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AIR FORCE MAGAZINE

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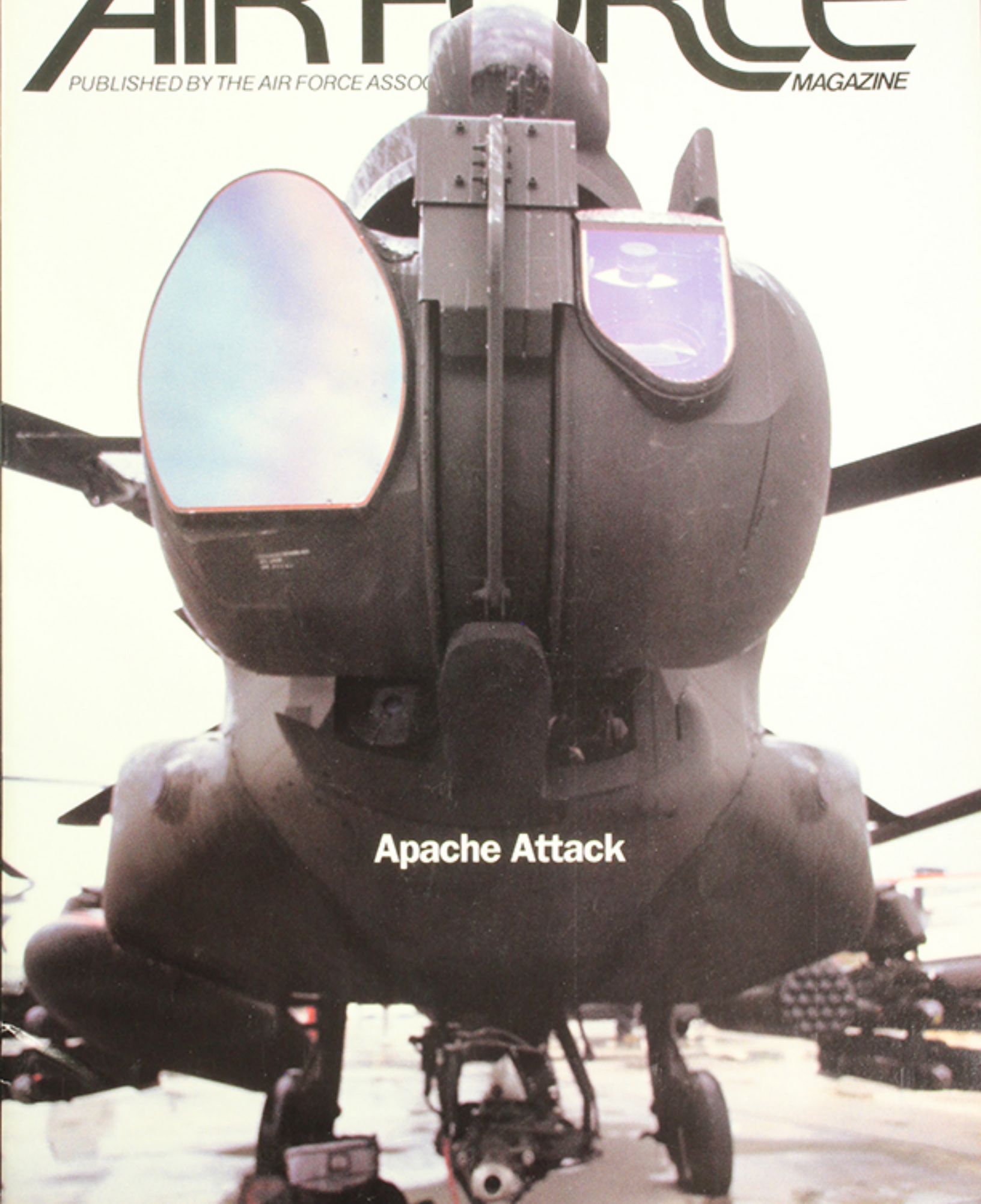
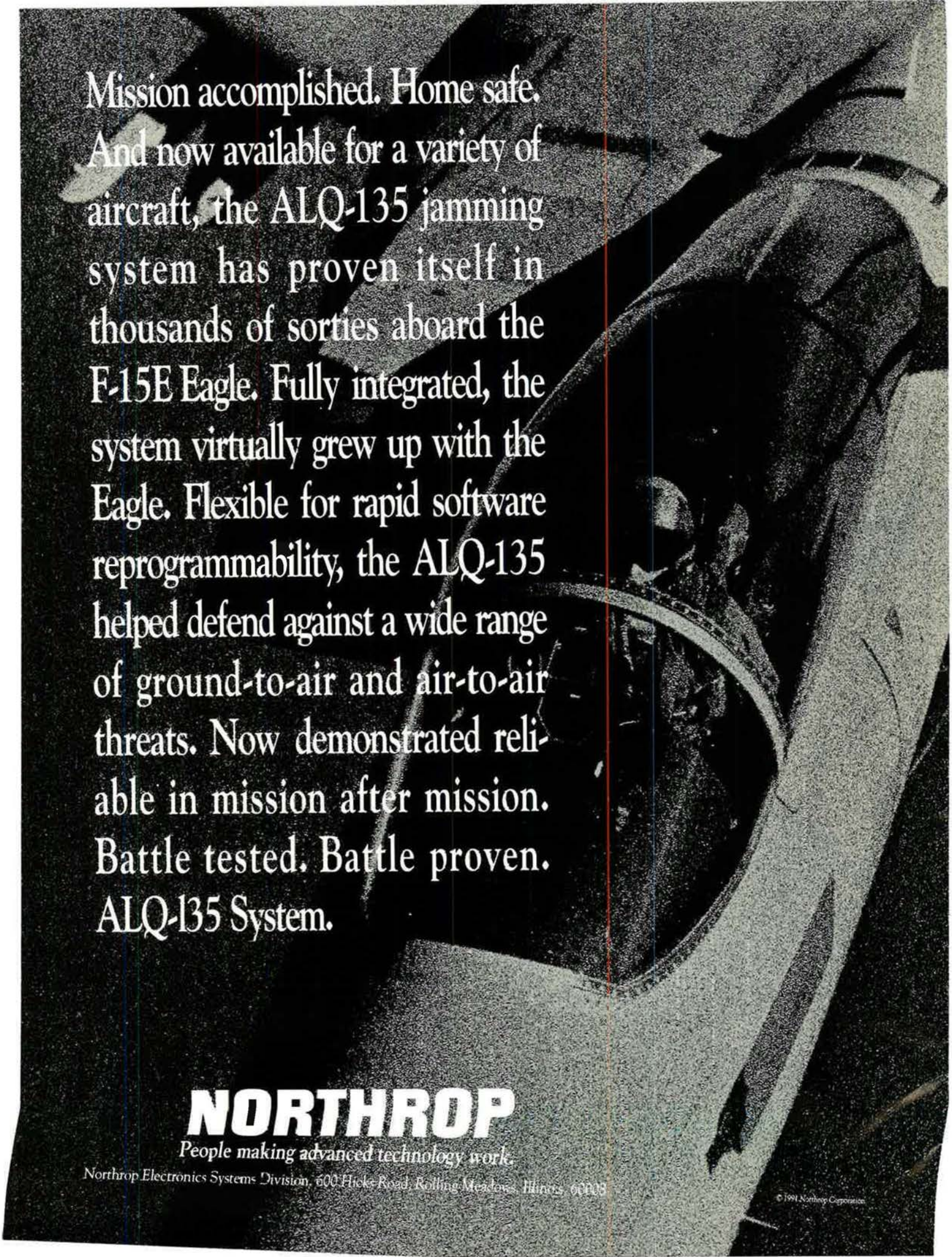


Apache Attack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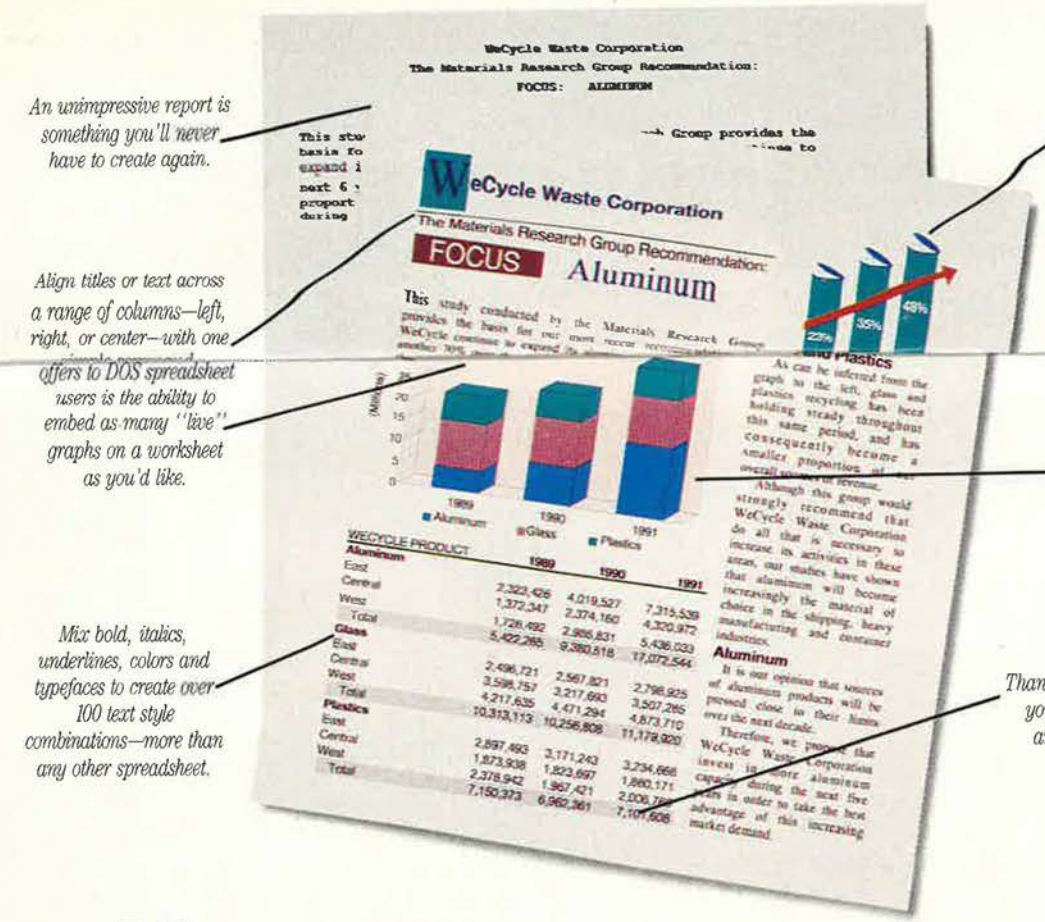

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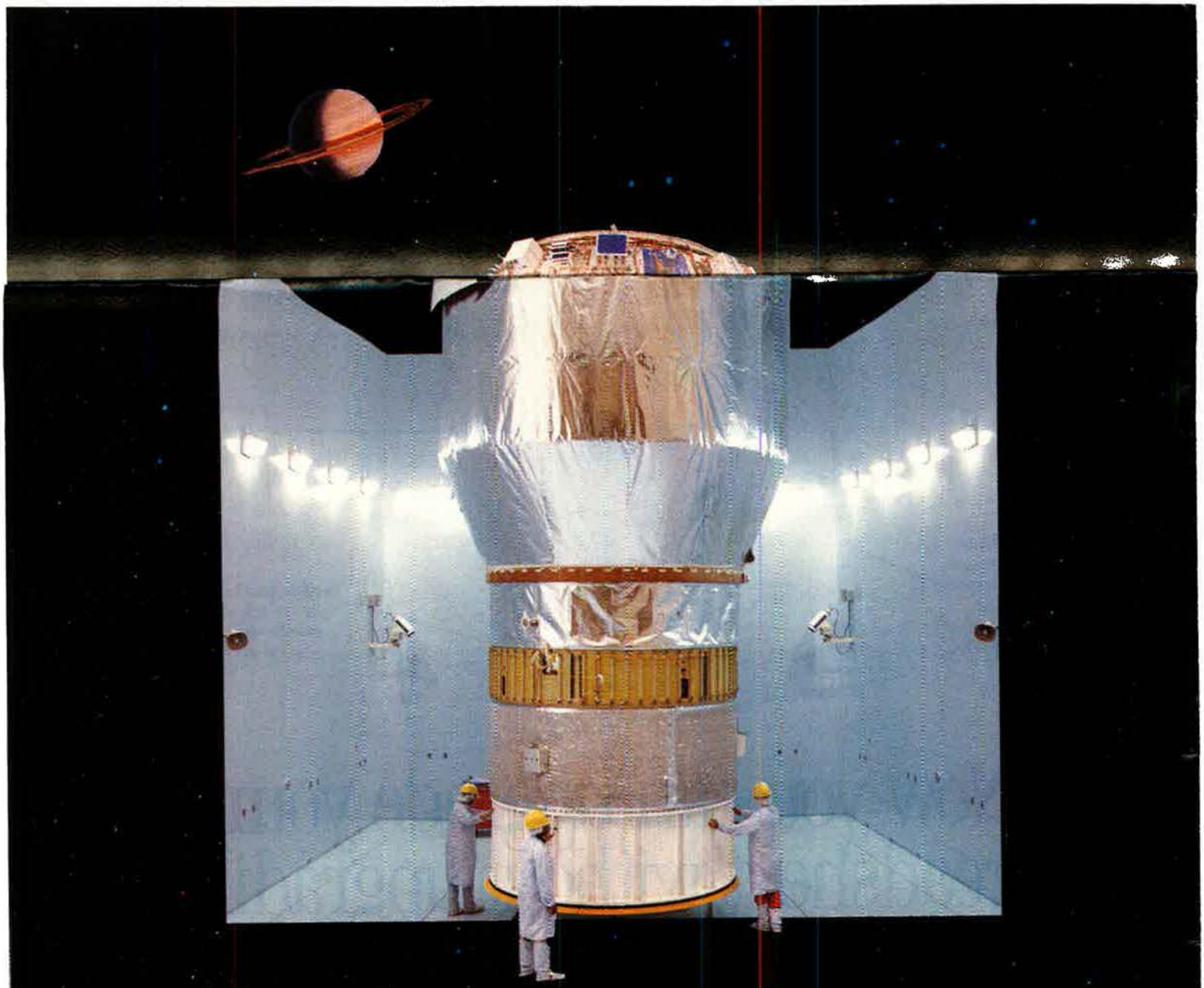

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GENERAL DYNAMICS

October 1991, Vol. 74, No. 10

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

The Value of Airpower

About the cover: Target acquisition sights and night-vision sensors bulge on this AH-64 Apache helicopter, contributing to its insect-like appearance. These are the electronic eyes that let the Apaches "own the night" as they opened Operation Desert Storm. For more on the Apaches' opening attack, see p. 54. Photo by Paul Kennedy.

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Editorial

By John T. Correll, Editor in Chief

Revolution in Progress

AUGUST 21 was a grand day for the Soviet Union and the world. The revolt of the reactionaries foundered on the streets of Moscow. When it failed, the whole rotten structure it sought to restore came tumbling down.

On September 5, the monolithic Communist state voted itself out of existence as soon as power can be transferred to the republics. The Soviet people are ridding themselves of a regime that was both tyrannical and inefficient.

The news is so good that there is a danger of overreacting to it. The new Union of Sovereign States is in political and economic chaos. Russian President Boris Yeltsin and former Soviet Foreign Minister Eduard Shevardnadze warn that the hard-liners may strike again if the economic crisis continues.

The excitement of throwing out the bad guys is over. Now the Soviets must turn to the grubby, difficult business of everyday affairs. The fuze on the reform movement was lit by economic problems. They are still there, and they have probably gotten worse while attention was diverted by the coup and the countercoup.

The Union-to-be is described as a federation, but it is emerging more along the lines of a confederation, a notoriously weak form of government. In the absence of strong central authority, it would take extraordinary cooperation among the republics to make a dent in the Union's worst problems, most of which transcend local or regional solutions.

Among other early tasks for the Union will be the mediation of border disputes and heading off policies that individual republics are inclined to pursue in a show of autonomy but that would further disrupt the interdependent economy.

The smaller republics are wary of domination by the Russian Republic, which has half the population, three-quarters of the territory, and seventy percent of the GNP. Mr. Yeltsin is trying to damp down these fears, but there is no way the Russian Republic can avoid being first among equals and probably a great deal more than that. It will be a very large nation, with substantially more people than Germany and Britain put together.

The old Soviet institutions are disappearing, but their replacements are not yet apparent. The Communist Party, for example, has been banished, or at least driven underground. Some political party, perhaps several of them, will rise eventually. We can only speculate about the doctrines they will espouse.

The Soviets themselves do not know exactly where all this will lead.

There are more questions than answers about the disposition of the Soviet armed forces. Nuclear weapons will be held as a collective asset and based, apparently, in the Russian Republic. Some central control of the air force and navy seems likely also. It is not yet clear how many of the four million Soviet troops will be disbanded or how the remaining units and equipment will be divided up by the federal force and the republics.

The armed forces will be a considerable factor in how events play out in the Union of Sovereign States. Bungled as it was, the August coup might have turned out differently with backing by the military.

The Soviets have asked the international community for aid. The West will probably provide food and perhaps much more. Congressional Democrats were quick to propose that the US contribution come out of the defense budget.

President Bush said that such measures were premature, but in a one-liner he threw out August 30 he cited the possibility of a "vastly restructured" US defense posture, depending on how things go in the Soviet Union. That is a questionable call.

US defense strategy, as revised in 1990, is geared primarily to regional crises and emerging threats. It assumes that the Soviets would make major force reductions and would need years to regenerate capability for a global threat.

In Europe, for example, US deployments are projected to diminish to three air wings, two army divisions, and a maritime presence in the Mediterranean. There and elsewhere, the options for vast restructuring will be limited.

As for the Soviets, they are fully occupied at home for the moment and are thus comparatively passive in international affairs. In time, they will probably show a more assertive face to the world. That does not necessarily mean a return to the aggressive foreign policy of the old regime, but we should be careful about assumptions.

Americans might remember their reactions when they awoke the morning of August 19 to the stunning news that the hard-liners had ousted Mr. Gorbachev. It was a reminder that our national security outlook can change overnight as the result of events halfway around the world.

What the Soviets have going is nothing less than a revolution, but it is still in progress. They do not know exactly themselves what comes next, much less where all this will lead. ■

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Letters

Debating McPeak's Plan

"One Base, One Wing, One Boss" *[see "Washington Watch," August 1991 issue, p. 17]*, which discussed Gen. Merrill McPeak's sweeping reorganization of the Air Force, pointed out several elements of the emerging scheme that are very attractive.

The plan is said to be based on the primacy of combat capability. Everyone who understands the service's reason for being supports that priority. It also puts support services under the control of the user. Most operators have longed for this. At the squadron level, the new Air Force will strongly resemble the Air Force of thirty years ago: Flying squadron commanders will "own" their airplanes and their maintenance personnel. These actions and others that realign functions and responsibilities appear very desirable on their face, creating a leaner, more responsive instrument of airpower with tighter lines of authority.

On the other hand, a detailed reading of the article reveals potential problems, with goals of one policy seeming to conflict with those of another. In the absence of any "stiff resistance" within the active service, perhaps it falls on the retired to point out potholes in the road to success. Since the Chief of Staff's own associates indicate that "he will not ease up in his efforts to reorganize," a lively internal debate on the merits of his plan may have been preempted.

According to the article, the stated goals of the reorganization initiatives are to streamline management, stimulate leadership, strengthen operations, and save money. It is difficult to determine how the composite wing idea can successfully contribute to all of those diverse goals.

First, the matter of cost merits examination. When TAC squadron commanders lost their maintenance personnel in the late 1960s, the rationale behind that reorganization was also cost reduction, in terms of both manpower and materiel. It was argued (and, by most accounts, proven) that functional support squadrons could provide maintenance and supply to several operational squadrons using less manpower and overhead. A price was paid in responsiveness and accountability, but, as advertised, it took fewer bodies to get the job done.

It is, therefore, difficult to understand how the composite wing of the 1990s, with several diverse types of aircraft, can prove to be anything but labor- and logistics-intensive. Those two factors translate into increased cost. The nagging concern is that widespread adoption of the inevitably expensive composite wing model in tomorrow's shrinking Air Force will lead to an even smaller total number of flying wings. The question then becomes how many composite wings are equal in combat capability to a greater number of current wings. I would not hazard a guess, but I would hope that the Air Force will have found the answer before fully embracing composite wings.

Second, the stimulation of leadership may or may not occur in the postulated environment of the mid-1990s. It will depend on the rank and job of the officer concerned. In this regard, there must be concern among officers in all of the support career fields. Even those in operations should give the proposed reorganization sober thought. Certainly the operational squadron commander will serve in a leadership nirvana. With responsibility for two dozen jets, thirty to sixty crew members, and hundreds of enlisted maintenance personnel, that lieutenant colonel will have an overflowing plate. As in the 1960s (at least in TAC and PACAF), command of an operational squadron will be a true test of leadership.

But what will happen at the rank of colonel? How will Air Force leaders pick the O-6s to be promoted to brigadier? During the last forty years, one pass-fail test of a colonel's leadership has been better than any other: command of an operational wing. I am among the recalcitrants who have decried even the partial dilution of that test. In recent years, the "Wing King" O-6 has become an endangered species as general officer billets have appeared at more and more Air Force bases. The result, in my view, has been that a colonel who wants to be a general is often under daily *de facto* supervision by a single general or group of generals who will have a large voice in his or her future. The exercise of initiative and decisive, innovative leadership is often stifled under those circumstances.

Mr. Canan's article suggests that O-6s will be selected for promotion from "important staff jobs" on various "joint and headquarters staffs" opened to colonels by giving wing command billets to generals. The five to seven years that will have passed between the worthy test of operational leadership as a squadron commander and the meeting with an O-7 promotion board should be viewed with alarm. Those years may not have included any real test of leadership (as opposed to staff savvy or Pentagon political skill). In such cases, the next significant test will not occur until after promotion to flag rank.

I fully agree with General McPeak's assertion that the Air Force must change to meet the current and projected circumstances it faces. While "the Air Force has no choice but to change," it seems to have many, many choices with regard to how it will change. The problems I predict may not occur, but many other unforeseen difficulties will probably be revealed.

In the absence of a healthy internal debate and the use of prudent trial periods where appropriate, the Air Force, at General McPeak's retirement in late 1994, will indeed be different, but it may not necessarily be "more competent and reliable" than the one he inherited in 1991. . . .

Col. Robert E. Venkus,
USAF (Ret.)
Ellicott City, Md.

It's nice to see that under General McPeak's reorganization the Air Force is no longer going to be the "blank check service." For too long, under the guidelines laid down by Gen. Curtis E. LeMay, the Air Force has been operated using old "One Type Mission Aircraft." The Navy has never had an entire wing composed of just one aircraft type.

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Letters

I am a quad-service vet. I have seen and worked around all types of operations in aviation in the Air Force, Army, Navy, and Marine Corps. By far, the Navy and Marines have the Air Force beat on flying hours and economic management.

General McPeak is only doing what has needed to be done for years. This is the decade that will eventually humble this spendthrift nation. The Air Force is no exception. The Navy and Marines have always operated under the composite wing concept. It's more economical and makes more sense when responding to an emergency. The Air Force is finally coming to terms with the economic reality that the Navy has been facing for decades. Even in the 1930s, the Navy operated carrier air wings with a mixed bag of aircraft. I only hope that the Air Force will in the future take a good look at Naval air ground personnel. I think it will find each "airedale" can perform three times the amount of specialties that his Air Force counterpart can. It makes sense to train people to perform more than one job.

I did not write this to bring out old interservice rivalries. They belong on the football field. I wish to point out that if the Air Force pursues the composite wing concept, it may find that the Navy's way of doing things isn't so bad after all. The Air Force has usually had to play catch-up with the Navy. For example, in Vietnam, the Navy flew fifty-eight percent of all the missions against the North. Its pilots were trained to be aggressive. Col. Jack Broughton brought this out in *Thud Ridge*. Fighter pilots were sent from the *Intrepid* in 1969 to an Air Force base in Thailand to teach Air Force jocks how to fly combat so they wouldn't get creamed flying the outdated finger-four formations.

I hope General McPeak's reorganization will bring the Air Force on line as a more effective fighting force. Not that it isn't already effective, as the last war showed. Perhaps this reorganization will help the Air Force become a more economical, more rational organization. I realize that this letter will produce plenty of clenched teeth and rebuttals. The fact remains that, for now, the Navy does it better. It's time for the Air Force to catch up.

Maj. Barry E. Sullins,
AFRES
Lakewood, Colo.

I can't resist a comment or two on "One Base, One Wing, One Boss." My main observation is, "What goes around, comes around, and, sooner or later, everything old is new again." As I remember my service from 1934 to 1967, I recall that the things the Chief of Staff is espousing generally existed then—particularly in the early years.

The main thing the Air Force leaders have forgotten in the reorganization plan are the reams and reams of regulations. These are the silent partners of every commander, by his side at all times, directing his every action. They also stand as a silent impediment to the commander's more effective use of resources and ingenuity.

The article also talked about "stove pipes" being out of fashion. How about the pay system? The services do not even pay their own troops anymore. A faceless civilian bureaucracy now does it. As a commander in 1940, I would go to the bank, get the dollars, and pay each soldier individually each month. These troops knew who their commander was.

L. C. Hess
Missouri City, Tex.

"One Base, One Wing, One Boss" seems like a very plausible plan, but how long can one of these "air wings" fight without medical support? There was no mention of the medical squadron at all. Logic would dictate that a medical group would be assigned to one of these wings supporting an Air Transportable Hospital.

I am sure this was just an oversight, but we've grown accustomed to being unrecognized until our services are needed.

1st Lt. Robert H. Cothron,
USAF
England AFB, La.

Important Ground-Pounders

The August editorial *[see "Let's Hear it for the Loggies," p. 7]* was a joy to read. It's about time somebody recognized the supply personnel and how important they are to any operation, whether it is peacetime or in combat. Ground-pounders have always taken the backseat when accolades were handed out. The flyboys always got the glory. Thank you for remembering some of the other very important people that made Desert Storm the success it turned out to be. I spent thirty-plus years in the supply career field, so I know firsthand how little attention was paid to this field—until somebody wanted something in a hurry that they had forgotten to order on time.

Col. Edwin L. Atkins,
USAF (Ret.)
Shalimar, Fla.

Secondary to None

With regard to Robert G. H. Carroll III's letter *[see August 1991 issue, p. 10]*, we find his response biased, and rightfully so, since he is a Pratt & Whitney employee. However, as General Electric Aircraft Engines employees, we are equally proud of our company and its accomplishments.

In truth, there is no "secondary source" for current USAF F-16 powerplants, given the fifty-fifty split of recent annual USAF Alternate Fighter Engine purchases.

One could certainly question Mr. Carroll's logic if he considers the F100-PW-229 "the preferred engine." Given the preference for the F110-GE-129 in head-to-head international competitions for F-16 powerplants, it would seem the data support the F110-GE-129 as the preferred engine. In addition, the F110-GE-129 is currently flying a very successful field service evaluation at an active TAC base, thus demonstrating its readiness to build on the excellent operational and combat base established by the F110-GE-100 engine.

The Air Force can be proud of the role it has played in the advancements made by both companies (and both engines) in fighter engine performance, reliability, maintainability, and supportability.

W. T. Whitfield
M. W. Buell
General Electric
Hamilton, Ohio

Applauding the Tankers

To Lt. Dennis J. Smith, who wrote to praise the KC-135s and their crews *[see August 1991, "Letters," p. 12]*, I say, "Hear, hear!" on behalf of the tanker crews who so ably supported us in Vietnam and, I am sure, did an equally commendable job in Desert Storm.

Lieutenant Smith rightly voiced concern about the lack of recognition afforded the men and women involved in the aerial refueling effort during Desert Storm.

I can attest to the bravery and mission orientation of our tanker crews. Having flown more than 250 missions in southeast Asia, most of them over the North, I know that many, if not most, of our missions would not have been flown were it not for our tankers. What's more, I know from personal experience that many of our fighters would not have made it home and the Hanoi Hilton would have had more long-term residents had it not been for the tanker crews who "stretched" to give us critically needed fuel.

I only wish there was some way to personally recognize each of the heroes who got us home so often to fly and fight another day.

Lt. Col. Ron Gawlitta,
USAF (Ret.)
Phoenix, Ariz.

The A-2's Comeback

I believe the caption on p. 78 *[see "The Sartorial Splendor of the Air Force That Was," June 1991 issue]* is in error. The A-2 jacket was introduced to the 380th BMW at Plattsburgh, AFB, N. Y., in 1987, if I remember correctly. I believe the photo of Lieutenant Colonel Plantikow was taken in 1987 or 1988 (not 1981) after his 5,000th hour in an FB-111.

Lyle A. Belleque
Ankara, Turkey

Honoring Eareckson

John Frisbee's "Eareckson of the Aleutians" *[see June 1991 issue, p. 86]* was both interesting and timely—interesting because I was one of "his boys" and timely because the latest issue of 11th Air Force Association's newsletter suggests that "we undertake a worthy crusade to rectify the failure of our government to recognize the contribution that Colonel Eareckson made to the Aleutian war effort."

The newsletter article suggests that we submit a proposal to Congress for a posthumous promotion and Medal of Honor for this officer. To which I add a hearty "Amen!" Under his guidance and protection, many of the boys of the 1930s became men overnight.

He seldom sent us when he could take us, and if he sent us he was concerned until we returned. He felt the loss of every crew deeply, especially when the loss occurred because of inadequate instrument flying aids, such as when one crew on the downwind leg at Umnak was suddenly shut out by fog and never heard from again. We didn't even have a control tower at the time.

I take pride and pleasure in the fact that I was on the crew that finally found the Japanese Navy in Kiska harbor and, as radio operator, encoded the message we flashed back to him ending the frustrating search for them.

Let's hope more of the 11th Air Force vets will check in and help bring about the honor and recognition Colonel Eareckson deserved.

Maj. Lester A. Smith,
USAF (Ret.)
Canyon, Tex.

Full Circle

I read "Curtain Up on Materiel Command" *[see August issue, p. 66]* with keen interest, since I was in the procurement field from 1951 to 1964.

Have we gone full circle by merging AFSC and AFLC? I was assigned to the B-52 Weapon System Project Office (WSPO, later SPO, and later PO) on the Air Materiel Command (AMC) side from 1953 to 1957. As I recall, Air Research and Development Command (ARDC) was formed to elevate the technical (engineering) function, and its command had executive responsibility for the system until the first production unit rolled off the line. At that time the AMC representative took over executive responsibility.

In those days, AMC was responsible for centralized procurement (including systems), but it decentralized logistics procurement to the Air Materiel Areas starting in about 1952. After my departure, there was a decision to give ARDC the procurement responsibility for systems, and thus AFSC was born. Did the Packard Commission suggest someone screwed up?

Are we trying to reinvent the wheel? Having spent my last two active-duty years in the B-52 PO, I have an appreciation for the tremendous amount of coordination and paperwork generated in such a program. As for Maj. Gen. Kenneth V. Meyer's concerns about Program Executive Officers' moving out of Washington, we had a full colonel in the Pentagon with whom we dealt and who attended all phasing group meetings.

As for "tampering with trained people," I was designated a procurement and production staff officer by AMC and, at the end of my twenty years, a procurement officer by AFSC heading a research and development procurement operation when the Air Force decided we should fall under the director of materiel! Since I was unable to support a flawed cost-reduction program, I opted for early retirement.

To those involved with recreating the old Air Materiel Command, I wish the best.

Lt. Col. Wendell D. Bundy,
USAF (Ret.)
Everett, Wash.

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

The Chart Page

Edited by Colleen A. Nash, Associate Editor

Foreign Holdings in US Technology

	Japan	UK	France	Netherlands	Canada	Switzerland	Taiwan	South Korea	Australia
Advanced materials	28	5	2	1	0	0	1	C	1
Aerospace	11	5	3	0	1	0	0	C	0
Chemical	12	4	6	1	3	1	0	C	0
Computers	63	11	2	1	3	1	12	3	1
Electronics	20	7	1	0	0	0	0	1	1
Semiconductor equipment	27	0	1	0	0	2	0	C	1
Semiconductors	41	1	1	0	[illegible]	0	1	C	0
Telecommunications	23	9	3	0	2	1	1	C	2

Since 1988, more than 500 foreign takeovers and investments in US firms have been reported to the Committee on Foreign Investment in the United States (CFIUS), which is charged with checking these actions for national security impact. CFIUS has blocked only one such investment. In many instances, the foreign penetration has been in high-technology sectors.

Source: Economic Strategy Institute.

US vs. Japan

Where the US Stands in Comparison to Japan on Emerging Technolcgies

Key: ↑ Ahead ↔ Even ↓ Behind

Technology	R&D Current	R&D Future	Product Information Current	Product Information Future
Advanced materials	↔	Losing	↓	Losing
Advanced semiconductor devices	↔	Holding	↓	Losing
Artificial intelligence	↑	Holding	↑	Holding
Biotechnology	↑	Losing	↑	Losing
Digital imaging technology	↔	Losing	↓	Losing
Computer-integrated manufacturing	↑	Holding	↔	Holding
High-density data storage	↔	Holding	↓	Losing
High-performance computing	↑	Holding	↑	Losing
Optoelectronics	↔	Holding	↓	Losing
Sensor technology	↑	Losing	↔	Holding
Superconductors	↔	Losing	↔	Losing

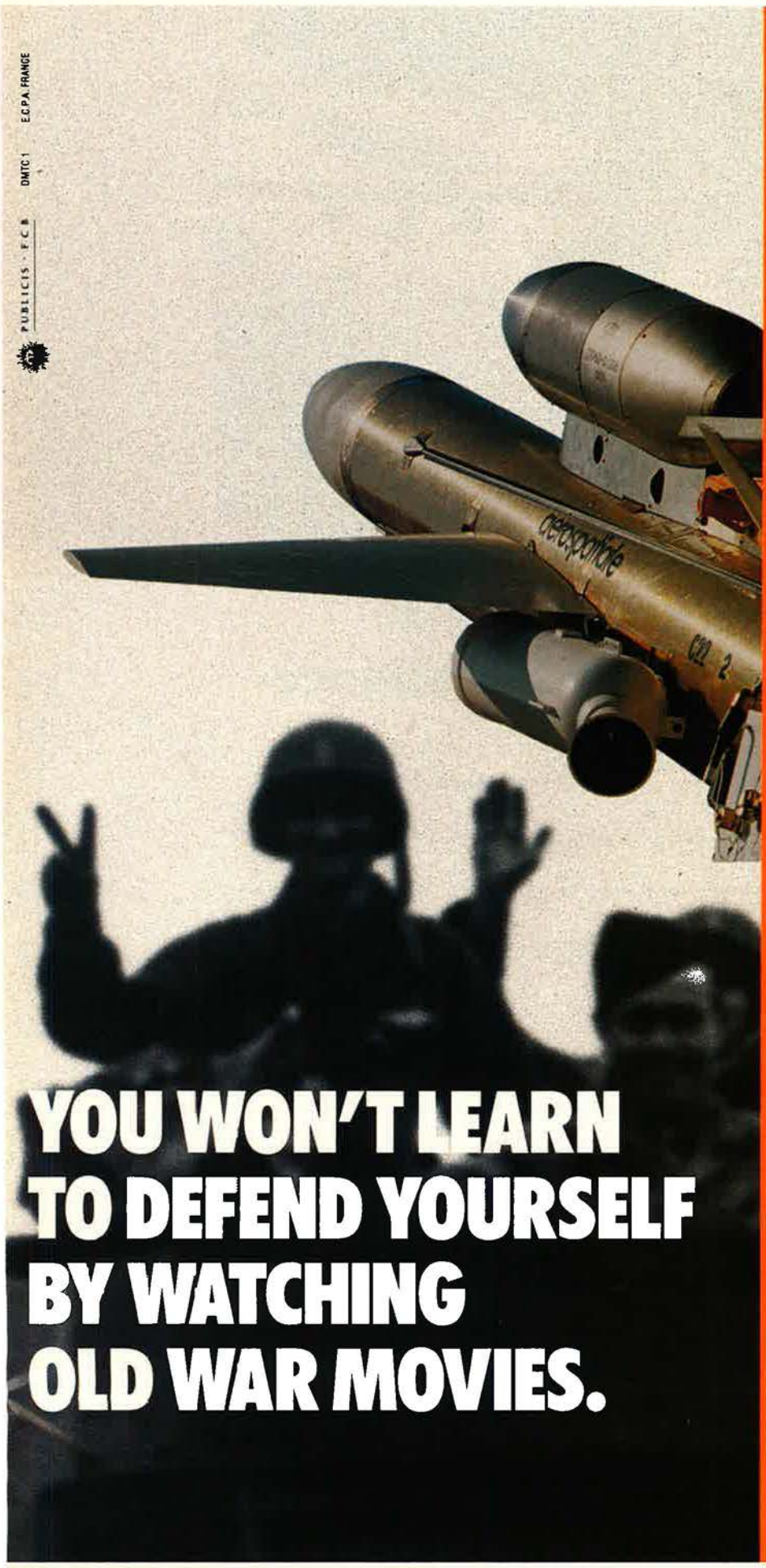
Related to the problem of increased reliance on foreign sources is the steady deterioration of US leadership in military technologies. For more on the defense industrial base, see "Declining, Diversifying, and Disappearing" and "Lifelines Abroad" in this issue.

Source: Department of Commerce.

Problems in Key Sectors

Bearings	Foreign dependence
Electronics	Foreign dependence
Fasteners	Foreign dependence
Forgings	Lack of productivity
Machine tools	Foreign dependence
Optics	Foreign dependence
Titanium	Tight capacity and foreign dependence

US armed forces are nervous about their increasing reliance on foreign sources. Of the problems identified in key sectors by Air Force Systems Command in its July 1990 report,* AFSC Industrial Base Assessment, *the dominant factor was foreign dependence.



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Washington Watch

By James W. Canan, Senior Editor

No More SAC, TAC, and MAC

Forty years ago, the Air Force saw its missions as separate and organized accordingly. The question has come up again, but this time the answer may be different.

A big issue that bedeviled the Air Force at birth has risen again forty-four years later amid moves to restructure the service. Should USAF and its missions be subdivided along strategic and tactical lines?

To the general public, the issue may seem academic. In the Air Force and in the defense community at large, it is anything but. It touches on nearly everything that the Air Force is and does, and it strikes the same raw nerves that it did in 1947.

At that time, USAF answered the question in the affirmative and, as a result, created Strategic Air Command and Tactical Air Command as bedrock major commands. SAC and TAC have held sway over missions and operations ever since and have come to seem indestructible.

They may not be. The question is before USAF again, and the answer may well be different this time around.

It now seems likely that the Air Force, intent on reorganizing to apply airpower with maximum effect in a changing world, will categorize its missions as nuclear and conventional instead of strategic and tactical and will replace or revamp SAC and TAC with the new missions in mind.

[As this column went to press, the Air Force was expected to announce plans to dissolve Strategic Air Command, Tactical Air Command, and Military Airlift Command and combine their missions and assets in two new commands: Air Combat Command (ACC) and Air Mobility Command (AMC). As conceived, ACC would embody all fighters, all bombers, all ICBMs, all reconnaissance aircraft, some tankers, some tactical airlift, and all command, control, communications, and intelligence (C³I) aircraft. AMC would enfold all strategic airlift, most tactical airlift, some tankers, and all rescue and aeromedical evacuation aircraft and operations.]

Ideas in this vein are percolating in Air Force leadership circles. They spring from the notion that longtime distinctions between strategic and tactical forces and operations have become anachronistic and artificial in the new heyday of globe-girdling, multipurpose US airpower *[see p. 26]*. They also appear to be compatible with reorganization proposals, some quite bold, that Air Force Chief of Staff Gen. Merrill A. McPeak and/or Air Force Secretary Donald B. Rice have already put into play.

It has been evident for some time that the case against strategic/tactical terminology and subdivisions has caught on in four-star country. General McPeak said as much early this year at an Air Force Association symposium in Florida.

"The difference between strategic and tactical has become very fuzzy, and the problem is that this gets in our way when we start thinking about how to employ airpower," the Chief of Staff declared.

Gen. John M. "Mike" Loh, commander of Tactical Air Command, struck the same theme not long ago at a session with defense writers in Washington. "There are strategic sets of targets and strategic levels of warfare, and there are tactical sets of targets and tactical levels of warfare," said General Loh, "but when you use 'strategic' or 'tactical' to distinguish between missions or between aircraft types, it's improper."

He noted, for example, that F-15Es categorized as tactical aircraft struck strategic targets during the war against Iraq while B-52s stereotyped as strategic aircraft were used to bomb tactical targets, such as Iraqi Republican Guard positions, in the Kuwait theater of operations.

B-52s bombed tactical targets during the Vietnam War too, and the Air Force sent F-105s and other so-called tactical aircraft against strategic targets around Hanoi.

"So the distinction between tactical and strategic has become very blurred, and we need to keep that in mind as we look at the whole range of how we organize the Air Force," General Loh declared.

The Air Force's reorganization plan resulting from that examination is partly out in public and should become obvious in all its dimensions very soon. The plan's initial phase is already being implemented along lines proposed by Secretary Rice or General McPeak.

Central to the plan are big changes in the composition and command structures of air wings, keystones of USAF's combat capability. New "composite wings" combining different kinds of airplanes for a wide variety of missions—strategic and/or tactical as traditionally defined—are central to General McPeak's initial proposals for remodeling the Air Force.

One such wing, called an "air intervention wing," is being formed at Mountain Home AFB, Idaho. It will be commanded by a brigadier general and will combine air combat and attack fighters, tankers, reconnaissance aircraft, AWACS planes and B-52 bombers, and perhaps, in due course, other types of planes.

The B-52s will be organic to the wing even though they will continue to operate from a SAC base after the wing is formed. The problem with basing them at Mountain Home right off is budgetary and has nothing to do with any intransigence on SAC's part about giving them up, Air Force officials maintain. The bombers will need special facilities at Mountain Home, and the Air Force has yet to come up with enough military construction money to build them.

USAF's "new look at airpower" showed that strategic and tactical considerations are often one and the same and "is the reason why we'll have fighters and bombers in this composite wing," said General Loh.

The TAC Commander was asked whether the Air Force's new emphasis

on intermingling strategic and tactical aircraft and missions in discrete units foreshadows the end of SAC and TAC as major commands. "We don't have anything specific in mind right now," he replied. "We're still in the investigative stage, looking at the whole range of how we're organized, at the entire command structure of the Air Force."

General McPeak's remarks at the AFA symposium early this year provided historical perspective on the question. The Chief of Staff recalled that "there was a big controversy after the Air Force was formed in the late 1940s about whether we ought to have a Tactical Air Command and a Strategic Air Command and other subdivisions categorizing airpower." Some Air Force leaders "were bitterly against any breakdown of that kind," he said. "Their argument was that we had spent years trying to convince the Army that airpower was an indivisible entity and that the minute we got it to ourselves, we wanted to start dividing it up again into little compartments."

He continued, "It seems to me it was right that we did [subdivide the Air Force] at the time. In the beginning, it was a rather straightforward proposition because Strategic Air Command supported the long-range nuclear deterrent and Tactical Air Command supported the airpower needs of the theater commander.

"Those distinctions have gotten fuzzier over the years. It is no longer the case that one [command] is nuclear and the other conventional. Tactical forces have been nuclear-capable for many years. SAC has not only conventional capabilities but also some aircraft that are dedicated to the conventional role and [that] no longer have a connection with the SIOP [Single Integrated Operational Plan]."

General McPeak also made the point that differences in range and payload once signified whether a plane was strategic or tactical but mean nothing nowadays. He noted that an F-15E can carry a bigger payload a greater distance without refueling than World War II strategic bombers could and that aerial refueling enabled eighteen squadrons of Air Force air-to-air and ground-attack fighters to fly nonstop from the US to the Gulf region just as expeditiously as did B-52 strategic bombers.

The number of engines on a plane marked it as strategic or tactical in bygone days but not now. General McPeak observed that "anything with two engines or less" was once considered tactical but that this has not been the case for some time. SAC flies twin-engine and single-engine reconnaissance planes, and TAC flies four-engine radar-picket and command-post planes, he reminded his audience.

Strategic and tactical have become "relative concepts" in describing warfare. "One man's strategic is another man's tactical," he said. "For us, invading Panama was tactical. For Noriega, it was strategic."

The Chief of Staff asserted, "So I don't know what the division is between tactical and strategic. It seems to me the distinctions never made much sense and are less relevant today."

He claimed that rapid-deployment, mixed-aircraft wings make sense for USAF at a time of "two trends that I can identify: the merging of strategic and tactical missions [and] the move from a garrison Air Force with a garrison mentality to an expeditionary Air Force with an expeditionary mentality—one that moves quickly from a CONUS location to a forward position ready to fight."

The Chief of Staff was asked at the AFA symposium whether reorganizing the Air Force around nuclear and conventional missions and commands might coincide with a unification of Air Force and Navy nuclear operations.

"Yes," he replied. He elaborated that such a joint-service arrangement could result from the Joint Chiefs of Staff's reexamination of the Unified Command Plan, "the document that specifies how the command and control arrangements work for joint activities of all kinds, including the nuclear deterrent force."

He emphasized that all this would have no bearing on the Air Force's plans for nonnuclear B-52s. Those bombers, he said, "are more like tactical assets, if we could only break our mental block about tactical and strategic, and it's conceivable that, at some point, they would move over and become part of Tactical Air Command or some other successor command with a different name."

Indications of major structural changes in store throughout US military commands, including those of the Air Force, surfaced in the months following General McPeak's symposium remarks. Four new unified US commands seemed likely: Strategic Command, Atlantic Command, Pacific Command, and Contingency Command. The joint strategic command (probably to be known as "STRATCOM") would enfold Air Force intercontinental ballistic missiles and Navy submarine-launched ballistic missile units. There was even speculation that the Air Force component of such a joint command will be a "strategic rocket command" carved out of SAC. One knowledgeable Air Force officer said flatly near the end of summer that "SAC and TAC are gone."

A month or so ago, General McPeak unveiled his initial plans for composite wings. The first such wing to blend tactical and strategic missions and assets would be the one at Mountain Home AFB. Shortly thereafter, General Loh addressed the question of how B-52s now belonging to SAC will fit into that wing to be run by TAC.

The TAC Commander noted that the wing is designed for "air intervention" overseas and that its B-52s, like all its planes, will come under the operational control of the theater commander in chief once it arrives. This is the way things worked in the Persian Gulf War, for example, with US Central Command's Gen. H. Norman Schwarzkopf and his air boss, Air Force Lt. Gen. Charles A. Horner, Jr., controlling all US air units and assets in the theater.

Things will be different when the wing is at Mountain Home. TAC will have operational control of it and will own its aircraft, including the B-52s, General Loh explained.

He took note of a roughly comparable command setup for the new composite 4th Wing at Seymour Johnson AFB, N. C. That wing combines a former TAC wing of F-15Es and a former SAC wing of KC-10s, both of which were based at Seymour Johnson, and dispenses with their "tactical fighter" and "aerial refueling" designations.

General Loh left no doubt as to which major command owns the 4th Wing. "It is a TAC wing with both fighters and tankers," he asserted. "They train together to deploy together." As a result, the wing's fighters and tankers "will be able to get to anywhere in the world faster and to function more efficiently on arrival."

A different sort of composite wing, paired tightly with the Army, is in the offing for Pope AFB near Fort Bragg, N. C., home of the 82d Airborne Division. TAC plans to base A-10 close-support aircraft at Pope "to work more closely" with the 82d and with other units of its parent 18th Airborne Corps.

"I hope to be able to bring additional types of airplanes to that wing as

well," General Loh added. The goal: "A quick reaction operation, so that when [the airborne troops] deploy, we can deploy with them and provide immediate offensive air support—close air support."

The new wing at Seymour Johnson and the one planned for Pope are much narrower in scope than the composite wing now taking shape at Mountain Home AFB. General Loh called that one "our first major composite wing" and said it will have "F-15s for air superiority, multirole F-16s, F-15Es for long-range interdiction, B-52s for long-range strike, AWACS aircraft, and some tanker aircraft."

He continued, "With that kind of package, when a crisis arises we will be able to deploy immediately with a whole spectrum of capabilities, including mission planning and command and control arrangements, and ready to fight on arrival."

At this writing, there apparently are no plans to include F-117 Stealth fighters in the Mountain Home wing. This could change, although prospects are highly speculative. F-117s would almost certainly work closely with composite intervention wings even if they are not organic to them. The stealthy "black jets" showed in the Gulf War that they are tailor-made for the kinds of missions that those wings would likely be called on to perform.

F-117s and B-52s formed a powerful partnership on at least one occasion in that war.

From the start of operations around the Gulf, allied air commanders had their eyes on a vast expanse of Iraqi military warehouses and maintenance facilities—mostly for Scud missiles and main battle tanks—at Taji, just north of Baghdad. The vital area was heavily defended by surface-to-air missiles.

"We wanted to attack Taji," General Horner later recalled, "but its size and defenses just didn't justify the exposure of airplanes carrying one or two bombs, because they'd take out [only] one or two buildings. So we had to send the B-52s against it."

Unlike the fighters, the B-52s carried enough bombs to devastate the sprawling Taji complex in fairly short order, but the bombers were more vulnerable to fire from the formidable arrays of SAMs. Those SAMs had to go. General Horner called in the F-117s. Throughout one night, the stealthy attack jets struck every SA-2, SA-3, and SA-6 site positioned to defend Taji, opening the way for highly successful B-52 attacks that followed.

Missions deep into Iraq were the exception for the B-52s. They flew far more "tactical" sorties near the front.

Lt. Gen. Michael A. Nelson, Air Force deputy chief of staff for Plans and Operations, observed that the B-52s "in some cases did very close-in bombing—detonating land mines, helping the Army build corridors to get through [front-line] defenses"—and that this showed how versatile big bombers can be.

Flexibility is the name of the game these days for Air Force planners and decision-makers.

Incorporating B-52s in the intervention wing at Mountain Home makes the same point. "It influences people to think differently about big bombers and what we can do with them," General Nelson declared. "The point is, don't think of them as being nuclear bombers only; think of them as being a flexible capability."

Flexibility is the name of the game these days for Air Force planners and decision-makers amid dwindling forces and tight budgets in a rapidly changing world. "First we determine what it is we need to do, then we look at all the capabilities available to us for doing it and use those that are the most helpful," General Nelson said. "We need to keep our options open and not get in a position where we fence off any capability because of doctrine or anything else."

This philosophy is reflected in the Air Force's approach to getting the most out of all big bombers, not just its B-52s. It envisions dual-role responsibilities for the B-1B and the B-2A: deterring or waging nuclear and conventional warfare. Both bombers figure in plans for the expeditionary air force now emerging.

At least some B-1Bs will be modified for conventional combat in the fairly near future. The Air Force maintained that B-1Bs were not needed in the Gulf War and could not have been used because all were armed exclusively for the SIOP mission. However, the Air Force said it had planned all along to equip the planes to carry conventional bombs, and it is now moving to do so.

"It's really a matter of training to get the B-1B into the conventional business, and it takes a while to do that," General McPeak said. He explained that the training involves such procedures as "putting the bombs on the pylons," practicing "dropping them off to make sure that they don't bang on the side of the airplane," and charting their trajectories in order to "establish ballistic tables for the aircrews to use in figuring their offset aimpoints."

Air Force officials emphasize that there is no nuclear connection between the composite wing being formed at Mountain Home AFB and the B-52s destined to be part of it. Those bombers will be "only the B-52Gs that have only a conventional role and [that] are not part of any nuclear plans," General Loh explained.

At some point, the Air Force may combine elements of TAC and SAC in a new composite command just as it is combining their airplanes in new composite wings. Teamwork between the commands is in fashion.

"With SAC and TAC working together, we intend to employ conventional B-52s more regularly in our day-to-day training and in our deployment plans," the TAC Commander declared.

As it became increasingly apparent that the Air Force reorganization meant big changes for SAC and TAC, its meaning for Military Airlift Command, which does business with both, also began to emerge. MAC seems secure as steward of intercontinental airlift, but it may lose its hold on intratheater airlift operations overseas.

At the AFA symposium early this year, General McPeak was asked about MAC's fate in light of the possibility that the Air Force would be reorganized along lines other than strategic and tactical.

The Chief of Staff praised MAC's performance prior to and during the Gulf War as "remarkable" and said it had been possible "only because airlift is commanded and controlled in the way it is now, as a functional area with one guy in charge." He predicted that intercontinental aircraft—the C-5s and the C-141s—would always be part of Military Airlift Command or something like it and declared that "the airlift mission is an essential one and is properly organized now for the most part, so I don't see any change in that general approach."

He indicated, though, that the intratheater (tactical) part of the airlift mission is ripe for change. The Air Force's new look at "the way we conceive of missions" may result in "an evolution of the way we handle our overseas [airlift] aircraft," said the Chief of Staff. ■

Dual Spectrum fire sensors will be installed on operational aircraft for the first time, as a Hughes Aircraft Company-built system has qualified for use aboard the Air Force's C-5 Galaxy military transport. The proven Dual Spectrum fire sensor can detect an explosion or fire in an enclosed space so quickly, a fire suppressant can be released before any damage occurs. The units, located in the pylon and nacelle of each engine, can be connected to warning panels on the flight deck and nitrogen purging systems on the aircraft. The sensors, which offer tremendous safety benefits to aircraft personnel, have long been used on tanks and other military vehicles, and more recently aboard civilian passenger buses.

The first transfer of missile technology between Hughes and Japan has been achieved, as 32 Hydra-70 rocket launchers have rolled off an assembly line in Japan. These production units will be mounted on the Japanese Ground Self-Defense Forces' AH-1S Cobra helicopter fleet. Hughes developed the launchers and delivered the initial 75 to Japan. The launchers are the first products to come from Hughes' 1988 manufacturing agreement with Minebea Ltd. of Tokyo.

The U.S. Army may soon have improved nighttime visibility and target detection capability, in battle and in bad weather, as a result of an infrared sensor array developed by Hughes. This second-generation focal plane array provides an infrared image with higher resolution and enhanced thermal sensitivity. It contains a detector chip bearing thousands of heat-sensitive detecting elements. Developed initially for the Army's Headstart Project, these arrays will eventually be common units for military sensors in systems from Army tanks to rescue helicopters.

TOW 2 missile launchers can now be tested in the field to ensure operational readiness. This complete test of electronics and electro-optical systems is performed at the launcher site, with a portable automated field test set developed by Hughes. The automated test set—the AT2FTS—verifies the launcher system's accuracy and locates any faulty assembly. The versatility of the AT2FTS' design lends itself to other test applications now being explored. In addition, the system is so automated operators need minimal training to use it.

Corporations in Great Britain now will be able to transmit data via rooftop satellite dishes instead of using their current terrestrial-based telecommunications systems. It's the result of British Telecom's new satellite business network using Hughes' Very Small Aperture Terminal technology. The satellite service provides business customers with high-quality data circuits to potentially thousands of remote sites throughout the U.K. and Europe. Supported applications include database access and downloading, reservations, stock transactions, credit card verifications, electronic mail, data broadcast, and business television.

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Aerospace World

By Frank Oliveri, Associate Editor

With Iraq's invasion of Kuwait in 1990 and the Soviet coup and countercoup this year, August is shedding its reputation as a slow news month. The world watched with dismay, then elation, as the apparatchiks tried to reassert their hegemony, only to be thwarted by "people power" reminiscent of the Philippines in 1986. The Old Guard has been rendered impotent, but implications for the nascent independent republics and the rest of the world have yet to come into focus.

★ The Pentagon has raised its count of US servicemen and -women killed by friendly fire in the Persian Gulf War. The Department of Defense now says inadvertent attacks caused thirty-five of the 148 total US combat deaths. In addition, seventy-two of 467 Americans wounded in action were hit by fire from US forces.

In an August 13 briefing, DoD identified twenty-eight friendly fire incidents, not all of which produced casualties. The attacks included sixteen by US ground forces on ground forces, nine by aircraft on ground forces, one by a warship on another warship, one from a shore battery on a ship, anc one by ground forces on a Navy aircraft.

In assessing the causes of the incidents, military briefers cited several factors. The most important was a lack of equipment to provide rapid, effective identification of a target as friend or foe. Inexperience may have played a role in some of the incidents. On one occasion, an antiradar missile broke its "lock" on an enemy radar, turned, and homed in on another radar, which happened to be manned by US forces.

The new figures mean that friendly fire accounted for twenty-four percent of a total of 148 war dead and fifteen percent of a total of 467 wounded, high levels by historical standards. The disparity may exist in part because comparable studies were not conducted in earlier wars, say Pentagon officials. In the past, the percentage of friendly-fire deaths as a portion of total deaths was set at about two percent.

Marine Corps Lt. Gen. Martin L. Brandtner, the Joint Staff's director for operations, said the proportion of friendly fire casualties clearly was higher than in previous wars. General Brandtner emphasized, however, that no other conflict even approached the intensity of the Gulf War. He also said that friendly fire casualties were probably underestimated in prior conflicts.

The high mobility and maneuver tactics that caused many of the friendly fire casualties also helped the US swiftly defeat Iraq and held allied casualties to historic minimums. Pentagon officials strongly maintain that such tactics save far more US lives than they cost.

★ The Senate and House passed legislation that eliminates regulations barring women from flying combat missions.

The Senate, which on July 31 voted to let women fly such missions, also authorized suspension of sex-based restrictions on sea and land combat roles. The House passed a bill in May that dropped the ban on women in combat flights. In addition, the Senate passed legislation requiring the formation of a fifteen-member commission appointed by the White House to study the issue of women's assignments in the military. The commission would be required to report to Congress by December 15, 1992.

Of the two-million-person US military force, 223,000 are women, of whom 35,000 served in the Persian Gulf War. Eleven women died in that conflict, including five who suffered combat-related deaths. Currently, women serve on transport aircraft and support ships, which routinely play potentially dangerous support roles.

Though the Senate move virtually overturned the forty-three-year-old legal ban on women in combat air-

craft, it does not require any service to let women fly in combat.

Defense Secretary Dick Cheney does not oppose the legislation. The four Chiefs of Staff have expressed reservations about opening combat missions to women.

★ A series of unusual incidents has rekindled intense interest in the fate of US servicemen still listed as Missing in Action (MIA) in the Vietnam War.

Debate over the MIA question flared anew following the public release in July of a grainy photograph alleged to reveal that three American officers, listed as MIA since the 1960s, are still alive. Soon after the appearance of the first photo came the disclosure of a second, this one allegedly revealing yet another missing US officer. In both cases, MIAs' relatives stepped forward to voice their belief in the authenticity of the photos.

Reacting to renewed public interest, White House National Security Advisor Brent Scowcroft said he did not believe any missing servicemen were alive in southeast Asia. Mr. Scowcroft, speaking on July 26, maintained there is no "credible evidence" that any MIAs are alive. He said "unscrupulous" individuals were using information provided by DoD to convince family members that MIAs were still alive. When asked if he believed that any MIAs were still alive, he replied bluntly, "No, I do not."

The Pentagon claims that the alleged photos of surviving MIAs have been traced to a January 1990 Soviet magazine depicting Soviet citizens, not Americans. Even so, the Bush Administration came under intense pressure and was forced to send a delegation to Vietnam on a mission to help resolve the MIA cases.

Some questioned the official line. Carl Ford, Jr., DoD's East Asian expert, told senators he believed that as many as ten US pilots were alive in Laos. Mr. Ford was speaking for himself and not for the Administration.

Sen. Bob Smith (R–N. H.), who sponsored a bill requiring formation of a committee to investigate whether MIAs might still be alive in southeast Asia, said Mr. Ford told him there was reason to believe MIAs were alive. Senate Minority Leader Bob Dole (R-Kan.) called for the establishment of a Presidential commission to investigate whether US servicemen are being held in southeast Asia.

Sikorsky Aircraft delivered its prototype MH-60K special operations helicopter to the Army on August 20. The MH-60K is a modified UH-60 Black Hawk equipped with terrain-avoidance radar and forward-looking infrared systems that allow for low-level flying missions at night and in adverse weather.

★ At the direction of Donald Yockey, Under Secretary of Defense for Acquisition, the Air Force will have to find approximately $884 million in reprogramming funds for the F-22 Advanced Tactical Fighter (ATF) program over the next five years, according to a synopsis of Mr. Yockey's acquisition decision memorandum (ADM) on the F-22.

The ADM, released on August 5, authorized engineering and manufacturing development (EMD) contracts to Lockheed and Pratt & Whitney totaling $12.7 billion (Fiscal 1990 dollars). The actual contracts were issued August 2.

Maj. Gen. Joseph Ralston, director of Air Force tactical programs, said Mr. Yockey based his ADM statements on results of an independent cost assessment, which diverged from the EMD cost assessment prepared by the ATF program office.

General Ralston said the difference between the two assessments, which cover Fiscal Years 1991–2001, does not begin to emerge until 1997. "This is something from 1997 and beyond," said the General. He said the Air Force has no budget for that time period, so "there is no significance to this theoretical problem." General Ralston said adjustments will be made in the 1994 program objectives memorandum to deal with the post-1997 problem.

In the ADM, Mr. Yockey ordered the Air Force to work with the Conventional Systems Committee of the Defense Acquisition Board (DAB) to craft performance and schedule guidelines that more clearly define the program. The Air Force will have to meet Mr. Yockey's criteria before the Pentagon will release long-lead funding for preproduction aircraft, full funding for preproduction air-

New Associate Editor

Frank A. Oliveri has joined the staff of AIR FORCE Magazine as an associate editor. He will specialize in the coverage of aeronautics. He came to the magazine in July, having spent nearly two years in Washington, D. C., working as a reporter and writer for *Defense Daily* covering the Pentagon and Congress. For his defense reporting, Mr. Oliveri won an award in 1991 from the Aviation/Space Writers Association.

Mr. Oliveri also has worked as a contributing editor for *Space Station News, Defense Marketing International, Defense Industry Report,* and *Soviet Aerospace & Technology.* Before coming to Washington, he worked for newspapers in Connecticut and New Hampshire.

Mr. Oliveri received a bachelor's degree in journalism from Southern Connecticut State University in 1987. He spent six years in the Connecticut Army National Guard, spotting 105-mm and 155-mm fire for the field artillery.

craft, and long-lead funding for low-rate initial production (LRIP). A DAB review will be held prior to commitment of long-lead money to low rate production.

★ Early this year, McDonnell Douglas sought a $1 billion cash advance to help solve the company's cash flow problems, but later withdrew the request when its financial condition showed improvement.

John McDonnell, chairman and chief executive officer of the nation's largest defense contractor, said in a January 24 letter that the funds would be used to finance such key programs as the F/A-18 strike fighter, the F-15 fighter, the C-17 transport, the T-45 trainer, the AV-8B attack aircraft, the AH-64 attack helicopter, and the Tomahawk and Harpoon missiles. Mr. McDonnell said current market conditions made it difficult to borrow funds necessary for the programs.

The letter, addressed to Under Secretary Yockey, stated, "We believe assistance in the form of advanced payments on existing production programs is in the best interest of the US government." It came shortly after the Navy, under orders from Secretary Cheney, terminated the Navy A-12 attack aircraft, which McDonnell Douglas and General Dynamics were co-developing. It also came shortly after the firms requested that DoD defer $1.35 billion in repayments for uncompleted work on the program. The Pentagon, fearing McDonnell Douglas might otherwise be pushed to the brink of bankruptcy, deferred repayment on February 5.

Mr. Yockey later told the House Government Operations Committee's Subcommittee on Legislation and National Security that he rejected the request for a $1 billion advance, though he did review other options to alleviate financial pressures on McDonnell Douglas. However, he said he would consider advance payments on the F-15 and F/A-18 because both were sound programs. He added the caveat that, before he approved such an advance, the firm would have to make "dramatic changes" to address its cash flow problems.

McDonnell Douglas withdrew the letter on April 1.

—USAF photo by SrA. Brian Schlumbohm

Two Air Force officers from Brooks AFB, Tex., received awards in August from the Air Force Association. Maj. Frederick Rudge, seen here performing a diagnostic test on the hyperbaric medicine chamber, was named Texas Physician of the Year, while Maj. Athanasios Malavakis was named Nurse of the Year.

★ Strategic Air Command (SAC) last month began implementing a new base organizational structure, which will include single-wing and dual-wing bases.

Wings with more than one type of aircraft—the so-called composite wings—will lose the identifiers "bombardment" and "reconnaissance" in their titles. The move is seen as an effort to streamline the command to meet mission requirements with fewer people, weapons, equipment, and bases.

Single-wing bases will consist of operations, logistics, support, and

—USAF photo by MSgt. Bill Thompson

Two Hungarian MiG-21 "Fishbed" aircraft visited the 52d Tactical Fighter Wing at Spangdahlem AB, Germany, in August. The MiGs arrived for the wing's family day and were escorted by an F-4G and an F-16. It was the first time since World War II that Hungarian aircraft had flown in German airspace.

Bell Helicopter Textron will head a team of firms in bidding for DoD's Tiltrotor Study and Demonstration Unmanned Air Vehicle System program. The team's proposal was delivered in August to the UAV Joint Program Office. The Bell team design is called "Eagle Eye." Flight demonstrations are planned for mid- to late 1992.

medical groups. At dual-wing bases, either missile or aircraft wings will assume host wing responsibilities in providing full support to both wings.

On September 4, CINCSAC Gen. George L. Butler reactivated 2d Air Force, deactivated in 1975, and 20th Air Force, deactivated in 1955. The reactivations are part of an overall SAC realignment. It is planned that bombers, tankers, reconnaissance aircraft, and ICBMs will be aligned under four "pure" numbered air forces.

★ An Air Force AGM-129A Advanced Cruise Missile (ACM) crashed in Utah while on a free-flight test following its launch from a B-52 in late July.

The General Dynamics–built ACM was the first to crash after five consecutive successful flights this year. The cause of the accident was under investigation in mid-August.

Aside from the testing anomaly, Under Secretary Yockey ordered the Air Force to choose one contractor for a winner-take-all buy of ACMs in Fiscal 1993. Mr. Yockey directed the Air Force to explore options that would set the buy at 1,500, rather than the planned 1,000, missiles. In an ADM on the Defense Acquisition Board's ACM review in July, Mr. Yockey backed an Air Force plan to complete the buy of about 250 missiles. Second-source contractor McDonnell Douglas is competing with General Dynamics for the ACM program. The next selection is expected to take place in Fiscal 1993.

"Mr. Yockey . . . directed that the Air Force shall also ensure that the proposal obtained for future production contains options for possible additional procurement of up to 500 missiles beyond the currently planned quantity of 1,000," the ADM states.

★ The Army may be depriving itself of the most effective weapon system for the interim medium antitank system by not including the Swiss Dragon in its testing for such a system, according to an Inspector General's "quick reaction" report on the acquisition management of the Army's Advanced Antitank Weapon System–Medium (AAWS-M) Supplemental Interim Medium Antitank System.

The report, released in mid-June, states, "Without the Swiss Dragon included in the test, the BILL [Bofors Infantry Light and Lethal] or MILAN [*Missile d'Infanterie Leger Antichar*] 2T antitank systems could be determined to be the superior system and designated as the Army's interim system." Integration of either of those systems would be more costly than the Swiss Dragon, which is a modified Dragon II already used by US forces. In March 1989, the Army Operational Test and Evaluation Agency found the MILAN "neither marginally effective nor operationally suitable" and the BILL "marginally effective but not operationally suitable." The Dragon II was judged both effective and suitable to Army needs.

The IG recommended that the Assistant Secretary of the Army for Research, Development, and Acquisition include the Swiss Dragon in the program.

★ **NEWS NOTES**—The US Attorney's office told the Air Force that the **contracts for the ATF and its engine are not part of the III Wind probe.** Concerns were raised when Rep. Nicholas Mavroules (D-Mass.) called for the delay of the ATF engine contract to Pratt & Whitney in late July because reports claimed that officials from the firm used illegal information to win F404 contracts from the Navy. However, based on the US Attorney's statements, the Air Force awarded the contracts.

The Air Force is strengthening longerons on all ninety-seven B-1B bombers at a cost of $50,000 each, after thirty-seven bombers showed cracks in that area. The longeron, just forward of the B-1B's wing carry-through box, is being strengthened with a boron epoxy plate glued or bolted onto the longeron. The Air Force is paying for the fix, but Rockwell, the builder of the B-1B, has been working with the Air Force to find the reason for the cracking. The thirty-seven B-1Bs with cracks are grounded until the fix can be applied, but they would be considered airworthy in a crisis.

The USAF-Navy Joint Primary Aircraft Training System (JPATS) program will now be considered a major defense acquisition program, subject to DAB scrutiny and approval. Under Secretary Yockey informed the individual service chiefs of his decision in July. The Air Force and the Navy plan to buy 495 and 347 aircraft, respectively, at a total program cost of about $4 billion. If potential foreign sales are included, the price could rise as high as $10 billion. The aircraft will replace the T-37B and the T-34C, which are nearing the end of their operational lives.

A coalition of California's business, industrial, labor, academic, and social service leaders, called **Californians for Aerospace Leadership (CAL),** has been formed in an attempt to enlist lawmakers' support in secur-

ing federal aerospace contracts for the state. The coalition was formed in July.

The space shuttle ***Atlantis*** **successfully landed** at Kennedy Space Center on August 11, despite a "hard mechanical failure" in one of three auxiliary power units. The landing was the culmination of a nine-day mission involving the deployment of NASA's fourth Tracking and Data Relay Satellite (TDRS-E). The TDRS-E updated the satellite tracking network, resulting in two operating satellites plus two spares in the space network. By landing the shuttle at Kennedy Space Center, rather than at Edwards AFB, Calif., NASA saved about $1 million and a week of processing because the spacecraft did not have to be carried across the country to Kennedy on the back of its modified Boeing 747.

The space shuttle ***Columbia*** **is being refurbished** by Rockwell in Palmdale, Calif., to allow for long flights. The spacecraft arrived in California in early August. Work is expected to last six months. The modifications will increase its duration capacity from seven to fifteen days. *Columbia*'s next flight is scheduled for June 1992.

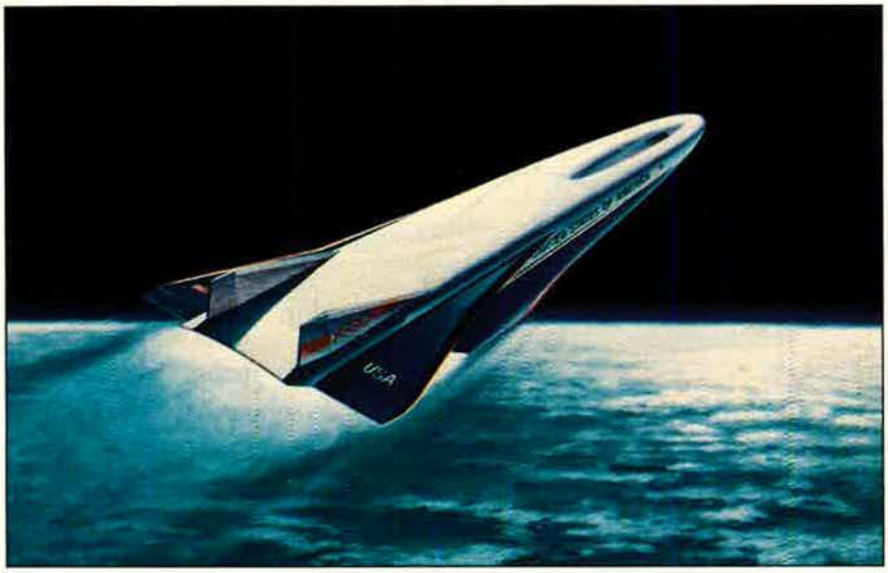
The Soviet Union began **flight-pad testing of the orbiter *Buran 2,*** following the rollout of the spacecraft in August. While the first *Buran* successfully completed unmanned flight in November 1988, *Buran 2* is expected to support manned travel. However, only some life-support systems have been installed in the orbiter to date. *Buran 2* is expected to make an unmanned flight late this year or early next year and dock with the space station Mir.

The US signed a landmark space cooperation agreement with the Soviet Union, in addition to agreements with Spain and Argentina, according to NASA. The US and the USSR agreed to allow astronauts from each country on missions on the US space shuttle and the Soviet space station Mir. This marks the first arrangement of the kind for the two nations. The agreement with Spain, reached in July, provides for support cooperation in space science and technology as well as for use of Spanish bases and installations as alternative landing sites for the US space shuttle. The agreement with Argentina, reached in August, calls for cooperation in the civil uses of space, with special emphasis on Earth and space sciences.

Tactical Air Command created a **new-generation fighter pilot training program** to replace the lead-in fighter training program at Holloman AFB, N. M. The new program, called Basic Fighter Transition (BFT), will emphasize aircraft handling, tactical formation, and basic fighter maneuvers. In addition, it provides an introduction to ground-attack procedures.

The Air Force used BQM-74C target drones as decoys at the start of the Persian Gulf War, which drew the attention of Iraqi air defense radar, revealing locations of missile and gun sites, according to the Pentagon. Those drones were then followed by high-speed antiradiation missiles (HARMs), launched from aircraft, that followed the radar emission to the source and destroyed it. The drones are built by Northrop Corp.

DoD awarded contracts to **ten firms to demonstrate 200-pound unmanned aerial vehicles** (UAVs) with forward-looking infrared (FLIR) capability. The contracts were awarded in August to McDonnell Douglas, Westinghouse Corp., General Atomics, International Aerospace Technologies, Daedalus Research, and AAI Corp.



DoD and NASA are sponsoring a competition among students interested in aerospace science and engineering to design, engineer, and fabricate a fifty-foot-long scale model of the X-30 National Aerospace Plane (NASP). The ultimate goal of the NASP program is a single-stage-to-orbit aircraft. Undergraduate engineers may compete for a top award of $125,000. Deadline for applications is October 15.

Rockwell International, Rafael, Hughes Aircraft, and Kollmorgen Corp. were awarded FLIR contracts.

The Defense Advanced Research Projects Agency's **Pegasus air-launched space booster successfully placed seven microsatellites in orbit.** The launch took place on July 17 from the wing of a NASA B-52. The microsatellites will provide regenerative transponder capabilities for analog signals and digital communications, as well as long-haul message relay via store-and-forward memory. Each satellite weighs forty-nine pounds.

A federal judge threw out a Navy decision to select General Dynamics Corp.'s Electric Boat to build the second *Seawolf*-class attack submarine, while requiring that new bids be sought. Tenneco's Newport News Shipbuilding is in competition with Electric Boat for Seawolfs.

Despite congressional passage of a nonbinding resolution against the Administration's proposal, **Saudi Arabia will be the beneficiary of a $365 million US arms sale** for bombs, cluster munitions, and AIM-7M Sparrow missiles to replace munitions expended during Operation Desert Storm. The sale, proposed in late July, is the sixth of its kind to a Middle East nation since the end of the Persian Gulf War on February 28 and brings total sales to countries in that region to more than $6 billion. Included in the sale were 2,000 Mk. 84 bombs, 2,100 CBU-87 cluster bombs, 770 Sparrow missiles, and spare parts. Congress had thirty calandar days to respond to the proposal, giving it little time to stop the sale before its August recess.

★ **DELIVERIES—Lockheed Aeronautical Systems Co. delivered the second C-5 equipped with an electronic countermeasures (ECM) system** to the Air Force on July 16, marking the completion of Lockheed's participation in the second phase of a project dubbed Pacer Snow. The goal of Pacer Snow was to install a defensive system on two C-5s.

★ **PURCHASES—McDonnell Douglas Corp.'s Douglas Aircraft Co.** was awarded a $1.14 billion fixed-price incentive firm contract for four **C-17 aircraft.** Expected completion: August 1993. In addition, Douglas Aircraft was awarded a $23 million face-value increase to a fixed-price incentive fee contract for the restructure of the delivery schedule for the C-17. Expected completion: December 1994. Douglas Aircraft also was awarded a $37 million face-value increase to a fixed-price incentive fee contract for C-17 aircraft Lot IV (Fiscal 1992) advance buy/long-lead requirements. Expected completion: July 1994.

Douglas Aircraft was awarded a $68 million increment to an advanced acquisition contract for the Fiscal 1989–90 procurement of twenty-four **T-45A Goshawk aircraft and support equipment.** Expected completion: November 1993.

The Army awarded **Raytheon Co.'s Missile Systems Division** a $244 million modification to a firm fixed-price contract for 647 **Patriot missiles.** Expected completion: December 1994.

Senior Staff Changes

RETIREMENTS: M/G Larry D. **Dillingham;** B/G Walter C. **Hersman;** M/G Jeffery D. **Kahla;** B/G Frederick W. **Plugge** IV; M/G James G. **Sanders;** B/G James P. **Ulm.**

CHANGES: B/G John L. Finan, from Dir., Budget Ops., and Chmn., OBRC, OSAF, Washington, D. C., to Vice Cmdr., AAFES, Dallas, Tex. . . . **Col. (B/G selectee) James L. Higham,** from Cmdr., 14th FTW, ATC, Columbus AFB, Miss., to Cmdr., 542d CTW, MAC, Kirtland AFB, N. M. . . . **Col. (B/G selectee) Thomas E. Kuenning, Jr.,** from Cmdr., Strategic Missile Center, SAC, Vandenberg AFB, Calif., to Cmdr., 20th AF, SAC, Vandenberg AFB, Calif. . . . **M/G George W. Larson, Jr.,** from Dep. Ass't Sec'y, Budget, OSAF, Washington, D. C., to Commandant, Industrial College of the Armed Forces, National Def. Univ., Fort McNair, Washington, D. C., replacing retired M/G David M. Goodrich.

Col. (B/G selectee) Tad J. Oelstrom, from Exec. Officer to Dep. CINC, Hq. USEUCOM, Vaihingen, Germany, to IG, Hq. USAFE; DCS/Productivity, Hq. USAFE; and Cmdr., European Inspection and Safety Ctr., Hq. USAFE. Ramstein AB, Germany, replacing B/G Lee A. Downer . . . **B/G James C. Roan, Jr.,** from Staff Judge Advocate, Hq. AFSC, Andrews AFB, Md., to Staff Judge Advocate, Hq. AFLC, Wright-Patterson AFB, Ohio, replacing B/G Nolan Sklute . . . **Col. (B/G selectee) Rondal H. Smith,** from Dir., Aircraft, Ogden ALC, AFLC, Hill AFB, Utah, to Exec. Dir., Quality Assurance, DLA, Cameron Station, Va. . . . **M/G Robert F. Swarts,** from Cmdr., AFCOMS, Kelly AFB, Tex., to Dep. Ass't Sec'y, Budget, OSAF, Washington, D. C., replacing M/G George W. Larson, Jr.

SENIOR EXECUTIVE SERVICE (SES) RETIREMENT: Raymond L. **Johnson.**

SES CHANGE: Harry E. Schulte, from Prgm. Dir., Range Systems, ASD, AFSC, Eglin AFB, Fla., to Prgm. Dir., AMRAAM, ASD, AFSC, Eglin AFB, Fla. ■

In addition, a $23 million modification to a firm fixed-price contract was awarded to Raytheon for Patriot missile ground support for Israel. Expected completion: January 31, 1994.

Hughes Aircraft Co. was awarded a $355.8 million firm fixed-price contract for Lot V production quantity of 540 **Advanced Medium-Range Air-to-Air Missiles (AMRAAMs).** Expected completion: January 1994. Another $186 million was awarded to Raytheon for Lot V production quantity of 270 AMRAAMs. Expected completion: January 1994.

The Army awarded **Boeing Helicopter** a $208.9 million modification to a firm fixed-price contract for low-rate initial production of eleven **MH-47E special operations aircraft.** Expected completion: April 30, 1993.

General Dynamics Land Systems was awarded a $768 million Army contract to build **M1A1 tanks** between September 1991 and April 1993. In addition, General Dynamics was awarded a $32 million modification to a cost reimbursement contract by the Army for long-lead material supporting 315 M1A2 tanks for Saudi Arabia. Expected completion: June 30, 1994.

Hughes Aircraft Co.'s Ground Systems Group was awarded an $837 million fixed-price incentive firm, firm-fixed-price, cost reimbursement contract for reprocurement of the terminated portion of the **Peace Shield** prime contract. The contract calls for the delivery of a C^3 system to the Royal Saudi Air Force. Expected completion: February 1996.

The Navy awarded a $328 million firm fixed-price contract to **McDonnell Douglas Corp.'s Missile Systems Co.** for the Fiscal 1991 production of **132 Harpoon missiles, 167 Standoff Land-Attack Missiles (SLAMs), and associated integrated logistics support.** Expected completion: January 1993.

More than seventy years after the end of World War I, ninety-six-year-old William Gerald, who was an aircraft mechanic in the US Army during the Great War, was awarded the World War I Victory Medal in August. Mr. Gerald received the medal after a concerned social worker brought his case to DoD.

The Navy awarded **ITT's Avionics Division** a $37.8 million fixed-price incentive contract for the Lot II low rate initial production of twelve **Airborne Self-Protection Jammer systems** for F/A-18 aircraft. Expected completion: May 1994. Additionally, the Navy awarded Westinghouse Electric Corp.'s Electronic Systems Group a $51 million contract for Lot II low-rate initial production of twenty-four ASPJ systems. Expected completion: May 1994.

Raytheon was awarded a $264.7 million firm fixed-price contract for 5,225 Air Force **Maverick missiles** and thirty-six Navy Mavericks. The contract includes seventy-nine spare guidance control sections. Expected completion: April 1994.

The Navy awarded a $19.6 million fixed-price incentive contract to **General Electric's Ordnance Systems Dept.** for guidance system components for the **Trident Missile Program.** Expected completion: July 31, 1993.

CAE-Link Corp. was awarded a $19.6 million increase to a cost plus incentive fee contract for **aircrew training devices** for B-2 aircraft. The contract will consist of eight weapon systems and two mission training devices. Expected completion: June 1995.

Agusta S.p.A. of Milan, Italy, and Sabreliner Corp. of St. Louis, Mo., have entered into an agreement to pursue a multimillion-dollar contract to replace the T-41 training aircraft. The team is proposing a missionized variant of Agusta's SF.260E to meet the Air Force's need. The contract, for as many as 125 aircraft, will be awarded through the USAF Enhanced Flight Screening program.

The Navy awarded **General Dynamics's Air Defense Systems Division** a $22.5 million cost plus award fee contract for **engineering and technical support services for the Standard Missile,** Blocks II and III. Expected completion: April 1994.

The Army awarded a $2.7 million increment as part of a $50.6 million firm fixed-price contract to **Hensel Phelps Construction Co.** to design and build **F-117A maintenance docks and hangars** at Holloman AFB, N. M. Expected completion: December 24, 1992.

Lockheed was awarded a $10 million contract for **investigative engineering services for the C-5A/B aircraft.** Expected completion: December 1991.

The Navy awarded a cost plus fixed-fee contract to **Syscon Corp.** that, including options, could total $154 million, to provide **test and evaluation support for the AEGIS Combat System.** The contract includes the establishment of test approach, development of test specifications, conduct of test operations, and the analysis of collected data. Expected completion: September 1991; with all options exercised, June 1996.

The Army awarded a $8 million firm fixed-price contract to **General Electric** for seventy-six turbine **rotors for Black Hawk and Apache helicopters.** Expected completion: June 30, 1994.

McDonnell Douglas's Space Systems Division was awarded $88 million of a $593.9 million cost plus award fee contract by the Army for the **Ground-Based Surveillance and Tracking System** (GSTS). Expected completion: September 30, 1996.

★ **HONORS—The 1990 Mackay Trophy** was awarded to an Air Force AC-130H Spectre crew for a mission flown during Operation Just Cause. Lt. Col. Billy Napier; Capts. Charles MacMillan, John Hicks, Phillip Ladd, Michael Radford, and William Lane; SMSgt. Michael Hosenbackez; MSgt. Jerry Anderson; TSgts. Bruce Brieshop, Glenn Lemay, Tony May, Larry Bower, and Mark Johnson; and Sgt. Stephen Jones of the 1st Special Operations Wing, Hurlburt Field, Fla., were cited for playing a key role in knocking out the Panamanian Defense Headquarters at La Comandancia on December 20, 1989.

Gen. Colin Powell, Chairman of the Joint Chiefs of Staff, was awarded the **Distinguished Public Service Medal** by the Center for the Study of the Presidency during its Twenty-Sixth Anniversary Awards Dinner on June 26.

An F-16 pilot held prisoner by Iraq and an A-10 pilot who led a daring mission to rescue a downed aviator deep inside Iraq during Desert Storm were awarded the Air Force's highest award, the **Air Force Cross.** Capt. William Andrews of the 50th Tactical Fighter Wing, Hahn AB, Germany, and Capt. Paul Johnson of the 354th TFW, Myrtle Beach AFB, S. C., were the only Air Force officers to receive the award for action during the conflict.

Air Force Logistics Command and Air Force Systems Command were the joint recipients of the **Caniff Spirit of Flight Award** presented by the National Aviation Hall of Fame at the organization's enshrinement ceremony July 20, in Dayton, Ohio. The award is presented annually to a group or organization in recognition of outstanding contributions to air and space flight. ■

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In the wake of Operation Desert Storm, no one seriously doubts that airpower is the dominant—at times, decisive—factor in modern warfare.

Lesson Number One

By James W. Canan, Senior Editor

ON THE eve of the Persian Gulf War, President Bush summoned the Joint Chiefs of Staff to Camp David to hear their views on how it would go. The Air Force's Gen. Merrill A. McPeak "told me exactly what to expect from airpower" and was so upbeat about it that the President suspected him of overstating his case, Mr. Bush recalled later.

As it turned out, "General McPeak, like the rest of the Air Force, was right on target. . . . Lesson number one from the Gulf War is the value of airpower," the President declared.

Airpower was a big winner in that war for all the world to see. Operation Desert Storm left no doubt that airpower can dominate modern war and can even prove decisive if there is no need to take and hold terrain.

There are caveats. Conditions around the Gulf were more conducive to the deployment, coordination, and application of airpower than they likely would be in many other parts of the world. The weather was bad for the region but very good by the standards of more northern climes. Modern air bases and support infrastructures were available to US and allied air units in Turkey and Saudi Arabia. Ground targets stuck out in the treeless, featureless terrain.

One thing is certain: The war did wonders for the Air Force's image. Never again will blue-suiters have to bear up under the hoary barb that the US has never won a major war since the Air Force became an independent service.

"We've heard that kind of kidding over and over through the years from our friends in the Army, Navy, and Marines, but we won't hear it any more," says Lt. Gen. Michael A. Nelson, Air Force deputy chief of staff for Plans and Operations (XO). "There can no longer be any serious question—if there ever was—about the validity of the Air Force as an independent service with a huge array of capabilities to bring to national requirements. To think of the Air Force in any other way is just nonsense."

Air Force leaders take great pride in the accomplishments of airpower in the Gulf War and in USAF's star role. As General Nelson says, "The record speaks for itself." They also emphasize, however, that airpower

—US Navy photo by PH3 Chester O. Falkenhainer

Fully armed for air-to-air combat, this F-15C from the 1st Tactical Fighter Wing, Langley AFB, Va., patrols the sky over Saudi Arabia during the Persian Gulf War. The 1st TFW's Eagles were in the vanguard of allied forces deployed to the Gulf. They moved quickly to cinch air superiority in the region as the first requisite of the triumphant allied air and ground campaigns.

wasn't everything and that the Air Force had lots of help both in the air and on the ground.

A Favorable Environment for Airpower

Lt. Gen. Charles A. Horner, Jr., who orchestrated the allied air campaign as commander of the Central Air Forces (CENTAF) component of US Central Command, claims that Operation Desert Storm "emphasized the role of airpower because of the strategy and the environment—the nature of the war. It did not make airpower the only element or the supreme element, but it did emphasize the contribution of airpower."

The Air Force came out of the Gulf War with high marks for farsightedness as well as firepower. The war was a proving ground for the doctrine, tactics, training, and systems that USAF had developed. For example, it underscored the importance of stealth, precision guided munitions (PGMs), integrated electronic combat, and centralized direction and coordination of air campaigns—something sadly lacking in the Vietnam War. Now the Air Force can continue to emphasize all these things with the high confidence that springs from success in battle.

In the Gulf War, USAF did what it was born to do.

The Air Force was formed as a separate service after World War II chiefly for the strategic mission, a mission with enormous influence on the outcome of that war and one uniquely and demonstrably suited to airpower. The Gulf War gave Air Force strategists a sense of déjà vu. They claim that USAF's aerial campaign against military targets in and around Baghdad and elsewhere deep inside Iraq was a classic example of the strategic mission. It was also eye-catching evidence that strategic airpower need not be synonymous with the use of nuclear weapons, they point out.

Through the years following World War II, as it deployed its bombers and intercontinental ballistic missile (ICBM) force under the banner of nuclear deterrence, the Air Force's strategic mission came to be defined as strictly nuclear, even though its leaders kept insisting—and sometimes demonstrated, as with strategic bombing in Vietnam—that the mission had a distinctly nonnuclear side as well.

In Desert Storm, the Air Force showed that side to a fare-thee-well, and its leaders are emphasizing the nonnuclear side in claiming that the B-2 Stealth bomber has a legitimate place in their plans to deter or wage conventional war. They are careful not to slight the nuclear side of the equation, though. They insist that nuclear deterrence is every bit as important as ever, notwithstanding recent progress in US-Soviet bilateral accords in cutting strategic arsenals.

The Air Force's Key Role

General Nelson, for example, notes that "the first order of business of the US Department of Defense is to deliver a credible nuclear deterrent," because "the Soviet nuclear capability remains the one thing in the world that could bring terrifying physical harm to our country and call into question our survival." He also notes that Air Force bombers and ICBMs constitute two-thirds of the US triad of strategic weapons designed to deter such a nuclear attack and that "we continue to take that mission very seriously.

"But the Air Force has now demonstrated beyond doubt that it has a key role in the national strategy as a deliverer of conventional weapons," General Nelson declares.

Given their precision and lethality, those conventional weapons are gaining on their nuclear cousins in terms of military effectiveness—destruction of key targets. Their prowess was one of Desert Storm's most dramatic revelations. Another was stealth.

Air Force F-117s took advantage of stealth and precision guided munitions in their surprise attack on a Baghdad military telecommunications facility that touched off the strategic side of the allied air campaign.

For the record, the first attack in that campaign, tactical in nature, was carried out by a team of Army AH-64 Apache helicopters and Air Force Special Operations Forces MH-53J Pave Low electronic warfare helicopters against Iraqi frontline air defense radars. *[See "Apache Attack," p. 54.]* But the F-117s had already penetrated Iraqi airspace, having escaped detection by Iraqi radars, and were bearing down on Baghdad as the helicopters opened fire.

The stunning success of the F-117 mission to downtown Baghdad, followed in bang-bang fashion by the Navy's Tomahawk land-attack missile (TLAM) strikes in the same vicinity, may well have been the beginning of the end for Iraq. Some

—USAF photo by TSgt. Rose Reynolds

A SAC B-52 from the 379th Bomb Wing, Wurtsmith AFB, Mich., takes off on a sortie against forward-deployed Iraqi ground forces. In the Persian Gulf War, B-52s bombed both tactical and strategic targets, as did such so-called tactical aircraft as F-111s, F-117s, F-15Es, and F-16Cs. All applied airpower to maximum effect.

airpower enthusiasts now insist that the war was over, for all practical purposes, as soon as the "black jets" and the TLAMs had their way and showed that Iraqi air defenses could do little or nothing about them.

With Air Force fighters in the forefront, allied air forces quickly gained control of the air and hit critical radar installations, airfields, war plants, and command-and-control nodes on land, leaving Iraq unable to defend against air attack or to produce offensive weapons. Those air forces fractured the enemy's military infrastructure, paralyzed its strategic communications, and strangled its logistical system.

By Air Force calculations, it took only one one-hundredth the number of bombs used against Vietnam through eleven years of war to shut down Iraq's gasoline production, cut off its electricity, and severely disrupt its transportation in the first few days of the air campaign.

General Horner points out that airpower played a pivotal role in strategic defense as well as on the attack. Deployed quickly, if thinly at first, Air Force airpower may well have prevented an Iraqi invasion of Saudi Arabia. With Iraqi forces poised for such a thrust, "it meant an awful lot to me" to have American and Saudi F-15s and Airborne Warning and Control System aircraft immediately available for patrolling and defending Saudi airspace, General Horner recalls. "Then we got the F-16s and the A-10s and the Navy carriers over there, and that also meant a lot in terms of slowing down an invasion. It didn't mean we could defend Saudi Arabia if we were attacked, but it meant that we could sure make it painful [for attackers]."

—USAF photos by TSgt. Perry Heimer

Iraqi aircraft shelters like those above were high-priority targets for allied strike aircraft. Below is a shelter devastated by precision bombing. The Gulf War underscored the importance of precision guided munitions, stealth, integrated electronic combat, and centralized command in modern air warfare.

War on Allied Terms

General Horner credits Gen. H. Norman Schwarzkopf, commander in chief of US Central Command and of coalition forces, with having been "right on target in using airpower to maintain the initiative and fight the war on our terms rather than on Saddam Hussein's terms." This was pivotal, the allied coalition's air boss maintains.

Why? Because, he says, "Saddam Hussein wanted to attack us. He didn't care if he lost a quarter of a million men so long as he could inflict seven to ten thousand casualties on us and say he defeated the Americans. His whole strategic point was to inflict casualties, and we were able to withhold that from him by using airpower to maintain the initiative."

Air Force Secretary Donald B. Rice sees the job of "reaching out and blocking aggressors" as one of airpower's prime functions nowadays. In his view, the Gulf War was "a snapshot of global reach and global power" and "proof that airpower—from all the services—has emerged as a dominant form of military might."

Dr. Rice and General Horner are among the Air Force's most emphatic exponents of the B-2 bomber as a leading agent of US nuclear and conventional airpower in the years ahead.

General Horner says he feels compelled "to make sure that people who go to war in the next one have the same kind of tools that I had," and "this is why I . . . talk about the need for the B-2."

Declares Dr. Rice, "We saw the value of heavy bombers in the war and the value of stealth. A long-range, high-payload, highly survivable bomber would have been very useful." In his view, "the B-2 captures the essence of airpower" and is needed for "the mission of deterrence of all conflict, nuclear and conventional."

Some airpower champions see the B-2 as the key to establishing airpower as the prime instrument of national security. They take the position that the US, now planning to withdraw from many overseas bases, will have to rely more and more on strategic attacks by stealth bombers from Stateside bases to keep enemies at bay around the globe. They also believe that strategic airpower has the potential for making land wars things of the past. As a result of the Gulf War, some

have concluded, for example, that battle tanks are already obsolete in the new heyday of airpower.

After the war, General McPeak said at a Pentagon briefing that allied air strikes had destroyed or decommissioned forty percent of Iraq's tanks, armored personnel carriers, trucks, and artillery pieces in the Kuwaiti theater of operations. It turned out that his figures, based on the best available bomb-damage assessments at the time, were quite conservative.

At Least Sixty Percent

Air Force sources now claim that airpower accounted for at least sixty percent of all kinds of Iraqi military vehicles along and behind the battlefront. This prompts some airpower enthusiasts to conclude that the Iraqi army would have surrendered the field sooner or later without having been attacked by allied ground forces—and, thus, that airpower could have won the war sooner or later all by itself.

The Air Force's uniformed leaders claim no such thing. They extol airpower but stop short of depicting it as the end-all of the Gulf War or of modern warfare in general. They tip their caps to ground forces and are quick to share credit with the air arms of coalition allies and the Army, Navy, and Marines.

For example, General McPeak expressed his "private conviction that this is the first time in history that a field army has been defeated by airpower—a remarkable performance by coalition air forces." He went on to say, "There are some things that airpower can do and some things that it cannot do, and that we should never expect it to do very well: move in on the terrain and dictate terms to the enemy. Our ground forces did that."

Air Force leaders appear to agree that airpower can win wars outright only "when the President decides there is no need to occupy territory and we can go ahead and use air until we achieve the national objective," as General Nelson says.

—USAF photo by SrA. Chris Putman

The Air Force DCS/XO emphasizes that all the services and all their air assets would likely be involved in such circumstances. He points out, for instance, that the application of US airpower in the Gulf War had as much to do with the "absolutely indispensable" airlifters and tankers ("not enough has been said about the role of the tankers") as it did with the fighters and bombers.

The war gave "the whole picture of what airpower is all about: space assets, intelligence gathering and reconnaissance, command and control, electronic combat, the shooters, the SEAD [suppression of enemy air defenses] campaign," General Nelson says. It was a textbook example of "the totality" of US airpower—"Air Force air and space, Navy air, Marine air, and Army air with helicopters," he says.

"It is virtually impossible for me to imagine a military operation at this point in history that does not employ airpower in some way, whether to drop bombs or get troops and materiel to the scene, or provide intelligence, or whatever," General Nelson says.

Airpower experts note that strategic air campaigns like the one in the Gulf War have enormous impact on ground and sea forces, because they influence decisions as to when, where, and how to employ those forces. By the same token, actions on land and at sea influence how airpower is employed.

Highly Integrated Airpower

General Nelson declares that the Gulf War "confirmed what we've known since 1942: that airpower must be highly integrated and used very efficiently and that the only way to do that is to have an airpower expert running the show with all the air assets in his grasp. Chuck Horner proved that that is indeed the way to do business."

To General Nelson, the Vietnam War, in its loosely knit interservice air operations and absence of overall strategic purpose, was "a perfect example of how not to use airpower." Even so, airpower proved persuasive in the end. The Air Force's Linebacker II strategic air

—USAF photo by SSgt. Lee Corkran

All the armed services contributed to the successful application of US airpower in Operation Desert Storm, and it was not just the "shooters" among them who showed their stuff. At top, a Navy F/A-18 from the carrier Saratoga gets gas from a USAF KC-135. Above, a K-loader takes palleted cargo from an airlifter.

campaign against North Vietnam had a great deal—maybe everything—to do with Hanoi's decision to talk peace.

In Linebacker II, long-range B-52 bombers and shorter-range tactical attack aircraft worked together in strategic attack. "So the Vietnam War also gave us, in that one instance, a glimpse of what could be done with integrated airpower in a strategic air campaign for national purpose," General Nelson explains. "Since then, we learned an awful lot about how to do it, and when the time came [in the Gulf War] for us to do it, it worked."

That war, he declares, "only underscored the doctrinal thinking that had been virtually consistent throughout the history of the Air Force—for example, that air superiority has to come first or you're lost, that it's important to have a single air component commander empowered to do everything that needs to be done in the air campaign."

The Air Force was much better prepared and far more confident entering the Gulf War than it was throughout the Vietnam War, General Nelson claims. He points out that USAF, in colored-flag exercises at Nellis AFB, Nev., and elsewhere, had had "ten to fifteen years of good hard practice in conducting a combined campaign in an electronic environment. We knew what we had to do with the various aircraft and how to work strike packages together in coordinating complex operations."

—US Navy photo by PH2 Susan Carl

EF-111 Ravens from the 366th Tactical Fighter Wing, Mountain Home AFB, Idaho, form up for refueling en route to area-jamming sectors over the war zone. The Vietnam War taught the Air Force lessons about electronic warfare that paid off handsomely in Operation Desert Storm. EW is crucial to contemporary airpower.

Technology Catches Up

There appears to be a consensus among air warfare experts that airpower triumphed in the Gulf War largely because technology had caught up with doctrine, strategy, and tactics.

Desert Storm left no doubt that "there has been a revolution in technology with regard to airpower" and that stealth and precision guided munitions rank high among its main elements, General Horner says. He claims that "PGMs give great efficiency to air warfare; we learned that toward the end of the Vietnam War."

As to stealth, "we have to realize that stealth is revolutionizing air warfare. I was as amazed by the performance of the stealth fighters as anyone. That first night [of the air campaign], I thought, boy, this is going to be tough, because Baghdad was a tough target. But those guys came back."

The Air Force sees stealth as part of its electronic combat skein and EC as a prime example of technology teaming with doctrine and tactics to put more pizazz in airpower.

General Horner, who flew Wild Weasel aircraft on many a SEAD mission in southeast Asia, describes the Air Force's EC in the Vietnam War as "kind of a string-along, learn-as-you-go affair. We were ill-equipped for electronic combat. The [electronic countermeasures] pods we had on the airplanes were pretty primitive. Many were R&D kinds of stuff. We never really had the EF-111 [standoff area-jammer aircraft] there. We never had a chance to integrate a whole [EC] package."

The Gulf War was a much different story. "We had a well-trained and well-equipped [EC] force and we were able to bring EC together, and it did a superb job, as our [extremely low] loss rate showed," the allied air boss asserts.

The war also revealed weaknesses that the Air Force is taking into consideration, along with the changing global military environment, in pondering future weapons and force structures. "It became obvious that we don't have good all-weather PGMs and that we need to make some changes in the way we're organized," General Nelson says.

What lies ahead? "We will have a smaller, highly mobile Air Force capable of arriving unannounced, delivering weapons very precisely, and keeping casualties to the absolute minimum. We will have to emphasize stealth because—among other reasons—we won't be able to afford all the combat support elements necessary to get a nonstealth force to work."

Major changes appear to be in store for all the armed services in response to tight budgets, new challenges, and the lessons of the Gulf War, most notably its show of the importance of airpower.

Air Force Col. Dennis Drew, professor of military strategy and doctrine at Air University, Maxwell AFB, Ala., and author of books on airpower, is among those who have long believed that "airpower has come to dominate modern warfare." This does not mean, he says, that land power and seapower have lost importance or are now relegated to support status. "Rather, it means new modes of operation, new forms of combat teamwork, new ways of thinking about the operational art, and revised force structures" all across the services. ■

From Clark in the Philippines to Torrejon in Spain, US operations are ending at hundreds of foreign bases.

The Flags Come Home

By Peter Grier

On June 28, 1991, the United States flag was lowered for the last time at Hellenikon AB, near Athens, Greece. Hellenikon only recently served as a valuable way station for US and allied forces deploying to the Persian Gulf region in Operation Desert Storm. At one time, it ranked as the largest US military outpost in Greece.

In recent years, however, Pentagon budget cuts, host nation reticence about the continued presence of US forces, and changing requirements for the forward defense of Europe have greatly diminished the value of Hellenikon to the US Air Force, which had long used it as a key facility for the defense of NATO's southern flank. Now in the hands of the Greek government, the base may be used to expand adjacent Athens International Airport, ripped up and made into a recreational center, or used for new housing.

"We are ushering in a new era, an era in which a base at Hellenikon is no longer needed," said the outgoing commander of the base, Air Force Col. Arthur G. Egge.

Other flag-lowerings will follow. As the Hellenikon experience shows, the question for the Air Force no longer is whether any of its overseas bases will be closed, but rather how many will shut down and where they will be.

Already doomed are two of the Air Force's largest and most pivotal foreign installations, one in Europe and one in the western Pacific. Torrejon AB, headquarters for USAFE's 16th Air Force and home of the 401st Tactical Fighter Wing, will be vacated by May 4, 1992, at the behest of the Spanish government. Current plans call for the 401st TFW and its 100 or so F-16s to relocate to a new facility at Crotone, Italy, that has yet to be built. It remains uncertain whether Congress will agree to pay the US share of moving the wing to that location.

On the other side of the world, Clark AB in the Philippines will be abandoned by the US in 1992, done in as much by the ash of volcanic Mt. Pinatubo as by Philippine opposition to the US military presence. Clark got its start in 1903 as a US Army cavalry post and was a key Pacific logistics hub during the

Korean and Vietnam Wars. It has long been the Air Force's largest single overseas installation.

The Big Question Mark

When it comes to the future of Air Force bases, Europe stands out as the big question mark. The Pentagon is starting to pare back its European infrastructure, with 314 sites now marked for closure. Many of these sites are housing units or other relatively insignificant subfacilities. The big crunch undoubtedly will come later. The Pentagon now plans to reduce Air Force presence in Europe from today's eight full tactical fighter wings to just over three by 1995. When that happens, entire major European bases will be endangered.

"We need to finalize our strategy and force structure in Europe and bring forward a final basing plan," Stephen J. Hadley, the assistant secretary of defense for International Security Policy, told Congress earlier this year.

At the end of World War II, the United States had rights to some 2,000 military facilities around the world, the legacy of the massive military infrastructure created in the all-out push to defeat the Axis powers. Political upheaval and changing military needs have greatly reduced that number over the years, to the point where the Pentagon now counts only about 300 major installations in foreign countries. Most are concentrated in western Europe and eastern Asia.

It is not difficult to identify the forces that are now shrinking the US network of overseas military bases in general and Air Force facilities in particular. They are the same ones that are changing overall US national security strategy. No longer is the Pentagon focused primarily on planning for the possibility of a big ground war in Europe that erupts into a global superpower confrontation. Instead, says Mr. Hadley, as the Soviet threat has declined, "regional conflict has replaced global war as the major focus of defense planning."

Instead of maintaining large, heavy, in-place forces, the US and its NATO Allies are moving toward lighter, more mobile forces capable of quick reaction to regional trouble. The theory of "forward defense" in Europe has been replaced by one of "forward presence"—a concept that envisions keeping relatively small groups of forces in place to show continuing US commitment to the defense of Europe and perhaps serve as a kind of tripwire that any enemy would be chary of crossing.

Laid on top of this are the budget cuts, which will force a twenty-five percent reduction in US force structure over the next decade, and the increasing restiveness with which nations view the presence of foreign troops, especially US troops, on their soil. Opposition from politicians in Madrid and from the Spanish public in general was the determining factor in the decision to shut Torrejon. Hellenikon was a convenient rallying point for anti-American Greek protesters and a target for anti-US terrorists, unlike US facilities in Crete, which will remain.

NATO Allies are moving toward lighter, more mobile forces capable of quick reaction to regional trouble.

Clark AB is a good example of how all these forces come together. Once judged irreplaceable as an Air Force stepping stone and support facility in the Pacific region, by 1991 it became more trouble than it was worth.

US military presence in the Philippines dates back to the acquisition of the island nation as an American colony in 1898, following the Spanish-American War. Though largely unfortified in the early decades of this century—part of a deliberate effort to avoid provoking the Japanese military leadership—the Philippines became a major US military site after it gained independence on July 4, 1946.

Longstanding Complaints

From the first, Philippine politicians complained about the purported unfairness of the 1947 Washington-Manila Military Bases Agreement, which had a duration of ninety-nine years and imposed no obligation on the US to pay monetary compensation or rents. Modifications shortened the agreement's time span and allowed for payments to Manila, but the US still faced political constraints on base use. For example, the United States did not launch combat air strikes from Clark AB for the entirety of the Vietnam War.

Rising nationalism following the 1986 Philippine revolution and the election of Corazon Aquino led to even greater agitation against US presence. Last year, the two sides began talking about what would happen when the base lease agreement expired in September 1991. Little progress was made. Then Mt. Pinatubo erupted, covering Clark with ash and destroying the electronic targeting equipment on the Crow Valley air-to-ground training range. At that point, the US decided unilaterally to give up Clark and pay only $203 million per year for use of the Subic Bay naval facility.

Even before the eruption, the US had withdrawn the last of the Air Force fighters based at Clark. With Soviet attack aircraft gone from Cam Ranh Bay, Clark's value as a combat station diminished greatly. Though Clark was still valuable as a logistics hub, the thinking went, Military Airlift Command could make do with other stopover locations.

Clark's most important airlift role, according to a RAND Corp. analysis of the base's utility, was as a refueling stop for aircraft traveling from either Guam or Japan to Diego Garcia, part of the British-owned

Indian Ocean archipelago used by US forces as an important rear-echelon staging area for Persian Gulf operations. From Clark, C-141 transports can reach Diego Garcia with almost a full load of cargo. The RAND study notes, however, that Singapore or Thailand could provide similar service.

Greater use of C-5s and C-17s could also help increase the Air Force's lift capabilities in Asia. An airfield in northern Australia would provide more politically certain access to the Middle East, notes the report, though it would add 1,000 nautical miles to the route. In any case, some MAC flights will still use Subic Bay's naval air facilities.

No More Crow Valley

The Air Force will miss Clark's training facilities. Crow Valley was the best air-to-ground range in the western Pacific. The Air Force plans to reconstitute most of the range in Alaska.

The air forces of Singapore, Thailand, and other US regional allies also trained at Crow Valley. Unlike USAF, they won't be able to pick up and move their exercises thousands of miles to the north. "They may be more substantive losers in all this than the US Air Force," says Larry Niksch, an Asian specialist at the Congressional Research Service (CRS).

Whether the Air Force will face other base closures as large and complete as Clark's in the coming months remains an open question. The Pentagon insists that while the base structure faces reductions, especially in NATO Europe, those reductions won't necessarily be as large as the reductions already planned for the force itself.

With mobility a key concern in future conflicts, many contingency bases controlled by the US may still be necessary, particularly in Europe. Planning such a network has become a complicating factor in the process of overseas base closure. Assistant Secretary Hadley told Congress, "Base closure does not necessarily follow from the removal of US forces. Some facilities may be needed for dual-based forces or for future reinforcements."

Many members of Congress, irked by the painful job losses stemming from the latest rounds of domestic base closings, think the Pentagon is dragging its heels on shutting foreign installations. They complain that most of the European facilities tapped for closing so far are minor—"radar towers, vacant lots, training fields, and artillery ranges where there are no personnel at all," in the words of a Democratic Study Group (DSG) report. The clear implication is that the Pentagon would do well to close overseas bases first.

The Pentagon hasn't released total figures, but the DSG report estimates that the job loss due to base closings in Europe announced so far will be far less than the 28,000 civilian and 30,000 military slots cut as a result of domestic closures. Members of Congress haven't received much information about where units being pulled back from overseas might be relocated.

"The Pentagon is still coming to grips with the end of the cold war," says a congressional staffer who follows the issue closely. "They [US officials] are reluctant to accept that you might not need the symbolism of the physical military presence. They say you have to close bases in a systematic way, which is another way of saying 'very slowly.'"

While the base structure faces reductions, they won't necessarily be as large as those planned for the force itself.

The Fight Over Crotone

Defense Secretary Dick Cheney insists that change has indeed come to the European basing structure. The Pentagon chief points out that fourteen percent of European facilities are already on the block, compared to only nine percent of installations in the United States. Congress is still angry about the issue, and opposition has focused largely on one item: Crotone.

The proposed air base at Crotone, located at the far southern end of the Italian peninsula, had its beginnings in a December 1988 meeting of NATO defense ministers. Concerned that the impending departure of the 401st TFW from Spain would create a gap in southern region defenses, the ministers announced their intention to pay for relocation of the wing somewhere else in the southern NATO area. The US was initially interested in two other Italian sites, Aviano and Comiso, but the Italians demurred on grounds of domestic political considerations. Crotone eventually won out over several other sites that were similarly located in remote, largely underdeveloped regions.

To Congress, Crotone represents a contradiction: a new base proposed when others are slated for closure, including the USAF portion of Comiso AS. Lawmakers have balked at approving the US portion of the bill for the new base, even though the NATO infrastructure fund is picking up the bulk of the cost.

To the US military, Crotone is an ideal forward-deployment spot on NATO's southern flank. "If I had only two US Air Force wings, I would want one in the southern region at Crotone," said the Army's Gen. John Galvin, Supreme Allied Commander Europe, in a congressional appearance earlier this year.

It's not hard to figure out the reason for General Galvin's view. From Crotone, the 401st's F-16s can cover the southern Mediterranean and range up toward Greece and even Yugoslavia. The base would also be an extremely good stopover spot for MAC flights between European bases and southwest Asia, located at just about the point transports get

down to their low limit on fuel, according to General Galvin. The value of bases in the NATO southern area has been demonstrated time and again over the past two decades. For example, the base now being vacated by the 401st TFW, Torrejon, served as the number one logistics base for resupply of forces in Desert Storm.

"Probably, an ideal spot would be something halfway between Torrejon and Crotone," said General Galvin, "except there is nothing but water between the two."

USAFE is working with the Italian government to locate an air-to-ground training range in southern Italy for the 401st, but they have yet to identify a suitable location. Faced with congressional opposition, USAFE has cut the US portion of Crotone's originally proposed costs by one-third. The Pentagon believes that NATO nations won't fund the airfield if Congress doesn't approve the expenditure. "It is unlikely that the NATO nations would agree to proceed without US participation," say Defense Department budget documents submitted to Congress.

Whatever happens with Crotone, the Air Force base structure in Europe will look different in the years ahead. The released list of installation closings leans heavily to shutting such minor posts as the Marienfelde Communications Annex in Berlin and the Martina Franca Bachelor Housing at San Vito, Italy. But when five tactical fighter wings, among other forces, finally pull out of Europe, there's going to be an awful lot of empty concrete somewhere. The Air Force operates some twenty major bases in the European theater. Observes Richard F. Grimmett, a CRS defense analyst, "They've got a lot of big facilities they've got to be thinking about."

"More Symbolic Than Significant"

The biggest Air Force closing in Europe announced so far, after Torrejon and Hellenikon, is Tempelhof Central Airport AS in Berlin, where all US operations are coming to a close. Mr. Grimmett points out that Tempelhof's function has long been "more symbolic than significant": It served as a US military entryway to a free city, Berlin, surrounded by Communist East Germany. Once the Berlin Wall fell, however, Tempelhof lost most of its symbolic value and became expendable.

USAFE's three numbered air forces have been headquartered at Torrejon (16th Air Force); at Sembach, Germany (17th Air Force); and at RAF Mildenhall, UK (3d Air Force). Of the latter two, Sembach seems the safest, in that it doubles as a major forward operating base for Royal Air Force tactical aircraft.

USAFE's eight tactical fighter wings are all physically separated from numbered air force headquarters. Three of the wings are based permanently in Germany: the 86th TFW at Ramstein AB; the 36th TFW at Bitburg AB; and the 52d TFW at Spangdahlem AB. It is difficult to envision a US pullout from the massive, 5,300-acre Ramstein base in the far western Rhineland. Besides its function as a base for a full fighter wing, Ramstein serves as USAFE headquarters and hosts major MAC units passing through Europe.

Four tactical wings are located in the United Kingdom, at RAF Upper Heyford (20th TFW), RAF Lakenheath (48th TFW), RAF Bentwaters (81st TFW), and RAF Alconbury (10th TFW). Of these, Lakenheath seems set to become a major European base for the Air Force's new F-15E fighter-bomber. The Pentagon requested $3.6 million in 1992 construction funds to support the changeover of the base from F-111s to the F-15E. The last USAFE TFW is the soon-to-be-homeless 401st.

What will happen to the big fighter bases when USAF units leave? For the moment, the Air Force isn't talking. The service repeatedly declines to field inquiries on the subject. The issue, says an Air Force spokesman, is "just too dynamic" at the moment.

Base closings might well focus on forward operating bases or continue with trimming radar sites and other small facilities. Almost certainly, the US will maintain access to all its current main operating bases, even if some are returned to host nation control and USAFE units merely rotate through on temporary assignments.

A USAF list of tentative 1994 building projects includes work at all seven tactical fighter bases in Europe.

General Galvin told Congress that military construction money will be spent only on "core installations" necessary for US forces no matter what their ultimate size. Both Lakenheath and Ramstein are slated for big construction projects next year. An Air Force list of tentative 1994 building projects, for which design money may be spent in 1992, includes projects at all seven remaining European tactical fighter bases.

One factor certain to figure in Pentagon decision-making is the relative popularity of the US presence in the United Kingdom, as opposed to Germany. Germany's strong environmental movement and heavy low-level flight training have led to increasingly fractious relations between some US bases and their neighbors. In the words of Mr. Grimmett, "You've got a lot of Germans who would like the US to go home." ■

Peter Grier is the Washington defense correspondent for the Christian Science Monitor *and a regular contributor to* Air Force *Magazine. His most recent article, "The Defense Management Makeover," appeared in the July 1991 issue.*

Radical budget reductions were the trigger—but only one of the causes—for an epic slide of the defense industrial base.

Declining, Diversifying, and Disappearing

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

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

IN WORLD WAR II, American industry mobilized to create the legendary "Arsenal of Democracy," turning its output from consumer goods to war materiel and achieving extraordinary rates of production. The great arsenal, however, lasted only as long as the war did, and we will not see its like again.

What the United States maintained through most of the postwar period was a defense industrial base (never the organized "military-industrial complex" of popular mythology) made up of prime contractors, suppliers, and subcontractors capable of meeting defense technology and production needs.

By the early 1980s, even this limited industrial base was deteriorating badly, especially at supplier and subcontractor levels. By 1982, Air Force Systems Command estimated that the supplier-subcontractor base had shrunk by more than forty percent over fifteen years.

Bad as it was, however, the decline in the 1980s pales by comparison with what is happening in the 1990s. For many reasons, conditions were ripe for a slide of epic proportions. One of those reasons —radical defense budget cuts— triggered the slide.

The heaviest losses are occurring today in the supplier and subcontractor tiers. Now as then, some of the worst problems are at the component level. In the 1990s, however, concern has escalated to larger parts of the defense industrial base.

The Navy has only two submarine suppliers: Newport News Shipbuilding of Newport News, Va., and Electric Boat of Groton, Conn. With Navy shipbuilding on the wane, there is concern that only one submarine yard will survive.

The production base for main battle tanks may go cold as early as December 1992, after the end of the M1A2 Abrams run. First deliveries

of a next-generation tank, the "Block III," are projected for 2003.

The US military buys helicopters from five US firms—Bell Helicopter Textron, Boeing Helicopter, McDonnell Douglas Helicopter, United Technologies/Sikorsky Aircraft, and Kaman. Some analysts speculate that two, perhaps three, might fold.

Termination of the Peacekeeper missile creates an unplanned break between last deliveries (1994) and the production start for the Small ICBM, a weapon whose political survival is not assured.

The scope and magnitude of the decline are underscored by an increase in concern that the industry may not be able to meet the needs of the military in wartime, that it is now overly dependent on foreign sources, and that US technological leadership is waning.

Vindicated but Gone

The Persian Gulf War was widely (and correctly) viewed as a vindication of the defense industry, but, in many ways, the war's successes reflected an industrial base that no longer exists. Even as the nation watched the war on television, the companies that produced the impressive weapons were releasing workers, closing plants, and seeking nondefense business.

The US government is not completely convinced there is a defense industrial base problem. Even when it grants that one may exist, Washington frets about what steps to take, if any. The *de facto* strategy is to let the market fires burn themselves out, then see what can be made of whatever is left of the base.

Through the 1980s, there were repeated warnings that the defense industry could not expand its production to meet wartime demands in less than eighteen months and that it was not possible to increase the output of even the most important weapons and war materiel much faster than that.

The issue began to attract broader attention in 1987, when the Defense Science Board warned that the US was losing its lead in the design and manufacture of electronic components and that the armed forces might soon be dependent on foreign suppliers for capabilities needed to maintain technological superiority.

Defense spending (adjusted for inflation) began to fall in 1986. Wholesale reductions, however, began with the November 1987 "budget summit," when the Reagan Administration made concessions to Congress and agreed to reduce the five-year defense plan further by more than ten percent. Since then, nearly all major defense programs have been touched by wave after wave of reductions. Dozens of programs were canceled outright and others were curtailed or "rescheduled" on short notice.

Surveying political changes in the Soviet Union and the breakup of the Warsaw Pact, the Bush Administration and Congress reached a consensus in July 1990 that defense budgets and forces could probably be cut by another twenty-five percent over a five-year period.

At a Boeing plant in Wichita, Kan., a KC-135 receives a new engine. The KC-135R modification made the tanker quieter, less smoky, and more efficient; some 250 aircraft have been converted since the early 1980s. Despite such successes, thousands of contractors, subcontractors, and suppliers have left the defense business, partly as a result of federal defense budget cuts.

By then the defense industry was already in flight. Major contractors had begun to cut their losses, diversify, and move to other markets. Defense stocks had lost forty percent of their market value over five years, and the price-to-earnings ratio had dropped to about half that of Standard & Poor's 400.

By the summer of 1990, the trend was so pronounced that the market was glutted with defense divisions for sale. Prices dropped so far that several companies decided to delay or forget about these divestitures.

The aerospace industry, a pillar of the defense industrial base, is doing well on the overall balance sheets, but that is attributable largely to the backlog of orders from the airlines, not to defense business. The relative profitability of the industry is often debated, but the quip, recounted by Kenneth Adelman and Norman Augustine, that "you can make a small fortune in the defense business—provided you start out with a large one" is uncomfortably close to fact for a number of firms.

A Shrinking Supplier Network

Numbers are not the whole story, but they are part of it. One widely accepted estimate holds that, between 1982 and 1987, the number of defense suppliers dropped from 138,000 to fewer than 40,000. Some (including 20,000 small firms) went out of business, but most simply moved to nondefense markets.

The Pentagon does not know how much further the shrinkage has gone, and neither does anyone else. During the preparation of the Air Force Association's report "Lifeline Adrift: The Defense Industrial Base in the 1990s," we heard varying estimates from informed sources on how deep the decline might go before leveling out. Speculation ranged from a low of fifteen percent to a high of fifty percent.

Small suppliers are disappearing, and even the giants of the industry have been shaken severely. *[See "Turbulence Rocks the Industry," September 1991 issue, p. 96.]* Of 244 firms responding to a 1990 survey conducted by the Defense Systems Management College, twenty-one percent said they were cutting back on or getting out of defense business.

Malcolm Currie, chairman and CEO of Hughes Aircraft, says that "if you think that much downsizing, mergers, and companies going out of the defense business [has] already occurred, you ain't seen nothing yet."

Ironically, this accelerated decline of the defense base happens at a time when DoD has adopted a new defense strategy, featuring smaller forces, reduced deployment overseas, and heavier dependence on "reconstitution of forces." In fact, the Joint Chiefs of Staff say that "reconstitution may well prove to be the linchpin of America's long-term security."

According to the new strategy, Washington must be prepared for a range of "plausible circumstances that might call for the application of US power." The scenarios vary in scope, intensity, consequences, and probability of occurrence. Minor conflicts would be handled by a "base force," smaller than today's but superbly trained and equipped. Reconstitution is seen as required for the more extreme scenarios, such as reemergence of a global threat from the Soviet Union.

Adm. David E. Jeremiah, Vice Chairman of the Joint Chiefs of Staff, says that the reappearance of a major new Soviet threat would be preceded by a long mobilization and "therefore, we will have time to reconstitute the necessary forces—provided we still have the infrastructure on which to build them."

A Hole in the Strategy?

Several assumptions are implicit: The base force can deal with all except the most extreme contingencies. There will be ample warning to prepare for broader conflict. Given time, the armed forces and the supporting industries will be able to regroup and respond.

Under the new strategy, the Persian Gulf War would be rated as a "major regional contingency." When Saddam Hussein invaded Kuwait last year, the twenty-five percent drawdown of US forces had not yet begun in earnest. Stock levels, built up in the 1980s, were high. US forces went to war with modern high-technology equipment, acquired in more prosperous days.

Even so, US forces and industry worked at a punishing pace to prepare for the fighting, which did not begin until nearly six months after the invasion. Despite the brevity of the war, the Pentagon had begun pulling its surge production options together before the conflict ended.

In a similar "major regional contingency" of the future, the base force would be smaller and perhaps less well provisioned. It may or may not have the advantages US forces enjoyed in the Gulf War: an incompetent adversary, extraordinary international support, and more than five and a half months to get ready.

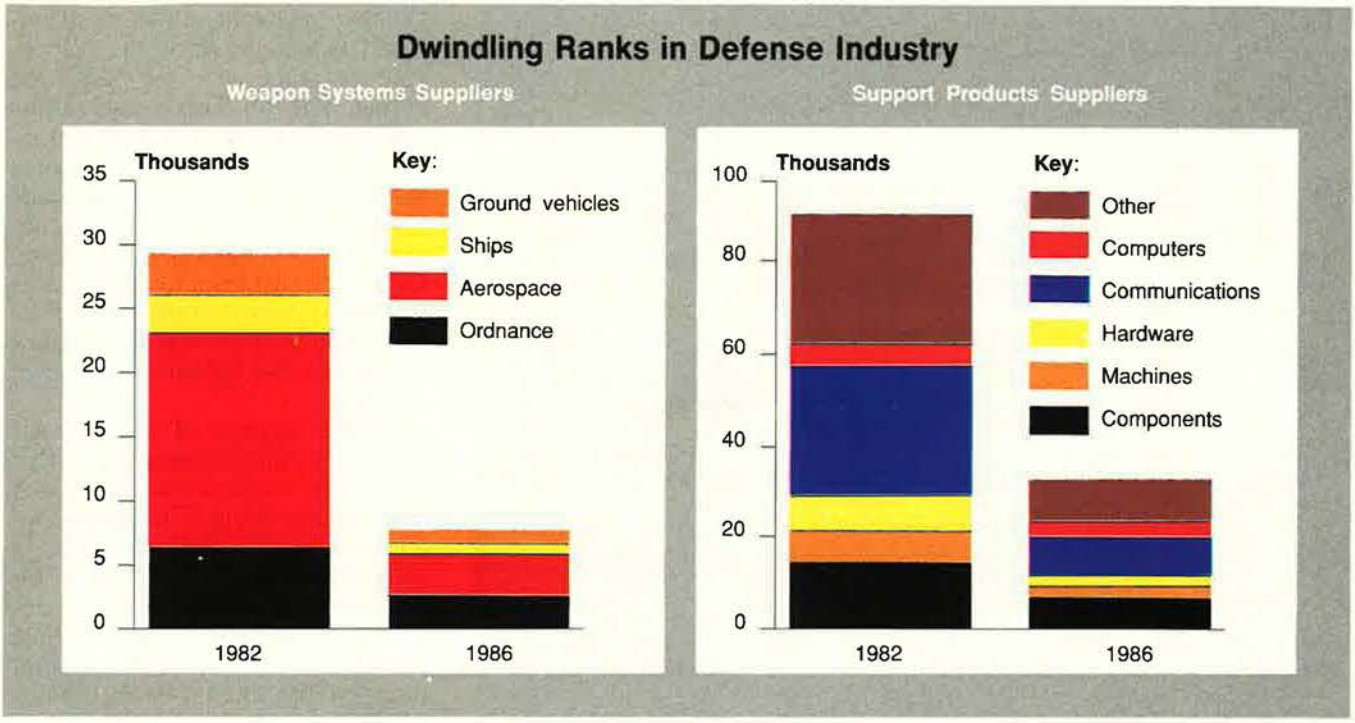
With smaller conventional forces, the Soviet Union might require considerable time to bulk up before it could once again present a global threat. Even after reductions and reforms, the Soviet armed forces could mount a challenge far exceeding anything seen in the Gulf War. US European Command believes that the Soviets still will be able to move thirty divisions in thirty days along a main axis of attack west of the Urals.

Defense analyst Jacques S. Gansler points out that, in all of its wars, the US has been able to mobilize forces much more rapidly than it could equip them. Not everyone is confident that enough of the base will survive for reconstitution and mobilization in a future emergency.

In this year's defense authorization bill, the House Armed Services Committee (HASC) expressed both general and specific concern about the industrial base. It noted, for example, that the US shipyard industry lost a third of its capacity in the 1980s. With business from the Navy diminished, it will not be possible to sustain the shipbuilding base without major new commercial orders.

Under current Air Force plans, the last F-16 fighter will roll off the line in 1993. Until F-22 Advanced Tactical Fighter output begins in 1997, HASC observed, there will be no ongoing production of Air Force fighters. Contrary to the Pentagon's wishes, the House voted to extend F-16 production beyond 1993, a move not reciprocated in the Senate. The Air Force says that with tactical force structure decreasing from thirty-six wings to twenty-six, it has no need for new F-16s.

Further, the Committee said, "with the expected twenty-five percent reduction in the defense budget



One of the most specific estimates of the decline was made by the Center for Strategic and International Studies in 1989. Drawing on information from government databases, CSIS concluded that more than 80,000 suppliers had left the defense market between 1982 and 1987. There is no reliable count of how many more have gone since then.

Center for Strategic International Studies, *Deterrence in Decay: The Future of the US Defense Industrial Base*, 1989. Reprinted by permission.

between now and 1995, the ability to mobilize will take on even greater importance."

Slow Revival

Even if the defense industrial base could be revived at a later date, it could not be done quickly. The Joint Chiefs of Staff estimate that, by 1997, it will take two to four years to restore production capability to the 1990 level, which was not that great a benchmark. The Joint Chiefs also note that only one or two suppliers remain for some critical items, adding that "we do not have either the authority or the resources to ensure that even this level of infrastructure will remain in the future."

Examples abound of the fragility and vulnerability of the industrial base at the supplier-subcontractor level. In May 1987 an accident destroyed a plant that produced half of the nation's ammonium perchlorate, and it took a year and a half to get a new plant running. In November 1988 the Pentagon discovered that its only domestic source of aerospace-grade rayon was closing its doors, a belated discovery that sent the government scrambling to qualify another source.

What most distresses some analysts, however, is that major problems now are beginning to affect prime contractors.

One major case is the US submarine-building industry. Tenneco's Newport News Shipbuilding and General Dynamics's Electric Boat Division are locked in a major struggle for survival that might leave the US Navy with a single supplier of underwater warships.

The submarine business is concentrated in only a relative handful of major production programs. The SSN-688 *Los Angeles*–class, nuclear-powered attack submarine is still in production, as is the Navy's *Ohio*-class Trident boat, a strategic-missile-firing submarine. In addition, the Navy plans to buy nine SSN-21 *Seawolf*-class, nuclear-powered attack boats over the next six years.

The Navy has split the SSN-688 orders more or less evenly. However, Electric Boat took contracts for all of the Tridents and the first two Seawolfs. Newport News is in litigation with the Navy over the award and claims that, unless it gets some Seawolf work, it will have to close facilities.

The Navy argues that Newport News has a good backlog of orders for *Los Angeles*–class submarines, as well as orders for three *Nimitz*-class aircraft carriers.

Preserving the Tank Base

Tank production is another concern. In its 1991 budget, the Army proposed terminating tank production after the M1A1 and M1A2 runs on the grounds that it could not afford to spend money on tanks it does not need. General Dynamics, the sole US builder of main battle tanks, has plants in Warren, Mich., and Lima, Ohio, but plans to close the Warren facility.

There is strong pressure from Congress to preserve the tank industrial base, with three possibilities seen for keeping the line open. One calls for upgrading the "vanilla" M1s, now roughly half the total Abrams fleet, to M1A1 standard. Option two calls for updating the M1A1 fleet to M1A2 configuration. Finally, the Army could upgrade the plain M1 to M1A2 configuration. The House Armed Services Committee prefers the third option and voted research and development money to pursue it.

Wave Riders, Classic Mobilizers, Emerging Technologists

There are three basic schools of thought about the defense industrial base, observes Gen. Robert T. Marsh, USAF (Ret.), chairman of AFA's Science and Technology Committee. In practice, individual opinions may combine elements of two—or even all three—of these schools, but those who hold strong opinions tend to align primarily with one school. These schools are worth examining in their pure forms, since the differences in assumptions and objectives bring the industrial base problem into sharper focus.

The "wave riders" (or *status quo* school) believe that defense cannot shape the industrial base and that it should adjust to realities created by a free market. They regard "doom and gloom" predictions as exaggerated. Some suppliers will opt out of the defense business, but others will come in. Foreign dependence will ebb and flow, but most friends will remain friends, and there will be sources for what the nation needs. If we maintain reasonable stocks, plan carefully, and address specific problems as they arise, the industrial base will serve defense well enough, perhaps even better than in the past.

This school assumes a comparatively low future risk to national security and further assumes that there will be adequate warning to prepare for a major crisis. This school is deeply committed to quality and productivity improvements but does not regard mobilization as a high priority.

Of the three schools, this is the largest, including both the optimists (who figure things will work out somehow) and the pessimists (who doubt that real change is possible). It is also the school most attuned to the Administration's free market doctrine.

The "classic mobilizers" envision possible conflicts that cannot be handled with standing forces and available stocks. They are concerned with problems of industrial capacity, production rates, sources of supply, lead time for components, availability of machine tools, and dispersal of trained manpower. The mobilizers worry more about foreign dependence than the other schools do. They are also more inclined toward industrial policy solutions.

Mobilization preparedness is expensive and difficult—two reasons why this school has traditionally been (and still is) a minority.

The "emerging technologists" are the newest school, with great popular appeal. Their main theme is to keep the US ahead or competitive in technologies identified as "critical" (DoD's term) or "emerging" (Commerce Department's designation). The approach, however, is weighted toward research and development.

Their concentration is on maintaining the *capability* to develop new technologies. Putting them into actual production is seen as less important. Consequently, they are not as concerned as the mobilizers about details of a multitiered production base with suppliers ready at all levels.

The emerging technologists are enthusiastic about flexible manufacturing and the integration of commercial and government efforts in high-technology endeavors.

They see the level of risk to national security as being lower than the mobilizers see it but higher than the wave riders' assessment. They assume there would be ample warning to move critical technologies into production and use.

Several M1A2 export deals are pending. If they pan out, the M1 line could stay open until 1995. There is strong competition, however, from several other nations, including Brazil, Britain, and Israel.

Experts predict that there will be considerable military helicopter business in the future. The question is whether there will be more than a handful of US producers around at that time. Boeing and Sikorsky have been selected to build the Army's new RAH-66 Comanche (formerly Light Helicopter). What happens next depends on final decisions affecting the Longbow Apache, the V-22 Osprey, and foreign military sales. Without foreign sales, the helicopter base likely will face serious trouble.

In the area of ICBMs, industrial sources say it will be difficult to maintain suppliers and other critical assets during the upcoming break in strategic missile production, particularly in view of the Small ICBM's uncertain future.

According to an industry assessment, the end of the Peacekeeper program, if it holds, will mean the release or retirement of 8,000 scientists, engineers, and specialists. The lost knowledge and experience of this work force cannot be quickly recreated.

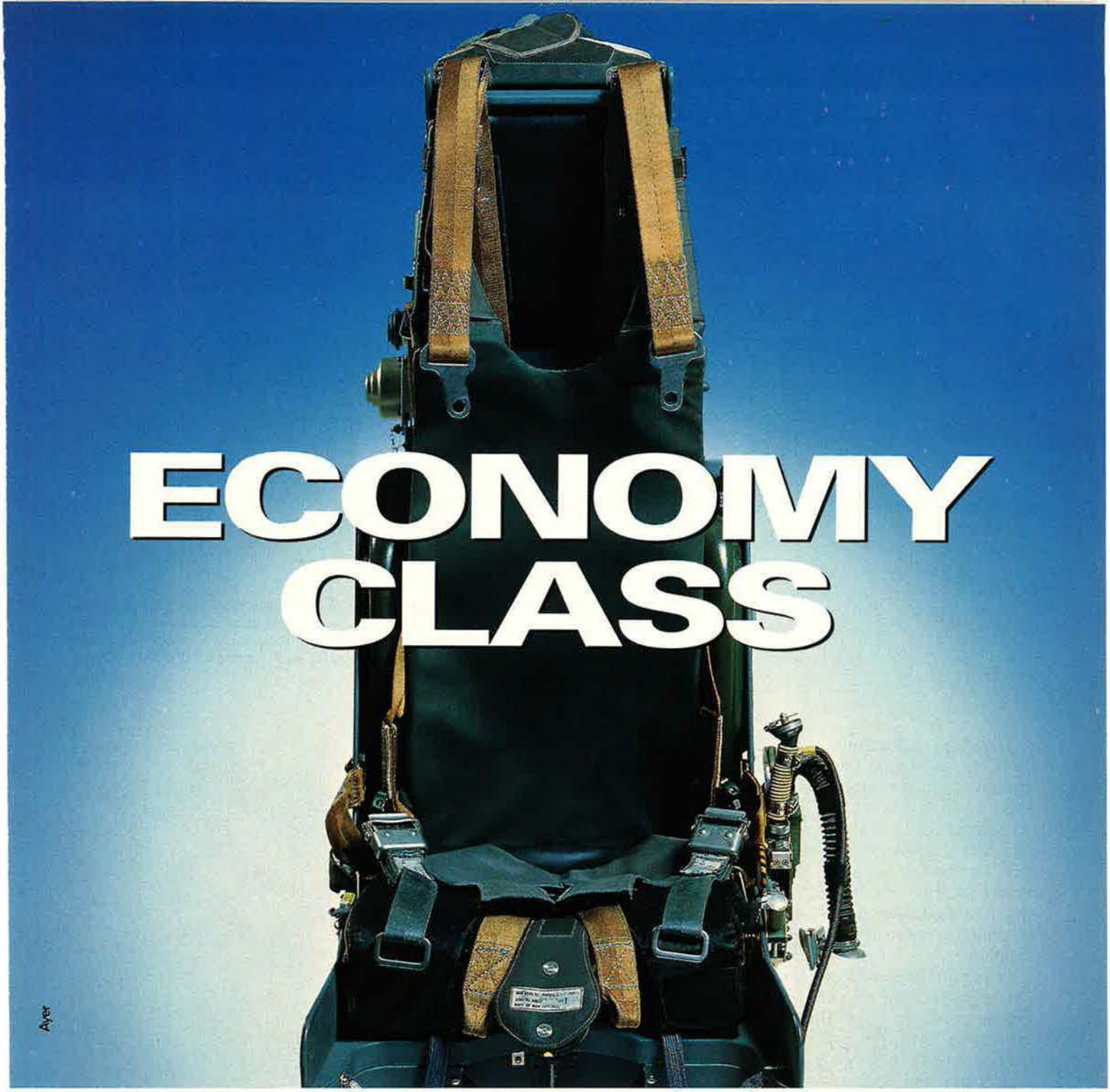
At present, there are two suppliers of fighter engines, Pratt & Whitney and General Electric. Concern has receded since the ATF engine contract went to P&W last spring. The Air Force says industrial base considerations played no part in the selection, but the choice of P&W—which needed the work—leaves the fighter engine production base in relatively good shape. GE will be sustained for some years by engine work on the Navy's F/A-18. It will also provide the engines for Japan's S-3 fighter (also known as FSX).

To the surprise of no one, Air Force Systems Command finds that its supplier-subcontractor base is soft and declining in numbers. An anomaly of the decline is that, in some instances, waiting times for components have actually decreased. The production lead time for landing gears, for example, dropped from twenty-seven months in 1983 to only twenty months in 1990. This appears to be temporary, an excess capacity in the supplier chain caused by the rapid drop in business. Analysts expect that, as vendors drop out, waiting times will increase once more.

The case could be made that shrinkage of the supplier-subcontractor base is not all bad. Tough times will weed out the weak and the marginal players and thus provide a clearer field for the best and most dependable. Whatever the merits of such arguments, the US seems destined to enter the future with a strategy that counts on the capability to reconstitute forces and a defense industrial base that is declining on all fronts.

No one expects the defense industrial base to disappear completely. After the decline has run its course, a substantial number of well-qualified suppliers will remain. Despite such problems as foreign dependence, limited competition, long waiting times for components, and occasional breaks in the supplier chain, the industrial base will probably be able to meet planned production requirements in peacetime.

There is less assurance that it will be able to respond adequately in wartime. If not, the US will have deceived itself into accepting an industrial base that looks good until the shooting starts and then flunks the test that really matters. ■



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Where should we—or can we—draw the line on foreign dependence for critical defense items?

Lifelines Abroad

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

The increasing reliance of US defense on foreign sources for electronics is worrisome. A Commerce Department analysis warned that Japan could be the world's primary electronics producer and trader "by the early 1990s."

FOREIGN dependence is the defense industrial base issue the American public understands best and to which it reacts the most intensely. In fact, the increasing penetration of defense and other markets by foreign suppliers has provoked such an emotional response that it complicates the task of those seeking sensible solutions to the problem.

Protectionist sentiment runs high in Congress. Part of it, no doubt, is genuine concern about the defense industrial base, but political passions are further driven by the loss of US jobs and business to foreign suppliers.

The Pentagon acknowledged in 1988 that it did not know the extent to which it relied on foreign parts and had no way to identify, much less minimize, such areas of dependence. DoD's data have improved since then, but, in the opinions of a Defense Science Board (DSB) task force, the General Accounting Office, members of Congress, and others, many blind spots remain.

Most observers agree, however, that the reliance of US defense on foreign sources is extensive and growing. The classic area of concern is electronics. The problem is evident in other sectors as well.

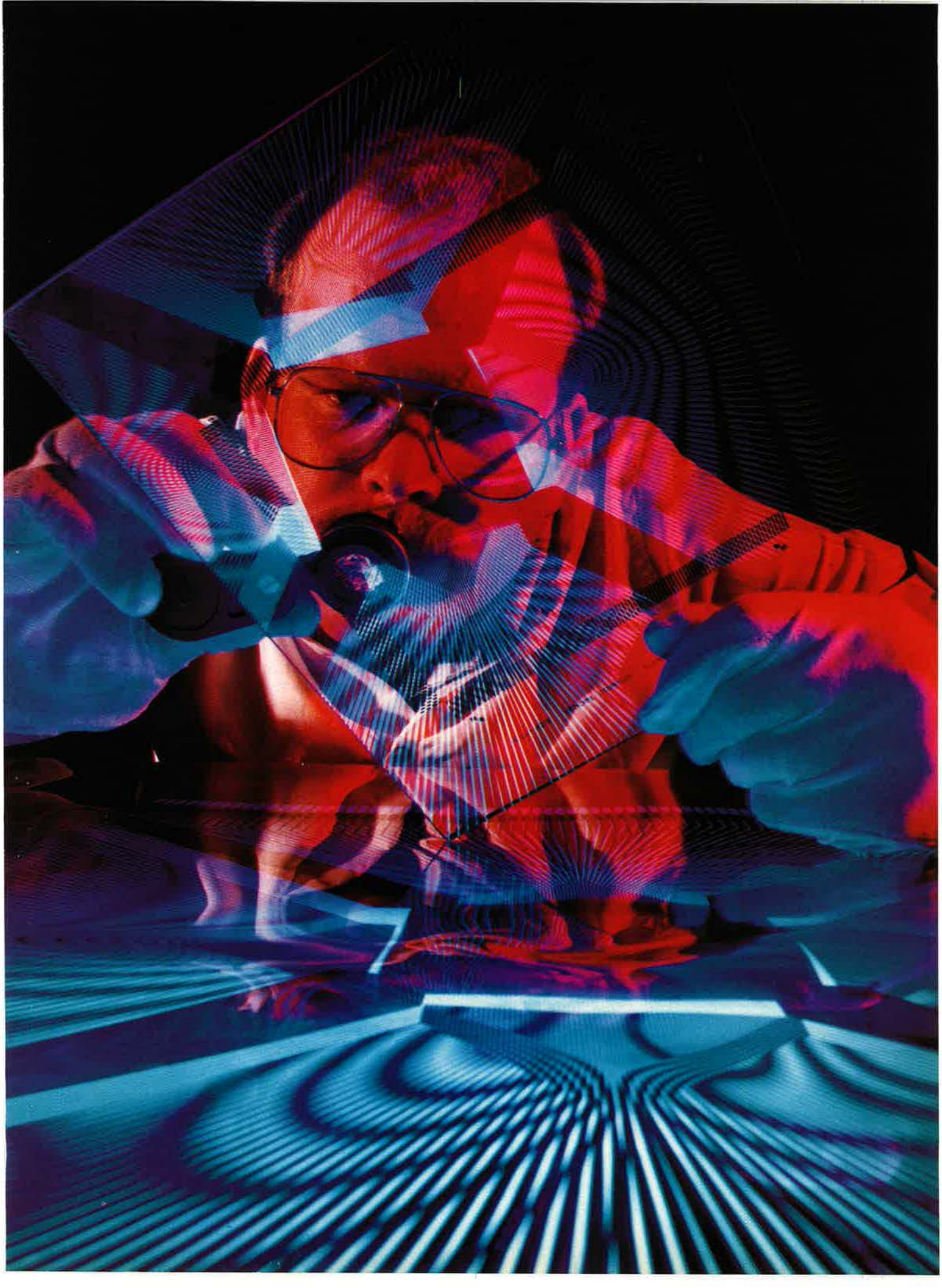
The nation's armed forces are understandably nervous about their increasing reliance on foreign sources. Of all the problems identified in key sectors by the 1990 Air Force Systems Command Industrial Base Assessment, the dominant concern was foreign dependence.

If foreign sources were unavailable in a crisis, the Joint Chiefs of Staff say, the US would be able to sustain accelerated production for only two months in such systems as the M1 tank, the AIM-7 missile, sonobuoys, and the F/A-18 fighter. It would be six to fourteen months before domestic sources could deliver the critical components and materials for continued production.

Controlled, Not Eliminated

It is generally recognized that foreign dependence is a problem that may be controlled but that cannot be eliminated. One key conclusion of *Lifeline in Danger,* the Air Force Association's 1988 study of the defense industrial base, was that the US cannot have an all-domestic defense industrial base. Even if it were possible, it would be unwise. "Buy American" policies, followed blindly, undermine interoperability and two-way trade with allies. They also drive up costs and jeopardize defense system quality by forcing prime contractors to buy higher-priced and sometimes inferior parts from domestic sources.

Nor can the US cut off access to



the best technology, which will be foreign technology in some cases. The proper objective is to identify critical, potentially harmful cases of dependence and concentrate on reducing them.

Acquiring defense products from foreign sources does not necessarily constitute dependence, and even dependence is not automatically crippling. Foreign suppliers may have needed some nudging in the course of Operation Desert Storm, but, in the end, they delivered. *[See box at right.]* Like much else about the defense industrial base, it is a matter of calculating the risks and the realities.

Sooner or later, political and strategic repercussions tend to develop when nations are dependent on foreign suppliers for defense products. History refutes the argument that dependence is of minor consequence.

Prof. Theodore H. Moran of Georgetown University points out that "all of the major European powers have experienced the agony of dependence on companies and technologies controlled from abroad." This has been true, he notes, "from the Suez crisis of 1956, for example, when the United States threatened to order its oil companies to cut off supplies if the British and French did not withdraw their military forces from the Canal, through the Johnson Administration's order to IBM and Control Data to withhold critical computer technology from de Gaulle's nuclear *force de frappe,* to the Soviet gas pipeline case of 1982."

During its long period of dominance in weapons production, the US routinely limited the access of other nations, including allies, to systems and technology. The US should expect similar practices by other nations as the direction of dependence shifts.

For example, the DSB report points out that the US had difficulty getting television cameras for missile mounts during the Vietnam War and that Japan's Diet held long debates over whether Kyocera should supply ceramic parts for US cruise missiles. Rep. Helen Delich Bentley (R-Md.) cites the case of Mobay Chemical Co., a German firm operating in the US that refused to sell chemicals to the Army for weaponry. When challenged, she says, "they told the Army, 'It is policy—so sue us.'"

Concern about US reliance on foreign sources inevitably invokes memory of the 1973–74 oil embargo, this nation's most wrenching experience of having supplies withheld by nations that had us in a position of dependence.

"We Might Have Had Trouble Recovering"

US forces relied on foreign suppliers in many instances during the Persian Gulf War. The Pentagon says that in no instance was there a failure to deliver. The Department of Defense assured Congress that there was trouble only twice in getting items from foreign suppliers and that both cases were resolved amicably.

Nevertheless, according to numerous reports, high-level persuasion may have been required to ensure these deliveries, and a Japanese spokesman confirmed that cooperation was a touchy public issue in Japan, where many of the sources were located. The Congressional Research Service says that, in several cases, foreign reliance complicated the smooth flow of supplies to the Persian Gulf, even when foreign governments were cooperating to the full extent.

In the war, Air Force Logistics Command relied on foreign suppliers for parts and subassemblies forty-two times. Noting that the command was awarding about 12,000 contracts a week during the war, AFLC Commander Gen. Charles C. McDonald called the level of foreign dependence relatively small. However, he added a warning. In three of the forty-two cases, no alternative supplier existed and the US was in a sole-source situation.

"Foreign dependency was not a problem, but if the coalition had been different, it might have been," he said. 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."

During the Gulf War, US forces relied on foreign suppliers for many items. While some defense procurement from foreign suppliers is inevitable and even desirable, foreign dependence, left unchecked, could lead to strategic vulnerability.

Still Saying No

The Japan That Can Say No, by Shintaro Ishihara (a million-copy best-seller in Japan), set off shock waves in the United States with observations that the Pentagon would be "totally helpless" without Japanese chips, that Japan "is in a very strong position," and that "when matters of crucial national interest warrant," Japan must "articulate our position and say no to the United States."

The DSB took note of this threat and others, commenting that, "as the leader of the Western alliance, the United States needs the freedom to take actions that our allies may wish to distance themselves from politically. Foreign dependence complicates such actions; it allows others to 'say no' and make it stick."

Mr. Ishihara is back with a new book, *The Japan That Can Definitely Say No*. It argues that Japanese technology made allied victory in the Gulf War possible and suggests that, if conflict occurs again in the Middle East, Japan could withhold financial support and spend it on "Japan's own creation of an international world order."

Politics and ideological disagreement aside, foreign governments may withhold technology for trade advantage. According to a DSB task force, that happens frequently. "Evidence of the willingness on the part of US allies to withhold technology from us is increasing, probably in direct relation to the extent of technology leadership," said the task force's report.

For example, it contends, Nikon makes its latest stepper semiconductor manufacturing equipment available in Japan up to twenty-four months before it will sell the devices to nondomestic firms. Nikon claims that this helps get the "bugs" out of the equipment before it is sold abroad. US chipmakers complain that this practice allows manufacturers in Japan to remain ahead of US competitors in the production of next-generation semiconductors.

In another, somewhat more disturbing case, the DSB says that a Japanese firm withheld the sale of an advanced microelectronics package for supercomputers to a US firm because the sale would have stripped a Japanese producer of its competitive advantage.

Testifying before Congress earlier this year, Nicholas Torelli, the deputy assistant secretary of defense for Production Resources, surveyed the situation with optimism.

"With the reduction of the threat comes a plausibility of a longer warning; thus, our previous concern about foreign dependency can be substantially softened," he said. "If the primary threat is perceived to be Third World conflicts, such as Desert Shield and Desert Storm, in which the US is operating in concert with international coalitions, the probability of interdiction or arbitrary cutoff of foreign sources may not be high."

Targeting and Seizing Markets

Considerable effort is expended to make US industry more productive and competitive internationally, but even if those efforts succeed, American firms must still face foreign government-industry cartels that target and seize markets with combined-arms tactics. The 1991 report to Congress by SEMATECH, an American consortium working to regain the US position in the computer chip market, provides a short case study in how Japan, Inc., works the drill.

If foreign sources were unavailable in a crisis, the Joint Chiefs of Staff say, the US might only be able to sustain accelerated production of M1 tanks for two months.

In 1975, says SEMATECH, Tokyo targeted semiconductors and provided its industry a wide range of assistance, including subsidized research and development, a protected domestic market, low-cost financing, antitrust immunity, and cartel-like planning. Japanese producers teamed with the powerful Ministry of International Trade and Industry to attack the US semiconductor market with determination. In the mid-1980s, Japan took a two-year loss of more than $4 billion, dumping American-designed, reverse-engineered dynamic random-access memory (DRAM) chips on the US market below the cost of production in order to gain market share.

It worked. Japanese conglomerates sustained the dumping long enough to drive all but two US firms out of the DRAM business.

In 1986, the US and Japan agreed to a pact that was supposed to stop the sale of chips at less than market rates. As part of the agreement, foreign producers—mainly American firms—were supposed to gain twenty percent of the Japanese chip market by 1991. Since then, and despite a small uptick last year, the US share of the global chip market has declined further. US sales to Japan fell far short of expectations, and the arrangement had a negative side effect. While US computermakers bought chips at the high prices established by the pact, Japanese computer manufacturers bought cheaper chips from domestic suppliers.

In June, the US and Japan agreed to extend the 1986 agreement with some changes. The revised deal eliminates the minimum chip price but again sets a target of twenty percent of the Japanese semiconductor market for foreigners.

The Economist plotted on a graph the expectations for sales in Japan under the 1986 agreement (a goal of twenty percent) and the actual experience of the past five years (topping out at thirteen percent, of which twelve percent was American and one percent European) and declared the divergence of the trend lines "the angle of unreality."

Foreign Takeovers

A variation on the straight dependence problem is the one of takeovers and penetrations of US industries by foreign investors.

In response to the Exon-Florio amendment (1988) to the Defense

The Strange Case of Moore Tool Company

Former State Department official Kevin Kearns got full effect with his angry article, "Who Will Build America's Nuclear Arms? The Sale of a Key Supplier Means It May Not Be Americans," in the January 13, 1991, Washington *Post*.

In short order, all hell broke loose. What Mr. Kearns had brought to light was the sale (a forty percent share, as it turned out) of Moore Special Tool Co.—described as a "crown jewel" of the US industrial base—to Japanese investors. To make matters worse, the acquisition had been reviewed and passed by the government's appointed watchdog, the Committee on Foreign Investments in the United States (CFIUS).

Characterizing Moore as "the sole US supplier to the Department of Energy for specific aspects of our nuclear weapons program," ten Congressmen wrote to President Bush, imploring him to block the sale, using emergency powers if need be.

Moore Tool was founded in 1924, serving local clock and brass firms from second-floor shop space above a diner in Bridgeport, Conn. It prospered through the Depression and grew into one of the world's leading producers of ultraprecise machine tools. By the 1980s, about ten percent of its sales were to the government, including tooling and other items for the nuclear weapons program.

Like others in the machine tool industry, however, Moore had run into hard times recently. It had laid off seventy of its 400 workers and needed capital to upgrade its plant and equipment to become more competitive in the overseas market.

Unable to find US investors, Moore struck a deal in which Fanuc Ltd. of Japan would buy forty percent of its stock for $10 million. The proposed acquisition passed through the CFIUS review without a ripple.

That changed quickly when Congressmen and others read Mr. Kearns's article. In view of Japan's strong opposition to nuclear weapons and its policies on export of weapons of any sort, there was great concern about Japanese acquisition of a critical Department of Energy machine tool supplier.

The controversy raged for a month, and on February 18, Fanuc dropped its offer to buy. With Japan in retreat, Washington's interest in the Moore Tool case diminished—except for its value in periodic clubbings of CFIUS.

Back in Bridgeport, however, the old realities had not changed. In June, four months after withdrawal of the Japanese offer, Moore Tool Co. was still searching for acceptable investors.

Production Act, the President set up the Committee on Foreign Investment in the United States (CFIUS) to review foreign investments that might impair US national security (which was not defined). Since its creation the committee has blocked only one of the deals it reviewed, a case in which the government ordered the divestiture of a US airplane parts manufacturer that had been acquired by an arm of the Chinese government immediately after the 1989 Tiananmen Square massacre.

Of the 540 foreign investments reported to CFIUS since 1988, the body has formally investigated twelve and made a negative recommendation on one. In some high-technology areas, says the Economic Strategy Institute (ESI), "CFIUS has even allowed the last remaining firm to be sold, apparently unconcerned that these deals will leave both the US military and the private sector completely reliant on foreign suppliers of many critical goods."

ESI adds that the US government refused to conduct a formal review of the foreign acquisition of Union Carbide Chemicals and Plastics Co., the only US producer of ultra-high-purity polysilicon, despite the fact that the firm developed polysilicon specifically for defense purposes. It was bought by Komatsu Electronic Metals Co. of Japan. Earlier this year, public and congressional outrage stopped Japanese acquisition of a critical machine tool firm, Moore Tool Co. The sale had been passed by CFIUS. *[See box above.]*

A June 1990 DSB report, sharply critical of CFIUS, said that "one problem with CFIUS is that the chairman, a Treasury Department official, has a primary goal of alleviating the overall budget and foreign trade deficits. Foreign investment is not only unavoidable but positively desirable as a means of repatriating US consumer dollars that cause imports to exceed exports. Obviously, the Treasury Department does not want to frustrate the desire of foreign firms to invest capital in the United States."

The DSB task force recognized that some foreign investments in US high technology are beneficial. In 1989, Materials Research Corp. (MRC), a key producer of semiconductor equipment, faced bankruptcy and could not find domestic financing. It stayed afloat with funds from Japan's Sony Corp. The task force reported that "with MRC, the United States now has at least a domestic location and relatively assured access to sixty percent of the world's equipment for sputtering materials [specialized materials used in the production of semiconductors]. If MRC had gone bankrupt, our assured access might have been reduced to roughly two percent."

Some members of Congress believe CFIUS needs new leadership and tougher orders. In her proposed Technology Preservation Act, Rep. Cardiss Collins (D-Ill.) suggests amending Exon-Florio to tighten controls and restructure CFIUS. The amendment would specify that impact on the US industrial and technology base be a criterion for review and would require that foreign investors in mergers, acquisitions, and takeovers give written assurance that their plans and intentions would not impair national security.

The level of foreign dependence in the defense technology base varies by industry. In some sectors, such as semiconductors or machine tools, foreign companies hold a majority of the market and control a major share of the technology. In others, like computers and materials, the US still holds a decisive lead in technology but foreign companies are taking an increasing share of the market.

Foreign dependence is not a new problem, and time has softened the psychological shock. The Pentagon and the services now take a practical view of the matter and have adjusted themselves to living with a certain amount of reliance on foreign suppliers.

Machine Tooling Is the Cornerstone

Some commodities and some industries, however, remain of special concern. Among these is the machine tool industry, which has been characterized as the "cornerstone of the nation's industrial base." Ma-

chine tools cut, grind, shape, and form materials, including metals, into useful products. From 1982 to the present, the import share of the US machine tool market rose from twenty-six percent to about fifty percent.

Defense Department purchases account for some ten percent of the US machine tool market. In 1987–89, DoD made 2,350 machine tool procurements. Of those, 1,550 were from the restricted list, meaning a waiver was required for non-domestic purchase. Foreign-made tools on the restricted list were bought in 108 cases.

Efforts to shore up the domestic machine tool industry have had some positive results. One of the most successful projects of the National Center for Manufacturing, a research consortium established in 1986, has been the development of a machine tool that combines tap and drill functions.

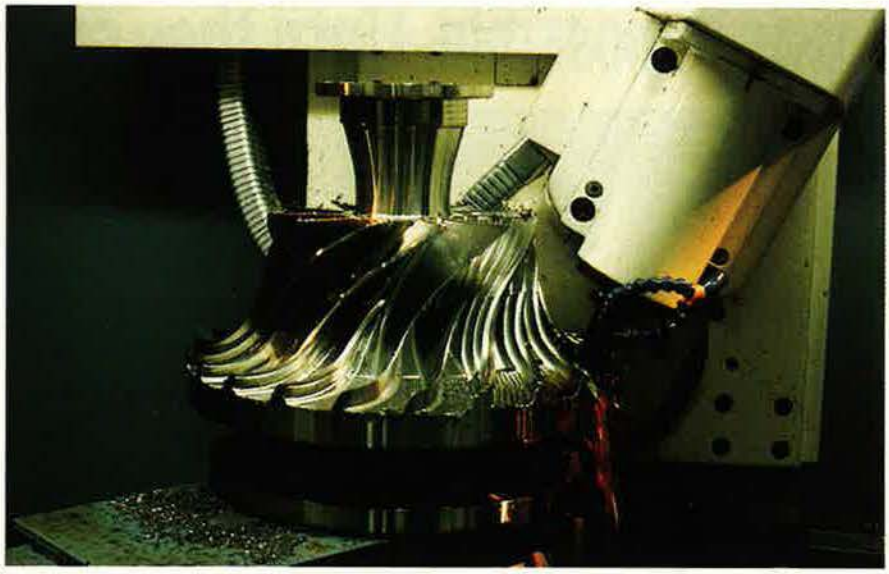
Nevertheless, the machine tool industry as a whole is still struggling, and the problem could have some long-range effects. Albert Albrecht, owner of a machine tool consulting firm, says that "what the statistical numbers do not reveal is the loss of engineering and shop floor skills. The loss of manufacturing talent, as a result of the decline in the machine tool industry, is perhaps more serious than the lost volume. It is conceivable that we could reach the point of having to depend upon foreign suppliers to tool up a US Army shell line in a GOCO [government-owned, contractor-operated] plant."

Mr. Albrecht points out that, in 1991, "overall earnings were down significantly, as were shipments. The industry needs help if it is to survive." It is conceivable that, by 2000, "there will not be a US machine tool industry to support our defense needs," he warns.

Meanwhile, the Japanese machine tool builders' backlog (5.7 months) now surpasses that of US firms (5.2 months). The demand is growing in this Japanese industrial sector, already working at capacity.

The "Four/Fifty" Rule

The question is not whether defense will be dependent on foreign sources—that's a given—but where we should (and can) draw the line.



The level of foreign dependence in the defense technology base varies by industry. In the machine tool sector, foreign companies hold a majority of the market and control a major share of the technology.

Professor Moran proposes a "Four/Fifty" rule, in which defense industrial strategists would seek to ensure that no four countries or four companies supply more than fifty percent of the world market. He further stipulates that sources under this rule should meet an "arm's length" standard. That would appear to exclude sources controlled by adversaries or others with interests potentially in conflict with the US defense program.

It is difficult to say how actual circumstances today square with the proposed "Four/Fifty" rule. For some commodities, the armed forces would probably welcome with joy the existence of four reliable sources.

It is no longer as easy as it once was to specify whether a source is foreign or domestic. As the Office of Technology Assessment notes, "Individual companies and entire industries are becoming internationalized. It is becoming increasingly difficult (if not impossible) to define what an American company is."

In any case, the government does not look at US sources alone but at those available in the entire North American industrial base. By long practice, formalized in the Defense Development and Defense Production Sharing Arrangements of 1959 and since reinforced, the US and Canada regard themselves as partners in industrial preparedness.

In today's multinational world, components of a product may be manufactured in several different countries and assembled in yet another. Determination of whether the finished item is foreign or domestic often involves percentages.

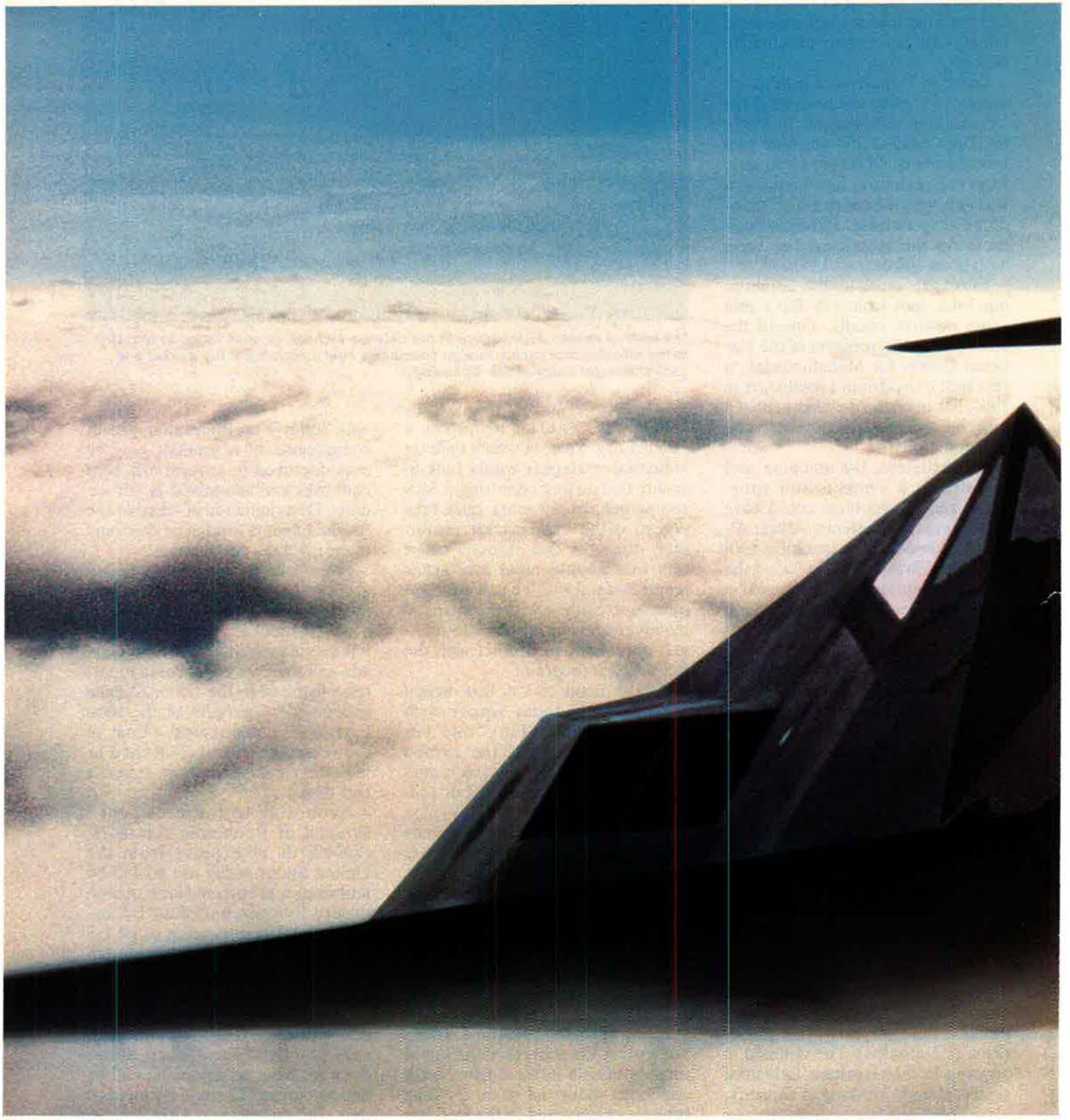
For example, the Defense Federal Acquisition Regulation Supplement goes to some length in defining a machine tool as US or Canadian if it is manufactured in the US or Canada and the cost of its components manufactured in the US or Canada exceeds fifty percent of the total cost of its components. "Cost of components" is further defined as including transportation expense and duties.

According to the President's Council of Economic Advisors, two-thirds of exports from the United States today are traded by multinational corporations. About twenty-five percent of all US exports and fifteen percent of all US imports are transfers between parent multinationals and their affiliates abroad.

Cyrill Siewert, former chief financial officer of Colgate-Palmolive, says bluntly, "The United States does not have an automatic call on our resources. There is no mindset that puts this country first."

Colgate-Palmolive does not loom large in the defense industrial base, but, in time, a US-based multinational with a more critical product line could adopt a similar attitude. ■

It was impossible. Until they called Lockheed.



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At nine Gs, you weigh 1,800 pounds and you feel every ounce of it.

G-Lock and the Fighter Jock

By Robert E. van Patten

A "G" IS A MULTIPLE of the gravitational pull of Earth. When a bucket full of water is spun around in a horizontal circle on a rope, Gs are what keep the water from spilling out. The water is being accelerated toward the center of rotation hard enough to generate a counter (centrifugal) force that keeps it in the bucket.

The same phenomenon affects the blood nourishing a fighter pilot's brain and vision when he maneuvers in tight turns in air combat. Not only do the Gs affect his blood supply, they also have an impact on every fluid, muscle, bone, and other tissue in his body. At nine Gs, a 200-pound pilot weighs the equivalent of 1,800 pounds, and he feels every ounce.

Over the last few years, media reports of pilot deaths resulting from G-induced loss of consciousness (G-LOC, or "G-Lock") in high-performance fighters have underscored the current realities of life for the professional fighter pilot.

The pilot who aspires to fly such fighters as the F-16 must first understand that this plane is a different proposition than the fighters of the preceding generation. In planes such as the F-4, pulling really high Gs is done infrequently and carefully. Because of the lack of limiters, it is possible to bend an F-4 seriously if it is stressed beyond design limits.

In a modern fighter, the presence of digital, fly-by-wire flight controls permits the use of "relaxed stability criteria." This means that you can build a basically unstable aircraft, keep it under control with computers, and use it to pull Gs like nothing seen before. This is what is meant by "high-agility aircraft."

Grave Risks for the Untrained

These design advances allow incorporation of G limiters, which prevent airframe damage and give the pilot the freedom to reach a maneuver limit of a bit over nine Gs in about one and a half seconds. In the past, any pilot who had not been properly trained to resist these effects was at grave risk.

This is why the training of the new-generation fighter pilot affects every aspect of his life, not just those having to do with the stick, throttle, and rudder.

Training on a centrifuge, a pilot, having lost consciousness at nine Gs, is still incapacitated as the Gs drop to 5.3. He will experience convulsions, followed by a period of partial consciousness and confusion, before recovering fully.

Tolerance of high, rapid-onset Gs varies widely from individual to individual and from day to day for each individual. The eight primary factors that determine acceleration tolerance are anatomy and physiology, body orientation with respect to the G vector, magnitude of Gs, duration of Gs, rate of change of Gs, proficiency in performance of self-protection maneuvers, protec-

tive equipment, and illnesses or medications.

Additional factors make the current generation of fighter jocks resemble athletes. These include body type, physical fitness, age, blood pressure, fatigue or rest status, diet and nutrition, and dehydration.

In aviation medicine, the effects of acceleration on human physiology are separated according to the body axis through which the acceleration acts. When flight surgeons talk about Gs, they are talking about the inertial effects of the acceleration. Three physiological axes are defined, and "+" and "−" signs are used to denote the direction of the inertial force in a given axis. These axes and their directions are defined as follows: +Gz, or headward acceleration ("eyeballs down"); −Gz, or footward acceleration ("eyeballs up"); +Gy, or lateral acceleration ("eyeballs left"); −Gy, or lateral acceleration ("eyeballs right"); +Gx, or transverse acceleration ("eyeballs in"); and −Gx, or transverse acceleration ("eyeballs out").

Thus, inside loops produce +Gz, outside loops produce −Gz, sideslips produce +Gy or −Gy, abrupt forward acceleration in the aircraft's longitudinal axis produces +Gx, and abrupt deceleration produces −Gx.

Human tolerance of acceleration is lowest in the +Gz direction. The vertical distance from the aorta to the retina of the eye is, on the average, 350 millimeters (almost fourteen inches). When one is sitting in a chair in normal one-G gravity, one's heart must pump a column of fluid up to the eyes and brain. Pulling +2Gz makes that fluid column twice as heavy (or twice as high, depending on how you choose to look at it). The heart must greatly increase its pressure output in order to keep the eyes and brain perfused with blood. At +5Gz, the heart must pump with even greater pressure in order to keep one conscious.

For the average relaxed and unprotected man subjected to gradually increasing acceleration in the +Gz direction, dimming vision starts at three to three and a half Gs. Loss of peripheral vision occurs at three and a half to four and a half Gs.

The Collapse of Vision

When dealing with acceleration, however, "tolerance" is a tricky word to define. Different kinds of tolerance endpoints are used. Symptoms of slowly applied +Gz acceleration are primarily visual, aside from sensations of increasing body heaviness. The earliest symptom is loss of peripheral vision, which becomes worse as the stress is sustained. The vision eventually collapses to tunnel vision, accompanied by graying or dimming of vision, followed by blackout, followed by unconsciousness.

These symptoms are caused by decreasing blood pressure at the level of the eyes. Because of this decrease in effective pressure, the heart is unable to fill the arteries in the retina, and, as this process goes on, the eyes cease to be perfused at all, and one is then "blacked out." The pressure of fluid within is still enough to perfuse the brain, or at least some of it. For this reason, it is possible to black out and still be conscious. If the stress is continued, unconsciousness will result.

G-LOC typically starts with fixation of the gaze. Then the eyes roll

up and to one side, and complete muscular collapse follows. There is a period of absolute incapacitation, and during the latter stages of this period the pilot may experience dreams and have convulsions. This is followed by a period of relative incapacitation in which the individual is nominally conscious but not capable of purposeful action. This process takes as long as thirty seconds, during which no one is flying the aircraft.

Human tolerance to rapid-onset-rate (ROR) acceleration is less than tolerance to gradual-onset-rate (GOR) acceleration. During a GOR acceleration (a less than one G per second increase in Gs), tolerance is increased by cardiovascular compensatory reflexes. Sensors in the circulatory system detect changes in flow and blood pressure and initiate changes that can raise the blood pressure. This process requires about ten seconds to develop fully and increases tolerance about one G.

In the extremely rapid buildup of Gs in modern fighters, there is no opportunity for these reflex actions to develop. The unwary pilot may lose consciousness abruptly as soon as oxygen in his brain is used up. This reserve of the brain maintains consciousness for three to five seconds, irrespective of the onset rate.

The brain's blood oxygen reserve is responsible for the anecdotes you hear around the bar that so-and-so pulled twelve Gs without blacking out. Sure he did, but not for long.

Through training and experience, pilots of high-performance aircraft learn to fine-tune their G tolerance by observing the changes in their peripheral vision as it progresses toward tunnel vision, grayout, and blackout.

It is common for pilots to add and unload Gs to maintain a maneuver short of actual blackout. When performing an ROR run in a "snap" maneuver to a sustained high-G level, there is a real danger of an abrupt G-LOC without any warning symptoms because there is no time for cardiovascular compensation and the individual is running on the brain's blood oxygen reserve. The anti-G straining maneuver (AGSM) can, to a degree, alleviate a rapid drop in pressure and is critical in these maneuvers.

Straining for Four Gs

The AGSM consists of a deep intake of breath, followed by breath-holding and grunting for about three seconds, followed by an explosive exhalation and repetition of the process. This act increases the pressure inside the lungs and chest and, in effect, supercharges the blood pressure on the "inlet" side of the heart. With this technique, a well-trained pilot can raise his blood pressure around four Gs' worth.

For their baseline protection, military pilots have the anti-G suit and anti-G valve. The anti-G suit is a cutaway trouser-like garment containing air bladders over the abdomen, thighs, and calves. In accordance with the level of Gs on the aircraft, these bladders are pressurized by the anti-G valve, which admits compressed air into the bladders as necessary. The anti-G suit has the effect of increasing resistance to the pooling of blood in the legs and the abdomen and provides one to two Gs of protection, depending on its design and the type of valve being used. This level of protection, combined with basic human tolerance, is sufficient for about six Gs of maneuvering—not high enough for the F-16. Additional protective measures must be used, and the AGSM can add the necessary tolerance margin needed to fly the F-16.

The important word here is "training." As the saying goes, "Pulling Gs makes you good at pulling Gs." It has been repeatedly observed that a long layoff from pulling Gs reduces one's ability to tolerate that stress. Frequent exposure to high, sustained Gs probably causes increased reactivity in the cardiovascular system, or perhaps frequent exposure begets better straining technique.

Riding the Centrifuge

When the magnitude of the G-LOC problem became apparent in the early 1980s, the aeromedical community designed and implemented a program to train pilots to reach an informed awareness of how Gs affect their physiology and to perform the AGSM effectively. This program was first implemented on the centrifuges in the research facilities at the USAF School of Aerospace Medicine at Brooks AFB, Tex., and, to a lesser extent, on the centrifuge at the Armstrong Aerospace Medical Research Laboratory at Wright-Patterson AFB, Ohio.

These complex centrifuges have a rotating arm about twenty feet long, at the end of which is a gondola mounted in at least one set of roll gimbals. These machines generate the G stresses of air combat maneuvers in a supervised, laboratory environment. The most recent addition to the USAF inventory of centrifuges is the one used in the

The centrifuge used in lead-in fighter training at Holloman AFB, N. M., is the Air Force's newest. At the end of a twenty-foot-long rotating arm is a gondola mounted in a set of roll gimbals. The machine generates the G stresses of air combat maneuvers in a supervised, laboratory environment.

A pilot's first line of defense against GLOC is the anti-G suit. As the G level rises, a valve inflates bladders over the abdomen, thighs, and calves to exert counter-pressure against pooling of blood in the lower body. Another bladder keeps the oxygen mask sealed to the pilot's face. The suit provides up to two Gs of protection.

lead-in fighter training (LIFT) program at Holloman AFB, N. M. This machine is dedicated to the enhancement of G tolerance skills in the potential fighter pilot.

The training takes an entire day. It begins with a classroom lecture by a flight surgeon or physiological training officer. Also included in the classroom session is a demonstration of the proper performance of the AGSM. This is most heavily emphasized since it is the cheapest, quickest, and most effective way to raise a pilot's G tolerance.

Following the classroom sessions, students move to the centrifuge and are individually exposed to a very-gradual-onset-rate centrifuge ride in which Gs build up at the rate of about a tenth of a G every second. In this ride, the pilot does not wear an anti-G suit and, in the early part of the run, is relaxed and not performing the AGSM. The ride continues until a pilot informs the medical monitor that he has lost a good portion of his peripheral vision. At that point, he commences the AGSM, and the level of Gs continues to build until he reaches a point at which he can no longer maintain his peripheral vision while straining. At that point, this initial run ends.

The objective of this run is to permit the pilot to learn how his personal symptoms of impending G-LOC develop and to observe how a properly performed AGSM can help overcome those symptoms to a large degree. The pilot is continuously monitored by closed circuit television and voice communication and coached and encouraged in his AGSM performance.

With the support of a flight surgeon, the pilot reviews his videotapes to understand what he is doing right or wrong. This is especially effective in cases where G-LOC occurs. For a pilot, G-LOC is a highly threatening event and is later viewed with high levels of anger, embarrassment, or denial. Denial is less rare than you'd think; an episode of G-LOC is usually accompanied by amnesia.

ROR in Check Six

After pilots complete the GOR run, they proceed to the ROR exposures. These consist of onset rates of six Gs per second up to plateaus of ten to fifteen seconds duration at levels ranging from +5Gz to +9Gz. Because fighter pilots spend a lot of time looking over their shoulders, they are given the opportunity in training to take rapid onset runs while in the "check six" position. These ROR, high-G runs are the brass rings of the training program. On successful completion of this program, the pilot is well trained and confident of his ability to cope with eight or nine Gs in his aircraft. The success of this program has been demonstrated by the marked drop over the past three years in the rate of pilot losses to G-LOC.

The Navy has initiated a G-LOC program of this type for Navy and Marine Corps fighter aircrews, constructing a new centrifuge dedicated to training. The advanced Navy machine will be equipped with both roll and pitch gimbal systems, both of which will be powered and under computer control. This machine promises to enhance training in the coming era of supermaneuverable aircraft and G stresses in multiple directions.

Some experts favor recurrent centrifuge training. Maj. Gen. V. A. Ponomarenko, commander of the USSR Air Force Institute of Aerospace Medicine, recently stated that Su-27 and MiG-29 pilots as well as other fighter/attack/reconnaissance pilots in the Soviet forces receive G-currency training. The Soviets claim to have never lost a pilot to G-LOC.

Because exercises that strengthen major muscles also enhance performance of the AGSM, USAF pilots are encouraged to pump iron. At the same time, they are encouraged to rein in their aerobic fitness regimens. The reasons are complex, but there is strong evidence that a high level of aerobic fitness can contribute to decreased G tolerance and increased vulnerability to motion sickness. Pilots are also encouraged to be aware of the impact of diet and lifestyle on G tolerance.

It cannot be said that the new generation of fighter pilots is composed entirely of straitlaced, humorless health fanatics. There are aspects of the "fighter pilot personality" that should not change, and God forbid that anyone should try to alter that. Nevertheless, the current crop has a new awareness of what it takes to be a true professional. ■

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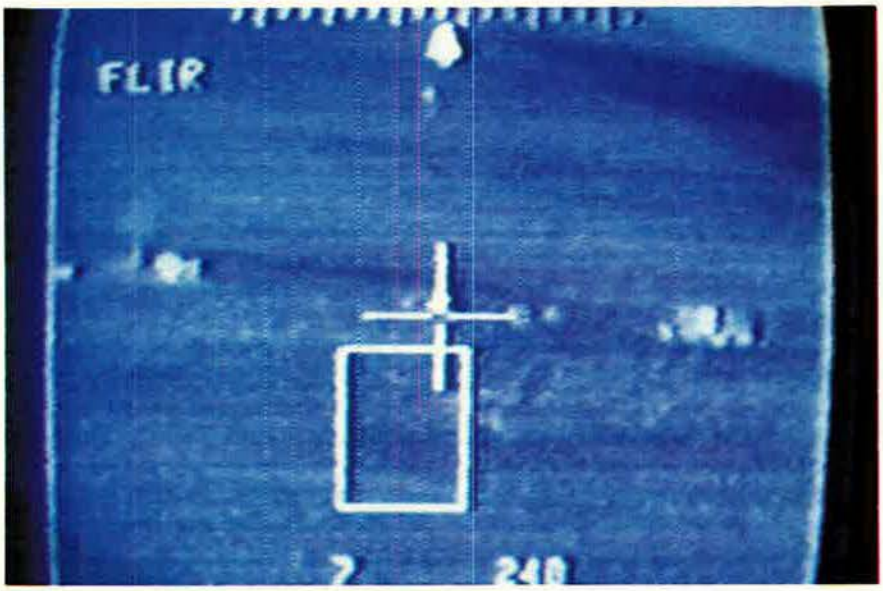
The helicopters would open the war. They had to take out Iraq's early warning net, and they had to get it all.

Apache Attack

By Richard Mackenzie



AT TEN seconds before 2:38 a.m., in a moonless sky over Iraq, eight US AH-64 Apache helicopters zeroed in on their targets. On their forward-looking infrared screens appeared the images of two Iraqi radar sites just north of Saudi Arabia, placed there to detect intruding fighters. They were linked to four Iraqi fighter bases and to the Intelligence Operations Center in Baghdad.

The unseen Apaches hovered low, four miles south of the radars. At the controls of Number 976, 1st Lt. Tom Drew broke radio silence. "Party in ten," he said. On cue, ten seconds later, the helicopters unleashed a salvo of laser-guided Hellfire missiles. "This one's for you, Saddam," muttered CWO3 Dave Jones, the pilot of another Apache.

The shots, fired in the predawn hours of January 17, 1991, marked the start of Operation Desert Storm and were among the most critical of the war, blinding Iraq's early warning net at a key moment. US Central Command relied entirely on the Apaches and USAF special operations helicopters to do the job. "If something had happened and we didn't do 100 percent [destruction]," said one gunner, CWO4 Lou Hall, "a lot of people were going to get hurt."

The Apaches did achieve 100 percent destruction, or close to it. Eyewitnesses report that, when the Hellfires hit the targets, the radar bases evaporated in clouds of smoke and flame. In the four and a half minutes it took to complete the task, the Apaches had, in the words of Gen. H. Norman Schwarzkopf, "plucked out the eyes" of Iraq's Soviet-supplied air defenses.

According to Gen. H. Norman Schwarzkopf, the January 17 attack by Army AH-64 Apaches "plucked out the eyes" of Iraq's air defenses. Above, one of the Apaches' FLIR screens one second before missile impact. For the mission that opened the war, the AH-64s were modified with 230-gallon external fuel tanks to ensure a return to base as smooth as the one shown at right, after a training mission in the US.

Nearly 100 allied planes, arriving twenty-two minutes after the raid, roared through the gaping hole in Iraq's network and raced north to strike critical, first-night targets. Air Force F-117s, relying on their stealthiness, already had penetrated Iraqi airspace and were nearing Baghdad by the time the Apaches fired, but destruction of the early warning sites greatly eased the task of nonstealthy allied planes sent into action that night.

Task Force Normandy

Such was the contribution of Task Force Normandy, handpicked crews of Army Apaches and Air Force MH-53J Pave Low electronic warfare helicopters. The story of how Task Force Normandy planned and executed the raid has been one of the war's closely guarded secrets. On-the-record interviews with Col. Dick Cody, the leader of Task Force Normandy, produce a portrait of a meticulously planned, unusually error-free use of helicopters in defense suppression.

The eight Apaches swooped on their targets like stealth fighters, using tactics and techniques honed in several months of intensive classified training. Contrary to reports that the raid was a last-minute, seat-of-the-pants caper dreamed up by General Schwarzkopf and his top commanders, planning and training began within weeks of Iraq's August 2, 1990, invasion of Kuwait.

Colonel Cody commanded the 1st Battalion, 101st Aviation Regiment, 101st Airborne Division, based at Fort Campbell, Ky. The battalion landed in Saudi Arabia on August 17, 1990, as the lead element of the division. It took seven C-5Bs and seventeen C-141s to carry its troops and equipment to Dhahran. Three days later, the battalion moved to a new site, loaded out its aircraft, and began its patrols of the Saudi-Iraqi border.

When it came to readiness, Colonel Cody and his men stood out, earning a reputation for being the best prepared of fourteen Apache units deployed to the Gulf. During its first month in the desert, Colonel Cody's unit turned in a startling fully mission capable rate of ninety-four percent. When CENTCOM began to look for a high-quality unit, the 1st Battalion was a natural choice.

"At that time," reports Colonel Cody, "they [CENTCOM planners] had been doing some studies on [Iraq's] early warning and ground-control intercept sites that overlapped and covered the entire Kuwaiti and Iraqi border. They were studying and making analyses of where to create a corridor."

With its 30-mm chain gun and full load of sixteen Hellfire missiles or seventy-six 2.75-inch rockets, the Apache fairly bristles with ordnance. This came in handy against Iraqi tanks (top) as well as during the opening attack. To ensure secrecy, the crews on the initial mission trained, refueled, and rearmed at remote sites (above).

The planners developed three major options for the defense suppression task. One called for using special operations forces (SOFs) to hit the radar sites with missiles. The second envisioned SOFs near the sites using handheld laser designators to direct Apaches to the targets. The third option centered on using Air Force fighter aircraft to destroy the targets.

At least two of the alternatives—the ones involving SOF units—raised grave danger that the operation might be detected and compromised before the allies could fire a shot.

The planners knew that conventional aircraft or cruise missiles would do the job. Yet without a pair of human eyes on the scene to assess the extent of the damage, the

allies would have no way of knowing whether the targets were truly dead.

Helicopter pilots, however, would be able to see for themselves how much damage had been done to these facilities. They could engage the targets repeatedly until they were sure of complete success. "This place was out in the middle of the desert, and we were working on intelligence that was four days old," says Colonel Cody. "They could have sneaked another van in there or moved things around."

It was a persuasive argument. By September 25, 1990, with CENTCOM planners having adopted, narrowed, and refined the plan, Colonel Cody was summoned to an office at King Fahd International Airport, headquarters for Commander of US Special Operations Command Central Col. Jessie Johnson.

Colonel Johnson outlined a joint force of Army and Air Force helicopters—Apaches and Pave Lows—that would sneak into Iraq to knock out radar and ground-control interception sites. "If we can get it conceptually approved," Colonel Johnson asked, "do you think you can do that?"

"Yeah," said the Apache pilot.

One Hundred Percent

Colonel Johnson came to the point. "If we get the go-ahead even to train for this," said he, "it will be based on you saying you can take it out 100 percent."

It would not be the last time Colonel Cody would be asked to make that guarantee. "That's not a problem," he said.

Colonel Cody was ordered to start training for the operation. He would work with Col. Rich Comer, commander of USAF's 20th Special Operations Squadron, part of the 1st Special Operations Wing at Hurlburt Field, Fla.

Colonel Cody recalls that the age of the men chosen for the mission averaged twenty-six years. He had twenty-four crews in the battalion. "I picked eight to go," he says, "but any one of the twenty-four could have done the mission."

In order to preserve the covert nature of the Normandy training and not raise suspicions, Colonel Cody kept command of the rest of his battalion. "I never relinquished my division mission with the 101st or the covering forces."

Not even the chosen crew members knew why, or for what mission, they were training. They knew they were practicing for a helicopter-borne, special operations raid, but they did not know that it would start the war. They did not know it would be in Iraq. They did not know the precise targets or the timing.

Colonel Cody goes on, "I selected crews. I did not select individuals. I took guys who had been flying together as combat crews the whole time. I did not select my most experienced individuals and pool them all together. I actually had some twenty-two-year-olds and twenty-three-year-olds in the front seats out there."

Joining forces with the Pave Lows was not a problem, says Colonel Cody. Flying night after night, the units practiced infiltrating denied airspace and attacking simulated radar sites simultaneously. They did six live-fire exercises, evaluating the Apaches' weapon systems, which include not only the Hellfires but also 2.75-inch rockets and a 30-mm chain gun.

Timing was everything. "It would do no good to hit one radar site and, two minutes later, to hit another one," says Colonel Cody. "We had to do it in such a way that we took down critical elements of those radar sites simultaneously so that Baghdad was not alerted to get [its] MiG-29s and ground-control intercept systems up."

The crews trained 700 miles away from the attack area. "All our training was done in a sandbox, so to speak, where we were located," says Colonel Cody. "We never practiced the route because of the sensitivity of the mission.

"All their systems were up during this time. All their intelligence-gathering networks were up—and everything else. So this was all done under the umbrella of joint training, just going out and practicing things."

—Staff photo by Guy Aceto

Working in concert with the Apaches, Air Force MH-53J Pave Lows, with Global Positioning System receivers and terrain-following radar, got the attack package to within nine miles of the target undetected and with pinpoint accuracy.

They learned some valuable lessons. "We practiced such things as what type of formation flights we wanted to fly," says the commander. "How low we wanted to fly. How fast we wanted to fly. All of this was done with no [voice communications]. What light signals [would emanate] from the Pave Lows. What techniques to indicate we're turning, we're not going to turn."

No Detailed Maps

One big problem was the dearth of maps. The ones that were available did not have much fine detail and were useless for pinpointing location. Enter the Pave Lows, equipped with the state-of-the-art Global Positioning System (GPS) for precise navigation. Flying as escorts to a predetermined point, the

Pave Lows could fix the position within eight grid points—about ten meters. The Apache systems could fix only within 100 meters.

"That was the main reason we had the Pave Lows with us, so they could use the GPS to mark our actual spot at the release point prior to reaching the target area," said Colonel Cody. "They [the SOF helicopters] would drop chem lights on the desert floor to mark the position. We then plugged that into our fire-control computers on each of the Apaches. We were updating over that point. That eliminated any built-up error in the Apaches' Doppler system and fire-control system.

"It gave our target acquisition designation system extreme accuracy so we could lock onto the targets at twelve to fifteen kilometers away. That was very important as we moved forward because we knew that, from about twenty and fifteen klicks, . . . they would pick us up." The attackers, he added, wanted to make sure they had their acquisition systems "already locked on to the targets as we got inside and they started picking us up."

In practice sessions, the Pave Lows would position the Apaches and break off to return to the prearranged site. Meanwhile, said Colonel Cody, "we would go on in and practice our attack tactics, how we would sequentially dismember and destroy these sites by sectoring our fire, how we would lay for each other if we had to, how we would fight if one guy got shot down, all the permutations and combinations of 'what if?'

"We practiced those battle drills in the engagement area and then we practiced coming out, linking up with the Pave Lows at the predetermined point and crossing a simulated border and then moving on to our other mission." These maneuvers were carried out not just at low level but at nap-of-the-Earth altitude.

From the first, the Pave Low's high technology helped dramatically. "We do it well in the Army," Colonel Cody says, "but the Pave Lows have a [precision with] which they are able to hit their checkpoints right on the money. Their terrain-following radar helped us quite a bit [in] anticipating when we had to come up and when we had to go down and still maintain our airspeed. The desert-flying experience they had with their systems, telling us how they were doing it and then our trying to duplicate that with our system, was the biggest thing in training."

Apache crews had high praise for both their night vision goggles and their FLIR, which, coupled with information provided by the Pave Lows, allowed the Apaches to operate with telling effect in the inky blackness of the desert night.

In late October, Colonel Johnson took a training videotape to Riyadh to show General Schwarzkopf how the Apaches performed in live-fire exercises. The CINC was impressed.

The Final Go-Ahead

By the week before Christmas, war was a distinct possibility. Gen. Colin Powell, the Chairman of the Joint Chiefs of Staff, and Dick Cheney, the Secretary of Defense, flew to Riyadh to review the war plans personally. They met in the underground war room from which General Schwarzkopf would run Desert Storm. When General Schwarzkopf came to the Apache–Pave Low mission, he called on Colonel Johnson and Col. George Gray, commander of the 1st SOW. Aides were ordered to leave the room.

Neither colonel had doubts, though both knew they were "on the blame line" if the plan miscarried. Colonel Johnson cited the Apache's ability to fly low at night, its low infrared signature, and its reduced radar signature. He also mentioned the accuracy of its standoff weapons.

This time, General Schwarzkopf himself popped the question. "Can you guarantee 100 percent success?"

"Yes sir," answered Colonels Johnson and Gray.

That was enough for Schwarzkopf. If Saddam Hussein didn't back down and leave Kuwait, the helicopters would start the war.

On January 14, 1991, Colonel Johnson ordered Task Force Normandy to deploy to Al Jouf, a desolate outpost close to the Iraqi border. "I think this thing's going down," he remarked to Colonel Cody. "We don't have an accurate H-Hour, but I need to have you in position no later than dark on the fourteenth."

On internal fuel, the Apache can fly fully combat-loaded (eight Hellfires, thirty-eight rockets, and 1,200 chain-gun rounds) for only a little more than two hours. To get around this limitation, the units adopted a suggestion first put forward by Lt. Tim De Vito, another Apache pilot. He recommended that the crews attach 1,700-pound, 230-gallon external fuel tanks to the Apaches' left inboard weapons storage area. The planners did not want to set up a refueling point like the Desert One base used in the abortive 1980 hostage rescue in Iran. To make room for fuel, each aircraft reduced its number of rockets to nineteen.

"It initially appeared that I would

have to use a Desert One type of refueling point," says Colonel Cody. "But because of the complexity of the mission, because of the problems that could have been incurred by putting refueling systems that close to the border or actually inside the border, tipping the hand of what we were doing, we came up with the wing tank concept. It had never been done before. It raised the gross weight of the aircraft some 1,500 pounds past its combat weight. But it gave us a strike capability in excess of 400 miles."

Getting to Al Jouf itself was a problem. "We even had to do that stealthily, without creating a signature," says Colonel Cody. "We rolled into King Khalid Military City—no radio calls or anything—refueled there and took right off. There were already a large number of other helicopters operating out of KKMC so we would have looked just like any training exercise."

—Staff photo by Guy Aceto

The Apache can take it as well as dish it out. In addition to its heavy load of armament, the helicopter has armored seats and Kevlar protection. During the initial mission, Apaches took some small arms fire but suffered no damage.

Arriving Undetected

Heading west, flying over flat terrain, they dropped low. "We got down where nobody would be able to pick us up along the border, even if they were looking for us," Colonel Cody recounts. "I think we got into Al Jouf pretty much undetected."

That night, he briefed his crews for the first time on the mission, giving them maps and photos. "Lo and behold," said one crew member, "it looks like everything we've been practicing."

As he sat in his helicopter talking with his gunner, Colonel Cody saw a dusty rental car speeding over the tarmac. The sedan pulled to a stop. Col. Ben Orrell, Colonel Gray's deputy, yelled from the driver's seat of the car, "I need to talk to you."

Colonel Cody climbed down and ran to the vehicle.

"We have just received H-Hour from the CINC," said Colonel Orrell. "It's 17, 0300. Your mission is a go."

At 1:00 a.m. on January 17 (local time), Colonel Cody's White Team of four Apaches and two Pave Lows, each weighing more than 18,900 pounds, pulled out of Al Jouf into a jet-black sky, all lights off, and headed north. Six minutes later, the Red Team followed.

As the White Team approached the border shortly before 2:00 a.m., Colonel Cody saw a flash below. Evidently hearing the sounds of the helicopters but unable to see them, an Iraqi on the front line had fired off a missile. It missed.

As they pushed north, flying at 120 mph about fifty feet above ground, the pilots created their own "stealthiness" with a combination of high speed, low altitude, total blackout on navigation lights, and total radio silence.

"Neither the Pave Lows nor we had ever flown in that area," recalled Colonel Cody. "We were seeing stuff for the first time. Most of our training was done on the east coast of Saudi Arabia where it's very, very flat and you have sand dunes. This was some 700 miles northwest, and it was entirely different. You had mesas and a little bit more terrain, which made it more dangerous.

"The Pave Lows had terrain-following radar, which helped them out quite a bit. We didn't have that, but

—Photo by Paul Kennedy

The Apache's primary sensor, the target acquisition and designation sight and pilot's night vision sensor, allowed the crews on that first mission to complete all phases of their attack with stunning accuracy, destroying the radar site totally.

our FLIR, coupled with our night-vision goggles, was just working great. So you had two different systems backing each other up. We were backing them up, and they were primary. The lead Apache in each one of those teams had a primary mission of navigation. We didn't leave anything to chance."

At the GPS points nine miles south of the radar bases, Pave Lows dropped chemical lights on the desert. As the Apaches used that position to update their navigational and targeting systems, the Pave Lows peeled off and went back to the rendezvous point.

The Apaches then flew for almost five more miles, fixing the targets in their sights.

© Erik Simonsen

Coalition forces banked so heavily on the Apache to open the Gulf War that Army commanders were asked to guarantee 100 percent success. They guaranteed it, the crews delivered it, and the way was opened for the successes that followed.

Looking Skyward

Without doubt, they got the drop on the Iraqis, who were looking skyward for fast movers, not for helicopters. It is believed they noticed something resembling "ground clutter" on their screens about two minutes before they were hit but were still trying to figure it out when the Hellfires arrived.

"OK, I've got the target area," CWO2 Thomas "Tip" O'Neal told his pilot, CWO3 Jones, when their Apache was still seven miles from the radar sites.

"Slowing back," said Jones, asking the range.

"I'm showing 12.2 [kilometers]."

"I'll keep moving."

"I've got one of the big 'uns all the way on the right."

Moving the FLIR lens, CWO3 Jones closed in on the first building they must hit. "There's the generator right there."

"OK."

"Aha!"

"Party in ten!" said Lieutenant Drew from the lead AH-64.

The FLIR screen flashed "LAUNCH." A clock counted down the missile's flight time. An Iraqi technician, seeing flashes in the distance as he emerged from a building, ran back inside. A dozen figures ran out other doors.

Then chaos engulfed the radar station. "Just incessant fire," recalls Colonel Cody. "Missile after missile, rocket after rocket, 30-mm after 30-mm coming from four aircraft that they [couldn't] even see. From the first shot, they were just running for cover. When we closed in to 4,000 meters, we engaged their ZPUs [Soviet antiaircraft machine guns] and antiaircraft artillery and put them out."

Colonel Cody's Apache was not far from that of his wingman, Lieutenant Drew, when they started to attack. The chaos intensified, says Colonel Cody, "when he [the wingman] puts out two or three rockets and everything lights up. You're sitting there looking at your FLIR and then your naked eye picks up these flashes. You had to be very, very careful not to mistake that [for] ground fire coming at you.

"We took those things down in three and a half to four and a half minutes, four aircraft flying in pretty close proximity to each other."

They got close to the targets, too. "Some of us got closer than 800 meters when we finished. We used 2,000 meters as a breakpoint, but, depending on what our targets looked like, as we were breaking and as we were being engaged, some of us moved in a little closer and then broke."

After shutting down the sites, they moved to other phases of the attack. "If all we did was hit [the generator], they could go to secondary power," explained Colonel Cody. "We had a follow-on mission statement of putting [the base] down for a couple of days so the Air Force wouldn't have to go in and retarget it. Then our follow-on was to totally destroy it. . . . We did all of the above."

As the Apaches broke and headed back, they had to stay low. Air Force fighters were coming in over their heads. They took some small-arms fire but no damage. "Then we had to link up all these attacking forces at night at a new rendezvous point," said Colonel Cody, "and then charge back across the Saudi border—coming the wrong way! We were a little nervous."

Apache team leaders passed the good news to the Pave Lows' crews, who passed it to Central Command headquarters. The code words—"California AAA" and "Nebraska AAA"—meant the primary targets had been destroyed, the entire bases had been destroyed, and there had been no US casualties.

In the CENTCOM war room, General Schwarzkopf heard the news, took a breath, clenched his jaw and muttered, "Thank God." ■

Richard Mackenzie is a free-lance writer in Washington, D. C. His most recent article for AIR FORCE Magazine, "A Conversation With Chuck Horner," appeared in the June 1991 issue.

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The Pentagon says environmental work at 17,482 polluted sites may cost $200 billion.

The Big Toxic Waste Cleanup

By Larry Grossman

—USAF photo by CMSgt. Vickie Graham

Long concerned with protecting its people and property (opposite, an EC-135 is decontaminated at Offutt AFB, Neb.), the Air Force now must spend billions of dollars and years of work to clean up an asset long ignored: the environment. Thousands of present and former defense sites are under investigation.

AFTER four decades of cold war operations, the US military has begun to understand fully the toll its actions have taken on the environment. The Defense Department has identified and vowed to clean up 17,482 polluted sites at 1,855 military installations in the US and abroad. The Environmental Protection Agency (EPA) says eighty-nine installations are so badly polluted that they have been placed on the "Superfund" list of high-priority jobs. The cleanup, warns the Pentagon's Inspector General, could cost $200 billion.

The Defense Department is not alone. The Energy Department, which builds nuclear warheads, identified another thirteen major pollution sites—many dotted with hundreds, or in some cases thousands, of individual polluted areas requiring cleanup. Energy officials estimate that eradicating the toxic mess will take up to thirty years and $150 billion in expenditures.

The military's post–cold war cleanup of its toxic mess already has begun and will go on for decades, a point underlined by Secretary of Defense Dick Cheney. "Defense and the environment is not an either/or proposition," says he. "To choose between these is impossible in this real world of serious defense threats and genuine environmental concerns."

Coming to grips with such problems will be painful. The Pentagon will be forced to shift billions of dollars to accounts for environmental cleanup and compliance and away from those for equipping and sup-

plying forces for traditional missions.

The services and defense agencies propose to increase environmental spending from a mere $700 million in Fiscal Year 1991 to $2.6 billion in FY 1992, half of which is earmarked for the cleanup of badly contaminated sites. The Pentagon wants to spend another $1.3 billion in FY 1992 on programs that will bring the military into compliance with federal, state, and local laws.

For its part, the Air Force has budgeted a total of nearly $1.8 billion for cleanup operations and $1 billion for environmental restoration projects over the next two fiscal years. Moreover, USAF plans call for spending a two-year total of $845 million on compliance with environmental laws.

"Compliance," says Gary D. Vest, Air Force deputy assistant secretary for Environment, Safety, and Occupational Health, "is our number one priority. It's not optional. It's an obligation."

The Lengthening List

At the heart of the Pentagon's cleanup effort lies the Defense Environmental Restoration Program, established in 1984. It mandates the investigation and cleanup of contaminated defense sites and formerly used properties. "Cleaning up toxic waste sites is our largest challenge," says Thomas E. Baca, deputy assistant defense secretary for the Environment. Since 1984, says Mr. Baca, "the number of sites . . . [has] steadily increased."

Mr. Baca maintains that the lengthening list reflects the Pentagon's "significant headway in building an environmental ethic." He adds, however, that this growth is leveling off and is expected to decrease over the next few years. Some 6,300 sites have been cleaned up and removed from the Pentagon's list.

In 1990, the number of Air Force installation restoration program sites increased by almost thirty percent, to 4,513 sites at 315 installations. At 448 Air Force sites, restoration has been completed and no further action is planned.

Pentagon work is conducted under the Superfund program, meaning the services follow a "worst first" policy in their cleanup priorities. An official DoD fact sheet notes that "top priority is assigned to removal of imminent threats from hazardous or toxic substances or unexploded ordnance."

Robins AFB, Ga., one of the US military's most contaminated sites, recently became the focal point of a special, joint USAF-EPA-Georgia agreement to put the cleanup of the polluted facility on a fast track. The plan for expedited handling of Robins, home of Warner Robins Air Logistics Center, eliminates much of the time-consuming paperwork that has plagued earlier efforts and will set a standard for the armed forces.

"The Robins plan could become a model for other installations to follow," says Rep. Richard Ray (D-Ga.), chairman of the House Armed Services Committee's environmental restoration panel. "The Department of Defense wants to begin cleaning up waste sites on bases around the country, but they often become bogged down with excessive regulations and time schedules."

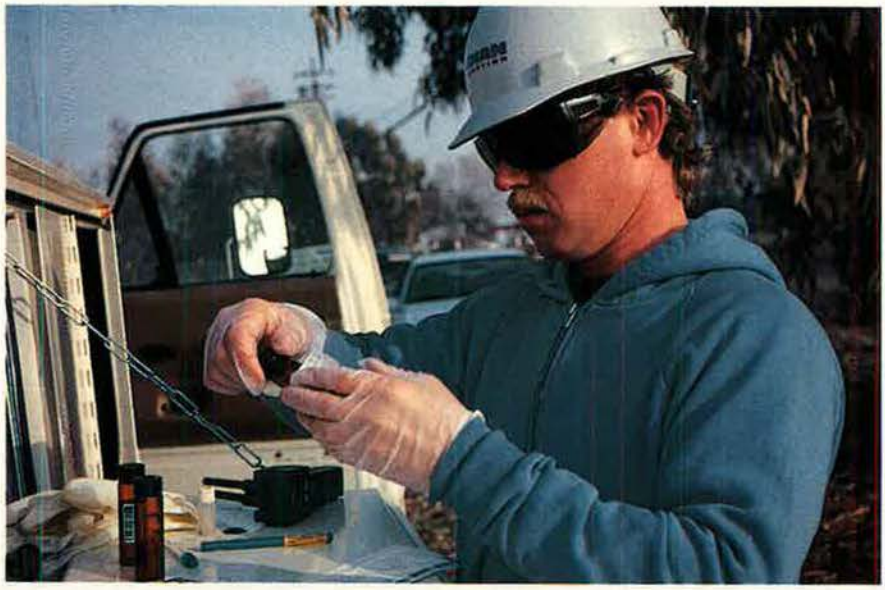
Over the fifteen-year period from 1963 to 1978, Air Force workers dumped forty-four million gallons of industrial chemicals and solvents into a sludge lagoon and landfill south of Robins's runway. The pollutants disposed of in this fashion included cyanide, tetrachloroethylene (TCE), and other cancer-causing chemicals. Some of these have been detected in nearby groundwater.

With the Pentagon set to close more bases, pressure is building to speed investigations and disposal of the military's toxic waste problems before the sites are transferred to civilian use. Of the fourteen Air Force bases included on the new closure list, three are on the Superfund list: Castle AFB, Calif.; Loring AFB, Me.; and Williams AFB, Ariz. In this circumstance, says Mr. Vest, "environmental requirements at closure installations are of prime importance in the Air Force environmental program."

No Wildlife Refuge Yet

The Air Force has some idea of what it will be up against when it begins cleanup of these bases. Earlier this year, the service closed Pease AFB, N. H.—a Superfund club member—before it was fully scrubbed. While state officials hope to turn Pease over to real estate for light industry, a convention center, and a wildlife refuge, the base has twenty waste sites, including toxic sludge dumps and a fire-training area that for many years was drenched with jet fuel and torched. Decontamination of the worst sites is under way, but the Air Force will not have completed its diagnosis of

—USAF photo by CMSgt. Vickie Graham



A worker takes water samples from a contaminated well near McClellan AFB, Calif. Industrial solvents, jet fuels, and other wastes, for years routinely dumped in open pits or stored in underground tanks on the perimeters of bases, have polluted groundwater and affected drinking water in many off-base communities.

the base until 1994. Some 500 of Pease's 4,365 acres most likely will be quarantined for years.

Cleanup of existing sites is not the only environmental task that now confronts the military. By the end of 1992, the services are to cut in half the 661,000 tons of hazardous wastes they produced each year at the peak of their output. At USAF's Oklahoma City Air Logistics Center, Tinker AFB, Okla., signs of change are apparent. Once ALC workers used toxic solvents to remove surface corrosion and soil from jet engine components. Now workers use high-pressure blasting with solidified carbon dioxide pellets—dry ice—to do the same job, in the process reducing the cost by $122,000 a year. The pellets vaporize on impact.

At Fort Ord, Calif., the Army is using high-pressure spray washers to degrease and clean automotive parts, eliminating the need for dip tanks filled with the highly toxic substance trichloromethane. The total cost of these units was $24,900, but the program will pay for itself in just two years.

The Navy also is getting into the act. Logisticians at Alameda Depot, Calif., have begun using an electrostatic aircraft-painting process that greatly reduces turnaround time. A P-3 Orion submarine hunter is now painted in six shifts, rather than twenty. The process uses electricity to bond paint to the aircraft's aluminum skin. Electrostatic painting eliminates overspraying and helped the Navy meet California's strict clean air standards.

Recycling of materials that once were routinely dumped or allowed to escape into the atmosphere will also play a key part in allowing the services to reduce their use of ozone-depleting Halon (a trademark for tetrafluoroethylene) and chlorofluorocarbons (CFCs), used in vast quantities as fire suppressants and refrigerants. Because the services lose up to ninety percent of their Halon through routine discharge into the atmosphere, recirculating gases as a regular part of training exercises is expected to have a beneficial effect.

Even so, and for good reasons, it may be impossible to eliminate these chemicals totally. The Navy believes there is a risk that it could end up spending enormous sums to fit its ships with new, unproven cooling systems that could in fact lower the capabilities of its weapons and endanger the lives of its crews.

Attempting to clean up their act, Air Force bases are modifying procedures, recycling materials, and exploring new technologies. At Eglin AFB, Fla., water decontamination equipment tests emissions-control options and air-stripping treatments (a process that removes hydrocarbons from water vapor).

"We need time for an orderly phaseout of CFCs and Halon," says Nancy Stehle, Navy deputy director for Environmental Issues. "We can live with a zero release policy, with the exception of fire extinguishing devices where safety of life is involved. We cannot, however, live with a zero use policy."

The Regulatory Maze

Though Mr. Vest and others maintain that compliance is the Air Force's top priority, achieving that goal certainly won't be easy. Regulatory overlaps often snarl Pentagon cleanup programs, entangling the services in federal and state laws and procedures. As states demand more control over federal activities, DoD's job is often complicated. "Complying with current laws and regulations has become increasingly difficult," says Mr. Baca. "The number of environmental laws and regulations governing our action has grown considerably."

In addition to federal regulations like the Clean Air and Clean Water Acts, the Pentagon must comply with state laws and regulations established to implement federal standards. In fact, many states have gone much further than Congress in enacting environmental legislation, imposing stricter rules.

The Air Force has developed its Environmental Compliance Assessment and Management Program (ECAMP), which gives a base commander an analysis of his own compliance efforts. Moreover, ECAMP identifies areas requiring the commander's attention and provides a basis for developing remedies. In 1990, more than half of ECAMP's 4,100 findings at seventy-six bases involved hazardous materials and waste.

The Air Force finished the first complete accounting of its compliance status last December. The report identified 186 open enforcement actions—1.5 per base. Mr. Vest says that sixty-two of these violations have been corrected and work is under way on the remainder. More than eighty percent of these compliance violations stem from hazardous waste and water handling.

Mr. Vest says the new compliance reporting process allows the Air Force to identify substandard and decaying infrastructure, which causes most violations. "We will identify facility projects necessary to achieve and maintain compliance and ensure they are considered in the budget process," he says. Additionally, the Air Force has begun

—USAF photo by CMSgt. Vickie Graham

Environmental deterioration threatens every nation. Sen. Sam Nunn of the Armed Services Committee points out that defense agencies have unique data collection and technological capabilities to solve environmental problems and should apply them, since the defense establishment is responsible for part of the problem.

assessing its wastewater treatment systems, hydrant refueling systems, corrosion control facilities, fire training pits, and underground storage tanks.

Air Force efforts to decontaminate groundwater include use of a modified drinking water system that serves as a centralized groundwater remediation system at Harrisburg, Pa. At Castle AFB, a 1,400-gallon-per-minute filtration system treats water contaminated with TCE.

A Shortage of Skilled Workers

In 1990 the Pentagon's Inspector General found that DoD and the services suffer a shortage of qualified engineers, geologists, and chemists needed to assess the danger posed by contaminated sites and to map out a course of remedial action. Such technicians are in great demand by private industry and other government agencies.

At the Air Force Institute of Technology, Wright-Patterson AFB, Ohio, USAF has established a central education office to evaluate available courses, symposiums, and workshops sponsored government-wide and by private business. An installation restoration course, offered four times a year, will train some 300 Air Force personnel in 1991.

Last year the Air Force launched its Commander's Environmental Leadership Course for general officers and others who command installations. It was established "to emphasize environmental concerns and to reinforce the service's goal of full environmental compliance," according to Mr. Vest. Seventy-six senior officers attended these courses in 1990, and more than 150 are expected to attend four 1991 conferences.

Mr. Vest says the Air Force offers a number of courses—many with federal, state, and local participation—to educate junior officers throughout the service about the technical, financial, and legal aspects of compliance. For instance, Strategic Air Command has formed a team of environmental and legal experts that will visit every SAC base during 1991 to ensure that the commander and his staff understand the Air Force's commitment to environmental restoration and conservation, not to mention the environmental requirements of their respective jobs.

Last year the Air Force established a new environmental manpower standard, a move that produced a twenty-four percent increase in personnel available to bases undergoing cleanup.

The Air Force has begun to address the problems with citizens groups across the country. In September 1990, the Air Force opened regional environmental offices in Atlanta, Dallas, and San Francisco. The three REOs work closely with state environmental agencies and the EPA's local regional offices, as well as with Air Force major commands and local, state, and federal regulators.

Meanwhile, Congress has saddled the Pentagon with environmental responsibilities that go well beyond cleaning up its own mess. Last year, lawmakers set aside $200 million for the Strategic Environmental Research and Development Program, an attempt to use the Pentagon's formidable research infrastructure for environmental purposes. Senior DoD, DoE, and EPA officials will steer the program through an interagency council, and a scientific advisory board will recommend environmental projects for the Pentagon to pursue.

Sen. Sam Nunn, the Georgia Democrat who heads the Senate Armed Services Committee, supported the measure and provided it with a powerful boost on Capitol Hill. He claims that the Pentagon is in the vanguard of the new environmentalism for three reasons. "First," says the senator, "because environmental deterioration in a very real sense threatens our national security and the security of the world. Second, because the defense establishment has unique data collection and technological capabilities. And third, because the defense establishment helped create some of the environmental problems we face today."

In an interview last year, Senator Nunn said, "We have to protect our [defense] research capability as a hedge against the future. So while we are protecting that research capability, both in governmental agencies and in the defense industry, why not take on one of the real challenges that face the world?" ■

Larry Grossman is a former associate editor of Military Forum *Magazine and a staff member of the House Armed Services Committee. His most recent article for* Air Force *Magazine, "SAC's Twin Triads," appeared in the August 1991 issue.*

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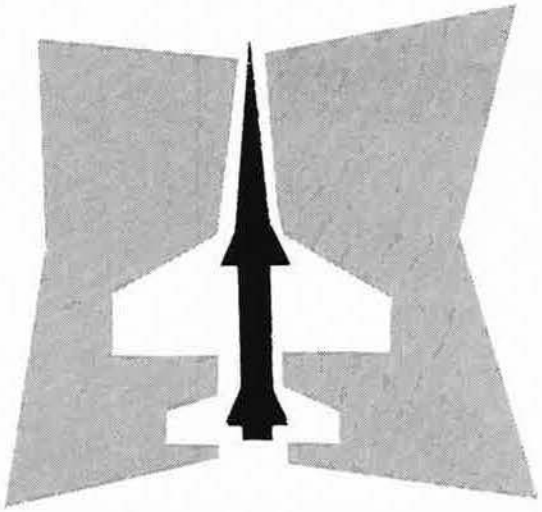

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USAF Armament and Ordnance Checklist

Works in progress at the Air Force's major program offices, Aeronautical Systems Division's armament offices at Eglin AFB, Fla., and Wright Laboratory's Armament Directorate, Eglin AFB

Advanced Medium-Range Air-to-Air Missile Joint System Program Office

Advanced Medium-Range Air-to-Air Missile
Program to develop and deploy the Air Force's and Navy's next-generation, tactical air combat missile, replacing the AIM-7 Sparrow radar-guided weapon. AMRAAM is a fire-and-forget missile that enables a pilot to aim and fire several missiles at multiple targets while manuevering. AMRAAM is to have all-weather, all-environment, radar-guided capabilities and be compatible with F-14, F-15, F-16, F/A-18, British Tornado F. Mk. 2, Royal Navy Sea Harrier, and German F-4F. **Contractors:** Hughes, Raytheon. **Status:** Production.

AMRAAM Preplanned Product Improvement
Program to ensure that AMRAAM retains superiority against a changing threat, that it takes advantage of opportunities to use emerging technologies, and that it is compatible with future as well as current fighters. Focus is on electronically erasable/programmable read-only memory chip insertion, ECCM, propulsion options, and ordnance enhancements. **Contractors:** Hughes, Raytheon. **Status:** Preplanned product improvement (P^3I).

AMRAAM Producibility Enhancement Program
Comprehensive value engineering program designed to introduce less expensive, alternative designs and high technology into AMRAAM and to expand the competitive vendor base. **Contractors:** Hughes, Raytheon. **Status:** Production.

Advanced Tactical Fighter Weaponization
Initiative to ensure resolution of weapon issues, weapon integration, and weapon research and development activities concerning the F-22. **Contractor:** None. **Status:** Ongoing.

Missile Rail Launcher
Program to provide AMRAAM and Sidewinder rail launch capability on F-15, F-16, and F/A-18, maximizing use of common components. **Contractors:** Hughes, United Telecontrol Electronics. **Status:** Production.

Air-to-Surface Weapon Systems Program Office

Advanced Attack Weapon
Program to integrate a millimeter-wave seeker with the AGM-65 Maverick missile. The millimeter-wave Maverick uses the target radar return for detection, discrimination, prioritization, and acquisition and track of air defense units (primary), tanks, and other targets within battlefield and deployment arrays. This will provide a true, totally autonomous, all-weather, day/night, lock-on-after-launch, standoff weapon to attack mobile ground forces. **Contractors:** Hercules, Hughes. **Status:** Demonstration/validation (dem/val).

Advanced Guidance Evaluation Program
Navy-USAF technical assessment of the imaging infrared (IIR), synthetic aperture radar, and laser radar (LADAR) sensor and associated mission planning technologies. Assessment includes engineering evaluation, algorithm analysis, laboratory simulation, and captive testing during FY 1991 and FY 1992. Program will result in recommendation to the Secretary of Defense regarding guidance and mission planning technology for current and future cruise missile applications. **Contractors:** McDonnell Douglas, GD, Loral, Raytheon. **Status:** Concept exploration.

Advanced Support Equipment
Effort to develop portable, Modular Automatic Test Equipment–qualified

tester to replace the existing AN/GJM-55 Test Set. It will operate with the AN/GJM-37A optical simulator, the infrared target simulator, and the RF coupler currently used in conjunction with the AN/GJM-55 test set. It will provide tactical air forces with a reliable capability to test and expedite repair of these air-to-surface weapon systems. **Contractor:** General Dynamics. **Status:** Full-scale development (FSD).

AGM-130A
Production of a rocket-powered, unitary (2,000-pound Mk. 84) version of the GBU-15 glide bomb, initiated through a product improvement program. The weapon provides a flexible, precision, standoff attack capability for the F-111F and the F-15E aircraft that increases the tactical air forces' capability to destroy high-value targets. Upgrades include a new solid-state TV seeker and improved IR seeker. **Contractor:** Rockwell. **Status:** Production.

AGM-142 Have Nap
Development of an electro-optical, air-to-ground, precision guided, conventional standoff missile system. The system has been in production in Israel since 1983. A Foreign Weapon Evaluation Program was conducted at Eglin AFB in FY 1987. A streamlined development program was completed to implement minor adjustments identified during the FWE Program. Provides standoff capability to SAC B-52s against fixed and mobile, high-value, soft targets. **Contractor:** Rafael Industries. **Status:** Production.

Autonomous Guidance for Conventional Weapons
Technology program to demonstrate capability of an IIR seeker to autonomously detect, acquire, track, and guide to a predetermined aimpoint on a prebriefed, high-value target. The seeker is being designed modularly to expand its application to a wide variety of weapons. **Contractor:** Texas Instruments. **Status:** Dem/val.

BSU-93 Air Inflatable Retarder
Program to procure new AIR for use with the M-117 bomb for carriage on the B-52. The BSU-93 is a modified Navy BSU-85 used with the 1,000-pound Mk. 83 bomb. The BSU-85 ring was modified to mate with the 750-pound M-117 bomb. This effort will satisfy SAC's requirement for M-117 bomb retarders. Production begins in FY 1992. **Contractor:** TBD. **Status:** Production.

Depot Automatic Test System
Program to provide long-term depot diagnostic test support for the AGM-130/GBU-15 family of weapons. A primary objective is to procure modern equipment qualified in accordance with Modular Automatic Test Equipment program guidelines. Equipment selected will be configured to meet these objectives and, along with associated equipment, will have a growth capability for future updates/modifications of the AGM-130/GBU-15 systems, including the improved data link and advanced support equipment. **Contractor:** Hughes. **Status:** Production.

GBU-15/BLU-109 Integration
Program to enhance tactical air forces' ability to attack hardened vertical targets with precision guided standoff weapons. The GBU-15 (2,000-pound Mk. 84) warhead can be replaced with the BLU-109, a penetrating 2,000-pound warhead. This increased-capability weapon can be delivered from the F-4, F-111F, and F-15E. **Contractor:** Teledyne Brown. **Status:** Production.

GBU-28/B Hardened Target–Penetrating Munition
Program that developed new bunker-busting weapon for use in Operation Desert Storm against deeply buried, hardened command and control facilities. Under USAF's rapid response program, the service developed a body design based on the BLU-109/B penetrator, extending the length by 54 inches (to 152 inches) and doubling the wall thickness to 2.25 inches. The bomb, flight tested on the F-15E and F-111F, demonstrated the capability to penetrate more than 100 feet of dirt or 20 feet of concrete. **Contractor:** Lockheed Missiles & Space Systems. **Status:** Production.

Improved Data Link
Program to replace the present AN/AXQ-14 data link used on the GBU-15. The new data link will provide the capability to counter current and projected electronic warfare threats using advanced antijam techniques. The new pod is compatible with the F-4E, F-111F, and F-15E aircraft and can be used with the GBU-15 and the AGM-130. **Contractor:** Team of Harris and Magnavox. **Status:** FSD.

Improved 2,000-Pound Bomb (BLU-109/B)/ FMU-143 Fuze
Development of BLU-109/B and FMU-143 fuze to defeat targets too hard to destroy with existing inventory bombs. The BLU-109/B retains interface modularity with Mk. 84 conical tail and guidance kits. Principal uses would be against reinforced concrete bunkers, caves, bridge piers, and landing surfaces, among others. **Contractor:** Lockheed. **Status:** Production.

Inertial Guidance Technology Demonstration Program
Program to produce low-cost inertial guidance and control kits to replace the standard steel tail fairing on an Mk. 82 bomb. Data from the aircraft delivery system (either INS or GPS) are used to calibrate and align the weapon's inertial unit prior to release. After release, the bomb guides itself on designated target coordinates with no aircrew interface. **Contractors:** Boeing, Northrop. **Status:** Demonstration.

Joint Tactical System Program Office

AGM-88 High-Speed Antiradiation Missile
Production of defense-suppression weapons that locate, guide on, and destroy enemy radar sites that control surface-to-air missiles. HARM is deployed on the F-4G Wild Weasel and the F-16 and is being considered for the F-15E. The Navy also uses HARM. The HARM-B Block III is currently in production. Block III retrofit was completed in March 1991. A hardware and software upgrade, HARM-C-1 (Block IV), is currently in DT&E/IOT&E. **Contractors:** Texas Instruments, Thiokol, Hercules. **Status:** Production.

Container Design Retrieval System
Program to maintain a central repository of all DoD specialized container designs to reduce duplication of containers for new DoD and other governmental agency container requirements. **Contractor:** None. **Status:** Ongoing.

F-16 HARM/Shrike Integration Program
Three-phase, quick-reaction-capability program to satisfy the tactical air forces' need to increase defense suppression capability by using the F-16 to augment the F-4G Wild Weasel force. No modification to the F-16 aircraft or the HARM/Shrike missile was permitted during Phases I and II. Phase III will provide HARM Block IV and Low-Cost Seeker capability. **Contractor:** Texas Instruments. **Status:** Production.

Sensor-Fuzed Weapons and Airfield Attack System Program Office

Sensor-Fuzed Weapon
Program to develop the first wide-area cluster munition with "smart" warheads capable of multiple kills per pass against armored targets. The SFW is a 1,000-pound-class cluster weapon containing ten BLU-108/B submunitions, each of which contains four "smart" armor-piercing warheads. The warheads use an infrared sensor independently to detect and fire on enemy vehicles. SFW will be compatible with all tactical aircraft. **Contractor:** Textron Defense Systems. **Status:** FSD.

Training-Testing Range System Program Office

Advanced Threat Training Emitter System
Program to provide advanced threat signals to SAC's Strategic Training Range Complex. Additions of red and blue or gray signals will be carried out by development of additional hardware compatible with existing Mini-MUTES control units. The ATTES units will be high-power, remotely controlled, and capable of autonomously acquiring and tracking participant aircraft. **Contractor:** Program definition. **Status:** TBD.

Air Combat Maneuvering Instrumentation/ Airborne Instrumentation Subsystem Pods
Production of the airborne portion of the ACMI system. Pods can be carried on any AIM-9 missile rail; some can be carried on AIM-120 rails. Pods are interoperable on all eight- and 36-aircraft ACMI systems, as well as on all US Navy TACTS ranges. Program includes fully automated/computerized pod test sets, which are deployed at each AIS pod maintenance facility. **Contractors:** Cubic Corp., Kollsman, Metric. **Status:** Production.

Air Combat Maneuvering Instrumentation/ Aircraft Central Computer Interface Subsystems
The ACCIS is an interface unit designed to let pre-MSIP F-15 aircraft perform on the ACMI in the same fashion as MSIP F-15s. **Contractor:** Cubic Corp. **Status:** Preproduction.

Air Combat Maneuvering Instrumentation Interoperability
Series of projects to upgrade all existing/operational ACMIs. Level I involves all Air Force and Navy aircraft. The system is designed to allow fighters in simulated combat to identify eliminated players easily. **Contractor:** Cubic Corp. **Status:** Production.

Air Combat Maneuvering Instrumentation/ Langley Display and Debriefing Subsystem
Development of a Red Flag Measurement and Debriefing System to be installed in conjunction with the Tactical Air Combat Training System upgrade at NAS Oceana, Va. This upgrade, in addition to expanding the range

area, changes Oceana from an eight-aircraft to a 36-aircraft configuration and changes the graphics displays from stroker to raster scan. **Contractor:** Advanced Data Tech Inc. **Status:** Production.

Air Combat Maneuvering Instrumentation Mini-DDS
Joint USAF-Navy project to provide a majority of the debriefing information currently available on the ACMI DDS to widely scattered users at their home bases at greatly reduced cost. The program will use state-of-the-art mini- and microcomputer equipment to reduce the cost of ACMI debriefing facilities. **Contractor:** TBD. **Status:** FSD.

Air Combat Maneuvering Instrumentation Upgrades
Projects to upgrade all existing/operational ACMIs. Projects will implement the AIM-9 product improvement and AIM-7 off-boresight target designation logic; replace large screen displays at Nellis AFB, Nev., Tyndall AFB, Fla., Langley AFB, Va., and Eglin AFB, Fla.; replace computers at Tyndall; and implement Mode VI on the Tyndall, Nellis, USAFE, Luke (Ariz.), Holloman (N. M.), and Korean ACMIs. **Contractor:** Cubic Corp. **Status:** Production, product improvement.

Alaska Air Combat Maneuvering Instrumentation
Project to provide means for improving training of Air Force fighter pilots in fighter tactics and techniques in Alaska. The range, located approximately 100 nautical miles west of Elmendorf AFB, Alaska, provides real-time monitoring and control of aircraft during combat training and records events for postmission debriefing and analysis. **Contractor:** Kollsman Corp. **Status:** Production.

AN/MST-T1V Mini-MUTES
Production of a variant of the AN/MST-T1A that allows dispersion of emitter signals to simulate an integrated air defense system. The remote emitters will be unmanned and will radiate multiple threat signals. **Contractors:** General Dynamics, Harris. **Status:** Production.

Bomber Airborne Instrumentation Subsystem
Project to develop internally mounted subsystem to perform the functions of the P4AM AIS pod and allow SAC bomber aircraft to play on ACMI and Tactical Air Combat Training System ranges. The program consists of (1) internal modification and interface of B-52 and B-1 aircraft to allow rack mounting of the BAIS electronic components, (2) the BAIS box itself, and (3) an organizational level test set. **Contractor:** Kollsman Corp. **Status:** Preproduction.

Egyptian Air Combat Maneuvering Instrumentation
Program that provides capability to train aircrews in air-to-air and air-to-ground combat as well as electronic warfare. It will support both the Egyptian Air Force and the US Air Force in Egypt. System provides real-time monitoring and control of aircraft during combat training and records events for postmission debriefing and analysis. **Contractor:** Cubic Corp. **Status:** Initial operational capability (IOC), product improvement.

Global Positioning System Production
Development of High-Dynamics Instrumentation Set, a full mil-spec GPS five-channel CA/P-code receiver for use in high-speed aircraft and in pods mounted on the aircraft. Data link subsystem is used for data communication between the participants and the RR/P and host range. Ancillary equipment includes a control display unit to communicate with GPS instrumentation sets and a data retrieval unit used to download recorded data for transfer to a host range computer. **Contractor:** Interstate Electronics. **Status:** Low-rate initial production.

Global Positioning System/ Strategic Training Route Complex
Program to integrate the GPS software and hardware and transitional devices into the STRC sites. **Contractor:** TBD. **Status:** Program definition.

Global Positioning System Translator Range Applications
Program to develop and test translators for test and training ranges. Translator will be used for low volume requirements and will receive L-band signals from all satellites in view, shift signals to another frequency (commonly S-band), and transmit this broad-band information to the ground station for reduction. **Contractor:** Interstate Electronics. **Status:** FSD.

Ground Jammer Follow-On (AN/MLQ-T4)
Production of I/J band radar jammer that includes functional duplication of known threat jammers. Modular construction and software changes will permit low-cost updates. **Contractor:** American Electronic Lab, Inc. **Status:** Production.

Ground Transmitters Global Positioning System Range Applications
Program to develop and test ground transmitters. The GTs will provide equipment that will enable triservice test and training ranges to augment GPS coverage when less than four Navstar satellites are in view. The SDI mission will require this increase in coverage to perform tracking of an interceptor missile and a reentry vehicle. **Contractor:** Stanford Telecom Inc. **Status:** FSD.

Gulfport North Range Air Combat Maneuvering Instrumentation
Program to expand existing Gulfport overwater ACMI to instrument airspace surrounding Camp Shelby, Miss. The north range consists of an additional Tracking Instrumentation Subsystem (TIS) master and 13 remotes (including one collocated with the master and one collocated with the microwave data link relay). The south range will be used primarily for air-to-air training and the north range for air-to-ground training of Guard, Air Force, and Navy pilots. **Contractor:** Industrial Data Link. **Status:** Production.

Gulf Range Drone Control System Upgrade
Program to replace all computer hardware of the older GRDCUS with a more powerful computer system to control both full-scale and subscale drones. It will include a mobile control system. The mobile system is part of the test equipment being acquired for the QF-4 full-scale aerial target and is designed to land damaged drones. This upgrade will also include a capability to accept the use of GPS data for time and space positioning information (TSPI). **Contractor:** TBD. **Status:** Program definition.

Low-Cost Global Positioning System C/A Receiver Global Positioning System Range Applications
Program to provide the US Army with up to 400 C/A Receiver units. This procurement will be a two-step competitive acquisition to procure approximately 700 units. **Contractor:** TBD. **Status:** Production.

Mid-Atlantic Tracking System and Western Space and Missile Center Upgrade, Navstar Global Positioning System Range Applications
Program to develop and integrate selected GPS equipment into the MATS at the Naval Air Test Center, Patuxent River, Md., and the Western Test Range at the WSMC at Vandenberg AFB, Calif. **Contractor:** Interstate Electronics. **Status:** FSD.

Missile Endgame Scoring System
Program will provide for development, test, and production options for QF-106 and BQM-34A Aerial Targets. **Contractor:** Motorola. **Status:** FSD.

National Training Center/Air Warrior Integration System
Program to place an ACMI range over the existing Army National Training Center Range at Fort Irwin, Calif. Data from the Army tracking system will be shared and integrated with the ACMI data stream so that weapons events can be conducted among both Army and Air Force players. Specially modified AIS pods will form part of the system to allow the Army system to designate airborne targets. **Contractor:** Cubic Corp. **Status:** Production.

Navstar Global Positioning System Range Applications
Program to develop and demonstrate a GPS system to calculate a participant's TSPI and telemeter this information to a central location for display and processing. This will be demonstrated at seven DoD ranges and as part of the SDI ballistic missile program. The system will use GPS receivers, GPS translators, and ground GPS processors. **Contractor:** Interstate Electronics. **Status:** FSD.

Naval Weapons Center Range Development Program, Global Positioning System Range Applications
Program to provide Naval Weapons Center, China Lake, Calif., with a TSPI system to support Integrated Naval Air Defense Simulation testing requirements, evaluation of new airborne countermeasures equipment, and tactics development. **Contractor:** Interstate Electronics. **Status:** FSD.

Okinawa Air Combat Maneuvering Instrumentation
ACMI system to be installed in the water 90 nautical miles northeast of Okinawa, Japan. It will include six large semisubmersible buoys and will be capable of handling eight high-activity targets. **Contractor:** Cubic Corp. **Status:** Production.

On-Board Electronic Warfare Simulator
Program to provide F-16 and F-15E aircrews with realistic electronic combat threat indications. This ground-independent, computerized threat simulator will cause aircraft radar warning receivers to react visually and aurally as though threats actually existed. **Contractor:** TBD. **Status:** Dem/val.

PACAF Measurement and Debriefing System/USAFE MDS
Program to upgrade the PACAF and USAFE ACMIs with the next-generation MDS capability. This involves the replacement of the eight-aircraft system with more modern systems such as the 36/45-high-activity aircraft system,

70 ground threats, and GPS/CGTS capability. **Contractor:** TBD. **Status:** Program definition.

QF-4 Full-Scale Aerial Target
Program to convert retired F-4 aircraft to full-scale aerial targets for use in support of aircrew training, tactical air forces weapon systems evaluation, and development test programs. **Contractor:** TBD. **Status:** FSD and production.

QF-106 Full-Scale Aerial Target
Conversion of retired F-106 aircraft to full-scale aerial targets for use in support of aircrew training, tactical air forces weapon systems evaluation, and development test programs. **Contractor:** Honeywell, Inc. **Status:** Production.

Range Control System
The RCS will support safety, overall management, and ground-control intercept training at the Range Control facility at Tyndall AFB, Fla. The RCS will receive and display sensor inputs and will provide the capability to receive and display other future sensor system inputs. **Contractor:** Rome Air Development Center. **Status:** Production.

Smokewinder Pods
Program to develop a visual cuing device to operate in conjunction with an ACMI AIS pod. The device will generate smoke to simulate missile/gun firing for a "shooting" aircraft and hit/kill by the "target" 36-aircraft systems and is intended to allow each service's aircraft and weapons events to play on the other's ranges. **Contractor:** EMI Tech Inc. **Status:** Preproduction.

Strategic Training Route Complex/
Route Integration Instrumentation System
Program to provide RIIS for a SAC training complex in the northwest US. Encompasses communication, control, information processing, and debriefing display capability for the STRC. The RIIS aircrew debriefing function will provide capability to review missions, analyze associated events, and evaluate aircrew performance. **Contractor:** GTE. **Status:** Production.

Translator Processing System Global Positioning
System Range Applications
Program to develop and test the TPS for test and training ranges. TPS will receive telemetry signals from the translator and process the position of the translator to the ground controller. The TPS provides tracking for the Army's SDI interceptor missile and reentry vehicle. **Contractor:** Interstate Electronics. **Status:** FSD.

Wisconsin Air Combat Maneuvering Instrumentation
Measurement and debriefing system ACMI to be installed at Volk Field, Wis. The system includes a dual TIS having two master stations and 18 associated remotes. The system provides instruments for military operating areas and other airspace surrounding the Combat Readiness Training Center at Volk Field, 90 miles northwest of Madison. **Contractor:** Kollsman Corp. **Status:** Production.

Wright Laboratory: Armament Directorate

Advanced Gun Technology
Program to develop and demonstrate simple, highly reliable, advanced aircraft gun and ammunition technologies to defeat advanced aircraft threats. Key performance parameter is the increase in muzzle velocity of rounds to 5,000 feet per second to obtain an all-aspect firing capability against fast, highly maneuverable aircraft. **Contractor:** GE. **Status:** Advanced development.

Advanced Technology LADAR System
Program to develop and demonstrate an affordable, high-resolution, LADAR guidance system for medium- and long-range air-launched attack of high-value, fixed, ground targets. Applies to cruise missiles and medium-range air-to-ground missiles. **Contractors:** McDonnell Douglas, General Dynamics. **Status:** Advanced development.

Aeromechanics Thrust
Have Slick program to develop technology options for low-cost, low-drag, low-observable, all-composite, air-to-surface munitions dispenser. Aerodesign allows standoff ranges from low-altitude release of up to 35 kilometers in the powered configuration. Aft dispensing technique allows multiple kills per pass. **Contractor:** McDonnell Douglas. **Status:** Advanced development.

Autonomous Synthetic Aperture Radar Guidance
Program to develop and demonstrate an affordable, all-weather, midcourse and terminal guidance system for medium- and long-range air-launched attack of high-value relocatable and fixed ground targets. Applies to conventional cruise missiles and medium-range air-to-ground missiles. **Contractors:** Loral, Raytheon. **Status:** Advanced development.

Beam Sight Technology Incorporating Night Vision Goggles
Program will design, develop, and test a fire-control system for crew-served weapons operated by gunners wearing night vision goggles. System will increase first-burst hit capability, reduce vulnerability by not using tracers, and increase effectiveness. **Contractor:** TBD. **Status:** Advanced development.

Electromagnetic Launcher Technology
Program to design and develop component and subsystem technologies for rapid-fire hypervelocity gun systems. **Contractors:** Sparta, PKD. **Status:** Exploratory and advanced development.

Guided Interceptor Technology
Technology program to develop sensors, seekers, processors, and integrated guidance systems for space-based conventional weapons. **Contractors:** Rockwell, Texas Instruments, Ball Aerospace, Hughes, Nicholes Research, Martin Marietta. **Status:** Exploratory and advanced development.

Hard-Target Ordnance Technology
Program to develop and demonstrate warhead, fuze, rocket motor, and integration technologies for a boosted penetrator weapon to defeat heavily hardened targets such as underground C^3I sites. **Contractors:** Lockheed, Motorola, AAI. **Status:** Advanced development.

Have Dash II
Program of experiments to develop bank-to-turn steering technology for medium-range air-to-air missiles. Flight test of this all-composite missile airframe will be the first time a nonaxisymmetric, air-to-air missile airframe has flown with bank-to-turn steering logic. This technology is critical to the development of air-breathing propulsion systems where inlet flow must be maintained over the flight environment. **Contractor:** Ford Aerospace. **Status:** Exploratory development.

Insensitive Munition Fuze Technology
Program will identify design concepts, critical technologies, and test techniques applicable to the development of an all-up round with insensitive munition fuzing. **Contractor:** AAI. **Status:** Exploratory development.

Insensitive Munitions Technology
Program to develop, qualify, and introduce into the Air Force inventory an insensitive high explosive that is safe to handle, store, and transport. Several explosives developed in-house, by the Navy, and by a contractor are being evaluated. **Contractor:** Atlantic Research Corp. **Status:** Advanced development.

Low-Cost Antiarmor Submunition
Joint USAF-Army program to develop a "smart" submunition to defeat ground-mobile threats. Program is funded under the Balanced Technology Initiative. **Contractors:** Martin Marietta, LTV, Raytheon. **Status:** Advanced development.

Low-Cost Standoff Weapon Technologies
Interlaboratory program to develop and demonstrate key technologies that will reduce the cost of future guided standoff weapons. Participants are Armament, Materials, Aeropropulsion, and Astronautics directorates. Goal is to develop, by 2000, medium-range standoff weapon technologies for defeating a multitude of targets at one-third the cost of AGM-130. **Contractor:** TBD. **Status:** Advanced development.

Millimeter Wave/Infrared Common Aperture Seeker
Program to develop a countermeasure terminal guidance seeker for direct-attack standoff autonomous acquisition of moving and fixed clustered armored targets. Applies to short-range air-to-ground attack missiles. **Contractor:** TBD. **Status:** Advanced development.

Programmable Ordnance Technology
Technology program to design and demonstrate an AIM-120 AMRAAM ordnance package to defeat the post-1995 air threat. The ordnance package will include an improved target detection device; a more lethal warhead; and an electronic safe, arm, and fire device. **Contractor:** Motorola. **Status:** Advanced development.

Space Target Vulnerability/Lethality Assessments
Technology program to develop threat descriptions, kill criteria, and test conditions to evaluate the effectiveness of SDI conventional weapons concepts. **Contractors:** GRC, SAIC. **Status:** Exploratory development, advanced development. ■

The Allies were thin on the ground. If not for 5th Air Force, North Korea's knockout blow might have succeeded.

The Equalizer in Korea

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

Pilots of F-84E Thunderjets (above) are briefed prior to a mission against North Korea in December 1950; an Air Force F-80E Shooting Star (opposite) takes off for a mission in August 1950. US airpower, striking from Japan at the start of the conflict, was the great equalizer in the Korean War.

IT WAS a sleepy summer Saturday afternoon, June 24, 1950, when word reached Washington, D. C., that North Korean armed forces had attacked across the thirty-eighth parallel. Secretary of State Dean Acheson was puttering around his Georgetown garden. President Harry Truman was home in Missouri. Immediately after he received word of the assault, Secretary Acheson passed the electrifying news to the President.

Soon after the North Koreans attacked, it became obvious that South Korean forces could not hold them off. Initial battles turned into routs. President Syngman Rhee, facing the certain fall of Seoul, moved his government south. President Truman ordered the evacuation of Americans in South Korea, calling on Air Force fighters based in Japan to provide cover.

The order was easier to issue than to carry out. The Air Force, like the rest of the US defense establishment, had been through severe economizing measures in the postwar years. Down to forty-eight groups—not all fully equipped or combat-ready—it was a shadow of its World War II self.

In Japan, 5th Air Force was in better shape than most, but even it had to scramble to find enough aircraft for the job. All but abandoned in the new emergency was the 5th's primary mission, the air defense of Japan.

Despite these problems, US conventional airpower was unquestionably the great equalizer in the Korean War, accounting for seventy-five percent of enemy tanks destroyed and for the strangling of enemy supply lines. Airlift, operating under the aegis of air superiority, became the essential supply agent of all the forces.

In Washington, events moved swiftly in the early weeks of the war. President Truman decided to intervene without consulting Congress or Gen. Douglas MacArthur, the commander in chief of US Far East Command, who shortly would find himself charged with a new responsibility: defense of South Korea.

The United Nations Security Council, which the Soviets at that time were boycotting, passed a resolution calling on member nations to "render such assistance to the Republic of Korea as may be necessary to repel the armed attack." As would be the case in the Persian Gulf War four decades later, the UN's imprimatur lent an air of legality and respectability to military action the


T-526

United States was in any event determined to undertake.

President Truman's warlike stance on Korea contrasted sharply with his earlier decision to rely on a strategy of nuclear deterrence while slashing conventional military forces. Secretary of Defense Louis Johnson, a man of political ambition, carried out the cuts with enthusiasm, though he shared President Truman's penchant for promising to defend various parts of the world.

As Shocked As Anyone

When North Korea attacked, General MacArthur had been as shocked as anyone in Washington. His responsibilities extended to Japan, the Ryukyus, the Marianas, and the Philippines. Formosa—or Taiwan, as China called it—had been left outside the declared US defense perimeter, and the Nationalists were pariahs to some in the State Department. Nonetheless, no one wanted Formosa to fall into the hands of Communist China. General MacArthur had called the island an "unsinkable aircraft carrier." In enemy hands, it would be a strategic salient.

The North's surprise attack permanently altered the Administration's previous indifference toward Taiwan. The Navy's Seventh Fleet began patrolling the Formosa Strait. The objective was to prevent either of the Chinese rivals from starting a war.

Meantime, the situation in Korea was becoming desperate. General MacArthur was once again in command of a hot war, and the outlook was reminiscent of Bataan. US ground troops in Japan, softened by the easy life of an occupation force, were poorly prepared for the shock of combat duty, let alone the rigors of mounting a last-ditch defense of a specific area, as was taking place at the Pusan perimeter.

When the war began, Thomas C. Richards, who later rose to the rank of four-star general in the Air Force, was a young Army corporal stationed in Japan. He recalls that, in those first weeks of the war, ammunition shortages were widespread and American soldiers who were generally untrained and decidedly unready were sent into action.

Air Force units were better prepared, but severe and immediate problems limited what they could do. Their aircraft inventory was a mixed bag, a reflection of both lean budgets and the lack of urgency of 5th Air Force's primary mission, the air defense of Japan. Forces of the 5th received no training in bombing, gunnery, or close air support.

Primitive, Dangerous Work

In addition to suffering from numerical shortages and a lack of secure bases in the remaining Korean foothold, 5th Air Force had almost no all-weather capability. Daylight air operations had given northern armor and other heavy formations a good beating, but there was little the Air Force could do at that time about the nighttime southward movement of enemy supply convoys.

Still, American B-26s, F-80s, F-82s, and even P-51 Mustangs went after the nighttime traffic. The US Marine Corps, operating all-weather F4U Corsairs from Itazuke AB, Japan, added to the after-dark capability. It was primitive and dangerous work, but it paid off. By the end of August 1950, North Korean truck convoys were dousing their lights and moving at a creep. Hard-earned crew experience made up for a lack of all-weather cockpits and munitions to some extent, but night continued to favor the enemy in resupply operations.

Throughout August and September, the military situation in the Pusan perimeter remained perilous for the Americans and their South Korean allies. The US Army had almost nothing in the way of reserves, nor did the Marine brigade. Airpower, including carrier aviation in the Sea of Japan, provided the only Allied advantage, and it turned out to be a decisive one in holding the line. The 8th Army's commander, Gen. Walton Walker, stated on more than one occasion that without 5th Air Force support his troops would have been driven into the sea.

Toward the end of August, the combined effect of US daylight air attacks on Communist armor and troop concentrations, nighttime harassment of Communist supply columns, and B-29 carpet bombing of Communist forces had produced a crisis for the enemy. Like the Iraqis forty years later, the North Koreans were slaughtered and demoralized by the one-sided air war.

Their last all-out assault took place on August 31, 1950. With trumpets urging on waves of attacking Communist troops, the North mounted a last desperate at-

When Communist China entered the Korean War, UN forces began a painful retreat, complicated by bitterly cold weather. If the Communists had mounted air attacks on Allied ground forces, it would have been a disaster. Here two airmen with US Far East Air Forces Bomber Command in Korea load a B-29 with bombs in a January snowstorm.

At right, the pilot of a US B-26 Marauder gives his crew a final briefing before a strike against North Korean positions. The B-26's mission was to seek out enemy vehicle convoys and rail traffic and destroy them, primarily on night missions, but Marauders also attacked enemy battle line positions in support of UN forces. Below is a North Korean railroad staging area after an attack by 5th Bomb Wing B-26s.

tempt to score a knockout blow against the defenders. During the bloody struggle that followed, there were times when it appeared the North Koreans would break through. But their lack of an effective air capability, and the maximum close support operations of 5th Air Force, US Marine Corps aviation, and the Royal Australian Air Force, together with valiant fighting by US and ROK ground forces, gradually exhausted the enemy. Disaster had been averted.

General MacArthur's visionary, and in some respects irrational, decision to make an amphibious assault at Inchon was the turning point in what can be called the first Korean War—the one against the North Koreans.

Inchon presented formidable obstacles to an amphibious operation. The tide there rises and falls many feet in accordance with the phase of the moon. The water would be sufficiently deep only on a few days, and then only for a few hours. If the landing could not be made on September 15, the US would have to wait until October 11 for the next suitable day. The risk of the assault force helplessly mired in the tidal flats was a planner's nightmare, but General MacArthur was adamant. It would be Inchon, and all would go well. He was right, and the great gamble has gone down in military history as a classic maneuver.

Scarcely 25,000 North Korean troops managed to escape the trap, although most of their generals did. For all practical purposes, the war after Inchon had turned into an Allied pursuit of a disorganized and defeated enemy. After some deliberation, the politicians decided there was a legal basis for UN troops to proceed north of the thirty-eighth parallel.

The Second Korean War

It was all starting to look easy until the eruption of the second Korean War—the one against the Chinese. The first sign of a Chinese entry into the war came in mid-October 1950, when a flight of Mustangs operating near the Yalu received antiaircraft fire from Chinese batteries across the river. Two weeks later, a few miles south of the Yalu boundary, a B-26 was bounced by a flight of Soviet-designed Yak-3s and Yak-9s. Since the World War II–vintage, propeller-driven Yaks were no match for Mustangs, let alone F-80s, this first air engagement caused no great worry, even if it signaled an end to US air supremacy. That same day, however, six MiG-15 jets crossed the Yalu and attacked a flight of Mustangs. At this point, 5th Air Force, with its Mustangs, B-26s, and underpowered F-80s, was not only at a disadvantage. It was outclassed.

Shortly thereafter, Communist Chinese ground units entered the war in strength. The second phase of the conflict took on a decidedly different aspect as the UN forces went on the defensive and began a slow, costly retreat. Bitterly cold weather added to the difficulties of the retreat, but one saving factor—the total absence of enemy air attacks—prevented a disaster.

By mid-December, arrival of F-86A Sabres in the theater had improved the air-superiority situation, although the lack of bases in the north put F-86 pilots at a severe disadvantage.

Chinese MiG-15s were operating from the sanctuary of home bases, while the F-86s were at the limit of their combat radius. Ingenious tactics, including spacing four-ship F-86 flights so they arrived at five minute intervals at different altitudes and at high speed, evened the game.

Superior pilots, only a few of them World War II aces but many with combat experience, racked up a lopsided

A lack of bases in the north gave F-86 Sabres, at the limit of their combat radius, a disadvantage against Chinese MiG-15s. The pilots of the F-86s evened the odds with ingenious tactics and eventually knocked down 800 MiGs while losing only fifty-eight Sabres. Here an F-86 gets a scrubdown from ground crewmen. The jets were cleaned often to reduce air friction caused by dirt and grime.

kill ratio in favor of the Americans. Nevertheless, having to fight at maximum range against an enemy operating from a nearby sanctuary made combat very tough. If Kim Il Sung had waited a few months before undertaking his venture south, the situation would have been even tougher. The postwar defense drawdown would have taken full effect and left the US with little in the way of conventional capability.

The US might have been seriously tempted to use nuclear weapons against North Korea. The very mention of this possibility by President Truman was enough to send shivers through the Allies.

During the bleak days of December 1950, when General Walker's 8th Army was in retreat down the western side of Korea and Gen. Edward M. Almond's X Corps was similarly retreating in the east, it seemed possible that the Chinese intervention might result in a general war that would involve the USSR. The situation in December was critical, with only the air battle going in favor of the United Nations Command. Fear of an all-out war with China, and probably with the Soviet Union, became the overriding influence on US and Allied policy. A cease-fire, rather than a military victory, became the effective goal of allied operations.

Truman Holds Firm

Britain's Prime Minister Clement Attlee was for a cease-fire at almost any price. President Truman adopted a firmer position, and the British came around in the interests of British-American unity. The Allies declared their intention to stand fast in Korea, although London said it would agree to a cease-fire under acceptable conditions. The US declared itself against any terms that would put MacArthur's troops at a disadvantage.

It was clear in December, however, that the days of rapid advance following Inchon were over and that military action would not unify the Korean peninsula. The war continued for two and a half years, to no real purpose save to return to the prewar *status quo,* with Korea divided into north and south.

For the most part, the war news from Korea made dreary reading. After the heady days in the fall of 1950 when the North Koreans were on the run, the bleak winter of Allied reverses set in. However, the air battles between F-86s and MiG-15s did catch the attention of the ordinary citizen. The stars were men like Joe McConnell and "Pete" Fernandez, engaged in their daily contest for air supremacy. It was a glorious time for American fighter pilots as they challenged the Chinese —and Soviet exchange pilots *[see "The Russians in MiG Alley," by Steven Zaloga, February 1991 issue, p. 74]*— while outnumbered and in view of the enemy sanctuary.

The final score heavily favored the US. The Americans had lost only fifty-eight Sabres in the process of shooting down or otherwise destroying 800 MiGs, even though there was little technical disparity in the fighting power of the airplanes. The pilots made the difference.

It is odd that so little attention was paid afterwards to lessons of the Korean War. Immediately upon signing the cease-fire, Washington reverted to a strategy based on nuclear weapons—the so-called doctrine of "massive retaliation" embraced by John Foster Dulles, President Eisenhower's Secretary of State until 1959. New fighter aircraft like the F-100, the F-84F, and the F-105 became minibombers dedicated to the mission of nuclear retaliation.

The MiG Alley saga was history—interesting, but no longer relevant. Nor was much attention paid to the heroic performance of the fighter-bomber crews in the interdiction and close air support missions. All this was old hat.

The Korean War soon faded from mind and view. The conflict was the nation's first venture into "limited war," a term that has meaning only in the political sense, for there was nothing limited about the violence. The US sustained 157,530 casualties, with 33,629 dead. South Korea had 1,312,836 military casualties, with 415,004 dead. The casualties of other heavily involved Allied nations—Britain, Australia, and Turkey—totaled more than 16,532. The Communist side lost an estimated two million. ■

Gen. T. R. Milton, USAF (Ret.), is a longtime Contributing Editor to AIR FORCE *Magazine. His popular "Viewpoint" column ran in these pages from 1974 through 1990.*

The Aerospace Education Foundation awards ten graduate study grants.

The von Kármán Scholars

By Arthur C. Hyland

THE Aerospace Education Foundation has announced its latest class of Dr. Theodore von Kármán Graduate Scholarship winners. AEF is awarding each recipient $5,000 for graduate-level academic work in aerospace-related fields.

The ten winners—eight men and two women—are the second group of beneficiaries of the program set up by AEF in 1989. Competition is open to Air Force ROTC graduates pursuing advanced degrees in science, mathematics, engineering, or physics.

The scholarships commemorate the work of Dr. Theodore von Kármán, science advisor to the Army Air Forces in World War II. Dr. von Kármán, at the urging of Gen H. H. "Hap" Arnold, organized and led what was later to become the US Air Force Scientific Advisory Board.

The winners were selected from a pool of applicants. The selection committee was chaired by Dr. John W. Williams, an AEF trustee and Vice President for Academics at Embry-Riddle Aeronautical University. Also on the panel were AEF Trustee Charles B. Jiggetts and Sue Ellen Darnell, AEF's Presidential Advisor and 1990 Christa McAuliffe Memorial Award winner.

AEF funds the program with proceeds from an initial sum placed in a scholarship fund and builds the endowment with contributions from AFA members, states, chapters, and corporate supporters.

The 1991 AEF Theodore von Kármán Graduate Scholarship winners:

Robert N. Beyerly, Flushing, Mich. B.S. aerospace engineering, University of Michigan. Graduate goal: M.S. mechanical engineering, University of Michigan.

Paul C. Bresnahan, St. Peter, Minn. B.S. aerospace/astronautical engineering, University of Illinois. Graduate goal: M.S. aerospace/astronautical engineering, university undetermined.

Kristen M. Gledhill, Chepachet, R. I. B.S. mechanical engineering, Cornell University. Graduate goal: M.S. aerospace engineering, Stanford University.

Paul A. T. Haris, Valley Forge, Pa. B.S. electrical engineering, Pennsylvania State University. Graduate goal: M.S. electrical engineering, Pennsylvania State University.

Charles K. Havasy, Scotia, N. Y. B.S. electrical engineering, Rensselaer Polytechnic Institute. Graduate goal: M.S. electrical engineering, university undetermined.

Michael S. Hopkins, Richland, Mo. B.S. aeronautical/astronautical engineering, University of Illinois. Graduate goal: M.S. astronautical engineering, Stanford University.

Roger G. Knapp, Kent, Wash. B.S. astronautical engineering, Massachusetts Institute of Technology. Graduate goal: M.S. astronautical engineering, Massachusetts Institute of Technology.

Renee L. Mong, Poulsbo, Wash. B.S. astronautical engineering, Massachusetts Institute of Technology. Graduate goal: M.S. astronautical engineering, Massachusetts Institute of Technology.

William J. Neuenfeldt, Menomonie, Wis. B.S. aeronautical engineering, Stanford University. Graduate goal: M.S. aeronautical/astronautical engineering, Stanford University.

William M. Ruark, O'Fallon, Ill. B.S. electrical engineering, Stanford University. Graduate goal: M.S. engineering/economic systems, Stanford University. ■


Beyerly


Bresnahan


Gledhill


Haris


Havasy


Hopkins


Knapp


Mong


Neuenfeldt


Ruark

The dead-reckoning charts used Greenwich Mean Time, and the navigation standard was soon adopted for military operations worldwide.

Zulu Time

By Bruce D. Callander Illustrations by Bob Stevens

THROUGHOUT the Persian Gulf War, television reporters kept telling US viewers what time it was locally in Saudi Arabia. They did that so their audience wouldn't get confused about who was doing what to whom, when. The whole thing would have been easier if everybody simply had used Greenwich Mean Time or, in military parlance, "Zulu Time."

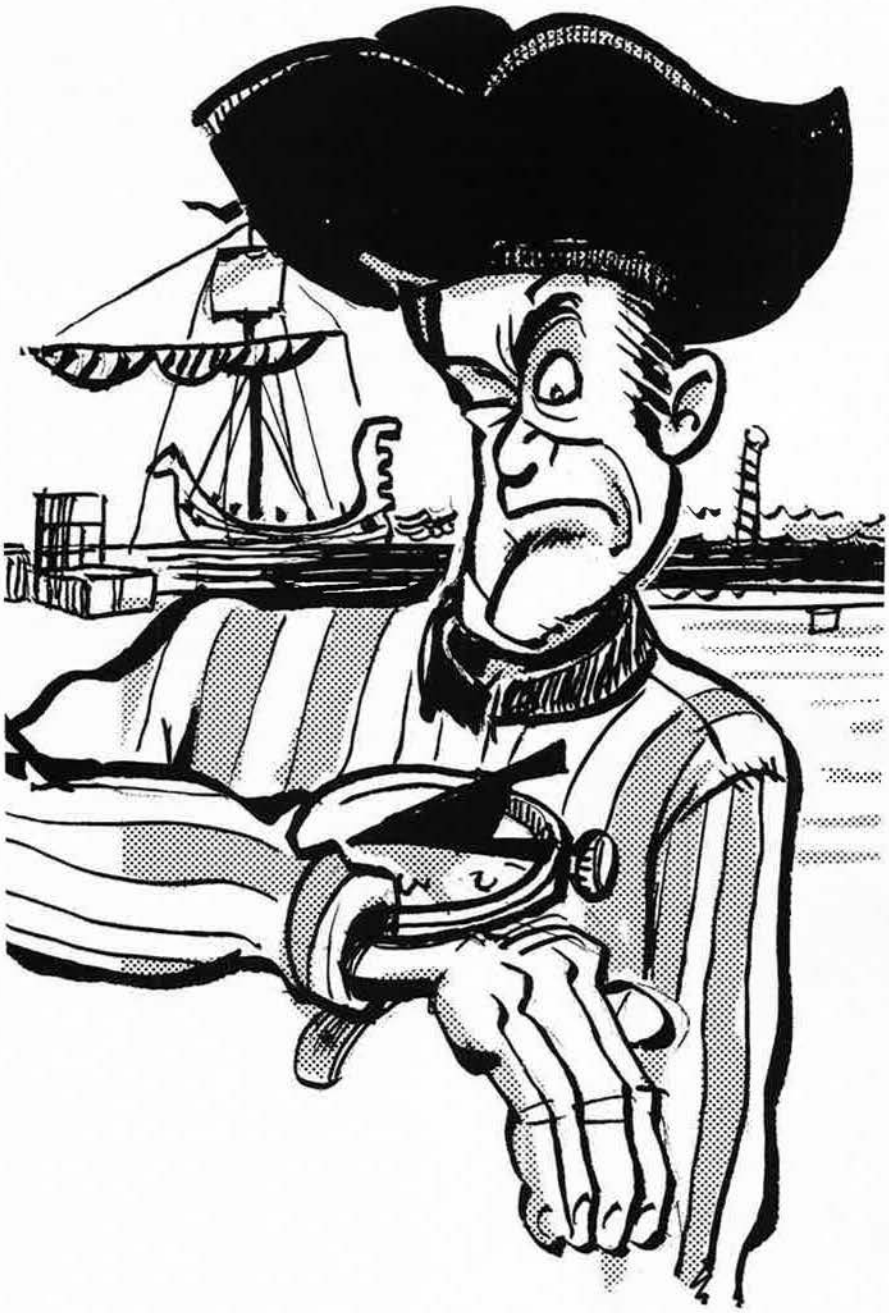
That international time system was created precisely to solve such problems. As Zulu Time evolved, the world also acquired a better navigation system, a more reliable timepiece, and far more sensible railroad timetables.

Before all that could happen, somebody first had to break the natural day into identifiable parts. For that, we may well have to thank the forebears of today's Iraqis. While the rest of the world was still counting on fingers and doing base-ten arithmetic, the ancient Mesopotamians fell in love with the number sixty—no one knows why—and used it to divide all sorts of things. By the time Mesopotamia became Iraq, the world was stuck with the twelve-month year (one-fifth of sixty), the twenty-four-hour day, the sixty-minute hour, the sixty-second minute, and the rest of it.

Once you had the numbers, you could keep time with a sundial, an hourglass, a pendulum, any number of things. If you needed to be precise, you could check your local observatory. That worked fine for several centuries. Then another problem came up.

People emerged from the Middle Ages with a more powerful yen to travel and took to the sea in large numbers. For a while, they just wandered around, not caring too much when they got home, but before long ships were hauling goods between the continents. As this import-export business grew more competitive, traders needed to know more than just which way was home. They had to know where they were at any given time and how to get where they were going by the shortest route.

European astronomers worked out a navigation system. In 1675, King Charles II built a major new observatory at Greenwich, England, and set it to turning out star charts. With enough of those charts,



a navigator could find his longitude and latitude any place in the world and keep to a precise course. All he needed was a sextant and a good clock.

What Was Missing

The bad news was that, though the Europeans had plenty of sextants, nobody had yet invented a really accurate timepiece. Ships still were getting lost at sea, sometimes permanently. By 1714, things were so bad that the British government offered a reward of £20,000 sterling to any one who could produce a state-of-the-art, reasonably accurate timepiece.

A mechanic named John Harrison came up with a chronometer that, after making a trip to Jamaica, was found to be "off" by a mere five seconds. The British government accepted it. Modern maritime navigation was off and running.

With one thing and another, however, it took Harrison forty years to collect his prize money, and it wasn't long afterward that world travelers faced another problem that the best of watches couldn't solve.

In the early 1830s, steam-driven trains were introduced in Britain and the United States. Soon goods and people were moving around faster than ever before, and the railroads were knitting together hundreds, perhaps thousands, of villages.

The hitch was that all of these burgs and hamlets kept their own time. An 1841 timetable for Britain's Great Western Railroad told bewildered passengers the following: "London time is kept at all stations, which is about four minutes earlier than Reading time, five and one-half minutes before Steventon time, seven and one-half minutes before Cirencester time, and fourteen minutes before Bridgewater time."

As the railroads expanded, things got worse. By 1880, railroad companies around the world had laid more than 150,000 miles of track. Railroads in the United States alone were dealing with more than 100 separate time schemes. In 1883, Canadian and US railroad companies worked out a system to relieve the situation. One year later, the plan was adopted by an international conference.

The plan divided the Earth into twenty-four time zones, demarcated by meridians fifteen degrees apart. France wanted Paris to be the starting line. The Americans promoted Washington. However, because Britain still ruled the waves, and much else besides, the time-organizers finally agreed to run the Prime Meridian through the old observatory at Greenwich.

Standard Time Gets Airborne

By the time the Wright brothers took to the air, standard time was used in most of the civilized world. The Wrights' first flights were too short to make full use of the system. Twenty years later, however, two Army Douglas World Cruisers circled the Earth, and global aviation was in business. The value of the standard time system became apparent.

As aviation shrank the globe, accurate navigation became even more vital. Over land, pilots could follow highways and railroad tracks;

by the mid-1920s, they even had a system of lighted airways and radio beacons. However, flying in bad weather and over water was quite another story. Most pilots weren't trained to cope.

Early in the 1930s, the US Army Air Corps created a unit at Bolling Field near Washington, D. C., to study the problem. It hired Harold Gatty, a navigator just back from a worldwide flight, as an advisor. Most of the needed tools were at hand. The Germans had developed an aerial sextant. Accurate drift meters had appeared soon afterward, along with slide rules for solving course and distance problems. The mariners' star charts had been adapted to aerial almanacs. The Army had watches as accurate as the big shipboard chronometers. The trick was to teach flyers to use the stuff.

The Air Corps set up a navigation training program for pilots and later expanded it into a full five-month course for navigators. At the heart of the new air training was a centuries-old technique. It amounted to drawing a scale model of the plane's course and airspeed and adding a line to represent wind speed and direction. From that, the navigator could figure his heading, ground speed, and time of arrival. Originally it was called "deduced reckoning," but the first word was abbreviated to "ded," and the phonetic pronunciation "dead reckoning" became the accepted term.

The process involved taking repeated position readings using everything from maps to celestial observation. Celestial fixes were made using star charts based on Greenwich Mean Time. The Army Air Forces adopted it not only for navigation but also for timing its worldwide operations. World War II navigators lived by it. Their premission "time hacks" took on the solemnity of religious rituals, and GMT bound the faithful together like some secret password. Army Air Forces navigators from Italy to the Far East could tell you to the second what time it was in that little town near London.

Since the war, technology has taken much of the drudgery out of navigation, and in many aircraft, black boxes have replaced human navigators altogether. Some systems even take their celestial "fixes" from man-made satellites rather than from the stars.

Time systems themselves have gone through a series of changes. Until well into this century, Greenwich Mean Day began at noon because astronomers didn't want to change dates during their overnight vigils. That practice confused other people, but it was not until the 1920s that the schedule was revised. The stargazers still kept their system but renamed it Greenwich Mean Astronomical Time. The rest of us went on a midnight-to-midnight routine. Officially it is "Universal Time," but most people continue to call it GMT or use the local British equivalent, "Greenwich Civil Time."

Zero, Zebra, Zulu

As is typical of the military, it coined its own term. Since Greenwich is the site of the "zero meridian," they called GMT "Zero Time" or simply "Z-Time." In the phonetic alphabet that the flyers of the time

used to make themselves understood on their radios, "Z" became "Zebra." When the alphabet was changed, the call sign became "Zulu."

Zulu Time no longer emanates from Charles II's old observatory. In 1958, the Greenwich astronomers moved to the English coast to escape London's fog and city lights. They still correct their observations to show the time at the Greenwich meridian, but the old building there has been converted to a museum.

Nor are the 1884 time zones still the neat parallel lines we envision. They wiggle around international borders and state boundaries and are redrawn every now and then. When US time lines were changed in 1963, they moved several west Texas towns into the Central Time Zone, where they are an hour ahead of parts of New Mexico that are farther east. In some countries, the time zones are based on half-hour differences from GMT. A few nations have not adopted standard time.

Some scientists and chronologists would like to dump the old, Mesopotamian system of keeping time and come out with metric clocks. Some firebrands proposed that change during the French Revolution, when the populace was trying to get rid of everything aristocratic, including the timepieces. They didn't succeed. Later drives didn't get any further.

Some sociologists think we already may have gone too far just by introducing digital clocks. If they take over completely, whole generations could grow up without ever seeing an analog clock face. They wouldn't know what the gunner in an old war movie was talking about when he said, "Bandits at ten o'clock high!"

We're probably in no immediate danger of going metric or all-digital, but there have been many subtler changes in the basic units of time. For centuries, for example, the second was the smallest division of the solar day. Then scientists discovered that electrical currents make quartz crystals oscillate at regular rates. Now atomic clocks use the natural resonance of cesium atoms to divide time even more finely, cutting it into millionths and billionths of a second.

Wait until somebody comes out with a powerplant able to kick a spacecraft along at close to the speed of light. At that speed, Albert Einstein maintained and subsequent experiments confirmed, your atomic Timex should slow to a crawl and your biological clock along with it. If Einstein was right, you could come back from a lengthy trip into the cosmos to find yourself younger than your grandchildren.

Chances are, if that happens, some operations type will be hanging around to make sure you close out your log on Zulu Time. ■

Bruce D. Callander is a regular contributor to Air Force *Magazine. Between tours of active duty during World War II and the Korean War, he earned a B.A. in journalism at the University of Michigan. In 1952, he joined* Air Force Times, *becoming editor in 1972. His most recent article for* Air Force *Magazine, "The Sartorial Splendor of the Air Force That Was," appeared in the June 1991 issue.*

Valor

By John L. Frisbee, Contributing Editor

The Will to Endure

The crew's survival depended on the pilot's fight for consciousness.

AFTER "Big Week" (February 20 to 25, 1944) had taken a heavy toll of Luftwaffe fighters, their attacks on AAF bomber formations were sporadic. Some days, none came up. At other times, they appeared in force. With the decline of German fighter strength and aggressiveness and the arrival of more P-51 Mustang long-range escort fighters, it now became operationally feasible to attack high-priority targets in and around Berlin.

Eighth Air Force launched its first strike against targets near Berlin on March 4, 1944. Because of bad weather, only part of the bomber stream penetrated to the outskirts of the city. Two days later the entire bomber force reached its targets, losing sixty-nine heavies to fighters and flak. On March 8, fighter opposition again was heavy.

It was "Big B" again on March 9. The target was an airframe factory at Brandenburg, about twenty miles west of Berlin. Leading the second section of the bomber force was 1st Lt. Kenneth G. Jewell, flying *E. Z. Duzit,* a B-24 Liberator of the 66th Squadron, 44th Bombardment Group. It was Lieutenant Jewell's second Berlin raid. Experience counted. He led the group safely around heavy flak areas, and on that day no fighters came up.

Over the target, the situation took a turn for the worse. They encountered solid cloud cover and, on the bomb run, heavy, accurate flak. As *E. Z. Duzit*'s bombardier released his bombs, the aircraft was hit by four bursts of flak. The nose wheel assembly and front oxygen system were destroyed, the radio was knocked out, and the number three engine and right side of the plane were heavily damaged. With that engine shut down, the hydraulic pump was out.

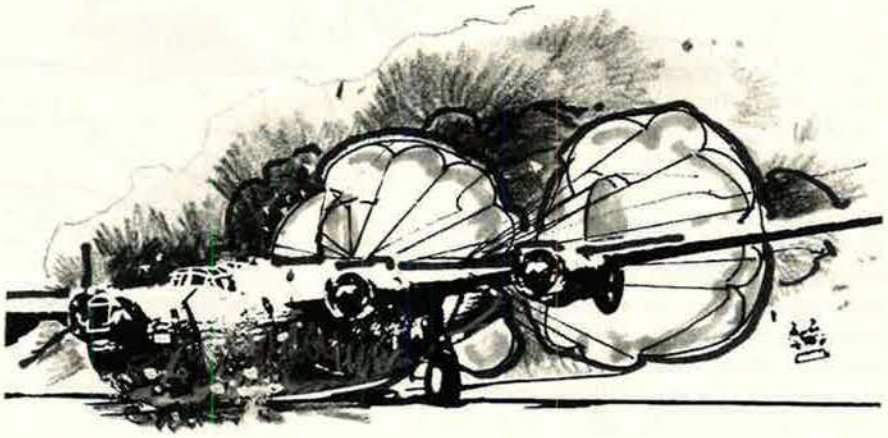
These were losses a B-24 could survive and still make it back to base under the hands of an able, skilled, and experienced aircraft commander—but the stricken bomber no longer had an able commander. A shell fragment had nearly severed Lieutenant Jewell's left leg, leaving the flight deck, in Jewell's words, "a gory mess." No one in the crew had a knife to remove the remains of his leg. Lifting the wounded pilot from his seat, they tended to his injury as best they could, stopping the gush of blood.

The B-24 was, momentarily, without a pilot at the controls. Jewell's copilot, flying his first mission, had vomited into his oxygen mask, choked, and passed out. The crew revived him, and the shaky young lieutenant managed to keep the plane under control.

Suffering excruciating pain and the psychological trauma of losing a limb, Lieutenant Jewell remained conscious throughout his ordeal. It was his responsibility to get his crew to their base at Shipdham. The likelihood of a safe landing would be greatly diminished if he were to lose consciousness, for his copilot had never landed a B-24 by himself—much less a damaged B-24. The bomber could be flown to England on automatic pilot but would have to be landed manually, which Jewell, with only one leg, could not do. He had members of the crew put him back in the left seat. For the next two and a half hours until Shipdham came in sight, he helped fly the bomber. As they turned on final approach, it was up to the inexperienced copilot, who had to rely on instructions from Jewell and what limited physical assistance the wounded aircraft commander could provide.

Without hydraulic pressure, the B-24 had no brakes. Lieutenant Jewell directed the crew to attach parachutes to the gun mounts and, when the plane touched down, to deploy them out the waist windows to slow the landing roll. At about seventy miles an hour, the nose dropped, and the big bomber skidded to a safe stop. With plenty of coaching from Lieutenant Jewell and help from the flight engineer, the copilot "did great," as Jewell was confident he would.

Heroism has been defined as the will to endure. For his extraordinary heroism, Lt. Kenneth Jewell was awarded the Distinguished Service Cross, but that is not the end of the story. After preliminary medical treatment in the UK, he was evacuated to Walter Reed Hospital in Washington, D. C. He later told Will Lundy, author and compiler of *44th Bomb Group Roll of Honor,* that Gen. H. H. "Hap" Arnold visited him in the hospital. Lieutenant Jewell persuaded the General that if RAF ace Douglas Bader could fly fighters with two artificial legs, Jewell certainly could fly with one. General Arnold agreed, and, in February 1945, Kenneth Jewell was returned to flying status, the first AAF pilot with an artificial leg. ■



Most of the Desert Storm troops and a lot of the cargo moved on 5,200 flights by the CRAF.

When the Airlines Went to War

By Frank Oliveri, Associate Editor

FOLLOWING the August 2, 1990, Iraqi invasion of Kuwait, the US quickly mobilized its forces and began the largest airlift in history, flying thousands of sorties and bringing millions of tons of equipment to the Persian Gulf region. The Air Force, in addition to using its own airlifters, soon called on the planes of the Civil Reserve Air Fleet to give the operation a boost.

In the first CRAF activation since the program began in 1952, civilian aircraft flew some 5,200 missions between August 1990 and July 1991, providing vital support to Operations Desert Shield and Desert Storm. At the peak of the war, CRAF aircraft numbered 110. They carried two-thirds of all passengers and one-fifth of air cargo to the war zone. In addition, civilian airlines carried eighty-five percent of all passengers and forty-one percent of all air cargo back to home bases.

The CRAF activation relieved pressure on an overtaxed Air Force fleet of C-5s, C-141s, and C-130s. Within weeks of Iraq's invasion, ninety-five percent of the Air Force's C-5s and ninety percent of its C-141s were "flying the pipeline" from the US and Europe to the Persian Gulf.

For their efforts, thirty-four airlines that took part in CRAF operations were honored on July 30 at a dinner hosted by Air Force Secretary Donald Rice at Bolling AFB, D. C. Attending the event were chief executive officers of each airline and leading military and government officials.

Military Airlift Command manages CRAF operations for the Department of Defense. MAC plans programs and coordinates operations with CRAF carriers. MAC also handles activation.

Three Stages for Flexibility

CRAF activation is divided into three stages, giving MAC the flexibility to put together the force it needs for any crisis. Each stage increases the number of civil aircraft assigned to the airlift mission. While MAC controls the overall mission, each airline carrier operates and maintains its aircraft with its own personnel and resources.

Stage I activates about forty aircraft for military duty and is geared toward minor emergencies.

Stage II, aimed at supporting an airlift emergency, may only be activated by order of the Secretary of Defense. It adds some 140 aircraft to the fleet called up in Stage I.

Stage III activates the rest of the CRAF, bringing the total to about 500 aircraft. This stage must be approved by the Defense Secretary after the President or Congress has declared a national emergency, state of war, or need to support a national security goal.

In the Gulf crisis, CRAF activation did not exceed Stage II.

Secretary Rice noted that two DC-10s, under contract to MAC, departed Pope AFB, N. C., on August 7, 1990, loaded with 520 troops from the 82d Airborne Division bound for Saudi Arabia. Some CRAF members volunteered before the CRAF activation on August 18.

Secretary Rice said there was reluctance to move to Stage II because, coming in the December holiday travel season, it had the potential to disrupt the airline industry. The US received offers of support from carriers in South Korea, Japan, and Italy.

As US and allied needs grew and combat seemed imminent, more demand was placed on US and allied transports. A shortage of long-range strategic lift aircraft prompted Defense Secretary Dick Cheney to initiate Phase II on January 18.

Each aircraft in CRAF is assigned one of five mission segments: long-range international, short-range international, Alaskan, domestic, and aeromedical. Each airline contractually pledges aircraft to different segments. The CRAF includes McDonnell Douglas DC-8s, DC-10s, and MD-80s; Boeing 707s, 727s, 737s, 747s, 757s, and 767s; Lockheed L-1011s; and Airbus A310s.

CRAF participation in the Gulf War included the following carriers: American West, American Airlines, American Trans Air, Arrow, ATI, Buffalo, Connie Kalitta, Continental Airlines, Delta Airlines, Eastern Airlines, Emery Worldwide, Evergreen International Airlines, Federal Express, Florida West, Hawaiian, Northwest Airlines, Pan American, Rich International, Rosenbalm, Southern Air Transport, Sun Country, Tower Air, Trans Continental Airlines, United Airlines, United Parcel Service, and World. In addition, the following foreign carriers participated: Alitalia (Italy), Cargolux (Luxembourg), Korean Air Lines (South Korea), Kuwait Airways, and Martinair Holland. ■

Books

Britain at War, by Roger A. Freeman. While this book's more than 200 superb photographs and drawings are enough to tell the story of the pain, suffering, and determination of British civilians during World War II, the accompanying narrative is an unexpected bonus. The author covers "the lull before the storm," the threat of invasion, the terrible bombing, and the more mundane aspects of Britain's wartime ordeal, such as the social scene and entertainment. Sterling Publishing Co., Inc., New York, N. Y., 1991, 96 pages. $14.95.

Command Performance: The Neglected Dimension of European Security, by Paul B. Stares. Whether or not the reader is interested in NATO's future, *Command Performance* can provide insight into an area frequently ignored: the relationship of the command system to overall military effectiveness. Command performance, the author asserts, rests on three factors: the quality of information reaching military decision-makers, the quality of the decision-making itself, and the quality of the communications used to transfer data to other actors. The first half of the book examines the Battle of France in May and June 1940, the Battle of Britain in the summer and early fall of 1940, and the Battle of Midway in early 1942. The second half concentrates on shortcomings in NATO's command system. Brookings Institution, Washington, D. C., 1991, 240 pages with appendixes and index. $11.95 (paper), $29.95 (cloth).

The Drift to War 1922–39, by Richard Lamb. This book, based on new archival material, challenges the accepted history of the interwar era. The author, a British historian, is particularly harsh when it comes to the "inexcusable' behavior of British statesmen: "At a distance of over fifty years it is difficult to understand why so many Conservative politicians should have given such support to Hitler and the Nazis, but the Liberal and Labour opposition also supported Eden in his policy of pandering to the Nazis and turning his back on the French." St. Martin's Press, New York, N. Y., 1991, 372 pages with photos, notes, bibliography, and index. $24.95.

Fire in the Streets: The Battle for Hue, Tet 1968, by Eric Hammel. The author says that, before Tet, Hue was "a city uneasily at peace in a nation totally at war." Then, after being ignored in the first years of the war, Hue became one of the key objectives of the North Vietnamese and Viet Cong during the ferocious battles of the Tet offensive. The real tragedy of the Hue attack lay in "the random deaths and maimings in the battles to liberate the city and in the nearly 2,000 documented cases of mass murder and execution" from which neither the city nor the nation ever recovered. Contemporary Books, Inc., Chicago, Ill., 1991, 371 pages with maps, photos, bibliography, and index. $24.95.

Heroes of World War II, by Edward F. Murphy. This historical catalog of World War II's Medal of Honor recipients weaves together the stories of the 433 people (out of thirteen million US servicemen and -women) who earned the most prestigious of all US decorations. Each vignette, recounting incidents from Pearl Harbor and D-Day on to the defeat of Germany and Japan, captures not only the feel of individual bravery but also the particular moment and its significance in the course of the war. A brief history of the Medal of Honor notes that the standards for conferring the medal are so high that more than half of the Medals of Honor since World War I have been awarded posthumously. Presidio Press, Novato, Calif., 1990, 365 pages with an appendix of the recipients, bibliography, and index. $24.95.

Reflections of a Warrior, by Franklin D. Miller with Elwood J. C. Kureth. Sgt. Maj. Frank Miller's tales from six years in Vietnam with Special Forces units are gripping, filled with the details of what it felt like to operate there in the company of Montagnard "hunters" whom Miller admired and on whom he relied. His description of the encounter that led to his Medal of Honor is as spellbinding as any action film of today. Presidio Press, Novato, Calif., 1991, 205 pages with glossary. $19.95.

Secret Agenda: The United States Government, Nazi Scientists, and Project Paperclip, 1944–1990, by Linda Hunt. Written in an accusatory style, *Secret Agenda* is not the product of a dispassionate historian but of a zealous investigative journalist bent on exposing alleged US misdeeds. Despite her less-than-academic style, the author has produced a well-researched book that could tarnish the reputations and accomplishments of some German scientists who have made major contributions to US science projects and the space program over the years. St. Martin's Press, New York, N. Y., 1991, 340 pages with photos, notes, bibliography, and index. $19.95.

Setup: What the Air Force Did in Vietnam and Why, by Earl H. Tilford, Jr. "Setup" is the author's shorthand explanation of how, in Vietnam, the Air Force fell victim to its own history. In what should prove to be a controversial book, Tilford asserts that in its Vietnam operations, the Air Force relied on strategic bombing "devised to fight industrial powers like Nazi Germany, Imperial Japan, and the Soviet Union." The thesis will draw heated rejoinders, but the book contains excellent discussions of major air operations during the Vietnam War, especially of differences among Operations Rolling Thunder, Linebacker One, and Linebacker Two. "Whereas Linebacker One was the first modern bombing campaign in aerial warfare, Linebacker Two was more of a throwback to World War II's era of B-29s ambling over their target cities in long bomber streams." The author also disputes the "myth" that Linebacker Two "brought Hanoi to its knees." He concludes that "the air war was occasionally pivotal, but it was never decisive." Air University Press, Maxwell AFB, Ala., 1991, 308 pages with maps, photos, notes and index. $12.00 (paper).

Spirits in the Sky, by John Matthews and Nancy Robinson Masters. This coffeetable reference book features more than 100 photographs of fully restored, working World War II airplanes, both Allied and Axis. These aircraft are part of the Confederate Air Force Ghost Squadron, formed in 1957 with the mission "to keep alive the memory and spirit in which these planes were flown in defense of our nation." Alongside these photographs are wartime photos and historical discussions of the planes' design and manufacture. Taylor Publishing Co., Dallas, Tex., 1990, 200 pages with photos and an appendix of the basic technical specifications of the aircraft. $39.95.

Top Guns: American Fighter Aces Tell Their Stories, by Joe Foss and Matthew Brennan. Based on twenty-seven Army, Navy, Marine, and Air Force pilots' first-person accounts of aerial combat, this well-edited book covers two world wars, the Korean War, and the Vietnam War. Nineteen memoirs are devoted to World War II's "air-to-air maneuvers, ground attack missions, [and] escape and evasion from deadly enemies." Korea and Vietnam sections chronicle the origins of jet combat, SAMs, and missiles. Pocket Books, New York, N. Y., 1991, 338 pages with notes, dedications, and short ace biographies. $21.95. ■

Photo depicts radiation patterns from a 2 inch Dual Linearly Polarized Sinuous Antenna

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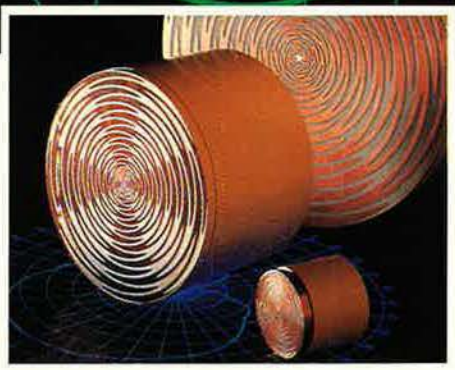

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AFA State Contacts

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): **Tommy Sylvester,** P. O. Box 386, Blytheville, AR 72316-0386 (phone 501-762-2761).

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): **John K. Scott,** 7648 S. Crocker Ct., Littleton, CO 80120 (phone 313-797-8366).

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 Lisella,** 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): **Edward J. Farrell,** 108 Suffolk Rd., Savannah, GA 31410 (phone 912-764-1941).

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): **Thomas A. Hilquist,** 533 N. Elmore, Park Ridge, IL 60068 (phone 708-694-7143).

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).

KENTUCKY (Lexington, Louisville): **James R. Jenkins,** 3276 Carriage Ln., Lexington, KY 40517 (phone 606-278-6848).

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): **Philip B. Turner,** P. O. Box 202, Caribou, ME 04736 (phone 207-496-6461).

MARYLAND (Andrews AFB area, Baltimore, College Park, Rockville): **Ronald E. Resh,** 416 Hungerford Dr., Suite 316, Rockville, MD 20850 (phone 301-294-8740).

MASSACHUSETTS (Bedford, Boston, East Longmeadow, Falmouth, Florence, Hanscom AFB, Taunton, Worcester): **David R. Cummock,** 174 South Blvd., West Springfield, MA 01089 (phone 413-737-5466).

MICHIGAN (Alpena, Battle Creek, Detroit, East Lansing, Kalamazoo, Marquette, Mount Clemens, Oscoda, Petoskey, Southfield): **Art Tesner,** 1909 Tahoe Cir., Okemos, MI 48864 (phone 517-349-7665).

MINNESOTA (Duluth, Minneapolis–St. Paul): **J. Robin Wohnsigl,** 8288 131st St. W., Apple Valley, MN 55124 (phone 612-853-3316).

MISSISSIPPI (Biloxi, Columbus, Jackson): **R. E. "Gene" Smith,** Rte. 4, Box 48, Starkville, MS 39759 (phone 601-327-4071).

MISSOURI (Richards-Gebaur AFB, Springfield, St. Louis, Whiteman AFB): **Otis M. Lytle, Jr.,** 804 E. Rosebriar, Springfield, MO 65807 (phone 417-882-9394).

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

NEBRASKA (Lincoln, Omaha): **Ralph Bradley,** 1221 N. 101st St., Omaha, NE 68114 (phone 402-392-1904).

NEVADA (Las Vegas, Reno): **George A. Peterson,** 3828 Cavalry Dr., Las Vegas, NV 89121 (phone 702-796-8888).

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 505-293-2529).

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): **James A. Riccardi,** 5293 Wilcox Rd., Whitesboro, NY 13492 (phone 315-330-7661).

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): **Ruby G. Crites,** 110 SW 18th, Milnot, ND 58701 (phone 701-839-2700).

OHIO (Akron, Cincinnati, Cleveland, Columbus, Dayton, Mansfield, Newark, Youngstown): **Jerry D. Schmidt,** 4140 Chico Ct., Springfield, OH 45502 (phone 513-257-4055).

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).

PUERTO RICO (San Juan): **Vincent Aponte,** P. O. Box 8204, Santurce, PR 00910 (phone 809-764-8900).

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).

SOUTH DAKOTA (Belle Fourche, Rapid City, Sioux Falls): **Robert Jamison,** 1506 S. Duluth Ave., Sioux Falls, SD 57105 (phone 605-339-7100).

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): **L. B. "Buck" Webber,** P. O. Box 619119, D/FW Airport, TX 75261 (phone 214-456-8231).

UTAH (Bountiful, Clearfield, Ogden, Salt Lake City): **Dan Hendrickson,** 1930 North 2600 East, Layton, UT 84040 (phone 801-825-1012).

VERMONT (Burlington): **Eugene A. Meiler,** 35 Pine Haven Shore, Shelburne, VT 05482 (phone 802-864-8000).

VIRGINIA (Alexandria, Charlottesville, Danville, Harrisonburg, Langley AFB, Lynchburg, McLean, Norfolk, Petersburg, Richmond, Roanoke): **Mary Anne Thompson,** 3146 Valentino Ct., Oakton, VA 22124-2836 (phone 703-734-6401).

WASHINGTON (Seattle, Spokane, Tacoma): **Gordon O. Wohlfeil,** 2021 Narrows View #224, Gig Harbor, WA 98335.

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

Chapter News

The newly formed **P-47 Memorial (Ind.) Chapter** met to elect its officers. President Charles Dougan, Vice President Ron Bell, Treasurer Al Kirlin, and Secretary Leo Johnson will lead the new chapter. National Vice President (Great Lakes Region) Cecil Hopper and Indiana State President Harold Henneke were on hand for the charter meeting.

Another newcomer to AFA, the **Mid-Iowa Chapter,** recently held its charter dinner in Des Moines. National President Oliver R. Crawford, the featured speaker, presented the chapter charter to President Gerald Loos, Vice President Mike Lacey, Treasurer Charles McDonald, and Secretary Larry Steele. In his speech, President Crawford used the successes of Operation Desert Storm as an example of how effective airpower can be when employed properly, and he emphasized the need for grass-roots support. The ceremonies were opened by the AFROTC color guard from Iowa State University. National Vice President (Midwest Region) Ray Peterman and National Director and former CMSAF Jim McCoy were among those in attendance.

USAFE Commander in Chief Gen. Robert C. Oaks lends a hand as the Lufbery-Campbell (Germany) Chapter kicks off its base membership drive at Ramstein AB, Germany. With General Oaks are Capt. Yolanda Cruz, who chaired the drive, and Brig. Gen. Richard Swope, who commands the Kaiserslautern Military Community and the 86th Tactical Fighter Wing. General Oaks also presented plaques for outstanding service to former Chapter President Capt. Kevin Ashley and Chapter Speakers' Chairman Lt. Col. Mel Vuk.

—USAF photo by Sgt. John Lipor

Though the B-1B was not a direct participant in Operation Desert Storm, it contributed by sitting strategic alert, helping free other assets for missions over the Gulf. Here, AFA National President Oliver R. Crawford discusses the B-1B's role with Capt. Randy Nuss During a visit to Dyess AFB, Tex. Captain Nuss is a B-1B pilot with the 337th Bombardment Squadron of the 96th Bombardment Wing.

The **Inland Empire (Wash.) Chapter** has a thriving Community Partner Program. Chapter President Jeremy Smith recently welcomed aboard John Madri, president of the Global Federal Credit Union. The chapter has increased its number of Community Partners by twenty-five percent this year.

The **Lt. Erwin R. Bleckley (Kan.) Chapter** continues its support of aerospace education. For the twentieth consecutive year, it presented its award to the outstanding AFJROTC Cadet at Derby High School. Cadet Col. Jay D. Custine is this year's winner.

Lee Niehaus, president of the **Total Force (Pa.) Chapter,** was honored as Pennsylvania's Man of the Year at the state convention. Mr. Niehaus, an AFA member for thirteen years, has also received a national membership

At this year's convention, Florida AFA's highest military honor, the Jerry Waterman Award, went to Maj. Gen. John A. Corder, commander of USAF Tactical Air Warfare Center at Eglin AFB, Fla. Pictured congratulating General Corder are (from left) National Director Martin H. Harris, President Crawford, and Florida State President Craig R. McKinley. AFA Executive Director Monroe W. Hatch, Jr., and Brig. Gen. Donald W. Sheppard followed General Corder as speakers at the convention.

award. State President Gene Goldenberg did the honors at the convention, which had a large turnout of Desert Shield and Desert Storm veterans.

The Government and AFA

AFA chapters across the country have been busy meeting with government officials to further AFA's mission. In New York, the **Brooklyn-Key Chapter,** an original charter chapter, received a visit from Secretary for Veterans Affairs Edward J. Derwinski. Secretary Derwinski went to Brooklyn to present an award to the chapter for 30,000 hours of volunteer service at Fort Hamilton VA Hospital. Chapter President Gene Festa accepted the award.

At the state government level, Nebraska's Gov. E. Ben Nelson met with a delegation of local AFA officials. Nebraska State President Ralph Bradley and **Lincoln Chapter** President C. Howard Vest met with Governor Nelson and his wife Diane at the Governor's Mansion in Lincoln and presented him with a Life Membership in AFA.

In Florida, members of the **Gold Coast Chapter** showed how effective concerted AFA action can be. They mounted a letter-writing campaign directed at Rep. E. Clay Shaw, Jr. (R-Fla.). Their purpose was to convince Representative Shaw to support Secretary of Defense Dick Cheney's favored version of the B-2 legislation, and they succeeded admirably. Representative Shaw met personally with Chapter President Fred Bamberger and Howard Eichner, Florida state vice president (Southeast) and chairman of the Gold Coast Chapter's Awards Committee, and told them he would support the Secretary's program. He termed himself a "convert" and credited the Air Force success in the Persian Gulf War with helping to change his mind.

Kentucky's Aerospace Educator

Jeffery Adkins, a physics and science teacher at Henry Clay High School in Lexington, Ky., was named Kentucky Aerospace Educator of the Year during ceremonies at Louisville, Ky. Mr. Adkins does all he can to bring aerospace education into the classroom. He initiated a course in astronomy and space science at Henry Clay and edits the Kentucky Space Education Newsletter, which goes to teachers throughout the state. Kentucky Vice President for Aerospace Education Vaiden Cox presented the award, which is accompanied by a $200 check.

"The Forgotten War"

In an effort to improve public awareness of what some have deemed "The Forgotten War," the **Anchorage (Alaska) Chapter** recently published *The Aleutian Warriors: A History of the 11th Air Force and Fleet Air Wing 4.* The book tells the story of the "air war fought over the weather-tortured Aleutian Islands" during the early days of World War II. Written by John Haile Cloe, the paperback draws on archival photographs, unit histories, and interviews with the participants

Nebraska's Gov. E. Ben Nelson (second from left) and his wife Diane accept a Life Membership from State President Ralph Bradley (left) and Lincoln Chapter President C. Howard Vest during ceremonies at the Governor's Mansion in Lincoln.

Thanks to the Madison Chapter, future generations will have a tangible reminder of the service of the men and women of the Madison, Wis., area who participated in Desert Storm. Here, Chapter President R. J. Thurber pitches in during the tree-planting ceremony at Truax Field, headquarters of the Wisconsin ANG.

to tell its story. All profits from *Aleutian Warriors* will go toward a scholarship fund for students in the Anchorage area. An earlier publishing effort by the chapter, *Top Cover for America,* recently sold out its third printing and has netted the chapter over $20,000 for its scholarship fund. *Aleutian Warriors* is available from Pictorial Histories Publishing Co., Inc., 713 S. Third St., Missoula, MT 59801. The price is $19.95 plus $5.00 for shipping and handling.

July Errors

Editing errors are responsible for two mistakes in the July 1991 coverage of the Iron Gate Ball. The ball has raised $1,844,300 through 1990 (not 1991), and the photographer's name, Sid Birns, was misspelled. We regret the errors.

Have AFA News?

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

Bulletin Board

Seeking contact with former members of the **14th Liaison Squadron. Contact:** W. S. Gleason, 5621 Ashton Lake Dr., Sarasota, FL 34231.

Seeking information on **Sgt. Thomas Orchall,** who was stationed at Selfridge Field, Mich., in 1942 and later at Chanute Field, Ill. **Contact:** Lt. Franz Serdahely, USAF (Ret.), 13023 Stevens Rd., Philadelphia, PA 19116.

Seeking information on the construction of **McIntyre Field** at Tocumwal, New South Wales, Australia, which took place from January through May 1942. **Contact:** Darryl McIntyre, P. O. Box E85, Queen Victoria Terrace, Canberra, ACT 2600, Australia.

Seeking contact with World War II veterans of **13th Air Force** who would be interested in forming an association. **Contact:** Lt. Col. John B. Turner, USAF (Ret.), 271 Eastpoint Ct., Spring Hill, FL 34606.

Seeking information on **Col. Gerald R. Johnson,** Capt. John Hampshire, Lt. Robert W. Deiz, Lt. David R. Kingsley, and Paula Loop. Also seeking information on the men aboard Colonel Johnson's B-25 on his last flight (October 7, 1945). **Contact:** William V Illani, P. O. Box 80, Selma, OR 97538.

Seeking **F-4 Phantom memorabilia,** photos, and patches. **Contact:** William Crean, 842 Waterford Dr., Delran, NJ 08075-2220.

Seeking contact with personnel who served at **RAF Spilsby** or **RAF East Kirkby,** England, in 1955–58. **Contact:** Richard Caville, 80 Bredenbury Crescent, Paulsgrove, Portsmouth, Hampshire PO6 3SL, England.

Collector seeks contact with other **USAF patch collectors.** Especially seeking F-111 and Thunderbird patches. **Contact:** John Huereca, 113 Gunter St., Travis AFB, CA 94535-5000.

Seeking contact with relatives of **Harold Byrd, Robert Ebner,** and **Francis Bailey,** pilots with the 75th Fighter Squadron, 23d Fighter Group, who were tentmates in Chihkiang, China, in 1944–45. **Contact:** Wallace H. Little, 357 Honey Cove, Fort Walton Beach, FL 32548-5212.

Seeking information on **Leeroy Cardwell,** an American who served in Norfolk, England, in 1945. **Contact:** R. Bensley. 139 Vale Green, Norwich, Norfolk NR3 2EL, England.

Seeking current addresses of World War II veterans of the **11th Fighter Squadron.** A plaque honoring this squadron will be dedicated at the US Air Force Academy in October 1992. **Contact:** W. H. Purdy, 902 W. Kendall St., Corona, CA 91720.

Seeking photos and information on the NASA/Boeing **AFTI F-111** aircraft and the General Dynamics **F-111A/E "Aardvark"** aircraft. **Contact:** Michael Ross Murriel, 31 Tabayoc St. Sta., Mesa Heights Q.C., the Philippines.

Seeking contact with people who were with the **US element in Oslo,** Norway, in 1956–57. **Contact:** Roger H. Baum, 10171 Humbolt St., Los Alamitos, CA 90720.

Seeking the whereabouts of **Ernest Martinez,** whose last known address was in Detroit. Also seeking **James Harean,** who was stationed at Goose AB, Labrador, in 1945, and anyone else who was stationed in Labrador. **Contact:** A. Fred Bailey, P. O. Box 324, Mounds, OK 74047.

Seeking contact with members of **718th Bomb Squadron,** 449th Bomb Group, 15th Air Force, based in Italy in 1943–45. **Contact:** Herman Negremann, 3-38 31st St., Fair Lawn, NJ 07410.

Seeking information and photos of **James Connally AFB,** in Waco, Tex., which was the home of the 3565th Navigator Training Wing and was closed in 1966. **Contact:** Pete Hjelmstad, Jr., 237 Shirley St., Waco, TX 76705.

Seeking contact with radio operators and mechanics of the **12th Tow Target Squadron** stationed at Hamilton Field or Santa Rosa, Calif., during World War II. **Contact:** William J. Brodsly, 1820 Redondela Dr., Rancho Palos Verdes, CA 90732.

Seeking information on **Lt. Stan Fish,** of the 365th Fighter Group, 9th Air Force, based at Beaulieu, England, in April 1944. That month, Lieutenant Fish borrowed a P-47 from a repair unit to get in some flying time. His aircraft and remains were found the next day at Devizes, about 75 miles north of Beaulieu. **Contact:** Don Goodenow, 3128 Sunnybrook Dr., Charlotte, NC 28210.

Historian seeks information on anyone who **died as a result of service in southeast Asia** during the Vietnam War. **Contact:** David W. Schill, 132 Harding Ave., Moorestown, NJ 08057.

Seeking information on **TSgt. Jesse Parker** and his aircraft, a Douglas A-26 Invader 350-C, *The Silver Dragon.* The aircraft and its crew chief were assigned to the 552d Bomb Squadron, 386th Bomb Group in France and Belgium during World War II. **Contact:** Col. Leslie L. Dunning, USAF (Ret.), 3340 Beaumonde Ln., Kettering, OH 45409.

Seeking contact with anyone who served in the **502d Tactical Control Group** in the US or Korea. **Contacts:** David F. Gray, 2800 S. Peninsula Dr., Daytona Beach, FL 32118. Lt. Col. John A. Bosseler, AFRES (Ret.), 11323 87th Ave. Ct. SW, Tacoma, WA 98498.

Seeking **Operation Desert Storm and Desert Shield patches** for the collection at Castle Air Museum. Also seeking any Air Force patches from World War II to the present. **Contact:** Frank Flynn, P. O. Box 488, Atwater, CA 95301.

Seeking World War II **Airkor sunglasses. Contact:** T. K. Warner, 316 W. Lakeview Dr., Palmdale, CA 93551.

Seeking contact with **Eugene W. "Gene" Murphy,** who was stationed at Fürstenfeldbruck, West Germany, in 1950. **Contact:** William K. Henson, Ing. White 505, 1644 Victoria, Pcia. de Buenos Aires, Argentina.

Seeking **USAF Thunderbirds Airshow posters** from 1979 through 1982 by Phil Summers. **Contact:** Fred Testor, 14 High Trail C. H., New Fairfield, CT 06812.

Seeking contact with former members of the **First Radio Relay Squadron,** stationed at Wiesbaden, Germany. **Contacts:** Mike Henderson, P. O. Box 117, Sautee, GA 30571. Bill Reep, Rte. 2, Box 540, Nebo, NC 28761.

For a documentary, seeking contact with pilots and crews who participated in **World War II flights over Hungary. Contact:** Mihaly Lenart, Global Productions, P. O. Box 1821, Palm Springs, CA 92263.

Seeking contact with World War II veterans of **407th Bomb Squadron,** 92d Bomb Group. **Contact:** Norman Berman, 8801 W. Golf Rd., Apt. 10D, Des Plaines, IL 60016.

Seeking **USAF unit patches,** especially of helicopter and special operations units. **Contact:** CWO2 Dan McClinton, US Embassy Helo Det., El Salvador, Unit 3105, APO AA 34023.

Seeking a **"Ruptured Duck,"** the pin awarded to troops when they were discharged in 1945. Also seeking contact with members of the Uvalde, Tex., 1941–42 flying class. **Contact:** MSgt. George T. Burks, USAF (Ret.), Rte. 1, Box 300, Carriere, MS 39426.

Seeking information on **Lt. Paul Hugo Ericson,** a member of pilot Class 42-H, who served at Ellington Field, Tex., and at Tinker Field, Okla., in 1942–43. His father was a Presbyterian minister in Dallas. **Contact:** Jimmie E. Parker, 1834 N. 2700 E., Layton, UT 84040.

Seeking contact with personnel stationed with the 984th Bombardier Training Squadron at Victorville AAF, Calif., from January to June 1943 who knew **Lt. William S. Barnes. Contact:** William H. Barnes, 400 Stagecoach Cir., Salado, TX 76571.

Seeking contact with World War II veterans of the **341st Bomb Squadron** who knew Lt. Lawrence "Rosh" Roscioli. I am especially seeking **Lts. William Kick, Edwin McBrayer, and Richard Smith. Contact:** Richard Murray, 1421 Wyldewood Dr., Madison, WI 53704.

Seeking information on the operational history of Hammer Field, a former World War II Army Air Field, located near Fresno, Calif., which was operated by the Army Air Forces from 1941 to 1946. **Contact:** Marianne C. Bojan, TechLaw Inc., 14500 Avion Parkway, Suite 300, Chantilly, VA 22021-1101.

Seeking a copy of ***Psychiatric Experiences of the Eighth Air Force: First Year of Combat (July 4, 1942–July 4, 1943)*** by Donald W. Hastings, David C. Wright, and Bernard C. Glueck. **Contact:** Lt. Col. John Ward, USAF (Ret.), 2703 Glassboro Cir., Arlington, TX 76015.

Seeking information on the whereabouts of **1st Lt. Robert S. Patterson** and **1st Lt. Charles E. Walker,** who were in the 68th Fighter Bomber Squadron, 58th Fighter Bomber Group, at K-2, Taegu, Korea, in 1952–53. **Contact:** Roger Warren, 7550 Palmer Rd., Reynoldsburg, OH 43068.

Seeking information on **Sal S. Trilling** and the **28th Aero Squadron** from 1916 to 1918. **Contact:** Bruce Trilling, 3112 N. Homestead Pl., Tucson, AZ 85749.

Seeking contact with former Air Force Cadet **Jack Bradford,** from Eugene, Ore., who may have been a B-17 pilot after 1944 and who bailed out safely after a midair crash. **Contact:** Paul Burns, 660 Maple St., Mount Morris, MI 48458.

Seeking contact with anyone who worked on or with **Cessna O-2As** in Vietnam from 1967 to 1972. **Contact:** Tom Murphy, 1426 Sharp Ave., Campbell, CA 95008.

Seeking old issues of **Air Force Magazine,** especially from the early 1950s to the late 1960s. **Contact:** Lance L. Terrell, P. O. Box 201028, Austin, TX 78720.

Seeking the whereabouts of **Sgt. Hutnell Odel Fisher,** USAF, who was stationed at Coney Weston, England, in 1945. **Contact:** Michael Copeman, 73 Nightingale Dr., Taverham Norwich, Norfolk NR8 6TR, England.

Seeking information on **Maj. Edward Gignac,** who was in the 320th Fighter Squadron, 326th Fighter Group, Westover Field, Mass., and was killed June 7, 1944, over France or the English Channel. **Contact:** Scott Morrow, 36 E. Shore Rd., Denville, NJ 07834.

Seeking copies of **letters sent home from the Korean War.** The mural artist for the Korean War memorial would like to read a few for background information. **Contact:** Bob Hansen, Korean War Veterans Memorial, 18th and C Sts. NW, Rm. 7023, Washington, DC 20240.

Seeking information on the disposition of **Tupolev Tu-95 Bear Bombers** being dismantled in the Soviet Union. Have any been made available to museums outside the USSR? **Contact:** James E. Masterson, 31 Stratford Rd., Natick, MA 01760.

Seeking information on the whereabouts of **Larry Reynolds,** who was stationed with the Air Force in England in 1964–65 and knew Betty Franks. **Contact:** Tina Fleming, 53 Exbury House, Brenthouse Rd., Hackney, London E9 6QE, England.

Seeking information on an incident in which a **B-52 tailgunner shot down a MiG** during the Linebacker operations in 1972. This B-52 was later lost to a SAM. **Contact:** Gregg M. Taylor, 808 Countryside Hwy., Mundelein, IL 60060.

Seeking a **catalog of USAF A-10 posters** and pictures. **Contact:** Steve Hunsicker, 12201 Van Spronsen Ct., Indianapolis, IN 46236.

Seeking contact with **Lawrence McCloud,** who was stationed at Stansted Airport in Essex, England, during World War II. He was part of an 8th Air Force ground crew. **Contact:** N. J. Clarke, 8 Russell Rd., Forty Hill, Enfield, Middlesex EN1 4TN, England.

Seeking contact with anyone who was in the **329th Transport Squadron,** MATS, stationed at Capodichino, near Naples, Italy, in 1944. Especially seeking contact with anyone who knew its commanding officer from April through August 23, 1944, Capt. William C. Gedecke. **Contact:** Lenore V. Brow, 7622 Fitch Rd., Olmsted Falls, OH 44138.

Seeking information on the whereabouts of **Ray Carnes,** who was stationed with the Air Force in Spain in the late 1960s or early 1970s before joining the Texas Highway Patrol. **Contact:** Beverly A. Wakefield, 55 Bovingdon Ct., Windsor Close, Bovingdon, Herts. HP3 0QU, England.

Seeking information on three Americans who were stationed at Depot #2 at Mount Louisa, Townsville, Australia, in 1942–45 with the 4th, 12th, or 15th Air Depot Groups, 5th Air Force Service Command: **Clarence Townsend,** an instrument technician; **Lieutenant DeFoe,** who was later transferred north; and **Lt. Col. Richard J. Kirkpatrick,** commanding officer of the 4th Air Depot Group. **Contact:** Rod Cardell, P. O. Box 497, Nambour, Queensland 4560, Australia.

Seeking contact with veterans of the **97th Bomb Wing,** SAC, who served at Blytheville AFB, Ark., between September 1961 and November 1963. **Contact:** Stanley M. Zydlo, Jr., 1245 Clover Dr., Palatine, IL 60067.

Seeking contact with anyone who knew **Charles McIntosh,** son of Alexander McIntosh and his German-born wife. Charles was killed while serving with USAAF in Italy during World War II. **Contact:** Graham McIntosh, White Hart Inn, 274 Main Rd., Hawkwell, Essex SS5 4NS, England.

Seeking a size 36/38 **World War II flight suit,** officer's uniform, cap, and other apparel for an educational exhibit. **Contact:** Jack Gren, 2906 Roscommon Dr., Fort Wayne, IN 46805.

Seeking copies of **ADC 62PI Programmed Instruction Guides** for possible reproduction and use by TAC and ANG pilots. I especially need volumes one, seven, and nine. **Contact:** Elmer W. Ross, P. O. Box 807, Everett, WA 98206.

Seeking contact with **Maj. R. G. Newell,** USAF, who was the officer commanding 19(F) Squadron (RAF) at RAF Leconfield from August 22, 1957 until July 27, 1959. **Contact:** Wing Commander N. B. Spiller, RAF, No. 19(F) Squadron, Wildenrath BFPO 42, London, England.

For a book, I am seeking contact with **Package Six fighter pilots and support** who served in Vietnam in 1972. **Contact:** John Roberts, Box 574, APO New York 09405.

Seeking information on **Capt. Robert S. Frick, Sr.,** and on the 5th Fighter Group of the Flying Tigers. Also seeking contact with **Walter Crust** and **Robert Millington. Contact:** Robert S. Frick, 39 W. Maryland, Phoenix, AZ 85013.

Seeking the whereabouts of **Cornelius Sanders,** who was an air traffic controller stationed at Lajes Field, the Azores, in 1961 and knew Magna Fonseca Borges. **Contact:** B. J. Merideth, 117 N. Brighton, Kansas City, MO 64123.

Seeking the whereabouts of **TSgt. Robert B. Phillips** and his wife Elaine, who were stationed at RAF Sculthorpe, England, in 1956–58. They moved in 1958 to El Paso, Tex. **Contact:** R. N. Rix, Greenacres, Beck Bank, West Pinchbeck, Spalding, Lincolnshire PE11 3QN, England.

Retired Turkish Air Force pilot seeks contact with US servicemen to trade color **photos,** slides, lithographs, and patches. **Contact:**

Mehmet Tombak, Kirmizitoprak, Eren, Eren Daire 11, Eskisehir, Turkey.

Seeking information, reminiscences, and anecdotes of the **Northwest Staging Route,** used during World War II to ferry aircraft from Alaska to the USSR under the Lend-Lease Act. **Contact:** Andrew A. Walz, 1399 Bunnell Dr., Burlington, Ontario L7P 2E3, Canada.

Seeking information on the whereabouts of **SSgt. Jack Manley,** who was with the 420th Air Refueling Squadron based at RAF Sculthorpe, England, in 1956–57. **Contact:** Christopher A. Poole, 28 Denby Close, Lillington, Leamington Spa, Warwickshire CV32 7PS, England.

Seeking **survival stories,** either military or civilian, that can be used to enhance training of the 3636th Combat Crew Training Wing. **Contact:** SSgt. Rick Wood, 3636 CCTW/DOV, Fairchild AFB, WA 99011-6024.

Seeking information on the whereabouts of **Sgt. Del "Hank the Yank from Texas" Hartley** and his family. Sergeant Hartley served at RAF Wethersfield, England, in 1969–70. **Contact:** Audrey Stringer, 11 Cannisland Park, Parkmill, Swansea, West Glamorgan SA3 2ED, Wales.

Seeking contact with former **constabulary troopers.** We now have a national group. **Contact:** B. J. Chambers, 530 Park Ave., Lancaster, PA 17602.

Seeking contact with members of **B-52 crews on the Linebacker operations** on Vietnam in 1969–70. **Contact:** Michael McGuckin, 38 Washington St., Tucson, AZ 85701.

Seeking a set of **manuals that Consolidated-Vultee issued with each B-24** built. These were leather-bound and consisted of five or six volumes that covered the aircraft and systems. **Contact:** George D. Hnatusko, 1904 S. 11th St., Las Vegas, NV 89104.

Seeking a **parachutist who landed in southwest Normandy, France,** in late 1944. He was rescued with a badly broken leg by a French couple who hid him from nearby Germans. His whistle number was AM-23 230 293 141 L1795. I have been advised that he was probably from the 101st or 82d Airborne Division. **Contact:** John Pepper, 8 Stembridge Rd., Anerley, London, SE20 7UF, England.

Seeking two members of Captain Rollins's crew of the **724th Bomb Squadron,** 451st Bomb Group, 15th Air Force: 1st Lt. Harvey Miller, bombardier (last known address Syracuse, N. Y.), and TSgt. Fred C. Gardner, aerial engineer (last known address McRoberts, Ky.). **Contact:** Bob Karstensen, 1032 S. State St., Marengo, IL 60152.

Seeking to buy or borrow **B-58 books,** especially *Convair B-58* by Jay Miller. **Contact:** William H. Houston, M.D., 836 Prudential Dr., Suite 1005, Jacksonville, FL 32207-8380.

Seeking information on **"The Bull and Fiddle Club,"** apparently an enlisted men's club attached to a Flexible Gunnery School in India in 1944–45. Their symbol was Mickey Mouse attempting to hit the backside of a bull with a bass fiddle. **Contact:** Maj. Charles C. Blanchard III, USAF (Ret.), 145 Lanman Rd., Niceville, FL 32578.

Seeking contact with anyone who knew **Lt. Roy T. Fling,** a P-47 fighter pilot assigned to 8th Air Force. He was reported missing in action over France in 1943. **Contact:** Maj. B. W. Heath, USAF (Ret.), P. O. Box 8194, Newport Beach, CA 92658.

Seeking information on **Capt. William U. Brownlow,** who went down over Berlin in a B-17 raid March 4, 1944. **Contact:** Robert Brownlow, Rte. 2, Box 101-3, Lake Geneva, WI 53147.

Seeking contact with members of the **155th (Night) Photo Reconnaissance Squadron** (World War II), which flew out of France, Belgium, and Holland. **Contact:** H. W. Clark, 3901 Stewart #41, Las Vegas, NV 89110.

Seeking a **canceled envelope mailed from the Gulf** during Operation Desert Storm. **Contact:** Pete Sarmiento, 404 Rosier Rd., Fort Washington, MD 20744-5539.

Seeking information on the whereabouts of **Arley Lloyd Stoddard,** an Air Force member stationed at RAF Sealand in Chester, Cheshire, England, in 1954. **Contact:** Dale Rose, 6 Alaw View, Rhosybol, Amlwch, Anglesey LL68 9UD, North Wales.

Seeking information on the whereabouts of **Lt. Philip Padulka,** who served with 4th Bomb Squadron, 34th Bomb Group, 8th Air Force, in 1944. May have been stationed at Mendelsham, England, during World War II. Last known address was in Chicago, Ill. **Contact:** Paul Perlongo, 1803 S. 55th Ct., Cicero, IL 60650.

Seeking contact with anyone who knew **1st Lt. Thomas F. Bloomfield** of the 21st Bomb Squadron (H), 11th Air Force. He was killed in action on January 16, 1943, in a B-24 on a mission to Kiska, Alaska. **Contact:** Lt. Col. Andy M. Kmetz, USAF (Ret.), 1715 W Haven Dr., Champaign, IL 61820.

Seeking information on the location of anyone from the **7331st Technical Training Group,** Kaufbeuren AB, West Germany, 1954–56. **Contact:** Frank Marriott, 813 Oak Knoll Dr., Mountain Home, AK 72653.

Seeking contact with pilots who graduated with **Class 43-E from Stockton Field,** Calif. **Contact:** Earl G. Anderson, Jr., P. O. Box 55626, Indianapolis, IN 46205.

Seeking information on **TSgt. Stanley Putala,** killed in action February 16, 1943, when his aircraft, the B-17 *Shak Hak* of the 303d Bomb Group, was shot down near St. Nazaire, France. **Contact:** W. Zelenski, 803 Beech St., Rome, NY 13440.

Seeking contact with **Richard A. Cano,** who was a member of the 393d Bomb Squadron, 509th Bomb Wing, at Pease AFB, N. H., from 1960 to 1964. **Contact:** Ralph K. Baber, Rte. 1, Box 237, Tow, TX 78672.

Seeking contact with **TSgt. John Mahoney,** who was stationed at Volk Field, Wis., during 1969. **Contact:** Louis Kridelbaugh, 7021 Aura Ave., Reseda, CA 91335.

Seeking contact with **MSgt. Calder Robertson,** who was stationed at RAF Bentwaters, England, in the early 1960s and at Bergstrom AFB, Tex., in the late 1960s. **Contact:** Joseph W. Koczan, 1 Forum Ct., Morris Plains, NJ 07950.

Seeking contact with crews of **B-25D/F10 photo-mapping aircraft** equipped with trimetrogon cameras. **Contact:** N. L. Avery, 2231 Bobcat Trail, Mount Shasta, CA 96067.

Seeking contact with members of **B-24 Crew #11** flying *Jigs Up,* piloted by William M. McCrory, Jr., out of Cheddington, UK, in late 1944 and early 1945. Also seeking information about the 113th Association. **Contact:** Bill Krueger, 3700 Elizabeth Ave. #84, Olympia, WA 98501.

Seeking information on the whereabouts of **John Enoch Ross** or his son **Sterling.** John was stationed near Worcester, England, from approximately 1944 to 1952, when he returned to his Virginia birthplace. **Contact:** L. Georgiou, 19 Fordmill Rd., Catford, London SE6 3JH, England.

Seeking information on the Soviet **Tupolev Tu-16** bomber, especially detail drawings and photos and information on the markings of different air forces that fly the aircraft. **Contact:** David M. Knights, P. O. Box 22272, Louisville, KY 40252.

Seeking information on **Wyatt Cooper "Tommy" Zornes,** from Princeton, W. Va. He was a Pfc. in the USAAF during World War II, stationed in Leicestershire, England, in 1945–46. **Contact:** James Wyatt Zornes, 65 Wigston Rd., Oadby, Leicester LE2 5QF, England.

Collector seeks **propaganda leaflets** of all kinds. **Contact:** B. F. Younginer, 411 S. Florida Ave., Lakeland, FL 33801.

Seeking the whereabouts of **Gerry Martinez,** who was a C-130 navigator with No. 37 Squadron based at RAAF Richmond, New South Wales, Australia. **Contact:** Maj. E. D. Connor, USAF (Ret.), 9310 Arabian Ave., Vienna, VA 22182.

Researcher and historian seeks any World War II Army or USAAF personnel who were assigned to the **98th General Hospital** or the **365th Station Hospital** in Paris during the Battle of the Bulge. **Contact:** Dale Titler, P. O. Box 7361, Courthouse Rd. Station, Gulfport, MS 39506.

Seeking contact with B-24 aircrews of the **9th Bomb Squadron,** 10th Air Force, stationed at Pandaveswar, India, in January 1943. Specifically want information concerning six B-24Ds that sank the Japanese transport *Nitimei Maru* 150 miles south of Rangoon on January 15, 1943. **Contact:** B. Dros, Haarweg 2, 3931 PB, Woudenberg, the Netherlands.

Seeking information on the whereabouts of individuals who were assigned to the **355th Munitions Maintenance Squadron**'s Gun Services Section from 1973 to 1976. Also seeking any historical information or photos relative to the 355th MMS and scale drawings and photos of the A-7D Corsair II. **Contact:** Gene Carlson, 1944 Tanglewood Dr., Lafayette, IN 47905.

Seeking information about **John Howard "Bee" Chisholm,** who served with 15th Air Force from 1940 to 1945 in North Africa and Italy. **Contact:** Larry Blaylock, Rte. 2, Box 144, Baldwyn, MS 38824.

Seeking color slides and photos on the **B-1 aircraft** to trade with others interested in the B-1. Also seeking information on other SAC aircraft, nose art, and nicknames. **Contact:** Don Logan, 7230 Cedaridge Cir., Wichita, KS 67226.

Seeking contact with pilots who graduated from **Class 45-B** at Pampa AAF, Tex. **Contact:** Pete Cotellesse, 114 Mossridge, Universal City, TX 78148.

Seeking members of the **359th Fighter Group,** 368th Fighter Squadron, 369th Fighter Squadron, and 370th Fighter Squadron who served in England during World War II. **Contact:** Tony Chardella, 105 Mohawk Trail Dr., Pittsburgh, PA 15235.

Seeking squadron patch of the **577th Strategic Missile Squadron,** which was based at Altus AFB, Okla., and a large color print of an Atlas-F ICBM. **Contact:** Samuel A. Jones, P. O. Box 122, Southern Pines, NC 28388.

Seeking a book published shortly after the Korean War titled ***The Greatest Airlift,*** the story of combat cargo during the Korean War. **Contact:** Cyndi Mosher, 850 Rockdale Ave., New Bedford, MA 02740.

Seeking contact with 392d Bomb Group bombardier **Jack G. Murray** and any of the sergeants on John Beder's crew, also JTF-7 Operation Hardtack. **Contact:** John Matt, Rte. 1, Box 885, Waterford, VA 22190.

Seeking information on the service use and eventual disposition of the **first USAF probe/drogue tanker airplane.** It was a B-29 modified in July 1953 at Tinker AFB, Okla., with a British reel installed in the lower aft turret position. Also seeking information on ten ECM trainers modified in 1950 for use at Keesler AFB, Miss. **Contact:** Richard A. Strouhal, 3308 Ridgewood Dr., Midwest City, OK 73110.

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 **Marenus Price Peterson,** who lived near RAF Mildenhall, England. After living in Virginia Beach, Va., in 1977 and Lackland AFB, Tex., in 1978, he was last known to be at Pope AFB, N. C., in 1979. **Contact:** Alice Braddy Mann, 3306 N. Bryant Blvd., #103, San Angelo, TX 76903.

Seeking information on the whereabouts of **Cpl. Boris Chezar,** who was stationed at Tinker AFB, Okla., about 1945 and painted a mural in the headquarters building. The Strategic Arts Alliance at Tinker would like to recognize him for his work. **Contact:** Gayle Goodman, 3301 Chetwood Dr., Del City, OK 73115.

Seeking information on patches, hats, and other paraphernalia associated with **special operations aircraft and units,** fixed and rotary wing, Vietnam to present. **Contact:** Jim Dawson, 17301 E. Baca Dr., Fountain Hills, AZ 85268.

Seeking any jackets, ribbons, diaries, and uniforms connected with **8th Air Force combat crews,** also any bawdy parodies sung by 8th Air Force combat crews. **Contact:** James B. McCloskey, 1 Silver Sage Ct., Cockeysville, MD 21030.

Seeking contact with **Greg Richards,** who was stationed at Pinedale, Wyo., in 1983. **Contacts:** Mike and Donna Spencer, 822 E. Iona Rd., Idaho Falls, ID 83401.

Seeking information on the whereabouts of Mr. and Mrs. **Francis Burke,** their son Tommy, and his wife Gwen, who were with the US Armed Forces in Garmisch-Partenkirchen, West Germany, between 1966 and 1970. **Contacts:** Ottilie and Joanna Bertasius, 87 Lordship Rd., London N16 5F, England.

Seeking photos of **Martin B-26 Marauders** for a pictorial history covering the men and women who built, maintained, and flew the Martin B-26 Marauder and for the enhancement of the photo archives of the Martin B-26 Marauder Historical Society. **Contact:** John O. Moench, 905 Sweetwater Blvd. South, Longwood, FL 32779-3430.

Seeking contact with **P-38 pilots who flew with Charles A. Lindbergh** in the south Pacific during World War II. **Contact:** Col. Lyndon L. Sheldon, USAF (Ret.), 2019 Essex Ln., Colorado Springs, CO 80909.

Collector seeks **USAF patches** and offers French Air Force patches in return. **Contact:** J. C. Cechetti, 53 Rue du Cormier, Romorantin 41200, France.

Seeking information on the whereabouts of Air Force member **Michael O'Shea.** Several years ago, he was stationed in Japan. **Contact:** Terrence P. O'Sullivan, 1423 Texas Ave., Houston, TX 77002.

Seeking information on **Carroll Ruby,** who was originally from Maryland and was stationed with the 763d Heavy Bomb Group in Spinnazola, Italy, from August 1944 until he was shot down on his thirty-eighth mission. **Contact:** Dennis Ruby, 4811 Sunday Ct., Sarasota, FL 34235.

Collector seeks any **fighter squadron scarves,** American or British. Also seeking other pilot memorabilia and patches. **Contact:** TSgt. Kenneth White, P. O. Box 103, Sheffield, MA 01257.

Seeking accounts from pilots of the Thunderbirds aerial demonstration team who flew the **F-4E Phantom II** (1969–73). Any extra photos or other memorabilia would be appreciated. **Contact:** Andrew Biscoe, 45 Carr Rd., Concord, MA 01742.

Seeking the whereabouts of **James O'Brien,** who was stationed at Shepherds Grove and RAF Mildenhall, England, between 1954 and 1961. He was a chef in the officers' mess. **Contact:** D. Borley, Mill Haven Bungalow, Hunston Rd., Badwell Ash, Bury St. Edmunds, Suffolk IP31 3DJ, England.

Seeking contact with **Joseph Accevedo,** who served with USAF at Sheppard AFB, Tex. in 1980. He married Maria Victoria Iranmanesh, who has a son named Mickey Majid Iranmanesh. **Contact:** Mehdi Iranmanesh, P. O. Box 13595-186, Tehran, Iran.

For a book on **USAAF Training Bases in Nebraska** during World War II, I am seeking personal experiences of aircrew members who trained at these bases and of any individuals who served at these bases. **Contact:** Lt. Col. George A. Larson, USAF, 12410 Walker Dr., Omaha, NE 68123-1551.

Collector seeks to trade USAF and NATO **patches. Contact:** Richard Rochon, 55 de Rouville #1, Gatineau, Quebec J8T 7H7, Canada.

Seeking memorabilia, photographs, and recollections regarding **Titan II operations** from 1960 to 1986. **Contact:** Becky Roberts, W. Duval Mine Rd., Green Valley, AZ 85614.

Seeking information on the whereabouts of **Lt. Col. Harold C. Perkins,** USAF, whose last known duty station was Langley AFB, Va., in the early

1970s as a weapon systems officer after a tour in Vietnam. **Contact:** Jerry Masel, 2800 Lake Shore Dr. 1916, Chicago, IL 60657.

Seeking all members of **pilot Class 47-C,** which flew B-25s, B-17s, and P-51s in advanced training. **Contact:** Bob Campion, Box 1712, Fulton, TX 78358.

Seeking copy of a pilot training manual for the **C-54 Skymaster** and a copy of systems, cockpit interiors, performance charts, and emergency procedures. **Contact:** Richard House, 109 Connecticut Ave., Warren, PA 16365.

Seeking information on the following officers stationed with 6th Air Force at the **Panama Air Depot** between 1942 and 1945: Major Weldon and Capt. Richard Rick, USAAF; Capt. Anthony Lind and Lt. Lester Thompson, Signal Corps. **Contact:** Carroll J. Watkins, 415 Plantation Dr., New Bern, NC 28562. ■

Unit Reunions

B-29 Anniversary
The Boeing Co., in association with the Museum of Flight, will celebrate the fiftieth anniversary of the B-29 August 14–16, 1992, in Seattle, Wash. **Contact:** Paul S. Friedrich, P. O. Box 3999, M/S 17-28, Seattle, WA 98124-2499.

Counterparts
Former advisors and their associates who served in southeast Asia between 1954 and 1975 will hold a reunion March 5–8, 1992, at the Breckinridge Inn Hotel in Louisville, Ky. **Contact:** Counterparts, P. O. Box 40, Circleville, WV 26804.

27th Bomb Group
Veterans of the 27th Bomb Group who served in the Philippines during World War II will hold a reunion October 17–19, 1991, at the Holiday Inn in Savannah, Ga. **Contact:** Paul Lankford, 105 Hummingbird Dr., Maryville, TN 37801. Phone: (615)982-1189.

31st Fighter Officers
Officers of the 31st Tactical Fighter Wing/Group who served between 1940 and the present will hold a reunion April 30–May 2, 1992, at the Fort Magruder Inn in Williamsburg, Va. **Contact:** Col. C. W. Strain, USAF (Ret.), 30 Beards Creek Cir., Chapin, SC 29036. Phone: (803) 781-0363.

Class 42-13
Members of Class 42-13 (Navigator) who served at Mather Field, Calif., will hold a reunion October 25–27, 1991, at the Holiday Inn City Centre in Chicago, Ill. **Contact:** Ted E. Gaty III, 2023 Bridgeport Dr., Lexington, KY 40502. Phone: (606) 268-4028.

57th Fighter Group
Members of the 57th Fighter Group (World War II), which included the 64th, 65th, and 66th Fighter Squadrons, will hold a reunion October 28–31, 1991, at the Gold Coast Hotel in Las Vegas, Nev. **Contact:** Tom Hannon, 1700 Golden Arrow Dr., Las Vagas, NV 89109-2547. Phone: (702) 796-7774.

90th Bomb Squadron
Members of the 90th Bomb Squadron (LNI) who served in Korea at Kunsan AB will hold a reunion October 24–27, 1991, in Tucson, Ariz. **Contact:** Gary Long, 6432 E. Bluebird Ln., Paradise Valley, AZ 85253. Phone: (602) 948-6540.

3520th Flying Training Wing
Members of the 3520th Flying Training Wing (T-33/B-47) who served between 1950 and 1955 will hold a reunion October 11–13, 1991, at McConnell AFB, Kan. **Contact:** Gina Dillard, 240 Penrose, Wichita, KS 27206. Phone: (316) 862-9675.

Kimpo Veterans
For the purpose of planning a reunion, I am seeking contact with former members of the 6166th Air Weather Flight, 67th Tactical Reconnaissance Wing, including ground monitor personnel who served in 1952 and 1953 at Kimpo AB, Korea. **Contact:** CMSgt. Richard H. Langill, USAF (Ret.), P. O. Box 162, Plainfield, NH 03781-0162.

5th Communications Group
Veterans who served in Korea with the 5th Communications Group and the 934th Signal Battalion between 1951 and 1954 are planning to hold a reunion. **Contact:** Rick Feiler, Box 405, Ardmore, OK 73402. Phone: (405) 657-8601.

Class 43-K
For the purpose of planning a reunion, I am seeking contact with former members of Class 43-K (Central Flying Training Command, San Antonio, Tex.) to compile a directory. **Contact:** Lt. Col. Harold A. Jacobs, USAF (Ret.), 17545 Drayton Hall Way, San Diego, CA 92128. Phone: (619) 485-5041.

Class 56-B
I would like to hear from members of Class 56-B who were stationed at Moore AFB and Laredo AFB, Tex., and who would be interested in holding a reunion. **Contact:** Richard L. Bancroft, 189 S. Lakeside Dr., Medford, NJ 08055. Phone: (609) 654-7091.

458th Service Squadron
For the purpose of planning a reunion, I would like to hear from members of the 458th Service Squadron who were stationed in Aldermaston, England, during World War II. **Contacts:** Leo C. Weinhold, RR 1, Box 49, Garfield, KS 67529. Phone: (316) 569-2387. George Paul Gerbracht, 2114 W. 29th St., Erie, PA 16508. Phone: (814) 864-2433.

821st Medical Air Evacuation Squadron
Seeking contact with veterans of the 821st Medical Air Evacuation Squadron (World War II) who served in the China-Burma-India theater. This squadron is having a reunion in 1992 at Bowman Field, La. **Contact:** Ralph B. Breckenridge, 1654 Augusta Way, Casselberry, FL 32707. ■

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.

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Coverage will not be provided under this plan for pre-existing conditions (conditions which were treated during the 6 months prior to the effective date), until the expiration of 6 consecutive months of coverage during which time no further treatment is received for the condition. After the coverage has been in effect for 12 consecutive months, ALL pre-existing conditions will be covered. Children of active duty members over age 21 (age 23 if in college) will continue to be eligible if they have been declared incapacitated and if they are insured under CHAMPLUS® on the date so declared. Contact AFA for details.

EXCLUSIONS

This plan does not cover and no payment shall be made for: routine physical examinations or immunizations; domiciliary or custodial care; dental care (except as required as a necessary adjunct to medical or surgical treatment); well-baby care after the age of 2 years; injuries or sickness resulting from declared or undeclared war or any act thereof or due to acts of intentional self-destruction or attempted suicide, while sane or insane; treatment for prevention or cure of alcoholism or drug addiction; eye refraction examinations; prosthetic devices (other than artificial limbs and artificial eyes), hearing aids, orthopedic footwear, eyeglasses and contact lenses; expenses for which benefits are or may be payable under Public Law 89-614 (CHAMPUS).

LOOK AT WHAT AFA CHAMPLUS® PAYS

Care	Retired	Active Duty
Inpatient civilian hospital care	the 25% of allowable charges not paid by CHAMPUS, plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year	the greater of the total daily subsistence fees, or the $25 hospital charge not paid by CHAMPUS
Inpatient military hospital care	the daily subsistence fee	the daily subsistence fee
Outpatient care (covers emergency room treatment, doctor bills, pharmaceuticals, and other professional services; see exclusions for limitations)	the 25% of allowable charges not paid by CHAMPUS, after the deductible has been satisfied, plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year	the 20% of allowable charges not paid by CHAMPUS after the deductible has been satisfied, plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year

CHAMPLUS offers many attractive benefits. For a complete description of the Plan, including exceptions and limitations, please refer to the Certificate of Insurance, or call our Insurance Division toll-free at

1-800-727-3337

x4985

To enroll in the program complete the application.→

RATES

For Military Retirees and Dependents
QUARTERLY PREMIUM SCHEDULE
In-Patient Benefits Only

Member's Age*	Member	Spouse	Each Child
under 50	$25.27	$54.15	$17.97
50-54	37.76	59.03	17.97
55-59	55.35	63.18	17.97
60-64	66.13	79.66	17.97

For Military Retirees and Dependents
QUARTERLY PREMIUM SCHEDULE
In-Patient and Out-Patient Benefits

Member's Age*	Member	Spouse	Each Child
Under 50	$39.00	$79.32	$40.84
50-54	51.25	87.34	40.84
55-59	70.85	115.33	40.84
60-64	89.00	132.80	40.84

*Note: Premium amounts increase with the member's attained age.

For Dependents of Active Duty Personnel
ANNUAL PREMIUM SCHEDULE
In-Patient Benefits Only

	Member	Spouse	Each Child
All Ages	None	$12.89	$7.72

In-Patient and Out-Patient Benefits

	Member	Spouse	Each Child
All Ages	None	$51.52	$38.61

APPLICATION FOR AFA CHAMPLUS®

Group Policy GMG-FC70
Mutual of Omaha Insurance Co.
Home Office: Omaha, Nebraska

Full name of Member _____
Rank Last First Middle

Address _____
Number and Street City State Zip Code

Date of Birth _____ Current Age ____ Height _____ Weight _____ S.S.N. _____
Month/Day/Year

This insurance coverage may only be issued to AFA members. Please check the appropriate box below: ☐ I am currently an AFA Member ☐ I enclose $21 for annual AFA membership dues. (includes subscription ($18) to AIR FORCE Magazine)

PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (check one)
☐ AFA CHAMPLUS® PLAN 1 (for military retirees & dependents)
☐ AFA CHAMPLUS® PLAN II (for dependents of active-duty personnel)

Coverage Requested (check one)
☐ Inpatient Benefits Only ☐ Inpatient and Outpatient Benefits

Person(s) to be insured (check one)
☐ Member Only
☐ Spouse Only
☐ Children Only
☐ Member & Spouse
☐ Member & Children
☐ Spouse & Children
☐ Member, Spouse & Children

PREMIUM CALCULATION

All premiums are based on the attained age of the AFA member applying for this coverage. Plan I premium payments are normally paid on a quarterly basis, but, if desired, they may be made an annual (multiplied by 4) basis. Plan II premiums are payable annually ONLY.

Quarterly (annual) premium for member (age ____) $ _____
Quarterly (annual) premium for spouse (based on members' age) $ _____
Quarterly (annual) premium for ____ children @ $ $ _____
_____
Total premium enclosed $ _____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Insured Dependents Relationship to Member Date of Birth (Month/Day/Year)

_____

_____

_____

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 6 months prior to the effective date of this insurance coverage will not be covered until the expiration of 6 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such preexisting conditionswill be covered after this insurance has been in effect for 12 consecutive months.

Date _____, 19_____ _____
(Member's Signature)

Form 6173GH App.

Application must be accompanied by a check or money order. Send remittance to: Air Force Association, Insurance Division, 1501 Lee Highway, Arlington, VA 22209-1198

AFA

10/91

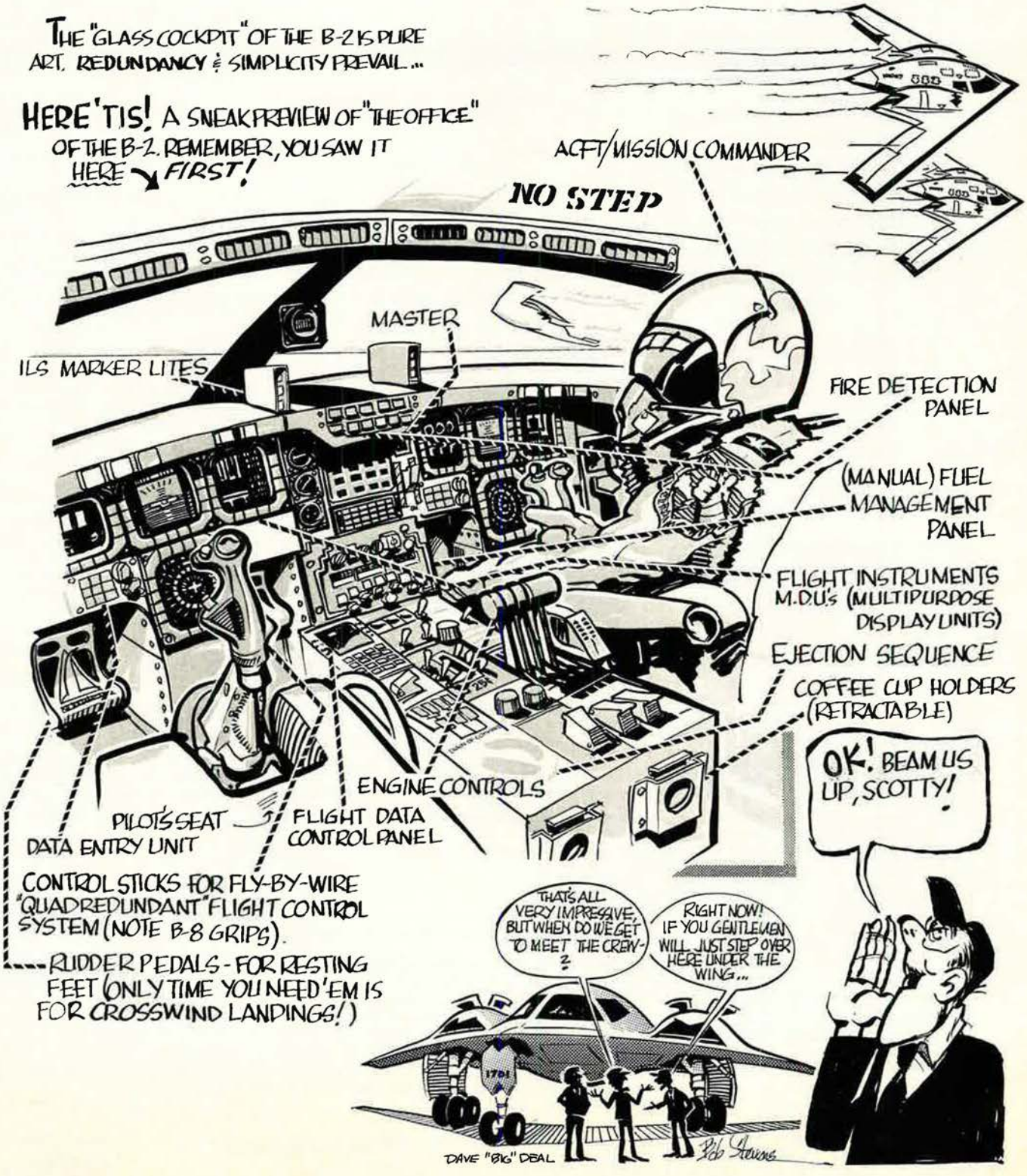
Bob Stevens'

"There I was..."

BACK AT AF PLANT 42, NORTHROP'S FINAL ASSEMBLY and FLIGHT TEST FACILITY FOR THE B-2 AT PALMDALE, CA. FOR A LOOK IN THE COCKPIT and TO TALK TO CREW MEMBERS OF THIS "STEALTHY ARMADA OF ONE". BECAUSE OF A HIGH DEGREE OF AUTOMATION, THE TWO-MAN CREW (PILOT & NAVIGATOR/SYSTEMS OPERATOR) CAN HANDLE HER WITH EASE. THE COMPUTERS ARE LINKED TOGETHER BY MULTIPLEX BUSES. SINGLE BUTTONS CONFIGURE BOTH AVIONICS and FLIGHT CONTROLS FOR TAKEOFF, LANDING, ETC.

THE "GLASS COCKPIT" OF THE B-2 IS PURE ART. REDUNDANCY & SIMPLICITY PREVAIL...

HERE'TIS! A SNEAK PREVIEW OF "THE OFFICE" OF THE B-2. REMEMBER, YOU SAW IT HERE FIRST!




Turkey


Norway


Egypt


Denmark


Finland


Portugal


Indonesia


Venezuela


Belgium


Israel


The Netherlands


Singapore


Bahrain


United States


Korea


Pakistan


Thailand


Greece

No other fighter protects national defense budgets like the F-16.

World leaders know the F-16 as a powerful protector of freedom. Its performance in Desert Storm provided dramatic proof. But what makes the F-16 even more remarkable is its ability to win budget battles. Customers want cost credibility. And we give it to them. In fact, one country was able to buy four additional airplanes within its original budget for 36.

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

GENERAL DYNAMICS
A Strong Company For A Strong Country

A SINGLE MISSILE FOR MULTIPLE PLATFORMS? ONE SLAM FITS ALL.

MDMSC: Smart choices for tough decisions.

Greater combat effectiveness. Improved operational efficiency. Two critical objectives of the USAF composite wing structure. And SLAM can help fulfill them both.

Built by McDonnell Douglas Missile Systems Company (MDMSC), the combat-proven Standoff Land Attack Missile is compatible with virtually all SAC and TAC aircraft. It's a conventional weapon that helps ensure aircraft survivability while knocking out its targets with pinpoint accuracy and low collateral damage—all with minimal pilot workload. And SLAM provides excellent battle damage assessment. Best of all, SLAM is ready now. Missiles have been in production since 1988. Worldwide logistics are in place. It's seen action in Desert Storm. That means known costs, known reliability, and known performance.

For the Air Force, help is not just on the way, it's here. It's SLAM.

MCDONNELL DOUGLAS
A company of leaders.