an advanced composite conical case, a forced-deflection nozzle, integrated stage, laser ignition system, GAP/boron propellant, and a noneroding nozzle. **Contractor:** In-house. **Status:** Exploratory development.

Advanced Liquid Axial Stage
This program will develop an advanced liquid axial rocket stage for a space-based kinetic energy weapon. This is the second stage of a two-stage vehicle that provides the target intercept velocity for a weight-minimized kinetic kill vehicle. **Contractor:** Aerojet. **Status:** Advanced development.

Advanced Polymer Components
Demonstration of the feasibility of thermotropic liquid crystal polymers as system components for rocket propulsion applications. These materials are characterized by extremely low density, high strength, chemical resistance, insulating properties, and low cost through injection processing. **Contractors:** Case Western Reserve Univ., College of William and Mary, Butler Univ., Univ. of Mississippi, and Univ. of Lowell. **Status:** Research and exploratory development.

Ammonium Perchlorate Specification
This effort will correlate the chemical and physical properties of ammonium perchlorate and the final solid propellant properties. It will establish new specifications and develop standardized testing techniques. **Contractor:** In-house. **Status:** Research and exploratory development.

Clean Propellant Development
The program objective is to develop and demonstrate low-risk and low-cost chlorine-free (clean) solid propellants for space-launch boosters. Efforts have demonstrated propellant formulations that have no chlorine and can be manufactured at a high rate and low cost. **Contractors:** Aerojet and Hercules. **Status:** Exploratory development.

Electric Insertion Transfer Experiment
Demonstration of a fully integrated electric orbit transfer vehicle in a realistic mission scenario. The vehicle integrates a state-of-the-art arcjet propulsion subsystem; a high-power solar power subsystem; and an autonomous guidance, navigation, and control package. **Contractor:** Cooperative research and development agreement (CRDA) with TRW. **Status:** Advanced development.

High-Energy-Density Materials Development
Program to identify, produce, characterize, and stabilize molecular systems that have potential for use as high-energy-density materials (HEDM) in propellants. **Contractor:** In-house. **Status:** Applied research.

Integrated Stage Concept for ICBMs
Program to develop a revolutionary motor configuration that greatly increases the volume available for solid propellant. This program will integrate and demonstrate key stage technologies in subscale hardware. **Contractor:** Aerojet. **Status:** Advanced development.

Liquid Engine Nozzle Advanced Material Application
Program to evaluate advanced composite materials (carbon/carbon and liquid crystal polymers) in a liquid oxygen/liquid hydrogen linear aerospike engine environment. **Contractor:** In-house. **Status:** Exploratory development.

30 kWe Class Arcjet Demonstration
Project to develop a flight suit consisting of a 26-kilowatt (kWe) low-impedance ammonia arcjet, power conditioning subsystem, diagnostic package, and control subsystem and to measure its integrated performance on Earth during a flight qualification test. **Contractor:** TRW. **Status:** Advanced development.

Phillips Laboratory: Space & Missiles Technology Directorate

Advanced Composites with Embedded Sensors and Actuators
Project to design, fabricate, test, and evaluate composite components with embedded sensors, actuators, and microprocessors for dynamic sensing and control of precision space structures. A secondary goal is to determine the applicability of sensors for health monitoring of space structures. **Contractor:** TRW. **Status:** Fabrication.

Advanced Spaceborne Computer Module
Development and production of standardized electronic data-processing modules for space applications. The program will produce processor, memory, and input/output modules that can be combined to produce a fully fault-tolerant space computer. **Contractors:** IBM and Honeywell. **Status:** Advanced development.

Advanced Space Communications Technologies
Program to develop and demonstrate advanced components, subsystems, and systems for integration into present and future A-J/EHF satellites. **Contractors:** Hughes, EMS, Research and Development Laboratory, and MIT/Lincoln Labs. **Status:** Development and demonstration.

EHF TT&C Payload
Development of telemetry, tracking, and commanding subsystem for addition to EHF Milsatcom payloads. This subsystem will provide survivable TT&C function for a satellite bus to replace or augment space ground link system subsystems. **Contractor:** Research and Development Laboratory. **Status:** Study contract.

Hybrids with Advanced Yield for Surveillance
Program to analyze, design, fabricate, characterize, test, and produce focal plane arrays, readouts, and hybrids for low- and moderate-background space sensors. **Contractors:** Hughes Aircraft Co. and Rockwell. **Status:** Pilot lines currently producing sixty hybrids per month.

IR Focal Plane Array Tests
Program for radiation-hardening tests of hybrid focal plane arrays and detectors produced for space surveillance applications. **Contractor:** Ball Aerospace. **Status:** Currently testing HYWAYS devices.

Lasercom
Development and demonstration of laser communications link for space applications. The final system will be able to demonstrate high performance Charge-Coupled Device (CCD) acquisition and heterodyne tracking. **Contractors:** MIT/Lincoln Labs and Hughes. **Status:** Development and demonstration.

Nondestructive Evaluation of Solid Rocket Motors
Program to investigate automation of labor-intensive procedures and data archival requirements for inspecting solid rocket motors. **Contractor:** Martin Marietta. **Status:** Development.

Quick-Cool-Down Joule-Thomson Cooler
Design, development, and demonstration of a quick-cool-down, long-storage-life Joule-Thomson Cooler for infrared detectors, which may be used on various strategic defense interceptor concepts. **Contractors:** MMR Technologies, Inc., Alabama Cryogenics Engineering, Inc., and APD Cryogenics, Inc. **Status:** Detail design.

Radiation-Hardened Microelectronics for Space
Program to research and develop advanced hardening technology for space electronics, develop prototype hardened parts and packaging technology for space applications, and investigate new qualification methods for advanced electronics used in space. **Contractors:** Mission Research Corp. (prime), TI, GE, Physitron, Vanderbilt Univ. (subcontractors). **Status:** Research, exploratory development, and advanced development.

Single Stage Reverse Turbo Brayton Cycle Cryogenic Cooler
Preliminary design and critical component demonstration of a reverse turbo Brayton cycle cooler for space. **Contractor:** Creare, Inc. **Status:** Critical component demonstration.

Sodium Sulfur Battery Flight Experiment
Flight experiment of sixteen-cell/28-volt/40-amp-hour battery module to demonstrate sodium sulfur battery operation in a zero-gravity environment. The goal is to verify this technology and apply it to Air Force satellite programs. **Contractors:** TBD. **Status:** Planned start in early FY 1992.

Space Integrated Controls Experiment (SPICE)
Applied research program to investigate and demonstrate (in an integrated experiment and computer simulation) the attenuation of disturbance effects, using active isolation, passive damping, advanced materials, active control, adaptive control, and active optics. **Contractors:** Lockheed and Honeywell. **Status:** Research and test-article fabrication.

Space Subsystems Technology
Exploration and technologies development for next-generation space-based radar. Goal is to develop advanced transmit/receive (T/R) modules, lightweight antennas, photonics, power management, thermal control, and signal/data-processing subsystems. **Contractor:** Research and Development Laboratory. **Status:** Flight test planning and advanced ground testing.

Surption Cooler Program
Effort to support potential SDI surveillance systems by demonstrating long-life, highly reliable surption cooler technology. **Contractor:** Jet Propulsion Lab. **Status:** Proof-of-principle testing.

Thermionic System Evaluation Test
Electrically heated performance test of the Soviet Topaz 2 space nuclear reactor. The program goals are to provide experience operating a space nuclear power ground test, provide insight into power system design, and provide benchmarks for US system and component models. **Contractors:** SPI and New Mexico Engineering and Research Institute. **Status:** Under way.

Wide Dynamic Range Mixer
Program to develop 44-GHz wide dynamic range mixer (100 db) costing less than $300 for Milsatcom, tactical missile, and EW applications. **Contractor:** Chang Industries. **Status:** Completing Phase II SBIR.

60-GHz Standard Space Systems Division Cross-Link
Program to develop hardware for space cross-link applications. The link will be capable of handling low to high data rates. **Contractors:** Sandia National Laboratories, GE, and Avoca Labs. **Status:** Development and demonstration.

65 Kelvin Standard Spacecraft Cooler
Design, performance prediction, analysis, detailed design, critical component fabrication, and demonstration of a cryogenic cooler capable of providing two watts of cooling at 65 degrees Kelvin for ten years of continuous unattended service in space applications. **Contractors:** Creare, Inc., and Hughes Aircraft Co. **Status:** Hardware fabrication.

256K Static Random Access Memory
This work involves developing and producing a fully radiation-hardened, space-qualified 256K SRAM, providing a sixteenfold increase in the density of memories over what is currently flying. **Contractors:** AT&T and Honeywell. **Status:** Advanced development.

Phillips Laboratory: Lasers & Imaging Directorate

Advanced Imaging Efforts
Development of methods to remove atmospheric distortions from images of space objects. These methods include computer postprocessing techniques such as speckle and hybrid imaging and preprocessing approaches with adaptive optical systems. **Contractors:** In-house and multiple contractors. **Status:** Research, exploratory and development.

Advanced Tracking
Investigation of acquisition, pointing, and tracking for laser systems in ground, air, and space experiments. The lab has developed in-house, advanced tracking systems to meet current and future requirements for active laser illuminated and passive imaging and weapon-class systems. **Contractors:** Multiple. **Status:** Research, exploratory, and advanced development.

Air Force Maui Optical Station
Research and development facility devoted to satellite tracking and imaging and the pointing and tracking problems associated with ground-based lasers. The facility is located on Mount Haleakala on the island of Maui, Hawaii. **Contractors:** Rockwell Power Systems (O&M). **Status:** Operational.

AMOS Four-Meter Telescope
The Air Force Maui Optical Station (AMOS) four-meter-class telescope program will increase the capabilities of the AMOS facility through installation of a large, state-of-the-art electro-optical system to be operational by 1995. **Contractor:** TBD. **Status:** Initial procurement stages.

Chemical Oxygen Iodine Laser
Development of advanced technologies, demonstration of the scaling of chemical lasers to weapons-power levels for strategic and tactical applications. Investigation of methods to enhance laser performance and develop novel pumping mechanisms. **Contractors:** In-house and several contractors. **Status:** Research, exploratory, and advanced development.

Malabar Test Facility
Located at Melbourne, Fla., near Kennedy Space Center, this optical surveillance tracking facility collects data for a broad range of DoD and other missions. **Contractor:** Harris. **Status:** Operational.

Multipurpose Multiple Telescope Test-Bed
This test-bed is a wide-field-of-view imaging array consisting of four symmetrical telescopes. This array can collect the power and distinguish the details of an equivalent single telescope equal to the area of all four smaller telescopes. **Contractors:** In-house and several contractors. **Status:** Establishing technology database.

Nonlinear Optics Center of Technology
Research into laser scaling through coupling of multiple devices; laser beam cleanup of system-induced distortions; correction, for imaging applications, of optical-system imperfections and atmospheric effects; and novel techniques for automatic target recognition. **Contractors:** Multiple. **Status:** Research, exploratory and advanced development.

Phased Integrated Laser Optics Technology
Program to develop new laser technology using semiconductor laser diodes for advanced applications. Research is conducted to develop semiconductor laser diodes and diode arrays, integrated optical elements, and control technologies and components. **Contractors:** Many. **Status:** Research, exploratory, advanced development.

Starfire Optical Range
This range, located at Kirtland AFB, N. M., houses a 1.5-meter telescope and auxiliary beam director with associate laboratories and control facilities for conducting night and daytime experiments. The impending installation of a new 3.5-meter telescope on the site will boost SOR to a world-class research facility. **Contractors:** Rockwell Power Systems, RDA, Contraves, and Univ. of Arizona. **Status:** Operational.

Phillips Laboratory: Advanced Weapons & Survivability Directorate

Electromagnetic Pulse
Development of new EMP sources, hardening methodology, EMP testing, and EMP hardening technology development. High-Altitude EMP (HEMP) tests on aircraft and other military hardware are conducted at Trestle (a large, all-wood, elevated test stand and high-voltage pulsers for simulated in-flight EMP tests); a large horizontal dipole antenna and pulser; and a large vertical antenna and pulser. **Contractors:** BDM, UIE, and Dikewood. **Status:** Engineering development, advanced development.

High-Energy Laser Effects
Investigation and measurement of laser effects on military components and materials using two carbon dioxide lasers (15 kilowatts and 45 kilowatts). **Contractors:** Logicon and RDA. **Status:** In-house basic and exploratory research.

High-Power Microwaves
Program coordinates Transient Electromagnetics Program; source development using pulsed-power test stands and anechoic chambers; HPM effects; and application studies. The new High-Energy Microwave Laboratory (HEML), constructed in April 1991 at Kirtland AFB, will house a shielded anechoic chamber designed for high-power microwave tests of military systems up to the size of a fighter aircraft. **Contractors:** In-house R&D in association with many contractors. **Status:** Basic to advanced R&D, including technology demonstrations.

Materials Damage
Research involves target damage assessments for directed-energy weapon effects and other experiments. **Contractor:** In-house. **Status:** Basic R&D.

Plasmas
R&D related to compact toroids, microfission and fusion, and parallel processing applications. High-energy-density plasma and radiation-source research and pulsed-power development are performed at the Shiva Star facility, an eight-megajoule fast capacitor bank (the nation's largest). In the near future, Phillips Laboratory will conduct explosive pulsed-power research and microwave propagation and effects experiments in its new High-Energy Research and Technology Facility. **Contractors:** Maxwell Laboratories, Inc., Mission Research Corp., and RDA. **Status:** Basic and advanced R&D.

Satellite Assessment
Research into space nuclear environments, classified satellite descriptions, and DEW satellite lethality. Assessment research centers on analyzing the susceptibility of space satellites to directed-energy and other weapons. **Contractor:** TBD. **Status:** Basic and advanced R&D.

Shock Physics
Research into survivable structures, silo hardening, and civil engineering assistance. Nuclear- and conventional-weapon blast and shock experiments, primarily at McCormack Ranch Test Range at Kirtland AFB. **Contractor:** New Mexico Engineering and Research Institute. **Status:** Basic and applied research.

Space Survivability
Research centering on payload assessment, debris mitigation, and SDIO passive survivability. **Contractors:** Many. **Status:** Basic R&D, development, technology infusion.

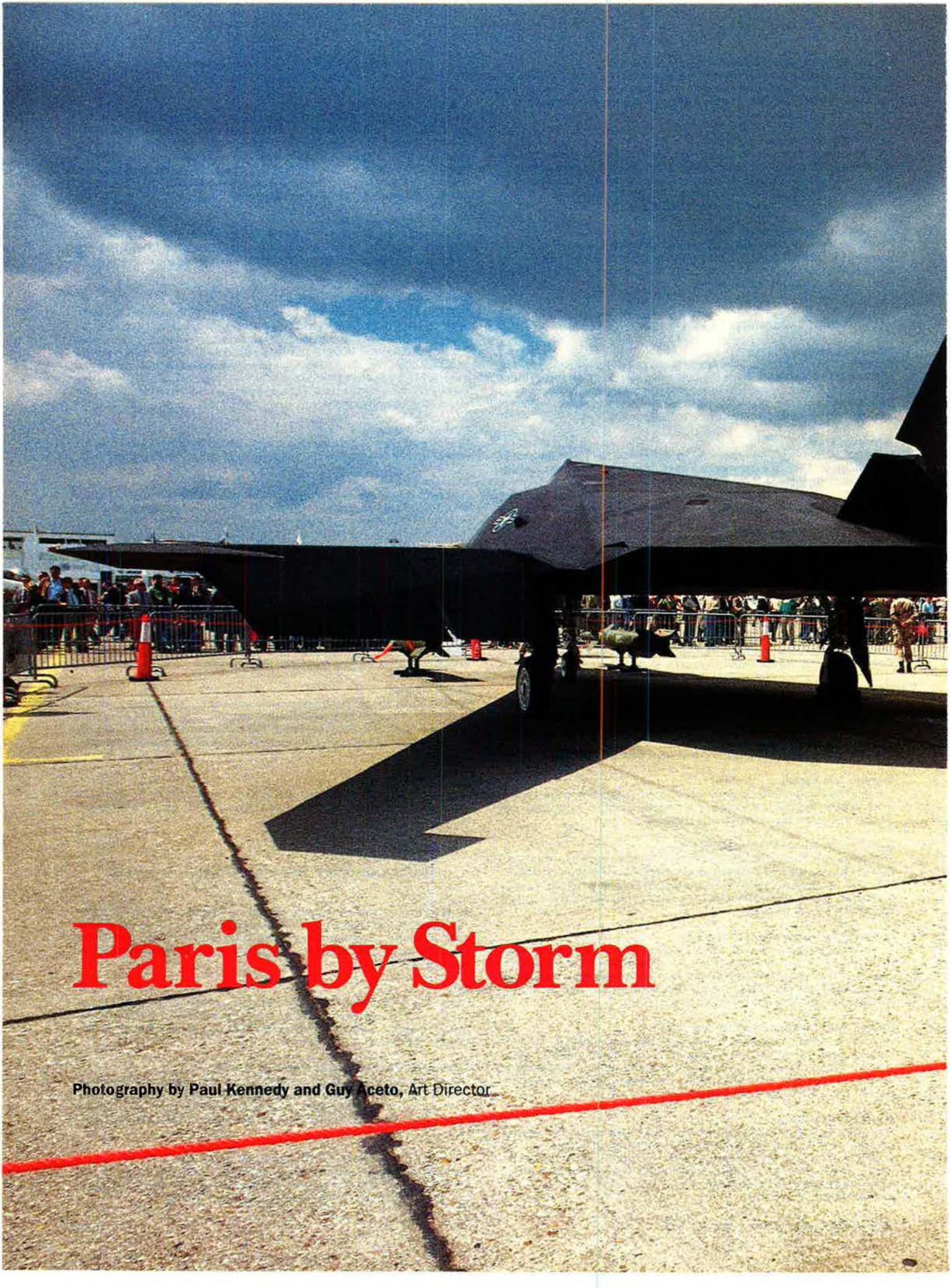
Phillips Laboratory: Space Experiments Directorate

Altair
Program to demonstrate acquisition, tracking, and pointing against boosting targets; collect high-resolution active and passive plume signature measurements; and gather background phenomenology in the ultraviolet, visible, and infrared spectral bands. **Contractors:** Many. **Status:** Advanced development.

Elite
Program to demonstrate integrated electric orbit transfer vehicle in a realistic mission scenario. Demonstrates arcjet propulsion for a LEO-GEO orbit transfer. **Contractors:** Joint venture with TRW in cooperative R&D plan. **Status:** Demonstration.

Lightweight Exoatmospheric Projectile Program
Development and integration of kinetic kill vehicle (KKV) technologies; demonstration of KKV state-of-the-art performance through low-cost ground and flight testing. Data collection using on-board sensor suite and mobile telemetry stations. **Contractors:** Boeing and Rocketdyne. **Status:** Flight testing.

Technology for Autonomous Operational Survivability
Demonstration of autonomous navigation/control bus technology. Testing and validation of new operational concepts. Transition of spacecraft technologies. **Contractors:** Many. **Status:** Integration and test. ■



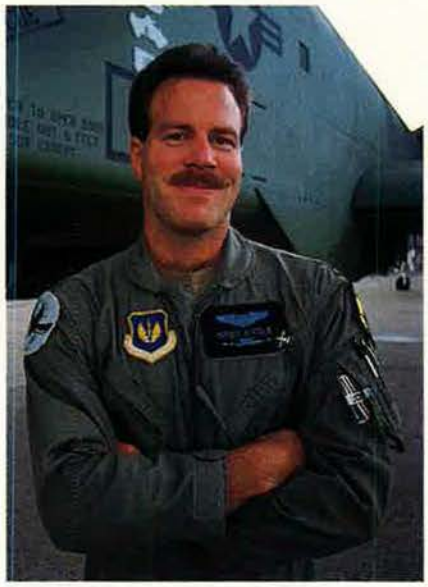
Paris by Storm

Photography by Paul Kennedy and Guy Aceto, Art Director

—Photo by Paul Kennedy

This Air Force F-117 drew throngs at the Paris Air Show last June. Anxious to see one of the stealthy attack planes that performed so impressively in the Gulf War, spectators at the show swarmed around the first F-117 ever to be displayed in public outside the United States.

—Photos by Paul Kennedy



Above: An Air Force A-10 is backdropped at the Paris Air Show by a Soviet Il-96 transport plane and stands nose-to-nose with a MiG-31 fighter. Right: Lt. Greg Engel of USAF's 10th Tactical Fighter Wing, RAF Alconbury, UK, prepares to tell air show onlookers what it was like to fly the A-10 on ground-attack missions during the Gulf War.

—Photos by Paul Kennedy

Above: The Soviet A-40 Albatross maritime patrol plane, a blend of aerodynamics and hydrodynamics, makes its international debut at the Paris Air Show. Right: The Il-96 transport and the tiny Su-26UT exemplified the wide range of Soviet aircraft on display at the show, a marketplace for Moscow's planes in recent years.

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—Photo by Paul Kennedy

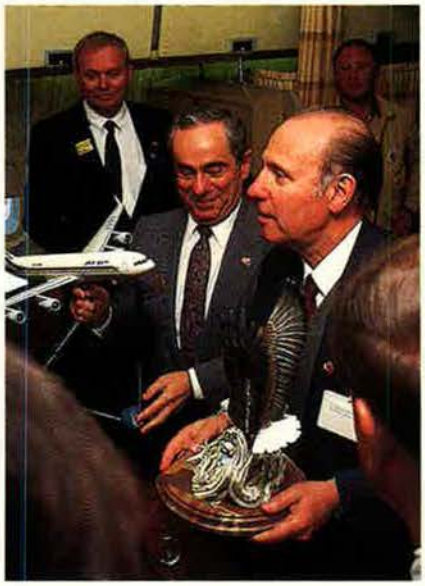
—Photos by Guy Aceto

Above: Influential visitors to the show check out facilities provided by Dassault, producer of fighter planes for the host nation. Far left: One such plane, a Mirage 2000, shows its stuff in one of the many flight spectaculars staged each day. Left: Dassault's Rafale, the newest French fighter, was a star attraction.

A golden-hued Canadair CL-215T turboprop amphibian makes a splash amid nonmilitary aircraft at Le Bourget, where it put on daily demonstrations of aerial firefighting techniques. The CL-215T is an upgrade of the CL-215, which was powered by radial piston engines. Spain and the province of Quebec are among its first customers.

—Photo by Paul Kennedy

—Photo by Guy Aceto



—Photo by Paul Kennedy

Right: Pratt & Whitney officials meet with Ilyushin Design Bureau counterparts at the show to seal an agreement signifying the new era of aerospace cooperation. PW2337 engines will power the Il-96M transport now being designed by Nyushin as a derivative of the Il-96-300 aircraft (above) on display in Paris.

—Photo by Guy Aceto

The British also contributed to the international mix at this year's show. The Jaguar (above) and Tornado (right) attack aircraft were pivotal to the success of the allied air campaign in Operation Desert Storm. Here, the Tornado crew fields questions about the Gulf War and the RAF's important role in the victory.

—Photo by Paul Kennedy

—Photo by Guy Aceto

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—Photo by Paul Kennedy

Above: The US Pavilion, a busy place throughout the show's run, featured exhibits from all the military services, such as this display of Army Patriot and other missile systems. Right: This Texas Instruments laser-guided bomb, a big attraction at the show, gave visitors a look at precision guided munitions, made famous by the Gulf War.

—Photos by Guy Aceto

Trainer aircraft did much of the flying at Paris. Above: The Shorts Tucano, an RAF trainer, takes to the air over Le Bourget for an impressive display of aerobatics. Right: A Galeb trainer from Yugoslavia is checked out before a flight demonstration. Trainer manufacturers were in a highly competitive mode at the show.

—Photo by Paul Kennedy

Displays depicting Soviet space programs and activities were crowd-pleasers at the air show. Here, a spectator checks out the history and accomplishments of Soviet manned spaceflight, an endeavor that has been a prime source of national pride and that the Kremlin evidently intends to sustain under economic pressure.

Global fascination with the Paris Air Show in aerospace circles is amply evident in this scene. Military airmen from several nations compare notes on the French Mirage 2000 in the background. Several major US aerospace companies gave the show a pass this year but their overseas competitors amply compensated for their absence.

—Photo by Guy Aceto

—Photo by Paul Kennedy

The show was not limited to international aerospace giants. Countless smaller companies also filled the huge exhibit halls with seemingly endless examples of their wares. Among them was Brunswick Defense, maker of this C-17's composite flap and the Tactical Air-Launched Decoy—a standoff, unmanned penetration aid for the US Navy.

—Photos by Paul Kennedy

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Jack Gordon, left, and Paul Martin of Lockheed Advanced Development Co. brief the press on the Gulf War achievements of the crowd-pleasing Lockheed F-117, above, and other systems and on progress with the F-22 Advanced Tactical Fighter being developed for USAF by Lockheed with Boeing and General Dynamics.

—Photo by Paul Kennedy

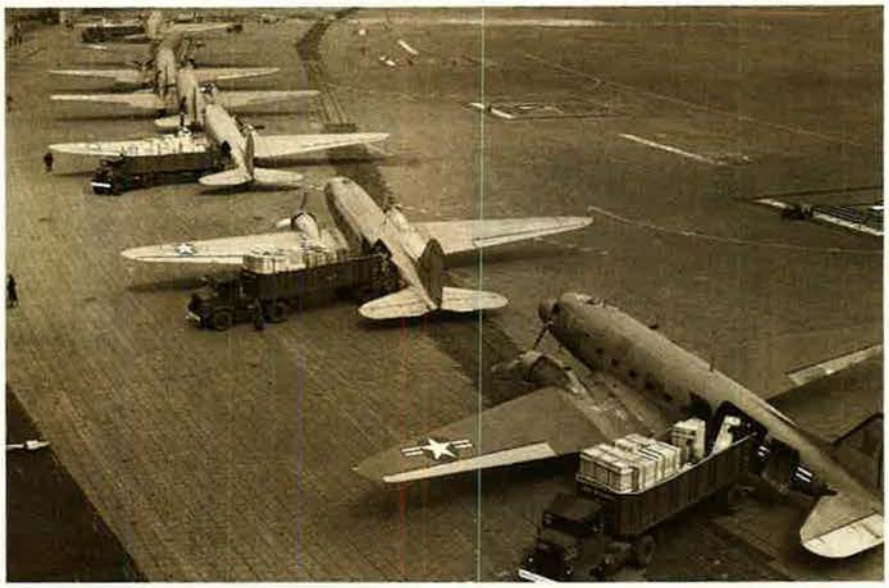
—Photo by Guy Aceto

These scenes from this year's Paris Air Show capture its essence. In the huge exhibit halls, deals are struck and information exchanged amid the wide variety of aerospace products from all over the world. Outside, whether parked or flying high, are the airplanes, the show's highlights and its reasons for being.

From the Himalayan Hump to the Persian Gulf War, the airlifters have gotten it done for fifty years.

They Deliver

By Stewart M. Powell



—USAF photo by TSgt. Dave McLeod

Had it been available, the C-5 (right, being worked on at Travis AFB, Calif.) doubtless would have eased the traffic jam of C-47s at Tempelhof Airport (above) during the Berlin Airlift. Even with the relatively tiny payloads of 1948–49, MATS (MAC's predecessor) delivered 2.3 million tons of supplies to the blockaded city.

It was an ordinary day, nothing unusual for the 80,000 men and women and 1,000 aircraft of Military Airlift Command. MAC C-141s and C-5s ferried US troops and gear home from the Gulf War. Workhorse C-130s in Saudi Arabia flew in support for the remnant of the 540,000-strong US force. To the north, MAC planes landed in Turkey with supplies for Kurdish refugees. To the east, in Bangladesh, MAC planes carried humanitarian aid to survivors of a devastating typhoon.

At the same time, MAC's airlifters were crisscrossing other parts of the globe on training and transport missions, ferrying US troops and supplies to Washington's far-flung forces.

For America's airlift corps, it was just another day, marked by the completion of 261 missions worldwide. But on this day—May 29, 1991—the flights also marked the fiftieth anniversary of Military Airlift Command, which in five eventful decades has grown to be a $5.2-billion-a-year operation, possessing $33 billion worth of equipment working at 287 locations in twenty-five nations worldwide.

The United States long has relied on airpower to exert influence in the world. If anything, the end of the cold war only clears the way for Washington to play an even more prominent role in international affairs. Its influence will be exercised in virtually every instance through the use of airlift.

Senior Bush Administration offi-


USAF

cials, crafting a new national security strategy, foresee a continued and growing need for rapid deployment of combat-ready US forces. "Our focus now is on regional crises and contingencies," Defense Secretary Dick Cheney told a Senate panel. "A capacity for crisis response is sadly all too relevant in a global security environment that could well be far more unstable than during the cold war."

Gen. Colin Powell, the Chairman of the Joint Chiefs of Staff, has made it clear that, whenever US forces go into combat, the Pentagon will deploy overwhelming force, much of it based in the continental US, sufficient to swiftly subdue an enemy.

The strategy puts greater emphasis than ever on the MAC fleet of C-5 Galaxies, C-141 StarLifters, and C-130 Hercules transports. "As forward forces decline but global interests remain, airlift will be even more in demand," maintains a recent Air Force white paper.

The Persian Gulf deployment was the prototype. "I think everybody understood the role of transportation, but it was made starkly visible this time," says Gen. H. T. Johnson, commander in chief of MAC and of US Transportation Command, which has its headquarters collocated with MAC at Scott AFB, Ill. "Anytime we have to take an action, we will have to move a force very, very quickly. From a strategy standpoint, I see transportation being of increased importance."

—USAF photo by SSgt. Dean Wagner

The humanitarian side of the airlift mission did not end with the Berlin Airlift. Whether rescuing Hungarian refugees in 1956, transporting orphans from Vietnam, or delivering Shiite Gulf War refugees to safety (above), USAF's airlifters have never ceased their efforts to lessen the misery in the world's trouble spots.

The "Real" Strategic Headquarters?

Some analysts go further in their estimation of the value of transportation in general and air transport in particular.

Harry G. Summers, a retired Army colonel and author of widely quoted books on military strategy, puts the situation in provocative terms: "In the post–cold war, postnuclear world, the real strategic military headquarters is not the Strategic Air Command at Offutt AFB in Nebraska, but the United States Transportation Command at Scott AFB in Illinois."

As it did in the Gulf, airlift will continue to handle the crucial early phases of emergency deployments. MAC rushed combat-ready troops and support crews for warplanes to the Gulf to underscore American resolve weeks before armed forces could have withstood a full-scale attack.

The first US aircraft to land in Saudi Arabia last August was an Air Force C-141 carrying an airlift control team to handle the vanguard of US air and ground combat forces. Air Force warplanes and 82d Airborne Division troops followed hours later.

Amid Pentagon worries that Saddam Hussein might order his Kuwait invasion force to seize the oil fields of eastern Saudi Arabia, MAC cargo planes rushed 91,000 troops and 72,000 tons of cargo into the Arabian peninsula in a mere thirty days—a record-breaking effort. All told during the buildup and the forty-three-day war, 111 C-5s, 227 C-141s, and 117 commercial aircraft activated by the Pentagon ferried 498,000 troops and 577,000 tons of cargo to the Gulf region.

The Gulf operation "may in many ways be a model for future conflicts in the post–cold war, new world order," says General Johnson. "The lesson we should take away . . . is that our nation must be prepared

—USAF photo by TSgt. Hans Deffner

SSgt. Roger L. Oberhelman (left) and Sgt. Carl Zepper, two of MAC's 78,000 active-duty members, discuss a C-130's operation. MAC is augmented by a further 68,000 people from the Guard and Reserve, making it a paragon of the Total Force concept.

with little warning to project significant US forces great distances to areas that may have little or no infrastructure."

The crucial role played by airlift forces was merely the latest of a series of successes for Military Airlift Command in global crises. The tools and procedures that proved so effective in Operations Desert Shield and Desert Storm were developed, refined, and rehearsed throughout the past half century.

The command and its workhorse fleet trace their origins to the Army Air Corps Ferrying Command, which delivered 1,350 aircraft to Britain under the Lend-Lease program in the early days of World War II. Ferrying Command's direct successor, the Air Transport Command, became the object of public fascination when its unpressurized, propeller-driven planes delivered 740,000 tons of war materiel to allied forces in China by "flying the Hump"—that is, over the towering Himalaya range.

71,000 Tons Per Month

The operation, relying on 722 aircraft, completed 167,285 trips from the steamy valleys of India's Assam province across the snow-capped Himalaya passes to maintain a land front against the Japanese as amphibious forces stormed the Pacific islands toward the Japanese homeland. The grueling airlift, which claimed 460 aircraft and the lives of at least 792 airmen, was delivering almost 71,000 tons per month by July 1945, with one transport aircraft taking off for China every three minutes.

The experience gained in the operation paid off handsomely in mid-1948 when Soviet Bloc forces blockaded the western sector of Berlin to protest the Allies' creation of an independent West Germany. Resupply of the isolated German city 110 miles inside Soviet-controlled territory became a landmark in the evolution of airlift and of the utility of military forces in peacetime.

The Berlin operation helped burnish the image of the new, independent Air Force and of the Military Air Transport Service (MATS), ATC's successor. By the time the Berlin Airlift ended after 463 days, Allied transports had turned in a total of almost 280,000 flights and delivered 2.3 million tons of supplies, with the loss of the lives of thirty-one Americans, twenty-eight Britons, and seven German cargo-handlers.

North Korea's surprise attack on South Korea on June 25, 1950, forced the Air Force's propeller-driven fleet of airlifters to overcome the challenges of transoceanic airlift operations. MATS ferried 214,000 United Nations troops and 80,000 tons of materiel to the Korean peninsula before a negotiated cease-fire ended the bloodshed. The organization refined air medevac operations, carrying more than 43,000 American wounded back to the United States.

US air transports also played key roles in the evacuation of 10,200 Hungarian refugees after the 1956 uprising, deployment of UN peacekeeping forces to the Middle East during the 1956 Suez Crisis, and rapid insertion of 10,000 American troops to West Berlin following construction of the Berlin Wall in 1961.

The greatest test of airlift capacity came during the nine years of heavy US involvement in the Vietnam War. Between 1964 and 1973, Air Force transports moved two million tons of cargo and more than two million troops to and from southeast Asia.

The Vietnam era saw the US make the transition from long-range, propeller-driven C-124 aircraft to jet transports. The Boeing C-135 Stratolifter, which had been introduced in 1961, was followed four years later by the Lockheed C-141 StarLifter, which was able to carry thirty-four tons of cargo 4,000 miles at a speed of 440 knots. The C-141 became the backbone of the fleet, a role it continues to play today.

The C-141 fleet was augmented in 1969 with the giant C-5 Galaxy. The enormous aircraft, with a payload of fifty tons, was designed to transport heavy Army combat equipment such as the M60 tank and give US conventional forces unmatched mobility.

—USAF photo by TSgt. Dave McLeod

Maintenance assumes growing importance as MAC's fleet ages. Though C-5s (above) are youngsters compared to C-130s (average age, 21.3 years) and C-141s (average age, twenty-four years), their heavy use during the Gulf War is sure to keep maintainers busy.

From Saigon to Israel

When a cease-fire took hold in Vietnam in early 1973, the new MAC lifter brought home thousands of US soldiers and 566 freed prisoners of war. Barely had that operation ended when, in October 1973, MAC was called on to deliver 22,395 tons of materiel to Israel over thirty-two days to enable the US ally to survive the most recent full-scale Arab-Israeli war.

MAC touched down in southeast Asia once again in 1975 to ferry 50,493 refugees to safety as North Vietnamese troops closed in on Saigon. Hundreds of orphans were flown to the United States in Operation Babylift—an exodus marred by the first crash of a C-5, which occurred following a massive decompression after takeoff. *[See "Valor: A Galaxy of Heroes, p. 73.]* It was

not until the outset of Operation Desert Shield fifteen years later that MAC lost the second C-5 aircraft to a crash. That C-5 crashed on takeoff from Ramstein AB, Germany.

During the Grenada invasion in 1983, MAC aircraft flew almost 1,200 missions to and from the Caribbean island to transport 36,911 troops and civilians and 15,374 tons of cargo over a nine-day period.

When Operation Just Cause, the invasion of Panama, began in December 1989, MAC aircraft dropped US-based Army Ranger paratroopers on Panamanian strongholds at Rio Hato and Tocumen International Airport in the largest night airdrop since World War II. During the eight-week operation, MAC transported almost 40,000 personnel and 21,000 tons of equipment during 775 missions.

The evolution of airlift operations has not been without bumps and challenges, however. Military airlift came under repeated congressional scrutiny in the 1950s amid concerns that the fledgling commercial airlines were being underutilized. By the time of the Vietnam War, however, the importance of military airlift had become widely appreciated. In 1966 Congress redesignated MATS as Military Airlift Command, elevating it to the level of other major commands.

MAC assumed responsibility for tactical airlift as well as strategic airlift forces in 1974, ending a dual system that existed during the Vietnam War. The role of MAC continued to expand with the addition of special operations forces and the Aerospace Rescue and Recovery Service in 1983. Special operations forces later moved to the Air Force Special Operations Command.

What lies ahead for America's airlift forces?

America's status as the world's only true superpower, with worldwide obligations intact, guarantees that MAC's airlift forces will remain at the forefront of all military planning. Moreover, American airlifters will no doubt be called on to support expanded UN operations.

MAC is assured a leading role in humanitarian operations around the globe, with its transports handling not only emergency government-sponsored assistance but also delivering privately donated relief on a space-available basis under the requirements of legislation passed in 1985. That commitment alone has been the spark for delivery of 1,500 tons of relief supplies over the past five years.

—USAF photo by TSgt. Hans Delfner

Rapid deployment of troops is arguably MAC's most important mission. During the first thirty days of Operation Desert Shield, MAC rushed 91,000 troops and 72,000 tons of cargo to the Gulf region. Above, soldiers from the Army's 101st Airborne Division pack an Air National Guard C-130.

—USAF photo by TSgt. Dave McLeod

The aircraft, uniform, and cargo have changed a lot in fifty years, but the mission remains recognizable to even the earliest pioneer of Air Corps Ferrying Command: getting the goods where they're supposed to go as quickly as possible. Here, a loadmaster pushes a pallet of supplies onto a C-5 Galaxy.

"Modest Growth" for MAC

Throughout the US government, support for airlift operations remains strong. The Joint Chiefs of Staff's latest net assessment insists that "today's environment dictates the need for more strategic lift assets." The Defense Secretary, in his annual report to Congress and the President, says mobility requires "modest growth" despite "large reductions" in virtually all other components of the nation's armed services.

All signs are that Congress shares the Pentagon's sense of priorities. Lawmakers indicate that they will favorably consider the recommendations of the Mobility Requirements Study being prepared, at Congress's insistence, by the Joint Staff.

The study, to be delivered later this year, will almost certainly call for maintaining if not expanding the airlift force.

The Democratic-controlled House also agreed last May to provide virtually all of the $2.7 billion that the administration seeks this year to continue its $35.3 billion program to build 120 new C-17 long-range transports. In the past, the House has voted to impose a number of restrictions on the timing of C-17 spending. Air Force officials now expect to win full congressional approval for production of six aircraft in Fiscal 1992, which starts October 1, and for twelve in Fiscal 1993.

The aircraft is designed to revolutionize airlift operations by combining the long-distance capabilities of the C-5 and C-141 with many of the short-airfield capabilities of the C-130. Supporters maintain that eighty C-17s, with their large payloads and ability to land on 3,000-foot runways, could have delivered to Saudi Arabia an additional twelve squadrons' worth of equipment and supplies and two light infantry brigades in the first twelve days of the Gulf crisis.

A MAC analysis declares that "in future conflicts, such delivery speed could spell the difference between deterrence and defeat."

In addition, the existing MAC fleet is getting a bit gray. Each of the twenty-six-year-old C-141s that flew in Desert Shield and Desert Storm flew an average of eleven hours daily, up from 3.6 hours in peacetime. The C-5s were used ten hours a day, up from 1.8 hours in peacetime, say MAC officials. Weight restrictions, imposed on the C-141 to extend the plane's service life to 45,000 flight hours, were waived during the crisis. Postwar checks unmasked cracks in outboard sections of the five-section C-141 wing.

"We took some risks," General Johnson told a panel of the Senate Armed Services Committee some weeks after the end of the war.

—USAF photo by TSgt. Dave McLeod

The continuing importance of airlift is illustrated by its sustained (or even slightly increased) budgets during a time when most other mission areas are coping with deep cuts. C-141s, here preparing for a night mission, are being modified to extend their service life, and Congress now seems inclined to fund the new C-17.

Refining the CRAF Program

Beyond upgrading the MAC fleet, officials are working to ensure US access to commercial aircraft that would be used to augment MAC airlifters in the next crisis. Activation of planes under the aegis of the 1951 Civil Reserve Air Fleet (CRAF) program took place last August. Officials required airlines to contribute aircraft to the Desert Shield effort at the height of the summer travel season, a move which unavoidably left many airline passengers stranded. Some commercial carriers have begun to reexamine their participation in CRAF.

However, Air Force Col. Ronald Priddy, who coordinated the reserve air fleet operations from MAC headquarters at Scott AFB, said that the $2.1 billion charter of requisitioned aircraft proved to be a boon. Sixty-four percent of US GIs and twenty-eight percent of combat equipment dispatched to the region by air went aboard commercial airliners provided by Pan American, United, Northwest, American, Federal Express, and other major carriers. No commercial airliner was lost or damaged during the operation.

Ahead, too, are efforts to guarantee that there will be continued support for MAC operations within the Air Force Reserve and the Air National Guard. MAC relied heavily on reserve forces, activating crews and equipment from all seven C-5 squadrons, eleven of the fifteen C-141 squadrons, and ten of the thirty-four C-130 units. Volunteers contributed, as well.

Many reserve military personnel remained on active duty beyond the end of the war. Some expressed frustration about being ignored, forgotten, or misled. General Johnson, reliant on reserve forces for his operation, expressed sympathy and tried to rush them home as quickly as he could. "If they're going to be there the next time you want them, you've got to release them," General Johnson said.

As MAC marked its fiftieth anniversary, there was no end in sight to the demands on American airlifters to bring relief to the desperate and combat forces to the scene of America's next military challenge. As Air Force Secretary Donald Rice put it, "Whether it's airlifting the XVIII Airborne Corps to their jumpoff point, delivering Patriots to Israel within eleven hours of the President's order, or airdropping food to starving Kurds—MAC is always there." ■

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The new CINC surveys the outlook for Strategic Air Command in a changing world.

SAC's Twin Triads

By Larry Grossman

WHEN President Bush initialed the Conventional Forces in Europe pact last fall, he declared a formal end to the cold war. The effect of that declaration is nowhere more apparent than at the headquarters of Strategic Air Command (SAC), Offutt AFB, Neb., and in the thinking of Gen. George L. Butler.

"That has an important impact on me as commander in chief of Strategic Air Command because, of all the commands, SAC is quintessentially the child of the cold war," says General Butler, who on January 25 replaced Gen. John T. Chain, Jr., as head of the nation's premier nuclear fighting force.

General Butler, the first post–cold war commander in chief of SAC and director of strategic target planning, came to the command with a twenty-first century vision for strategic air forces. For the first time in forty-five years, the Russian-red eyeshades that colored SAC's view of the strategic landscape have been cast aside. Being rediscovered are often-forgotten conventional fighting capabilities.

"Nuclear deterrence remains job one," says General Butler. However, it is clear that, for the CINCSAC, the words "nuclear" and "strategic" are not synonymous.

The SAC that General Butler envisions will form the basis of "Twin Triads" of nuclear and conventional fighting capabilities. The first element is the familiar triad of *nuclear* deterrence, based on mutually reinforcing groups of bombers, intercontinental ballistic missiles (ICBMs), and submarine-launched ballistic missiles (SLBMs). The second grouping is SAC's conventional warfighting triad. It is composed of long-range bombers, aerial refueling planes, and reconnaissance airplanes.

General Butler came to SAC after serving as director of Strategic Plans and Policy (J-5) for the Joint Chiefs of Staff. There, he oversaw development of Gen. Colin L. Powell's new national military strategy and had a major role in shaping the associated base force concept, which defines the minimum force levels needed to meet the President's national security objectives.

As director of J-5, General Butler also cochaired what he calls "a historic and unprecedented" review of

US nuclear targeting requirements and the single integrated operational plan (SIOP), the US blueprint for nuclear combat, in light of recent changes in eastern Europe.

"In the aftermath of the cold war," the General maintains, "we are going to be involved for some indeterminate period of time in strategic disengagement—disentangling ourselves mentally, bureaucratically, and militarily from the habitual ways of thinking and acting of forty years of cold war animosity."

"Disturbing Regularity"

But not all the way. General Butler is concerned about the Kremlin's continued modernization of Soviet land- and sea-based nuclear forces and improvements to an extensive air defense system.

"While there are many signs and manifestations of a profoundly changed US-Soviet relationship," remarks the General, "the one sign that represents the thread of continuity back to the cold war era is the fact that the strategic production lines just keep running with disturbing regularity."

He notes that the Soviets continue to deploy SS-18 Mod 5 and Mod 6 ICBMs. While rail- and silo-based SS-24 deployments have probably ended, deployment of the road-mobile SS-25 continues. At least two new ICBMs, follow-ons to the SS-24 and SS-25, are in development. The Soviets are developing two new, more accurate SLBMs, and the Moscow antiballistic missile system is nearing full operational capability.

For nuclear war planners, this is distressing. They think that, until the Soviet Union demonstrates benign intentions comparable to those of nuclear allies Britain and France, nuclear deterrence will remain the cornerstone of US security.

"With the Soviets, there's still that question" about intentions, says General Butler. "Because I believe that the cold war as we knew it has ended, that suggests that I believe there has been a fundamental change in intention." Still, he adds, the commander in chief of SAC is charged with maintaining an adequate nuclear posture and this requires SAC to hedge against a reversal of recent trends in the Soviet Union. "The consequences of [a possible reversal of course] are so important, so significant, that this country must still continue to make some investment of its own to provide the tools of nuclear deterrence," General Butler says.

Episodically, SAC has played an important role in conventional warfare; the Korean and Vietnam Wars and the Panama operation come to mind. General Butler points out that, as soon as those conflicts were over, "we came home quickly and went back into our familiar nuclear deterrent triad."

"The Twin Triad preserves the logic of the nuclear deterrent triad into the next century with the B-2, but [the new bomber] is now equally available for a conventional warfighting role."

In the Persian Gulf War, however, SAC's U-2, TR-1, and RC-135 reconnaissance aircraft helped Gen. H. Norman Schwarzkopf, the commander in chief of US Central Command, to see and subsequently to shape the battlefield to his liking. The Desert Shield deployment of forces and Desert Storm air campaign could never have taken place without the nearly 300 SAC tankers that were available for the daily Air Tasking Order drafted by CENTCOM air boss Lt. Gen. Charles A. Horner and his top planner, Brig. Gen. Buster C. Glosson.

Early in the air war, moreover, thirty-three B-52G bombers, which SAC had dedicated to conventional missions, were raining scores of tons of bombs on Iraqi troops dug deeply into the Kuwaiti desert. General Butler says, however, that General Schwarzkopf requested SAC to commit additional B-52 bombers to the fray. Free of longstanding fears that war in the Middle East could escalate into a full-blown superpower confrontation, General Butler moved quickly to meet General Schwarzkopf's request.

Using the SIOP Bombers

"I took bombers that were literally committed to the SIOP and sent them to the Gulf," General Butler says. "With great confidence, we were able in this war to comfortably take those additional bombers that were in the nuclear war plan and send them to the Gulf where they could operate in the conventional role. That got us over a tremendous psychological hurdle because we recognized at that point that bombers can in fact be in one role or the other depending on the call of the President."

The centerpiece of the Twin Triad concept is the controversial B-2 Stealth bomber. "The Twin Triad preserves the logic of the nuclear deterrent triad into the next century with the B-2, but because the nuclear case is less compelling, less urgent, [the new bomber] is now equally available for a conventional warfighting role."

With respect to strategic nuclear deterrence, the prospective role of the B-2 is well known. It hedges against a vulnerability in the ICBM and SLBM forces.

"But winning the cold war," General Butler says, "has given us wonderful flexibility where we can be much broader in our thinking about the role of the bombers."

In the conventional role, the capabilities that stealth technology offers were displayed throughout Desert Storm by the combat successes

of the stealthy F-117. Stealth technology not only paid off in reduced risk to American pilots in the war against Iraq, it opened the door to an overwhelming combat advantage by restoring the element of surprise, assuring the success of the air campaign.

The advantage of the B-2, says General Butler, is its single-aircraft blend of the range and payload of the B-52 with a low-observability radar signature similar to that of the F-117. The B-2 can carry more than ten times the payload of the F-117 at over five times the unrefueled range. In this circumstance, says General Butler, the B-2, which can reach anywhere in the world on one refueling, shapes up as the key to US power projection.

With the continuing meltdown of the conventional Soviet threat have come charges from B-2 skeptics that the Air Force is using the successes of the Gulf air war to exaggerate the case for building the B-2. They point out that, only a year ago, General Chain said he wouldn't risk his most costly nuclear asset to fight a conventional war.

With respect to the first charge, General Butler counters that a little institutional memory should put to rest the plane-without-a-mission argument. He notes that in the original requirements statement drafted in 1981, the concept for what was then known as the advanced technology bomber called for a plane that was "capable of assured survivability across the entire conflict spectrum" —including conventional warfare.

With regard to General Chain's comment, the new SAC boss says he will not critique the decisions and the preferences of his predecessor, who operated in a different strategic environment.

General Butler does, however, offer a provocative idea. "Maybe the right designation for the B-2 is the A-2 or the B/A-2," he says. "The B-2 is a bundle of potential energy, and I want to convert it to a lot of kinetic energy." As for General Butler's two other bombers, the B-52 and B-1, they fit with the B-2 into a low-, medium-, and high-end Twin Triad bomber force.

The B-52s, however, are getting old and losing their ability to penetrate densely defended airspace. In Iraq, for example, the B-52Gs were forced out of their low-altitude operational envelope up to 40,000 feet, out of range of antiaircraft artillery.

"Iraq confirmed my suspicions that the days are numbered for the B-52 in a penetrating role in the Soviet Union," General Butler says. Because the Soviet periphery is so much bigger than that of Iraq, he adds, the B-52 will still be able to find weak spots to penetrate. But as these defenses are modernized, the ability of the B-52 to break through becomes questionable.

In its nuclear deterrent triad role, the B-52H will carry the air-launched cruise missile (ALCM) and the long-range, stealthy, advanced cruise missile (ACM).

General Butler disagrees vigorously with the claim, advanced by some commentators, that cruise missiles launched from B-52Hs at standoff ranges are enough to assure the viability of the bomber leg of the triad—without the B-2. "If that's your only capability," he argues, "you can be quickly driven out to the point where your range is eaten up just getting to the shorelines [of the Soviet Union]."

B-2s equipped with nonnuclear standoff cruise missiles will also play an important role in the conventional bomber leg of the Twin Triad. The Air Force, says General Butler, is exploring a variety of weapons accurate enough to allow the B-2 to go up against a wide array of high-value targets.

"The B-1 has a higher survivability factor in a penetration role in the Soviet Union without the ECM than the B-52H with a full-up ECM, by a significant margin."

The B-1 Will Be Back

SAC has a fleet of ninety-seven B-1B bombers. The General contends that, even with all its highly publicized problems—a defective electronic countermeasures (ECM) suite, cracking engine blades, and so forth—it is still the best bomber in the world. In fact, says General Butler, "the B-1 has a higher survivability factor in a penetration role in the Soviet Union without the ECM than the B-52H with a full-up ECM, by a significant margin."

Once the Air Force resolves B-1 ECM troubles and equips the plane with other core defensive systems, the Rockwell-built bomber will be able to penetrate the densest Soviet air defenses through the late 1990s.

The B-1, says General Butler, is presently optimized for the nuclear deterrent triad and has a limited conventional capability. Even so, outside experts would like to see the Air Force push ahead with integrating conventional cruise missiles onto the B-1.

General Butler says the problem with outfitting the B-1 as an ALCM or ACM carrier is more complicated than just figuring out how to hang the missiles from the underside of the plane's wings. "The B-1 under START [Strategic Arms Reduction Talks Treaty] could carry and fire conventional cruise missiles, but you have to buy into a verification regime that allows the Soviets the absolute confidence that those are conventional rather than nuclear cruise missiles," General Butler says. Otherwise, the B-1 would count as a cruise missile carrier. Because of the nature of START's

counting rules, General Butler says, there is a danger. The Air Force has to be careful that each B-52 and B-1 doesn't wind up counting as ten weapons (the number of ALCMs each would carry) rather than one.

"That's one of the most constraining factors that I find as I look at the future of the bomber force. It's taken away some flexibility," General Butler says.

He continues: "The situation that concerns me most for nuclear and conventional warfighting is just that, if the budget squeeze continues, then I have to choose between my bombers. I am concerned that we not constrain, perhaps through arms control, the role of the B-1 [to such an extent] that, if I am forced fiscally to diminish my B-52H force, I can't transfer its capabilities to the B-1."

The Air Force's stable of ICBMs remains at the heart of General Butler's vision of nuclear deterrence. His work on the base force concept led him to ask a basic question: If the Soviet Union continues to decline as a threat and the US budget deficit continues to squeeze defense spending, what would be the proper size for the US nuclear deterrent force?

The Pentagon's strategic planners gamed the probable outcomes and limitations of various START proposals that included the elimination of destabilizing multiwarhead ICBMs like the Soviet SS-18 and the US Peacekeeper. Through this exercise, General Butler said, planners reached "a considered conclusion that we could shrink the nuclear deterrent forces."

General Butler says that, if the various START proposals work out as planned, the nation's nuclear deterrence can be preserved with an ICBM force of about 500 Minuteman IIIs, equipped with whatever number of warheads can be placed on them consistent with START's sublimit of 4,900 warheads on ballistic missiles. The exact nature of the force required would hinge primarily on the fate of the ten-warhead Peacekeeper ICBM (fifty of which are deployed in silos) in any follow-on arms negotiations with the Soviets with respect to overall ICBM levels.

To hedge against unpleasant surprises in the uncertain future of the Soviet Union, General Butler says, it is essential to finish research and development on the Peacekeeper rail-garrison program, conduct its one planned demonstration test shot, and continue development work on the mobile Small ICBM.

No Bolt From the Blue

General Butler concludes that, as the Soviet threat has declined, the urgency of deploying new ICBMs has been reduced somewhat. He maintains that a so-called "bolt-out-of-the-blue" Soviet attack on the US has never been less likely and that the need for increased ICBM survivability has similarly declined. "I think we have enough mobility for the time being in ballistic missile submarines and bombers," he claims. "I have never used words like 'the highly vulnerable ICBM leg of the triad' because I don't believe that. I never have, and I don't now."

General Butler believes the SAC game plan fits well with the budget pressures and strategic opportunities of the day. He concedes that it will be tough to get Congress and the American public to pay for what is, in effect, a nuclear insurance policy.

"You have to recognize that for a democracy to stand by a hedging strategy is a bit of a test," says the General. "It's a little bit of a breathtaking leap of faith.

"On the [one] hand, that is a measure of how quickly this nation has accepted the reality of the end of the cold war, and on the other, it's a measure of the tremendous pressures represented in a continuing budget deficit and the fact that, if we don't fix it, all the strategy in the world is irrelevant."

In the major, eighteen-month review of US nuclear targeting practices and the SIOP that General Butler cochaired, he saw more consonance than ever existing among national targeting guidance, the SIOP, and the forces required to fulfill nuclear warfighting objectives, though he won't discuss specifics.

Under the proposed START Treaty, says General Butler, targeting requirements will not be reduced enough to bring about a fundamental change in his national targeting guidance. But all that could change in the event that the superpowers negotiate a START II Treaty that limits both sides to, say, 3,000 weapons.

"In my estimation, we haven't hit that breakpoint yet as we have modified target sets and requirements," General Butler says. He adds, however, that a limit of 3,000 weapons "would require different guidance because you couldn't cover today's target set according to today's weapons rules." ■

General Butler sees "tremendous pressures represented in a continuing budget deficit and the fact that if we don't fix it, all the strategy in the world is irrelevant."

Larry Grossman, a free-lance writer based 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 was "The Basic Beam" in the July 1991 issue.*

Better air-to-air weapons are helping to erase a glaring Soviet combat deficiency.

Higher Marks for Soviet Missiles

By Reuben F. Johnson

FOR a decade or more, a gap existed between the performance of Soviet front-line fighters and that of Soviet air-to-air missiles. This disparity has been fast diminishing —if not disappearing altogether.

Western experts regard the MiG-29 and Su-27 to be potent warplanes, perhaps the equals of current US fighters. Soviet air-combat weapons, however, have been demonstrably inferior.

Now, the USSR produces missiles that not only represent marked improvement over their predecessors, but compare favorably to today's US AIM-9 Sidewinder and AIM-7 Sparrow air-to-air weapons. The most notable of the group are these:

- The AA-10 missile, NATO code name "Alamo." The AA-10, successor to AA-7 "Apex," was developed as a radar-guided, medium-range weapon to be used on both the MiG-29 and Su-27 fighters.

The missile comes in long- and short-burn versions and is seen as the USSR's answer to the radar-guided, 1970s-vintage Sparrow, which is still present in large numbers in the Air Force inventory. The

—Staff photos by Guy Aceto

Soviet efforts to market their advanced aircraft abroad have been hampered by serious deficiencies shown in combat by their air-to-air missiles, resulting in disastrously lopsided kill ratios in such conflicts as the 1982 war in Lebanon. The AA-11 (above) in combination with the MiG-29 (right) may change all that because of its high maneuverability, larger warhead, and head-on attack capability.

Soviets also produce heat-seeking AA-10s.

The AA-10 comes in at least four different versions, which vary between eleven feet, ten inches and fifteen feet, one inch in length; between 440 pounds and 529 pounds in weight; and between fifteen and one-half miles and twenty-two miles in range. The missile has a diameter of seven and one-third inches and a wingspan of two feet, three and one-half inches.

The AA-10 is believed to have a solid-propellant rocket motor and improved guidance. Experts maintain that the AA-10 probably has capabilities similar to those of another relatively new Soviet air-to-air missile, the AA-9 "Amos," which reportedly has achieved successes against simulated "cruise missiles" launched from aircraft.

Some analysts say that Soviet designers use the AA-10 as a basis for new air-to-air antiradiation missiles (ARMs) and that this group would include a passive radar homing version to attack fighters and surveillance aircraft.

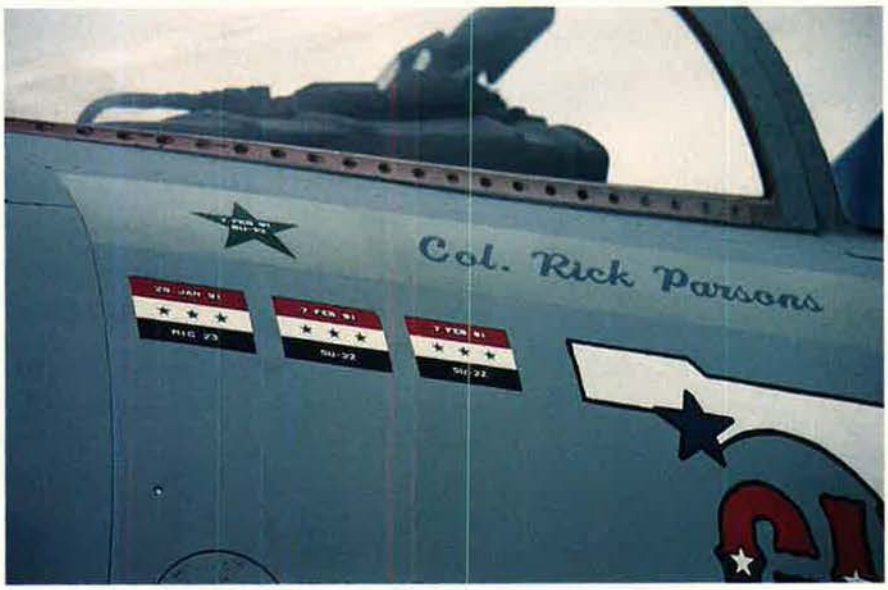
• The AA-11 missile, NATO code name "Archer." The Archer is the successor to the Soviet AA-8 "Aphid" and is the Soviet Union's most advanced tactical heat-seeking weapon. Compatible with both of the new Soviet air combat fighters, the AA-11 is seen as being perhaps even a slight step beyond the infrared-guided Sidewinder—a judgment that must await the test of actual combat.

Western experts believe that the Archer introduces into the Soviet inventory a weapon that has, to a significant degree, the kind of head-on attack capability contained in later models of the Sidewinder.

The AA-11 missile is ten feet long, seven inches in diameter, and weighs about 275 pounds. It has an effective combat radius of about five miles, making it a close-range missile. It has considerably more range than its predecessor, however, which could not operate beyond three miles at the most. The AA-11 has movable sets of control vanes and fins fixed on its cruciform surfaces. There are also four thrust-vectoring surfaces set in the path of the engine exhaust. These innovations are thought to give the new air-to-air weapon great maneuverability.

Unclassified literature reports that the AA-11 contains an active radar fuze, which may be replaced in later models by an active laser fuze. The new air-to-air missile has a thirty-three-pound, fragmentation warhead —much larger than that of Aphid.

The Kremlin seems eager to demonstrate the strides it is making. At the Paris Air Show in June, the Soviet MiG-31 at Le Bourget Airport displayed three different air-to-air missiles. Though two of them were the older, well-known AA-6 "Acrid" and AA-8 Aphid weapons, the third was the AA-9 Amos, the newest long-range, radar-guided missile known to be in the Soviet inventory. Never before seen in the West, it is carried in the warplane's underfuselage recesses. Some experts estimate that it has a range of at least forty-five miles and perhaps as much as ninety-three miles.



The Gulf War added another chapter to the woes of Soviet-equipped nations. Though other factors (such as poor training) contributed to Iraq's air war debacle, the inferiority of its equipment made the result almost a foregone conclusion. This F-15 chalked up three of the US forces' forty-one kills vs. losses of exactly zero.

—Staff photo by Guy Aceto

The results of Desert Storm may have been very different, however, had Iraq been equipped with the latest Soviet aircraft and missiles, seen here at the Paris Air Show. The MiG-31 and the radar-guided AA-9 Amos (in red cover), with its range estimated at forty-five to ninety-three miles, would have proved formidable.

For the Soviet Union, improved air-to-air missiles represent a major step toward solving one of the most glaring deficiencies of its air forces. Indeed, possessing effective and reliable air-to-air weapons is deemed today to be critical.

Assessing Recent Performance

One analyst of Soviet military affairs, Steven Zaloga, has compiled data from recent air combat engagements. The research confirms a trend that has been accelerating since the Vietnam War years, when many US missiles were fairly unreliable: Gun kills, though they still occur, are becoming a progressively smaller and less important part of air combat operations.

Mr. Zaloga points out that, during the 1982 air war over Lebanon, fighters of the Israeli Air Force downed eighty-five of Syria's aircraft and that ninety-four percent of these Israeli victories could be attributed to missile attacks. All forty kills scored by IAF F-15 fighters, and thirty-five of the forty scored by IAF F-16s, were achieved with missiles.

Postwar assessments of the 1982 Falkland Islands war show that British Harriers using Sidewinders shot down eighteen of the Argentine Air Force's aircraft. In the entire war, there was only one confirmed British gun kill—the downing of a lumbering Argentine C-130 transport. In 1986 and 1987, at a time of armed border clashes between Pakistani and Afghan air force units, Pakistani F-16s shot down five Soviet-built Afghan aircraft, four of these being missile kills. The US Navy's F-14 fighter engagements with Libyan aircraft in the past decade have been all-missile affairs. Missiles launched by Libyan pilots have never hit the mark, but the US weapons generally have succeeded.

The record of air combat in Operation Desert Storm reconfirms and dramatizes the existing trend. In that relatively brief but intense air war, USAF and USN aircraft downed a total of forty-one Iraqi aircraft—both fighters and helicopters. Air-to-air missiles provided thirty-eight of the forty-one US victories (the Sparrow scored twenty-five kills, the Sidewinder thirteen). Only two victories (by USAF A-10s) are classified as gun kills. One Iraqi plane flew into the ground trying to avoid pursuers.

Serious Deficiencies

In stark contrast, the Iraqi air force scored zero kills against American fighters, and one reason was the poor quality of Soviet air-to-air weaponry (others included poor pilot training, inferior command and control, and the loss of initiative in the very first minutes of the war). When trying to market their fighter aircraft abroad, the Soviets for years have been hampered by the serious deficiencies shown in combat by their earlier air-to-air missiles.

At the outset of the Gulf War, it was not publicly known whether the Soviet Union had supplied the Iraqi Air Force with its top-of-the-line air-to-air weapons. The thinking among Western experts was that, if Iraqi warplanes were equipped with the Alamo and Archer systems, its MiG-29s would have posed a severe threat to allied fighters. However, it now appears that Iraqi fighters possessed only older-generation weapons: the AA-2 "Atoll," AA-6 Acrid, and AA-7 Apex, plus some French systems.

More often than not, pilots using Soviet missiles have wound up on the short end of engagements against Western weapons. For example, as Mr. Zaloga and others have pointed out, Syrian pilots flying MiG-23s armed with the radar-guided AA-7 Apex failed to score a single hit on Israeli fighters in the 1982 Lebanon engagements. Experts say that this is due in large part to the ability of Israeli F-15s to launch the US-built radar-guided Sparrow before the Syrian Apex missiles could engage their targets.

The Israeli F-15s and F-16s also scored a number of head-on hits with the heat-seeking Sidewinder. In this particular type of air-to-air attack, the Soviet AA-8 missile used by the MiG-21, MiG-23, and MiG-29 is regarded by Western observers as a poor performer. The unclassified literature indicates that the AA-8 has only a minimal head-on capability—if any.

Even in optimum targeting situations, Soviet missiles have been less than effective. The most widely publicized example of this came in October 1988, when an Angolan MiG-21 pursued and attacked a BAe 125 business jet carrying the then-

—Staff photo by Guy Aceto

The AA-10 and AA-11 represent major steps toward solving a serious weakness in Soviet forces. Installing these effective and reliable weapons on the MiG-29 (right) will greatly complicate the task of those opposing it—good news for the ten nations that fly the MiG-29, bad news for their opponents.

—Staff photo by Guy Aceto

Rather than countering AMRAAM (above) with a radar-seeking missile of their own, the Soviets may deploy an antiradiation missile version of the AA-10. Western analysts estimate that a Soviet pilot could launch an ARM configured for the 10,000-MHz frequency at almost no risk to other Soviet aircraft in the combat area.

President of Botswana. The MiG launched two AA-8s at this rather unchallenging target. One of the missiles missed due to failure of its guidance system; the other struck the target's right engine pod, but did not fatally damage the plane. The "soft" aircraft landed safely, pointing up the weaknesses of the AA-8's small, 13.2-pound warhead.

It was embarrassing incidents such as this, plus the disastrously lopsided missile kill ratio of the Lebanon air war, that propelled the Soviet Union to launch the development of a new generation of air-to-air missiles in the early 1980s. The aforementioned AA-10 and the AA-11 are among the products of this development.

One distinctive feature of the AA-10 is that it can be produced in both radar-homing and heat-seeking variants. The dual nature of the AA-10 shouldn't come as too much of a surprise, however. Development of a missile that can have both infrared and radar seekers is consistent with Soviet air war doctrine.

Soviet air-defense interceptors, such as the Su-15 "Flagon," have a double-launch capability programmed into their fire-control system. Standard Soviet practice is for the aircraft's fire-control computer to launch one IR missile and one radar missile at the same time, the strategy being that IR countermeasures employed by the target aircraft will not affect the radar missile, and vice versa.

Though it probably makes each missile more effective and certainly adds to the probability that a weapon will kill its target, the practice forces the Soviet pilot to operate within parameters that are far narrower than those observed by his opponent. His engagement envelope is limited by this "double pump" procedure.

For this and other reasons, Air Force tactical doctrine has never recommended this double-launch, IR/radar type of operation. In combat, however, pilots of US aircraft have been known to fire sets of more than one of the same type missile at a single target.

No Soviet AMRAAM?

At present, the Soviets have not deployed or even shown unambiguous signs of developing an autonomous, radar-guided missile comparable to the US AIM-120A Advanced Medium Range Air-to-Air Missile (AMRAAM), a joint USAF-Navy project. The absence of such a program may be due to the inability of the Soviet electronics industry to manufacture the type of miniaturized radar seeker used on AMRAAM or due to the high cost of such a weapon.

However, some analysts believe that there may be an additional, even more significant, reason. Soviet air tacticians may well have decided that there are cheaper and better ways to combat AMRAAM-equipped forces than by trying to copy it and field such a weapon on Soviet planes. What alarms some Western analysts is that the USSR, rather than designing its own version of AMRAAM, appears to be developing a new generation of air-to-air antiradiation missiles, including an ARM variant of the AA-10.

Soviet deployment of an advanced ARM is seen by some to be a potentially effective countermeasure because US fighter aircraft radars transmit on the same frequency—around 10,000 MHz. Since most Soviet radar frequencies are much higher or much lower than this, the Soviet pilot could probably launch an ARM configured for the 10,000-MHz frequency at almost no risk to other Soviet aircraft in the combat area.

AMRAAM is still the best air-to-air missile in the world today. Though a number of the missiles were rushed to the Persian Gulf region for possible use against Iraqi planes, AMRAAM was not fired operationally in Desert Storm. In the war over Iraq and Kuwait, however, US pilots discovered that, in a tail chase, Sparrow's propulsion system faded before it could catch Iraqi fighters fleeing to Iran. Had AMRAAM been available during the departure of the Iraqi planes, those planes probably would not have made it to Iran.

Even so, US air war tacticians and US pilots facing Soviet-built aircraft should be concerned that an enemy pilot is able to lock on to US aircraft from longer range and that this missile capability, coupled with the passive, almost undetectable Infrared Search and Track systems of the MiG-29 and Su-27, means that US aircraft will be more vulnerable than before. ■

Reuben F. Johnson, formerly a foreign technologies analyst for General Dynamics and GE Aircraft Engines, specializes in Soviet defense issues. This is his first article for AIR FORCE *Magazine.*

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The Systems-Logistics merger creates a new organization responsible for a lot of the Air Force's money and personnel.

Curtain Up on Materiel Command

By James Kitfield

WHEN Gen. Ronald W. Yates assumed control of Air Force Systems Command last year, he accepted a job far different from that of his predecessors. For nearly thirty years, the four-star commander of AFSC always had been at the epicenter of Air Force procurement, unmatched in his power to develop and acquire multibillion-dollar weapon systems. Packard Commission reforms changed all that.

Indeed, for those who knew it in the days when it was the locus of Air Force acquisition, today's AFSC is unrecognizable. The command, in the aftermath of what AFSC officials concede was a rocky adjustment to the Packard reforms, has shifted from managing major weapon systems to supporting the newly appointed Program Executive Officers (PEOs).

Yet the pace of change in the Air Force is torrid these days, and even this "new" arrangement is being rapidly overtaken by events. General Yates, who was the first officer to assume the post of AFSC commander under the changed circumstances, also will be the last to do so because AFSC itself is about to fade away. By July 1, 1992, the Air Force will have completed the merger of its two big buying bureaucracies—AFSC and Air Force Logistics Command (AFLC)—and brought forth a new entity, Air Force Materiel Command (AFMC) at Wright-Patterson AFB, Ohio.

The new organization won't be in charge of shaping and executing weapons development and production programs. That is to be the job of the Air Force's service acquisition executive, the various PEOs, and the individual program directors. However, Materiel Command will have a hand in every aspect of Air Force materiel management, and it will be huge. USAF planners maintain that it will absorb nearly one-fifth of the Air Force's total population (a full forty percent of its civilian workers) and be in charge of administering fifty-two percent of USAF's total budget—the operations and maintenance, procurement, and research and development accounts. This single command will be involved, to a greater or lesser degree, in the support of each Air Force weapon from the time it is a gleam in an engineer's

The Air Force has already identified some key programs for the new Materiel Command to focus its energy on. The new command's officers seek to close the seam between the former responsibilities of Air Force Systems Command and Air Force Logistics Command by making logistics and maintainability up-front concerns on such systems as the ATF (here undergoing wing assembly).

eye to the day of its retirement party at the Davis-Monthan boneyard.

This is not merely a yen to reform defense management for its own sake. Also fueling consolidation, say Air Force officials, were worsening budget pressures and plans to shrink the Air Force some twenty-five percent by 1995. Seldom have economizing measures been more critical—and the Air Force more willing to accept them.

Ironically, the pace of change in recent years not only has facilitated the merger of AFSC and AFLC, it also has sparked the greatest concern about the wisdom of the changes now taking place.

"The streamlining that both commands have undergone in the past couple of years and the attention we've both focused on the quality revolution are the reasons why we [the two commanders] both feel that combining our headquarters is now feasible," says Gen. Charles C. McDonald, commander of AFLC. Major changes have largely erased the differences in functions and approaches that would have made a merger of the two commands far more difficult.

The Commands Slim Down

AFLC has in the last year begun slashing some 10,000 workers from its labor force, streamlined its headquarters, reduced the number of its management layers, and realigned major functions at its Air Logistics Centers.

AFSC, in response to Defense Secretary Dick Cheney's 1989–90 Defense Management Report, has cut its product divisions from six to four, transferred contract management responsibilities to the Defense Logistics Agency, restructured its laboratories from fourteen independent centers to four superlabs, and begun cutting its work force by roughly 5,000 slots. Along the way, it also relinquished space-launch operations to Air Force Space Command.

Yet even while AFSC has been adapting to those changes and the planned merger, the Air Force acquisition structure has been juggling key programs that are supposed to form the bedrock of USAF force structure well into the next century. AFSC has been handing off major systems authority to the PEOs while continuing to provide the program offices with personnel and other support. Officials know that, in the process of institutional change, the service faces a heightened danger of fumbling such systems as the C-17 airlifter, B-2 bomber, Advanced Medium-Range Air-to-Air Missile, or Advanced Tactical Fighter (ATF).

"I am worried, and I do have real concerns about how we balance all this," says General Yates. "When you talk about changes of this magnitude, where you're moving, rearranging, and remolding, there is bound to be a period when we're less efficient. And frankly, this is a heck of a time to crank some inefficiencies into the organization."

To smooth the integration, the two big acquisition commands formed a handpicked, eleven-member Integration Planning Team and located it near the Pentagon in Crystal City, Va. Team captain Maj. Gen. Kenneth V. Meyer, AFSC's chief of staff, began the planning task by conducting an in-depth study of the materiel management systems of the other armed services, as well as those of Britain, France, and Israel, among others.

The team was looking for a model that would mirror its concept of a one-stop shop to cover all aspects of life-cycle support for virtually every system. None existed.

"Everywhere we looked, however, we did find that the pendulum in weapons acquisition is swinging back towards tighter integration of the entire process," says General Meyer. "And one key reason is that the weapons themselves are becoming more tightly integrated."

He notes, for example, that the proposed engines for the F-22 ATF are expected to be so fully integrated into the F-22's basic airframe that technicians will no longer be able to readily pull them off to work on them. "That," says General Meyer, "means that the acquisition and logistics systems increasingly need to work together from the very beginning, and we're finding that that fits nicely with our concept behind the new command."

Cradle-to-Grave Care

The name the team gave that concept was Integrated Weapon System Management (IWSM). It basically envisions a "cradle-to-grave" approach to Air Force materiel management.

One key advantage, says General Meyer, is that it will present a single point of contact and a consistent contracting style to both the using command and the defense industry.

"Right now, the user has two guys to deal with, and the industry folks have two separate corporations they have to sell to," says General Meyer. "With IWSM, they will have total visibility over a weapon system with one program director. And that guy will be supported by our labs, our acquisition work force, and our logistics depots."

As recently as two years ago, the new PEOs—the supermanagers of the new acquisition setup—were complaining publicly about having to wrest control of their programs from a Systems Command bureaucracy that was reluctant to relinquish management authority. That unpleasantness was smoothed over by AFSC's shift to playing a supporting role, rather than the lead, in the new acquisition setup. Even today, however, there are observers who believe that the former AFSC weapons-buying bureaucracy might not remain forever subservient to the PEOs and that it could even make a comeback of sorts by indirect means. In this view, the new Materiel Command, far from being a benign helper for the PEOs, may turn out to be the 800-pound gorilla of the acquisition process, able to exert considerable influence on programs by dint of its enormous size and exercise of its support function.

Integrated Weapon System Management envisions a "cradle-to-grave" approach to Air Force materiel management.

"There is growing concern," says General Yates. "There's been a dramatic change from a year and a half ago, when PEOs would have told you that Systems Command was getting in their way. Today, they say they can't do their job without us. But I think they are also beginning to perceive how dramatically IWSM and this new command could affect the way they do business. So while no one's pushing the panic button, there are some worries."

According to General Yates, those in charge of AFMC will seek to assuage those concerns in the same way that AFSC, under his direction, largely eliminated the tension and suspicion that once marked its relations with the PEOs—by focusing exclusively on providing support for the program and steering clear of issues involving program management or review.

Today, asserts General Yates, "there's never a conflict between Systems Command and the Program Executive Officers on program management because we are not involved in programs anymore. Our job is to train, organize, and equip the people that [the PEOs] need. And if there is ever a conflict, I yield to the program director."

The plan calls for the new Materiel Command to establish headquarters at Wright-Patterson, already home to AFLC. Air Force officials say that Wright-Patterson was chosen over other facilities for a number of reasons.

First, facilities for the headquarters already exist at Wright-Patterson, and there will be no new construction involved. With an 850-person headquarters at Andrews AFB, Md., near Washington, D.C., AFSC headquarters is smaller by roughly half. Second, AFSC's largest element, the Aeronautical Systems Division, is already located at Wright-Patterson. Finally, since the days of the Wright brothers, whose aircraft shack still stands on the base grounds, Wright-Patterson has served as the Air Force's spiritual center for aircraft development.

For the PEOs, whose programs live or die based on the decisions made in Washington, the proposed transfer of the Materiel Command headquarters to Ohio has caused consternation.

"Some PEOs have voiced concerns about our moving out of town," says General Meyer. "They feel that Washington is where the decisions are made, and the people involved in the program need to keep on top of that."

A Line to Welch's Office

In response, those in charge of shaping the new command propose to address those concerns with new technology, including plans to develop a fully integrated database and provide AFMC workers in Ohio with real-time computer and video access directly to the office of Air Force acquisition executive John J. Welch, Jr.

While the idea of a one-stop shop for weapons support has a certain elegance, Air Force officials concede that the true challenge will come in grappling with the very messy details involved in combining

two massive and disparate organizations.

"We've all recognized from the beginning that the notion of cradle-to-grave weapon system management is easy to say and hard to do," observes General McDonald.

As a first step, the Integration Team has formed and coordinated some seventy-five study teams, comprising more than 1,000 workers from the two commands. Members of AFSC's System Program Offices and AFLC's System Program Managers have been given the task of developing a seamless operations plan to cover all key program tasks, including requirements, financial management, systems engineering, testing and evaluation, contracting, logistics, technology insertion, and systems management.

Given a totally clean slate, they have had to decide issues ranging from whose contracting regulations to adopt, to where a program office should be located, to whether its manager should come from the logistics or acquisition community.

"I'd be naïve to say that we don't have some guys out there who are going to go head-to-head," says General Meyer. "As we put these two organizations together, there will be somebody saying, 'We do contracts this way,' and someone else saying, 'We do them another way.' So we'll have a learning curve that involves scrap and rework. But this business is ninety percent attitude, and, in general, the attitude has been very positive."

For the initial phase of the merger, the Air Force has selected a number of programs on which the new Materiel Command is to focus its energies. They include the Navstar Global Positioning System, Joint STARS aircraft, B-1B bomber Life-Support Systems, the AGM-65 Maverick missile, the F-15 fighter, the F-111 fighter, the F-16 fighter, the FPS-124 radar system, the E-3 Airborne Warning and Control System aircraft, electronic warfare systems, the Low-Altitude Navigation and Targeting Infrared for Night system, ballistic missiles, automated test equipment, the B-2 bomber, and the F-22 Advanced Tactical Fighter.

General Meyer says the Integration Team specifically sought a list that would cover the full range of systems, from weapons still in development to mature systems nearing retirement.

"One key thing we're looking at is the point where program management responsibility traditionally shifts from one command to the other," he says. "We want to close that seam between the two so that, on new programs like the ATF, we're pushing logistics and maintainability concerns up front and, on older systems, we're inserting new technology faster and better."

The emphasis in the short term is to take it slow "to make sure nothing gets broken in the process of merging."

Living With Diversity

Some of the teams working on those selected programs have already briefed the Integration Team on their progress. Officials say that what is emerging is a wide variety of approaches to the basic management task. "Basically, when the command officially opens for business next year, I think we're going to have sixteen prototypes, with no two precisely the same," says General McDonald.

"And we're not going to reject any solutions until they proceed long enough to show warts. So while we're looking for some standardized structures, we can also live with a fair amount of diversity."

Air Force officials say that, in most cases, program maturity will determine which organization gets to provide the management, at least in the early going. Newer weapons such as the ATF will almost certainly be headed up by someone with an acquisition or a systems background, and gravitate toward one of AFSC's four product divisions (redesignated Air Force Materiel Command product centers). Mature weapons such as the F-111 will probably be managed by someone with a logistics background and be run from one of AFLC's five Air Logistics Centers, which will also be redesignated.

While the Integration Team has already established a provisional headquarters at Wright-Patterson and is on schedule for the July 1992 opening, officials say they will err on the side of caution in terms of reorganizing at the field level. It is caution born of the knowledge that, in the midst of the largest reorganization of its acquisition and logistics system in thirty years, the Air Force is also nurturing its future generation of aircraft through a period of political, budgetary, and technological vulnerability.

"We do have to make sure we don't disrupt any of our big programs by tampering with the thousands of trained people and processes at the field level that make our system go," says General Meyer. In the future, he says, AFMC may establish engineering satellite offices at each logistics center, or four logistics satellite offices at the four product centers. The emphasis in the short term, however, is to take it slow.

"I think the commendable job both these commands did during Desert Storm shows that they're not broken now," says General McDonald. "That's not what this [change] is about. And I want to make sure nothing gets broken in the process of merging them." ■

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Small suppliers, critical to defense industrial production, are an endangered species.

All Companies Great and Small

By F. Clifton Berry, Jr.

IN autumn 1989, it became clear to all that the West had won the cold war without all-out combat. Since the fall of the Berlin Wall, the United States has won a quick, hot war in Panama and successfully fought, in coalition with twenty-four allies, a large and intense war against Iraq.

These victories are vivid reminders of the benefits that accrue to the country that possesses well-trained troops and the best weapons in the world.

Tribute is being paid to the training, planning, and integration of forces to achieve a clear-cut goal. At the same time, the armed forces and the industrial base that provides the wherewithal for victory are now shrinking. Even though a build-down is inevitable, Washington will continue to require sizable forces and a supporting defense industrial structure if it is to be confident that it can cope with future threats.

Unfortunately, and despite the fact that there is broad agreement that the US must maintain a healthy industrial base, all signs point to continuing decline. The free marketplace is proving to be an unreliable

way to ensure the retention of technologies and industrial capabilities necessary to fight and win wars. That is because the wrong companies and people may be squeezed out of the arena, causing the loss of essential capabilities. Nowhere is the problem more glaringly evident than at the smaller end of the defense industry—the companies and suppliers who provide critical support to prime contractors.

Dan Tellep, Lockheed chairman and chief executive officer, maintains that the aerospace industry is "as capable as ever" in technological innovation, but that there is "a developing concern that the disappearance of second- and third-tier suppliers will begin to impact us."

Part of the problem stems from critical weaknesses found throughout the US economy. For some analysts, recent scandals in the savings and loan industry and the shaky condition of the banking system have raised the specter of financial collapse. Despite the post-Depression safeguards built into the system, the national financial structure is showing signs of strain. If the financial edifice is weak, then the weaknesses will spread into the national industrial structure and its defense component.

Today, some officials and experts maintain that a new national policy —and national legislation—are needed to save the financial system. National policy, they assert, has preserved US agriculture. However, officials of the Bush and Reagan Administrations have studiously avoided saying or doing anything that might be construed as setting "industrial policy."

Travails of the Subtiers

In November 1988, Avtex Fibers Front Royal, Inc., a producer of specialized rayon fibers, announced it was closing its doors. Foreign competition had driven it out of the clothing business—and out of another business, too. The Pentagon discovered to its horror that Avtex was the sole US source of aerospace-grade rayon critical to production of missiles and rockets.

Shocked, the government immediately moved to prop up Avtex, kept it open long enough to acquire large rayon stockpiles, and developed a new source. It is a story that, in its essentials, is repeated countless times across the defense industry. Everywhere, small firms and suppliers are being squeezed out of the field or smacked with turbulence. Examples, large and small, abound:

- In May 1987, an accident destroyed a plant that produced almost half of the nation's supply of ammonium perchlorate. AP is vital to the propulsion systems of many weapons, among them the Army's Multiple Launch Rocket System and USAF ballistic missiles. It took some eighteen months to build and qualify a new AP plant. Throughout that time, AP supplies were rationed to only the highest priority needs. The MLRS program was slowed significantly.
- Traveling wave tubes are critical to electronic amplification. In the US production base, however, there is great turbulence. For example, according to an Air Force Systems Command assessment, Watkins-Johnson Co. sold and abandoned its TWT production capability, Teledyne/MEC greatly reduced its production force, General Electric sold its TWT operations to Varian, Huggins Laboratories and Northrop Electronic Tube Systems went out of business, and Star Microwave was purchased by Korean interests.
- In recent years, the United States manufacturing sector has lost roughly half its industrial base for flat-die steel forging. Production has moved abroad. Moreover, very few American companies now manufacture forge press equipment within the United States. The large replacement parts for large presses—hammer or hydraulic —are produced overseas.
- Semi-Gas Systems, Inc., has long been a major US supplier of critical, high-purity gas systems to US semiconductor manufacturers. Sematech, the Austin-based chip-making research consortium, had invested heavily in the upgrading of Semi-Gas, its view being that the firm was an irreplaceable resource in the US fight to regain its former lead in the world semiconductor market. Last summer, however, Japan's giant Nippon Sanso moved to buy Semi-Gas. Though members of Congress tried to block the sale, ownership of Semi-Gas has passed to the Japanese.
- The US government refused to formally review the foreign acquisition of Union Carbide Chemicals and Plastics Co., the only US producer of ultrahigh-purity polysilicon, despite the firm's development of polysilicon specifically for defense purposes. UCC&P was bought by Japan's Komatsu Electronic Metals Co. The US firm was the last remaining producer of ultrahigh-purity polysilicon—an advanced material developed as part of an Air Force contract. The takeover transfers to foreign hands a widely recognized leader in the production of a critical defense material.

—Colleen A. Nash

Inevitable Downsizing

Indeed, the Republican administrations have made it clear that, when it comes to picking winners and losers in the world economy, they are only too willing to let the market decide.

Industry leaders acknowledge the inevitability of the downsizing. At the same time, they reach consensus on crucial points. Virtually everyone agrees on the need to preserve the national technology base, to remain innovative in applying the technologies, and to make a profit.

On the other hand, no one can say with assurance who the second-, third-, fourth-, and lower-tier suppliers really are. The Defense Department does not know. It has made efforts to determine key weaknesses, most notably by attempting to collect and analyze information on the base and its subtiers *[see box]*.

Within DoD, the development of a database on the defense industry has been under way for several years. It is called the Defense Industrial Network (DINET). DINET, however, has been starved for funds. Six years after its beginning, it is still little more than a prototype system, according to the General Accounting Office.

Even with limited funds, the Office of Industrial Base Assessment (OIBA) within DoD has developed enough information to raise concerns about lower-tier suppliers, the companies with the talent and equipment to provide goods and services to the prime contractors.

For example, OIBA conducted a study to determine the sources for precision glass, the sort that is needed for such high-technology items as infrared sensors for aircraft and tanks. At first, it appeared that multiple suppliers, both foreign and domestic, were available to primes such as Texas Instruments, Martin Marietta, and McDonnell Douglas.

But as the investigators explored successively lower tiers, the trails eventually converged on a single source, Schott Glass Co. of Pennsylvania. It made no difference whether you were a prime contractor or subcontractor; you had to do business with Schott Glass. Yet on the Pentagon's list of thousands of defense contractors and producers, Schott's name did not even appear.

If Schott went out of business,

who would supply precision glass? As it happens, Schott USA is robust and so is its parent firm, which is German, so it is unlikely that the defense industry is facing an incipient calamity. However, the situation is far bleaker when it comes to other critical commodities.

Conducting such investigations takes time and money. Until now, the top levels of the Department of Defense have neither sought nor provided funds to make DINET a full-scale operable database. Thus, when industrial base decisions are made, they are based on partial information—or none at all.

What Happens to the Little Guys?

US industry responded admirably to the requirements of Operation Desert Storm. Maj. Gen. Charles R. Henry, an Army officer who serves as deputy for acquisition management at the Defense Logistics Agency (DLA), is among the military leaders commending industry's response. He told the Defense Policy Advisory Committee on Trade how well the US industrial base rose to the challenges.

"My story is about the thousands of second- and third-tier suppliers . . . who kept potential show-stopping O-rings and filters and widgets coming to the primes and to Saudi . . . so the headline-makers like the Patriots could do their thing," said the General. He cited examples such as production and delivery of shackles for the M1 tank, filters for generator sets to support the Patriot, and vital relays for C-5, C-130, and C-141 transport aircraft. In those and all other cases, suppliers large and small responded.

But when the shooting stopped, the production requirement ebbed. DLA spent more than $2.6 billion on 513,336 requisitions for subsistence, medical supplies, and clothing and textiles alone. Overnight, the requirements dropped to the amounts needed to restock the shelves.

To suppliers, many of them small businesses, the business was good temporarily, but not steady or long-term in nature. DLA has issued a statement claiming that "the build-down is potentially harder than the buildup." The mammoth agency said it is reviewing all contracts on a case-by-case basis and that it is "working with vendors to get their input on how to do an orderly build-down to peacetime requirements without hurting or destroying the industrial base."

Commodities such as shackles and filters are used in both the defense and commercial economies. Providing them for urgent military needs does not pose anywhere near the kind of challenge that military-specific components do.

During the Persian Gulf crisis, for example, the Army asked Textron Lycoming to be ready to surge production of its AGT1500 gas turbine engine, the powerplant that propels the M1A1 Abrams battle tank. Textron Lycoming successfully met the surge requirement; its assembly and testing capacities were expandable.

However, the demand could not be met so smoothly by its second- and third-tier subcontractors. Typically, they were small companies whose survival could not be taken for granted. Those with commercial business on the books were reluctant to drop that part of their work in order to fill a short-term defense need. Often, these suppliers asked Textron Lycoming, "Will the business be here next year?" Without assurance that long-term business would result, the small companies were reluctant to commit.

Fortunately, the demand for AGT1500 tank engines was not as severe as it might have been, so the issue did not come to the crunch. But the principle is important to remember in evaluating suggestions for ensuring the health of the industrial base.

Out of Business

For example, suppose the Air Force wanted to resume production of the F-117A Stealth aircraft. Lockheed executives say that many of the small custom machine shops that performed so well with the "Skunk Works" in developing the F-117A have gone out of business, or gone on to other business. They would not be available for a new production run of the F-117A.

Even the small, highly skilled aircraft model-making companies are no longer on call to major airframe manufacturers. In the absence of sustained defense business, they have turned to making models for the entertainment industry or theme parks.

The Army's Tank-Automotive Command studied the consequences of a halt in production of the M1 Abrams tank, which seems possible. More than twenty-five percent of the second- and third-tier suppliers would soon go out of existence.

Other small subcontractors might be able to convert to commercial business and survive. But they would be unavailable to the Army if the nation needed to resume tank production. If they disappear, and the Army has to start from scratch, it would then take the US more than fourteen months to deliver the first engine for new tanks and more than three years for production of the gas-turbine engines to hit the most recent rate of 120 per month. By the time tank production built up to a modest rate, the emergency that prompted the buildup would probably have long since receded into history.

The same problems afflict companies involved in aircraft and warship production. Once the thousands of small suppliers have expired or shifted out of the defense sector, their talents and equipment are irretrievably lost.

Experts maintain that there is an urgent need for valid information on where the vulnerabilities of the industrial base truly lie. The vulnerability might be a dependency on foreign sources, as was discovered during Desert Storm, or it might be overreliance on a single supplier, as in the case of precision glass.

Because the Department of Defense seems reluctant to request and spend funds to build up the DINET database, others will have to provide the information. What seems clear is that, without such information, even those willing to take steps to rescue the defense industry will be hard put to do so. ■

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Valor

By **John L. Frisbee,** Contributing Editor

A Galaxy of Heroes

Unless the C-5 pilots could bring a shattered aircraft under control, 328 people would die.

At 16:03 hours April 3, 1975, Air Force C-5A Galaxy, serial number 68-218, lifted off the runway at Tan Son Nhut AB near Saigon, bound for Clark AB in the Philippines. The huge strategic transport carried the most precious cargo Aircraft Commander Dennis "Bud" Traynor and his crew of sixteen had ever flown. This was the initial mission of Operation Babylift, directed by President Gerald Ford to bring Vietnamese orphans to the US in the few remaining days before the Republic of Vietnam fell.

In the C-5's troop compartment were 145 orphans and seven attendants, most of them civilian volunteers being evacuated from Vietnam. The cargo compartment held 102 orphans and forty-seven others. A ten-person medical team had volunteered to take care of the sick. The adults would have their hands full caring for the children, some only a few days old, but the weather was good and the 60th Military Airlift Wing crew and its aircraft were tops in the airlift business. Spirits were high as Captain Traynor and copilot Capt. Tilford Harp guided the Galaxy through 23,000 feet on a heading of 136 degrees. All was well.

Then at 16:15, twelve minutes after takeoff, there was what seemed to be an explosion as the lower rear fuselage was torn apart. Rapid decompression filled the plane with fog and a tornado of debris. The pressure door, most of the rear loading ramp (whose locks had failed), and the center cargo door had disappeared, leaving a gaping hole in the rear of the fuselage. Control and trim cables to the rudder and elevators were severed, leaving only one aileron and wing spoilers operating. Two of the four hydraulic systems were out. This was an emergency not foreseen by the C-5's builders or operators—a critical flight situation not covered in any flight manual. The lives of 328 people rested in the hands of Captain Traynor and his crew who, if any were to survive, had to invent a technique for managing a seemingly unmanageable aircraft. They had perhaps three minutes to solve that problem.

Before damage assessment was completed, Captain Traynor found that, with the elevators inoperative, he had no pitch control. As the nose dropped, airspeed increased to 300 knots. The C-5 began to climb, approaching stalling speed. A bank to the right and simultaneous power reduction brought the nose down in a steep dive. Normal pilot reaction would have been to chop the power, but Traynor's knowledge of aerodynamics told him better. Instead he added power and as airspeed increased the nose slowly came up. Climb toward a stall again was checked by a steep bank and power reduction. Coordinating their efforts, Traynor managed the aircraft's pitch with changes in power settings while copilot Harp controlled roll with the one working aileron and wing spoilers. In this way, the pilots established a marginally controlled rate of descent at 250–260 knots. The lag between power adjustments and aircraft response was considerable. Great finesse would be needed to make a successful landing and that, if possible, at somewhere in the range of a screaming 250 knots.

The aircraft was maneuvered gingerly to an altitude of 4,000 feet on a heading of 310 degrees in preparation for landing on Tan Son Nhut's Runway 25L. About halfway through a turn to final approach, the rate of descent increased rapidly to 4,000 feet per minute. Seeing they couldn't make the runway, Captain Traynor told copilot Harp to roll the wings level while he applied full power to bring the nose up. At fifty feet, Traynor retarded the throttles to idle and the C-5 touched down in a rice paddy. Skidding about 1,000 feet, the aircraft again became airborne for a half mile before hitting a dike and breaking into four parts. The cargo compartment was completely destroyed, killing 141 of the 149 orphans and attendants. Only three of 152 in the troop compartment perished. Five of the flight crew, three of the medical team, and three others lost their lives, but 175 of the 328 aboard survived.

The Accident Investigation Board attributed the survival of any on board to Captain Traynor's unorthodox use of power and his decision to crash-land while the aircraft was under some control. Captains Traynor and Harp were awarded the Air Force Cross for extraordinary valor during those terrifying fifteen minutes.

Once the wreckage came to rest, the flight and medical crews—many of them injured—performed countless acts of heroism in carrying the surviving orphans to safety. Thirty-seven medals were awarded to crew members or their next of kin. Flight nurse Regina Aune received the Cheney Award for 1975. *(See June 1986 issue, "Valor," p. 115.)* The crash of the Babylift C-5 was a tragedy that was saved from apocalyptic catastrophe only by a galaxy of heroes led by Capts. Dennis Traynor and Tilford Harp. ■

In military sensors, communications, and computers, this new technology could produce "revolutionary" results.

Superconductivity

By C. David Chaffee

THE idea that electricity can pass through matter without meeting physical resistance is baffling. High school physics students know about Ohm's law and are taught to factor resistance into every electrical equation. In short, producing currents free of physical opposition appears to be an exercise in witchcraft. Yet that is the promise of "superconductivity."

Superconductivity is a condition in which matter offers little or no impedance to the movement of electrons. Experts have discovered that some metals exhibit near-zero resistance, making it possible to create powerful currents and magnetic fields. By drastically reducing resistance, one can produce more efficient performance in mechanical systems, whether they are aircraft engines, airborne communications systems, computers, or space-based sensors.

Not surprisingly, the Pentagon has been trying to harness superconductivity to systems, with the first efforts having begun forty years ago. But there is a catch: Materials "superconduct" only when chilled to extremely low temperatures. The problem up until late 1986 was that, in order to superconduct, systems had to be cooled to near "absolute zero," a hypothetical temperature at which virtually all heat and movement cease. That's about −460° Fahrenheit.

Five years ago, however, two IBM researchers working in Switzerland found a new family of materials that superconducted at much higher temperatures (though, to be sure, the temperatures still are exceedingly cold). Follow-up experiments, conducted mostly in the US, showed that one could raise the superconducting temperature of some materials above the boiling point of liquid nitrogen (−321° Fahrenheit). The discovery brought practical superconductive systems much closer to reality.

The new substances are called "high Tc," and they are able to superconduct even when "heated" to a relatively high temperature of −251° F. (The term "high Tc" is used to differentiate the new materials from low-Tc compounds, which only superconduct to about −420° F.) The US defense establishment was among the first to see their inherent potential. The Defense Advanced Research Projects Agency (DARPA), Navy, and Air Force immediately launched major, aggressive programs, financed by funds taken from other projects. Air Force researchers are acutely aware of the problems of cooling a device to such extremely low temperatures, but express confidence that in time the goal can be achieved.

The obstacles to widespread use of superconductivity seem less daunting than they once did. No longer do materials have to approach temperatures of absolute zero in order to superconduct, and scientists, using a technique shown here, can produce superconducting film under normal atmospheric conditions, rather than in a vacuum.

"Revolutionary" Applications

Soon after the discovery of the high-Tc compounds, DoD put together a five-year plan recommending that half a billion dollars be spent to refine these new materials into products. The plan claimed

—Photo courtesy Alfred University

there was no fundamental reason why technologists could not create a superconducting equivalent of the transistor. Such a device would have "revolutionary" applications.

This commitment was backed by senior DoD officials. In testimony to Congress shortly after the IBM discoveries, Deputy Under Secretary Ronald Kerber had this to say: "While it is difficult to foresee the full national security implications of superconductivity, . . . the Department should and will devote substantial resources to this new, dynamic, and important technology."

"We have grandiose ideas," says Dr. Ted Berlincourt, a physicist who wrote the five-year Pentagon plan and has remained a strong advocate in the years since. "We want more computing power in space. We want focal plane arrays. We want to have infrared sensors in space technology that can survey the Earth to detect missile launches."

In many areas, DARPA has led the way in high-temperature superconductivity. It sent out its first technical solicitation in the summer of 1987, only months after the first high-Tc superconductors were identified. This and follow-up efforts led to contracts with more than forty companies, which, in turn, have led to some of the first high-Tc applications. Example: the creation of a four-bit, high-Tc, analog-to-digital converter.

In recent months, DARPA has tried to pool some of these efforts to create synergy among interested companies. This first took the form of consortia and now seems to be headed in the direction of "teaming" arrangements.

The highly coordinated Navy effort was laid down in a five-year plan unveiled in 1989. Areas of interest included sensing devices, analog and digital electronics, fundamental properties, materials processing, and the High-Temperature Superconductivity Space Experiment (HTSSE, pronounced "Hit-See").

Scheduled to take place in late 1992, the first HTSSE mission is expected to see seventeen high-Tc superconducting devices carried aloft in a satellite. The devices are simple ones, including filters, resonators, patch antennas, delay lines, multiplexers, oscillators, microwave cavities, and bolometers.

Creating Prototypes

In Fiscal 1987, the Air Force effort had a budget of $4 million, and it began to grow from there. Main areas of interest included terahertz radar signal processing, antennas, sensors, communications, and navigation. Plans call for the Air Force to spend $2 million to $3 million annually for basic research, a similar amount for development, and, separately, about $10 million over several years to produce some prototype components.

"Superconductivity has always been of some importance to the Air Force," says Dr. Helmut Hellwig, director of the Air Force Office of Scientific Research (AFOSR).

The Air Force is committed to both low-Tc and high-Tc superconductors, and the primary interest is in electronics, says Dr. Hellwig, who took up his position in April 1990, moving over from the Department of Commerce. "Unlike the Navy, whose goals include magnets or shielding, our focus is to make functional electronic devices for detectors, transistor-like devices, sensors, and computers."

Dr. Hellwig explains that simply

cooling materials to cryogenic levels brings the noise down, making most devices more sensitive. "When those devices become superconducting, you have even higher detectivity, greater sensitivity, and less loss, which translates into less wasted power," says Dr. Hellwig. "That's very important, especially for the Air Force, as we are striving for high packing densities. That means the same capabilities in smaller volume with less waste heat, or more capability with the packages we are used to."

Infused with superconductive materials, computers could have much greater speed, says Dr. Hellwig. Communications could also be enhanced to terahertz, or far-infrared, levels, meaning that any given carrier could handle much more information and respond much more quickly to signals, adds Col. Art Pavel, AFOSR's deputy commander. "We are talking about capabilities beyond the tens to hundreds of gigahertz at which satellites now operate."

The Air Force has no field deployment of superconductive devices, yet it has made a decision to have prototypes ready by 1994 or 1995. Rome Laboratory is leading the charge, with Wright Laboratory and Phillips Laboratory helping in a coordinated effort to move lab projects into prototyping. Approximately one-fourth of AFOSR's funding flows directly to Air Force labs, such as the three involved with the superconductivity program.

In one prime example, Wright Laboratory this year awarded to Du Pont a $688,482 contract to develop a process for fabricating high-temperature superconducting thin films. These films could lead to devices such as filters, oscillators, and resonators.

"The general goal is to demonstrate feasibility of devices of a receiver nature, including antennas, detecting devices such as focal plane arrays, and inertial guidance systems," says Dr. Hellwig.

Focal plane arrays (FPAs), based on superconductive materials, would detect and pick up huge quantities of photons and transmute them into an image. The prime use of FPAs would be to look for "invisible pictures." By this, officials mean that they would be able to sense the presence of cold bodies in space and on Earth. "Superconductors offer the possibility of being able to move to a colder part of the color spectrum to detect these cold bodies," says Dr. Hellwig. It would mean that, "in normal environments, you can detect a nonoperating aircraft as opposed to only an aircraft with a hot exhaust. Or you may be able to detect a missile sitting in a cold field, perhaps because it has a motor generator running with it."

"Black Cat at Night"

Another possible application is that of detecting low-temperature targets in environments that don't have varying temperatures, a feat that Dr. Hellwig says would be analogous to "finding a black cat at night."

USAF already is putting cooled FPAs on airplanes, says Colonel Pavel. They are cooled to liquid nitrogen temperatures but are not, at this stage, superconducting.

"If you could make the high-Tc superconductors work, you would have no additional systems challenge," adds Colonel Pavel. "You would gain what the superconductivity offered—the higher-speed electronics and higher detectability."

Should such systems be put on satellites or unmanned aerial vehicles (UAVs)? Dr. Hellwig says that satellites may be cooled more easily and that, for that reason, practical superconductors will be used in satellites first. Others believe that UAVs would provide operational advantages.

"I can think of very few airborne systems that, in the future, won't have cooled focal planes of one kind or another," says Colonel Pavel. "If you are a combat aircraft that needs to see in the dark and needs robust IR sensing capability, then once you have resident on that vehicle the cooling capability, the extension of cooling your electronics is not a big step."

USAF scientists and technologists realize that superconducting devices cannot be used in a system unless they first are cooled and then reach room temperature without a major degradation in performance. "We recognize it as a challenge," says Dr. Hellwig. "It has to be done in conjunction with making the components. It has to be a systems approach."

Cooling is not the insurmountable problem that it often seems to be, for two reasons, says Colonel Pavel. The electronics to be cooled generally are small and conceivably could be placed in a small, closed system. Also, instruments do not have to be cooled all the time, only during operation.

USAF is part of a DoD-wide effort to spur development of superconducting digital electronics for insertion in higher-speed computers. The Low-Temperature Superconducting Device Electronics (LTSDE) program is part of the Pentagon's University Research Initiative effort. The Air Force will control at least $1 million of the $4 million annual allotment. With these funds, the Air Force intends to develop new computers using superconducting compounds and new optoelectronics.

The effort to develop superconducting digital electronics is driven in part by the large lead the Japanese have in this field. Japanese companies have already developed simple superconducting systems using high Tc while the US effort has been geared largely to bringing along analog devices.

Colonel Pavel thinks the first Air Force use of a superconductive component might be either a sensor or a microwave circuit. Dr. Hellwig says that a microwave filter at high frequency, which would provide spectral discrimination at very high frequencies, looks promising.

"Superconductivity in electronics affords us the ability to get better data rates by a factor of ten—those figures are actually conservative—and better power by a factor of 100," says Dr. Hellwig. "Superconductivity can aid communications by providing more frequency capability, greater sensitivity, lower power communication, and more data per channel. It is a key, key item." ■

C. David Chaffee is executive editor of Superconductor Week, *based in Washington, D. C., and author of* The Rewiring of America: The Fiber Optics Revolution, *published by Academic Press. This is his first article for* Air Force *Magazine.*

Reviews

Visions of Infamy: The Untold Story of How Journalist Hector C. Bywater Devised the Plans that Led to Pearl Harbor, by William H. Honan. Well, where *did* Japan get the idea that it could launch a surprise attack on the US, a far larger and stronger power, and succeed? Did it come from the warlords? From Adm. Isoroku Yamamoto, the Japanese fleet commander? Or might it have come from a brilliant, colorful, pub-crawling—and now virtually forgotten—British spy-cum-journalist named Hector C. Bywater? Surprisingly, the answer may be the latter. Mr. Honan, a New York *Times* correspondent, has spent some twenty years gathering evidence to support the claim, and he has come up with some remarkable stuff.

Readers may recall that Hector Bywater, a prominent naval writer of the 1920s, was the subject of C. V. Glines's December 1990 AIR FORCE Magazine article, based partly on Honan's research. In *Visions of Infamy,* Honan documents Bywater's considerable influence on the thinking of Japan's strategists. With his articles and books—notably *The Great Pacific War* in 1925—he provoked debates with the likes of former Assistant Secretary of the Navy (eventually, President) Franklin Roosevelt and Admiral Yamamoto himself. Bywater laid out—in detail—how Japan could conduct the assault on US bases in the Philippines, how it might set up a naval perimeter, which weapons it would use, how the US would fight back in a bloody "island-hopping" campaign, and who the eventual victor would be.

Honan's key claim is that Bywater did not so much see the future as shape it by providing Japanese naval strategists with practical war plans that made initial victory seem not only possible but inevitable. (Bywater, however, always argued that Japan would go down to defeat in any prolonged war with the US.) Professional and amateur historians will argue for years about the meaning of the new information that Honan adduces. Is it convincing? For now, and until someone counters Honan's facts, the answer is yes. St. Martin's Press, New York, N. Y., 1991. 329 pages with photos, maps, and index. $22.95.

The Commanders, by Bob Woodward, *Panama: The Whole Story,* by Kevin Buckley, and *Secret Dossier: The Hidden Agenda Behind the Gulf War,* by Pierre Salinger with Eric Laurent. Here are three titles providing three different "snapshots" of contemporary history—or so we are led to believe. Among these, Mr. Woodward's book has received the most media attention. Taken individually, each has shortcomings; read collectively, the books might give readers some insight into the national security decision-making process of the Bush Administration. Woodward's book deals with events leading up to the 1989 Panama invasion and the 1991 Gulf War. Mr. Salinger's work focuses on the period before the Gulf War. Mr. Buckley's book, as the title suggests, is entirely about the Panama operation.

By juxtaposing Woodward's book with Buckley's, the reader can compare two very different portraits of the Army's Lt. Gen. Frederick Woerner, the commander in chief of US Southern Command, who was relieved a few months before Operation Just Cause took place. In *The Commanders,* General Woerner, a thirty-five-year veteran and recipient of the bronze star with oak leaf cluster for valor in Vietnam, comes off as a "wimp," while in *Panama: The Whole Story* there is a certain nobility about General Woerner and his understanding of the region, not to mention his ability to look beyond a military operation to its aftermath.

In these books, there are interesting spins to the first mission of the F-117A fighter. Woodward claims that, in order to stun the Panamanian troops, the F-117s were to drop two 2,000-pound bombs about fifty yards from the Rio Hato Panama Defense Forces barracks. Gen. Colin Powell, Chairman of the Joint Chiefs of Staff, later decided to make the targets 200–250 feet from the barracks to increase the margin for error. (The low-ranking Panamanian Defense Forces soldiers were not the real enemy of the US, the thinking went.) Buckley, on the other hand, says that the plan was to destroy the barracks and that General Powell at the last minute altered the plan, much to the chagrin of the Army Rangers, who expected the barracks to be destroyed.

In *Secret Dossier,* Salinger and Laurent provide a less intimate account of the inner circle of US policymakers. They do, however, bring more attention to events in Middle Eastern capitals. Their overall perspective is also different. "This is not a book about war," they write. "It is a book that shows how war could have been avoided." Still, there are possibilities for comparison with Woodward. Take, for example, the now-famous exchange between April Glaspie, the US ambassador to Iraq at the time, and Saddam Hussein. Woodward paints a more favorable picture of Ambassador Glaspie than that which emerges in *Secret Dossier.*

Of the three books, the most useful is Buckley's, mainly because Buckley has appended extensive notes on sources for all of his chapters. Consequently, the reader can see how Buckley came to his conclusions. In the cases of Woodward and Salinger and Laurent, tales are told as if these authors were omnipresent and omniscient. Unfortunately, Woodward has not only pioneered this new approach—resulting in a kind of quasi-journalism/quasi-history—but also has made it popular. It seems clear that he is sometimes being used as a medium for revisionism, while at other times he manipulates and embellishes his script. Since he never footnotes or identifies any source, we never know which is which. *The Commanders,* Simon & Schuster, New York, N. Y., 1991, 399 pages with index. $24.95. *Panama,* Simon & Schuster, New York, N. Y., 1991, 304 pages with chapter notes and index. $21.95. *Secret Dossier,* Penguin USA, New York, N. Y., 1991, 241 pages. $9.95.

Pilots, by William Neely. This book goes beyond the traditional coverage of a slice of history or a particular type of pilot. Instead, Mr. Neely surveys pilots of all types of aircraft: jet fighters, blimps, space shuttles, and commercial airliners—even crop dusters. He explores what makes pilots tick, painting the calm, the daring, and the fear that characterize pilots' experiences. While doing so, Neely blends the words of famous pilots—Jimmy Doolittle, Chuck Yeager, Robin Olds, Art Scholl—with engaging narrative that provides historical context and background, from the Wright brothers' first flight, to the exploits of American mercenaries during the Mexican Revolution, to pilots' experiences in the world wars and on into spaceflight. His harrowing accounts of recent commercial airliner tragedies and near-misses will give readers pause, but will also instill confidence in the ability of a pilot to remain calm, even with a gun pointed at his or her head. Simon and Schuster, New York, N. Y., 1991, 229 pages. $19.95.

Great Weapons of World War II, by John Kirk and Robert Young. The authors began with a major premise in mind: "It is nearly impossible to understand the war . . . without some knowledge of the terrible machines with which it was fought." A useful catalog for the World War II history buff or general reader, the book includes sections on aircraft, ships, tanks and tank destroyers, artillery, small arms, and miscellaneous weapons used in the war. Walker and Company, New York, N. Y., 1990, 348 pages with photos. $39.95. ■

AFA Nominees for 1991–92

By Katie Storm

At a meeting on May 25 in Colorado Springs, Colo., the Air Force Association Nominating Committee selected a slate of candidates for the four national officer positions and the six elective positions on the Board of Directors. This slate will be presented to the delegates at the National Convention in Washington, D. C., on September 16.

The Nominating Committee consists of the five most recent past National Presidents and one representative from each of the twelve regions.

Nominated for his second term as National President was **Oliver R. Crawford** of Austin, Tex. Mr. Crawford is a private investor. Active in many business and civic organizations, he has served as Chairman, Bergstrom Austin Community Council; Trustee, Texas A&M University Research Foundation; Vice Chairman, American Airpower Heritage Foundation; and Trustee, Southwest Research Institute. He is a member of the Texas A&M University Century Council and the Austin Council on Foreign Affairs.

Mr. Crawford was born in Amarillo, where he attended public schools. He entered the US Army Air Forces in 1943 and served as a fighter pilot during World War II. He was a member of the Air Force Reserve until 1959. After attending Washington State University and South Texas College of Law, he began work with Time-Life, Inc., a New York publishing company with extensive holdings in Texas, where he served as an officer and director of several subsidiary companies between 1956 and 1974. He served as a member of the Board of Directors of the First State Bank, Jasper, Tex., from 1959 to 1975.

Mr. Crawford has received numerous honors, including the rank of brevet major general from the Air National Guard and the Commander's Cross of the Order of Merit from the President of what was then West Germany. The Commander's Cross was West Germany's highest civilian honor and the peacetime equivalent of the Blue Max. He is listed in several volumes of *Who's Who* and in *Leading Men in the United States of America*.

He has flown eighty-seven different types of civilian and military aircraft, logging more than 12,850 flying hours in jets and propeller-driven planes. He currently flies a twin-engine Aerostar and a Curtiss P-40 Warhawk as a colonel in the Confederate Air Force.

Mr. Crawford joined AFA in 1946 and served on the Finance Committee, as Texas State President, as a member of the Texas executive committee and the Austin chapter executive committee, and as National Vice President (Southwest Region), Austin chapter president, and Aerospace Education Foundation (AEF) Trustee. Currently, he serves as National President, Chairman of AFA's Executive Committee and a member of AFA's Resolutions Committee, Chairman of the National Vice Presidents, and an AEF Trustee. He has received AFA's Presidential Citation, Exceptional Service, Special Citation, and Medal of Merit awards. He was AFA's Man of the Year in 1989 and is a Life Member of AFA and a Charter Life Member of AEF.

Jack C. Price of Clearfield, Utah, was nominated for his second term as Chairman of the Board. Prior to his retirement in 1988, he served as Deputy Director of Distribution for

Air Force Logistics Command's Ogden Air Logistics Center (ALC) at Hill AFB, Utah. In this capacity, he directed a large depot-level complex dealing with wholesale and retail receipt, storage, issue, and shipment of materiel worldwide.

Mr. Price held a number of management and supervisory positions with the Ogden ALC. He was Chief of the Missile and Aircraft Systems Division in the Directorate of Maintenance. Before that, he served as Deputy Chief of the Aircraft Division; Chief of the Navigational Instruments, Photographic, and Training Devices Division; and Chief of the Missile Division.

The recipient of numerous performance awards, Mr. Price has also been active in a number of professional, technical, and managerial associations during his career.

Born in Iowa, he moved to Utah in 1953. He attended Weber State College, where he majored in management logistics. He served a six-year tour in the Air Force prior to and during the Korean War and began his civil service career at Hill AFB in 1953.

Mr. Price served previously on the Executive, Finance, Resolutions, Constitution, and Organizational Advisory Committees of AFA. He has also served as National President, National Secretary, National Vice President (Rocky Mountain Region), Utah State President, Utah State Vice President, Ute chapter president, Ute chapter vice president, AEF Trustee, and AEF Trustee Emeritus. Currently, he is National Chairman of the Board, a member of the Resolutions and Executive Committees, and an AEF Trustee. He has received AFA's Presidential Citation, Special Citation, Exceptional Service, and Medal of Merit awards. He is a Life Member of AFA and a Charter Sustaining Life Member of AEF.

Mary Ann Seibel of St. Louis, Mo., currently AFA's appointed National Secretary, was nominated for her first elected term as National Secretary. Ms. Seibel is Director of Personnel for the Air National Guard's 131st Tactical Fighter Wing in St. Louis.

With a base population of more than 2,000 individuals and twenty-one units, hers is the third largest Personnel Office in the Air National Guard. She directs the base Family Support Program and has the collateral duty as Federal Women's Program Manager. Her previous assignments include Commander, Communications-Computer Staff Officer, Executive Officer, and Base Services Officer. She completed the Air War College Seminar program in 1989. Ms. Seibel has twenty-seven years of federal civil service and fourteen years of military service. She was commissioned as a 1st lieutenant in 1976. Ms. Seibel was a 1986–87 participant in the Leadership St. Louis program and is now a member of its alumni association. She is on the Advisory Council for Parks College of St. Louis University. She serves on the Military Affairs Committee of the St. Louis Regional Commerce and Growth Association.

Ms. Seibel is also a past president of the Junior Women's Chamber of Commerce and a member of the National Association for Female Executives, Sen. Christopher Bond's National Affairs Policy Roundtable, St. Louis World Affairs Council, Missouri National Guard Association and National Guard Association of the United States, Missouri Committee for Employer Support of Guard and Reserve, and the Airlifters Association.

Ms. Seibel was born in St. Louis and attended Webster University, where she majored in business management. She received her bachelor of arts degree in business administration from Columbia College in Columbia, Mo.

Ms. Seibel served previously on the Long-Range Planning, Resolutions, and Executive Committees of AFA. She has also served as National Director, Under-40 Director, and Missouri State Vice President. She has been a member of the Junior Officer Advisory Council and president, vice president, and executive-committee member of the Spirit of St. Louis Chapter. Currently, she serves as National Secretary; Chairman, Resolutions Committee; and member, Executive and Constitution Committees. She is Spirit of St. Louis Chapter Aerospace Education vice president and chairs the Base Membership Committee. She has received AFA's Exceptional Service Award and the AFA Medal of Merit twice. She is an AFA Life Member and Charter Life Member of AEF.

Nominated for his fifth term as National Treasurer was **William N. Webb** of Midwest City, Okla. He is an advisor in Air Force Association matters for the commander of the Oklahoma City ALC.

Born in western Oklahoma, Mr. Webb attended local schools at Burns Flat, Okla., and Southwestern State Teachers College, Weatherford, Okla., in 1945. He moved to Midwest City in 1950 and obtained employment at the Oklahoma City Air Materiel Command (now Oklahoma City ALC) at Tinker AFB. He started work at Tinker as a warehouseman and completed his career in April 1981 as Chief of the Management Organization for Distribution. His responsibilities included accounting, manpower, funding, data systems, and engineering. He is a Life Member of AFA.

Mr. Webb joined AFA in 1960. He has held the office of National Vice President (Southwest Region) and has served on the Finance Committee for thirteen years, been Chairman of the Building Acquisitions Committee, and served as an AEF Trustee. Currently, he is Chairman of the National Finance Committee, an AEF Trustee, and a member of the Executive Committee, the Central Oklahoma (Gerrity) Chapter, and the Oklahoma executive committee. He has received AFA's Special Award, twice received AFA's Exceptional Service Award, and was honored with the first Storz Award for membership.

The following individuals are permanent members of the AFA Board of Directors under the provisions of Article IX of AFA's National Constitution: John R. Alison, Joseph E. Assaf, David L. Blankenship, John G. Brosky, Dan F. Callahan, Robert L. Carr, George H. Chabbott, Earl D. Clark, Jr., M. Lee Cordell, R. L. "Dev" Devoucoux, James H. Doolittle, Russell E. Dougherty, George M. Douglas, Joseph R. Falcone, E. F. "Sandy" Faust, Joe Foss, Meryll M. Frost, Barry Goldwater, Jack B. Gross, George D. Hardy, Alexander E. Harris, Martin H. Harris, Gerald V. Hasler, John P. Henebry, Robert S. Johnson, Arthur F. Kelly, Victor R. Kregel, Nathan H. Mazer, William V. McBride, James M. McCoy, Edward J. Monaghan, J. B. Montgomery, J. Gilbert Nettleton, Jr., William C. Rapp, Julian B. Rosenthal, Peter J. Schenk, Joe L. Shosid, William W. Spruance, Thomas F. Stack, Edward A. Stearn, James M. Stewart, Harold C. Stuart, James M. Trail, Forrest L. Vosler, A. A. West, and Sherman W. Wilkins.

The six individuals whose photographs appear below are nominees for the six elected Directorships for the coming year. Asterisks indicate incumbent National Directors.

***Donald D. Adams,** Omaha, Neb. Consultant. Former National Vice President (Midwest Region) and State and Chapter President. Current National Director. Life Member of AFA and Charter Life Member of AEF.

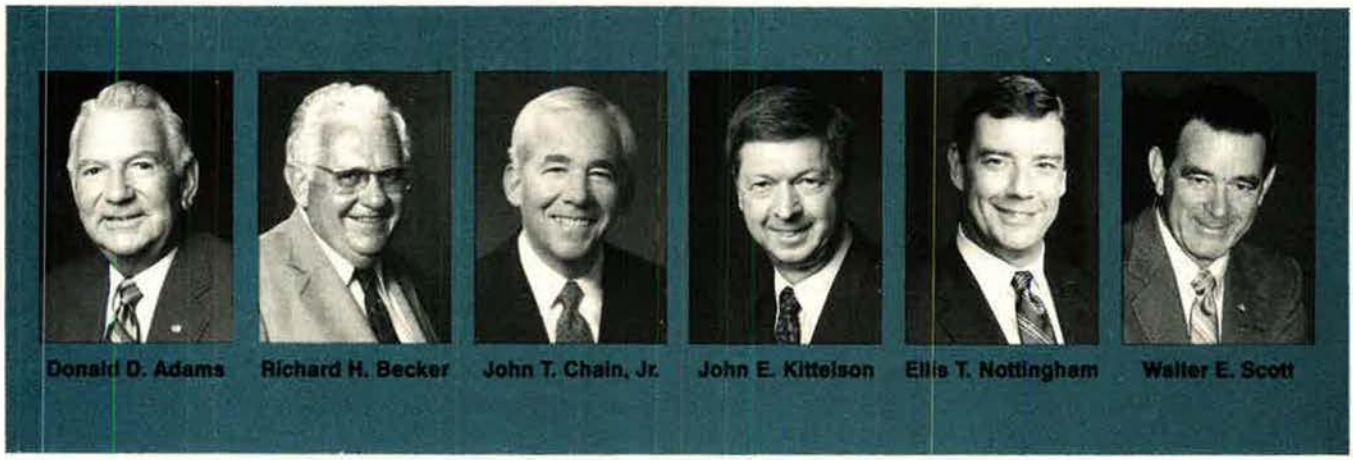
***Richard H. Becker,** Oakbrook, Ill. Retired senior account executive. Former National Director, State and Chapter President, Advisory Council Member for AEF, AEF Trustee, national committee member, and national committee chairman. Current National Director. Life Member of AFA and Charter Life Member of AEF.

John T. Chain, Jr., Fort Worth, Tex. Executive vice president. Retired Air Force General. Former commander in chief of Strategic Air Command.

John E. Kittelson, Sioux Falls, S. D. Insurance and investment agent. Former National Vice President (North Central Region) and State and Chapter President. Current National Vice President (North Central Region), committee chairman, committee member, and council member. AFA Life Member.

***Ellis T. Nottingham,** Arlington, Va. Director, government relations. Former National Director, Under-40 Director, state officer, Chapter President, national committee member. Current National Director and committee member. Life Member of AFA and Life Member of AEF.

***Walter E. Scott,** Dixon, Calif. Retired. Former National Director, national committee chairman, National Secretary of AEF, state officer, national committee member, AEF Trustee, AEF Trustee Emeritus, and Advisory Council Member for AEF. Current National Director, national committee member, National Secretary of AEF. Life Member of AFA and Charter Life Member of AEF. ■



Katie Storm is administrative assistant on AFA's Volunteer & Regional Activities staff.

AFA State Contacts

Following each state name are the names of the communities in which AFA chapters are located. Information regarding these chapters or any of AFA's activities within the state may be obtained from the appropriate contact.

ALABAMA (Birmingham, Gadsden, Huntsville, Mobile, Montgomery): **William M. Voigt,** 401 N. 20th St., Birmingham, AL 35203 (phone 205-254-2330).

ALASKA (Anchorage, Fairbanks): **Larry D. Willingham,** 20151 Lucas Ave., Eagle River, AK 99577 (phone 907-694-4034).

ARIZONA (Green Valley, Phoenix, Prescott, Sedona, Sierra Vista, Sun City, Tucson): **William A. Lafferty,** 1342 W. Placita Salubre, Green Valley, AZ 85614 (phone 602-625-9449).

ARKANSAS (Blytheville, Fayetteville, Fort Smith, Hot Springs, Little Rock): **O. W. Lewis,** 717 E. Walnut St., Blytheville, AR 72315 (phone 501-763-8682).

CALIFORNIA (Apple Valley, Bakersfield, Camarillo, Edwards, Fairfield, Fresno, Los Angeles, Merced, Monterey, Novato, Orange County, Pasadena, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, Sunnyvale, Vandenberg AFB, Yuba City): **Arthur Trost,** 288 Lombardi Cir., Walnut Creek, CA 94598 (phone 415-934-2889).

COLORADO (Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Pueblo): **William D. Croom,** 31 N. Tejon, Colorado Springs, CO 80903 (phone 719-550-3214).

CONNECTICUT (Brookfield, East Hartford, Middletown, Storrs, Stratford, Torrington, Waterbury, Westport, Windsor Locks): **John T. McGrath,** 97 Morgan St., Middletown, CT 06457 (phone 203-344-4636).

DELAWARE (Dover, Milford, Newark, Rehoboth Beach, Wilmington): **Robert M. Berglund,** 128 W. Loockerman St., Dover, DE 19901 (phone 302-674-0200).

DISTRICT OF COLUMBIA (Washington, D. C.): **John J. Stirk,** 1501 Lee Highway, Arlington, VA 22209-1198 (phone 703-247-5820).

FLORIDA (Avon Park, Broward County, Cape Coral, Daytona Beach, Fort Walton Beach, Gainesville, Homestead, Jacksonville, Leesburg, Miami, New Port Richey, Ocala, Orlando, Palm Harbor, Panama City, Patrick AFB, Port Charlotte, Sarasota, Spring Hill, St. Augustine, Sun City Center, Tallahassee, Tampa, Titusville, Vero Beach, West Palm Beach, Winter Haven): **Craig R. McKinley,** 735 Palmera Dr. E., Ponte Vedra Beach, FL 32082 (phone 904-741-7101).

GEORGIA (Athens, Atlanta, Columbus, Dobbins AFB, Rome, Savannah, St. Simons Island, Valdosta, Warner Robins): **Dan Callahan,** 100 Ridgecrest Pl., Warner Robins, GA 31088 (phone 912-929-1485).

GUAM (Agana): **Daniel A. Cox,** Box 7252, Tamuning, GU 96911 (phone 671-646-9255).

HAWAII (Honolulu, Maui): **Bob Noack,** P. O. Box 618E, Honolulu, HI 96818 (phone 808-422-2922).

IDAHO (Boise, Mountain Home, Twin Falls): **Ralph D. Townsend,** P. O. Box 45, Boise, ID 83707-0045 (phone 208-389-5226).

ILLINOIS (Belleville, Champaign, Chicago, Elmhurst, Moline, Peoria, Rockford, Springfield-Decatur): **Paul M. Cleary,** 911 Meadowlark, O'Fallon, IL 62269 (phone 618-632-6678).

INDIANA (Bloomington, Evansville, Fort Wayne, Grissom AFB, Indianapolis, Lafayette, Marion, Mentone, South Bend, Terre Haute): **Harold F. Henneke,** 359 W. Edgewood Ave., Indianapolis, IN 46217 (phone 317-786-5865).

IOWA (Des Moines, Marion, Sioux City): **Carl B. Zimmerman,** 608 Waterloo Bldg., Waterloo, IA 50701-5495 (phone 319-234-0339).

KANSAS (Garden City, Topeka, Wichita): **Samuel M. Gardner,** 1708 Prairie Park Ln., Garden City, KS 67846 (phone 316-275-4555).

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LOUISIANA (Alexandria, Baton Rouge, New Orleans, Shreveport): **Doyle D. Blasingame,** 208 Wellington Dr., Bossier City, LA 71111 (phone 318-746-0252).

MAINE (Bangor, Loring AFB, North Berwick): **Richard F. Strelka,** 54 Country Rd., Caribou, ME 04736 (phone 207-492-4381).

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MISSISSIPPI (Biloxi, Columbus, Jackson): **Henry W. Boardman,** 10 Bayou Pl., Gulfport, MS 39503 (phone 601-896-8836).

MISSOURI (Richards-Gebaur AFB, Springfield, St. Louis, Whiteman AFB): **Charles E. McGee,** 5231 Lawn Ave., Kansas City, MO 64130-3152 (phone 816-861-5231).

MONTANA (Bozeman, Great Falls): **Jim Banks,** 7 Hill St., Bozeman, MT 59715-6029 (phone 406-587-7629).

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NEW HAMPSHIRE (Manchester, Pease AFB): **Frederic C. Armstrong,** 206 Woodland Rd., Hampton, NH 03842-1426 (phone 603-436-6909).

NEW JERSEY (Andover, Atlantic City, Belleville, Camden, Chatham, Cherry Hill, Forked River, Fort Monmouth, Jersey City, McGuire AFB, Middlesex County, Newark, Old Bridge, Trenton, Wallington, West Orange, Whitehouse Station): **Dolores Vallone,** 143 Marne Rd., Hopatcong, NJ 07843 (phone 201-770-0829).

NEW MEXICO (Alamogordo, Albuquerque, Clovis): **Robert H. Johnson,** P. O. Box 5051, Kirtland AFB, NM 87185 (phone 505-843-6230).

NEW YORK (Albany, Bethpage, Binghamton, Brooklyn, Buffalo, Chautauqua, Griffiss AFB, Hudson Valley, Nassau County, New York City, Niagara Falls, Plattsburgh, Rochester, Staten Island, Suffolk County, Syracuse, Westhampton Beach, White Plains): **Vincent J. Tampio,** 50 Main St., Silver Creek, NY 14136 (phone 716-631-6465).

NORTH CAROLINA (Asheville, Charlotte, Fayetteville, Goldsboro, Greensboro, Greenville, Havelock, Hickory, Kitty Hawk, Littleton, Raleigh, Wilmington): **Norman E. Davis,** P. O. Box 387, Wrightsville Beach, NC 28480 (phone 919-256-6036).

NORTH DAKOTA (Fargo, Grand Forks, Minot): **J. Michael Phillips,** 110 49th Ave. S., Grand Forks, ND 58201 (phone 701-795-3510).

OHIO (Akron, Cincinnati, Cleveland, Columbus, Dayton, Mansfield, Newark, Youngstown): **Fred F. Kubli, Jr.,** 823 Nancy St., Niles, OH 44446 (phone 216-544-7752).

OKLAHOMA (Altus, Enid, Oklahoma City, Tulsa): **Kenneth W. Calhoun,** P. O. Box 300217, Midwest City, OK 73110 (phone 405-736-5642).

OREGON (Eugene, Klamath Falls, Portland): **John Lee,** P. O. Box 3759, Salem, OR 97302 (phone 503-581-3682).

PENNSYLVANIA (Allentown, Altoona, Beaver Falls, Bensalem, Coraopolis, Drexel Hill, Erie, Harrisburg, Homestead, Indiana, Johnstown, Lewistown, Philadelphia, Pittsburgh, Scranton, Shiremanstown, State College, Washington, Willow Grove, York): **Eugene Goldenberg,** 2345 Griffith St., Philadelphia, PA 19152-3311 (phone 215-332-4241).

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RHODE ISLAND (Warwick): **John A. Powell,** 700 St. Paul's St., North Smithfield, RI 02895 (phone 401-766-3797).

SOUTH CAROLINA (Charleston, Clemson, Columbia, Myrtle Beach, Sumter): **Charles W. Myers,** 42 Palmer Dr., Sumter, SC 29150 (phone 803-775-7352).

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TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tullahoma): **Wayne L. Stephenson,** 12409 Valencia Point, Knoxville, TN 37922-2415 (phone 615-966-2569).

TEXAS (Abilene, Amarillo, Austin, Big Spring, College Station, Commerce, Corpus Christi, Dallas, Del Rio, Denton, El Paso, Fort Worth, Harlingen, Houston, Kerrville, Lubbock, San Angelo, San Antonio, Waco, Wichita Falls): **John P. Russell,** P. O. Box 5789, Abilene, TX 79608 (phone 915-698-8586).

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WISCONSIN (Madison, Milwaukee, Mitchell Field): **Gilbert M. Kwiatkowski,** 8260 W. Sheridan Ave., Milwaukee, WI 53218-3548 (phone 414-463-1849).

WYOMING (Cheyenne): **Irene G. Johnigan,** 503 Notre Dame Ct., Cheyenne, WY 82009 (phone 307-775-3641).

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

A Boost for Ramstein

A hot cup of coffee was probably far down the list of items desired by the forces of Desert Shield and Desert Storm in and around Saudi Arabia. For Air Force Security Police serving in the chillier latitudes of northern Europe, however, it almost qualifies as one of the four major food groups. The donation of eighteen coffee-makers by the **Lufbery-Campbell (Germany) Chapter** to the members of the 377th Combat Support Wing and the 377th Security Police Group at Ramstein AB, Germany, was, therefore, a welcome one.

Ramstein, always a bustling place, became even busier as activity in the Persian Gulf increased. The Security Police were especially hard-pressed because of the increased vigilance against terrorist threats, which required long hours of guard duty and patrol, most of them during the cold German winter. Chapter President Lt. Col. Jim "Snake" Clark thought the coffee-makers would be a useful token of appreciation for the extra efforts put forth by the Security Police of Ramstein during the operations.

USAFE Commander in Chief Gen. Robert C. Oaks examines the photographs in a pictorial essay on Washington state presented to him by Inland Empire Chapter President Jeremy Smith in appreciation for his speech at a chapter meeting. The General's speech focused on allied cooperation during Desert Storm.

Alabama Convention

Jeremiah A. Denton, Jr., much-decorated Vietnam veteran and former US Senator, was the featured speaker at this year's Alabama State Convention in Mobile. AFROTC, Army ROTC, and Civil Air Patrol cadets joined AFA members from Alabama and surrounding states, state officers, and national officers for the three-day event. The convention featured an Aerospace Education Workshop, a business session for state and chapter officers, and a tour of the Mobile Navy Home Port and Mobile Museum before culminating with the awards banquet at which Mr. Denton spoke.

National Chairman of the Board Jack C. Price attended the convention as did National Vice President (South Central Region) H. R. "Bobby" Case, National Director Dr. Frank M. Lugo, Alabama State President William Voigt, Mississippi State President Henry Boardman, Arkansas State President Wayne Lewis, and former National Vice Presidents (South Central Region) James LeBlanc and Cliff Ball. Mobile Chapter President William Divin accepted the Outstanding Chapter in Alabama Award on behalf of the chapter.

Go West

National Vice President (Far West Region) Robert A. Munn and National Board Chairman Jack Price recently completed a tour of that region's more distant outposts, traveling to Guam and Hawaii to visit AFA chapters. In Hawaii, they met with Maj. Gen. Malcolm Armstrong, vice commander in chief of PACAF, and Brig. Gen. Kenneth Eickmann, PACAF's deputy chief of staff for Logistics, at Hickam AFB. Hawaii Chapter President John Parrish and Tom Keeney, past president, officiated at the meeting. Mr. Munn and Mr. Price then flew to Maui, where they met with Maui Chapter President-elect Lou Macnik and discussed the importance of a strong Community Partners program. While on Maui, they toured one of AFSPACECOM's satellite-tracking stations some 12,000 feet above sea level.

Though it is remote geographically (a seven-hour flight from Hawaii), Guam is very much a part of the AFA organization. The **Guam–Arc Light Chapter** does its part in furthering AFA goals and maintaining strong ties with the men and women at Andersen AFB. While there, the two AFA officers met with Col. George De Govanni, commander of Andersen's 633d Air Base Wing, and other officers and NCOs. They also met with Chapter President Dan Cox and First Vice President Chuck McManus for a tour of the base and a discussion of AFA activities on Guam and of ways to improve communications with national headquarters.

Chapter News

Chapter President Ed Dvorak of the **Riverside (Calif.) Chapter** recently presented a check for $15,000 to Col. Paul Gill, commander of the 22d Air Refueling Wing at March AFB, Calif., for the base's Morale, Wellness, and Readiness fund. This donation, raised from a Bob Hope celebrity golf tournament, pushed the chapter's total donations to the base over the $200,000 mark. The chapter also provides scholarships to area AFJROTC units and makes an annual donation to the local VA hospital.

The **Charles A. Lindbergh (Conn.) Chapter** heard a fine speech from Maj. Gen. Stephen M. McElroy, USAF Program Executive Officer for Tactical Strike Programs. His talk centered on the performance of advanced weaponry in Operation Desert Storm, particularly the E-8A Joint STARS aircraft. The chapter presented him with an Aerospace Education Foundation Ira C. Eaker Fellowship in appreciation for his talk. Chapter President William Shields, founding Chapter President Al Hudson, and State Vice President for Aerospace Education and Chapter Vice President Marshall Dunbar, Jr., praised the General's speech, which was heard by a sizable audience, including some newly returned veterans of Desert Storm.

Other participants in Desert Storm, namely the men and women of the 317th Tactical Airlift Wing from Pope AFB, N. C., received an expression of thanks from the **Pope Chapter** at the chapter's annual golf tournament. Wing Commander Col. Maxwell C. Bailey accepted the citation from Chapter President Bill Michael on behalf of his unit. The golf tournament raises money for five area high school AFJROTC units.

Jack Matthews (second from left, holding AFA's Gill Robb Wilson Award for outstanding contributions in the field of arts and letters) poses before one of his paintings with (from left) PACAF Vice Commander Maj. Gen. Malcolm Armstrong, AFA Board Chairman Jack Price, and former Hawaii Chapter President Tom Keeney.

The **Fran Parker (N. M.) Chapter** showed its support for the men and women of Desert Storm in a highly visible manner. They purchased two billboards: one reading "We support our troops" and the other welcoming the troops home.

The **Panhandle (Tex.) Chapter** turned out in force for Amarillo's "Welcome Home" parade for Desert Storm veterans and later participated in the highly successful Amarillo Air Show '91, which included a performance by the Thunderbirds. The chapter is especially proud of its treasurer, Tony Salazar, who was recently named "El Mejor de lo Nuestro" ("The Best of our Own") by the city's Hispanic community. A retired USAF lieutenant colonel, Mr. Salazar has served two terms as president of the Amarillo Chapter and does much charity work with local youth and church groups.

The **Major John S. Southrey (Mass.) Chapter** has been active in the "Wright Flight" program, designed to encourage local students. Students sign a contract stipulating that they must generally improve their grades and attendance, take eight lessons in aviation, and pass a test

In a ceremony at Barksdale AFB, La., Lt. Gen. Ellie G. Shuler, Jr. (left), commander of 8th Air Force, accepts the Aerospace Education Foundation's President's Award from Ivan McKinney (center), president of the Ark-La-Tex Chapter, and State President and Bossier Chamber of Commerce General Manager Doyle Blasingame.

Coming Events

August 2–3, **Minnesota State Convention,** Hinckley, Minn.; August 3, **Indiana State Convention,** Bloomington, Ind.; August 3, **Mid-America Ball,** St. Louis, Mo.; August 9–10, **Alaska State Convention,** Anchorage, Alaska; August 15–17, **California State Convention,** Edwards AFB, Calif.; August 16–18, **Oregon State Convention,** Salem, Ore.; August 22–24, **Utah State Convention,** Ogden, Utah; August 23–24, **Oklahoma State Convention,** Altus AFB, Okla.; August 24, **Nevada State Convention,** Reno, Nev.; September 6–7, **New Mexico State Convention,** Albuquerque, N. M.; September 6–7, **Washington State Convention,** Seattle, Wash.; September 6–7, **Wisconsin State Convention,** Milwaukee, Wis.; September 15, **Montana State Convention,** Malmstrom AFB, Mont.; September 15–18, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C.

Georgia State Vice President Maj. Donald N. Edmands, Jr., presents AFJROTC Cadet 2d Lieutenant Brandee Nickodem of Wayne County High School in Jessup, Ga., with the citation that accompanies her award of the AFA Medal.

with a score of eighty-five or better. The fifteen who passed, from Westfield and West Springfield, Mass., were rewarded with an airplane ride. State President David Cummock praised the program, saying, "Volunteerism works best with the Wright Flight program because it brings the kids, teachers, and pilots together."

A large crowd was on hand at the Hurlburt Field Officers Club for the **Eglin (Fla.) Chapter's** Scholarship Awards Night. Maj. Gen. John Corder, commander of the USAF Tactical Air Warfare Center, spoke at the banquet, emphasizing Air Force participation in Desert Storm, particularly the contributions of Special Operations Forces and other units from Hurlburt Field and Eglin AFB, Fla. AFJROTC Cadet Col. Robbie L. Crabtree from Fort Walton Beach High School won the Jimmy Doolittle Award, which includes a $2,000 scholarship. Cadet Col. Brian Dewey of Choctawhatchee High School picked up the Gen. Robert D. Russ Award, which comes with a $1,500 scholarship, and Cadet Lt. Col. Joseph A. Antonetti of Niceville High School collected the Eglin Chapter Award, also worth $1,500. Chapter President Bob Patterson and Chapter Vice President for Awards and Scholarships Troy Dent assisted General Corder in the awards presentations.

Have AFA News?

Contributions to "AFA/AEF Report" should be sent to Dave Noerr, AFA National Headquarters, 1501 Lee Highway, Arlington, VA 22209-1198. ■

Bulletin Board

Seeking the whereabouts of **Gerald Apple,** who was a waist gunner on a B-17 in Europe during World War II and who wrote a book while a POW in Austria. **Contact:** William Vancegriff, P. O. Box 21, Catharpin, VA 22018.

Seeking information on **patches and insignia of Operations Desert Storm and Desert Shield,** especially special patches for fun or official use. **Contact:** Rick Rizzo, Aviation News, 406 Revere Beach Parkway, Revere, MA 02151.

The Veterans Administration Stamp and Coin Club of Tucson, Ariz., has **used postage stamps available for collectors** who are veterans. **Contact:** Charles R. Carn, Veterans Administration, Tucson, AZ 85723.

Seeking contact with the survivors of **Col. Thomas Dwight Johnson,** who was stationed in Wiesbaden in the late 1940s and early 1950s and worked for Decca Navigation, Inc., in Washington, D. C., for many years. He died in Belgium in 1971. **Contact:** Barbara Bailey, 160 Greenvale Rd., Eltham Park, London SE9 1PQ, England.

Seeking contact with members of the **21st and 388th Fighter Bomber Wings** who were passengers on the *General Elroy L. Eltinge,* which sailed from Houston, Tex., to France in November 1954. The 21st FBW opened Chambley AB, and the 388th FBW opened Etain AB. **Contact:** Thomas W. Young, Sr., 830 W. Amsden St., Denison, TX 75020.

Seeking contact with veterans of the **23d Photo Reconnaissance Squadron** who trained at Peterson AFB, Colo., and served in North Africa, Italy, Sardinia, Corsica, or southern France during World War II. **Contact:** William L. Martin, 4360 Sedate Ln., Colorado Springs, CO 80917.

Seeking information on **Capt. Dave Lewis,** a bombardier/navigator of the 452d Bomb Group, 3d Bomb Division, 45th Bomb Wing, who was lost on a mission September 3, 1944, when his aircraft went down from flak over the Channel Islands. I am also seeking the 452d's group history. **Contact:** Don Goodenow, 3128 Sunnybrook Dr., Charlotte, NC 28210.

Seeking to purchase a set of World War II **Army Air Forces technical sergeant stripes. Contact:** Calvin J. Sewell, 600 N. W. Ave. G, Hamlin, TX 79520.

Seeking a **pilot training manual** for the Douglas C-54 Skymaster. **Contact:** Richard Hause, 109 Connecticut Ave., Warren, PA 16365.

Seeking information on **Leon DeLock,** of Miami, Fla., who was stationed at Sudbury, Derby, England, in 1942–43. **Contact:** J. A. Burton, 9 St. Clares Close, Littleover, Derby DE3 3JG, England.

Seeking contact with anyone who knew **Thomas Boyd,** who flew P-51s in England during World War II. **Contact:** Ernest T. Moriarty, W. 105 Warwick Rd., Orange, MA 01364.

Air Force ROTC cadet seeks Air Force **major command insignia,** as well as insignia from Air Force weather squadrons and other weather units, past and present. **Contact:** Lloyd E. Weber, 7560 Southern Dr., Columbia, MO 65201.

Seeking **patches** from the following units: 51st Composite Wing and 51st Aircraft Generation Squadron, both of Osan AB, Korea, and 81st Tactical Fighter Wing, 81st Aircraft Generation Squadron, 509th and 510th Aircraft Maintenance Units, at RAF Bentwaters, England. **Contact:** Karen Higgins, 17 Eaton Ave., Auburn, MA 01501.

Seeking contact with veterans of the **73d Troop Carrier Squadron** ("Whitacre's Wonders"), 434th Troop Carrier Group, who served in England and France in 1943–45. Also seeking reunion information for this unit. **Contact:** Bill Mitchell, 8423 Santa Clara, Dallas, TX 75218.

Seeking information on **William B. Brewer,** who served in the Philippines during World War II and spent two years as a POW. In 1950, he traveled from San Antonio, Tex., to Edwards AFB, Calif., via Yuma, Ariz., with a woman named Eddie Marie. **Contact:** Maydell Leicht, 2917 Brock Way, Bakersfield, CA 93306.

Collector seeks any and all **F-4 Phantom patches,** active duty, Guard, and Reserve. **Contact:** Capt. Gil Zamora, 19 Alaska Cir., George AFB, CA 92394.

Seeking the whereabouts of **Col. Thomas P. Dickey,** director of maintenance for the 18th TFW and later the 436th MAW in the late 1960s; **Lt. Col. Kenneth R. Van Zandt,** chief of maintenance for the 18th TFW in the late 1960s; and **CMSgt. Allen T. Hudson,** whose last known duty station was Beale AFB, Calif., working on SR-71s. **Contact:** William H. Deuell, 3841 Andrew Jackson Dr., Pace, FL 32571.

Seeking contact with anyone who knew **John Joseph Walsh,** who worked in communications at RAF Mildenhall and RAF Ruislip, England, in 1950–54. **Contact:** Mitchell Fitzjohn, 2A Ward Rd., Cambridge, England.

Seeking information on **George Nelson,** who was stationed at RAF Lakenheath, England, in early 1962. **Contact:** Barbara A. Knott, 109 Shaw St., Runcorn, Cheshire WA7 5TY, England.

For a documented history, seeking actual **flight crew accounts of escapes** that involved the use of blood chits. **Contact:** Jeffrey T. Guidry, 114 Oak Leaf Dr., Slidell, LA 70461-8920.

Seeking contact with crew members of **B-24 Liberators** who flew missions over Romania during World War II. **Contact:** Doru Varlan, P. O. Box 18-115, Oficiul Postal 18, Sectorul 1, 71500 Bucharest, Romania.

Seeking contact with members of **Class 44-I** at Freeman Field, Ind., who subsequently trained at Harlingen, Tex., to be B-24 copilots. **Contact:** Harvey Long, 2546 Baseline, Box 0324, Grand Island, NY 14072.

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

Seeking contact with members of the **97th Bomb Wing,** SAC, who were at Blytheville AFB, Ark., in 1961–63. **Contact:** Stanley M. Zydlo, Jr., 1745 Clover Dr., Palatine, IL 60067.

Seeking contact with **people whose fathers were killed or missing in World War II.** Also seeking information on the locations of memorials to World War II soldiers. **Contact:** Ann Bennett Mix, P. O. Box 4369, Bellingham, WA 98227.

Seeking contact with crew members who survived the **crash of the B-17 *Old Black Magic,*** in Germany on April 20, 1945. **Contact:** Vern Schmidt, 3427 N. Orchard, Fresno, CA 93726.

Seeking contact with personnel involved with the following programs: the **X-15** research aircraft, the **B-70** (Weapon System 110), and the related **F-108** (Weapon System 202). **Contact:** Terry Panopalis, 70 Gregoire, Candiac, Quebec J5R 5N5, Canada.

Seeking the whereabouts of **Sgt. Barry L. Harriman,** who was stationed in Suffolk, England, in 1976 where he was the owner of a 1966 TVR Tuscan. **Contact:** J. C. Catt, Horseshoe Cottage, Fisher Ln., Chiddingfold, Surrey GU8 4TE, England.

Seeking correspondence with artists specializing in **aviation art** for professional advice on techniques. Also seeking contact with aircrew and maintenance personnel involved with the operation of the **AT-28D Trojan** and the **OV-10A Bronco** aircraft, particularly for close air support and forward air control missions in the Vietnam War. **Contact:** Maj. Edmundo F. Gammad, 15th Strike Wing, Sangley Point, Cavite City 4101, the Philippines.

Seeking photos, negatives, or slides of **nose art** on USAF aircraft from 1955 to the present. **Contact:** Randy P. Walker, 412 S. W. 46th St., Oklahoma City, OK 73109-7418.

Seeking contact with people who were stationed at **Tempelhof Central Airport,** Berlin, and had supernatural experiences. **Contact:** Beverly Garside, MHS Box 55, APO New York 09210.

Collector seeks brochures, pictures, and manufacturer releases on the **YF-22 ATF. Contact:** Brad A. Ware, P. O. Box 2236, Bothell, WA 98041-2236.

Seeking information on the **662d Aero Squadron,** stationed at Kelly Field, Tex., in World War I. **Contact:** Lt. Col. Harold E. Skipper, USAF (Ret.), 4410 Fairways Blvd. #503, Bradenton, FL 34209.

Seeking information on **USAAF and USAF training wings,** groups, and units, for the period 1945–77. **Contact:** John Turford, 6-66 Elora Dr., Hamilton, Ontario L9C 7B3, Canada.

Seeking contact with alumni of **Arnold Air Society. Contact:** Arnold Air Society, Executive Management Center, P. O. Box 3610, Pinehurst, NC 28374.

Seeking titles of **unit histories,** no matter how small, especially of units that participated in Operations Desert Shield and Desert Storm, for an updated bibliography of *USAF and Earlier Organizational Histories Since 1916.* **Contact:** James T. Controvich, 97 Mayfield St., Springfield, MA 01108.

Seeking information on or contact with the **355th Tactical Fighter Wing** pilot who ejected from F-105 aircraft #62-4243 based at Takhli, Thailand, in 1969. **Contact:** Ray Chatelain, 4806 Leeward Ct., Austin, TX 78731.

Seeking contact with members of **13th Air Force Guerrilla Support Air Party #3,** which served behind enemy lines on Mindanao, the Philippines, during World War II. **Contact:** Brayton L. Smith, Jr., 64 Wade Dr., Summit, NJ 07901.

Seeking the whereabouts of **Capt. Jack A. Green, USAF,** who was stationed at Wright-Patterson AFB, Ohio, in 1989, in order to deliver to him his prepaid copy of the history of the 352d Fighter Group, *The Bluenosed Bastards of Bodney,* now published. **Contact:** Bob Powell, 1545 Rainier Falls Dr., Atlanta, GA 30329.

Seeking contact with **Jimmy L. Grammer,** formerly of Louisville, Ky., who attended tech school in Amarillo, Tex., in 1954–55 and whose last known address was in California. Also seeking **Sgt. James R. Morris** of Oklahoma, who was stationed at RAF Sculthorpe, England, with the 85th Bomb Squadron in the mid- to late 1950s. **Contact:** Richard L. McCormick, 307 S. Meridian St., Greenwood, IN 46143.

Historian seeks photographs and personal accounts from aircrew and ground crew members of **USAFE B-66 Destroyers** from 1957 to 1966. **Contact:** David Taylor, The Old School House, Maldon Rd., Langford, Essex CM9 7SS, England.

Seeking contact with people who knew **2d Lt. Eugene Bradley,** of the 57th Fighter Group, who died in a P-40 crash August 21, 1941, in Windsor Locks, Conn. **Contact:** Bob Conrad, 85 Renee St., Bristol, CT 06010. ■

Unit Reunions

Air Force Postal Couriers
Personnel who served in Air Force Postal Courier organizations will hold a reunion September 19–21, 1991, in Colorado Springs, Colo., not September 20–21, 1991, as reported in the April 1991 issue. **Contact:** Maj. James K. Foshee, USAF (Ret.), 3509 Deer Trail, Temple, TX 76504. Phone: (817) 774-7303.

AAF/USAF Crash Rescue Boat
AAF and USAF Crash Rescue Boat personnel will hold a reunion October 3–6, 1991, in the Patrick AFB, Fla., area. **Contact:** John E. Hagan, 3706 Winward Lakes Dr., Tampa, FL 33611-4820. Phone: (813) 837-6658.

Azores Veterans
Personnel stationed at Lajes Field, Azores, during the 1940s and 1950s (all services) will hold a reunion September 26–28, 1991, at Wright-Patterson AFB, Ohio. **Contact:** Robert M. Watson, 4171 Rondeau Ridge Dr., Kettering, OH 45429-1325. Phone: (513) 299-2473.

British Flying Training School
Personnel assigned to #6 British Flying Training School, Darr School of Aeronautics in Ponca City, Okla., during World War II will hold a reunion October 10–13, 1991, in Ponca City. **Contact:** Lillian Taylor, P. O. Box 1453, Ponca City, OK 74607. Phone: (405) 765-7608.

Columbus AFB
Personnel assigned to Kaye Field/Columbus Army Flying School and Columbus AFB, Miss., since 1941 will hold a reunion November 1–2, 1991, in Columbus, Miss. **Contact:** Sherry Medders, Public Affairs Division, Columbus AFB, MS 39701-5000. Phone: (601) 434-7067.

Flight Test Branch Personnel
Members of the 2875th Test Squadron (formerly Flight Test Branch) stationed at Robins AFB, Ga., will hold a fiftieth-anniversary reunion October 25–26, 1991. Past and present members and spouses are invited. **Contacts:** Capt. Allen Scheibe or SSgt. Rick Byers, 2875th Test Squadron (AFLC), Robins AFB, GA 31098-5990. Phone: (912) 926-3102. DSN: 468-3102.

P-40 Warhawk Pilots
P-40 Warhawk Pilots will hold a reunion October 30–November 2, 1991, at the Marriott Hotel in El Paso, Tex. **Contact:** John Roth, 1017 Adams S. E., Albuquerque, NM 87108. Phone: (505) 268-2903.

Roswell/Walker Veterans
Military and civilian personnel who were stationed at Roswell AAF or Walker AFB, N. M., will hold a reunion September 20–22, 1991, at the Roswell Inn in Roswell, N. M. **Contact:** TSgt. Lott W. Porter, USAF (Ret.), P. O. Box 2744, Roswell, NM 88202.

Southern Aviation School
Pilots in primary flight training, instructors, and other personnel assigned to the Southern Aviation School, Camden, S. C., between 1941 and 1944, will hold a reunion September 6–8, 1991, in Camden, S. C. **Contact:** Bill Hawkins, P. O. Box 789, Camden, SC 29020. Phone: (803) 432-9595.

Strategic Support Squadrons
Members of the 1st, 2d, 3d, and 4th Strategic Support Squadrons will hold a reunion October 10–13, 1991, at the Marriott Hotel in El Paso, Tex. **Contact:** Ray Rote, 7741 N. 16th Ln., Phoenix, AZ 85021. Phone: (602) 943-4969.

1st Radio Squadron
Members of the 1st Radio Squadron (1942–45) assigned to Patterson Field, Ohio (now Wright-Patterson AFB), will hold a reunion in September 1991, in Dayton, Ohio. **Contact:** Horace Moore, P. O. Box 735, Rosebud, TX 76570. Phone: (817) 583-4300.

2d Photo Recon Squadron
Members of the 2d Photo Reconnaissance Squadron who served on Palawan Island during World War II will hold a reunion in September 1991, in Oklahoma City, Okla. **Contact:** Francis McLochlin, 425 Hillside Ave., Lake Placid, FL 33852. Phone: (813) 465-4131.

11th Bomb Group
Members of the 11th Bomb Group will hold a reunion December 2–9, 1991. **Contact:** Robert E. May, P. O. Box 637, Seffner, FL 33584. Phone: (813) 681-3544.

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.

12th Tactical Recon Squadron
The 12th Tactical Reconnaissance Squadron and its predecessors will hold a reunion October 3–5, 1991, in Montgomery, Ala. **Contact:** Paul Valentine, Rte. 1, Box 270, Jacksons Gap, AL 36861.

19th Troop Carrier Squadron
Members of the 19th Troop Carrier Squadron (World War II/Berlin Airlift) will hold a reunion September 26–28, 1991, in Dayton, Ohio. **Contact:** Jesse E. McSwain, 1012 N. Larrimore St., Arlington, VA 22205-1413. Phone: (703) 533-1390.

20th Tactical Fighter Wing
Members of the 20th Tactical Fighter Wing will hold a reunion September 17–22, 1991, in Las Vegas, Nev. **Contacts:** Al Krisch or Diane Palmer, 3135 Palora Ave., Las Vegas, NV 89121. Phone: (702) 457-2797.

22d Bomb Wing
Members of the 22d Bomb Wing will hold a reunion September 21, 1991, at the Marriott West Hotel in Golden, Colo. **Contact:** Lloyd L. Hager, 7406 Hobble, San Antonio, TX 78227. Phone: (512) 673-3754.

Class 41-H
Members of Class 41-H (Luke Field, Ariz.) will hold their fiftieth-anniversary reunion October 30–November 1, 1991, at the Crown Sterling Suites Hotel in Phoenix, Ariz. **Contact:** Ray Tanner, 2143 W. Camelback Rd., Phoenix, AZ 85015.

Class 41-I
Veterans of the Army Air Corps Engineering Officers Class 41-I will hold a fiftieth-anniversary reunion September 18–21, 1991, at the Red Lion

Hotel in Colorado Springs, Colo. **Contact:** Clark Fisher, 6611 Outlook Dr., Mission, KS 66202. Phone: (913) 432-4685.

43d Bomb Group
Members of the 43d Bomb Group, which included the 63d, 64th, 65th, and 403d Bomb Squadrons, will hold a fiftieth-anniversary reunion October 21–27, 1991, in Norfolk, Va. **Contact:** Bob Richardson, 602 Air Park Rd., Ashland, VA 23005. Phone: (804) 746-7101.

Class 44-H
Class 44-H (Eagle Pass, Tex.) will hold a reunion October 11–12, 1991, at the Hilton Hotel in Salt Lake City, Utah. **Contact:** Ted Syms, P. O. Box 8417, Salt Lake City, UT 84108. Phone: (801) 582-7522.

Class 67-C
Members of UPT Class 67-C (Moody AFB, Ga.) will hold a reunion October 25–27, 1991, in Valdosta, Ga. Former instructors are also invited. **Contact:** Norman E. Ellard, 6401 Urschel Ct., Oklahoma City, OK 73132. Phone: (405) 721-2175.

86th Fighter-Bomber Wing
Members of the 86th Fighter-Bomber Wing who served any time in Germany since 1947 will hold a reunion September 25–29, 1991, in San Antonio, Tex. **Contact:** A. B. Nickels, P. O. Box 791431, San Antonio, TX 78279-1431.

96th Bomb Group
Members of the 96th Bomb Group will hold a reunion in conjunction with the 8th Air Force Historical Society September 17–22, 1991, in New Orleans, La. **Contact:** Thomas L. Thomas, 1607 E. Willow Ave., Wheaton, IL 60187. Phone: (708) 668-0215.

313th Fighter-Bomber Squadron
Veterans of the 313th Fighter-Bomber Squadron (World War II) will hold a reunion August 16–19, 1991, in St. Joseph, Mich. **Contact:** Chester Byrns, 298 Ridgeway, St. Joseph, MI 49085. Phone: (616) 983-2788.

330th Bomb Group
Members of the 330th Bomb Group will hold a reunion September 12–16, 1991, at the Holiday Inn in Norfolk, Va. **Contact:** Don Murray, 1101 Peck Rd., Richmond, VA 23235.

356th Fighter Group
Members of the 356th Fighter Group which included the 359th, 360th, and 361st Fighter Squadrons and the attached and support units will hold a reunion October 3–6, 1991, at the Holiday Inn in Norfolk, Va. **Contact:** Kenneth Male, 2988 Hillcrest Rd., Schenectady, NY 12309. Phone: (518) 783-0207.

405th Fighter Squadron
Veterans of the 405th Fighter Squadron, 371st Fighter Group (World War II), will hold a reunion October 24–28, 1991, at the Crystal City Marriott Hotel in Arlington, Va. **Contact:** L. P. Cellitti, 4017 W. 138th Terrace, Leawood, KS 66224. Phone: (913) 681-8024.

434th Troop Carrier Wing
Veterans of the 434th Troop Carrier Wing will hold a reunion September 13–15, 1991, at the Hampton Inn in Indianapolis, Ind. **Contacts:** Billie J. Gillespie, 5119 E. 20th Pl., Indianapolis, IN 46218. Phone: (317) 356-4442 or (317) 882-5665 (Joseph Thomas).

448th Bomb Group
The 448th Bomb Group will hold a reunion September 5–7, 1991, at the Holiday Inn Coliseum Hotel in Hampton, Va. **Contact:** Cater Lee, P. O. Box 850, Foley, AL 36536.

460th Bomb Group
Members of the 460th Bomb Group and the 55th Bomb Wing will hold a reunion September 16–19, 1991, at the Mirage Hotel in Las Vegas, Nev. **Contact:** Robert F. Cutler, 19135 US Hwy. 19 N., #A-16, Clearwater, FL 34624. Phone: (813) 536-1018.

482d Bomb Group
Veterans of the 482d Bomb Group (World War II), including the 36th, 812th, 813th, and 814th Bomb Squadrons and attached units, will hold a reunion September 17–22, 1991, in New Orleans, La. Please send a stamped, self-addressed envelope for additional information. **Contact:** Dennis R. Scanlan, Jr., Scanlan International, One Scanlan Plaza, St. Paul, MN 55107.

566th Air Service Squadron
Members of the 566th and 359th Air Service Squadrons will hold a reunion October 1–5, 1991, in Tampa, Fla. **Contact:** Jack Nobel, 4555 E. Hillsdale Ln., Inverness, FL 32652-9057. Phone: (904) 726-1082.

MATS Squadrons
For the purpose of planning a reunion, I would like to hear from members of the 1501st Air Terminal Squadron (Travis AFB, Calif.) and the 1502d Air Terminal Squadron (Hickam AFB, Hawaii) who served between 1955 and 1960. **Contact:** James G. Hampton, 3401 Lincoln Ave., Covington, KY 41015-1269.

Class 42-H
I would like to hear from members of Class 42-H (West Coast Training Center) who would be interested in holding a fiftieth-anniversary celebration next year. **Contacts:** John Martin, 2512 Ocean Pines, Berlin, MD 21811. Lt. Col. Allen T. Miller, USAF (Ret.), 539-B Keolu Dr., Kailua, HI 96734.

Class 42-I
I am planning a fiftieth-anniversary reunion for members of Aviation Cadet Class 42-I, to be held in October 1992, in San Antonio, Tex. **Contact:** John A. Giese, 314 Ridgehaven Pl., San Antonio, TX 78209. Phone: (512) 822-0250.

Class 51-F
I would like to hear from members of Class 51-F who would be interested in holding a fortieth-anniversary reunion September 1991. **Contact:** C. B. Robinson, 205 Ridgecrest Cir., Denton, TX 76205. Phone: (817) 382-6118.

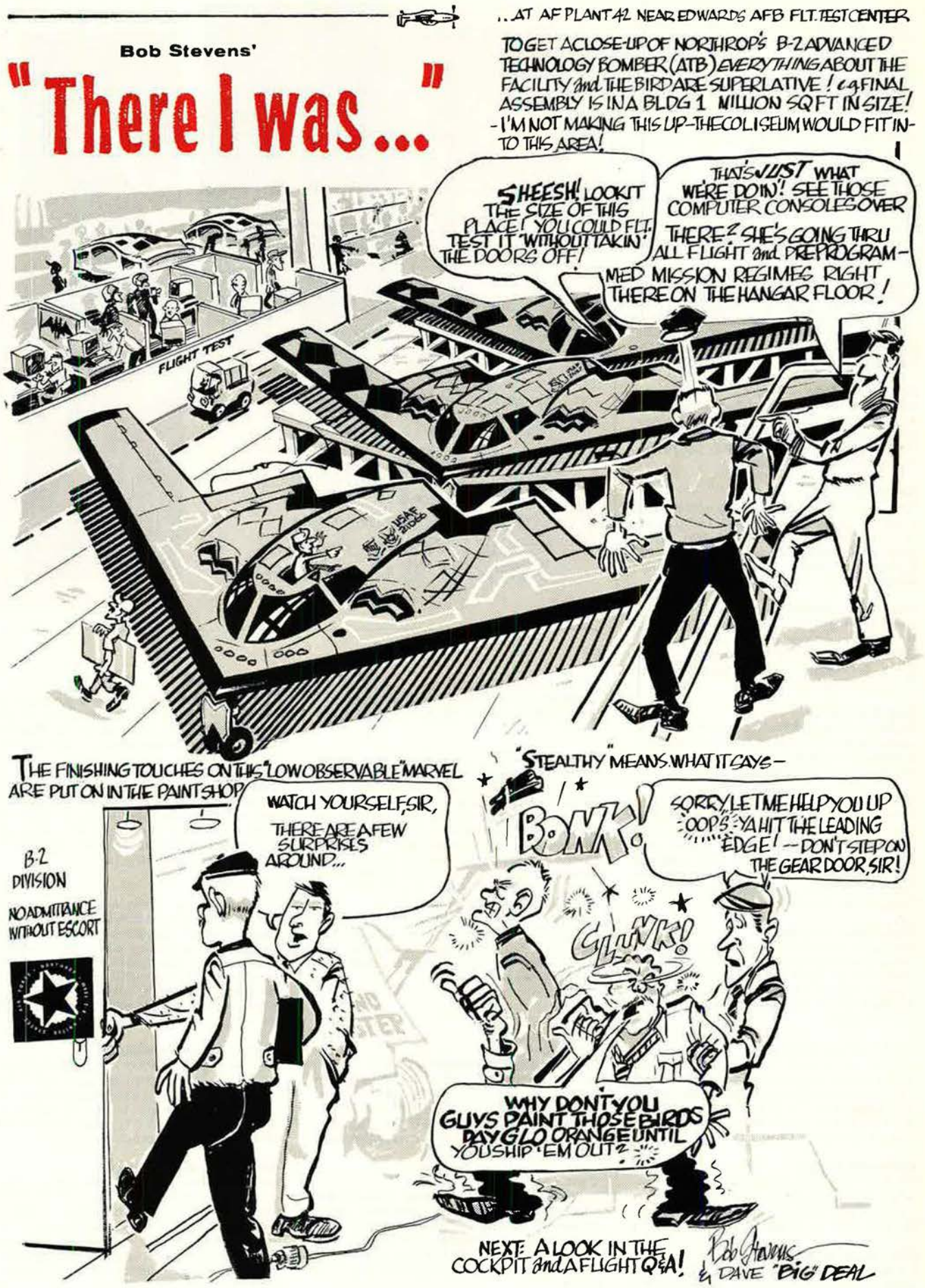
Class 65-G
We would like to hear from members, instructors, and friends of Class 65-G of the 3641st Pilot Training Squadron (Laredo AFB, Tex.) who would be interested in holding a reunion. **Contacts:** Col. Bernard L. Talley, USAF (Ret.), 7009 Wester Way, Dallas, TX 75248-1544. Phone: (214) 931-6911. Bob Casey, 3935 Clares Ct., Fairfax, VA 22033. Phone: (703) 591-2079 or (800) 336-0136, ext. 7123.

279th Ordnance Maintenance
I am seeking members of the 279th Ordnance Maintenance (AA) Company (World War II) for the purpose of holding a fiftieth-anniversary reunion in 1992. **Contact:** Virgil A. Bodenhamer, 19830 Weybridge, Apt. 101, Mount Clemens, MI 48043. Phone: (313) 463-2397.

405th Fighter-Bomber Group
For the purpose of planning a reunion in 1992, I would like to hear from members of the 405th Fighter-Bomber Group, including the 509th, 510th, and 511th Fighter-Bomber Squadrons assigned to Langley AFB, Va., between 1952 and 1958. **Contact:** Roger Warren, 7550 Palmer Rd., Reynoldsburg, OH 43068. Phone: (614) 866-7756. ■

Bob Stevens'

"There I was..."



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