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AIR FORCE MAGAZINE

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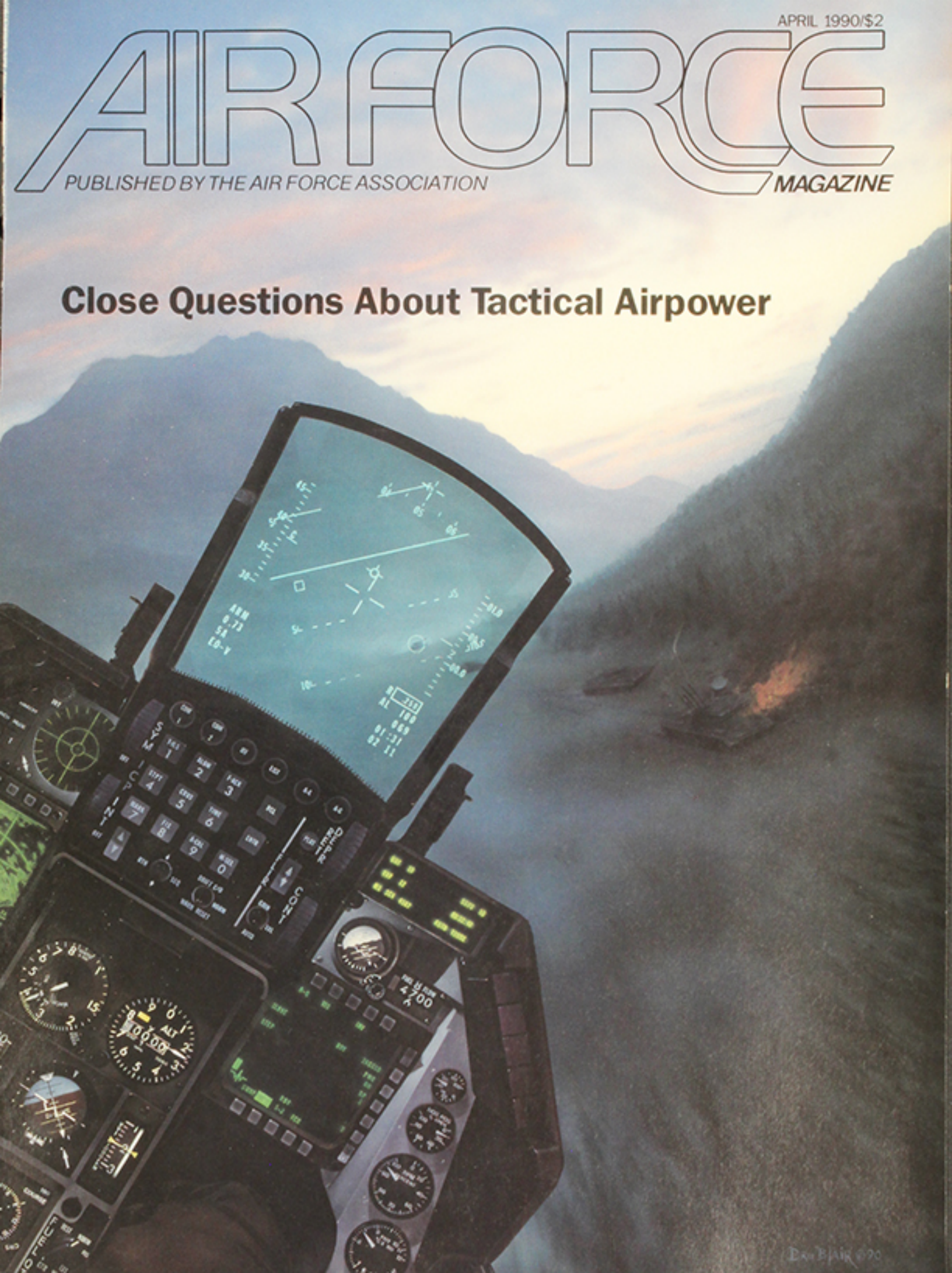
Close Questions About Tactical Airpower



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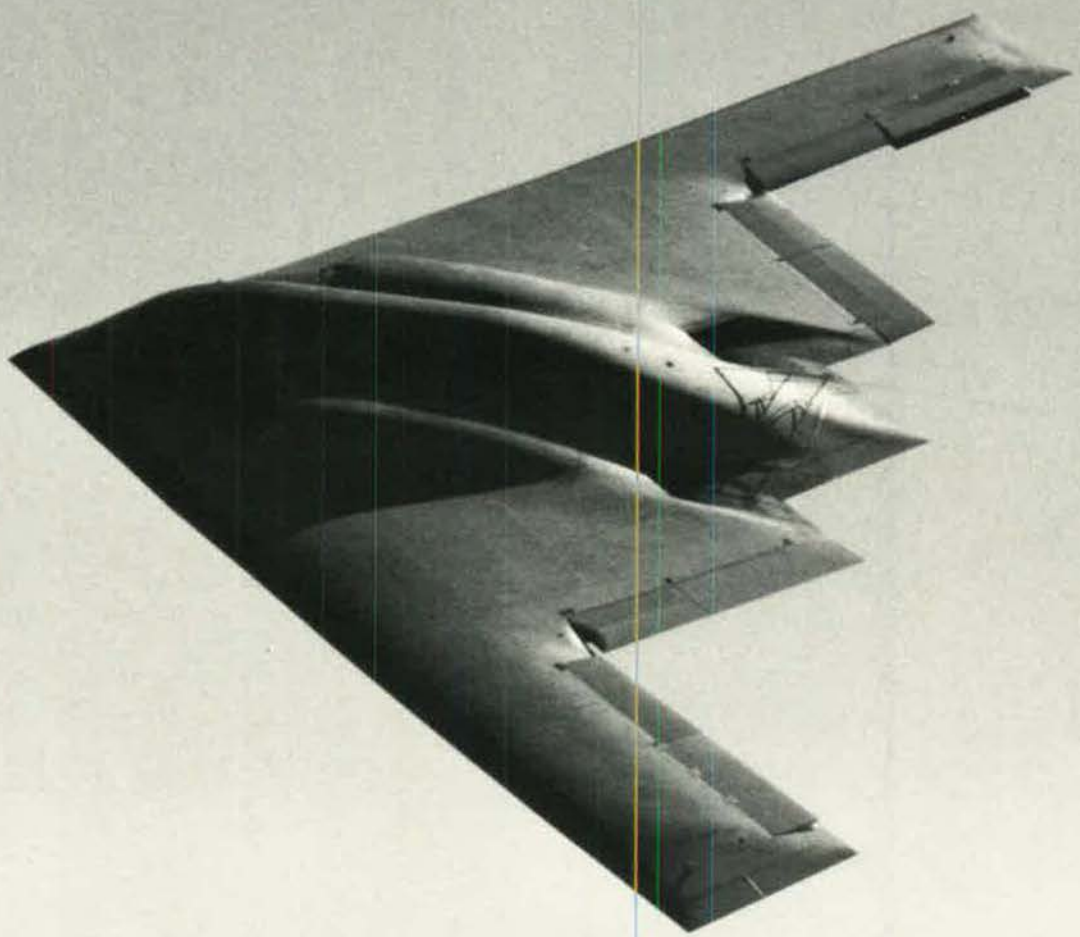

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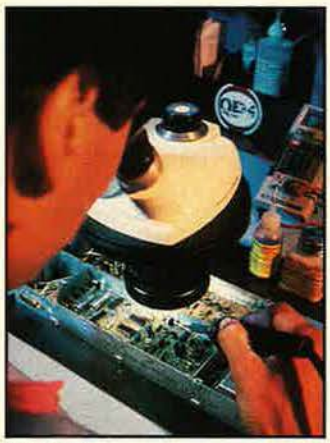

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About the cover: This Dru Blair illustration, "Falcon Sunrise," shows the view from the cockpit of an F-16 as it gives close air support to troops on the ground.

Close Questions About Tactical Airpower

Departments

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Editorial

By John T. Correll, Editor in Chief

Requirements and Wolf Stories

I HAVE just reread "The Plane That Would Not Die" from *The New Republic.* The article points with scorn to a military aircraft program that began as a strategic system but whose original mission was swept away by changing times. The Air Force, to the disgust of the author, tried to keep the aircraft alive on the pretext of utility in tactical theater operations.

The article castigates the expensive airplane as "unproven," rushed through testing with shaky electronics. Contractors and the Pentagon are in cahoots with politicians from states where the procurement money is spent. The General Accounting Office urges that production be deferred and the program held in research and development status.

"In spite of official protestations that this [defense budget] is a lean request, there are pouches of flab," *The New Republic* says, and this airplane "is an obvious one."

The language is tiresomely familiar, of course, but the object of vilification is not the B-2 Stealth bomber or any system currently controversial. "The Plane That Would Not Die" was the E-3 Airborne Warning and Control System (AWACS), and the article is dated April 13, 1974.

AWACS, of course, went on to become one of the most successful military aircraft of modern times. It is almost universally regarded as among the more valuable assets in existence for tactical or global contingency operations. The E-3 is the only aircraft that NATO has ever bought directly in the name of the entire alliance.

A number of yesterday's controversies are flying today and performing very well. The C-5 airlifter and the F-111 fighter-bomber are two more examples of aircraft that survived savage criticism and later proved their merit in operational service. It seems faintly ridiculous that they were ever ridiculed as potential mistakes or that serious questions arose about whether a need existed for them.

The critics have since moved on, applying approximately the same questions and allegations to a different generation of weapon systems. Given the present determination to reduce the defense budget, there are plenty of listeners for the critics' pitch, and almost every weapon program is on somebody's hit list.

Defending systems in development is not easy. Most of them exhibit blemishes at this stage, so they are vulnerable to criticism. When budget pressures are this intense, any high-cost system is subject to cancellation unless the justification for it is ironclad.

Those who invoke the old parable about crying wolf sometimes forget how the tale turned out. There *was* a wolf—and he got the sheep.

It is tough to make a compelling case that any system, considered by itself, is indisputably, unequivocally, *absolutely* required. The critics can argue convincingly—and not always erroneously—that part of the mission can be laid off on another system or on some combination of other systems. They point to options that help compensate for the absence of this system. They cite ambiguity in relevant aspects of the threat.

Sports analogies are popular at times like this. A football team with a strong defense and a highly accurate field-goal kicker doesn't need the league's best running back. But how smart is it to begin wondering if the kicker might be expendable too?

Some critics work themselves into approximately the same mindset about weapon systems. If a requirement, standing alone, cannot be demonstrated as absolute, it must not be a requirement. Nonrequirements should be canceled.

In "Tons for Guns" in the March 5, 1990, issue, for example, our old friend *The New Republic* wants to toss out the Peacekeeper missile, the B-2 bomber, and SDI strategic defenses. The Midgetman missile could be kept in R&D status (sixteen years just fly by, don't they?). That would scrub nearly all of the nation's strategic modernization programs.

Other cancellation enthusiasts are eyeing the Advanced Tactical Fighter, the C-17 airlifter, readiness levels, and force structure. Who needs a kicker in a league this easy?

Armed conflict is less predictable than football. It is not well understood by people who think of it as an academic exercise—or as a sports metaphor—rather than as something fought with bullets and blood. If combat requirements are figured short, the consequences can be very bad.

Can some reductions and cancellations be absorbed safely? The answer is probably yes. It depends on the compensating capabilities that remain—and, to some degree, on luck. Canceling weapons in big bunches is not a sensible proposition. It is, however, the approach toward which the nation is drifting.

The military, which will fight the wars if there are any, tends naturally to perceive requirements from a "worst case" perspective. The weapons-cutters think the military's requirements list is bloated and its estimate of danger overstated. They believe the military is crying wolf.

Those who invoke that particular parable ought to remember the rest of it. The way the story played out, there indeed *was* a wolf—and in the end, he got the sheep. ■

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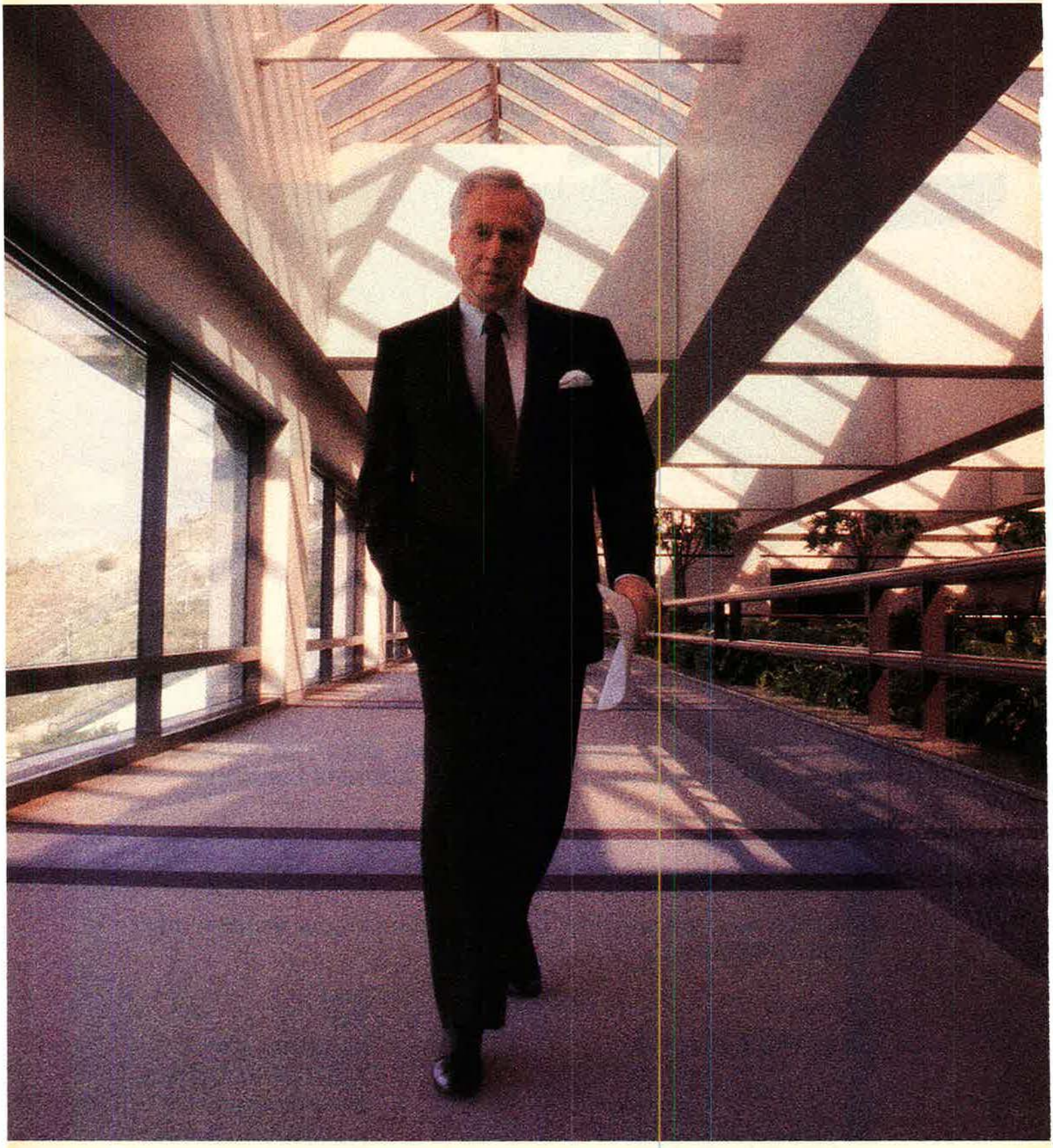

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Letters

Meeting Today's Threat

I disagree with Gen. T. R. Milton's thesis in his article "A Rush for the Exits" *[see "Viewpoint," January 1990 issue, p. 100]*. General Milton reminds us that a Russia by any other name (such as *perestroika*) is still the same Russia that we've faced for forty-odd years and that we must continue a strong presence of US forces in Europe to oppose that sinister empire. I disagree for two reasons.

First, this same preoccupation with a conventional US war machine oriented toward the "big war" in central Europe has driven US strategy and tactics since World War II and has eclipsed a much more realistic need to cope with the low-intensity conflict threats faced by US forces around the world. For example, MC-130s, V-22s, and low-cost fighters suitable for Third World conflicts frequently took a backseat to more glamorous programs like the F-117 and the Advanced Tactical Fighter, designed for the classic threat array in Europe.

Second, the Warsaw Pact is defunct. We now see not only satellite states of the Soviet Empire seeking freedom from Moscow, but also the Soviet Republics themselves shaking the very foundations of the Soviet Union. Given its domestic problems and the loss of its "buffer," the Soviet Union couldn't possibly sustain an all-out offensive against western Europe—those countries that US forces are charged to defend.

I see the scaling down of forces in Europe as an opportunity, not a problem, for the Air Force of the 1990s. We can revamp our doctrine, strategy, tactics, organization, and weapons development to move from a tired old war machine designed to refight World War II in Europe toward more capable forces for meeting today's threats.

Maj. Roger L. Smith, USAF
Misawa AB, Japan

Lindsey's Crew

I thoroughly enjoyed the article about "The Bridge at L'Isle Adam" *[see "Valor," by John L. Frisbee, January 1990 issue, p. 96]*. However, as a former member of the 394th Bombardment Group, I wish to point out a "significant" error. The tail marking of the 394th was a diagonal white stripe, not the horizontal stripe depicted.

Additional information on Captain Lindsey's crew: Staff Sergeant Donald was missing in action; 1st Lt. William Smith, TSgt. Richard Wylie, SSgt. Albert Lawson, and Sgt. Perla Fees, Jr., were taken as prisoners of war; 1st Lt. Gerald Hson was returned to the States; and 1st Lt. Harley Hooper and 2d Lt. Arthur Erbe were returned to duty and later sent back to the States.

Lt. Col. Joseph J. W. Demes, USAF (Ret.)
Merritt Island, Fla.

Eielson Heroism

The article concerning the crash of the RC-135 at Shemya Air Station and the feats of TSgts. Tommie Wood and Dave Gerke was almost correct *[see "Valor: Chivalry at Shemya," by John L. Frisbee, December 1989 issue, p. 103]*. I remember the dead, cold silence as I walked into the operations section of the 6985th Electronic Security Squadron on the Monday after the crash. Both Tommie and Dave were assigned to the 6985th ESS (not the 6981st ESS as the article stated) at the time of the Cobra Ball crash. It was my pleasure to have served with them and the other members of that crew for several years at Eielson AFB, Alaska. I later served with Dave at Kelly AFB, Tex., and visited with Tommie during a TDY trip to Korea. I also remember visiting Tommie after he was released from the hospital to his quarters at Eielson. Mr. Frisbee's description of his injuries is fairly accurate, but Tommie lay in bed for longer than a month recuperating from them. Due to the extensive burns received by Dave, it was several weeks before we saw him. Their unselfish acts of heroism are typical of the men and women who fly from Eielson—I only wish that there had been more Technical Sergeants Woods and Gerkes to come to the aid of those who perished in the crash that night.

SSgt. Steve Balser and SSgt. Harry Parsons were the two members of the 6985th ESS who gave their lives in the crash. It was Steve's first trip to the rock, and Harry was getting checked out as an airborne mission supervisor. Both were outstanding airmen and good friends.

SMSgt. William J. Jennings, USAF
Vaihingen, West Germany

Shaken, Undeterred

Your December 1989 "Aerospace World" column included an item on the October 1989 STS-34 space shuttle mission, which placed NASA's Galileo Probe on its journey to Jupiter with an Air Force-developed Inertial Upper Stage (IUS). There was, in fact, a fourth "major hurdle" [besides the three mentioned in the column] to overcome for a successful launch. We were surprised you neglected to mention the role of the Air Force's IUS Mission Control Center (MCC) at Onizuka AFB, Calif., in the mission. Our task was made much more difficult when, at 5:04 p.m. on the evening before the launch, Onizuka AFB and the San Francisco Bay area experienced a 7.1-magnitude earthquake.

Initially, the IUS MCC had to be evacuated in order to assess building damage and assure safety of personnel. When the building was verified safe to reenter, Air Force and Contractor IUS flight controllers—most with only sketchy information that their families and homes were okay—immediately returned to duty and began to assess damage and the MCC's

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 are sorry 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

ability to support the shuttle. They found the IUS command and control system completely inoperative, with the space shuttle scheduled to launch in less than twelve hours.

Through a tremendous team effort —and with personal concerns temporarily placed in the background—mission-essential IUS command and control capabilities at Onizuka AFB were restored and mission-ready within six hours. At that point, senior NASA and Air Force mission management officials conferred and agreed to proceed with the space shuttle countdown, including orbiter tanking. Within ten hours after the earthquake, the IUS MCC was back in full operation. While cleanup crews were still at work in many areas of the building, the IUS MCC supported shuttle liftoff flawlessly all the way through completion of a textbook payload injection on an interplanetary trajectory.

Galileo Program personnel later reported that the IUS had placed the probe on such a supernominal trajectory that planned vernier burns for orbital adjustments were not required and fuel was saved. Much has been said about individual and combined efforts throughout the Bay Area immediately following this earthquake disaster. I wanted the record to show other, equally significant, efforts in support of our national space programs.

Col. James L. Grogan III, USAF
Commander,
Consolidated Space Center
Onizuka AFB, Calif.

A Grand Old Flag

The caption for the aerial photo of the College Park Airdrome *[see "Eighty Years at College Park," by C. V. Glines, January 1990 issue, p. 99]* states that it was taken "around 1910." You apparently overlooked a major clue—the forty-eight-star flag in the foreground—which was adopted on July 4, 1912, and therefore establishes an earliest possible date.

Larry Fisher I
East Hampstead, N. H.

The First Shot

At the risk of earning the sobriquet "nitpicker," I must nevertheless correct C. V. Glines's statement *[see "Eighty Years at College Park," January 1990 issue, p. 98]* that "Col. Isaac N. Lewis . . . fired the first aerial shots" in 1912. That honor belongs to Lt. Jacob E. Fickel of the 29th US Infantry, the first man to fire a weapon (a Springfield rifle) from an airplane in flight. This took place at Sheepshead Bay Race Track, N. Y., on August 20, 1910. His pilot was Glenn H. Curtiss.

Maj. Gen. Jakie Fickel commenced his military career as a US Revenue Cutter Service cadet in the US Coast Guard from 1902 until 1904, whereupon he enlisted in the Army as a private. In 1907, he was first sergeant, Company K of the 27th US Infantry, when he was commissioned a second lieutenant. He was the first and only commander of the Southwest Air District, which replaced the old First Wing and, in turn, served as the first commanding general of the Fourth Air Force. He was a rated command pilot, combat observer, and aircraft observer.

Colonel Lewis remains the first man to fire an automatic weapon from an airplane in flight.

James L. Ballance
San Francisco, Calif.

Linebacker Coverage

The "Valor" article "The Seventh Man" on p. 55 in your February 1990 issue was the first time I have read in your magazine about a B-52 crew's

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experience in combat operations. It was a pleasure to read about the bomber's particular mission that day on December 27, 1972, during the famous Linebacker II employment. The article not only pointed out the significance of the mighty B-52 during Linebacker II, but it also described the courage and professionalism that each crew member aboard that B-52D displayed.

Your article further demonstrated the importance of crew coordination and how indeed it can save lives. As a crew member on a B-52H, I, along with all active and former B-52 crew members, would like to congratulate AIR FORCE Magazine on a superb article.

Capt. Steven L. Amato,
USAF
Carswell AFB, Tex.

With reference to your magnificent article on Capt. John Mize and his crew in "Valor" in the February 1990 issue, I would agree with Captain Mize that he had "a seventh man" on board the night he and his crew performed so admirably on their Linebacker II mission of December 27, 1972. My hat is off to the BUFF crews who endured the SAM [surface-to-air missile] environment of Hanoi, using tactics that have historically involved a gut-wrenching, straight-and-level bomb run in a *big* airplane. Their conduct that night was certainly worthy of the decorations they received.

I must challenge the reference to Captain Mize being the first SAC recipient of the Air Force Cross, however. Maj. Rudolf Anderson, one of our early SAC U-2 pilots, was awarded the very first AFC ever presented. It was awarded posthumously for his performance on a Cuban reconnaissance mission on October 14, 1962. Major Anderson lost his life on that mission, the only fatality of the crisis.

Maj. Gen. Patrick J. Halloran,
USAF (Ret.)
Riverside, Calif.

Weather or Not

There are still some "omissions" following your Fort Irwin article *[see "All Together at Fort Irwin," by Jeffrey P. Rhodes, December 1989 issue, p. 38]* and the subsequent letters to the editor.

During my last assignment, I accompanied elements of the 24th Infantry Division (M) to the National Training Center (NTC) at Fort Irwin a few times. I happen to be a weather officer, not a pilot or Tactical Air Command and Control Specialist. Because weather is one of the three essential elements in intelligence preparation of the battlefield, along with the enemy and the terrain, any good Army G2/S2 [intelligence unit] will be accompanied by its Military Airlift Command Air Weather Service weather team to the field, including the NTC.

Weather personnel also live on Army installations and work with their supported units on a day-to-day basis. Our modified tables of organization and equipment provide our equipment through the Army. We are trained to deploy in whatever manner our Army customer does: airborne, air assault, light fighters, you name it.

Not that the Tactical Air Control Party folks don't deserve the credit given to them, they just have other Air Force company out there.

Maj. Steven M. Savageau,
USAF
Eagle River, Alaska

Competing Internationally

Reader Bob Severs of La Porte, Ind., was partially on target with his January issue letter regarding John T. Correll's editorial in the October 1989 issue, titled "Unskilled and Unprepared." No question, parents should be held accountable for their children's education, but only to the extent that they can provide the internationally competitive education "everyone" talks and writes about. This has never been easy. School districts traditionally lay claim to the title "best school district in the country," a claim difficult to dispute under present criteria for academic excellence. Until educators endorse and accept international-level, nationally sponsored standardized testing (*e.g.,* at grades four, eight, and twelve) for all students, parents will continue to sidestep the issue of responsibility for educational deficiencies with passive disinterest.

Lt. Col. Kenneth H. Conley,
USAF (Ret.)
Bellevue, Neb.

Funding IMAX

We were pleased to see the item on the IMAX theater addition under construction at the United States Air Force Museum in your "Aerospace World" section *[see January 1990 issue, p. 26].*

We would like to clarify one point, though. The theater is being funded by and constructed under the auspices of the Air Force Museum Foundation. The Foundation, a private,

nonprofit organization chartered by the State of Ohio, raised the funds for the main Museum building in 1970 and again raised $5.4 million in a split-funded project with the federal government for the Modern Flight Gallery addition, which opened in 1988. As you stated, the Foundation will manage the day-to-day operation of the theater after turning the completed project over to the Air Force.

We greatly appreciate your continued support in getting the word out on the Museum's activities and projects.

Linda S. Smith
Chief, Public Affairs
USAF Museum
Wright-Patterson AFB, Ohio

Engine, Engine

I am [writing] to inform you of a mistake in your January 1990 issue *[see "The Push for Fighter Engines, by F. Clifton Berry, p. 76, photo caption]*. After mentioning the P&W F100-PW-229 (on test stand), you incorrectly listed the General Electric F110-GE-129 engine as an F100.

Michael Haley
GE Aircraft Engines
Lynn, Mass.

About That Cover

The caption under the heading "About the cover" incorrectly calls the Soviet BMP a tank *[see "Contents," December 1989 issue, p. 5]*. In the article on p. 38 concerning the National Training Center, the BMP is classed as an Infantry Fighting Vehicle.

Lt. Col. John T. MacLaughlin,
USAF (Ret.)
Hillcrest Heights, Md.

Under the Big Blade

In his letter, CMSgt. Harold Barbin *[see "Airmail," November 1989 issue, p. 12]* mentioned that the B-66 "went under the Big Blade, chopped up right there at Sculthorpe." Not true. Two squadrons were active in France, at Toul Rosiere and then at Chambley. The squadrons were the 42d Tactical Reconnaissance and the 19th Photographic Reconnaissance Squadron. Along about February 1966, President de Gaulle asked NATO and the military to leave France. The 42d TRS ended up in Takhli, Thailand, and the Douglas Destroyer led many bombing runs into Vietnam. Many fighter pilots can testify to this and were thankful to have them in the sky. I left Thailand and the B-66s behind in May 1967. The B-66Bs were primarily for electronic countermeasures, and the RB-66C was used for photo recon. The last I heard, the B-66s ended up being replaced and sent to retire at Davis-Monathan AFB, Ariz.

CPO Pete Cuipenski,
USCGR
New Port Richey, Fla.

Medical Shortage

I work in the USAF medical system. I am interested in why, in all of your recent articles, for example "The Air Force's Quandary" *[see "Washington Watch," by Robert S. Dudney, February 1990 issue, p. 12]*, you fail to mention how the medical system will be affected by upcoming budgets. I certainly hope the medical area's budget is not cut severely. To be honest, it seems to me that your magazine shows no interest at all in the medical system. Don't forget that good medicine is just as vital to aerospace defense as airplanes and aircrews.

The Air Force has a shortage of people in my career field. Perhaps if you had more articles on aerospace medicine, more people would become interested in working in it.

A1C John A. Fiske, Jr.,
USAF
Hurlburt Field, Fla.

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Washington Watch

By James W. Canan, Senior Editor

Weighting the Strategy

USAF, finally joining the roles-and-missions battle, points out the inherent ability of airpower to strike quickest, hardest, and with the least risk.

"What will the Air Force contribute? The ability to project US power and influence worldwide . . . , to hit hard, when that's the option. Global reach and global power."

Thus did Secretary of the Air Force Donald B. Rice describe the basics of "the new game plan that the Air Force has been developing while watching the other team change players, strategies, and rules" in today's uncertain strategic environment.

The occasion was a March 1 luncheon meeting in Washington of the National Security Industrial Association (NSIA). Addressing a large and attentive gathering of defense industry executives, Secretary Rice went public for the first time with the Air Force's view of its future.

He noted that deterring nuclear war will continue to be the Air Force's prime responsibility. He contended, though, that the US must gird itself for nonnuclear missions in far-flung places against newly formidable adversaries. Accordingly, the Air Force's long reach, quick reflexes, and big punch with conventional weapons should make it the service of choice for the National Command Authorities in the years ahead, he said.

Secretary Rice's speech had the effect of delivering Air Force firepower in a roles-and-missions battle building up among the military services. That battle threatens to become the fiercest of its kind in many years. The services are fighting for pieces of the budget and the action in parlous and highly competitive times. The budget is shrinking. The action, losing its Soviet focus, is taking on a much different look.

In his remarks, the Air Force Secretary gave the other services their due. He noted that "carefully crafted complementary forces" will likely be needed to protect US interests in all foreseeable global contingencies and that "each service offers unique capabilities." He looked ahead to situations in which the Air Force will team "with the Navy in control of access" to contested areas and "with the Army in spatial control" of such territory.

He left no doubt, however, that the Air Force sees itself as first among equals, as having the edge over the other services in several respects.

One, he said, is "survivability." Air Force operations of the sort likely to be required in the changing world would "put relatively few people at risk," in contrast to the larger numbers of sailors and soldiers at risk in battle formations on land and at sea.

Equating the Air Force with "speed, range, lethality, and flexibility, the inherent characteristics of airpower," Secretary Rice pictured a leading role for the service "in the most likely scenarios" that lie ahead for the US—those involving "conventional forces in sharp, short-duration operations where we may have to punch hard and terminate quickly." In them, airpower will be decisive, he said. "Range," he added, "takes on new meaning when we balance the need for global reach against the likelihood that we will lose some forward bases."

The Secretary noted that "aircraft carriers are absolutely essential" to the far-flung deployment of US airpower, but pointedly went on to say that "one squadron of F-15Es can match" the air-to-ground firepower of a carrier.

By his reckoning, what it comes down to is that "the Air Force has the unique ability to get at the heart of an adversary directly, to get at his capacity to wage war" quicker, harder, and with less risk than any other service.

In some strategic planning circles, this is called "seizing the king by the throat," wherever he may be, off the battlefield as well as on it, thereby bringing the king's armies to their knees.

Dr. Rice's speech staking claim to a favored place for the Air Force was widely hailed in blue-suit circles as having come not a moment too soon. A notion was afoot at the Pentagon and on Capitol Hill that the other services had jumped out ahead of USAF in asserting their cases for preeminence in the new strategic scheme of things and that the Air Force leadership had been a bit slow off the starting block.

The word was that high-level civilian officials in the Office of the Secretary of Defense, and perhaps Secretary Richard Cheney himself, had already bought the Navy/Marine sales pitch that the best strategy for the US to play up is a maritime strategy, the very strategy for which the Navy and Marines claim that they are tailormade.

In private and, on at least one occasion, in public, high-ranking Air Force officers wondered aloud why OSD had embarked on a full-scale review of major aircraft development programs, with an eye to possible cuts, but had conspicuously laid off reviewing major ship programs. Of the four aircraft programs officially under OSD scrutiny, the Air Force had three—the B-2 Stealth bomber, the Advanced Tactical Fighter, and the C-17 airlifter—and, arithmetically at least, the most to lose. The Navy had the other—the A-12 Advanced Tactical Aircraft.

The Navy and Marine Corps had wasted no time in pressing their case. From the outset of the current defense programming and budgeting cycle, their leaders claimed primacy for that Navy/Marine team—with its self-contained air components and built-in, long-range mobility—in US strategic planning. They described the changing world as one in which Europe, where the Army and the Air Force have long held sway, is diminishing in importance, and in which other regions—demonstrably reachable from sea and air by the Navy and the Marines, if slowly—have at least equal claim on US intentions.

In this vein, Chief of Naval Operations Adm. Carlisle A. H. Trost testified

before the House Armed Services Committee that the Navy has everything under control and that he sees a need for "relatively little change" in the ways that the sea service is constituted and operates.

In companion testimony, Marine Corps Commandant Gen. Alfred M. Gray emphasized that the US is a maritime nation. He claimed that US security requirements, save for strategic nuclear capabilities, which "are not at issue," have become "almost irrelevant with respect to the Soviet Union in terms of our dependence on the sea lines, our economic lifelines."

Ever blunt, General Gray told the House Committee that the US defense budget should be "weighted" to favor Navy and Marine Corps programs and other requirements.

The Air Force and Army saw the Navy/Marine position as presumptuous. USAF and the Army acknowledged Europe's diminishing significance as a strategic front, at least for now, but strongly advised against writing it—or them—off. As to the rest of the world, the Army and the Air Force conceded nothing to the Navy and the Marines. They are claiming robust roles for themselves, too, around the seven seas, and lately they have been raising their voices about it.

Army Chief of Staff Gen. Carl Vuono put out a white paper not long ago called "The US Army: A Strategic Force for the 1990s and Beyond." It acknowledged that the Army needs to shift emphasis from heavy armor and linear-battle concepts and should concentrate instead on building forces and equipment that will make it more maneuverable and mobile, more flexible and versatile.

Pointing out that "the changing strategic environment will make far-reaching demands on the US military establishment, particularly on our conventional forces," the white paper declared that "the Army will have to adapt its structure to carry out the new responsibilities" that it expects to take on around the world and become more of an expeditionary force.

To which the Marines replied that the nation already has such a fighting force—called the Marines.

The Air Force leadership made its first moves outside the Pentagon in the roles-and-missions skirmishing in mid-February, when Dr. Rice and Chief of Staff Gen. Larry D. Welch began testifying before congressional committees in behalf of USAF's budget request for Fiscal 1991.

Their theme was "The Air Force and US National Security: Global Reach and Global Power." Secretary Rice in particular, stressed that the Air Force, as "a versatile combat force," is the only service that is capable of combat in all spheres—in sea and land campaigns and, most especially, in air campaigns.

The Secretary emphasized that "direct power projection" over all ranges is a capability unique to USAF.

The Air Force leaders did not advocate a lone-wolf role for USAF. "Our planning will be conducted in complementary fashion with that of the Army and the Navy," their statement said.

But there was nothing bashful or overly deferential about it, either. "The emerging Air Force will provide unmatched capabilities in extending US global reach and the ability to respond rapidly to fast-developing conventional crises," USAF's top leaders asserted.

The "up with the Air Force" message came across louder and clearer than ever in Dr. Rice's speech at the NSIA affair. Some in the audience interpreted it as a heart-of-the-matter message, as if the independent identity of the Air Force were at issue and being reestablished.

Meanwhile, the political seas were becoming a little heavier for the Navy. On the day before Dr. Rice's speech, Sen. Sam Nunn (D-Ga.), Chairman of the Senate Armed Services Committee, took the Navy to task, admonishing Admiral Trost for having testified that the Navy is sitting pretty and should be immune to change.

Noting that the Air Force and the Army were facing up to the contemporary scene and were considering cutting five air wings and five divisions, respectively, Senator Nunn said to the Admiral: "When the threat changes as fundamentally as it has, you can't have one of the services saying, 'It doesn't affect us.' "

Kutyna and Space Launch

On April 1, Lt. Gen. Donald J. Kutyna was scheduled to leave his post as Commander of Air Force Space Command and move down the block at Peterson AFB, Colo., to become the four-star Commander in Chief of US Space Command and North American Aerospace Defense Command.

General Kutyna had every reason to expect a smooth transition. He has been in the space business as an Air Force officer for more than a decade, since before there were such things as space commands, and knows every inch of the territory.

As Commander of Air Force Space Command, General Kutyna ran the largest component, by far, of the tri-service US Space Command. His operatives carried out space-surveillance and ICBM-alert operations side by side with NORAD personnel in Cheyenne Mountain's many underground control centers.

On most major issues, General Kutyna sees eye to eye with the man he succeeds, Air Force Gen. John L. Piotrowski, who was scheduled to retire on April 1. For example, both are strong believers in the nation's need for antisatellite (ASAT) weapons and for space-based sensors to keep better track of satellites and to spot hostile aircraft and cruise missiles as soon as they take to the sky.

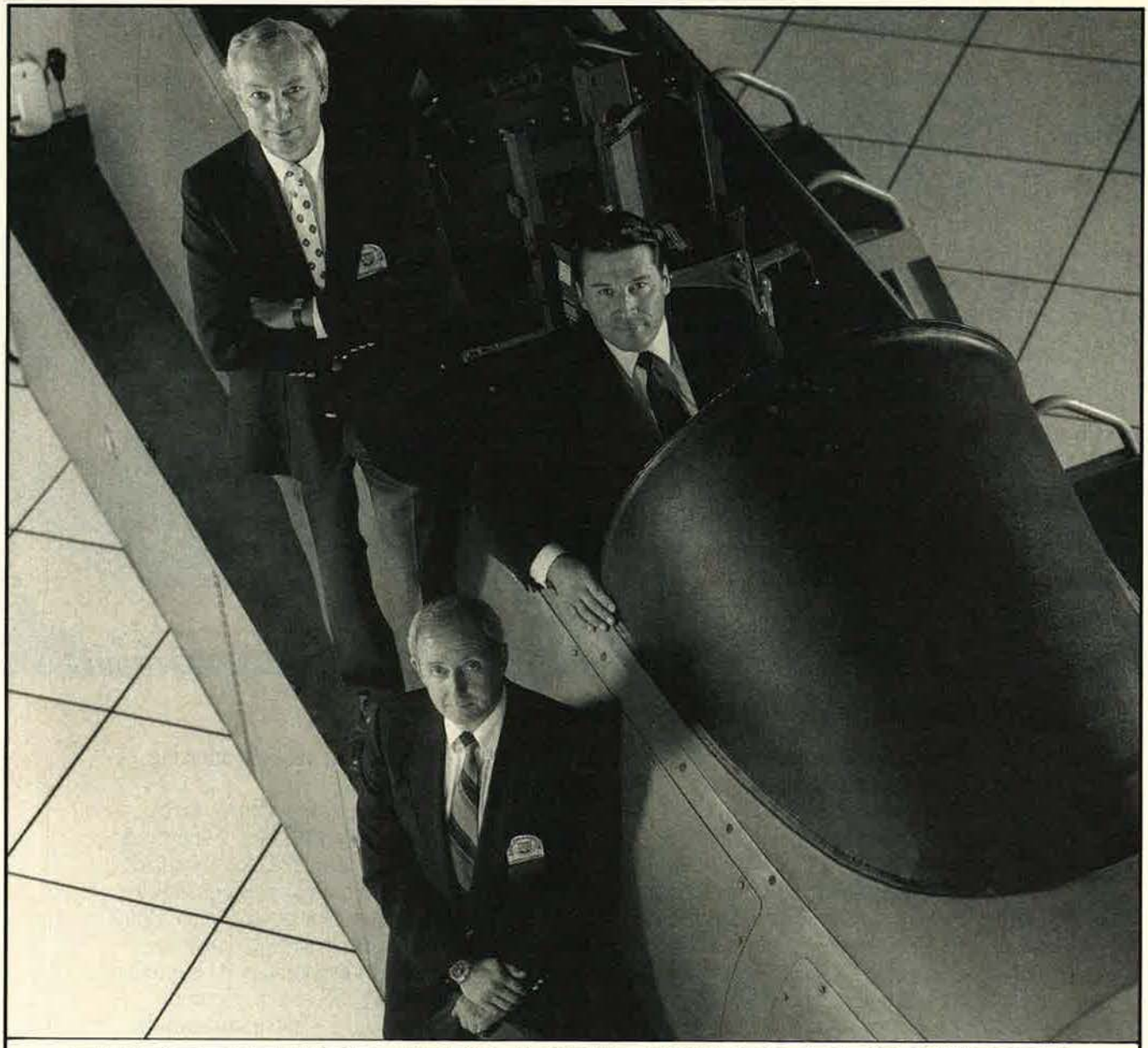
General Piotrowski was widely regarded as a worthy champion of such systems, which tend to be politically controversial, technically complex, and very expensive. He did a great deal to advance their causes in decision-making forums at the Pentagon and on Capitol Hill. But the going was tough and will probably be even tougher for General Kutyna, given the arms-control trends and fiscal realities of the times.

Now that he is the nation's number one operational commander for space, General Kutyna's views on how best to develop heavy-lift space-launch capability for the future can be expected to carry greater weight than ever. There has never been any mistaking where he stands in this. He is staunchly in favor of the Air Force-conceived Advanced Launch System development program—in which NASA also participates, if not always enthusiastically—and opposed to NASA's Shuttle-C development program that has the bipartisan political backing of many of the space powers-that-be in Congress.

A Shuttle-C heavy-lift launch vehicle would embody all elements now common to the space shuttle system except for the manned orbiter. The orbiter would be replaced by an unmanned payload canister capable of trucking twice-as-heavy cargo into low-earth orbit.

General Kutyna was asked for his views on Shuttle-C while taking part in an Air Force Association symposium on the future of the Air Force late last year in Los Angeles, Calif.

He replied, "Shuttle-C represents twenty-five-year-old technology. What the nation needs is the Advanced Launch System, employing new tech-



EXPERIENCE-IT'S A NATIONAL RESOURCE

McDonnell Douglas's 18 contract instructors at Luke AFB represent over 61,000 hours in fighter aircraft with a total of 27 combat tours and three MIG kills.

Experience like that is hard to find on active duty these days—but it is a resource too important to waste. That's why the Tactical Air Command selected McDonnell Douglas Training Systems Inc. to provide academic and simulator instructors for the F-15 and F-15E Eagle training programs. McDonnell Douglas retains professional resources like these Luke instructors for A-10, OV-10, F-111/EF-111, and F-4 training programs. It also trains SAC KC-10 aircrews and is going to train crews for the MAC C-17 airlifters. And now McDonnell Douglas has been selected by the U. S. Navy to train aircrews for the E-6A.

Retaining human resources is good for everyone. It's good for the retirees whose skills are saved. It's good for the students who learn from experienced instructors. It's good for the Air Force which achieves new cost efficiencies in its training programs. Everyone wins!

Among the leaders training leaders, Steve Harris, top; Jim Lentzkow, in cockpit; and Rob Van Sickle, bottom.

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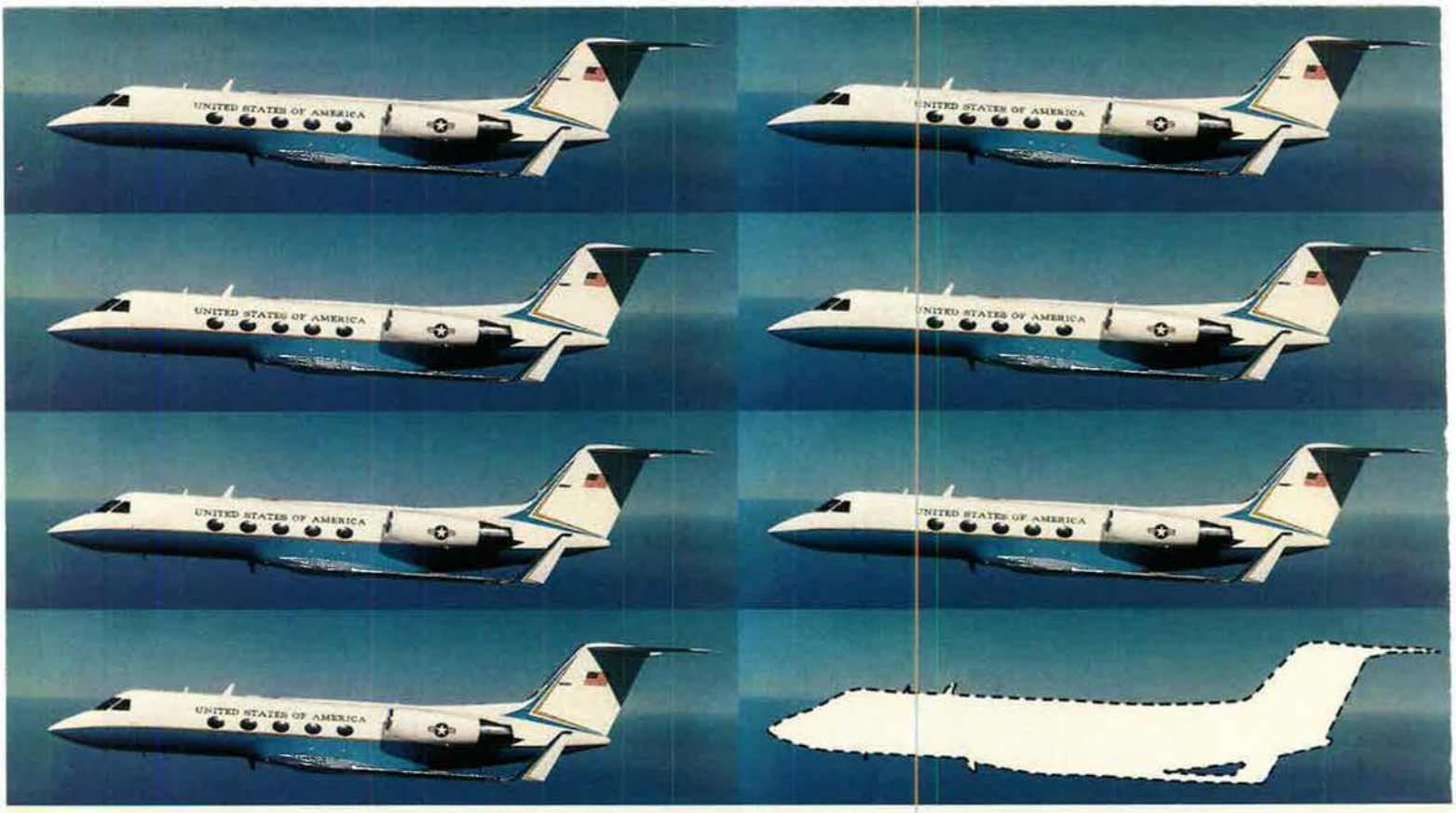

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U.S. Air Force Special Air Missions–SAM–is getting a real workout these days.

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nology. It would lower our launch costs and increase our launch responsiveness and reliability. Going with Shuttle-C would be a political decision, not a technical decision. I hope we're smart enough to go for the Advanced Launch System. The technology is there, if we want to put it to use."

A salient point in this issue is that the Air Force would have plenty of uses for the family of unmanned launch vehicles, not just heavy lifters, expected to emerge from the ALS program, but would have much less use, if any, for Shuttle-C vehicles. Shuttle-C has been earmarked from the start for launching elements of the manned space station.

The space station has long been coveted by NASA but does not exactly excite the Air Force, to put it mildly.

In early March, there was good news from an unlikely quarter for opponents of Shuttle-C. A NASA study concluded that the cost of using Shuttle-C as a space station transportation system would be much higher than previously estimated, perhaps prohibitively high. But congressional supporters of Shuttle-C seemed undaunted and pressed on with plans to fund it munificently in the NASA budget for Fiscal Year 1991, whether NASA likes it or not.

Meanwhile, the ALS program has come up against harsh fiscal facts of life in the Air Force side of the federal counting house and, like many other key programs, is being slowed and stretched.

Martin C. Faga, Assistant Secretary of the Air Force for Space, recently addressed himself to ALS. He reaffirmed that "one of our continuing needs is for improved launch capability," but acknowledged that "it is going to be difficult to meet the demand, because the investments are so great. . . . It's going to be tough to take programs such as our Advanced Launch System from technology to reality in the near term."

General Kutyna can be counted on to hang tough for ALS and all other programs aimed at improving and quickening US space-launch capabilities. He is for space all the way. He exemplifies the generation of senior Air Force officers, including growing numbers of general officers, who started out in air operations but switched to and stayed with space programs and operations. He was a command pilot with more than 4,000 flying hours in twenty-five different fighters and bombers, and he earned the Distinguished Flying Cross with one oak leaf cluster, plus many other decorations, during the war in southeast Asia. Subsequently, he moved over to the space side of the Air Force and never left.

As an officer in Air Force Systems Command and on the Air Staff at the Pentagon, General Kutyna was involved in one way or another with a host of space programs that came along through the late 1970s and the 1980s, including the space shuttle and various other launch systems and satellites.

The new CINC of USSPACECOM subscribes wholeheartedly to the Air Force's official position that, in the future, "spacepower will be as decisive in combat as airpower is today" and that USAF "must prepare for the evolution of spacepower from combat support to the full spectrum of military space capabilities." He is not at all sure that there will be roles in space for fighter pilots such as he, or for pilots in general, in years to come.

He was outspoken at the AFA symposium with his views on that question, asserting, "We've had military man in space from the dawn of manned spaceflight, looking for missions, and we have found very few, if any. Just look at the nature of things we do in space—communications, surveillance, warning systems, navigation. We don't use man for most of those things down on earth, so why would we put man in space to do them?"

He noted that the Air Force was even then studying the future of military man in space and had devised "a bunch of experiments that we're flying on the space shuttle, and, I've got to tell you, they're just awful. What they amount to is looking out the window and saying, 'Gee, isn't it pretty out there.' "

One such experiment involved tracking the wake of a ship, General Kutyna said, and added, "There's a fifty-fifty chance that if you follow the wake of a ship in the right direction, you're going to find a ship at the end of it. Well, you don't need a man to do that. There are systems out there that will do that four times over and five times better than somebody looking out the window of a shuttle."

He described another such experiment as involving a shuttle crewman "acting as a switchboard" for communications with an infantry commander on the ground, and declared, "Communications satellites have been doing that job for twenty years."

General Kutyna acknowledged that "there may be military missions for man in space," but emphasized that "we've got to start looking at them in a different way—not looking at the scientific things that man might do, but looking at man's unique capabilities," compared to the capabilities of machines, for useful operations in space.

"Any sensor that man has, I can beat with a machine, be it seeing, hearing, feeling—anything," the General declared. "But what I can't beat with a machine is man's ability to correlate the inputs of several sensors and come to a conclusion."

Such capability may be at its best in the human brain, but that brain may not be needed in space, he said, because information gained by electronic sensors "can always be telemetered down to the ground" for correlation and analysis.

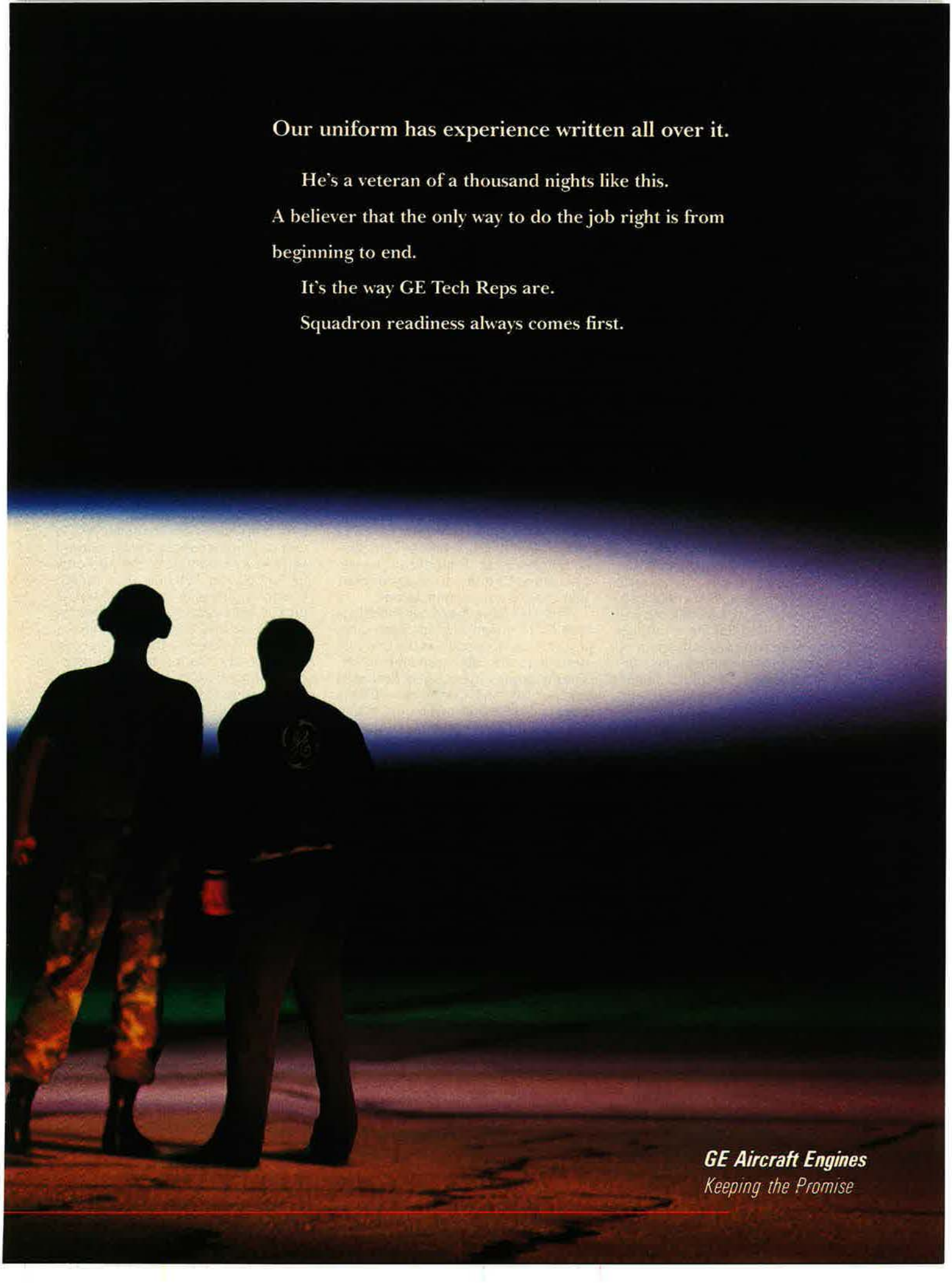
He continued, "So the question is, how often do we need a brain in orbit? What's the first thing an astronaut does in the shuttle when he has a problem? He says, 'Hello, Houston, I have a problem,' and 400 brains down on the ground help him solve it."

It is possible, General Kutyna continued, that brainpower and another distinctively human attribute, manual dexterity, will be required, or desirable, "for building things and for maintenance" in space. But he added that, in most such endeavors, robots can probably carry out the requisite "repetitive processes" better than humans. He said that construction and maintenance of the proposed space station may need the human touch, but expressed doubt that military satellites will ever need it, or even be amenable to it.

"We have roughly 150 satellites on orbit, and only about a dozen are at altitudes that man can get to," General Kutyna said. He noted that a great many satellites are 22,300 miles distant, in geosynchronous orbits, and declared that it would cost far more to build the orbital transfer vehicles needed to "take Mr. Goodwrench out to those orbits" than it would to "build reliability into the vehicles [satellites] in the beginning.

"Every study we have ever done tells us to put the reliability into the vehicles, because we probably wouldn't be able to fix them once we got out there anyway."

He concluded, "The way we should start thinking about military man in space is to look at his unique capabilities and derive the missions from them, not from, 'Gee, I'd sure like to fly on the shuttle,' or, 'Isn't it pretty from up here.' " ■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Capitol Hill

By Brian Green, Congressional Editor

Aspin's Stunner on Personnel

Impact on the Air Force would include frozen promotions, a shutdown of recruiting and reenlistment, and a further manpower drop of 43,000.

Rep. Les Aspin (D-Wis.), Chairman of the House Armed Services Committee (HASC), stunned the services and the Pentagon by announcing that he did not intend to consider the Pentagon's request to reprogram already approved funding in order to protect personnel from budget reductions imposed by the part-year sequester *[see "Capitol Hill," January 1990].*

The action, if it holds up, could reduce Air Force active force end strength this year by 43,600 in addition to the planned Fiscal Year 1990 reduction of 26,000. Reductions would be achieved by denying all reenlistments for first- and second-term airmen, denying reenlistment for most career airmen, and shutting down virtually all officer and enlisted accessions. To achieve the required savings, the Air Force would also have to freeze promotions for all officers and most enlisted ranks. Total DoD personnel reductions could be as high as 184,000.

Aspin justified his decision on the basis of President Bush's stand last August that personnel would not be exempted from mandatory budget cuts imposed by the Gramm-Rudman-Hollings balanced budget law (GRH). Subsequent negotiations led to a budget compromise that imposed the part-year sequester. The FY 1990 Defense Authorization Bill orders the Secretary of Defense "to minimize the negative effects" on military personnel and indicated that reprogramming requests to augment personnel funds were expected.

Chairman Aspin's action is opposed by Rep. Beverly Byron (D-Md.), who chairs the HASC Military Personnel and Compensation Subcommittee, but is strongly supported by Speaker of the House Tom Foley (D-Wash.). According to Representative Aspin, the move is motivated by political considerations. "If we don't stand firm now, this Administration will have us 'playing chicken' with the budget every year, distorting the deficit reduction process, and relying on [Congress] to save it from its more irresponsible excesses," he said.

Base Closures DOA

Secretary of Defense Dick Cheney's list of proposed base closures, which includes four Air Force bases, is "dead on arrival," according to many on Capitol Hill. HASC Chairman Aspin accused the Pentagon of putting "a political gun to the head" of members of Congress with a base in their districts and argued that four times as many "Democratic" bases were slated for closure as "Republican" bases. Secretary Cheney strongly denied that the list was a political one.

Representative Aspin called for legislation to create another base closure commission, such as the one that developed the 1988 base closure list. The Pentagon did not select the bases on that list, and Congress's options were limited to approving or rejecting the whole list. This time, Congress will get a separate shot at each of the base closures proposed by Secretary Cheney.

Budget Hearings

Prospects are virtually nil that the Pentagon's request for $306.9 billion in defense budget authority (which includes some DoE and other funding) for 1991 will survive. The chairmen of the House and Senate Budget Committees—Rep. Leon Panetta (D-Calif.) and Sen. James Sasser (D-Tenn.)—both indicated their intent to cut defense in order to meet deficit targets imposed by GRH.

The deficit target for FY 1991 is $64 billion (in outlays, not budget authority), $36 billion less than the FY 1990 target of $100 billion. The Executive Branch's Office of Management and Budget (OMB) projects a baseline deficit (FY 1990 spending adjusted for inflation, in excess of expected revenues) of about $84 billion and plans budget cuts to meet the FY 1991 target. The Congressional Budget Office projects the "baseline" deficit at $138 billion, but the OMB projection is the one that must be used, according to law.

Hearings and other congressional statements indicate that from $10 billion to $15 billion in outlays could be chopped from the defense outlay request of $303.3 billion. In budget authority, that could amount to a reduction of $20 billion to $30 billion and a fall of seven to ten percent compared to last year.

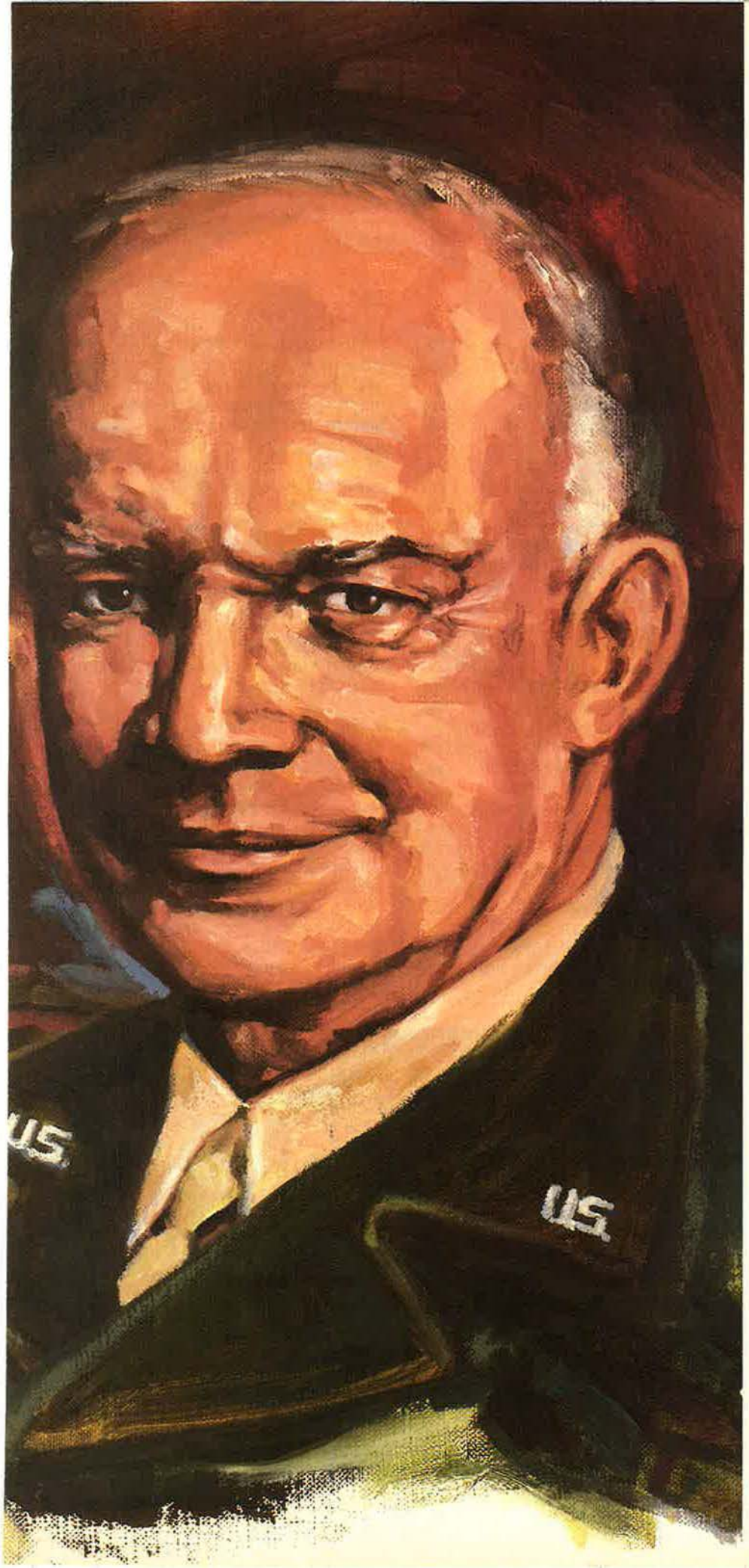
Retirement System to Change?

President Bush proposed a plan to modify the military retirement system that, if approved by Congress, would reduce lifetime retired pay for current active-duty members of the Air Force by $33,000 to $69,000. The recent budget submission would eliminate the FY 1991 cost-of-living allowance (COLA) for civil service and military retirees. The President also proposed permanently altering the method of calculating COLAs for military retirees, starting in FY 1992. The COLA is now based on increases in the consumer price index (CPI), but in the future it would reflect the CPI minus one percent. This change would apply to all military retirees.

Reps. Mary Rose Oakar (D-Ohio) and Michael Bilirakis (R-Fla.) and Sen. Paul Sarbanes (D-Md.) have all introduced legislation to restore full COLAs to military retirees.

More B-2 Woes

Frank Conahan, the Director of Defense Studies of the General Accounting Office (GAO, the investigative agency of Congress), testified that he favors a "pause" in the B-2 Stealth bomber program of from one to three years, because of the early stage of testing, uncertainty about the bomber's ultimate performance and cost, and changing world conditions. He conceded that such a delay would raise B-2 costs (though how much is unknown without further study) and noted that program cost was a key congressional consideration. Several B-2 supporters in Congress attacked the GAO report as biased and political. ■



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Dwight D. Eisenhower
American General &
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Aerospace World

By Jeffrey P. Rhodes, Aeronautics Editor

★ The first step in the Air Force's plan to return to dual-track training, or Specialized Undergraduate Pilot Training (SUPT), was taken on February 21, as Air Force Systems Command's Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio, selected the team of McDonnell Douglas, Beech Aircraft, and Quintron as the winner of the Tanker/Transport Training System (TTTS) competition.

Under the SUPT concept, pilot candidates who have completed basic flight training in the Cessna T-37 will then be identified for one of two tracks. Future bomber and fighter pilots will get their advanced training in the Northrop T-38 (as all pilot candidates do now), while those selected to fly the larger tanker and transport aircraft will move to the TTTS track. Currently, about fifty-four percent of those making it to advanced training are slotted for tanker or transport aircraft. The addition of the new track will help extend the life of the T-38 fleet to 2006, when the supersonic trainers are scheduled to be replaced.

The TTTS program will very likely be the largest buy of business jets in history—211 aircraft. A virtually off-the-shelf business jet offered the Air Force the least expensive option of starting SUPT and beginning dual-track training in the shortest amount of time.

TTTS is not just an aircraft buy. The contractor team also has to provide an aircrew training system with simulators, part-task trainers, courseware, and a contractor-run logistics system. This is the first time the Air Force has procured an entire training system.

As team leader, McDonnell Douglas will coordinate the training system and its syllabus and integrate the system. Quintron will provide simulators (a total of eleven if all options are exercised), while Beech will provide the aircraft, a modified version of the commercial Beechjet 400A, called the 400T. Under the military designation system adopted in 1962 and according to ASD officials, the aircraft will be designated T-1A. The initial $8,893,171 contract covers one year and calls for the production of the first aircraft. Total value of the TTTS contract is approximately $1.5 billion.

As configured for the Air Force, the Beechjet will have a jumpseat fitted between the two cockpit seats. In normal training, one student will sit in the left seat, the instructor will sit in the copilot's seat on the right, and a second student will ride in the jumpseat. The 400T will also differ from its civilian cousin in that it will have a beefed-up structure to handle an increased number of landings, a birdstrike-resistant windshield, additional fuel tankage to meet the Air Force's 250-nm divert requirement, single-point refueling, and fewer cabin windows. The aircraft will also feature a Collins five-tube electronic flight instrumentation system, a turbulence detection radar system, a digital autopilot, and a central diagnostic system.

The first aircraft is scheduled for delivery in October 1991. If all options are exercised, twenty-eight aircraft will be delivered in 1992, thirty-six in 1993, forty-eight in 1994, thirty-nine in 1995, forty-three in 1996, and the final sixteen aircraft in 1997. Beech Aerospace Services, Inc., will provide logistic support for the aircraft when they enter service.

Simulators and other training devices must be in place at Reese AFB, Tex., the first of five Air Training Command student pilot training bases, by March 1992. Instructor pilot transition training will begin at Randolph AFB, Tex., the following June. Student instruction will start in September 1992. Williams AFB, Ariz., Laughlin AFB, Tex., Vance AFB, Okla., and Columbus AFB, Miss., will be the other bases to conduct tanker/transport training.

Other TTTS contenders included the team of General Dynamics, Cessna, and CAE-Link and the team of FlightSafety International, Learjet, and Allied Signal.

★ Secretary of Defense Richard Cheney announced on January 29 that DoD is considering closing thirty-five domestic military bases and realigning or reducing forces at more than twenty other installations beyond those recommended by the 1988 Commission on Base Realignment and Closure *[see "Aerospace World," March 1989]*. The proposed closings would take place during FY 1991 through FY 1994.

Unlike in the last round of cuts, the Navy would bear the brunt of the rec-

The team of McDonnell Douglas, Beech Aircraft, and Quintron was selected as the winner of the Air Force's Tanker/Transport Training System competition. This is how the Beechjet 400T (to be designated T-1A) will look in its Air Force livery.

ommended closings, as fourteen facilities would be closed. Thirteen Army facilities and four Defense Logistics Agency sites would be closed under the new plan. Air Force installations targeted for closure include Bergstrom AFB, Tex., Eaker AFB, Ark., Los Angeles AFB, Calif., and Myrtle Beach AFB, S. C. Fifteen other Air Force bases and two other operational sites were listed as candidates for force realignment or reduction.

Under current law, domestic military installations cannot be closed unless Congress is notified and, depending on environmental impact, other studies are prepared. This does not apply to foreign installations, and Secretary Cheney also announced that the US would end operations at nine overseas installations, that three facilities would revert to collocated operating base status, and that forces would be drawn down or realigned at two other overseas sites.

The overseas sites where the US military will end operations are RAF Fairford, RAF Wethersfield, and RAF Greenham Common, UK; Comiso AB, Italy; Zweibrücken AB, West Germany; Nea Makri Naval Communications Station and Hellenikon AB, Greece; and Erhac AB and the Eskisehir Munitions Storage Site, Turkey. Kwangju, Suwon, and Taegu ABs, Korea, will revert to collocated operating base status. Navy forces would be drawn down at NAS Bermuda and realigned at the San Miguel Naval Communications Station in the Philippines.

—Staff photo by Guy Aceto

On March 6, Lt. Col. Ed Yeilding (pilot) and Lt. Col. J. T. Vida (RSO) set four speed records, including a transcontinental mark of 2,112.52 mph (1:08.17 elapsed time) over the 2,404.05 statute mile course, on the last flight of SR-71 64-17972. The aircraft was then turned over to the National Air and Space Museum. Above, the crew accepts congratulations from Senator John Warner (R-Va.) upon their arrival.

★ The era of the Lockheed SR-71 "Blackbird" high-altitude, high-speed reconnaissance aircraft officially ended on January 25, as Strategic Air Command and company officials held a retirement ceremony for the plane at Beale AFB, Calif., the 9th Strategic Reconnaissance Wing's home base.

In his speech before a crowd of nearly 1,000 people, Lockheed Executive Vice President Ben Rich, the current head of the company's Advanced Development Projects section (the "Skunk Works") and one of the SR-71's designers, enumerated SR-71 facts and some of the plane's notable accomplishments in the twenty-five years since the Blackbird first flew on December 22, 1964. Here are some of the highlights:

The first operational SR-71 was delivered on January 7, 1966, by Col. Doug Nelson and Col. Ray Haupt. The Blackbird is the only combat airplane in the history of the Air Force to retire without the loss of a single crew member and one of the few that was never shot down. SR-71 crews have flown almost 65,000,000 miles, half of those miles at speeds greater than Mach 3. One flight from San Diego, Calif., to Savannah, Ga., was made in fifty-nine minutes.

The SR-71 has a radar cross section equal to that of the B-1B bomber now in use. The SR-71 was the first to have a composite structure capable of withstanding temperatures in excess of 800 degrees Fahrenheit; the average surface temperature of the Blackbird in flight is 550 degrees Fahrenheit. The SR-71 is the only airplane more than twenty years old that has never had wing cracks or needed its wings replaced. When the Air Force used it to simulate high-speed Soviet fighters such as the MiG-23 for supersonic intercept maneuvers, the SR-71 crews had to slow down. Finally, the SR-71's Pratt & Whitney J58 engines have a thrust equivalent to that of the ocean liner *Queen Mary.*

Gen. John T. Chain, Commander in Chief at SAC, added that the first operational sortie was flown on March 21, 1968, and that SR-71 crews flew 3,551 operational sorties. A total of 385 people have flown in the airplane at speeds higher than Mach 3.

Nine SR-71s were donated to museums. Aircraft were flown to Robins AFB, Ga., Castle and March AFBs, Calif., Lackland AFB, Tex., Offutt AFB, Neb., the Air Force Museum at Wright-Patterson AFB, Ohio, and Dulles International Airport, Va. The aircraft flown to Dulles will be installed in the National Air and Space Museum extension there *[see "News Notes," below].* Aircraft to be displayed at Beale and Edwards AFBs, Calif., were already at those locations. Three other SR-71s will be loaned to NASA and will continue to fly as high-speed research airplanes.

★ "We have technology that is important for defense," said new Northrop President and CEO Kent Kresa at a recent meeting with Washington reporters. "Despite the fact [that] defense is getting smaller, technology is the keynote of the country's strategy. And the biggest and most important technology to this company is the B-2. The program is going well."

Mr. Kresa noted that under current plans (based on the FY 1990 budget), the company is gearing up to produce two aircraft a month starting in late FY 1993 or early FY 1994. He said that all of the facilities are in place to ramp up to twenty-four aircraft a year and that the process of gearing up would start in FY 1991. "The plane is purchased in lots as a function of the budget, though, so the real issue is to get to a rate so that we can efficiently produce it," noted Mr. Kresa. The original plan was to ramp up to thirty-six aircraft a year, a rate the company is capable of reaching.

The Northrop president also talked about the common, single, integrated computer database used in the B-2 program. He noted that all of the elements are in one location so that a part is able to go from design to tooling to production by a single comput-

Aerospace World

er network. The network is tied in to the major B-2 subcontractors and to the company's facility at Air Force Plant 42 in Palmdale, Calif., where the B-2s are built.

All of the design information put into the database is sent to a separate location from the Pico Rivera, Calif., design facility every four hours. The off-site location is in a different geological area of California, so all of the records are retained. Two years ago, the epicenter of a relatively minor earthquake was only eleven miles from Pico Rivera, and the system was knocked out. Because of the off-site location, only the last four hours of work were lost. Mr. Kresa noted that multiple encryption and physical security measures are in effect at both plants.

★ **APPOINTED**—Implementing the defense procurement reorganization reforms directed under the Defense Management Report *[see "Washington Watch," March 1990 issue]*, the Air Force has named the **five officers who will serve as Program Executive Officers** (PEOs). Maj. Gen. Edward P. Barry (tactical airlift programs), Maj. Gen. Eric B. Nelson (C^3 programs), Brig. Gen. (Maj. Gen. selectee) Stephen M. McElroy (tactical strike programs), Brig. Gen. Garry A. Schnelzer (space programs), and Brig. Gen. Joseph K. Glenn (strategic programs) will serve as the PEOs. They will report directly to the service's senior acquisition executive, the Assistant Secretary of the Air Force for Acquisition, John J. Welch, Jr.

★ **HONORS**—Former Air Force Academy defensive tackle **Chad Hennings,** the Outland Trophy winner and a consensus All-America pick in 1987, **has been named Western Athletic Conference Defensive Player of the Decade** for the 1980s in a recent vote of conference school sports information directors and media members who regularly cover the WAC. 2d Lieutenant Hennings recently completed A-10 transition training and will be assigned to the 81st Tactical Fighter Wing at RAF Bentwaters, England.

Capt. Diane Rauschenbach, a flight nurse with the 435th Tactical Airlift Wing's 2d Aeromedical Airlift Squadron at Rhein-Main AB, West Germany, recently received the **Dolly Vinsant Award,** given annually to the top Air Force evacuation nurse. The award, presented by the Confederate Air Force, is named in honor of Wilma "Dolly" Vinsant, a World War II flight nurse killed in the line of duty.

★ **PURCHASES—McDonnell Douglas** was awarded a $99.7 million contract modification on January 31 **for FY 1990 long-lead procurement of C-17 airlifter parts.** The contract is for the purchase of items for six C-17s. McDonnell Douglas **awarded subcontractor contracts totaling $21.6 million for C-17 wing components** on February 9. Under the contracts issued for Lot III production, Beechcraft ($2.03 million) will make the airlifter's winglets, Reynolds Metals ($1.5 million) will make wing skins, California Contour Industries ($5.1 million) will make spar caps and stringers, and Kaman ($12.9 million) will make bulkheads and ribs. All of the subcontractors except Kaman were previously subcontractors to Lockheed, which was dropped from the program for what Douglas Aircraft Co. officials said were "reasons of cost and schedule." The first C-17 is expected to be completed late this year.

Raytheon received a $105 million ASD contract on January 31 for development of the **ground-launched version of the Tacit Rainbow** loitering antiradiation missile (designated BGM-136A) for the Army. The company also received a $5.05 million contract to qualify as a second-source contractor for the air-launched version of Tacit Rainbow (AGM-136A). Raytheon is teamed with McDonnell Douglas and E-Systems for both efforts. Northrop is the prime contractor for the AGM-136A.

Flight Refuelling received a £40 million ($68 million) British Aerospace contract to **design and install air-to-air refueling gear and other equipment necessary to convert thirteen Royal Air Force VC10 transports to tankers.** Five Super VC10s will be brought out of storage. British Aerospace will do the conversion work, while eight VC10s now serving as RAF transports will be converted by Flight Refuelling's sister company, FR Aviation, at its facility at Bournemouth International Airport. Delivery of the tankers will start in 1992, and the VC10s will replace fourteen Victor K. Mk 2s.

The University of Southern California has been selected to receive a Defense Advanced Research Projects Agency contract worth approximately $12.5 million **to establish an advanced optoelectronics materials center.** USC was selected over Cornell and the University of New Mexico. Optoelectronics technology has important military considerations in such areas as signal processing for

radars, high-performance communications networks, and supercomputers for use in antisubmarine warfare and intelligence data analysis. MIT, UCLA, Kent State, and Columbia will serve as subcontractors on the program.

In a milestone purchase, **Hughes** won the contract **to build the last production lot of AIM-54C Phoenix** long-range air-to-air missiles for the Navy. The winner-take-all competition between Hughes and Raytheon was only the second competitive buy of the thirteen-foot-long, 985-pound, Mach 5 missiles. The $201.6 million contract calls for 420 missiles, which are to be delivered by 1992. Phoenix, which has a range in excess of 110 miles, will be replaced in the mid-1990s by the Advanced Air-to-Air Missile now in development.

★ **DELIVERIES**—The **Wright Research and Development Center,** an agency of ASD at Wright-Patterson AFB, Ohio, **along with the Air Force Electronic Combat Office** at the base, **dedicated the new Electronic Combat Simulation Research Laboratory** (ECSRL) in ceremonies on January 12. ECSRL's mission is to develop simulation technology and conduct analyses in support of the Center's exploratory and advanced development program in electronic combat. The facility also supports development of digital simulation models for the Air Force electronic combat test process. ECSRL is the only facility of its kind in the Air Force.

★ **MILESTONES**—After several delays, **the first test flight of the Army's High Endoatmospheric Defense Interceptor** (HEDI) on January 26 **was nearly a complete success.** Launched at the White Sands Missile Range in New Mexico, the HEDI test vehicle, with its kinetic kill vehicle integrated technology experiment (KITE) warhead, achieved nine of its ten test objectives before it self-destructed 8.5 seconds into its planned 14.9 second flight. The premature detonation is under investigation. The test vehicle, a modified Sprint rocket booster, left its launch rail at a speed of 300 feet per second. At second-stage burnout at the five-second mark, the vehicle was traveling almost 8,000 feet per second. Shroud separation and seeker cooling were normal. The detonation came at an altitude of approximately 30,000 feet, instead of the planned 50,000 feet. The second test, scheduled for next summer, will be a test of the KITE's infrared seeker. The third and final KITE test, now scheduled for late 1992, will involve an attack against a simulated target. McDonnell Douglas, Hughes, and Aerojet are the HEDI contractors.

Coronet Cove, the Air National Guard's commitment to defend the Panama Canal, **ended on January 31 after more than eleven years.** Since December 1978, Guard A-7 units deployed to Howard AFB on a rotational basis as part of the US defense of the Canal. More than 13,000 sorties totaling 16,959 flying hours had been flown since Coronet Cove began. The end of the deployment came about as a result of the general drawdown of US forces in Panama. Future defense of the Canal will be handled by deploying active-duty and Guard units to Panama as needed. The 114th Tac-

tical Fighter Group from Sioux Falls, S. D., made the last Coronet Cove deployment.

Air Force Maj. Eileen Collins, a student at the Air Force Test Pilot School at Edwards AFB, Calif., **is the first woman to be selected as a pilot candidate for the space shuttle.** Major Collins is one of twenty-three people (seven pilots and sixteen mission specialists) chosen by NASA on January 17 for its 1990 astronaut class. Other Air Force officers selected to become astronauts include Maj. James Halsell, Maj. Charles Precourt, and Capt. William Gregory as pilot candidates and Capt. Susan Helms, Capt. Richard Searfoss, and Capt. Carl Walz as mission specialist candidates. The astronauts-to-be will undergo a one-year training period at NASA's Johnson Space Center in Houston, Tex., before being certified as shuttle crew members.

The **first Boeing VC-25A made its first flight** from the company's facility in Wichita, Kan., on January 26. The aircraft, a modified 747-200B that will be used for Presidential transport, was piloted by company test pilot Paul Bennett and Air Force Maj. Ray Johns. The aircraft will now undergo a two-stage test program before it is delivered to the 89th Military Airlift Wing at Andrews AFB, Md., on September 30. In Phase I, the aircraft will be equipped with instrumentation to measure performance during flight. The instrumentation will be removed for Phase II, which will involve aerial refueling tests. Testing is being carried out by a combined Air Force-Federal Aviation Administration team. Shortly before delivery, the aircraft will be painted at Boeing's Renton, Wash., facility in the distinctive scheme designed by Raymond Loewy. The second VC-25, now being modified, is to be delivered in 1991.

The **Navy launched two Lockheed UGM-133A Trident II, or D5, sea-launched ballistic missiles in succession for the first time** on February 12. The missiles were launched from the USS *Tennessee* (SSBN-734) while submerged off the coast near Cape Canaveral AFS, Fla. The first shot marked the end of the nine-launch test program. The second missile, launched immediately after the first, was counted as the first test in the Trident II Demonstration and Shakedown program. The UGM-133A is forty-four feet tall.

The **General Dynamics FB-111, modified with a digital flight-control system, successfully completed the first phase of its test program** at Edwards AFB, Calif., in late January. The aircraft was flown fifty-nine times for 135 hours in the two-phase test program. Maneuvers including accelerations, decelerations, wingsweep changes, wind-up turns, rolls, and landings were demonstrated during the flights. Simulated air-to-ground weapon deliveries, aerial refuelings, and flights at speeds greater than Mach 2 were also performed. The aircraft is now being fitted with short wingtips in order to simulate the F-111. Lear Astronics developed the aircraft's flight-control computer, while GD developed the computer software. The digital flight-control system is scheduled to be fitted to the entire F/FB/EF-111 fleet by 1994.

The **Rockwell AGM-130A rocket-powered glide bomb completed its operational flight test program** with two successful shots in late January. *[See "Comeback of the AGM-130," p. 50.]* In both tests, which were conducted at the Naval Weapons Center Test Range at China Lake, Calif., an F-111F was used as the carrier aircraft. In the January 25 test, the missile was released from an altitude of 20,800 feet. It descended to a 1,000-foot preselected cruise altitude, then flew over mountainous terrain to score a direct hit on a simulated warehouse 21.6 miles away. In the January 27 test, the AGM-130 was released at an altitude of 420 feet. It climbed to 2,000 feet and traveled 13.8 miles before hitting its target, a radar van. A second F-111F crew controlled the weapon during flight. This was the first test where the target's altitude was higher than the launch altitude of the missile. The AGM-130 recorded eight successes in nine operational test launches.

The **Air Force's fleet of Lockheed C-5A/B Galaxy transports recently passed the 1,000,000-flight-hour plateau.** A company field service report noted that, as of January 17, the 127-aircraft fleet had logged 1,001,384.7 hours. The fifty C-5Bs now in service are proving quite reliable. The maintenance man-hour per flight hour (MMH/FH) is approximately 30.40, almost ten hours less than the 40.0 MMH/FH figure called for in the original contract. The C-5A first flew in 1968 and entered Air Force service in June 1970.

★ **NEWS NOTES**—The **37th Tactical Fighter Wing,** the unit that flies the Lockheed F-117A Stealth fighter, **will be moving to Holloman AFB, N. M.,** in FY 1992. The 37th TFW is moving from the Tonopah Test Range Airfield in Nevada to Holloman because of high operations and support costs associated with the planes at the remote site. A major cost is the practice of flying personnel the 150 miles from Nellis AFB, Nev., to Tonopah. This was done initially to preserve secrecy about the planes and the base. Full-time manpower authorizations at Tonopah will be reduced by 1,958, but the base will be used as a satellite location to Nellis in support of Red Flag operations. To free ramp space at Holloman for the 37th TFW, 111 T-38A and AT-38B aircraft will be transferred to other units starting in early 1991.

The first Boeing VC-25A to be used for Presidential transport lifts off for the first time on January 26 from the runway shared by Boeing and McConnell AFB near Wichita, Kan. The aircraft is scheduled to be delivered on September 30.

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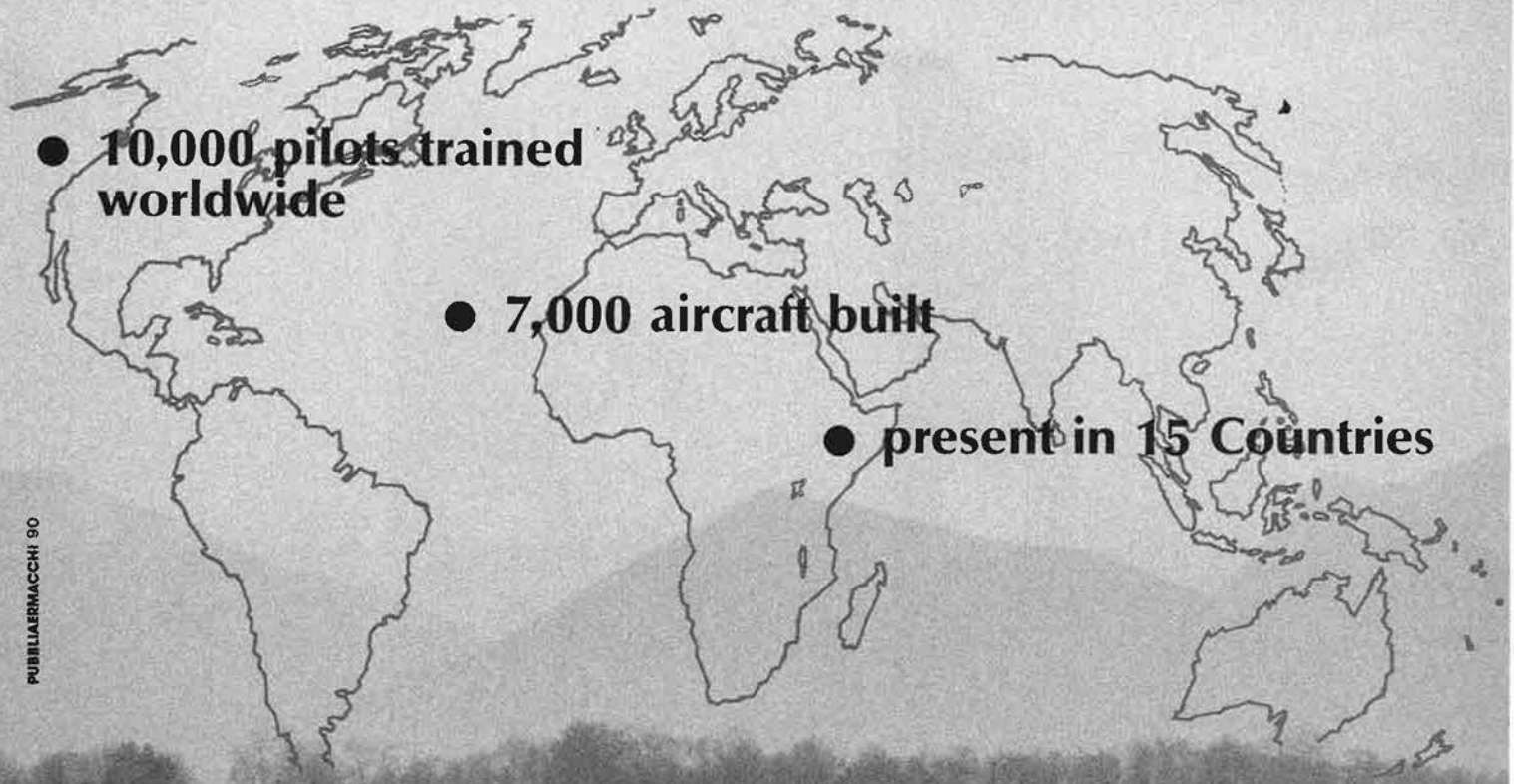

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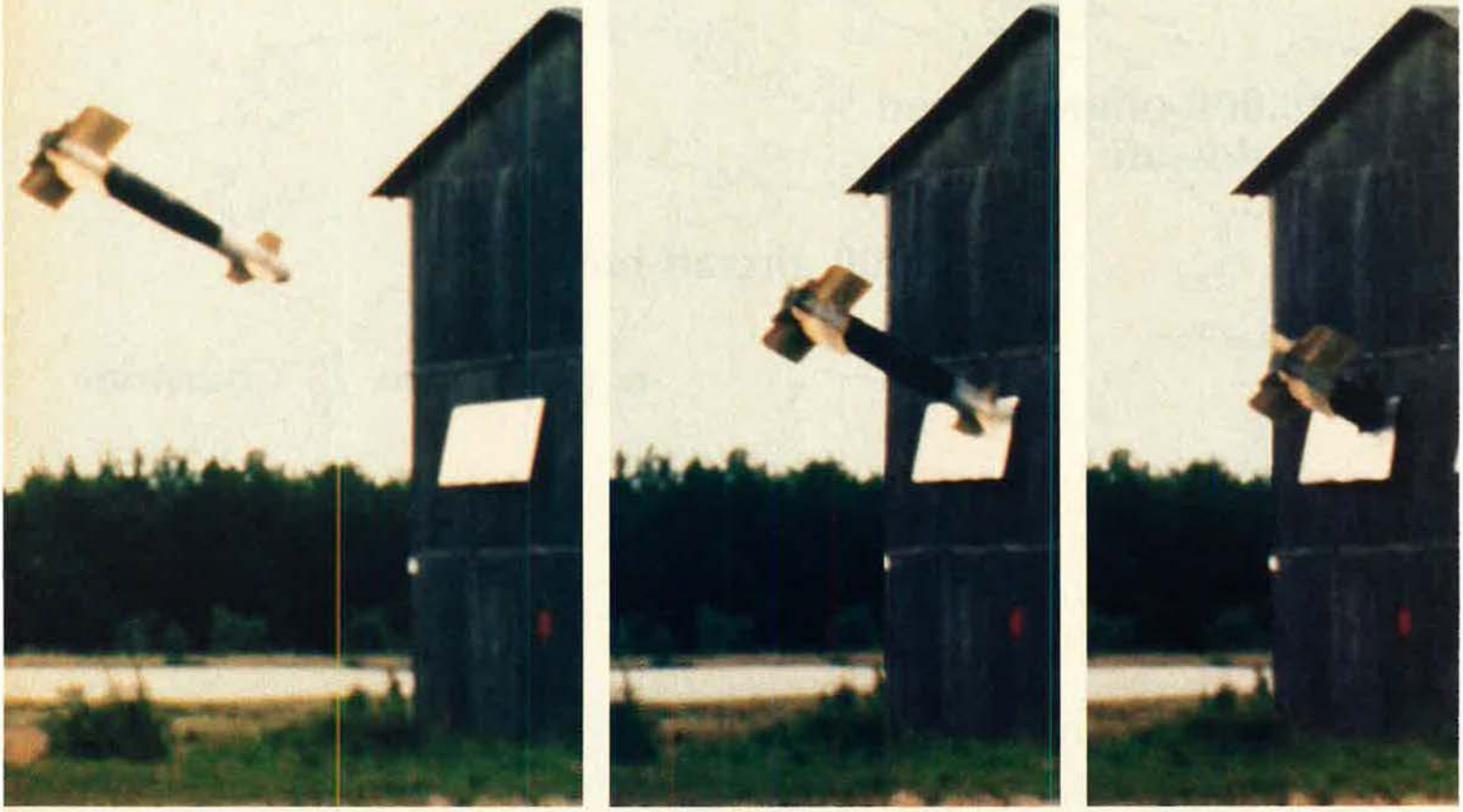
Actual flight test photo AGM-130, Eglin AFB, Fla.



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Military construction projects totaling $100 million will be needed at Holloman for beddown of the F-117s, which were recently revealed to be powered by two General Electric F404-GE-F1D2 nonafterburning turbojet engines.

The **Air Force is planning to disband its Aggressor units** at Kadena AB, Japan, at RAF Alconbury, England, and at Nellis AFB, Nev. The fifty-one F-16s flown by the Aggressor units will be transferred to operational squadrons to save flying hours and reduce the number of new aircraft needed. A small cadre of adversary-tactics specialists equipped with six F-16s will now travel to Air Force bases for periodic combat training. This cadre, which will be based at Nellis, will be the core of a Red Force at Red Flag exercises. Because many units now fly the same aircraft as the Aggressors, the concept of dissimilar air combat training (a secondary reason the Aggressors were formed in 1974) has pretty much gone by the boards. A majority of units can now train with units near their homes that fly a different type of aircraft.

During its meeting on January 29, the **Smithsonian Institution's Board of Regents reaffirmed its preference for Dulles International Airport,** outside Washington, D. C., **as its choice for the site of the proposed extension of the National Air and Space Museum.** Baltimore-Washington International Airport was the other site considered. While both sites were acceptable, Dulles offered considerably more acreage on federally administered land. The expansion is being planned as a three-stage effort. Phase I, the most extensive, will include building exhibit space for the museum's larger airplanes, storage for the museum's study collections and archives, offices, a theater, and necessary building and visitor services. The museum's aircraft restoration section would move from the Paul Garber Facility in Suitland, Md., to a special climate-controlled hangar at Dulles. Phases II and III include additional hangars and three exhibition galleries. The museum hopes to open Phase I of the annex by 1995.

Approximately thirty Air Force helicopter pilots will soon get to fly with the Army. Selected lieutenants and junior captains will be loaned to Army UH-60 and UH-1 units in the continental US that have a night vision goggle mission. The tours will last from two to three years. Army units at Fort Campbell, Ky., Fort Bragg, N. C., Forts Ord and Irwin, Calif., Fort Polk, La., Fort Lewis, Wash., Forts Hood and Bliss, Tex., Fort Carson, Colo., Fort Stewart, Ga., and Fort Drum, N. Y., are participating in the program.

A Kansas Air National Guard pilot successfully landed his F-16A after colliding with the guy wires of a 450-foot-tall radio tower on January 23. The 184th Tactical Fighter Group pilot, whose name was not released, was returning from a training mission when he clipped two half-inch steel cables on KHUT-FM's radio tower near Hutchinson, Kan. He was able to regain control of the fighter and land at McConnell AFB. The F-16's left wing and tail were damaged, but the pilot was not injured. The pilot was reportedly too low (250 feet in a 500-foot-minimum area) and was distracted while changing radio frequencies when he hit the wires. The accident is under investigation.

Two important payloads were recently launched aboard McDonnell Douglas Delta II boosters. On January 24, the **sixth Rockwell Navstar Global Positioning Satellite** was successfully launched from Launch Complex 17A at Cape Canaveral AFS, Fla. The launch, delayed from January 11, marked the completion of one quarter of the GPS constellation. There will be twenty-one operational satellites and three on-orbit spares.

The second payload, launched on February 14, was the **Ball Corp.-built Relay Mirror Experiment** (RME). It was also launched from Launch Complex 17 at Cape Canaveral. Placed in a low-Earth orbit, RME's objective is to determine how accurately and with what stability a laser beam can be di-

April Anniversaries

- *April 1, 1915:* French Lt. Roland Garros shoots down a German Albatros two-seater with a Hotchkiss machine gun fixed on the nose of his Morane-Saulnier Type L monoplane. The airplane's propeller is fitted with wedge-shaped steel deflector plates that protect the blades from damage as the rounds pass through the propeller arc.
- *April 12, 1930:* Led by Capt. Hugh Elmendorf, nineteen pilots of the 95th Pursuit Squadron set an unofficial world record for altitude formation flying over Mather Field, Calif. The P-12 pilots reach 30,000 feet, shattering the old record of 17,000 feet.
- *April 10, 1945:* The last Luftwaffe wartime sortie over Britain is made by an Arado Ar-234B pilot on a reconnaissance mission out of Norway. The Ar-234 was one of just a handful of jets to see action in the war.
- *April 23, 1945:* Flying Consolidated PB4Y-2 Privateers, Navy crews from Patrol Bombing Squadron 109 launch two Bat missiles against Japanese ships in Balikpapan Harbor, Borneo. This is the first known combat use of automatic homing missiles during World War II.
- *April 18, 1950:* The Air Force announces it will buy 1,250 aircraft at an estimated cost of $1.2 billion from FY 1950 procurement funds. Of this total, $303.2 million will go to Boeing for eighty-two B-47B Stratojet bombers.
- *April 21, 1950:* Piloted by Lt. Cmdr. R. C. Starkey, a Lockheed P2V-3C Neptune weighing 74,668 pounds becomes the heaviest aircraft ever launched from an aircraft carrier. The Neptune was flown off the USS *Coral Sea* (CV-43).
- *April 7, 1955:* The first production Lockheed C-130A Hercules transport (serial number 53–3129) flies for the first time at the company's Marietta, Ga., facility.
- *April 1, 1960:* The RCA-built TIROS 1 (Television Infrared Observation Satellite), the world's first meteorological satellite, is successfully launched from Cape Canaveral AFS, Fla., atop a Thor launch vehicle.
- *April 4, 1960:* Project Ozma is initiated at the National Radio Astronomy Observatory at Green Bank, W. Va., to listen for possible signal patterns from outer space other than "natural" noise.
- *April 22, 1960:* A Federal Court of Appeals upholds a Federal Aviation Administration order that automatically grounds pilots over sixty years old.
- *April 11–17, 1970:* Thirteen proves to be an unlucky number for the Apollo program. First, astronaut Thomas Mattingly contracts German measles and is replaced by Jack Swigert two days before launch. During liftoff, one of the Saturn V's five first-stage engines shuts down prematurely. Finally, an explosion in the Service Module cripples the ship and forces the crew to use the Lunar Module as a lifeboat to get back to Earth. After a tense four days, the Apollo 13 crew, which also includes Navy Capt. Jim Lovell and Fred Haise, safely splashes down in the Pacific.
- *April 24, 1980:* Operation Evening Light, the attempt to rescue American citizens held hostage in Iran, is a dismal failure. At the start of the operation, mechanical difficulties force several Navy RH-53 helicopter crews to turn back or ditch. Later, one of the RH-53s collides with an Air Force HC-130 in a sandstorm at the Desert 1 refueling site. Eight US servicemen are killed in the accident.

rected and tracked using fast-steering mirror technology. Two separate ground stations are required for the Strategic Defense Initiative experiment. As the spacecraft passes over USAF's Maui Optical Station on Mount Haleakala, Hawaii, a low-power laser will be fired at the RME. A laser will also be fired from the scoring control site, also on Maui. The spacecraft-relay mirror will reflect one of the beams to Earth toward a target board located at the experiment scoring and control site. The RME uses twelve fast-steering mirrors.

The **third captive-carry flight of the Pegasus air-launched space booster** over the Pacific on January 30 **was a near-complete success.** Only minor anomalies were noted during the flight, but none was considered serious enough to have canceled a launch. The two-hour flight was made to test modifications to the booster's launch-support equipment that proved faulty on the second captive-carry flight. The test also validated range safety and tracking activities. The NB-52 crew simulated two launch cycles during the flight. The first live launch, expected in early spring, will boost a three-function DARPA payload called Pegsat into low-Earth orbit. Pegasus is a collaborative venture between Orbital Science Corp. and Hercules.

The **Anglo-American fund-raising campaign to build the American Air Museum in Britain recently initiated its efforts** to raise the total of $16 million needed for the project. The American Air Museum, to be built at Duxford, England, a World War II Eighth Air Force base that is now part of the Imperial War Museum, will house the IWM's collection of American aircraft and will serve as a tribute to thousands of Americans who served in England during World War II and as a symbol of US-British friendship. The building itself, a fingernail-shaped structure with a glass front and suspended walkways from which to view the aircraft from above, is built around a B-52D that was donated in 1983. Other display aircraft include a B-17, P-51, B-29, P-47, and C-47. The building will contain other exhibits and a theater. Organizers hope to have the money raised and construc-

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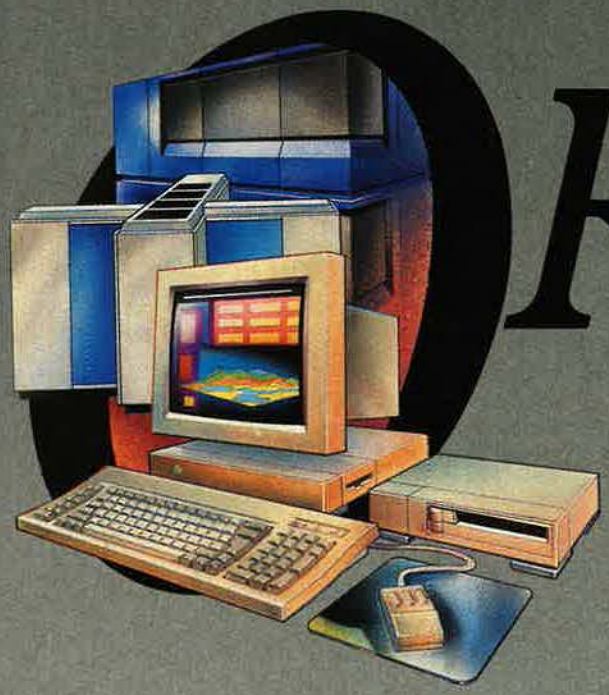

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Useful Information...from a World of Data

The Goal

A message handling system for military intelligence centers that provides enhanced performance at significantly reduced operations and maintenance costs.

The System

The DoDIIS Automated Message Handling System (AMHS) will serve as a streamlined analyst's tool, offering rapid incoming message dissemination, large database search and retrieval, and outgoing message generation, coordination and release.

The Team

TRW has assembled a seasoned team for its AMHS effort—Planning Research Corporation, Xerox, and Computer Systems Research—veterans of many years of message handling system design, development and integration. Our approach will meet intelligence community needs by providing a scalable, flexible system, configurable to fit diverse mission, site, and user-unique requirements.

Low Risk

The team's design for AMHS, under development for over two years, uses non-developmental hardware and software components, already field-proven at over 20 operational sites, for the lowest possible risk. Our seamless, easily adaptable user interface simplifies training and improves system functionality and analyst performance.

Low Cost

TRW's advanced technologies, combined with our team's extensive intelligence center integration experience, means less development time—and that means less cost.

Ready Now

In fact, TRW's design meets most of the proposed AMHS requirements now. Our knowledge of distributed systems and information security will result in an AMHS with the highest total system performance and user capability. Our design will easily evolve to meet AMHS' Compartmented Mode security operation with minimum program risk.

TRW and AMHS

For the first time, intelligence analysts will be able to work with text-message sources as useful information rather than as raw data.

And with TRW's AMHS design, they'll be able to do it more quickly, with less effort, and at a lower cost.

TRW

TRW Systems Integration Group

tion started in 1992, the fiftieth anniversary of Eighth Air Force's arrival in England. The US contribution to the project will be approximately $10 million.

A former instructor at the Air Force Academy has a starring role in the latest TV advertisement for Nike athletic shoes. The ad, which premiered during the National Basketball Association All-Star Game on February 11, features Lt. Col. Douglas Kirkpatrick, wearing civilian clothes, explaining how Chicago Bulls star Michael Jordan is able to "fly" on his way to the hoop during a game. Colonel Kirkpatrick, a member of the American Institute of Aeronautics and Astronautics, speaks the line, "Michael Jordan has overcome the acceleration of gravity by the application of his muscle power in the vertical plane, thus producing a low-altitude earth orbit" during the sixty-second ad. Colonel Kirkpatrick is now assigned to Peterson AFB, Colo.

★ **DIED**—Retired Air Force **Gen. Samuel C. Phillips,** who headed NASA's Apollo lunar landing program from 1964 to 1969, of cancer on January 31 at his home in Palos Verdes Estates, Calif. He was sixty-eight. General Phillips's work as manager of the Minuteman intercontinental ballistic missile program (1959–63) brought him to the attention of NASA. He was "loaned" to the space program and returned to the service after the first moon landing in 1969. A veteran of World War II, General Phillips later served as director of the National Security Agency and Air Force Systems Command. After retiring in 1975, he became a vice president of TRW.

Frank R. Collbohm, a founder, and later president, of the RAND Corp., of a stroke on February 12 at his home in Santa Monica, Calif. He was eighty-three. RAND (a term coined by Arthur Raymond from Research ANd Development) was begun at Douglas Aircraft in 1946 and was quickly spun off as a nonprofit think tank. It played a key role in the development of US ballistic missiles. Mr. Collbohm helped establish the organization and retired as its president in 1967. During his career, he helped design the DC-1, DC-2, and DC-3 aircraft for Douglas and flew them as a test pilot. He was a recipient of the Department of Defense's Distinguished Public Service Medal and the Air Force's Exceptional Service Award. Mr. Collbohm was one of ten Air Force space pioneers honored by the National Space Club in 1989. ■

Senior Staff Changes

RETIREMENTS: L/G Spence M. **Armstrong;** B/G Loring R. **Astorino;** L/G Edward J. **Heinz;** Gen. John L. **Piotrowski;** Gen. Bernard P. **Randolph.**

PROMOTIONS: To be **General:** Donald J. Kutyna.
To be **Lieutenant General:** Thomas S. **Moorman,** Jr.; C. Norman **Wood.**

CHANGES: M/G Edward P. Barry, Jr., from Vice Cmdr., ASD, AFSC, Wright-Patterson AFB, Ohio, to PEO, Tactical Airlift Prgms., Wright-Patterson AFB, Ohio . . . **B/G Frank Cardile,** from Dep. Cmdr. for Tac. Sys., ESD, AFSC, Hanscom AFB, Mass., to Vice Cmdr., ESD, AFSC, Hanscom AFB, Mass., replacing M/G Eric B. Nelson . . . **M/G James R. Clapper, Jr.,** from DCS/Intel., Hq. SAC, Offutt AFB, Neb., to ACS/Intel., Hq. USAF, Washington, D. C., replacing M/G (L/G selectee) C. Norman Wood . . . **Col. (B/G selectee) Sebastian F. Coglitore,** from Vice Dir., Plans, J-5, Hq. USSPACECOM, Peterson AFB, Colo., to Command Dir., NORAD, Peterson AFB, Colo. . . . **Col. (B/G selectee) Stewart E. Cranston,** from Dir., Spec. Prgms., Ass't Sec'y of the Air Force for Acq., OSAF, Washington, D. C., to Vice Cmdr., ASD, AFSC, Wright-Patterson AFB, Ohio, replacing M/G Edward P. Barry, Jr.

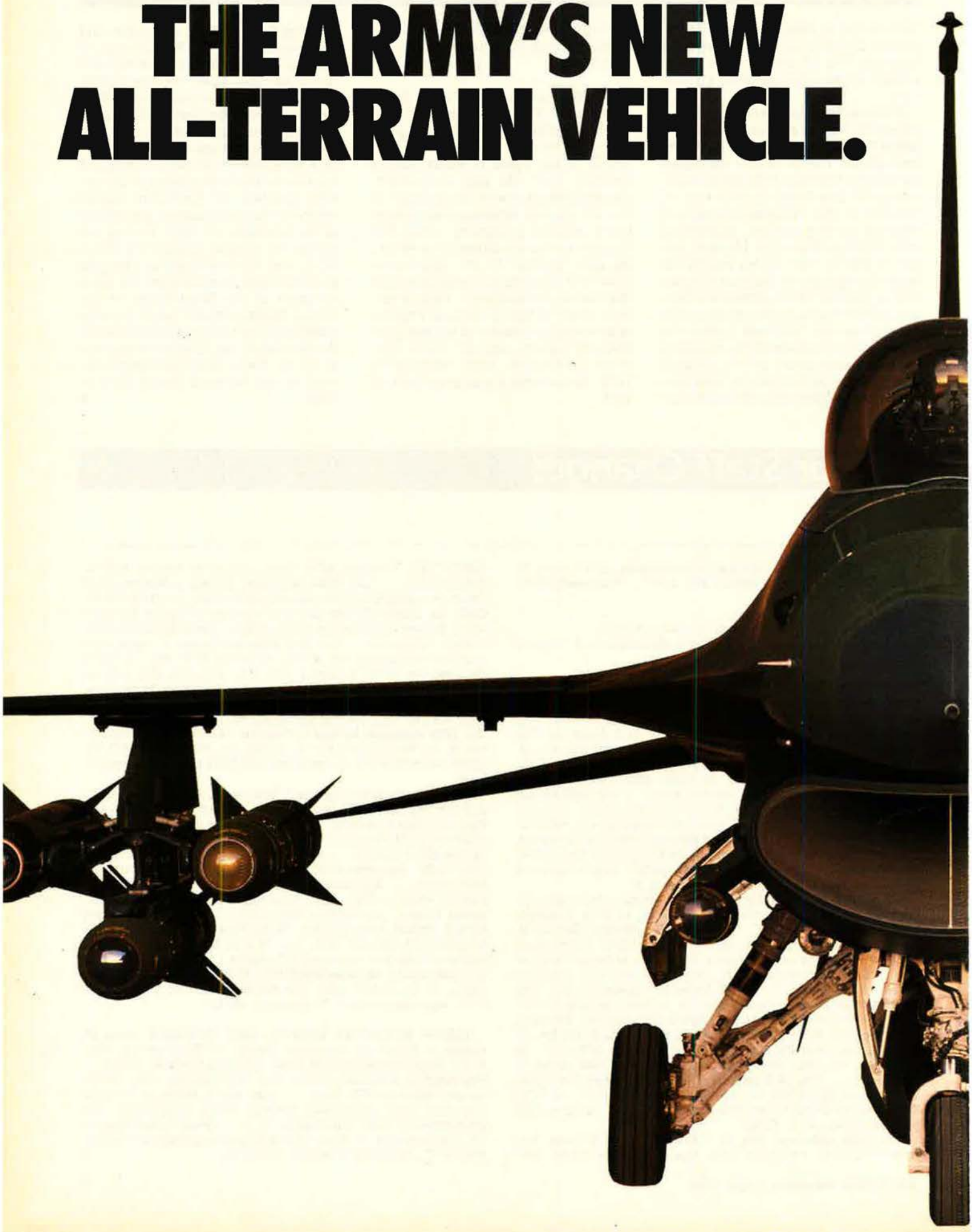
B/G Joseph K. Glenn, from Dir., Spec. Prgms., Under Sec'y of Defense for Acq., OSD, Washington, D. C., to PEO, Strategic Prgms., Washington, D. C. . . . **B/G (M/G selectee) Donald G. Hard,** from Dep. Dir., Plans, DCS/P&O, Hq. USAF, Washington, D. C., to Dir., Space and SDI Prgms., Ass't Sec'y of the Air Force for Acq., OSAF, Washington, D. C., replacing M/G (L/G selectee) Thomas S. Moorman, Jr. . . . **B/G James L. Hobson, Jr.,** from Vice Cmdr., 23d AF, MAC, Hurlburt Field, Fla., to Cmdr., 322d Airlift Div., MAC; and DCS/Airlift Forces, Hq. USAFE, Ramstein AB, Germany, replacing M/G William H. Sistrunk . . . **M/G Frank B. Horton III,** from Dep. Dir., Foreign Intel., DIAC, DIA, Bolling AFB, D. C., to DCS/Intel., Hq. SAC, Offutt AFB, Neb., replacing M/G James R. Clapper, Jr. . . . **Col. (B/G selectee) William E. Jones,** from Dep. Dir., Forces, DCS/P&O, Hq. USAF, Washington, D. C., to DCS/Plans, Hq. AFSPACECOM, Peterson AFB, Colo., replacing B/G (M/G selectee) Jay W. Kelley.

B/G (M/G selectee) Jay W. Kelley, from DCS/Plans, Hq. AFSPACECOM, Peterson AFB, Colo., to Vice Cmdr., AFSPACECOM, Peterson AFB, Colo., replacing retiring M/G G. Wesley Clark . . . **L/G (Gen. selectee) Donald J. Kutyna,** from Cmdr., Hq. AFSPACECOM, Peterson AFB, Colo., to CINCNORAD; CINC, Hq. USSPACECOM; and DoD Manager for Space Transportation System Contingency Support Ops., replacing retired Gen. John L. Piotrowski . . . **Col. (B/G selectee) Lester L. Lyles,** from Ass't DCS/Systems, Hq. AFSC, Andrews AFB, Md., to DCS/Systems, Hq. AFSC, Andrews AFB, Md., replacing M/G (L/G selectee) David J. Teal . . . **B/G (M/G selectee) Stephen M. McElroy,** from Vice Cmdr., ESD, and Dep. Cmdr., RD&A, MSD, AFSC, Eglin AFB, Fla., to PEO, Tactical Strike Prgms., Washington, D. C. . . . **Col. (B/G selectee) Bobbie L. Mitchell,** from Ass't DCS/Requirements, Hq. MAC, Scott AFB, Ill., to Dep. Dir., Plans, DCS/P&O, Hq. USAF, Washington, D. C., replacing B/G (M/G selectee) Donald G. Hard.

M/G (L/G selectee) Thomas S. Moorman, Jr., from Dir., Space and SDI Prgms., Ass't Sec'y of the Air Force for Acq., OSAF, and Ass't for SDI to Vice Cmdr., AFSC, Washington, D. C., to Cmdr., Hq. AFSPACECOM, Peterson AFB, Colo., replacing L/G (Gen. selectee) Donald J. Kutyna . . . **M/G Eric B. Nelson,** from Vice Cmdr., ESD, AFSC, Hanscom AFB, Mass., to PEO, C^3 Prgms., Hanscom AFB, Mass. . . . **B/G Garry A. Schnelzer,** from Spec. Ass't for Launch Matters, SSD, AFSC, Los Angeles AFB, Calif., to PEO, Space Prgms., Los Angeles AFB, Calif. . . . **Col. (B/G selectee) Dale E. Stovall,** from Dep. Dir., Plans, Policy, & Doctrine, J-5, Hq. USSOCCOM, MacDill AFB, Fla., to Vice Cmdr., 23d AF, MAC, Hurlburt Field, Fla., replacing B/G James L. Hobson, Jr. . . . **M/G (L/G selectee) C. Norman Wood,** from ACS/Intel., Hq. USAF, Washington, D. C., to Dir., Intel. Community Staff, CIA, Washington, D. C., replacing retired L/G Edward J. Heinz.

SENIOR EXECUTIVE SERVICE (SES) CHANGES: John M. Griffin, to Chief Sys. Engineer, Deputy for Engineering, ASD, AFSC, Wright-Patterson AFB, Ohio, replacing Frederick T. Rall . . . **Raymond L. Johnson,** to Dir., Sys. Engineering, ASD, AFSC, Wright-Patterson AFB, Ohio . . . **Judy Ann F. Miller,** to Principal Dep. Ass't Sec'y (Manpower, Reserve Affairs, Installations, and Environment), OSAF, Washington, D. C. . . . **Paul C. Rambaut,** to Dir., Life Sciences, Air Force Office of Scientific Research, Bolling AFB, D. C., replacing Robert K. Dismukes. ■

THE ARMY'S NEW ALL-TERRAIN VEHICLE.



When it comes to providing close air support for America's troops, nothing comes close to the F-16 attack fighter.

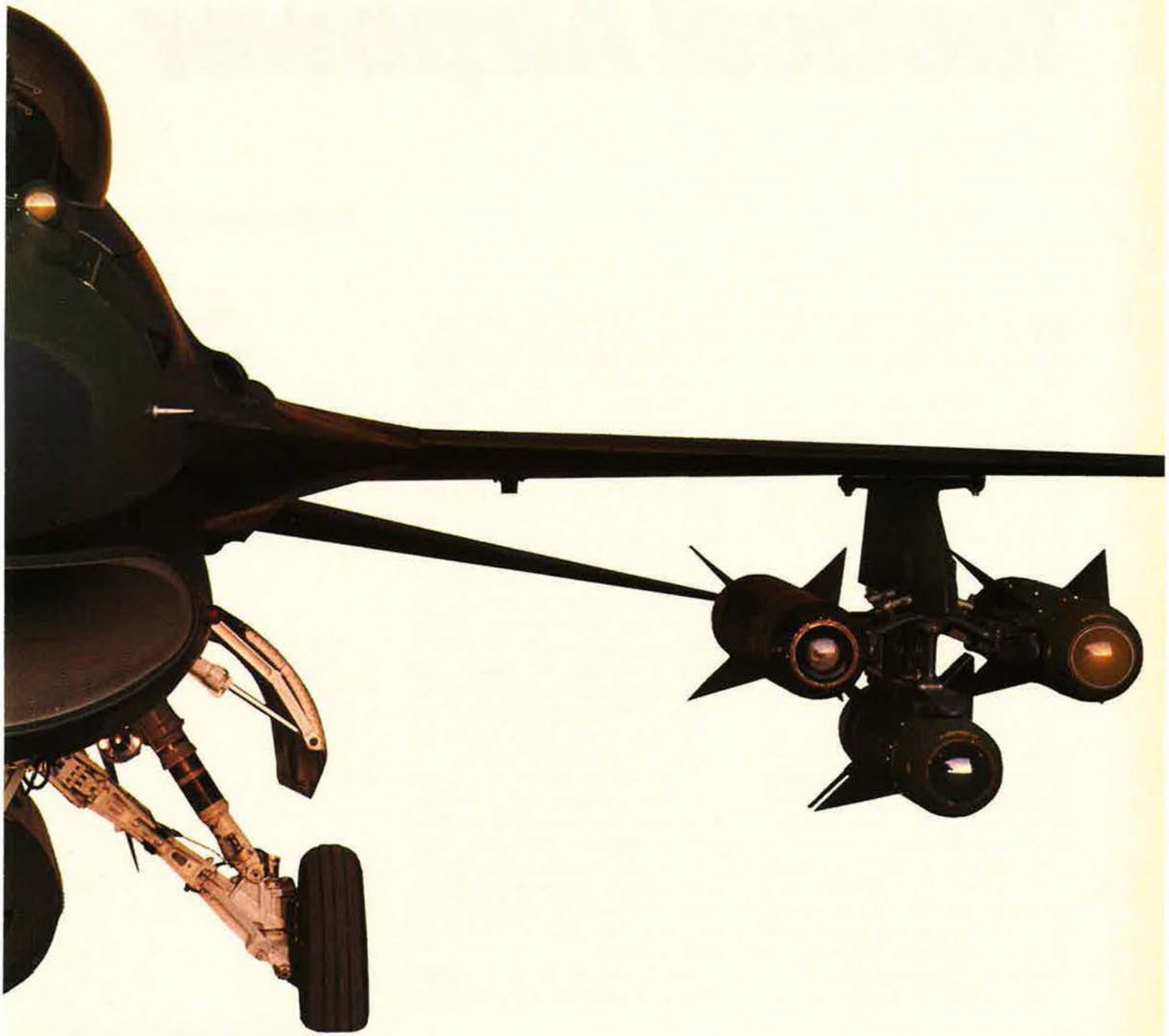
Small, agile and fast, the F-16 can be in and out of the battlefield before the enemy knows what hit him. And before he can hit back.

In its new close air support role, this multimission aircraft will be hardened and equipped with the latest technologies including an Automatic Target Handoff System, a Digital Terrain System, and a Navigation/Attack FLIR.

And the F-16's advanced weaponry and all-weather avionics can deliver a lethal mix of ordnance, day and night, with pinpoint, first-pass accuracy.

All of which makes the best fighter in the sky, the best fighter down in the dirt.

GENERAL DYNAMICS



The force is shrinking toward thirty-three fighter wings, with no certainty where the reductions might stop.

—Illustration by Dru Blair

Foggy Future for Tactical Airpower

By John T. Correll, Editor in Chief

Troop levels are going down. Military requirements cannot be predicted with certainty. There is still a need, however, for tactical forces that are prepared to do dangerous things in dangerous places.

WITH peace breaking out from the Atlantic to the Urals, what's the point in keeping up combat readiness?

"When the President says, 'Go to Panama in forty-eight hours,' readiness is very important," Gen. Michael J. Dugan, Commander in Chief of US Air Forces in Europe, replied at AFA's Tactical Warfare symposium in Orlando, Fla., February 1–2.

Whatever US armed forces are asked to do in the future, General Dugan said, "the taxpayers will want us to do it *now*," and there is not much sense "in having a military force that's good only for parades on the Fourth of July."

Besides, as General Dugan and others at the symposium said, although the immediate and obvious dangers in Europe have receded, the elements of a major military threat are still there.

Gen. Robert D. Russ, Commander of Tactical Air Command, said the threat has diminished enough for the US to make some reductions of its own, but urged that the nation "proceed very cautiously."

The leaders of the tactical air forces are no more certain than anyone else about what lies ahead. It's clear that the defense budget will be cut and that forces will be smaller. Beyond that, the outlook is too foggy to predict in any detail.

The tactical air forces reached a level of thirty-eight combat-coded fighter and attack wings in 1988. They stand today at thirty-six wings and, according to General Russ, are headed down to thirty-three. The present mix is twenty-four active-duty wings and twelve from the Air Guard and the Reserve. Seven wings are assigned to air superiority, six to close air support, and eight to interdiction (including battlefield interdiction). Fifteen are "multirole," with duties in both air superiority and ground attack.

"The tactical forces are in the best shape I've seen them," General Russ said. "We've about peaked out all the readiness indicators." The Fiscal Year 1991 defense budget request, sent to Congress in January, would continue the training tempo for tactical aircrews at 19.5 flying hours a month.

Reductions in the new budget have not satisfied the clamor to

bring troops home from Europe, demobilize more units, ease up on readiness, and cancel weapon systems.

What the Soviets Took Home

General Dugan, USAFE Commander in Chief since April 1989, has had a ringside seat at the Soviet drawdown in eastern Europe. Reductions are indeed taking place, he said, and the numerical dimension of the threat has lessened. As a result, NATO needs fewer weapons than it did before.

The Soviet Union and the Warsaw Pact "will have fewer things with which to wage war, and, correspondingly, we have fewer things to shoot at," General Dugan said. Under the proposed Conventional Forces in Europe (CFE) limits, NATO air forces anticipate "in the range of a twenty-percent reduction in the target base."

In some cases, the Soviet Union is pulling out older equipment in substantial numbers but bringing in a smaller number of more capable systems. While upwards of 700 aircraft have been withdrawn, General Dugan said, "they have been backfilled with about 400 very modern MiG-29s."

Technological upgrade has not slackened. It may even be intensifying. "This appears to be the basis of Mr. Gorbachev's deal with his military leadership," General Dugan said. The Red Army and the Soviet air forces accept lower force levels but are allowed to modernize aggressively. In the long run, they gain a more capable force.

Some of the withdrawals are not exactly what they seem to be on the surface. Three tank divisions pulled out, for example—but most of their assigned manpower and about 4,000 of their nonarmored vehicles have been redistributed to other units.

"What's gone back to the Soviet Union were the tanks, the flags, and the pictures that ended up in the Western press," General Dugan said. In testimony to the Senate on February 7, the Army's Gen. John R. Galvin, Supreme Allied Commander in Europe, said, "Artillery pieces have been shifted to residual units, upgunning batteries from six to eight guns and battalions from eighteen to twenty-four."

General Dugan noted that if the CFE negotiations work out, the Soviet Union will give up about 40,000 tanks and have 20,000 left. He said that "20,000 tanks is about seven times the number Hitler had when he started World War II, and he never got much above 20,000."

Despite Soviet reforms and troop reductions, General Dugan said, "a country of 289,000,000 people, with more than fifty percent unintegrated minorities, speaking some 123 different languages, in a state of near-anarchy in several of its regions, afflicted by Muslim fundamentalism all across its southern borders, and with 10,000 nuclear weapons is a potential and real threat to lots of people in the world."

Force Ratios and FOFA

Arms control might bring the balance of forces in Europe close to parity. The Soviets, who will be making their cuts from a position of overwhelming numerical advantage, will take the larger share of the reduction. This would lead to "exchange ratios that we could only *hope* to achieve in wartime," General Dugan said.

These exchange ratios would help NATO if it sticks with the strategy

The New Net Assessment

In a preview of the Pentagon's new net assessment, Gen. Colin L. Powell, Chairman of the Joint Chiefs of Staff, told the Senate on February 5 that the Soviet Union figures to remain a military superpower with "vast potential," no matter how benign stated Soviet intentions may be.

General Powell said that the United States must continue to rely on a forward defense by forward-deployed forces in Europe and other areas critical to US interests.

"Non-Soviet Warsaw Pact nations currently furnish forty percent of the forces in the Central region and fifty percent of those in the Southern region," he said. Considering "the new political orientation" in eastern Europe, the Pact's military capability and the prospect for hostilities have been reduced.

As for Soviet forces, General Powell said they "have been using some of the equipment they have removed [in widely publicized redeployments from Europe] to make other units more capable, and although they have reduced tank production this year by about half, they continue to outproduce us. Production of new and more capable aircraft and ships continues at a vigorous pace. Equally important, the Soviets are producing equipment whose sophistication rivals our own."

of Follow-On Forces Attack (FOFA), in which allied air forces go after enemy units in the rear echelons before they can join the main battle.

With parity of forces, General Dugan said, "an attacker has to make a choice about where he wants to mass if he's going to penetrate, as opposed to the current circumstance where, in large measure, he can attack almost across the whole front."

The aggressor would want a force ratio of three or four to one at the point of attack. In a parity matchup, that would require lateral movement in order to mass. Such maneuvering would be spotted by the Joint STARS deep-look targeting system, and it would be vulnerable to long-reaching FOFA-style weapons. The net result is a strong deterrent to aggression.

General Dugan believes that nuclear weapons will continue to be an important factor in theater warfare but that, in the future, both sides will have fewer of them.

Of considerable significance, he believes, is a change in Soviet thinking since the Chernobyl nuclear powerplant disaster in 1986. Previously, the concept that a nuclear war could be won was prevalent in Soviet military theory. With a vigorous civil defense program and enough shelters, the Soviets had believed they might ride out a nuclear exchange with acceptable losses. The devastation and cost of Chernobyl came as a sobering revelation, General Dugan said, and, as a result, "they have changed their minds severely."

Fighter Lead Is Gone

With force numbers dropping on both sides, the military balance of the 1990s will be measured increasingly by quality. Consequently, tactical air force leaders argue, the case for modernization is about as strong as it was before.

Soviet air forces already operate the Su-27 and the MiG-29. General Russ rated these aircraft as "very comparable" to the F-15, which has seen service with the US Air Force for the past fifteen years.

"That lead we had in technology and capability with the F-15 and F-16 is gone," he said. Alluding to trends of "a classified nature," General Russ said the Soviets are working on even more capable fighters.

USAF contends that without the speed, stealthiness, and survivability of the Advanced Tactical Fighter (ATF) and other modern systems, it will be poorly prepared to meet Soviet fighters in the air or to operate generally in future battles.

"All of our missions except defensive counterair require us to penetrate and operate over hostile territory," General Russ said.

General Dugan agreed, adding that in modern warfare, action beyond the forward edge of the battle area "is what air forces are all about."

General Dugan said that "CFE talks are focusing on tanks and artillery, infantry fighting vehicles, airplanes, and helicopters. Nowhere in there does anyone say anything about surface-to-air missiles. The Soviets have a significant numerical advantage there, similar to their numerical advantage in airplanes."

It is not just in Europe that lethal missiles and air defense systems are found. General Dugan predicted that they will continue to proliferate, particularly in the Third World. Operating against them will require speed, stealth, and other characteristics built into the ATF.

General Russ had high praise for the F-15E dual-role fighter, now operational at Seymour-Johnson AFB, N. C. "It is probably the highest-leverage system I have anywhere in the inventory," he said.

The F-15E, outfitted with Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) pods, performs either deep strike or air-superiority missions. Its production run, however, was cut short in last year's budget.

Several good systems were terminated for budgetary reasons, General Russ said, and the rationale in the case of the F-15E was "that we would have a break period between now and when the ATA [the Advanced Tactical Aircraft, developed by the Navy for joint service use] came available and that we had sufficient capability to last us between now and then."

A more recent cancellation is the Maverick antitank missile, terminated after this year's purchases. General Russ said this should not leave the tactical force unduly short, because "as you reduce your force structure, you reduce the number of munitions you need."

The new budget also cuts deeply into "air base operability," programs that prepare forward air bases to recover after an attack and to resume operations rapidly. General Dugan said that some improvements, from reinforced buildings to redundant pipelines, are complete, much of the work done with NATO infrastructure money. The Air Force itself decided that base op-

erability needed more study. It is rebaselining plans and channeling resources toward "the places we are assured bases will be open a few years from now."

Force Mix and Requirements

A member of the symposium audience asked if the Air Force will keep developing aircraft specialized for single functions or whether new systems would be designed for multiple or "swing" roles as an economy measure.

As the force gets smaller, General Russ said, the mix will probably tend toward "airplanes that can do a little air-to-air and a little air-to-ground to provide the commander the flexibility to swing the force."

All other things being equal, specialized aircraft would be the choice. "If you don't have the luxury to specialize everywhere, you ought to specialize for the most difficult missions," General Russ said, citing deep strike, interdiction, night operations, and air superiority. "Those are the ones you should concentrate on specializing."

A different sort of force-mix issue—and a recurring theme in defense reduction proposals—is the transfer of active-duty missions to the National Guard and the Reserve. One suggestion, for example, would leave the reinforcement of Europe in a crisis to those units.

At present, the Guard and the Reserve operate a third of the wings in the tactical fighter force. There is no serious question about their capability. They have performed superbly in regular operations for years, and they often win against active-duty competition in the Gunsmoke and William Tell fighter meets.

"The only difference in a Guard or Reserve tactical fighter unit today is twenty-four hours," General Russ said. "We mobilize and send an active-duty wing within seventy-two hours. We give the Guard and the Reserve twenty-four hours to get started so they can recall their people."

The sticking point is the rotation base. The active-duty force alternates between assignments overseas and in the United States. If too many of the wings at home are in the Guard and the Reserve, most of the assignments available for the active-duty force would be overseas.

Without rotation billets back home—and replacements rotating from Stateside bases to relieve them—airmen in the tactical force would serve much longer and more frequent tours abroad. General Russ said that Guard and Reserve conversions cannot be taken to the point where "we'll have people staying overseas eight or nine years and not being able to rotate."

Given the present instability of world politics, it is impossible to predict the requirements for tactical air forces in the future, but General Dugan said that "US interests, which drive strategy, will remain global in scope."

Forward defense, rapid reinforcement, and the ability to project power for long distances are still important, he said. In a difficult and dangerous world, coalition defense is likely to continue, and US forces will be central to allied strategy.

"I think the United States will remain in a key role of balancer and leader in the alliances," General Dugan said. "No other nation has volunteered, no other nation has been elected, and no other nation is more acceptable to the bulk of our allies." ■

"Move Back Eighteen Feet"

Brig. Gen. Carl A. Hagan, Deputy Chief of Staff for Training at Army Forces Command, shared a soldier's view of tactical airpower at the Orlando symposium. General Hagan's son Steve, a captain in the 82d Airborne Division, had been on the Panama operation. On the first night, his unit found itself in a difficult spot.

Fortunately, Captain Hagan told his father, there was an AC-130 gunship overhead: "We explained our situation, and the guy [in the gunship] said, 'Where are you?' and we showed him, and he said, 'Where are the bad guys?' and we showed him that. There was a pregnant pause for a couple of seconds, and then he said, 'You need to move back eighteen feet.' "

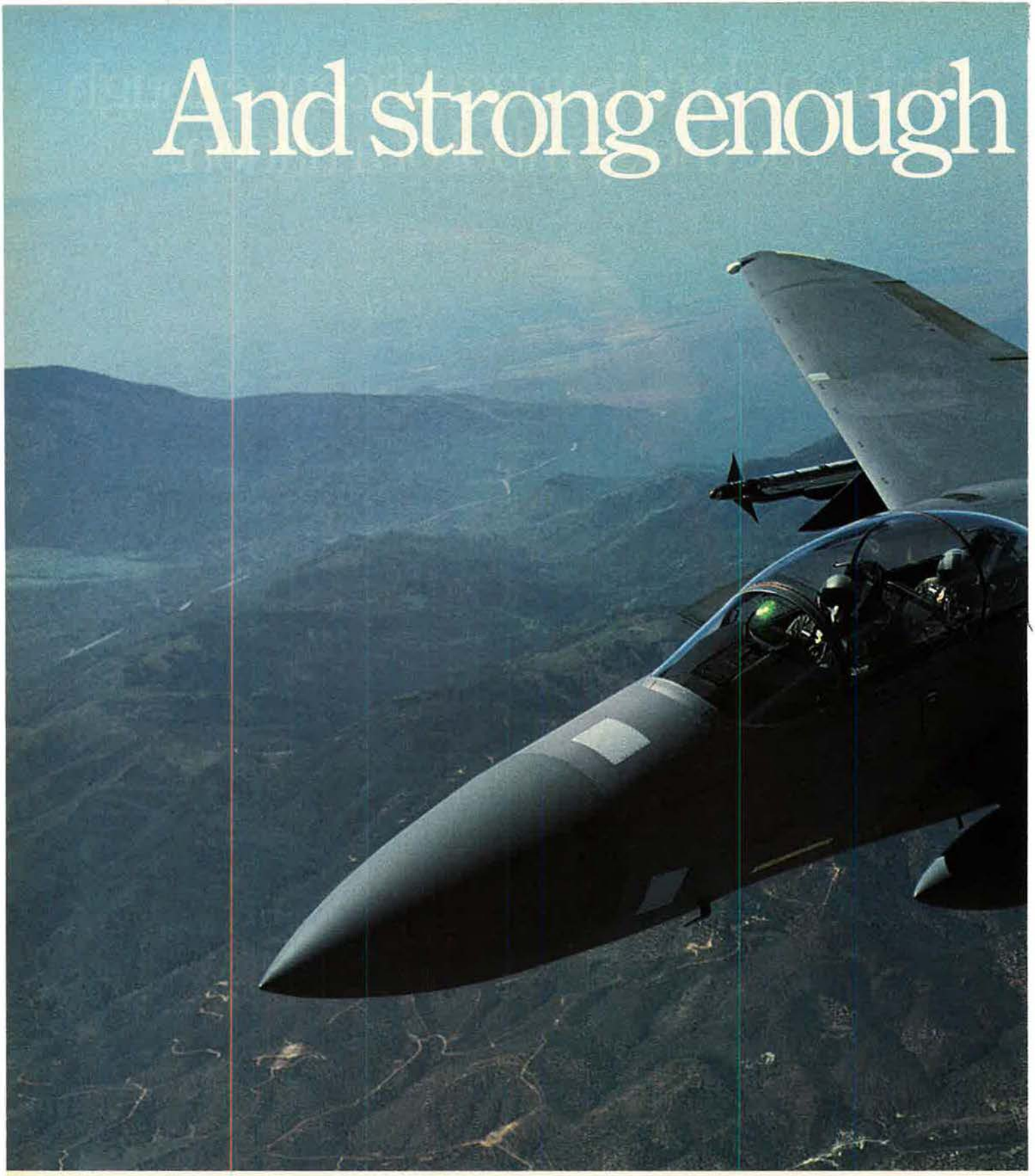
"They did that," General Hagan reported, "and the AC-130 did its thing and eliminated all opposition. Now that's close air support."

Further on the subject of Panama, someone from the symposium audience asked TAC's Gen. Robert D. Russ why the Air Force employed its secret F-117 Stealth fighter. Was the choice mainly for show? Couldn't the mission have been performed by some other aircraft?

"If you're going into a fight, why would you take your second-best airplane?" General Russ shot back. "We used the best damn airplane we had to do the job, and it did exactly what we asked it to do."

Only one bird is magnificent enough to be the symbol of a nation.

And strong enough



America's Eagle, the F-15E. So powerful it can climb like a rocket to knock enemy aircraft —or even a satellite—out of the sky. So agile it maneuvers the way only an Eagle can. So advanced it is the perfect partner for 21st century fighters.

Built for the U.S. Air Force by McDonnell Douglas, the F-15E is right for a time when more must be done with fewer resources. When we must expect greater capability from a smaller arsenal. And America's Eagle comes through. It stands alone, ready to deliver the

world's most powerful one-two punch.

Unmatched air-to-air or air-to-ground, the Eagle's strength is in its superior flexibility. And America's strength is in its guardian—America's Eagle, the F-15E.

THE F-15E

EAGLE

This may be the year when tactical force modernization gets the shakedown of a lifetime.

Systems Under the Gun

By John T. Correll, Editor in Chief

THIS looks like the year of determination for the tactical air forces. Actions in 1990 could effectively decide how fighter units will —or won't—be equipped as they enter the twenty-first century.

Congress, prodded by public opinion, is in a mood to kill weapons. Depending on which systems, if any, are killed, the modernization choices in some mission areas will be limited to renovation of current systems.

For the bigger tactical programs, no alternatives are now under development. Even if substitute systems were approved and funded, they would start from scratch, pushing their availability to operating forces well into the future.

Several programs have been canceled or cut short already. Others, including the Advanced Tactical Fighter, are on various hit lists circulating in official Washington.

As part of last year's budget reductions, the Pentagon put an early end to production of its F-15E dual-role fighter. The FY 1991 budget request, sent to Congress in January, terminated more programs. While the Air Force's major tactical systems are still alive, Congress may insist on further cancellations before the budget is settled.

Looming as equally critical—if not more so—are the deliberations by the services, the Joint Chiefs of Staff, and the Office of the Secretary of Defense on the revised defense program to be proposed for 1992 and beyond. Weapons development, along with manpower levels and force structure, will be subjected to an extraordinary shakedown.

The Soviet empire in Europe collapsed more suddenly than anybody expected. The Defense Department, caught with its FY 1991 plans nearly complete, made some adjustments, but the new budget is widely regarded as transitional, based on concepts and assumptions that may no longer apply.

The workup of the 1992 program, already begun, will include a fundamental reassessment of military roles, missions, and strategies. The continuing problem of the federal deficit—which, by law, must be reduced to zero in FY 1993—puts additional pressure on the budget.

A high-level board in the Pen-

Continued production of the F-15E has already become a casualty in the budget-cutting battles between the Pentagon and Capitol Hill. The dual-role fighter, which TAC Commander Gen. Robert Russ praised as "probably the highest-leverage system I have in [TAC's] inventory," was terminated in FY 1990. Only 200 of the 392 aircraft originally planned will be built.

tagon was supposed to wrap up, around March 30, its comprehensive review of four aircraft programs: the B-2 bomber, the C-17 airlifter, the Navy's A-12 Advanced Tactical Aircraft, and the Air Force's Advanced Tactical Fighter (ATF).

A stringent congressional review awaits those aircraft that pass the Pentagon board's scrutiny. The prevailing assumption is that the B-2 and the ATF will get the toughest looks.

ATF Is the Centerpiece

The tactical modernization program for which the Air Force's heart beats bluest is the ATF. Its F-15 Eagle has been the world's best air-superiority aircraft for fifteen years, a long time for a fighter to maintain dominance.

Current Soviet fighters, the MiG-29 and the Su-27, are catching up. The Soviet Union is offering these aircraft for export—Cuba being the latest nation to buy the MiG-29—and is said to have new fighters in development.

Even if all goes well, the ATF would not enter service before the late 1990s. Without the ATF by then, the Air Force says, it will fall behind in aerial combat capability. The United States has no other comparable fighter program in progress.

The plan, if it holds, is that the Air Force will buy a variant of the Navy's ATA for deep interdiction and the Navy will buy an ATF variant for its air-to-air mission.

Two competing ATF prototypes, the Lockheed/Boeing/General Dynamics YF-22A and the Northrop/McDonnell Douglas YF-23A, will fly this year.

The Air Force has tried hard to make this a model acquisition program, and, by all indications, the development is going well. The demonstration/validation phase was extended by several months recently, but program officials said this was because they wanted more data before issuing the formal Request for Proposals to contractors.

Pivotal in the case of the ATF will be how well it measures up to two long-announced Air Force objectives: a maximum weight of 50,000 pounds and a unit flyaway cost of $35 million in 1985 dollars. The Air Force has said that minor deviations from those numbers are tolerable but that it intends for the ATF to come in reasonably close to baseline objectives.

The actual cost depends, in large part, on which features the Air Force chooses to put into the initial version of the ATF. The development has always been an exercise in tradeoffs and constant rescrubbing of requirements. Thrust-reversers were eliminated, for example, when it was found they added too much in cost and weight. More recently, the Air Force has been pondering its options for ATF avionics.

If the Air Force wants all the bells and whistles on the first model, a significant cost overrun is probable. Fortunately, the ATF is designed to a modular architecture. The decision-makers have an extensive range of mix-and-match options. A stripped-down, vanilla configuration would still have the main characteristics of stealthiness, speed, and supportability. Later models could be retrofitted with other capabilities as requirements evolve and funding permits.

AMRAAM Takes Its Licks

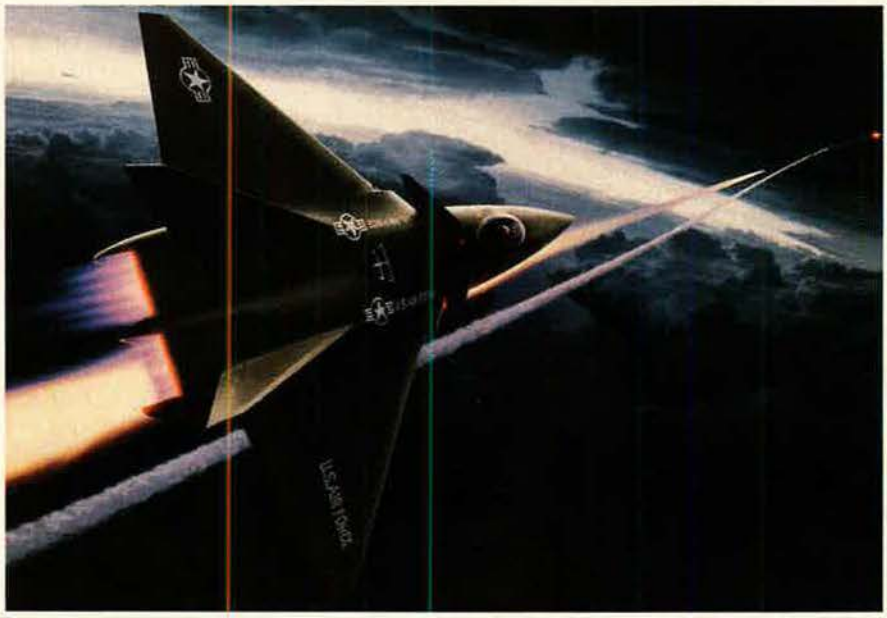
The year got off to a bad start for the ATF's primary ordnance, the AIM-120A Advanced Medium-Range Air-to-Air Missile (AMRAAM). In February, the Air Force suspended acceptances of production missiles, citing quality-control problems—vibrations, cracks, loose screws, and the loss of a fin—that showed up when the weapons were flown aboard F-15 carriage stations.

The difficulties appear to be in peripheral and finish work, mostly in subcontracted items. The Air Force, which eventually expects the missiles to withstand an average of 450 flight hours before maintenance, wants the reliability problems fixed. It says, however, that it is well pleased with the basic system design and performance.

At AFA's Tactical Warfare symposium in Orlando, Fla., on March 2, Maj. Gen. Kenneth E. Staten, Commander of Air Force System Command's Munitions Systems Division, said that the AMRAAM is a "success story" and that the missile itself is a "killer."

Eighty missiles have been launched against targets in full-scale development testing. Twenty-one of those shots were direct hits. In all, sixty-two were scored as "successful," with the missiles either hitting their targets directly or passing within the warhead's lethal range.

General Staten said the Air Force will try again on the "four vs. four" or "World War III" shot with AMRAAM that failed last August. The problem last time, he said, was



Without the ATF, seen here in artist's concept, USAF will fall behind in combat capability to the still rapidly modernizing Soviets. The Air Force has tried to make the ATF a model acquisition program, and the ATF's modular configuration helps keep USAF's options open by allowing future upgrades through retrofitting.

Another program in danger is the AIM-120A Advanced Medium-Range Air-to-Air Missile (AMRAAM), slated as the ATF's primary ordnance. Quality-control problems caused USAF to suspend acceptances of AMRAAM in February, and Rep. Denny Smith expressed grave doubts about deploying it without an effective IFF system.

software, both in the missile and on the launching aircraft. The correction in missile software has been validated, and the aircraft software is believed ready, too.

The four vs. four test was "probably the toughest air-to-air shot that's ever been attempted in peacetime," General Staten said. An F-15 fired four AMRAAM missiles simultaneously at four independent targets flying inside a chaff corridor. Two of the targets had self-projection jammers, and all were protected by area jammers keyed to the F-15 and AMRAAM. To make the test more difficult, one of the targets suddenly broke right in an 8-G turn at the worst possible time for the missile.

Meanwhile, AMRAAM may have picked up another problem laterally as a result of questions about the Mark XV combat identification system. Money for the Mark XV was dropped from the FY 1991 budget, and the Defense Department is running a study, due for completion in April, to determine the Mark XV's future.

"If you decide to cancel the Mark XV program, then I believe you must likewise cancel the AMRAAM program," Rep. Denny Smith (R-Ore.) wrote to Deputy Secretary of Defense Donald Atwood January 31. Representative Smith said that "without a very capable IFF [Identification, Friend from Foe] system, we run a grave risk of shooting down our own forces in the confusion of combat." AMRAAM, he said, requires precise identification data to have "any hope" of performing its beyond-visual-range mission.

A former Air Force pilot aligned with the reform movement, Representative Smith acknowledged that "I have long been a skeptic of the advertised AMRAAM beyond-visual-range capabilities, even under the rosiest of Air Force projections."

Interdiction and Attack

The termination last year of the F-15E fighter was a bitter pill for the tactical air forces. Production will end at 200 aircraft rather than the 392 planned originally.

The multimission F-15E, which began entering operational service in December 1988, is impressively

F-15 Eagles, such as this one flying over Alaska, have been the world's best air-superiority aircraft for fifteen years, a long time for a fighter to maintain dominance. They must continue to shoulder the bulk of that mission until at least the late 1990s when, if all goes well, the ATF will enter service.

modified for long-range strike missions at night and in bad weather while keeping its basic F-15 air-superiority characteristics.

The Air Force awaits a variant of the Navy's A-12 Advanced Tactical Aircraft to fill its remaining deep-interdiction needs of the future. It is widely believed in the defense community that the Navy has approval for the A-12 hard-wired with Congress.

This month, the Defense Acquisition Board will again take up the old question of a close air support aircraft to replace the A-10. The Air Force wants the "A-16," a missionized version of the F-16, for this job, but is opposed by a faction that promotes a slower, heavily armored aircraft known derisively as "the mudfighter."

According to dozens of studies, the mudfighter concept does not match either the realities of modern combat or the Army's requirements for close air support under the Air-Land Battle doctrine. So far, the tactical air forces—sometimes accused of exhibiting insufficient interest in the Army's needs—have been unable to get approval for the system they believe is best for the mission.

The Air Force was turned down last year in its bid to acquire the A-16, but was given money to improve the attack capabilities of 225 A-10s and 146 existing F-16s. It was also told to plan a competitive flyoff of candidates to succeed the A-10.

—Staff photo by Guy Aceto

The mainstay of the close air support mission is still the A-10, though debate has raged for years about which aircraft will replace it. Promoters of the "mudfighter" adamantly oppose the missionized version of the F-16 that the Air Force wants for close air support but has been unable to get approved.

Some field commanders say that, while they would prefer a missionized F-16 for close air support and battlefield air interdiction, the standard, unenhanced F-16 performs these tasks rather well.

The standard F-16, however, faces uncertainties of its own. Production drops from 180 aircraft in FY 1989 to 150 in FY 1990. The January budget proposal would hold procurement at that rate for the next several years.

The annual report on deficit reduction options, published in February by the Congressional Budget Office, points to possible five-year savings of $4 billion in outlays ($2.26 billion in budget authority) from reducing procurement of F-16s to seventy-two a year.

CBO states explicitly that it is identifying options, not suggesting actions. It also recognizes the disadvantages. Curbing F-16 procurement would "presumably" lead to less efficient production rates and higher unit costs, CBO acknowledges, and taken along with the F-15E cancellation and other reductions, an F-16 cutback might hinder the Air Force in keeping pace with tactical improvements by the Soviets.

Conversely, CBO notes, "slowing procurement of the F-16s should bring future inventories of Air Force fighters more in line with the requirements associated with an anticipated smaller force."

That is a perspective shared enthusiastically by those inclined to use the CBO options as a shopping list for defense cuts. It is also a sample of the language the Air Force will hear a lot of before this critical year is out. ■

These F-16s from the 57th Fighter Weapons Wing have been outfitted to demonstrate the Fighting Falcon's prowess in the close air support mission. Some field commanders have said that, while they would prefer a missionized version, even an unenhanced F-16 performs close air support well.

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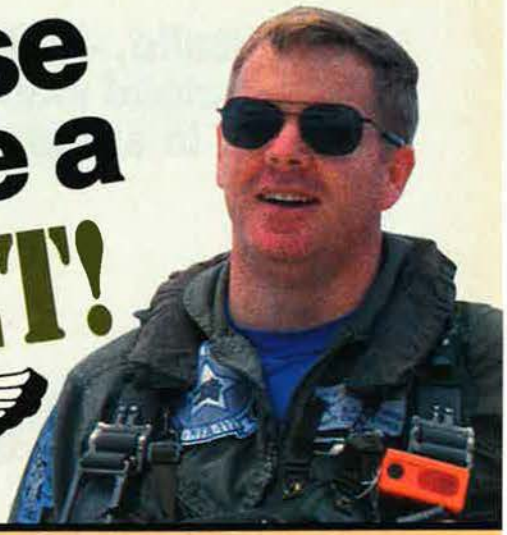

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This missile, once nearly written off as dead, helped make the Air Force a believer in standoff weapons.

Comeback of the AGM-130

By James W. Canan, Senior Editor

THIS is the story of how the Air Force finally became a believer in standoff weapons, largely—and ironically—as a result of its work with one such weapon that kept misbehaving, an air-to-ground missile that flew up, not down, and came very close to winding up in the scrap heap.

In a month or so, the Air Force will bring forth its first roadmap for the future development of standoff weapons. Drawn up by Tactical Air Command, Strategic Air Command, and Air Force Systems Command, the document will be presented as evidence that USAF has the best of intentions for weapons that it has long been accused of spurning.

Critics of the Air Force's weapon-systems preferences and priorities through the years have claimed that the service is reluctant to tap the potential of standoff weapons for the worst of reasons—because they would undercut USAF's rationale for high-performance ground-attack fighters and its need for the pilots who fly them.

The Air Force has denied this accusation and is now moving to put it to rest by giving such weapons their place in the sun. It claims that their improved technologies and lower costs make them conducive to procurement and deployment in large enough numbers to make a difference.

Gen. Larry D. Welch made this clear in addressing an Air Force Association symposium in Los Angeles, Calif., late last year.

"We have finally reached the point where we truly know how to build effective standoff weapons, and there are new technologies on the horizon that will enable us to do that even more effectively," the Chief of Staff declared. "You will see an increased emphasis on complementing manned aircraft with standoff weapons of various kinds."

The new bullishness on standoff weapons was generated by work done at Eglin AFB, Fla., home of Air Force Systems Command's Munitions Systems Division. The Air Force decided early this year to abolish MSD as a self-contained entity for research and development and to transfer the responsibility for its programs elsewhere.

It was under MSD's auspices that

An AGM-130 standoff missile, a powered variant of the GBU-15 glide bomb, undergoes preflight checking. The Air Force nearly gave up on the AGM-130 because of flight-test failures, but the missile's comeback led USAF to regain its optimism about standoff weapons in general.


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standoff weapons began coming into their own. The division played a leading role in devising the roadmap, which will focus, for the first time, on future requirements for standoff weapons and on the technologies that the Air Force should pursue in order to fulfill those operational needs.

The Missile that Couldn't

The timing of the Air Force's decision to go for standoff weapons was anything but random. It had to do with the turnaround of a pivotal program, the comeback of a missile called the AGM-130 that USAF had just about left for dead.

USAF and Rockwell International Corp. began developing the AGM-130 several years ago as the prototypical standoff weapon—a longer-range, powered variant of Rockwell's unpowered, short-range GBU-15 glide bomb. The GBU-15 worked well, but the AGM-130 did not. In developmental testing, it turned out to be "a nightmare."

That description comes from Corky Siegel, a Rockwell vice president who runs the standoff weapons business segment of the company's Missile Systems Division in Duluth, Ga. He was assigned to that job two years ago as part of a management makeover aimed at saving the AGM-130.

USAF was resigned to giving up on the AGM-130. The missile had failed in almost every way imaginable. Its rocket motor wouldn't fire, or it just wouldn't fly right, or something, always something.

Toward the end of 1988, Munitions Systems Division, then called Armament Division, issued Rockwell what amounted to a show cause order, challenging the contractor to come up with reasons why the AGM-130 should not be scrapped. The Air Force told Rockwell that it had no intention of spending another penny on the program.

Rockwell tried to buy time. It told the Air Force that it could turn the AGM-130 program around as a result of improvements afoot in program management, quality control, and workmanship and that the company was willing to meet all costs of setting things right.

Kent Black, Rockwell's Chief Operating Officer conveyed this message in a letter to Edward J. "Pete" Aldridge, Jr., then the Secretary of the Air Force, and in a meeting with Gen. Bernard Randolph, AFSC Commander. Rockwell was granted a reprieve, but with rigorous reservations.

"The Air Force told us that we had three more chances, three more flight tests, and that two of them had to work, or the program would be terminated," Rockwell's Mr. Siegel recalls.

Things went from bad to worse in the very next test. In a dramatic display of aberrant behavior, an AGM-130 launched by an F-4 made like an air-to-air missile. Instead of heading for its land target, it climbed to nearly 5,000 feet, ran out of energy, and dropped like a rock.

Now the odds were terrible. In test shots to come, the AGM-130 would have to go two for two, bat a thousand. Gen. Robert D. Russ, Commander of Tactical Air Command, pointedly reminded Rockwell executives of this at a chance encounter in Washington. "That's what you call pressure," Mr. Siegel says.

Then things began looking up. Rockwell's engineers found that the previous flight-test failure of the AGM-130 had been caused by something relatively simple—a faulty relay switch in the guidance-control circuitry had steered twenty-eight volts to the wrong place. Fixing it was quick and easy.

Back to the flight line.

"The next two tests were successful," Mr. Siegel recalls, "and we were on our way. Since then, we've had a whole string of successes in operational flight tests."

One such success was scored late last January in the eighth and next-to-last of a series of Air Force initial operational test and evaluation launches. An AGM-130 came off an F-111 doing Mach 0.9 at 20,800 feet, descended to 1,000 feet, maintained that preprogrammed cruising altitude for nearly twenty-two miles over mountainous terrain, then nosed over and scored a direct hit on its target, a structure simulating a storage warehouse.

"Actually, the missile was off by two inches, but it was the toughest AGM-130 test profile we'd ever flown," says Mr. Siegel, tongue in cheek.

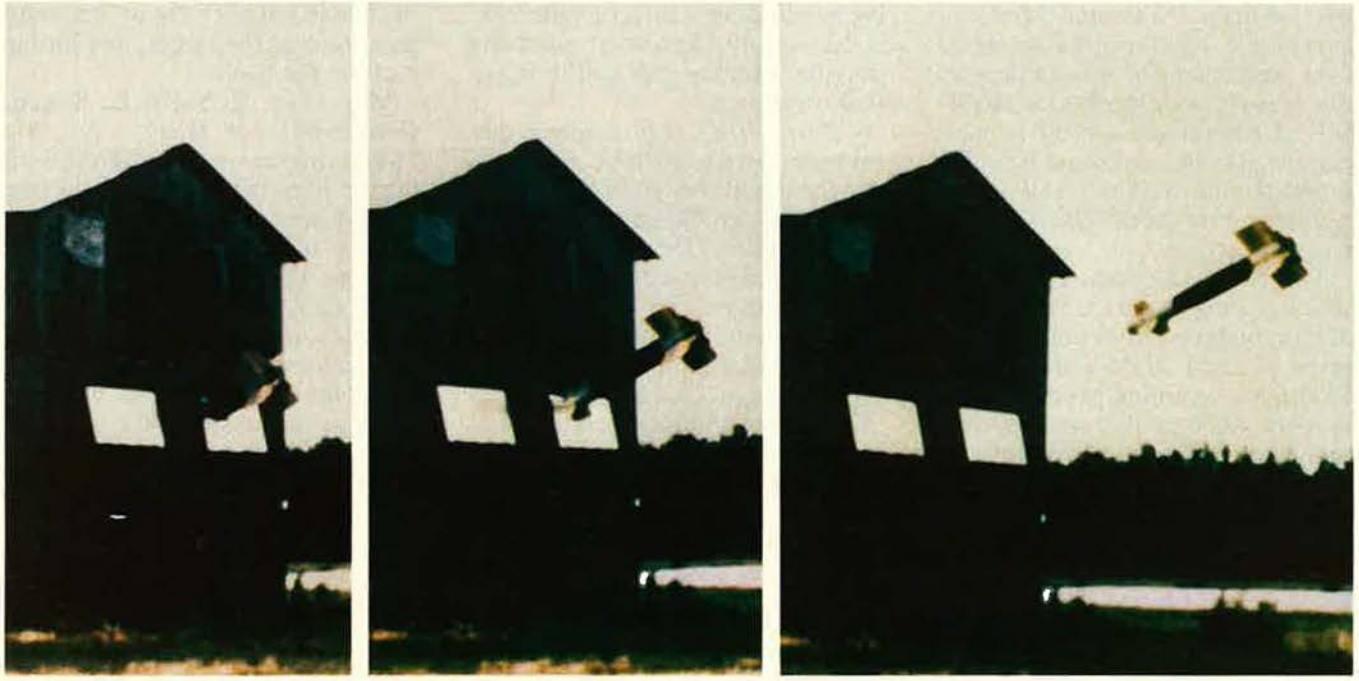
Fresh Perspectives

How did Rockwell salvage the program? First and foremost, by taking another look at it from the fresh perspectives of new management and engineering leadership.

"We did a total systems engineering review," Mr. Siegel explains. "We found that all the [missile's] faults could have been detected on the ground and that all the failures would have been prevented in the air."

The AGM-130's sole design problem lay in guidance-computer soft-

An AGM-130 goes aloft on an F-111 for a flight test. AGM-130s can be launched by F-111s, F-15Es, and F-4s, and they can be adapted to F-16s. Each missile can carry a 2,000-pound warhead more than twenty miles, something that no other nonnuclear missile in the US arsenal can do.



An AGM-130 hits its target after a twenty-mile flight. USAF is intent on developing new guidance systems to make the AGM-130 and other standoff weapons fully autonomous, thus enabling their host aircraft to hit multiple targets in one sortie and to stay out of harm's way while doing the job. As things now stand, the AGM-130 must be remotely guided to its target.

ware that "just needed tweaking," the Rockwell executive says. The missiles built for developmental testing, however, were plagued by "a lot of little things—a bad switch here, wrong wiring there, wrong-sized safing pins, a faulty relay" that added up to something big.

"We had proved that the AGM-130 could work. What we hadn't proved was that it wouldn't fail," Mr. Siegel declares.

The main task for the new management team at Rockwell's Missile Systems Division was to change the culture there by making all hands more attentive to improving quality of all things at every turn. The Air Force has since adopted such an approach and calls it "total quality management."

Says Mr. Siegel, "We had total quality management before there was Total Quality Management. We called it 'the right way to manage.'"

The Air Force did not put all the blame on Rockwell for the flawed AGM-130 program or passively stand aside while the company struggled to save it. Management changes were made within MSD, in which Col. Glenn H. Vogel took charge of the systems program office (SPO) for air-to-surface guided weapons.

By all accounts, the SPO had a big hand in helping Rockwell resuscitate the AGM-130 and managed to keep on track several other programs related to it. The SPO's assistant director, Lt. Col. Joe M. Banks, recalls that "when the AGM-130 got into deep, deep trouble and came very close to the brink, many of our other programs were affected right along with it, to one degree or another. Now they are all coming back together."

A Boost for Standoff Weapons

Failure of the AGM-130 program probably would not have spelled doom for the development of standoff weapons in general. The Air Force would have continued working on standoff technologies, but would have eyed them with even less confidence than before, which wasn't much, and would not have taken to them with the alacrity now evident.

At the AFA symposium last October, General Russ joined General Welch in emphasizing the importance of standoff weapons to the tactical air forces and took note, in that context, of the AGM-130 program's turn for the better.

"Recently, we have made some headway with the AGM-130," the TAC Commander said, "and while it doesn't meet all of our standoff needs, it is what we need now and what we can afford."

The AGM-130 is, in effect, a product-improved GBU-15. It uses the same support equipment and aircraft data links as the glide bomb. Both weapons can embody TV or imaging-infrared (IIR) guidance systems. But there is one very big difference between them: range.

Thanks to its rocket motor, which gives it a minute-long shot of energy and enables it to climb and drop down over mountains in its glide-boost-glide flight to the target, the AGM-130 can fly three times as far as the GBU-15.

The effective range of the GBU-15 is said to be more than five miles but less than ten, which barely qualifies it as a short-range standoff weapon. The Maverick missile, designed primarily to destroy tanks, has roughly the same range. It too can use a TV seeker or an IIR seeker and is destined to incorporate millimeter-wave radars that were put into development at MSD.

When it comes to range, neither the GBU-15 nor the Maverick is in the same league as the AGM-130. It is not quite in the medium-range class, generally defined as forty to sixty miles, but it is getting there. It already flies a lot farther than any tactical standoff weapon that the Air Force has ever had.

The AGM-130 packs the biggest punch, too. It is the only standoff

weapon in the US arsenal capable of carrying a 2,000-pound warhead over such distance. As an example, the Navy's developmental AGM-84E SLAM missile is roughly comparable in range, but shoulders only a 500-pound warhead and is expected to cost about $800,000 if put into production.

The AGM-130 costs much less, which is a major plus in these times of tight budgets. Rockwell pegs the price of each AGM-130 at about $250,000, assuming production of roughly 4,000 of the missiles over ten years. A decision to begin production is expected any time now. Major subcontractors are Hercules for the rocket motor and Honeywell for the radar altimeter.

Holding Hands With the Missile

The AGM-130 is by no stretch of the imagination an autonomous weapon. It is remotely controlled by the Weapon Systems Operator (WSO) of the launch aircraft or another aircraft in the vicinity. The WSO can steer the missile right and left and can direct it to descend in increments of 200 feet. The missile's seeker picks out landmarks along the way and transmits their images back to the TV screen in front of the WSO.

"The WSO doesn't have his hand on the joy stick at all times," explains the AGM-130 program manager, Lt. Col. Marvin J. Brigman, Jr. "He can direct the missile by entering headings into the computer. He is constantly looking at what the [missile's] seeker sees and trying to find waypoints.

"If the WSO sees a tower that isn't supposed to be there, he knows that the missile isn't going where it's supposed to go. So he enters a heading correction. Then he may see a certain road intersection, for example, and know that the missile is back on course, and then, okay, there's the target.

"Now he locks the seeker, takes the stick, and starts steering in earnest."

This beats flying the airplane itself to the target. It can be kept well out of range of antiaircraft guns or SAMs in the target area. But holding hands with the missile until the bitter end is an awkward arrangement and leaves something to be desired.

That something is a capability called "fire and forget," or "launch and leave." It has been built into the AIM-120A Advanced Medium Range Air-to-Air Missile (AMRAAM) that the Air Force has put into production, but is nowhere to be had—despite much talk about it over many years—in air-to-surface weaponry.

USAF is bent on making the AGM-130, and all of its standoff cousins to come, autonomous, meaning that they would receive target-acquisition data from their host aircraft and then go off and do the whole job of flying to the target area, finding the target, and hitting it all by themselves.

Maj. Gen. Kenneth E. Staten, Commander of MSD, says that "we're increasingly building into the weapons the capability to do the precise selection of targets, so that we can unburden the crew of the airplane, the launch platform, from doing that."

General Staten warns against "oversimplifying our justification, our demand, for standoff weapons in terms of the survivability of airplanes."

He says that "other arguments may be stronger" in behalf of such weapons.

He continues: "Survivability is important, sure. We shouldn't overdo that argument, though, because in combat, lives are often at risk. But there are cost-efficiency considerations too in survivability. In the economy equation, losing airplanes is a big driver of costs.

"I prefer to argue for standoff weapons more in terms of what they enable us to do. They expand the area of influence of the airplane. They put more targets at risk. They make planning more difficult for an adversary commander, when he knows that the airplane can attack a broader set of targets than the one it's flying at."

Standoff weapons will be much more effective at all such things once they become autonomous and move up to the launch-and-leave class.

Autonomous Guidance

The key to such capability is a program appropriately called autonomously guided conventional weapons, or AGCW. With Texas Instruments its prime contractor, the program aims at developing a modular imaging-infrared seeker for a wide variety of air-launched weapons to be used against high-value fixed-position targets—for example, bridges, runways, ammunition dumps, and command posts.

The AGCW program—indeed, the Air Force's hopes for all autonomous standoff weapons—may rise or fall on the computerized mission prebriefing system now in development.

Wanda C. KausHagen, the program manager, explains that such a

An advanced aircraft munitions dispenser, painted white, is moved into position for a sled test, prior to flight testing at Holloman AFB, N. M. Such dispensers are being developed in standard configurations for a variety of munitions and aircraft as USAF heads full-steam into the standoff-weapons era.

Strategic Air Command has turned to the Israel-made AGM-142A Have Nap missile, shown here, to give B-52 bombers potent, nonnuclear, standoff capability. USAF now believes that standoff weapons are here to stay.

system "becomes even more important when you take man out of the loop. It is heavily dependent on intelligence. The crews [of the launch aircraft] must give the weapons enough information about the imagery of the target to enable the seekers to know what they're going to find once they start looking. So mission planning, or weapon prebriefing, probably at the squadron level, is critical."

The mission-planning system would be an expert system embodying lots of sophisticated software, which can be very tricky. Program officials are confident that it can be accomplished.

TAC wants autonomous seekers for the AGM-130 and the GBU-24/B low-level, laser-guided bomb, also known as Paveway III, as fast as possible. SAC has weighed in with a requirement for the autonomous long-range conventional standoff weapon (LRCSW), now in its developmental infancy as a joint Navy/Air Force program. It will have to be far more accurate than existing strategic cruise missiles. The reason is that the cruise missiles carry big-bang nuclear warheads, whereas the LRCSWs will carry 1,000-pound or 2,000-pound conventional warheads and will have to hit their targets right on the nose.

SAC now has but one nonnuclear standoff weapon, the Israel-made, medium-range Have Nap missile that it adopted for B-52G bombers. The LRCSW could be ready for SAC operational service by the end of this decade.

Work on making missiles autonomous will not be worth much, however, unless the guidance systems of the launch aircraft can communicate with the guidance systems of its weapons and can give them precise position-location data at the instant of their launching.

Help from Satellites

This data-handoff procedure is called transfer alignment and initialization of the missile as it comes off the airplane. It has to be done with great precision, and this is where the constellation of Global Positioning System (GPS) navigation satellites comes into play. The crews of ground-attack aircraft equipped with GPS receivers can continuously fix their positions in time and space—and thus, also, the starting points of each missile that they launch—within a few meters.

There is another big reason for the growing importance of GPS satellites in standoff-weapons scenarios. GPS-oriented navigation is also in the cards for the weapons themselves. Reductions in the cost and size of GPS terminals in recent years make MSD officials optimistic about incorporating them in tactical standoff missiles.

GPS is not the whole answer. The relatively weak signals from the navigation satellites would be vulnerable to the intense jamming that they would encounter in target areas. For some shorter-range missiles, GPS would not be worth the candle. It would take as much time for them to make connections with the satellites as it would to fly into target areas.

The key will be to equip standoff weapons with various combinations of GPS, inertial, and terminal homing systems. Advanced guidance technologies, such as those of ring-laser gyros for inertial systems and synthetic aperture radars and laser radars for missile seekers, look promising.

The longer a standoff weapon's range, the greater its cost, which is mostly a factor of its guidance. All along, the Air Force has been unwilling to pay the combined costs of terminal-guidance sensors, which are indispensable to all missiles of whatever ranges, and of midcourse-guidance inertial systems, which are needed in long-range and medium-range missiles, but not in short-range missiles.

This is the main reason why medium-range and long-range standoff missiles have gone begging. Now, though, costs of materials and avionics used in inertial systems have come down even as their quality has gone up, officials claim. This, they say, will make it possible for USAF to use inertial systems, perhaps in tandem with the GPS system, to guide missiles into target areas at any range with unprecedented precision. Such target-approach accuracy will ease the demands on terminal-guidance systems, which can be made simpler and less expensive.

The Air Force is taking advantage of advances in inertial guidance technology to turn dumb bombs into smart ones. It is building inertial systems into new tail cones for the Mk 80 series of general-purpose bombs.

USAF has thousands and thousands of such bombs. If they are equipped with inertial guidance, an F-16 carrying its maximum load of six such bombs would be able to attack six separate targets in one pass, theoretically at least, rather than just one target with the whole bomb load. The guided bombs will not qualify as truly standoff or autonomous weapons, but the F-16 pilots likely won't care about that. ■

The AFTI/F-16 explores close air support technologies for whatever airplane eventually gets the job.

Close Support Test-bed

By **Jeffrey P. Rhodes,** Aeronautics Editor

ONE of Washington's most contentious and unpredictable defense debates in recent years focuses on close air support—and the question of who will provide it. For Air Force technologists, the CAS furor must surely be puzzling.

Congressional critics charge that the Air Force is neither equipped for nor much interested in the "unglamorous" mission of providing aerial fire support to the Army. Lawmakers want new in-depth studies of potential CAS aircraft. It is popular to talk of stripping USAF of the CAS mission and giving it to the Army.

The problem with the charge, claim USAF officials, is that it doesn't square with the facts. They say that they are only too aware that, once enemy planes are downed and targets deep behind the lines destroyed, US airpower will come down to making pinpoint CAS attacks on targets near friendly forces. More to the point, they say, USAF technologists are working overtime to make sure that the Air Force can do just that.

The work is going on in many USAF venues. In particular, how-

In the first phase of USAF's close air support technology demonstration, an Army Bell OH-58D Kiowa scout helicopter like this one was fitted with an Automatic Target Handoff System digital data link. The OH-58 pilot transferred target data directly to the AFTI/F-16's computer in "voiceless" CAS operations.

The Advanced Fighter Technology Integration F-16 is now back at the General Dynamics plant in Fort Worth, Tex., being readied for the second half of the second phase (CAS II) of the technology demonstration effort. Once testing resumes, the AFTI/F-16 will demonstrate weapons delivery from low altitude while avoiding collisions, guided by the plane's digital map.

ever, the Air Force points out a program now being run by Air Force Systems Command's Aeronautical Systems Division (ASD), located at Wright-Patterson AFB, Ohio. USAF officials say it provides graphic evidence that the Air Force has a great interest in making short work not only of Soviet MiGs, but also of Soviet tanks.

As part of the ASD program, a highly modified preproduction example of the General Dynamics F-16 fighter—the Advanced Fighter Technology Integration (AFTI) testbed aircraft—is being pressed into service again, this time as the guinea pig for new CAS technologies.

"We are looking at technologies that will allow us to penetrate, attack, and survive in the CAS and battlefield air interdiction arenas," says Maj. Myres Drew, the AFTI/F-16 program manager at the Flight Dynamics Laboratory, a laboratory within the Wright Research Development Center of ASD.

"Effective CAS has three main components," notes Major Drew. "First, it has to be precise. Pilots want to make a first-pass kill, get battle-damage assessment, and make a survivable egress from the area.

"Second, it has to be responsive. The CAS pilots are the hose at a fire. They should be pointed at where they are needed most.

"Finally, it has to be interoperable. The Army has to be able to talk to us and we to them."

The CAS Test Program

The AFTI/F-16 CAS demonstration program is a three-stage effort that increases in difficulty and complexity at each stage. The first stage, completed in 1988, was a test of a digital data link from forward air controllers to the AFTI/F-16.

The second phase, now under way, centers on the testing of two-ship attack procedures and manual night attacks. The third stage will work up to multiple target acquisition.

"The test program is not linked to a specific aircraft," notes Major Drew. "We are waiting on the ultimate decision on a replacement CAS aircraft. We hope to transfer the technologies we develop here into the A-10, OA-10, F-16, and CAS-X [a close air support, experimental aircraft], whatever that turns out to be. There are a lot of possibilities as to where we can go."

The first stage, CAS I, is viewed at ASD as a complete success. Flights at Edwards AFB, Fort Irwin, and the Superior Valley Tactical Range, all in California, demonstrated the feasibility of a new digital Automatic Target Handoff System (ATHS), which allows for accurate, high-speed, low-altitude, one-pass attacks.

USAF believes that the concept of one-pass attacks will be central to future CAS battles. In addition to maintaining the element of surprise, the technique will make it possible for CAS aircraft to destroy a target and make an escape. The need for a second pass would give surface-to-air missile operators or antiaircraft artillery gunners a better chance to track and shoot down American CAS aircraft. Like this one, all the other technologies to be demonstrated in the test program are based on the need for USAF planes to destroy a target on the first pass.

The early flights in CAS I were tests of refinements made to the

AFTI/F-16's Digital Terrain Management and Display System, which includes the Sandia Inertial Terrain-Aided Navigation computer algorithms (giving the pilot navigation data accurate to within 160 feet) and improvements to the plane's helmet-mounted display (HMD).

Using the HMD as a cuing device, USAF test pilots conducted five attacks with conventional, ten-degree pop-up deliveries on targets at Fort Irwin. Such typical CAS targets as tracked and wheeled vehicles, air defense sites, and bridges were attacked in the tests.

The next step was a demonstration of the ATHS, which allowed for the first-ever Army-Air Force "voiceless" CAS operations. This is important because forward air controllers currently would have to call in strikes via voice radios. These devices are vulnerable to jamming or the all-too-frequent attack pilot response, "Say again?"

Using the ATHS digital data link, Army pilots flying in Bell OH-58D Kiowa scout helicopters relayed target data directly to the AFTI/F-16's computer. Information such as initial route waypoints, position of friendly forces, and target locations were plotted directly on the plane's moving-map display. The data transfer was made in fewer than five seconds, and it eliminated the AFTI pilot's need to write down the standard nine-line target briefing as he heard it over the radio.

"The data put the pilot's eyes close enough to the target at first glance that it was good enough for target acquisition," notes Major Drew. "Not having to look all around allowed the pilot to have the target in sight—sometimes in excess of several miles—before he had to start the attack maneuver. This reduced the attack timeline by one-third."

The Next Step

The major goals for the CAS II phase of the program include demonstrations of enhanced internetting, all-terrain ground collision avoidance, and a manual night attack capability. This phase of the program was scheduled to end earlier this year.

Flights of the AFTI/F-16 to demonstrate enhanced internetting began last December at Fort Hood, Tex., with the General Dynamics F-16B company demonstrator used as the second aircraft. The AFTI/F-16 pilot acted as the spotter, acquiring the targets with either a Pave Penny laser spot tracker or a digital message from the ground. Using the ATHS, he transmitted the data to the F-16B. Its pilot then had the same target information, whether he had visually acquired the target or not.

"We used ATHS as a command and control network," says Major Drew. "This way, data on multiple targets can be given to a flight of aircraft. They will then be able to take out more of the targets on the first pass."

Before continuing to the next segment of the CAS II tests, the AFTI/F-16 will undergo extensive modification. The aircraft's radar will be replaced with the APG-68 radar installed in current production model F-16Cs, and the AFTI's avionics and flight-control equipment will be brought up to the current F-16/Block 40 standards.

The aircraft will also get a head-steerable navigation forward-looking infrared (FLIR) sensor, further improving its sensor suite. The major external change will be the re-

In the successful first phase of the technology demonstration effort (CAS I), an Army pilot used the McDonnell Douglas-built, mast-mounted sight on the OH-58D's rotor hub to generate images (as seen on the two multifunction displays on the panel at left) that conveyed targeting information to the AFTI/F-16's pilot (above).

When the AFTI/F-16 emerges from its refit later this year, the aircraft will have the APG-68 radar that is fitted in current production F-16s, and the avionics will be brought up to the Block 40 production standards. The AFTI/F-16 will also get a head-steerable, forward-looking infrared sensor, but its trademark canards will not be replaced.

moval of the AFTI/F-16's trademark canards.

Then testing will resume. One of the original algorithms developed for the AFTI/F-16, the Automated Maneuvering Attack System (AMAS), will be used as a demonstration of a weapon delivery while avoiding collisions, based on specific terrain as presented by the digital map. The AMAS, which links the plane's flight-control system with the entire avionics system, is normally used to fly unconventional attack profiles. In fact, AMAS allows the pilot to release weapons even when flying in five-G horizontal turns.

A ground collision avoidance system backs up the normal terrain-following/terrain-avoidance mode of the radar and will be integrated with digitized landmass data. The system predicts the aircraft's flight path through the surrounding terrain and will signal an impending impact with the ground to the pilot. If the pilot does not respond, the system will automatically fly the aircraft out of danger.

The final objective in CAS II is the demonstration of a night attack capability. The major problem is that current night vision goggles are not ejection-safe, and a combined HMD/NVG system that the pilot can wear if forced to eject is necessary. This combination will allow the pilot to monitor aircraft position and performance regardless of where he looks outside the cockpit. The helmet will be integrated with the FLIR sensor.

The Advanced Stages

"What we will do in CAS III," says Major Drew, "is 'smash' all these sensors and capabilities together and fly off of them. We want to have as much automatic control and detecting capability as is needed to do the job."

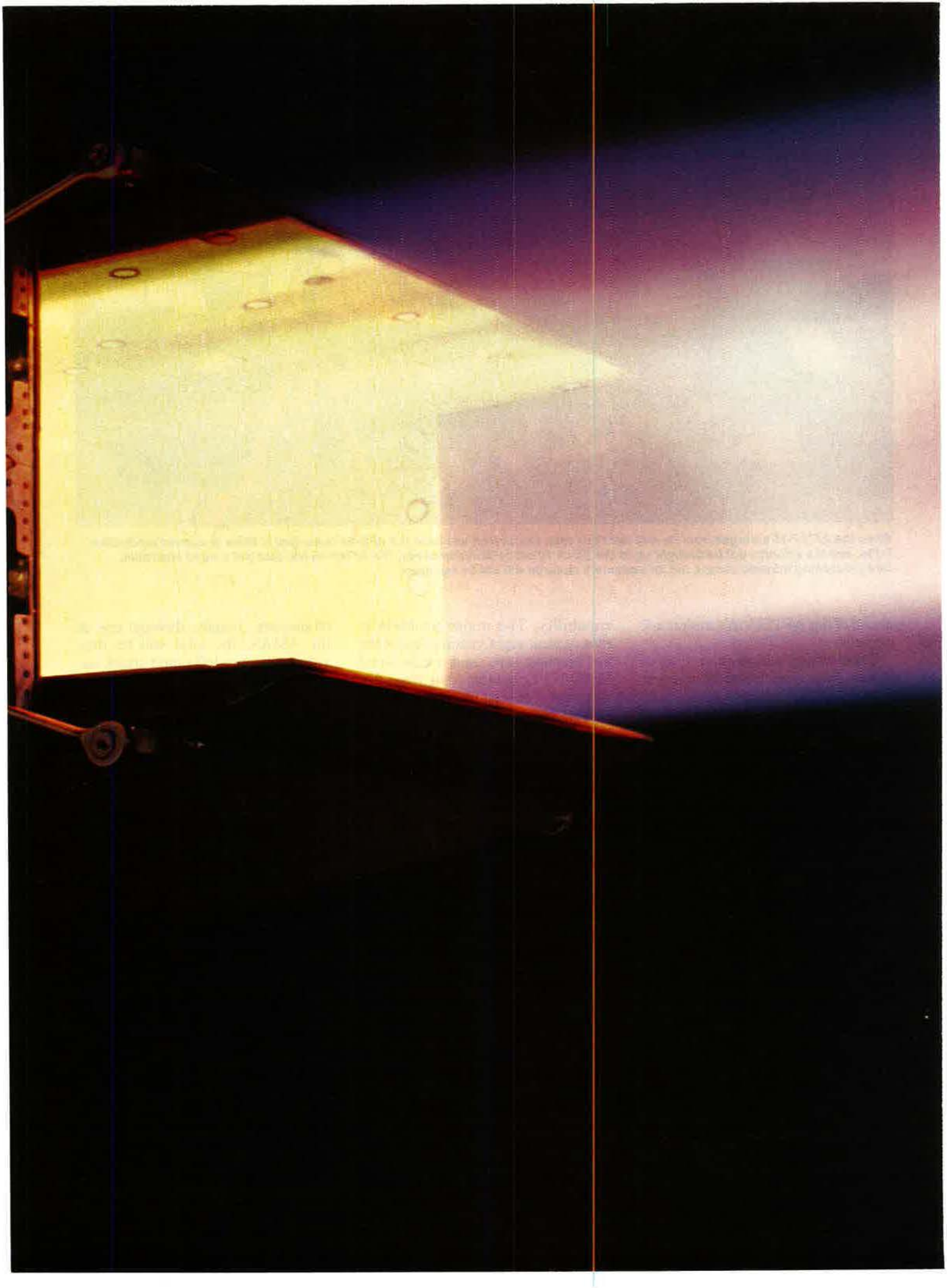
The major goal for CAS III (scheduled to be completed at the end of FY 1991) is to demonstrate the ability to conduct covert, day/night, all-weather penetration and attack. This will be accomplished via use of a digital database that will be programmed with enough route, target, and threat information to greatly reduce the pilot's work load.

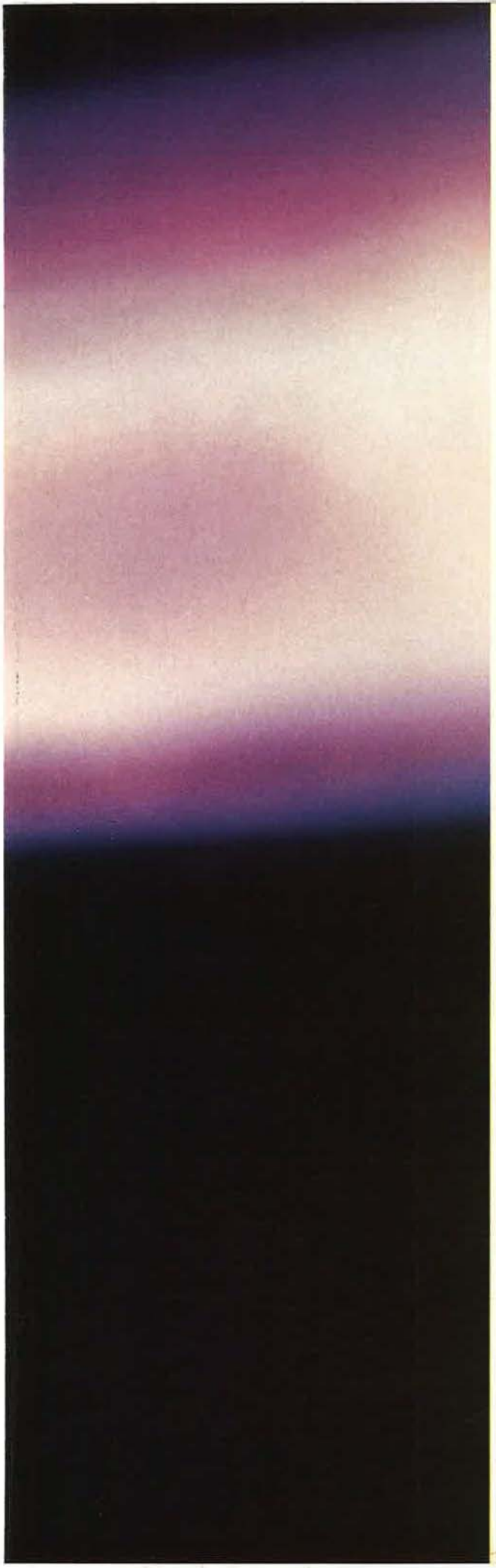
Once in the target area, the pilot will get a sensor cue from a variety of sources. Finally, through use of the AMAS, the pilot will be provided with standoff target attack capability, even in the maelstrom that will be found in the low altitudes over a battlefield.

"I'm not saying that the CAS-X airplane will have to do all of this," says Major Drew. "We want all the automation in the airplane that is possible. The pilots will be the ones to decide how much is necessary on any given mission. But we have to have the capability there."

The technologies that will come from this program are many. Enough will be known about the application of technology to close air support that the Air Force will have design and application criteria for CAS aircraft.

The fighter community will have acquired flight-validated algorithms for all-terrain ground collision avoidance, terrain-following/terrain-avoidance, and threat avoidance. In addition, a proven, integrated system that includes a digital data link, digital terrain systems, and sensor data and that also has a capability for limited emission tactical operations will be available. ■





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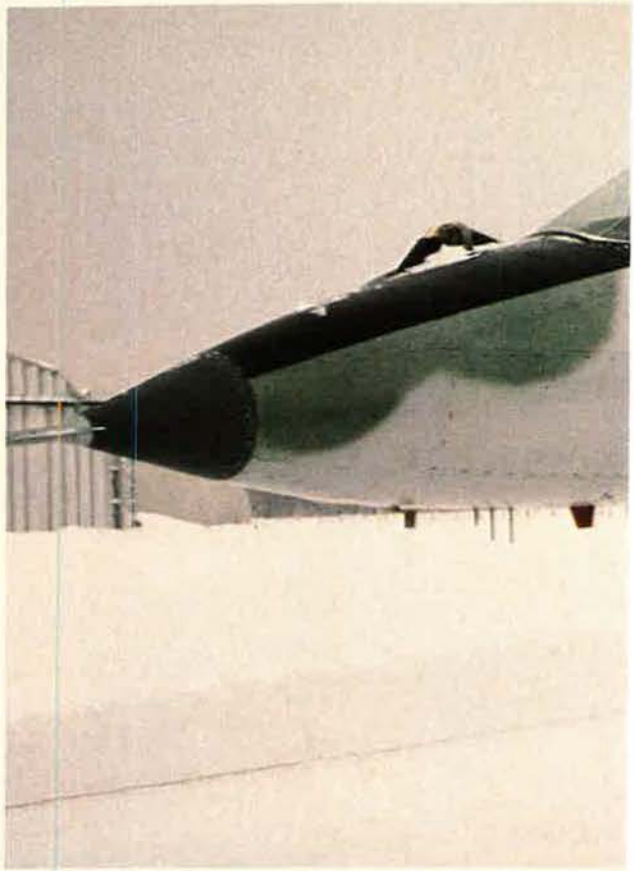
Flying with Mikoyan's chief test pilot, a Westerner puts a Soviet fighter through its paces.



Pilot Report: MiG-29

By Benjamin S. Lambeth

THE USSR first demonstrated the MiG-29 to Western viewers in 1988 at the Farnborough Air Show. Since that time, the Mikoyan Design Bureau has become a major force in Western aerospace circles. MiG-29 flights were key attractions in 1989 at the Paris Air Show and the Abbotsford Air Show near Vancouver. For the latter, MiG-29s flew via Elmendorf AFB, Alaska, the first time since World War II that Soviet combat aircraft have landed on US soil. At these events, I built up close contacts with Valery Menitskii, Mikoyan's chief test pilot. On one occasion, I noted that I would welcome a chance to be the "first American analyst" to fly a MiG-29. On August 16, 1989, when the MiGs landed at Elmendorf on the way home, I was part of USAF's greeting party. There, Menitskii extended an invitation: On my next trip to Moscow, I could plan on flying. No reciprocal gesture from me was sought. The occasion for my flight was a previously planned research trip to Moscow with two RAND colleagues.

The MiG-29 (called "Fulcrum" by NATO) is a twin-engine combat aircraft about the size of a US Navy F/A-18 Hornet. It is very similar in design to the Sukhoi Su-27. Although operated primarily as a counterair fighter, the MiG-29 has full dual-role combat/attack capability.

I piloted the MiG-29 on December 16, in weather as nonconducive to flying as any I have experienced. Menitskii had ferried Mikoyan's two-seat MiG-29UB company demonstrator from Soviet Flight Test Center at Ramenskoye to Kubinka AB, southwest of Moscow, where I boarded the aircraft after a short briefing.

The original plan was for me to fly the aircraft from the front cockpit. Because of severe weather, however, Menitskii decided at the last minute that he should sit up front. I had no quarrel with this. We manned up in blowing snow, with a low ceiling and very poor visibility. Indeed, our first attempt to get airborne was scrubbed in hopes that the weather would improve.

Within an hour, the ceiling had lifted to the point where Menitskii was ready to give it another try. We gathered our gear and returned to the aircraft, which Mikoyan personnel already had cleared of snow, and prepared for another attempt.

With ground power back on and the canopy down to the cracked position, Menitskii and I did a quick intercockpit communication system (ICS) check. We then got the report from the automatic terminal information service, had a terse exchange with the command post, and began the engine start sequence as Menitskii closed the canopy fully. Our call sign was Menitskii's pilot number—817.

The Tumansky R-33D engines in the MiG-29 can only be started from the forward cockpit. Menitskii selected an automatic start sequence. The right engine cranked first and stabilized in idle at around seventy percent rpm, at which time the left engine start sequence commenced automatically.

The fan turbine inlet temperature (FTIT) gauges showed no movement in the rear cockpit, even though we had a steady rpm rise and it was obvious that we had accomplished a good lightoff on both engines. When I informed Menitskii of this, he replied that the FTIT readout was selectable to the front or aft cockpit and that he was getting a good indication. Maj. Bob Wade, a Canadian Forces pilot who had flown the MiG-29 at Abbotsford, later told me that the FTIT peaked at 750 degrees Centigrade

on each engine during start and then stabilized at around 450 degrees Centigrade at flight idle. As both engines attained idle rpm and the generators came on, the inlet foreign-object damage prevention doors cycled shut and the alternate louvers on each wing root leading-edge extension came open. The inlet doors remain closed until weight comes off the nosewheel during rotation. Then the louvers close and the hydraulically actuated inlet doors cycle open.

We got taxi clearance and rolled out of the chocks no more than four minutes after start sequence began. This told me that either Menitskii had entered a stored heading into the inertial navigation system (INS) before shutting down after his arrival at Kubinka or that the aircraft has a very fast-aligning inertial platform. In such marginal weather, it is unlikely that Menitskii would have accepted anything less than a full alignment for our flight.

Taxi and Takeoff

Once the canopy was closed, a periscope mounted atop the canopy center frame popped open, and a small rectangular mirror extended downward to permit visibility of the taxiway and runway over the nose from the aft cockpit. The image was focused on infinity, with the horizon on the mirror precisely aligned with the true horizon. This gave the effect of looking through the ejection seat headrest in the front cockpit. Use of the periscope is optional, and it must have been selected by Menitskii, since I did nothing to open it. The periscope closes automatically upon gear retraction and reopens when the gear is selected down.

It took a five to ten percent increment of thrust above idle to get the MiG moving. Menitskii taxied down the parallel taxiway to the departure end of Runway 04, then taxied the length of Runway 04 before making a 180-degree turn at the end for takeoff on Runway 22. Final external inspection of the aircraft must have been done by Mikoyan technicians before we left the parking area, since we did not hold for a last-chance quick check in the arming area as is standard US practice. The runway and taxiway were covered with packed snow and ice.

During taxi for takeoff, I tried to decipher the vertical fuel-quantity indicator. It read in liters and featured several pointers whose function was not clear. I abandoned the effort and later found myself periodically asking Menitskii about our fuel state. Invariably he would laconically answer, *"Normalno."*

With Menitskii holding the brakes, power was advanced to 100 percent. The nosewheel oleo strut compressed noticeably from the added thrust, with the pitot tube seeming to spike itself into the runway. There was no tendency for the tires to rotate on the wheels at full military power.

Because of the poor weather and Menitskii's desire to conserve fuel in case a divert became necessary, we made a nonafterburner takeoff. After a quick scan of the engine gauges, Menitskii released the brakes and said, "You've got it."

I came on the controls at that point and performed the takeoff sequence. The MiG-29 comes with nosewheel steering, which I assume was selected to a low-gain mode. It took considerable rudder pedal movement to keep the nose centered in the first fifty to sixty kilometers per hour (kph) of takeoff roll. The aircraft accelerated rapidly in military power, and the rudders became effective almost immediately. As briefed, I came back with the stick at 200 kph indicated and rotated the aircraft to a five-degree nose-high attitude for takeoff. The aircraft flew itself off the ground at around 230 kph.

The stick required a noticeable tug to bring the nose up, although the feeling was not unnatural. At that moment, I ceased thinking "MiG-29" and told myself that I was flying a generic fighter, with certain airspeeds and other parameters to monitor. I decided that I would simply concentrate on flying the airplane and make mental notes about its handling characteristics whenever they caught my attention.

As the MiG accelerated in a gradual climb, I called for gear and flaps, which Menitskii selected up. Maximum allowable gear-down speed is 500 kph indicated. We were at or beyond that as we approached the end of the runway. Menitskii called

The author suits up for his flight. Contrary to Western practice, Soviet pilots wear their G-suits, made of a light, thin, nylon-like material, under their flight suits. The rest of the Soviet cold-weather flying ensemble includes heavy socks, flight overalls, boots, a summer-weight flight jacket, a winter jacket, helmet, mask, and gloves. The helmet, though substantially larger than USAF-issue, is surprisingly light and comfortable, with an internally mounted visor. The mask microphone is supplemented by a strap-on throat microphone.

for a right turn out of traffic, which I executed, noting as I looked back that we were pulling a slight smoke trail.

Straight and Level

I had barely rolled wings level on a northeasterly heading when we entered solid overcast at 200 meters above ground level (AGL). I heard Menitskii talking with what I assumed was a departure control agency. I could feel him overriding me on the controls to stay on his desired heading as I continued an instrument climb.

I began to feel the effects of the language barrier at this point, though my Russian was more than adequate and I had made a strong effort for weeks to master basic fighter operations terminology. We didn't have the banter between cockpits that would have been normal under other circumstances. I had to be deliberate in what I asked, although Menitskii always understood me and, for the most part, I understood him. Anytime I felt clueless, which was often while we were in the weather, I would simply say "Valery pilot" and give him back the aircraft.

We broke out at around 1,500 meters AGL and found ourselves between heavy cloud decks, with no blue sky and practically no horizon reference. I noticed a lighter area off the left wing and suggested to Menitskii that we might work to the north in search of a partial clearing. The horizontal situation indicator (HSI) in the MiG-29 is similar to the standard USAF HSI with an analog DME (distance-measuring equipment) readout in kilometers in the upper left-hand box and a needle inside the compass card to indicate the heading to the selected station. It was reassuring to have this, since we were above a solid cloud cover throughout most of the flight. As it turned out, we never ventured more than thirty kilometers from Kubinka.

The rear cockpit featured a Western-style altimeter that indicated in feet. This had been installed in the demonstrator aircraft so the pilot could comply with air traffic control in transits through international airspace en route to and from the air shows. I found little problem orienting myself to unfamiliar airspeed indications in kilometers, but I found it comforting to have a "real" altimeter that read in feet. Particularly when one is close to the ground in an unusual attitude, such as a split-S recovery, it helps to know immediately just how much play room one has left without going through the mental gymnastics of converting meters to feet.

The Flight Profile

It quickly became obvious that we were not going to find better flight conditions. Menitskii indicated that we should press ahead and make the best of what we had. The maneuver sequence we flew consisted of these events:

- Three loops, one flown by Menitskii and two by me.
- A split-S performed by Menitskii and a second one by me.
- Four consecutive high-rate aileron rolls by me, followed by three maximum-rate aileron rolls and ten seconds of inverted flight by Menitskii.
- An unloaded roll by me.
- Two hammerhead turns, with Menitskii first demonstrating and me then repeating.
- Finally, a hard level turn at 7.5 Gs by me.

Once Menitskii completed the first loop, I resumed control of the aircraft and got us established, wings level, at about 6,000 feet for the next one. With throttles at military power and airspeed accelerating through 500 kph, I began a four-G pull and immediately began looking for a horizon reference. The effect was like flying inside a milk bottle. Without a distinct horizon and no ground reference except barely discernible cloud tops below, I looked back in the cockpit to cross-check the attitude indicator.

The attitude reference system was unlike anything I had ever seen, with a vertically rotating drum to indicate pitch attitude and a separate airplane symbol superimposed that rotated through 360 degrees of arc to indicate bank angle. Considerable rudder input was needed to hold the nose in a constant plane as I maneuvered the aircraft past the vertical. I could feel Menitskii continuously adding rudder corrections as the airspeed bled off.

With the attitude indicator giving me disorienting cues as the aircraft approached the halfway point, I looked back outside and rolled wings level to the nearest horizon, which was a ragged ceiling at around 12,000 feet. We came over the top inverted at around 200 kph and completed the loop sequence. I applied more back stick during recovery than Menitskii thought necessary, but the aircraft never exceeded 5 Gs, and I experienced no sensation of buffet at any point throughout the maneuver. Evidently the aircraft does not automatically trim to 1-G flight as does the F-15/16/18 class of fighters, since I recall having to trim during airspeed transients during the loop and at other times.

I could observe the maneuvering flaps sequencing on the flap-position indicator and assumed they were automatic. Since it was impossible for me to see any part of the wing from the aft cockpit, even with the seat raised to the full up position, I was unable to monitor the leading-edge flap. Nor could I tell whether the ailerons washed out at high angles of attack, since all I saw was the top half of the vertical stabilizers through large rear-view mirrors mounted on either side of the rear canopy bow.

Visibility from the aft cockpit was noticeably poorer than from any current US fighter. Visibility from the front seat (or out of the single-seater) is undoubtedly better, although it continues to be limited by high canopy rails and an obstruction in the 5:00–7:00 cone created by the aft canopy bulkhead.

A Different Operational Philosophy

This is not surprising, though, considering that the MiG-29 has been designed according to an operational philosophy very different from that behind Western fighter design—at least up to now. The Soviet concept of fighter employment remains heavily tied to off-board command and control, from either a GCI (ground controlled intercept) site or an airborne command post. Under this arrangement, the mission controller will continue to give steering commands to the pilot until the terminal stages of an intercept are attained and he is near a firing solution.

Apparently in keeping with this

employment doctrine, the MiG-29 cockpit is not configured to maximize pilot situation awareness. A typical engagement profile would more likely feature a high-speed slashing attack, followed by a blow-through, rather than a pitchback, to engage the opponent in a turning fight. In addition to restricted visibility, the absence of handgrips around the cockpit indicates that the MiG-29 is not routinely operated with high-G wrenching and turning or close-in, high angle of attack maneuvering in mind, though it possesses outstanding performance characteristics in that regime.

Completing the loop and split-S sequence, I accelerated to 600 kph (maximum speed on the flight), pulled the nose twenty degrees above the horizon, and executed four consecutive high-rate aileron rolls to the left. I did not apply any rudder and noticed a slight tendency of the nose to hunt around the roll axis. My control input (less than full stick deflection) produced a roll rate of around 270 degrees per second.

Menitskii then took the aircraft and performed three consecutive maximum-rate rolls, cracking my helmet against the canopy and generating a roll rate close to 360 degrees per second. In both Menitskii's and my consecutive roll sequences, I noticed no roll-coupling tendencies. Immediately thereafter, Menitskii trimmed to level flight and rolled inverted, sustaining this attitude for ten seconds as we hung in the straps.

A Flashy Finish

Next, Menitskii demonstrated his well-known hammerhead turn, which others had told me he could perform with a degree of virtuosity that "would do any crop duster proud." I was not aware that a modern fighter with limited rudder authority at slow speed was capable of performing this maneuver, at least not without a large application of asymmetrical thrust to help drive the nose around the yaw axis. After Menitskii completed his demonstration, I took control of the MiG-29. With no instruction from him and having never tried this trick in a high-performance aircraft, I simply tried to emulate Menitskii by repeating my own last hammerhead maneuver—in a Beechcraft T-34 more than ten years ago.

At 500 kph indicated, I entered a 4-G pull and continued bringing the nose up until the aircraft reached an eighty-degree pitch attitude, at which point Menitskii said, "Stop." I then held that nose position with the throttles set at military power and let the airspeed decay to around 250 kph, at which time I applied full left rudder and enough opposite aileron to keep the outside wing from picking up as it generated extra lift in the yaw.

I could feel Menitskii on the controls with me intermittently throughout the maneuver. The nose of the aircraft carved an effortless arc around the yaw axis during the float from right to left. I felt that I was in full control throughout this maneuver and could vary the yaw rate easily by playing the amount of rudder input. I could see enough horizon to complete the maneuver symmetrically using visual references. I allowed the nose to arc through as we headed back downhill, left the power where it had been set at the time of entry, and executed a 4-G pull to a wings-level recovery on a reciprocal heading.

I did not get to perform two briefed maneuvers, no doubt because of Menitskii's reluctance to get into exaggerated flight regimes in such poor weather. The first was a full aft-stick, wings-level stall, with the angle of attack pegged at thirty units (the redlined maximum indicated) and the stick held back to override a stall warning system. The other was the tailslide that attracted world attention when done at Farnborough by Anatoly Kvotchur.

Earlier, Menitskii had spoken proudly of the MiG-29's stable handling characteristics in the tailslide and told me to expect completely controllable and predictable performance throughout. I said that this could hardly be considered a serious combat maneuver, since it would be foolish to sacrifice all of one's energy in such a manner, even in a last-ditch situation. He concurred and said that its purpose was to demonstrate the exceptional aerodynamic efficiency of the aircraft.

Though I did not get to do the tailslide, Major Wade performed it twice at Abbotsford. As he recounted, he entered at about 3,000 feet AGL, brought the nose up to the pure vertical, retarded both throttles to idle, allowed the airspeed to bleed to zero, and then advanced throttles from idle to full afterburner in a single movement while still in a fully developed tailslide. He reported achieving a simultaneous afterburner lightoff in two seconds and was easily able to

The roomy cockpit of the MiG-29 resembles USAF F-105/F-4-vintage design. The author's cockpit (above) had a few vertical tape instruments and many round analog dials. G-suit, oxygen, and communications leads were on the left. The throttles moved along horizontal bars mounted against the left side wall. The inboard throttle carried a speedbrake switch and an ICS button. There was no radar display, but there was a keypad with digital readouts that may have been part of the INS system.

bunt the nose forward out of the maneuver for a nose-low recovery, with full stabilizer authority and no tendency of the aircraft to roll off at any time.

Descent and Approach

After the hammerhead sequence, Menitskii resumed control, contacted ATC, and reentered the weather on an en route descent to Kubinka. We broke out at around 900 feet AGL, headed toward the runway at an angle of about forty-five degrees left to right. Menitskii brought us down to about 200 feet AGL and directly overflew the headquarters building, at which time I shook the stick, took the aircraft back, and asked if I could do a little low-level flying. Menitskii replied that low flying was prohibited in that area. He also was not eager to let me take the aircraft out to its normal operating limit of 9 Gs. I did, however, execute a hard level turn to the left just below the cloud deck, continuing through about 270 degrees of turn and peaking at 7.5 on the G meter. I sensed the G-suit starting to inflate at about 3 Gs but otherwise was rarely aware of its operation. With constant G maintained through most of the turn, the airspeed bled from 550 to about 400 kph. I sensed absolutely no buffet either then or at any other time.

At this point, Menitskii again took control of the aircraft with the airfield at our 4:00 position. He set us up for an instrument landing system (ILS) approach on Runway 22 and allowed me to resume control as he extended the gear and flaps. I was instructed to maintain 300 kph on the approach. The pitch and bank steering command bars on the HSI worked about like ours. I called the runway in sight and flew a long straight-in approach while straining to orient myself outside the cockpit. I did not see a visual approach slope indicator, though there were bright white runway threshold lights and a row of red lights to assist with lineup. I could barely make out the runway over the nose, even with the periscope, so I continued to fly the ILS while visually cross-checking the airfield environment until I lost the runway under the nose altogether.

Throughout, we used the basic control augmentation mode (one of six flight-control system modes). Apparently Menitskii had selected a coupled CAS-ILS mode for the approach, because at one point I heard a female voice warning, *"Glissad opasno"* ("Glide dangerous"). On cross-checking the HSI, I noted that we were about one bar-width low, so I added power to reintercept the glideslope.

Severe weather at Kubinka AB brought about a change of plans: Mikoyan pilot Valery Menitskii, instead of the author, flew in the front cockpit. They took off from a runway covered with packed snow and ice but were able to land on a cleared portion with the aid of the drag chute.

As we neared the airfield perimeter, Menitskii said "Valery pilot" and took the aircraft back at the last moment for a perfect spot landing on the cleared portion of the snow-covered runway. We touched down at 240 kph indicated. Menitskii made no effort to aerobrake and instead promptly lowered the nose for a firm touch on the runway. A few seconds into the rollout, he deployed the drag chute just as I had hit the ICS button to ask if we would be using it.

My flight was never intended as a formal performance evaluation. I am not a test pilot trained to detect the handling subtleties apparent to one with greater experience. The weather limited us to sampling a small portion of the MiG-29's operating envelope, though Menitskii had intended to show me more.

My flight was far more significant for its political than for its aeronautical implications. Over fifteen years, I have entered twenty-seven fighter, attack, and jet-trainer aircraft types into my logbook and flown with every major component of USAF, Navy, and Marine tactical air arms, as well as with foreign air forces. None of these experiences matches my precedent-setting half-hour sortie in the winter sky over Moscow. Mikoyan's chief designer confirms that I am the first American to fly the MiG-29 and the first Westerner to fly any type of fighter or attack aircraft in Soviet airspace since World War II.

This is yet more evidence that the USSR is changing in ways few would have expected, or even imagined, a year ago. If current trends continue, a day may come when Soviet test pilots (perhaps including Menitskii) will have a turn in a front-line US fighter and US pilots will do likewise in the Soviet Union. As the Soviet Union continues its reform effort, open dialogue between defense professionals such as Valery Menitskii and me could become increasingly commonplace. Despite all the issues that divide the two superpowers, it strikes me as a goal worth pursuing. ■

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The defense program, already cut sharply, is in for still more cutting before Congress gets through with it.

The Budget Heads Downhill

By Robert S. Dudney, Executive Editor

JUST two months after it was launched, the Pentagon's high-stakes campaign to preserve US military power is faltering.

The proposal by President Bush to spend $1.5 trillion over five years to maintain core elements of US strength faces serious danger. Threatening his plan to shape a smaller but potent post-cold-war force are several factors:

- Intense budget-cutting fervor in a Congress that seems bent on slashing many more billions from an already minimal program.
- Mounting opposition to the B-2A bomber and the Peacekeeper and Midgetman ICBMs, keys to US strategic modernization plans.
- Sharp pressures to cut or curtail new conventional weapons once earmarked to fight Soviet forces in Europe.

The President's defense program is not dead, but it has clearly slipped into deep trouble. Even Administration officials concede that the President must now scramble to prevent wholesale force reductions and keep basic program elements intact.

With the unveiling on January 29 of the Pentagon's new $295.1 billion budget request for Fiscal Year 1991, Secretary of Defense Dick Cheney proposed a defense blueprint that cuts troops, tanks, ships, and aircraft. Further, it calls for Pentagon budgets to decline by two percent each year, after inflation.

Even so, defense expenditures in Fiscal Years 1990–94 would total about $1.5 trillion—a sufficient amount, in Cheney's view, to permit an orderly reduction of US forces and still keep them modern and combat-ready.

The fundamental requirements, Cheney insists, are "that we cut in an intelligent fashion, that we build down gradually, and that we do so in a fashion that preserves the essence of our military capability, that preserves a quality force."

Congress Sharpens the Axe

Lawmakers, however, are serving notice that they are prepared to impose more radical cuts. No sooner had Cheney taken his downsized 1991 budget to Capitol Hill than Sen. James Sasser, the Tennessee Democrat who heads the Budget Committee, warned that Congress "at a minimum" would cut it by another $10 billion, a claim echoed by Sasser's House counterpart, Rep. Leon Panetta (D-Calif.).

"I don't think there is any chance in the world," Sasser warned Cheney, "that Congress will give you the budget you requested."

Congressional critics—and they are many—maintain that the Pentagon has failed to react strongly enough to sweeping changes in the Soviet Union and eastern Europe. Rep. Les Aspin, House Armed Services Committee Chairman, found Cheney's cuts to be too "timid," suggesting that big programs will be axed. Sen. Sam Nunn, Chairman of the Senate Armed Services Committee, claims that the Pentagon has no "clear vision" of where it is going.

Equally intense is criticism of strategic programs. Aspin thinks it is "very unlikely" that Congress will fund the number of B-2 bombers the Air Force wants. Three past chairmen of the Joint Chiefs of Staff took a shot at the Pentagon plan to deploy ten-warhead LGM-118A Peacekeeper ICBMs in railcars and the single-warhead MGM-134A Midgetman in mobile launchers.

Gen. David Jones, USAF, Gen. John Vessey, USA, and Adm. William Crowe, USN, all advised Congress to put these programs on hold pending the outcome of START negotiations.

Lawmakers also are turning their guns on service plans to field a new generation of conventional systems. Attracting strong attention are two USAF programs—the Advanced Tactical Fighter and C-17 strategic airlifter—and the Navy A-12 Advanced Tactical Aircraft, a plane USAF also intends to buy. All are expensive. Some critics claim that, with the Soviet threat declining, such weapons have become expendable.

The Administration wants to pursue a cautious approach to restructuring US forces. Secretary Cheney points out that the Soviet Union still maintains 600,000 troops in Europe. While dangers of a "premeditated" Soviet attack there have declined, he notes, "the volatility and unpredictability of the situation there has, in many ways, increased the chance of an inadvertent conflict." Furthermore, he claims, potential US foes elsewhere in the world are building large, advanced arsenals.

In light of this, Cheney has proposed what he describes as "prudent" cuts in the previously planned 1991 budget, though service leaders find them painful indeed.

Only last April, President Bush planned to request $317.5 billion for the Pentagon in 1991. The actual, $295.1 billion arms budget represents a 2.6 percent decline from 1990 levels and an up-front cut of $22.4 billion in previously planned 1991 levels. The Air Force's budget was capped at $94.8 billion.

A Dramatic Decline

Even more dramatic is the long-term defense funding decline outlined in the President's new plan. In his April 1989 program, President Bush proposed to spend $1.666 trillion on defense in Fiscal Years 1990–94. That figure has now dropped to $1.499 trillion, a loss of some $167 billion in just nine months.

The Pentagon says that, under the latest plan, the DoD budget in 1995 would consume only four percent of the Gross National Product, the lowest share in more than fifty years and a full percentage point less than today. The defense budget as a share of federal outlays would fall to twenty-one percent, also the lowest share in more than fifty years.

In reducing the 1991 Pentagon budget, Cheney was obliged to administer cuts in important areas. One is investment. Funding for procurement falls from $81.5 billion this year to $79 billion in 1991, a one-year decline of 9.1 percent after the effects of inflation are discounted. From 1990 to 1991, funds for research and development fell one percent.

Cheney noted that Congress approved termination in FY 1990 of production funding for the V-22 Osprey aircraft, new production of the F-14D fighter, the F-15E fighter, the Army Helicopter Improvement Program, the AIM-54 Phoenix missile, and the M88A2 improved recovery vehicle. With these terminations, the Pentagon will save $3.425 billion that would have been spent in 1991.

Even Administration officials concede that the President must now scramble to prevent wholesale force reductions and keep basic programs intact.

The Pentagon came up with another fourteen program terminations in 1991. Total savings for these will be $2.976 billion in 1991.

The Army was hardest hit. The Pentagon will terminate production of the service's main M1 tank after the 1991 buy, which will be funded by $1.4 billion diverted from 1990 accounts. The Abrams tank plants in Detroit, Mich., and Lima, Ohio, will be laid away.

Other Army program terminations include the AH-64 Apache attack helicopter, the non-line-of-sight missile, the Chaparral missile, and the Mk 19 grenade launcher.

The Air Force's budget protects big strategic and conventional weapon programs but eliminates some low-priority ones. These include the AGM-65 Maverick air-to-ground missile, AIM-132A Advanced Short-Range Air-to-Air Missile, Airborne Self-Protection Jammer program, Combined Effects Munition, Follow-on Wild Weasel, Air Base Survivability, and autonomous precision-guided munition.

The Navy loses the Sea Lance, an advanced standoff weapon for anti-submarine warfare operations and smaller programs.

Total new four-year savings for the twenty programs comes to $28.3 billion.

Other programs, though they will continue, saw their budgets reduced significantly. This is especially true in the Air Force, where three high-profile conventional programs were slowed for various reasons. The 1991 budget proposes about $1 billion for the Advanced Tactical Fighter program, $600 million less than the Air Force planned, as a result of USAF's decision to delay full-scale development for six months. Planned 1991 procurement of the C-17 airlifter, once pegged at ten aircraft, is now set at six. USAF is cutting from 2,000 to 1,250 the number of Advanced Medium-Range Air-to-Air Missiles it intends to buy in 1991.

Some aircraft modification pro-

grams were cut back. Changes were made to the pricing and scheduling of the F-15E program and the Defense Support Program. Communications and electronics programs were reduced.

More Force Cuts

In addition to cutting programs, Pentagon budgeteers took another whack at force structure, which has been going down for two years. Left intact, for the moment at least, were strategic forces. They will continue at 1990 levels. Conventional forces took the hits.

The revised 1991 plan calls for the Army to eliminate two active US-based divisions—the 9th Infantry Division at Fort Lewis, Wash., and the 2d Armored Division at Fort Hood, Tex. That will leave the Army with sixteen active divisions, the same number it had before the Reagan rearmament program.

In 1991, the 556-ship Navy will experience a net loss of ten ships. It will retire two of its four *Iowa*-class battleships, only recently taken out of mothballs and refurbished at great expense. The Navy will begin planning for deactivation of a nuclear cruiser in 1992 and a second in 1994. Also to be retired are three *Permit*-class attack submarines over and above three already targeted in Bush's April 1989 budget revision, and another two *Sturgeon*-class boats.

Faring somewhat better were the Air Force and the Marine Corps. USAF is called on to deactivate fourteen conventionally armed B-52G bombers based at Andersen AFB, Guam, and to dispense with WC-130 weather reconnaissance planes. The Marines will begin planning for deactivation of fourteen artillery batteries.

Under Cheney's plan, the US conventional military force in 1991 will have thirty divisions (sixteen active and ten reserve Army units, plus three active and one reserve Marine units); fifty-five tactical air wings (twenty-four active and twelve reserve Air Force units, thirteen active and two reserve Navy units, and three active and one reserve Marine units); and 546 battle force ships built around fourteen deployable aircraft carriers.

With force structure declining, the end strength of the military will fall to just 2,038,800 service members by September 1991. That is 38,000 fewer than this year, 91,400 fewer than last year, and about the same number as in 1980.

Apportionment of the 38,000 reductions falls most heavily on the Army and the Air Force. The Army in 1991 will have 728,000 soldiers, 17,000 below today's level. The Air Force will drop to 530,000 uniformed personnel, a one-year decline of 15,000. Both services in 1991 will have their smallest active-duty forces since 1950. As for maritime forces, the active-duty Navy will lose some 6,000 sailors, leveling off at 585,000. The Marine Corps holds on to all of its 197,000 troops.

Force structure changes initiated in 1991 would save a total of $7.5 billion through 1994—$1.7 billion in 1991 and $5.8 billion later.

Trimming Installations

For members of Congress, the Pentagon's most painful cuts focus on local military bases, the source of revenue and jobs for many local economies. Cheney proposes closing or scaling back seventy-two military installations at home and fourteen overseas. House Democrats complain that ninety percent of proposed domestic base closures are in Democratic districts. Cheney denies charges of partisanship, saying base-closure candidates were selected by the services.

The new budget also seeks $917 million to defray costs of closing bases targeted by the Commission on Base Realignments and Closures. By 1995, net savings will total $1.2 billion.

With the savings from such cuts, Secretary Cheney hopes to accumulate sufficient funds to meet what he sees as the nation's top defense priorities: high-quality personnel, technological supremacy, and a strong nuclear deterrent.

"If we're going to have a smaller force," says Cheney, "if we're going to have to operate with less money in future years, it's absolutely essential that we preserve the quality of the force."

Indeed, US military personnel came out pretty well in the new budget, all things considered. The plan proposes a new, 3.5 percent pay raise, continuation of current benefits, enlistment and reenlistment bonuses, and special pay for critical skills.

Equally important, the Pentagon appears determined to preserve the combatworthiness of sailors, soldiers, airmen, and Marines. The budget continues current training at what Cheney calls "effective" levels.

For USAF tactical fighter crews, that means 19.5 flying hours per month. Airlift crews will fly 30.2 hours per month and strategic crews 17.6 hours per month.

Army ground operating tempo, that service's primary training indicator, will continue to be 800 tank miles per crew per year. Army aviation crews will log 14.5 flight hours per month. Ship steaming days for the forward deployed Sixth and Seventh fleets will be 50.5 per quarter, and twenty-nine days per quarter for the home-based Second and Third fleets. Active-duty US Navy and Marine pilots will fly twenty-five hours each month.

Surviving Procurement Programs

Those major procurement programs that remain will also be relatively well-funded. For USAF, procurement funding will hit $31.5 billion in 1991, $5.9 billion less than originally planned. USAF aircraft procurement will total $14.2 billion, down from today's level of $15.3 billion but still sufficient to fund purchases of the last thirty-six F-15E fighters, another 150 F-16 multirole fighters, and additional specialized aircraft. Missile procurement jumps from $6.6 billion this year to $9 billion.

Navy procurement is well below the pace set during the fleet buildup of the 1980s. As late as 1989, the Navy procured twenty-two ships and 207 aircraft. This year, it will be seventeen ships and 140 aircraft. In 1991, the Navy's procurement budget will pay for only fourteen warships and 111 aircraft.

Major warship purchases include $3.7 billion for production of two new SSN-21 *Seawolf*-class attack submarines and continuing SSN-21 development activities; five DDG-15 *Arleigh Burke*-class destroyers equipped with the AEGIS air-defense system; and one LHD-1 *Wasp*-class amphibious ship. The Navy and Marine Corps will buy sixty-six F/A-18 strike fighters,

twenty-four AV-8B close air support aircraft, twelve remanufactured F-14A fleet defense interceptors, and six E-2C Hawkeye surveillance aircraft.

The biggest Army procurement programs in 1991 will be the purchases of seventy-two UH-60 Blackhawk helicopters, 600 M2 Bradley Fighting Vehicles, 817 Patriot air-defense missiles, 220 units of the Air Defense-Heavy system, 6,922 FIM-92 Stinger surface-to-air missiles, 13,946 TOW-2 antiarmor missiles, and 24,000 more Multiple Launch Rocket System rounds. Though the M1 tank is to be canceled in 1991, the Army will buy a last batch of 225 with funds culled from prior-year programs.

The Pentagon budget request also maintains major weapons development programs such as the Air Force's E-8A Joint Surveillance Target and Attack Radar System (Joint STARS) and AGM-131B SRAM-T air-launched nuclear missiles; the Army's replacement for the Lance short-range nuclear missile, LHX helicopter, and a tank of the future; and the Navy's stealthy A-12 attack aircraft and P-7A antisubmarine warfare aircraft.

The latest Cheney defense budget makes plain that the Secretary is determined to pursue across-the-board modernization of the US strategic nuclear forces. His budget supports major programs for sea, air, and land elements of the strategic triad.

In accordance with last fall's agreement with Congress, USAF seeks a whopping $5.5 billion to fund procurement of five B-2 bombers and its continuing development program. That marks a twenty-nine percent increase over B-2 funding this year.

To provide mobility for the Peacekeeper ICBM, the Pentagon wants Congress to approve $2.2 billion for rail-garrison basing, including $1.3 billion for procurement of the first seven missile trains. When planned purchases of twelve more missiles are thrown in, Peacekeeper funding would top $2.8 billion. The 1991 budget also contains $202 million to continue development of the Midgetman and its launchers, now set for deployment in 1997.

For the sea-based leg of the triad, $1.45 billion has been set aside to finance construction of the eighteenth Trident ballistic-missile-firing submarine and $1.75 billion for fifty-two UGM-133A, or D5, sea-launched ballistic missiles. There are advanced procurement funds for the nineteenth and twentieth Tridents, to be requested in coming years.

When it came to funding the Strategic Defense Initiative, there was no bow to the opposition in Congress. The Pentagon seeks $4.5 billion in research money for the "Star Wars" missile-defense system, up $900 million from 1990 levels. (The Department of Energy is requesting an additional $200 million for its own SDI activities.) The request reflects strong Administration support for the so-called "Brilliant Pebbles" concept of building space-based, kinetic-kill interceptors.

Cheney emphasizes that the 1991 reductions are the "first steps." More reductions would be in store if currently benign international trends continue.

"First Steps"

Cheney emphasizes that the reductions in the 1991 defense budget should be viewed as the Administration's "first steps" in responding to the reduced military threat that stems from internal decline in the Soviet Union and political upheaval in its former eastern European satellites. More reductions would be in store if currently benign international trends continue.

He and the services have begun work on developing a new 1992–97 Six-Year Defense Program that will be submitted to Congress next year. Long-range manpower plans envision cuts over five years totaling 200,000 military and 100,000 civilian defense workers. In addition to cuts already made, Cheney says, he might eliminate three more Army divisions and up to five Air Force and Navy tactical air wings and curtail construction of the Trident SSBN and other warships. Even the Navy's fleet of fourteen deployable big-deck aircraft carriers might be chopped.

These steps, Cheney emphasizes, won't—or shouldn't—be automatic. "*If* we get a START agreement, *if* we get a CFE [Conventional Forces in Europe] agreement, *if* eastern Europe goes non-Communist, *if* the Soviets can be persuaded to withdraw most of their forces from eastern Europe, then we can begin to talk about these other reductions."

Still, all signs are that Cheney will be hard pressed to hold the line even this year, given Congress's growing impatience to divert defense funds to help reduce the federal deficit and finance popular domestic programs. One seasoned veteran of the defense budget wars, Admiral Crowe, speaks for many in the Pentagon with this assessment of the danger: "It is not the thought of drawing down that bothers me as much as the 'land rush' mentality I see developing in some quarters. Building down [a military force] is harder than building up. There are two ways to do it: smart and dumb. Our history suggests that we usually do not draw down wisely." ■

The Chart Page

Edited by Colleen A. Nash, Associate Editor

Details of the Budget Drop

In January, President Bush presented to Congress a DoD budget request for Fiscal Year 1991 that is 2.6 percent below the FY 1990 level, adjusted for inflation. The proposal for the **entire defense program** (DoD activities and some activities in the Department of Energy and other federal agencies) is $306.9 billion in budget authority and $303.3 billion in outlays for FY 1991. The **direct program** (DoD activities only) is $295.1 billion in budget authority and $292.1 billion in outlays.

The Pentagon says that at the levels proposed in the 1991 request, defense spending will have declined by a cumulative 15.9 percent (after inflation) since 1985. "By 1995, defense spending will be at its lowest level, measured either as a share of GNP or as a portion of total federal spending, since before World War II," says Secretary of Defense Dick Cheney.

While he recognizes the political imperative, he warns against cutting too deeply. "We need to maintain the quality of the force, our ability to attract first-class people, and military readiness—the measure of proficiency of our forces."

Funding levels can be expressed in several ways. Totals are most frequently stated as **budget authority** (the value of new obligations, including some to be met in later years, which the government is authorized to incur) or **outlays** (actual expenditures, some of which are funded by budget authority in previous years).

Another difference concerns the value of money. When funding is in **constant** or **real dollars,** the effect of inflation has been factored out to make direct comparisons between budget years possible. A specific year, often the present one, is chosen as a baseline for constant dollars. When funding is in **current** or **then-year dollars,** no adjustment has taken place. This is the actual amount that has been spent, budgeted, or forecast.

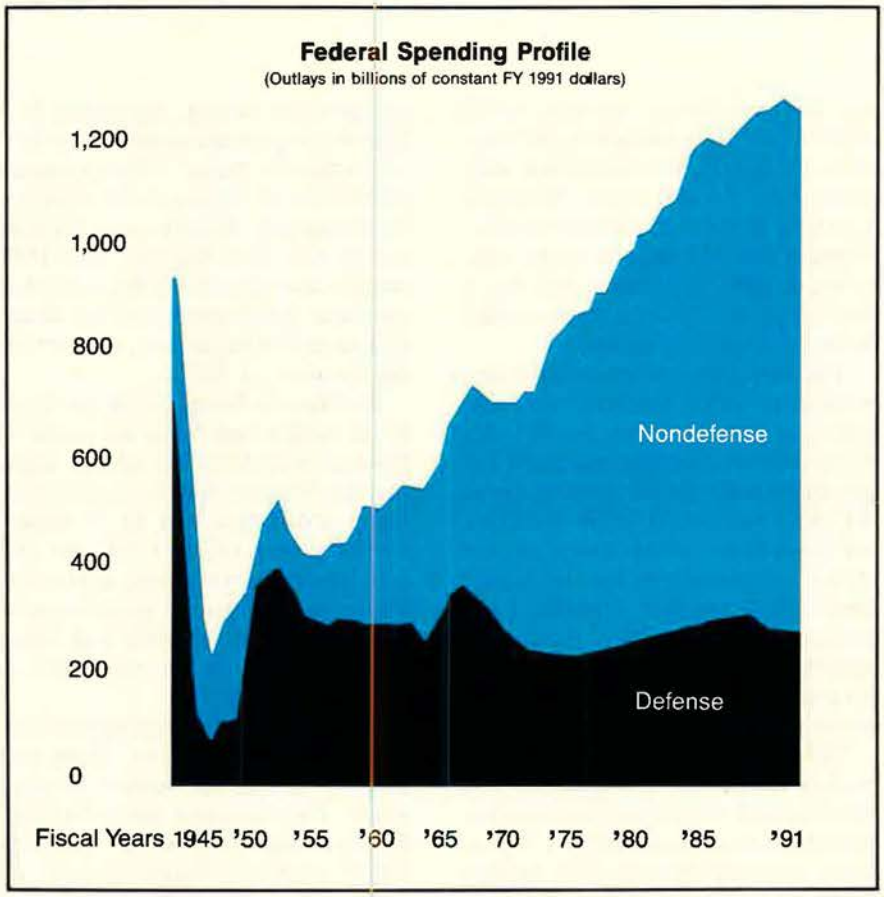
The following charts address only the direct program. In some instances, numbers on the charts in this section may not sum to totals shown because of rounding.

The Fall in the FYDP

(Budget authority in current $ billions)

	Fiscal Year					Cumulative
	1990	1991	1992	1993	1994	1990—94
April 1989 Plan	295.6	317.5	332.4	351.0	369.4	1,665.9
Cuts	−4.2	−22.4	−32.4	−46.6	−61.4	−167.0
January 1990 Plan	291.4	295.1	300.0	304.4	308.0	1,498.9

The FY 1991 budget request is $22.4 billion (adjusted for inflation and other economic factors) below the Administration's April 1989 budget plan. It takes another $167 billion out of the Five-Year Defense Program. Including previous reductions, the FYDP has been cut by $231 billion in the past year.



The real growth in federal spending since 1945 has been in such nondefense areas as social and entitlement programs and interest payments. Planned defense outlays represent a declining share of total federal outlays.

The Relative Burden of Defense

Fiscal Year	Federal Outlays as Percent of GNP	DoD Outlays as Percent of Federal Outlays	DoD Outlays as Percent of GNP	Non-DoD Outlays as Percent of Federal Outlays	Non-DoD Outlays as Percent of GNP
1950	16.0	27.5	4.4	72.5	11.6
1955	17.6	51.5	9.1	48.5	8.6
1960	18.2	45.0	8.2	55.0	10.0
1965	17.5	38.8	6.8	61.2	10.7
1970	19.8	39.4	7.8	60.6	12.0
1971	19.9	35.4	7.0	64.6	12.8
1972	20.0	32.6	6.5	67.4	13.5
1973	19.1	29.8	5.7	70.2	13.4
1974	19.0	28.8	5.5	71.2	13.5
1975	21.8	25.5	5.6	74.5	16.2
1976	21.9	23.6	5.2	76.4	16.7
1977	21.1	23.4	4.9	76.6	16.2
1978	21.1	22.5	4.7	77.5	16.4
1979	20.5	22.8	4.7	77.2	15.8
1980	22.2	22.5	5.0	77.5	17.2
1981	22.7	23.0	5.2	77.0	17.5
1982	23.7	24.5	5.8	75.5	17.9
1983	24.3	25.4	6.2	74.6	18.2
1984	23.1	25.9	6.0	74.1	17.1
1985	24.0	25.9	6.2	74.1	17.8
1986	23.6	26.8	6.3	73.2	17.3
1987	22.6	27.3	6.2	72.7	16.4
1988	22.3	26.5	5.9	73.5	16.3
1989	22.2	25.6	5.7	74.4	16.5
1990	21.8	24.0	5.2	76.0	16.6
1991	21.0	23.7	5.0	76.3	16.0

Where the Money Goes

(Budget authority in $ millions)

	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991
Current Dollars								
Military Personnel	48,363	67,773	67,794	74,010	76,584	78,477	78,548	79,054
Retired Pay	16,503	—	—	—	—	—	—	—
Operations & Maintenance	70,950	77,803	74,888	79,607	81,629	86,221	86,761	90,092
Procurement	86,161	96,842	92,506	80,234	80,053	79,390	82,561	77,855
Research, Development, Test and Evaluation (RDT&E)	26,867	31,327	33,609	35,644	36,521	37,530	36,809	37,972
Military Construction	4,510	5,517	5,281	5,093	5,349	5,738	5,266	5,578
Family Housing	2,669	2,890	2,803	3,075	3,199	3,276	3,221	3,458
Other	2,127	4,650	4,508	1,807	419	204	−1,796	1,123
Total	**258,150**	**286,802**	**281,390**	**279,469**	**283,755**	**290,837**	**291,369**	**295,131**
Constant FY 1991 Dollars								
Military Personnel	63,155	80,110	77,261	82,442	82,100	81,460	81,142	79,054
Retired Pay	20,872	—	—	—	—	—	—	—
Operations & Maintenance	88,314	94,934	90,434	93,034	92,451	93,680	90,885	90,092
Procurement	110,696	120,712	111,707	93,481	89,698	85,559	85,627	77,855
RDT&E	34,311	38,819	40,562	41,706	41,198	40,653	38,306	37,972
Military Construction	5,820	6,905	6,423	5,973	6,021	6,203	5,469	5,578
Family Housing	3,355	3,535	3,349	3,576	3,604	3,546	3,356	3,458
Other	2,700	5,710	5,385	2,100	473	221	−1,872	1,123
Total	**329,224**	**350,724**	**335,123**	**322,311**	**315,546**	**311,324**	**302,915**	**295,131**
Percent Real Growth								
Military Personnel	1.2	26.8	−3.6	6.7	−0.4	−0.8	−0.4	−2.6
Retired Pay	−1.2	−100.0	0.0	0.0	0.0	0.0	0.0	0.0
Operations & Maintenance	5.2	7.5	−4.7	2.9	−0.6	1.3	−3.0	−0.9
Procurement	3.8	9.0	−7.5	−16.3	−4.0	−4.6	0.1	−9.1
RDT&E	13.6	13.1	4.5	2.8	−1.2	−1.3	−5.8	−0.9
Military Construction	−3.2	18.6	−7.0	−7.0	0.8	3.0	−11.8	2.0
Family Housing	−4.4	5.4	−5.2	6.8	0.8	−1.6	−5.4	3.0
Total	**4.6**	**6.5**	**−4.4**	**−3.8**	**−2.1**	**−1.3**	**−2.7**	**−2.6**

The constant dollar (adjusted for inflation) portion of this chart makes it possible to compare the real gains and losses. Lower budget authority in the Military Personnel Accounts in FY 1986 reflects the congressional direction to finance $4.5 billion for the military pay raise and retirement accrual costs by transfers from prior-year unobligated balances. From 1985 on, Retired Pay accrual is included in the Military Personnel appropriation.

Service Shares

(Budget authority in $ millions)

	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991
Current Dollars								
Army	62,181	74,270	73,128	73,984	75,813	78,079	77,606	75,798
Navy	82,088	99,015	96,113	93,500	100,281	97,675	99,609	99,484
Air Force	86,108	99,420	94,870	91,624	88,324	94,685	92,944	94,817
Defense Agencies/OSD/JCS	10,746	13,126	15,520	19,195	17,021	18,154	17,855	21,175
Defense-wide	17,027	970	1,759	1,168	2,315	2,245	3,356	3,858
Total	**258,150**	**286,802**	**281,390**	**279,469**	**283,755**	**290,837**	**291,369**	**295,131**
Constant FY 1991 Dollars								
Army	80,613	90,936	86,997	85,305	83,959	83,236	80,557	75,798
Navy	104,583	121,238	114,555	107,752	111,475	104,511	103,514	99,484
Air Force	108,512	120,836	112,464	105,289	98,230	101,442	96,780	94,817
Defense Agencies/OSD/JCS	13,977	16,514	18,986	22,604	19,275	19,705	18,574	21,175
Defense-wide	21,540	1,200	2,120	1,362	2,608	2,429	3,490	3,858
Total	**329,224**	**350,724**	**335,123**	**322,311**	**315,546**	**311,324**	**302,915**	**295,131**
Percent of Real Growth								
Army	4.2	12.8	−4.3	−1.9	−1.6	−0.9	−3.2	−5.9
Navy	−2.8	15.9	−5.5	−5.9	3.5	−6.2	−1.0	−3.9
Air Force	13.6	11.4	−6.9	−6.4	−6.7	3.3	−4.6	−2.0
Defense Agencies/OSD/JCS	11.8	18.2	15.0	19.1	−14.7	2.2	−5.7	14.0
Defense-wide	−1.8	−94.4	76.6	−35.8	91.5	−6.9	43.7	10.5
Total	**4.6**	**6.5**	**−4.4**	**−3.8**	**−2.1**	**−1.3**	**−2.7**	**−2.6**
Service Percentages								
Army	24.1	25.9	26.0	26.5	26.7	26.9	26.6	25.7
Navy	31.8	34.5	34.2	33.5	35.3	33.6	34.2	33.7
Air Force	33.4	34.7	33.7	32.8	31.1	32.6	31.9	32.1
Defense Agencies/Defense-wide	10.6	4.9	6.1	7.3	6.8	7.0	7.3	8.5

The bulge in the Navy budget for 1988 reflects funding for two *Nimitz*-class carriers. From 1985 on, budgets of the individual services include Retired Pay accrual.

Manpower Trends

(End strength in thousands)

	Actual										Programmed	
	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991
Active Component Military												
Army	777	781	780	780	780	781	781	781	772	770	744	728
Navy	527	540	553	557	565	571	581	587	593	593	591	585
Marine Corps	189	191	192	194	196	198	199	199	197	197	197	197
Air Force	562	575	588	597	597	601	608	607	576	571	545	530
Total	**2,055**	**2,087**	**2,113**	**2,128**	**2,138**	**2,151**	**2,169**	**2,174**	**2,138**	**2,131**	**2,077**	**2,040**
Reserve Component Military (Selected Reserve)												
Army National Guard	366.6	389.0	407.6	417.2	434.3	440.0	446.2	451.9	455.2	457.0	447.3	447.3
Army Reserve	213.2	232.0	256.7	266.2	275.1	292.1	309.7	313.6	312.8	319.2	309.2	309.2
Naval Reserve	97.1	98.3	104.8	109.1	120.6	129.8	141.5	148.1	149.5	151.2	153.4	149.7
Marine Corps Reserve	35.7	37.3	40.5	42.7	40.6	41.6	41.6	42.3	43.6	43.6	44.0	43.9
Air National Guard	96.3	98.3	100.6	102.2	105.0	27.3	112.6	114.6	115.2	116.1	116.2	116.3
Air Force Reserve	59.8	62.3	64.4	67.2	70.3	75.2	78.5	80.4	82.1	83.2	84.9	85.2
Total	**868.7**	**917.2**	**974.6**	**1,004.6**	**1,045.9**	**1,006.0**	**1,130.1**	**1,150.9**	**1,158.4**	**1,170.6**	**1,155.0**	**1,151.6**
Direct Hire Civilian												
Army[1]	312	318	321	332	343	359	353	358	337	347	334	334
Navy	298	310	309	328	332	343	332	343	337	343	337	330
Air Force[1]	231	233	235	238	240	250	250	252	241	249	249	246
Defense Agencies	75	79	80	82	85	91	92	96	95	98	98	103
Total	**916**	**940**	**945**	**980**	**1,000**	**1,043**	**1,027**	**1,049**	**1,010**	**1,037**	**1,018**	**1,013**

[1]These totals include Army and Air National Guard technicians, who were converted from state to federal employees in FY 1975.

General-Purpose Force Trends

	FY 1980	FY 1984	FY 1986	FY 1988	FY 1989	FY 1990	FY 1991
Land Forces							
Army Divisons							
Active	16	16	18	18	18	18	16
Reserve	8	8	10	10	10	10	10
Marine Corps Divisions							
Active	3	3	3	3	3	3	3
Reserve	1	1	1	1	1	1	1
Army Separate Brigades[1]							
Active	8	8	7	8	8	8	8
Reserve	26	23	20	20	20	19	19
Army Special Forces Groups							
Active	2	4	4	4	4	5	5
Reserve	4	4	4	4	4	4	4
Army Ranger Regiment	0	0	1	1	1	1	1
Tactical Air Forces (Primary Aircraft Authorized/Squadrons)							
Air Force Attack and Fighter Aircraft							
Active	1,608/74	1,734/77	1,764/78	1,868/79	1,769/79	1,743/75	1,746/75
Reserve	758/36	852/43	876/43	909/43	897/42	867/42	849/42
Conventional Bombers							
B-52G	0	0	0	0	61	33	33
Navy Attack and Fighter Aircraft							
Active	696/60	616/63	758/65	758/67	730/65	698/66	684/66
Reserve	120/10	75/ 9	107/10	121/10	118/10	61/10	116/10
Marine Corps Attack and Fighter Aircraft							
Active	329/25	256/24	333/25	346/25	335/25	348/26	383/27
Reserve	84/ 7	90/ 8	94/ 8	96/ 8	90/ 8	102/ 8	102/ 8
Naval Forces							
Strategic Forces Ships	48	41	45	43	42	40	41
Battle Forces Ships	384	425	437	437	434	412	397
Support Forces Ships	41	46	55	60	64	66	68
Reserve Forces Ships	6	12	18	25	26	33	40
Total Deployable Battle Forces	479	524	555	565	566	551	546
Other Reserve Forces Ships	44	24	21	21	21	21	17
Other Auxiliaries	8	9	7	5	3	3	3
Total Other Forces	52	33	28	26	24	24	20

[1]Does not include roundout brigades; does include the Eskimo scout group and the armored cavalry regiments.

Personnel Cuts

	FY 1990 Reduction	FY 1991 Reduction	Cumulative Reduction
Active Military			
Army	−26,000	−16,000	−42,000
Navy	−2,000	−6,000	−8,000
Marine Corps	—	—	—
Air Force	−26,000	−15,000	−41,000
Selected Reserves	−16,000	−3,000	−19,000
Civilians	−16,000	−5,000	−21,000
Total	**−86,000**	**−45,000**	**−131,000**

–Staff photo by Guy Aceto

Army and Air Force active-duty manpower levels will be at their lowest since 1950. A civilian hiring freeze and other measures have been taken in hopes of achieving the reduction by attrition.

Program Terminations

(Budget authority in current $ billions)

System	FY 1991	FY 1991–94
V-22 Osprey	−1,395[1]	−6,468
F-14D Aircraft	−469[1]	−1,991
Army Helicopter Improvement Program (AHIP)	−328[1]	−1,400
Phoenix Missile	−333[1]	−614
M-88A2 Improved Recovery Vehicle	−90[1]	−309
F-15E Aircraft	+303[1]	−3,317
Apache Helicopter	−682	−2,528
M1 Tank	−1,086	−6,249
Maverick Missile	−367	−743
Air Force Airborne Self-Protection Jammer	−264	−1,199
Combined Effects Munition	−142	−399
Sea Lance ASW Standoff Weapon	−156	−975
Non-Line-of-Sight Missile	−131	−1,202
Advanced Short-Range Air-to-Air Missile	−7	−46
Follow-On to F-4G Wild Weasel	−12	−176
Air Base Survivability	−19	−130
Chaparral Missile	−26	−157
MK 19 Grenade Launcher	−20	−130
OV-1D Aircraft Mod Program	−37	−120
Autonomous Precision Guided Munition	−27	−114
Total	**−5,288**	**−28,267**

[1]Terminated in FY 1990 budget, but funding planned in outyears (FY 1991–94).

The Tempo of Training

	FY 1989	FY 1990[1]	FY 1991[1]
Flying Hours per Crew per Month			
Army Combat Forces	14.6	15.0	14.5
Army Reserve	8.0	8.0	8.0
Army National Guard	9.0	9.0	9.0
Navy/Marine Tacair/ASW	25.0	25.0	25.0
USNR/MCR Tacair/ASW	11.0	11.0	11.0
Air Force Tacair	19.3	19.5	19.5
Air National Guard	11.0	11.0	11.0
Air Force Reserve	11.0	11.0	11.0
Air Force Airlift	31.0	30.1	30.2
Air National Guard	15.0	15.0	15.0
Air Force Reserve	15.0	15.0	15.0
Air Force Strategic	18.2	17.7	17.6
Air National Guard	16.0	16.0	16.0
Air Force Reserve	16.0	16.0	16.0
Navy Steaming Days per Quarter			
Deployed Fleets	52.5	50.5	50.5
Nondeployed Fleets	27.5	29.0	29.0
US Naval Reserve Nondeployed Fleets	21.0	21.0	21.0
Army Ground Miles per Year	820	800	800
Army Reserve	200	200	200
Army National Guard	288	288	288

[1]Requested.

DoD says that it will maintain operating tempos at the levels needed to ensure ready forces. For the most part, training operations will continue at the FY 1990 budgeted level.

Impact on Force Structure

(Dollars in millions)

	FY 1991	FY 1992–1994
Deactivate Two Army Divisions	−$1,227	−$4,940
Retire Two Battleships	−75	−534
Retire Two Nuclear Cruisers	+9	+99
Deactivate Eight SSNs	−232	−105
Marine Corps Artillery Batteries	−5	−44
Deactivate Fourteen B-52s	−71	−246
Minuteman II	−128	TBD
WC-130 Weather Reconnaissance	+5	—
Total	**−$1,724**	**−$5,770**

Funding for Major USAF Systems

(Budget authority in $ millions)

	FY 1989	FY 1990	FY 1991
Aircraft			
AC-130U Gunship	400.8	262.6	55.1
C-17 Airlifter	2,014.4	2,319.3	2,716.8
C-130H (Guard and Reserve)	406.9	308.2	120.0
Civil Air Patrol Aircraft	1.8	2.5	1.9
F-15E Fighter	1,554.8	1,534.9	1,844.7
F-16 Fighter	3,199.3	3,220.2	2,972.7
KC-135 Reengining	750.5	574.6	459.7
LANTIRN Night Precision Attack System	709.0	261.8	200.3
MC-130H Combat Talon	377.4	227.0	139.2
NH-60G Helicopter	78.5	66.9	43.5
TTTS Tanker/Transport Trainer	13.6	148.0	195.5
E-8A Joint STARS Aircraft	232.1	88.1	232.5
C-27A Mission Support Aircraft	—	83.6	90.6
B-2 Bomber	5,307.6	4,302.1	5,535.9
HC-130 Tanker Rescue Aircraft	—	42.6	—
C-20 Jet Transport	—	49.2	—
C-26 Transport Aircraft	—	36.0	—
Missiles			
AMRAAM Air-air Missile[1]	801.1	698.6	915.5
HARM Air-ground Missile[1]	217.4	81.0	33.6
IIR Maverick Air-ground Missile[1]	261.1	173.5	7.3
Peacekeeper ICBM	1,266.1	1,723.7	2,836.3
Sidewinder Air-air Missile[1]	37.1	.5	.4
Sparrow Air-air Missile[1]	54.0	—	—
SRAM II Air-ground Missile	190.9	226.3	183.4
Have Nap Air-ground Missile	36.1	24.7	27.9
Advanced Cruise Missile (ACM)	97.0	367.6	540.9
Other Procurement			
9-mm Handgun[3]	1.9	—	—
Defense Meteorological Satellite Program (DMSP)	208.7	164.2	197.5
Defense Satellite Communications System (DSCS)	86.3	73.3	80.4
HMMWV 5/4-Ton Truck[2]	4.3	—	—
Mobile Armored Recon Vehicle (MARV)	20.6	.3	—
Medium Launch Vehicle (MLV)	255.4	164.9	269.7
Navstar Global Positioning System	120.8	80.9	250.6
Over-the-Horizon Backscatter Radar (OTH-B)	201.1	219.6	254.5
Space Boosters	801.9	680.8	472.1
Space Shuttle Operations	44.3	82.8	34.2
North Warning System (NWS)	198.5	196.0	7.6
R&D			
Advanced Tactical Fighter	674.5	1,045.9	1,047.4
Aircraft Engine Component Improvement Program[1]	132.9	111.6	135.5
Advanced Launch System	—	86.2	60.3
Joint Programs			
Unmanned Aerial Vehicles (UAVs)	90.4	111.2	103.6
Strategic Defense Initiative	3,710.4	3,581.7	4,471.3
Air Defense Initiative	155.1	149.9	246.9
Long-Range Conventional Standoff Weapon	33.4	18.8	55.4
National Aerospace Plane	228.4	192.5	158.0

[1] Navy and Air Force funding involved.
[2] Army, Navy, and Air Force funding involved.
[3] All services.

Thanks to quality, innovation, and a boost from technology, Sacramento ALC has a lot of the maintenance gremlins on the run.

Revolution in the Hangar

By Douglas Baldwin

Not long ago, only forty percent of Air Force F-111 fighters could get airborne at any given time. The rest were too gimpy to fly. Stand next to an F-111 long enough, the old joke went, and you will hear it break.

No one cracks jokes about the F-111 anymore. Today more than seventy percent of the swingwing planes are ready for immediate action. In addition to achieving this huge increase in mission-capable rates, maintainers have chopped the cost of depot repairs to $55 an hour—about what it takes to fix the family car.

Improved F-111 maintenance is but one success story to be seen at USAF's Sacramento Air Logistics Center (ALC) at McClellan AFB, Calif. The improvement is no accident. It stems from "QP4," Air Force Logistics Command's new quality-improvement program. QP4 (meaning "quality = people + process + performance + product") has brought a revolution in the upkeep of aircraft, space systems, and support equipment needed to keep USAF aircraft fit to fight.

The F-111 woes were symptoms of a larger problem: the Defense Department's failure to emphasize quality standards as strongly as it emphasized production goals. A new quality program was born in 1987, when Gen. Alfred Hansen, Commander of AFLC at the time, decided that only a shakeup of AFLC's "corporate mindset" would break the pernicious routine of fix-inspect-reject-fix-again.

In the quality-improvement program, the technician on the shop floor joins executives in decision-making. The individual will take a greater interest in his job if he is part of a quality team that works smarter and faster because innovative ideas are adopted.

The program relies heavily on the initiative and innovative thinking of small process action teams (PATs), natural work teams, quality circles, and individual efforts. The goal is to fix things right the first time and give up reliance on costly after-the-fact inspections.

"We are staking our future on QP4," says Gen. Charles C. McDonald, new Commander of AFLC. "The payoff will be well worth the growing pains of change."

Engineers in Sacramento's Advanced Microelectronics Technology Center build such replacement parts as circuit boards from scratch, with nothing to go on but the obsolete component itself. This "reverse engineering" enables Sacramento ALC to save time and money by customizing generic replacement arrays.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This commitment to quality has sparked an explosion of innovation, affecting not only hardware but also defense workers. This is most apparent at Sacramento Air Logistics Center, AFLC's high-tech pacesetter and a prime focus of QP4 application.

Innovation at Sacramento

Sacramento is taking the lead in such key technologies as use of advanced composite materials, microelectronics, Very-High-Speed Integrated Circuits (VHSIC), and advanced space and threat-simulator equipment.

It makes use of X-ray and neutron radiography for nondestructive inspection, "reinvents" out-of-inventory electronics through reverse engineering, "freezes" F-111s for structural diagnosis, and performs battle-damage repairs.

"Being at the leading edge of technology in so many important areas in AFLC has risks and rewards," says Maj. Gen. Trevor Hammond, commander of the complex located north of California's capital, "but we are comfortable with our position here."

In one of McClellan's first quality program applications, ALC workers formed a process action team to overcome delays in the remanufacture of F-111 horizontal stabilizers. This has always been a labor-intensive task, often requiring eighteen months of work to produce a single part.

Under the new plan, workers set a goal of producing thirty-six stabilizers a year. They succeeded. The key was close observation by team members. They identified major problems in the accuracies of a five-axis machine that had been used to cut aluminum honeycomb for the part. By redesigning the gripping mechanism of the machine, the team solved the accuracy problem.

Last fall, USAF found that the leading-edge slat actuators on its A-10 close air support airplanes had begun to fail. It also discovered problems within the actuator's aluminum hydraulic fluid cylinder. USAF suspected that the two problems might be related.

Sacramento ALC launched a system-wide investigation of the problems. The investigative team, led by A-10 technician Dennis Lorentz and engineer John McPherson, discovered failure in the aluminum part of the fluid cylinder. They determined that forged steel should be used rather than aluminum. This design change not only addressed and solved the original concern about the A-10's structural integrity; it also increased the mean time between failures (MTBF) of the aircraft's actuator-cylinder system to 4,000 hours, up from 1,840.

The F-111 provides another example of increased worker initiative. Engineers last fall solved a problem with the F-111D that has saved the government nearly $1 million.

USAF officials were aware that the traveling wave tube in the F-111D's APQ-130 attack radar was failing after only about twenty hours, a situation that made the radar virtually useless. Rob Rice and Don Cahayla, of Sacramento ALC's Directorate of Material Management, traced the problem to a bias resistor on the high-voltage control card. This led to installation of new tubes, which corrected the problem and brought dramatic increases in system reliability. Failures now occur only after 200 hours of use.

Another success that the ALC's Maintenance Directorate attributes to the QP4 team approach is a sharp reduction in F-111 fuel tank leaks, a particularly pernicious problem that had long bedeviled repair schedules. "We changed the way we attack the aircraft," says PAT leader Henry Nitz, "from training and testing to tools and sealant removal." The result is obvious. Whereas in 1987–88 there had been fourteen leakage delays involving F-111s, there were no leaks in the thirty-seven planes worked on last year.

Into the Deep Freeze

Other Sacramento initiatives are less orthodox. To those at Sacramento ALC who keep the aging F-111 agile and airborne, for example, the phrase "fresh frozen" has special meaning.

The term well describes a unique method for testing the F-111's structural integrity. In each test, the aircraft is chilled to a temperature of minus forty degrees Fahrenheit. Once in this state, the F-111 is subjected to a series of violent operations, the force of high-powered rams pressing wings and control surfaces to the limits of their design. Parts that might later fail in flight, with catastrophic result, are identified by sound and stress sensors attached to key surface points. The deep-freeze treatment, found Stateside only at McClellan, takes half a day.

The F-111 is the only aircraft in the US inventory to undergo such a bizarre examination. The principal reason is that there is a uniqueness to the metals found in forged parts. The forgings are made of the Ladish D6ac alloy, a metallurgical stew of

Nondestructive inspection technician Gerald Abah programs the world's largest robot to inspect an entire F-15 for cracks and corrosion. McClellan's new facility, the only one of its kind, allows the internal inspection of intact aircraft using X-ray and neutron radiography.

vanadium, molybdenum, manganese, and seven other metals. Only at extremely cold temperatures does the alloy clearly reveal a propensity to crack and fail.

All 411 of the swingwing planes—389 in USAF's inventory and twenty-two in Australia's—must be tested regularly. Only two freeze-stressed F-111s have ever suffered catastrophic damage, which is a tribute to the sophistication of the computerized test facility and to the operators whose motto, with apologies to Hippocrates, is "first, don't break the airplane."

Efforts to avoid harming the operational aircraft have sparked various innovations. The ALC at McClellan, for example, houses the world's only comprehensive system for so-called nondestructive inspection of aircraft and their components. The program, known as Pacer Impact, includes the new N-ray neutron radiography and X-ray systems. These systems can, in effect, conduct a CAT scan of an aircraft, circumventing the need for disassembly.

In the past, mechanics had to perform the equivalent of exploratory surgery on aircraft to find potential problems. Skin, wings, and tail would be removed in time-consuming inspections.

All that has changed. The new, two-part system—using a pair of ceiling-suspended robots with giant, clawlike arms—scans the inner workings of an airplane without disturbing them. The conventional X-ray robot detects problems such as cracks in metal structures. The N-ray robot uses neutron technology to detect hydrogen molecules present in all moisture and corrosion. The benefits are great: An F-111 inspection that once took more than a month now can be performed in thirty-six hours.

This system also can be used to inspect composite structures. By reading the absence of neutron-absorbing molecules at cracks and points of separation, the machine can spot possible problems before they become dangerous. This is a feature that makes the N ray an increasingly valuable tool for the maintenance of composite-dependent twenty-first-century aircraft.

The original systems, which cost $19 million, will pay for themselves in fewer than eighteen months. A smaller, stationary version of the neutron system entered service in January. Plans call for it to be used to check aircraft components and other parts.

Workers in the aircraft wash rack wear protective gear and air supply equipment while using high-pressure water guns to deseal F-111 fuel tanks. Fuel leaks are a common problem in F-111s. A special Process Action Team modified maintenance processes to significantly reduce maintenance delays caused by fuel leaks.

Reverse Engineering

Sacramento ALC also has come up with an answer to the question frequently asked by weapon system operators: What do you do when a manufacturer stops making a part that is crucial to the operation of an electronics system?

Conventional solutions range from complex modifications of a similar item to a lifetime buy with the initial weapons purchase.

Sacramento, however, is taking a more innovative approach. Through "reverse engineering," it now is "emulating" technologies no longer made. At the one-of-a-kind Advanced Microelectronics Technology Center, replacement parts such as integrated circuit chips and circuit boards are built from scratch with nothing to go on but the outmoded device itself.

The replacement part must be a functional equivalent, fully emulating the old part. In the past, marketplace economics made the manufacture of small quantities of obsolete microchips a very expensive proposition. Sacramento ALC found a new solution in the form of generic replacement arrays. These are uncommitted sets of resistors, transistors, and other parts that can be configured in an infinite number of ways. These might be compared to standardized auto frames, around which special bodies are built.

The cost of generic master arrays may run to $500,000, similar in cost to the design of a single chip. Each individual "personalization," however, can cost as little as $10,000.

The value of the process is immediately evident. In one recent case, Sacramento ALC was asked to duplicate a line receiver circuit for the Navy's ASA-70 tactical display panel. The part was reverse engineered, prototyped, and successfully tested, all at the Sacramento center. The Alameda Naval Air Rework Facility pegs the savings throughout the life of the system at $4.5 million. This does not include the imputed cost of 1,000,000 hours of system "not-ready time" that the Navy has managed to avoid.

Composite Solutions

Increasingly widespread use of composite materials is also apparent at Sacramento. Parts made from such advanced materials are proving stronger and less susceptible than metals to breakage and corrosion.

The Air Force's Advanced Composites Program Office (ACPO) at McClellan directs design and manufacture for the insertion of ad-

A-10s are among the aircraft given new strength and longer life through the use of composite materials developed at Sacramento ALC. As part of programmed A-10 maintenance, as shown here, the wings' leading edges are removed and replaced with ones made of advanced composites to prevent damage from birdstrikes.

vanced composites in older aircraft. The F-111, F-4, and A-10 are among the aged aircraft given new strength and longer service life.

On some F-111s flying today, forward ventral strakes are made entirely of graphite and Kevlar epoxy skins cast over a Nomex honeycomb. The new, reparable strakes, which stand up four times longer than their metal predecessors, are designed and built at McClellan. So are the new wing leading edges for the A-10. Made of hybrid laminate, they spring back from the impact of a four-pound birdstrike at 300 knots. The A-10 will also wear a tough new inboard flap made of a material with the improbable name of PEEK, standing for polyetheretherketone, reinforced with graphite. A new rudder built of graphite-epoxy skin over a Rohacell foam core makes the empennage of an F-4 stronger and more rigid.

Serious problems with the GFU-7/E link tube carrier that serves the A-10's 30-mm gun and with the widely used ALE-40 Chaff-Flare Dispensing System were overcome with thermoplastic injection molding. The original carrier warped when exposed to extremes of heat or cold, jamming the depleted-uranium ammunition en route to the tankbuster cannon.

Specially designed dummy magazines are helping to solve problems of corrosion and foreign object damage to the sensitive firing electrodes on the flare dispenser. The new magazines have the added advantage of streamlining airflow over the fuselage of the carrying aircraft. ACPO designed and manufactured the molded structures with its own technology and machinery. The Air Force estimates a saving of nearly $10 million in forgone maintenance on the dispenser systems still in inventory.

Innovative use of electronics technology is getting a boost under the QP4 approach.

To help keep the F-111 in the air until at least 2010, outdated avionics will be replaced in 163 F-111s. Ring-laser gyro Standard Inertial Navigation Units, Global Positioning System navigation receivers, and new integrated cockpit display systems will be installed.

Nearly complete is a separate F-111 Avionics Modernization Program (AMP), calling for installation of new digital flight-control systems on nearly the entire USAF fleet of 389 aircraft. AMP is raising the MTBF of the bombing-navigation system from 3.6 hours to more than twenty-one hours.

Engineers are developing a VHSIC replacement for the "black box" central computer system on the F-111. The VHSIC replacement will be a single black box with ten times more memory. It zips through four times more instructions per second.

Logistic Support for Future Aircraft

Since 1981, technicians at McClellan have been quietly providing logistic support for the F-117 Stealth fighter—and thinking hard about what the 1990s will hold for the Advanced Tactical Fighter. "We had 152 people locked up in a building to work on the F-117," General Hammond says. "They didn't talk to anybody, not even their families, about what they did."

Sacramento is slated to be the ATF's full-service depot, where the sophisticated fighter will undergo analytical condition inspections, configuration and software modifications, and repair of its mechanical, electrical, and other subsystems.

A Sacramento imperative is to make sure reliability and maintainability are engineered into the ATF. There will be about thirty times more computer software in the ATF than in the F-111, and the new fighter will have an Ada code line capacity of 4,500,000 to 6,000,000 lines.

The fighter will rely primarily on computer engineers, plus extraordinarily well-trained technicians, to handle high-pressure hydraulics, VHSIC, and composite materials. In the most integrated aircraft ever built, all of the ATF's avionics subsystems—radar, navigation, electronic warfare—will be controlled by multiple computers and software. The entire ATF will be tested as a single electronic system.

The need for stronger logistics support has rarely been greater. Eighty percent of USAF's inventory for 2010 is on the ramp today. There will be more fixing than building in years to come. Those new aircraft that do come along—the ATF and F-117A—will strain the logistic system to the limits. Viewed in this light, QP4 could not have come at a more propitious time. ■

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By John L. Frisbee, Contributing Editor

Epitaph for a Valiant Airman

In the opening days of the Korean War, only desperate measures could save the UN foothold at Pusan.

By World War II pilot standards, Louis Sebille was an old man. When he began flight training in January 1942, he was two months beyond the maximum age of twenty-six. Nevertheless, he proved to be an outstanding pilot and a born leader. According to his contemporaries, he also was a man of great poise and charm, which is not surprising. After leaving Wayne State University in Detroit, he spent some time as a nightclub entertainer in the Chicago area, a fact that Sebille didn't advertise.

After earning his wings, Lieutenant Sebille was assigned to the 450th Bombardment Squadron, 322d Bomb Wing, at MacDill Field, Fla., flying the accident-prone Martin B-26 Marauder ("One a day in Tampa Bay"). The group moved to England in early 1943. There Louis Sebille piloted one of twelve B-26s in the first minimum-level Marauder attack against targets in Europe. Three days later, the 322d sent a squadron on a similar mission. One B-26 aborted; all others were lost to flak and fighters. After that, Marauders operated at medium altitude.

Sebille rapidly advanced to flight leader, then to squadron operations officer, and in rank to major. He flew sixty-eight combat missions, most of them as either group or wing leader, before returning to the States in March 1945. Comments by his superiors noted his tactical skill, courage, and inspirational leadership. Here, it would seem, was an airman with a future.

Older readers will remember the disorganization and confusion in the early postwar Air Force as its size plummeted from 2.4 million men and women to fewer than 400,000 with virtually no combat-ready capability. Like many others, Sebille was lured from the service by the promise of a flying future with the airlines. Less than a year later, in July 1946, he was offered a regular commission and returned to active duty in a variety of flying assignments, among them instructor pilot in the F-51 Mustang and F-80 Shooting Star. Two years later, he arrived at Clark AB in the Philippines and, in November 1948, was appointed Commander of the 67th Fighter-Bomber Squadron, 18th Fighter-Bomber Group.

As the political situation along the Communist periphery in Europe and Asia deteriorated, Major Sebille was faced with the formidable task of training new and recalled pilots and of converting from F-51s to F-80s. On June 25, 1950, North Korea invaded the South in overwhelming numbers, rapidly forcing South Korean troops, soon reinforced by US ground forces, back toward a perimeter defense around Pusan at the southern end of the peninsula.

A few days later Sebille's squadron was ordered to convert back to F-51s, move north from Clark to Ashiya on the southernmost main Japanese island of Kyushu, and join in a desperate defense of the Republic of Korea. In less than a month the squadron was in place, combat-ready.

Early in the afternoon of August 5, 1950, Major Sebille led a formation of F-51s, armed with 500-pound bombs and rockets, on a strike against enemy troops advancing toward Pusan. Reporting in to the Joint Operations Center at Taegu, they were told to contact a Mosquito FAC near Hamchang. Sebille then was directed to attack enemy forces crossing the Naktong River. On the first pass Sebille was able to release only one of his two bombs. He and his wingmen began strafing troops and launching rockets against equipment concealed under trees on the river bank, Sebille still carrying one 500-pounder.

Capt. Martin Johnson, one of the Major's wingmen, checked Sebille's aircraft as they pulled up from a pass on enemy trucks and saw engine coolant streaming from his leader's F-51. Johnson urged Sebille to break off the attack and head south for airstrip K-2 at Taegu. Since the plane was still under control, he could at least make it to friendly territory and bail out before his engine quit.

Captain Johnson later reported that Major Sebille replied, "I'll never be able to make it back. I'm going back and get that bastard." Sebille then lined up on an enemy truck and flew directly into it at a thirty-degree angle, his guns blazing until he crashed into the ground in a huge ball of fire.

Maj. Louis Sebille was posthumously awarded the Medal of Honor for his heroic sacrifice. He was the first of only four Air Force men to be awarded the nation's highest decoration for valor during the Korean War. On August 24, 1951, Air Force Chief of Staff Gen. Hoyt Vandenberg presented the Medal to Louis Sebille's widow and young son in a ceremony at March AFB.

In the September 1951 issue of Air Force Magazine, Captain Johnson ended a tribute to Major Sebille with these words: "On this summer afternoon in Korea we had lost a remarkable friend, a fine commander, and a very brave man." No military leader could hope for a more eloquent epitaph than that. ■

The possibilities of this hot technology go far beyond home entertainment.

Why Is the Pentagon

THE visual fidelity is stunning. In an air reconnaissance ground station, the video screen has images so crisp that one can discern individual leaves on trees. Flight simulators give trainees the impression they are gazing out a window. Mission planners work with vividly detailed video maps. In the cockpit, a fighter pilot sees high-resolution images of target and flight data.

Those are the kinds of military advances that may, sometime in the 1990s, be brought on by one of today's hottest technological phenomena. "High-definition television" (HDTV) has been seen mainly, as a federal commission put it, as a commercial "opportunity of almost unparalleled proportions." The evidence today, however, is that HDTV's military value might also prove to be great.

The Pentagon has budgeted a modest $30 million to support research and development of HDTV display activities. Even so, increasing numbers of congressmen, senators, and aerospace officials are sounding the alarm that the US needs to spend more, perhaps up to $500 million annually in private and government investment. They warn that failure to keep pace with both Japan and Europe in this technology might do lasting economic and technological damage.

What, in fact, is high-definition TV, and why is everyone saying these things about it?

Twice As Good

HDTV is a technology that Japan's major electronics houses have been working on throughout the 1980s, and it's poised to sweep the worldwide marketplace—*if* the United States, Japan, and western Europe can agree on a common set of technical standards. The attraction of HDTV is simple: It has at least twice the picture quality of standard TV sets, its depth and clarity being roughly equivalent to what is found in a wide-screen, 35-millimeter movie.

That is great for home entertainment. It's even better for military users who need high-resolution, instantaneous displays of all kinds of data and imagery. In the latest in a series of government and industry studies of HDTV, the General Accounting Office (GAO) in December placed military applications at the top of the list of potential HDTV uses, followed by medical, space, and other scientific applications.

"For its broad range of video applications in battle management, command and control, training and simulation, and intelligence analysis," GAO maintains, "the Department of Defense needs high-definition, low-cost, dynamic, multimedia displays for presentation in motion video, real-time graphics, maps, and photographs."

GAO spelled out five near-term military applications in which HDTV could make important contributions if the costs of this new technology could be brought down to reasonable levels:

- *Real-Time Video Processing.* This is a particularly important application for USAF, which is planning to replace its current film reconnaissance systems with real-time video at the same 35-mm resolution. This will reduce information time lags and vulnerability of reconnaissance aircraft to hostile action without sacrificing image clarity.
- *Flight Simulators.* Networked visual simulators, such as the Sim-

Watching High-Definition TV?

By John Rhea

net project at the Defense Advanced Research Projects Agency (DARPA), would have sharper on-screen images and thereby permit more realistic combat training for pilots.

• *Defense Mapping*. The Defense Mapping Agency, which is now converting all of its maps to an entirely digital format, could use HDTV to reduce costs of present customized systems even as it provides higher resolution of existing maps.

• *Cockpit Displays*. Higher-resolution displays could be used to help harness prospective advances in aircraft sensors and make possible greater use of data fusion in easily manipulated form.

• *C³I*. Large-screen displays of great clarity could provide increased detail for intelligence data that would aid war planners.

The Compatibility Problem

In the commercial world, the major stumbling block to implementing an HDTV revolution is that none of the countries can agree on a common standard. That's holding back the worldwide commercial market until at least the mid-1990s. The military may have to go it alone, and DARPA has launched a three-year development program to look at the possibilities.

The Japanese, meanwhile, are pushing ahead with a domestic system using direct broadcast satellites. Their public broadcasting system, Nippon Hoso Kyokai, conducted the first large-scale public demonstration at the 1988 Olympic games in Seoul, South Korea, and the system is becoming operational in Japan this year.

The compatibility problem is based on the fact that, in order to achieve improved picture quality, HDTV needs more than the six MHz (6,000,000 bits per second) of bandwidth allocated by the Federal Communications Commission for commercial television channels. Most of the competing versions of HDTV need at least nine MHz.

The FCC has been adamant that any commercial HDTV format approved for domestic use must fit within the six-MHz limitation. Otherwise the estimated 160,000,000 home TV sets in this country would become obsolete, and so would all the existing TV broadcasting equipment. As a result, Americans aren't likely to have HDTV sets in their homes until close to the year 2000.

That's not an immediate problem for military users, because they aren't dependent on the commercial broadcasting channels anyway. They can use either direct broadcast satellites (like the Japanese) or cable (particularly the new high-bandwidth optical fiber cables) if they need more than six MHz.

However, there are two prime reasons why it would be advantageous for military users to squeeze their HDTV traffic into the six-MHz standard channels. One is that narrower bandwidths are less vulnerable to electronic countermeasures. An even more compelling reason is that, by being compatible with a growing commercial HDTV industry, the military could take advantage of economies of scale. This is how DARPA's Very-High-Speed Integrated Circuit program worked, in effect piggybacking on work already under way in the semiconductor industry.

The consensus of a series of recent reports on HDTV commissioned by the Commerce Depart-

ment, the Electronic Industries Association, and the American Electronics Association is that home sets could go on the market in the mid-1990s at about $2,500 each and proceed down the traditional experience curve common among all high-technology industries to about $1,000 by the year 2000. The key assumptions here are that there will be an international agreement on standards and that there will be sufficient customer acceptance to push up sales to at least 10,000,000 sets a year within the next fifteen years.

That kind of volume, in addition to driving down costs, should attract more industry participation, which in turn should push the technology faster and assure the military users of more qualified sources of supply.

Under the standard for today's TV sets, established in 1953 by the National Television Standards Committee (NTSC), each TV frame consists of two interlaced fields of 262.5 lines, for a total of 525 horizontal lines. To convey motion, the fields are alternately updated sixty times a second, creating a new frame every one-thirtieth of a second.

HDTV would differ from the NTSC standard in two ways. It would at least double the number of lines—the various approaches range from 1,050 to 1,260—and each line would be scanned every one-sixtieth of a second (or "de-interlaced") to eliminate the flicker-ing common to today's NTSC TV sets. HDTV screens also would be wider. The ratio of width to height would be about five to three instead of today's four to three.

Two Solutions

These are the reasons why the HDTV signal is too big to fit within the six-MHz constraint originally established by the NTSC and upheld by the FCC. There is an "elegant" solution to this problem and a "brute force" solution.

The brute force approach is simply to increase the bandwidth and forget about transmitting over the allocated commercial channels altogether. That's the Japanese approach, but it causes problems because the amount of bandwidth available within the electromagnetic spectrum for communications is finite—and is thus a very valuable commodity.

The more sophisticated approach, which is understandably favored by US would-be producers of commercial HDTV sets and which is one of the possibilities being investigated by DARPA, is to stay within the bandwidth limitation by using state-of-the-art microprocessors to compress the signal at the sending end and then reconstruct it at the receiving end.

DARPA's R&D program is divided into two parallel efforts—displays and processors—launched on December 28, 1988, by a broad agency announcement (BAA 89-06) soliciting industry's ideas. As of early 1990, ten contractor teams had been selected to deliver pre-prototype hardware *[see box on this page]*.

The processing effort is further subdivided into two general approaches, one that uses advanced coding schemes to send all the data and one that uses "psycho-visual processing theory" to send only those data needed by the human eye to reconstruct the image itself, explains the Army's Lt. Col. J. Mark Pullen, Deputy Director of DARPA's Information Science and Technology Office.

The former approach—sending all the data—is aimed at intelligence and other applications in which the HDTV system serves in an information-processing mode, he adds. The latter, used for large-screen situation displays, is intended "to fool the human brain."

Part of the DARPA effort is directed at finding the tradeoff, functionality vs. costs, of the two approaches. "We have to determine what to send and what not to send," Colonel Pullen says.

The good news is that current semiconductor technology is adequate to accomplish the task, according to Colonel Pullen. Even for real-time applications, the necessary data compression could be accomplished by applications-specific integrated circuits with a complexity below 1,000,000 transistors per chip, which is well within the state of the art. The signal processing wouldn't necessarily be done with a single chip, but rather by several chips cascaded together.

Solving the Display Bottlenecks

The purpose of the display effort is to find the bottlenecks in the interface between humans and computers and to do something about them, according to Dr. Marko Slusarczuk, DARPA program manager for high-definition systems. Defense computing—in fact, all computing—is rapidly going digital, and the displays have to keep up.

Dr. Slusarczuk cites the example of cockpit displays. Today's pilots need more data, and they need it faster, since the aircraft fly faster. As a result, cockpit displays have

DARPA's High-Definition Display Program

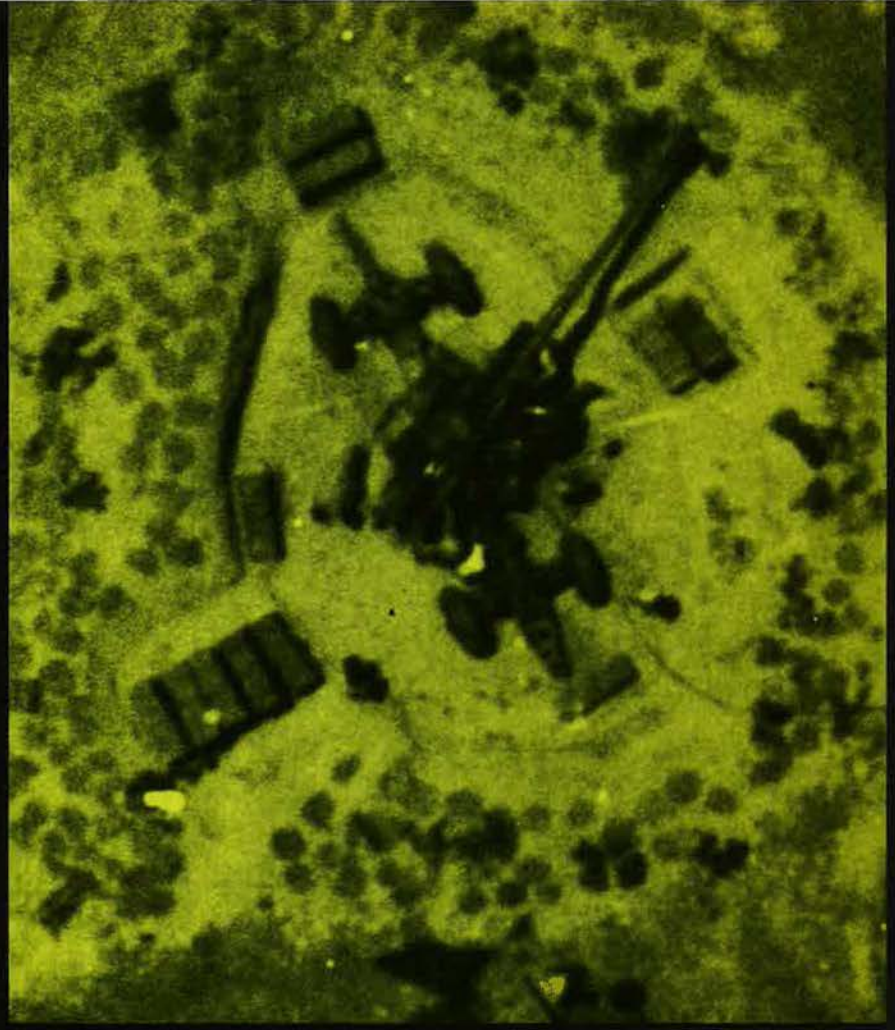
On December 28, 1988, DARPA launched a development program aimed at advancing the state of the art in systems that generate, store, manipulate, distribute, and display moving images with high resolution. The program is divided into two parallel efforts: displays and processors. As of January 9, 1990, DARPA had awarded ten contracts, as follows:

Displays

- NewCo Inc., San Jose, Calif.: display technology.
- Raychem Corp., Menlo Park, Calif.: display technology.
- Texas Instruments, Inc., Dallas, Tex.: display technology.
- Projectavision, New York, N. Y.: display technology.
- Photonics Technology Inc., Northwood, Ohio: plasma flat panel displays.
- Magnascreen Corp., Pittsburgh, Pa.: flat panel displays.
- Planar Systems Inc., Beaverton, Ore.: flat panel displays.

Processors

- David Sarnoff Research Center, Princeton, N. J.; Sun Microsystems, Mountain View, Calif.; and Texas Instruments Inc., Dallas, Tex.: high-definition-image work stations.
- Adams Russell Electronics, Waltham, Mass., and Massachusetts Institute of Technology, Cambridge, Mass.: advanced compression technology.
- Qualcomm Inc., San Diego, Calif.: advanced compression technology.



Harmless ground clutter or a lethal antiaircraft weapon? If a pilot is looking at the picture above, he can't be sure, especially in the split second he has to make a decision in today's aircraft. High-definition TV will give him an image more like the one at right, showing him that what he sees on the ground is anything but benign.

grown larger by about an inch per decade, he says.

That's not the answer, according to Dr. Slusarczuk. What the pilots really want is a "reconfigurable cockpit" that would display one set of data at takeoff, another while airborne during the routine phases of a mission, and yet another during combat conditions. "Video is a form of information," he says, "and we need to process and manipulate digital information."

Another example, one that was on GAO's short list, is tactical reconnaissance. Flying 35-mm cameras over the target areas and bringing the film back for processing runs into a series of problems, according to Dr. Slusarczuk.

First there's the time lost in flying both ways and doing the chemical processing back at the base. There's also the risk of losing the aircraft—and the information—to hostile action. Furthermore, the aircrew may stumble onto more important targets than those specified in its original orders and not know what to do about them without two-way communications with its base. The result may be multiple missions, each with its attendant risk and loss of time, to accomplish a single reconnaissance objective.

Dr. Slusarczuk also raises the question of resolution. While 35-mm film may initially have fidelity as high as 5,000 lines per frame, this is degraded by a series of reproductions (much like photocopying a photocopy) until the resolution may fall below a thousand lines per frame by the time it gets to the end user.

One of the reasons that displays have been a bottleneck in advanced electronics systems is that they have been the component least amenable to solid-state technology. While vacuum tubes have been replaced by chips for just about every other function over the past forty years, cathode ray tubes (CRTs) persevere for displays. Solid-state physicists refer to them sarcastically as "the only fire bottle" left in electronics. They're fragile, expensive, and power-hungry.

The DARPA effort is looking at the entire spectrum of candidates to replace CRTs: plasma displays, solid-state and gas lasers, liquid crystal displays (LCDs), and electroluminescence. Despite some successes in digital watches and the new laptop personal computers, however, solid-state displays in the past have suffered from high costs and low reliability.

HDTV for the home entertainment market may be stalled by political and economic considerations, but the military requirements are becoming apparent—and the technology base is being put together to meet these requirements. ■

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The appeal of cheap foreign chips and immediate profit was too much for this bold venture to overcome.

The US Memories Fiasco

By Stephen P. Aubin

ITS name was US Memories Inc., and no start-up company ever began with a louder bang. The *Wall Street Journal* cast the event in most dramatic terms: "Computer Firms Make Bold Pitch to Retake Market Lost to Japan." Major economic and defense benefits were forecast. That, however, was ten months ago.

The consortium to make state-of-the-art computer chips was backed by seven giants of the semiconductor industry. US Memories seemed poised to rescue a strategic industry battered by Japanese competitors.

It was not to be. First, Sun Microsystems and Apple Computers, two potential key players, balked. Sanford Kane, chief of US Memories, couldn't enlist other companies. Finally, having failed to win sufficient support, US Memories collapsed. The plan sank without a trace.

More than just one firm was slipping under the waves. In the wake of the US Memories fiasco, the United States finds itself bereft of answers to a vexing question: How can the US, against fierce foreign competition, ensure the survival of a dynamic semiconductor-making industry within its borders?

Stakes are high. Today's $50 billion international chip industry leverages a $750 billion global electronics market. Some 2.6 million US jobs depend on that market and thus on secure chip supplies.

Moreover, semiconductors are critical to modern weapons. Among those dependent on chip technology are all missile-guidance systems; avionics for F-16, F-15, and F/A-18 aircraft; and radar gear on AEGIS cruisers, to name but a few.

With the world market glutted by cheap foreign chips, a sudden cutoff is unlikely. What matters is having access when the global market tightens. Without secure domestic sources, experts warn, the US could be at the mercy of foreign suppliers.

Many saw US Memories as the solution. Quite evidently, they were wrong. Now, government, industry, or both will have to shape a new way to stem the erosion of the US semiconductor base. The tale of US Memories is an object lesson in how difficult the task will be.

US Memories was a unique consortium, launched by seven companies: Advanced Micro Devices,

Inc., Digital Equipment Corp., Hewlett-Packard Co., IBM Corp., Intel Corp., LSI Logic Corp., and National Semiconductor Corp. It was designed specifically to make dynamic random access memory chips, also known as DRAMs.

DRAMs Are the Drivers

The DRAM is one of the most vital types of semiconductors produced. Random access memory is an area in which a computer stores information and from which it retrieves data. A DRAM chip is dynamic, meaning that the computer refreshes it frequently.

DRAMs are ubiquitous, found in watches, cameras, cars, microwave ovens, telephones, and hundreds of other products. The DRAM, in Mr. Kane's words, is "a central component" on which most consumer electronics depend, and it lies at the heart of development of such advanced products as supercomputers and weapons.

Important in themselves, DRAMs are even more critical for their indirect effects on the semiconductor industry. DRAMs are described as a "technology driver," meaning that the processes used to produce them push the leading edge of the chip-manufacturing art, and the effects trickle down throughout the industry.

DRAM manufacturing, notes one US Memories report, "is in many ways the beginning of a technology chain. . . . DRAMs have a simple structure, and advances in DRAM technology are almost entirely [the result of] advances in production technology."

In short, the more dynamic a nation's DRAM-making base, the healthier its overall semiconductor industry will be.

In light of the DRAM's two-part significance, government and industry officials view recent US performance in this area as cause for alarm.

In the past decade, the US share of the worldwide DRAM market fell from seventy percent to less than fifteen percent. The market share of Japan, once negligible, has now risen to a commanding seventy-five percent of sales. In sales of the one-megabit DRAM, now the world standard, Japan's dominance is even greater: ninety percent.

This dramatic shift in the market has had a devastating impact on US productive capacity. Today, world sales can support just four US DRAM-making concerns. IBM produces DRAMs exclusively for internal use. Texas Instruments, Micron Technology, Inc., and Motorola, Inc., manufacture them for the general market.

However, the DRAM market is highly volatile because its manufacturing technology changes so rapidly, often in just two or three years. In such a situation, today's winners can become tomorrow's losers, and vice versa. The market for one-megabit DRAMs will grow for a few years, but the electronic-products industry even now is switching over to a new standard: the four-megabit DRAM. It will be the focus of furious "chip wars" of the future.

Gearing Up for Chip Wars

It was, in part, to prepare for the coming competition in the four-megabit DRAM market that US Memories was formed. Today, IBM is the only US firm making this new DRAM. In Japan, however, Hitachi, NEC, and others are producing the four-megabit DRAM. Firms in Europe are capable of the same.

The seven founding companies of US Memories had an ace in the hole: IBM's willingness to license its four-megabit DRAM design and manufacturing technology to the consortium to use in making its own DRAMs. The US Memories scheme would have allowed members to take advantage of IBM's pioneering work.

IBM evidently concluded that it was in its own interest to give US chip-makers a boost into the four-megabit DRAM market, probably because IBM, though itself a significant producer of chips, still relies heavily on outside vendors.

Each of the seven founding companies anted up $50,000 to launch the venture. They also agreed to invest collectively $200 million in equity. In an effort to raise another $300 million, US Memories offered other investors one to ten percent of equity, giving them stakes of $5 million to $50 million.

Even more vital was the requirement that investors had to agree to

Today's $50 billion international chip industry leverages a $750 billion global electronics market. Some 2.6 million US jobs depend on that market. Moreover, semiconductors are critical to modern weapons.

buy a percentage of US Memories's DRAM output equal to one-half of its equity percentage, whatever the price of each DRAM.

This arrangement was highly unorthodox for a venture out to capture a greater share of the market. However, the claims of the *Wall Street Journal* notwithstanding, recapturing market share was not principally what US Memories was about.

Above all, US Memories aimed to provide a secure source of DRAMs within the United States for US electronics manufacturers. The idea was that, even if the consortium's DRAM prices ended up higher than those produced by foreign concerns, it didn't matter. What did matter was that there would exist a secure US supply of high-quality DRAMs.

Thus, by pledging to buy a set amount of US Memories's DRAMs, each corporate investor was ensuring success of the project and—more important—taking out an insurance policy for itself.

Such insurance certainly seemed necessary. In the period 1985–87, Mr. Kane points out, Japan's DRAM-makers dumped chips in the US market at below-cost prices. US electronics companies bought the lower-cost chips, and US DRAM-makers went bust. Then the market tightened, and Japanese DRAM-makers, inundated by domestic demand, cut shipments to the US. Computer and other electronics firms in the US scavenged for chips, prices skyrocketed, and the US firms lost profits and customers.

Increasing the US supply, however, would not be easy. One major challenge for would-be DRAM-makers is finding money to keep pace with changing technology and to pay for advanced equipment needed to manufacture the chips.

IBM President J. D. Kuehler notes that the first such chips, manufactured in 1950, held a single bit of information. Since the 1K-bit DRAM chip appeared in 1970, the density of DRAM chips has doubled every year. Today's chips contain 4,000,000 bits of information, equivalent to 800 double-spaced typed pages, all on a chip no larger than a thumbnail. By the year 2005, semiconductor chips storing one billion bits of data will be in use.

Wonders Aren't Cheap

However, such wonders don't come cheap. As chip-making processes grow more advanced, costs soar. Some fifteen years ago, contact printers costing $35,000 drew circuit patterns on chips. A new device, the "stepper," has automated the process. Each one costs $1.7 million, and a production line requires up to fifty.

Already the race is on for even better processes. For example, says Kuehler, IBM is developing a process based on X-ray lithography. At present, circuits are created by shining visible light through stencil-like devices on to silicon. But circuits are shrinking to half-micron size (200 half-micron circuits equal the width of a human hair). By the mid-1990s, circuit size will be halved again. At that point, X rays must be used. IBM has spent $500 million on its Advanced Semiconductor Technology Center at East Fishkill, N. Y., a facility using this X-ray lithography.

For the founders of US Memories, therefore, the harsh new reality was unmistakable. Given the enormous cost of chip-making, US semiconductor firms needed some way to collaborate, pool their resources, and share technology for mutual benefit. Without it, they thought, the US semiconductor infrastructure would be hard pressed to survive in future competition with rich, ambitious, and cutthroat foreign firms.

The choice that confronted the US electronics industry, especially computer manufacturers that use DRAM chips, was equally unmistakable. They could invest in a venture that guaranteed them a secure DRAM-manufacturing base but which might never turn a profit. Or they could continue to buy cheap foreign DRAMs now and accept the long-term risk of near-total dependence on foreign suppliers as US suppliers withered.

As the fall of US Memories makes clear, American companies overwhelmingly chose the latter course. In no uncertain terms, US computer and electronics firms sent the message: Why think about tomorrow when DRAMs are cheap and plentiful on the world market today?

In no uncertain terms, US computer and electronics firms sent the message: Why think about tomorrow when DRAMs are cheap and plentiful on the world market today?

One might call it a triumph of short-term thinking.

This was not totally unexpected. In general, the lack of support for US Memories underscores the long-standing inclination within US industry to go it alone and underestimate the threat from foreign competition. The cultural reality was put this way in a report by the National Advisory Committee on Semiconductors:

"In the past, US semiconductor firms have not supported cooperative research in the early phases of process and materials development. They viewed their early research efforts as proprietary and did not share the results."

Balking at Cooperation

Sematech, a government-supported consortium designed to improve semiconductor manufacturing technology through joint research and development, did manage to bring together some manufacturers and semiconductor materials and equipment (SM&E) firms prior to the competitive phase. As the failure of US Memories attests, however, most American concerns are unwilling to take the next, logical step: cooperation in joint production of goods for the market. Another general problem is the industry's unwillingness or inability to invest in its own productivity.

IBM is the exception. The computer giant has invested heavily in new manufacturing technologies used to make the four-megabit DRAM. IBM, which used to make all of its chips from five-inch silicon wafers, now makes its four-megabit DRAMs from silicon wafers that are eight inches wide. Eight-inch wafers don't cost much more than smaller ones, but they yield about 450 chips. The yield of a five-inch wafer is approximately 150 chips.

The transition was not easy. IBM took on the expensive task of recalibrating its existing tools and purchasing new ones. The capital investment, reports senior information manager Paul Bergevin, has been more than offset by increased efficiency and productivity.

Most other US chip-producers use six-inch wafers. For them, the cost of converting to eight-inch wafers would be too high for the short-term payback they would receive. Moreover, with chip prices depressed, they may not even have the option of spending capital if it cannot be recouped relatively quickly.

What Happens Now?

After the demise of US Memories, the main question quickly became apparent: What will happen to the US infrastructure?

Many US manufacturers, having given up on the idea of creating a unified front, are already moving to cut their own deals with foreign producers in an effort to lock in a supply of chips now. For example, Intel Corp. decided in early 1990 to form a joint venture with NMB Semiconductor Co. of Japan. The idea is that Intel will market NMB Semiconductor's DRAMs in the US, thereby gaining access to a stable supply. For its part, NMB will gain access to Intel's established sales network.

The state of semiconductor manufacturers in the United States has a direct effect on the health of semiconductor materials and equipment suppliers and, ultimately, on the health of the whole industry.

US semiconductor materials and equipment firms have an interest in the success of US chip-manufacturers and vice versa. That is why there had been general support in the SM&E sector for US Memories and why the demise of parts of the SM&E sector has been of such deep concern to chip-manufacturers.

As the number of chip-producers dwindles, some critical chip toolmakers and materials suppliers are forced to seek offshore ownership. Examples abound:

- The potential acquisition by Japanese interests of Perkin-Elmer, the leading US maker of advanced lithography equipment, is the latest in a series of foreign purchases watched closely by US government and industry.
- The recent sale of Monsanto's silicon materials unit to the West German firm Huels dropped US-owned silicon wafer production from a fifteen percent share of the world market to 1.8 percent.
- Materials Research Corp., a critical US manufacturer of semiconductor equipment and materials, accepted a tendered offer from Sony, the giant Japanese conglomerate.

As the National Advisory Committee on Semiconductors summed up the problem, "These companies represent important capabilities in the United States. It would be damaging to the semiconductor industry, and to US manufacturing as a whole, if these skills continue to migrate abroad."

Japan Keeps Pressing

Meanwhile, there can be no doubt that the Japanese are pressing preparations to dominate the four-megabit DRAM market. In 1989, the semiconductor divisions of Japan's seven top producers hiked capital spending ten percent. "The companies," observes the authoritative *Financial Times*, "claim that most of this increase is to get production of four-megabit chips under way and to accelerate moves to step up overseas production."

From a national security standpoint, dependence on foreign sources for such a critical component is not something any responsible Secretary of Defense would advocate. Even on purely commercial grounds, such dependence is not wise. In periods of peak demand, US computer companies and electronics firms could be starved of chips due to the inclination of foreign manufacturers to cater to local customers first. That is exactly what happened when the Japanese shut off supplies to US firms in 1987.

US Memories Inc. may have been ahead of its time, but there may not be much time left. Unless a technological breakthrough in manufacturing brings down the costs of semiconductor production, and more firms are able to enter the field, the US electronics and national defense industries may one day find themselves wholly dependent on foreign sources for the most vital components of their products. ■

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The Soviets said it was a fraud, and many believed them. Now the USSR itself has acknowledged the truth.

Yes, There Was a Moon Race

By James E. Oberg

WHEN Apollo 11 astronauts touched down on the moon in the summer of 1969, they brought their spacecraft to rest in a lunar region whose name seemed appropriate to the occasion. The near-flawless voyage ended in the Sea of Tranquillity.

There had been, however, an earlier lunar visitor. Only hours before the US Apollo landing, an unmanned lunar probe approached the moon, flying in as part of a last, desperate effort by the Soviet Union to arrive there first. It crashed. In retrospect, it seems that the scene of that lunar mishap was equally fitting. The place was called the Sea of Crises.

The full irony of these events, however, was lost on most Americans. They were unaware of the multiple crises plaguing the USSR's man-on-the-moon push. Indeed, few were—or are even now—aware that a serious Soviet lunar program existed. But it did.

The issue, long in dispute, is suddenly settled. In yet another startling episode of *glasnost,* the Soviet press has released a flood of revelations proving once and for all that the USSR raced the US to the moon and intended to win.

Now confirmed openly are Soviet moon-exploration schedules that were competitive with Apollo plans, the names and histories of Soviet lunar boosters and landers, and identities of the lunar cosmonauts. Even photos of manned lunar craft are available.

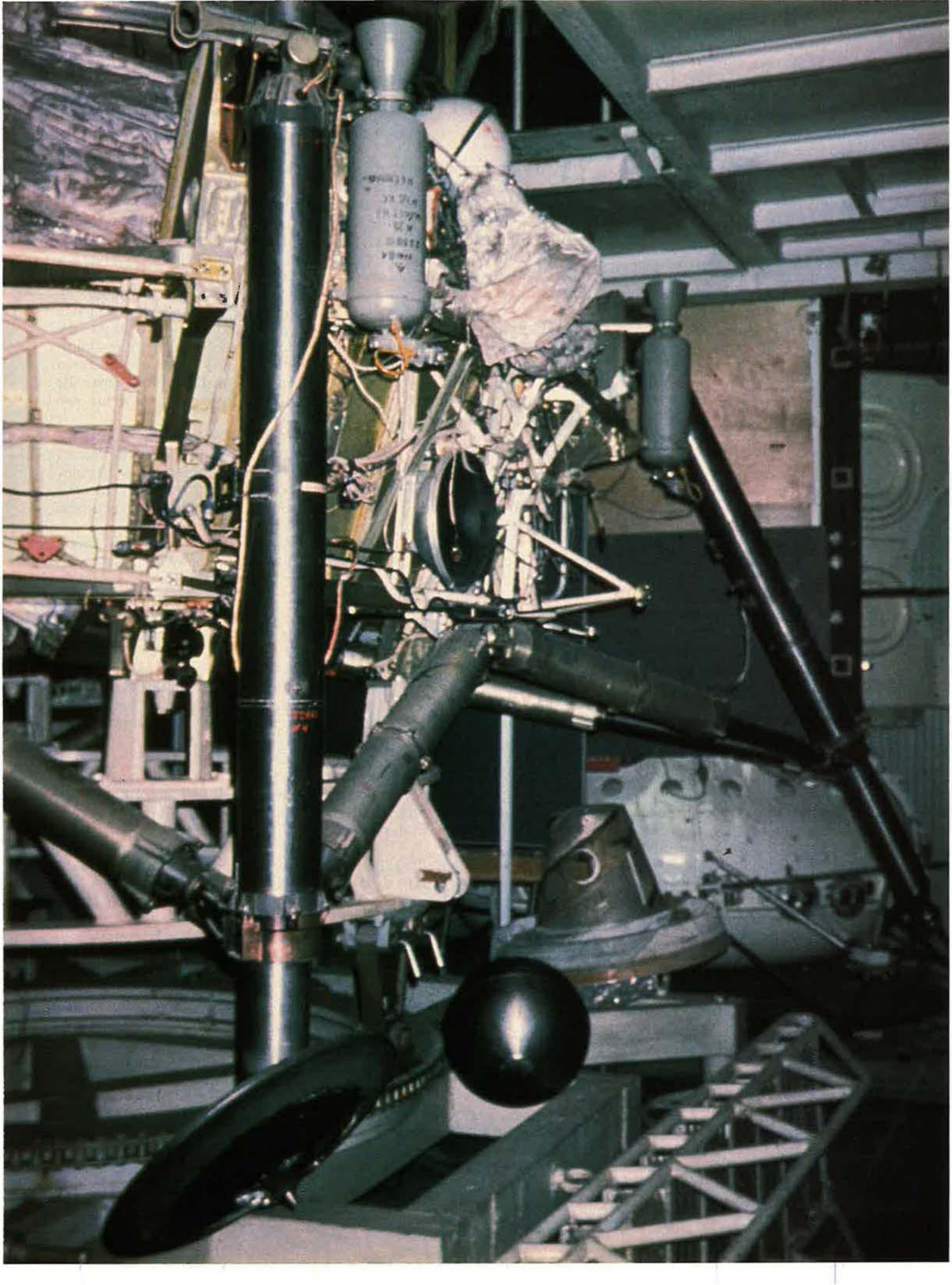
In exploding the myth that they never entered the moon race, the Soviets themselves have vindicated those few Western experts who correctly interpreted Soviet space activities.

Much of the Western political and media elite had by 1963 concluded that the moon race was a fraud. After Apollo 11, the USSR sniffed that it never was interested in such a costly, perilous, marginal operation. Many bought this self-serving line.

Examination of newly disclosed evidence about one of the most intense phases of the superpower rivalry makes plain that US actions came in response to an authentic Soviet challenge.

New information also offers insights into what went wrong with

A centerpiece of the Soviet manned lunar landing effort was "Project L-3," the equivalent to the Apollo lunar module. Plagued by technical problems and crippled by power struggles in the scientific community, the Soviets would not be able to perform even an unmanned test of L-3 until after Armstrong and Aldrin had walked on the moon.



Soviet plans. For those convinced that Moscow was aiming for the moon, the mystery has been why, after successful unmanned flights in the late 1960s, the Soviets never staged a manned shot. The answer is that, to the last, the program was racked by deep bureaucratic struggles and bitter clashes between competing individuals.

A Two-Part Program

We now know the Soviet lunar program was divided into two distinct parts.

The first part of the campaign was a program, called "Zond" in public and "Project L-1" in secret, that aimed to carry out a manned flyby of the moon. The second stage focused on mounting an actual lunar landing, utilizing a hitherto secret spacecraft, called "Project L-3," and a huge superbooster, the N-1.

Even in the 1960s, Western space experts had identified the Zond project as potentially aimed at producing a manned, lunar space vehicle.

In the Soviet Union of the early 1960s, there were two main competing spacecraft teams, the equivalents of Western aerospace corporations. They were those run by Sergei Pavlovich Korolev and Vladimir Nikolaievich Chelomey, both now deceased.

Korolev operated a design bureau in Kalinin, north of Moscow, and a major spacecraft and rocket plant in Kuybyshev, on the Volga River. Chelomey's design bureau was in Moscow, as was his rocket factory. Supporting all of the rocket manufacturers was an engine-design group based in Leningrad, headed by Valentin Petrovich Glushko, also now deceased.

In 1963, the Chelomey team was given a special task: It was to build a superrocket, known as UR-700 at the time, but soon to be known as "Proton." Within the CIA, the rocket was called the SL-9; later versions with improved upper stages were called SL-12 and SL-13. Conceived as a military missile to carry Premier Nikita Khrushchev's 100-megaton nuclear "terror bomb," Proton was soon applied to space transport needs.

At the same time, Korolev's team was designing its own superbooster to compete with Chelomey's UR-700/Proton. It got the name N-1. In the West, the rocket became known as the SL-15 or Type G. It was the first Soviet rocket designed without a primary weapons-carrying mission.

The two premier Soviet rocket designers, Chelomey and Korolev, had competing plans for manned lunar flight. In 1962–63, as the US Apollo program gained force, the Soviets had two groups at each other's throats, but had no overall lunar strategy.

Big Struggle, No Master Plan

Korolev's team took its plans for what would become the future Soyuz vehicle and developed a scheme to mount a simple, manned lunar flyby mission using only the small R-7 booster. The plan called for launchings of four or five orbital refueling vehicles, followed by near-Earth assembly and fueling of a manned vehicle. The vehicle was to fly around the moon and return.

Chelomey's team had a far different plan. It counted on using a single launch of its new Proton rocket, three times more powerful than R-7, to carry a manned space vehicle directly to the moon. Early plans called for using a spacecraft of the team's own design, though the two-man Voskhod spacecraft was later considered.

In the struggle for preeminence, each group made an appeal to Khrushchev. Chelomey even hired Khrushchev's son as an officer in his rocket organization. Arguments went back and forth. Finally, early in 1964, the Soviet leadership made its decision.

Khrushchev formally selected Chelomey's team to carry out Project L-1, the manned lunar flyby program. The event likely was to take place in 1966 or 1967. Khrushchev told Korolev's team to concentrate its efforts on hardware to support Project L-3, the manned lunar landing, and specifically on perfecting the lander itself and the N-1 superbooster. The Kremlin ordered the landing to take place in 1968, two years ahead of when NASA planned to put Americans on the moon.

The plans were thrown immediately into turmoil, however, when designer Korolev undertook constant efforts to seize and run all of the projects—Chelomey's no less than his own. Korolev's demands were not unreasonable. L-1 and L-3, in terms of the Apollo project, would be the "command module" and "lunar module." Development of the two had to be tightly coordinated.

Politics vs. Science

Then came a bigger blow to stability of the program: the sudden ouster of Khrushchev in October 1964. When Khrushchev was sacked, Chelomey lost his key Kremlin patron. Korolev launched a campaign to persuade Leonid Brezhnev, the new General Secretary, and Dmitri Ustinov, minister in charge of space, to transfer authority over the L-1 lunar flyby program to his own bureau.

In late 1965, Korolev succeeded. It turned out to be a hollow victory for his team, however, as Korolev died only a few months later. His deputy, Vasily Mishin, assumed command.

At the time of Korolev's death, the US was already more than halfway through the Gemini program and had begun to flight-test prototype Apollo hardware. A unified plan for lunar orbit rendezvous had been written. NASA centers and contractors were in harness. The Saturn 1B, with the essential liquid-hydrogen engine for the second and third stages of the Saturn V, had been proven.

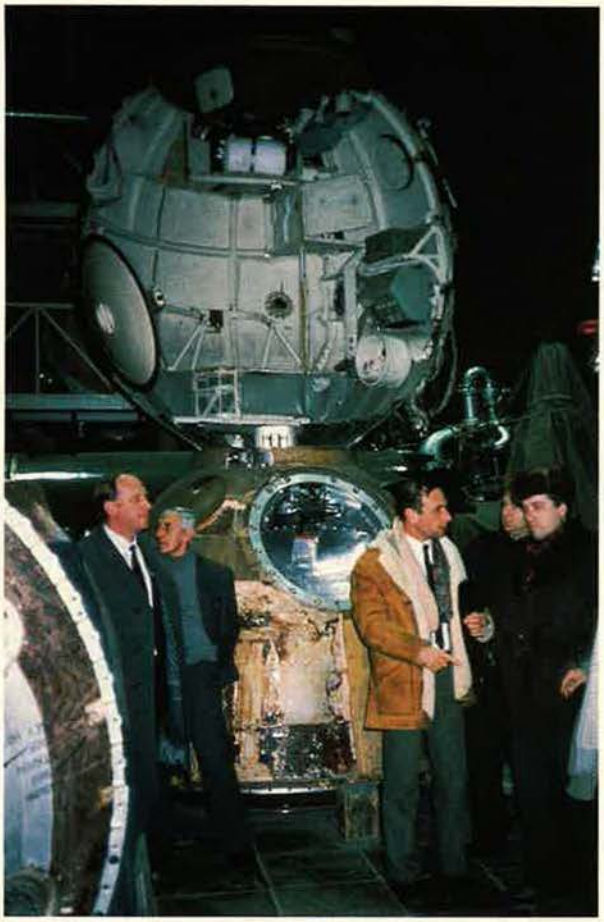
The Soviet program was stumbling badly. The Kremlin's final, official approval of the entire lunar program came only in February 1967, shortly after the Apollo 1 fire killed three astronauts and seemed to derail the US program indefinitely.

In 1967, US suspicions about Soviet intentions became fully aroused. NASA, led by Administrator James Webb, began calling attention to evidence that Moscow had embarked on a manned lunar landing program. In hindsight, it becomes obvious that US Air Force intelligence satellites had detected huge N-1 boosters at launch sites and engine tests at the Kuybyshev factory.

Having won the internal power struggle, the Mishin team—formerly Korolev's—was now supported by Chelomey's Proton booster. Plans called for several flight tests,

leading to a manned lunar landing in the third quarter of 1968. The Mishin team was directed to begin tests, in the spring of 1967, of its own giant N-1 booster. The N-1 design, as finally approved, was a two-stage system with a payload capacity of 95,000 kilograms in low-Earth orbit. Thirty engines were mounted in pairs at the base of the first stage. Rocket fuels for all the stages, Mishin argued, should be kerosene and liquid oxygen. For Proton, however, Chelomey selected hypergolic fuels, hydrazine and nitric acid. Glushko sided with Chelomey. Glushko's unwillingness to cooperate with Mishin dragged out the N-1 process.

Throughout 1967, the Soviet lunar program continued to be dogged by mishaps and difficulties, first with the Mishin team's new Soyuz/L-1 command module and then with Chelomey's troublesome Proton/UR-700 booster, which had experienced a string of launch failures. The Soyuz/L-1 project suffered a disaster in April when an accident killed a cosmonaut. Even so, L-1 was far enough along by mid-1967 that the USSR organized a special cosmonaut team to train for the lunar mission.



The division of labor between the scientific team that worked on the Soyuz/L-1 command module (seen here) and the team that worked on the various boosters caused a great deal of strife, resulting in delays in the program. A string of launch failures was followed by a disaster when, in April 1967, an accident killed a cosmonaut.

Cosmonauts Begin to Train

The select cosmonaut team numbered about twenty members, including Yuri Gagarin, Pavel Belyayev, Valery Bykovski, and Alexei Leonov. They were hardened veterans, and they had to be. One of them, Andrian Nikolayev, told Radio Moscow that once, as he and Gagarin watched a launch of a Proton/Zond, the booster exploded and sprayed the pair with poisonous nitric acid fumes. The would-be lunar explorers had to flee for their lives.

Well into 1968, Soviet efforts continued to flounder. The ambitious development and test schedule for the N-1 superbooster proved impossible to meet, and the whole of 1968 was spent trying to get the first flight vehicle ready for a launch.

This, of course, was not known in the West. The Soviets had completed their ground facilities and were hauling mockup N-1 rockets back and forth to test pad plumbing, wiring, and other systems. To those viewing the photographs taken from American spy satellites, the Soviet hardware and activity looked impressive.

Observations such as these led to a NASA decision to accelerate the Apollo schedule. By August 1968, NASA had chosen a bold plan. There would be no more waiting. The second manned Apollo mission, using the Saturn V booster, would be sent from Earth to carry out a flyby of the moon.

Shortly afterward, on September 23, 1968, the unmanned Zond 5 returned to Earth, confirming NASA in its decision to step up the pace. Several earlier failures of the Zond had escaped the notice of intelligence agencies. Even with the Zond 5, a failure in the navigation system had forced an emergency landing in the Indian Ocean, but this was not known. Two months later, in the fall of 1968, an unmanned Zond 7 command module did make a successful circumlunar flight, clearing the way for a possible manned mission.

Recently published Soviet diaries reveal that Soviet authorities wanted to carry out at least two more unmanned tests of the Zond module. In the US, however, no one suspected such top-level Soviet caution. US space officials saw that the Soviets would have a launch window on December 8, 1968, after which the moon would not be in proper position for flights from Soviet territory for a number of months. Moreover, Apollo 8's manned lunar voyage was set for December 20, 1968, and the Kremlin knew it. The Americans were all but certain that the Russians would go first.

Despite this confluence of opportunity and motivation, Moscow waited. For twenty years, this mystery of "the missing lunar launch" stumped Westerners, who speculated on possible hardware problems, medical problems, even bad weather at the launch site. It seems now that, at the crucial point in the moon race, the Soviet authorities may simply have lost their nerve.

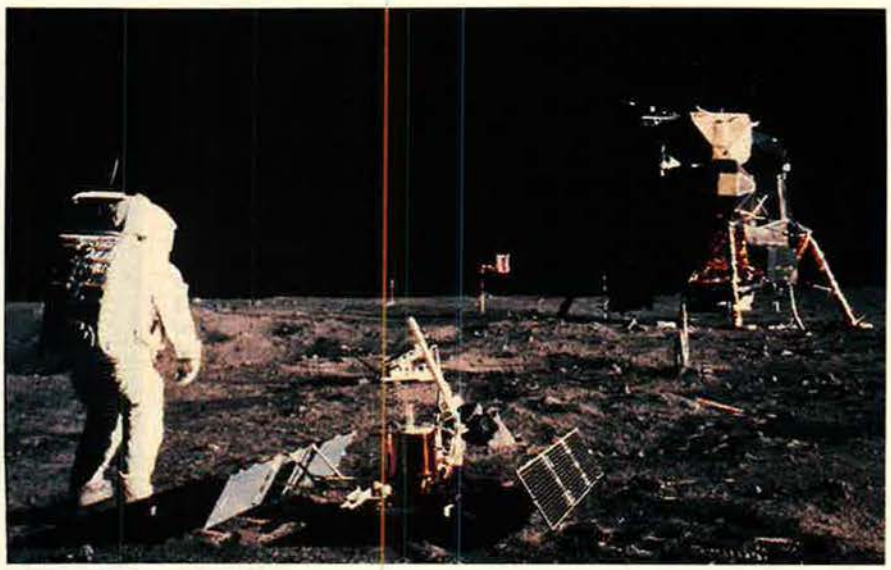
The US did not, and Apollo 8 blasted off on schedule. Not only did Apollo 8 edge out the USSR's planned lunar flyby; in addition, the US mission conducted ten complete orbits of the moon, a feat the Russians hadn't planned to attempt. Moscow undeniably had lost the first big round in the moon race.

It is now clear that many Soviet space officials bitterly opposed the cautious approach. Lev Kamenin, son of the cosmonaut training chief and aide to Soviet space officials, wrote in his diary for the day at the Apollo 8 launch: "For us this [day] is darkened with the realization of lost opportunities and with sadness that today the men flying to the moon are named Borman, Lovell, and Anders, and not Bykovski, Popovich, or Leonov."

The trio of cosmonauts named in Kamenin's diaries had in fact been designated as the commanders of two-man teams preparing for the mission.

Though its plans to be first with a manned flyby had been trumped, the Soviet Union was not out of the competition. No human yet had actually landed on the moon. Soviet space officials knew that NASA was experiencing difficulties with Saturn V's second stage and with the lunar landing vehicle. In late 1968, few Soviets—or even Americans—expected the US to attempt an Apollo landing before 1970, and perhaps not until 1971. For the Soviets, then, the most spectacular aspect of the moon race was still on, and the L-3 lunar landing program was still in the running.

In fact, it was nearing a climax of sorts. A pair of tests of the L-3 lunar landing vehicle, two years behind schedule, were set for 1969. If these went well, a manned Soviet lunar landing would be possible by the end of 1970.



On July 20, 1969, the US won the race to the moon, though virtually no one outside of the USSR knew for sure that the Soviets had been competing. The event caused consternation and great disappointment among Soviet space officials, while the Soviet media gave only minimal coverage to the US triumph.

An Unsuspected Advantage

The Soviets had one advantage totally unsuspected in the West: They did not intend to use the N-1 superbooster to launch cosmonauts. Instead, plans called for Soviet cosmonauts to be launched inside their fully-fueled Soyuz/L-1 command module, stacked atop a Proton booster. Then, a few hours later, the moon craft would be launched unmanned on an N-1. The two spacecraft would immediately link up in low orbit and head for the moon.

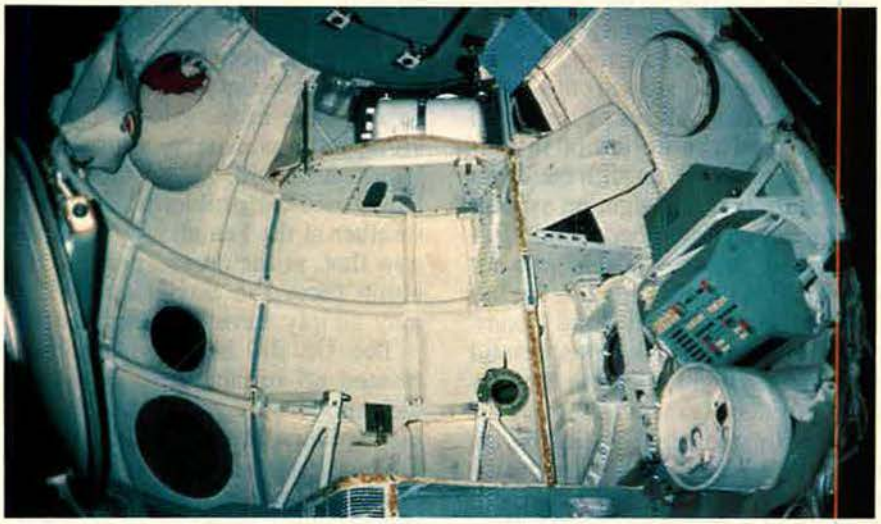
The practical consequence was that there would be no need to put the N-1 through the immensely intricate—and time-consuming—safety verification process for manned flight.

Soviet rendezvous flights in 1967–69 followed an unusual profile of launching first the manned ship, then an unmanned ship. This was the opposite of the sequence for visiting a space station. The strange Soviet profile was evidently designed to accommodate the needs of the manned lunar landing mission.

However, much depended on the Proton being made reliable enough to trust with a manned launch. In 1968, there were grave doubts on that score. The N-1 booster also was crucial to the landing mission. Western intelligence sources have over the years leaked unflattering accounts of the doomed rocket's flight tests. However, they seem to have entirely missed the first N-1 launch on February 21, 1969. The rocket flew well for a full minute before sensors detected a fire in the tail section and shut down all engines.

The next flight of the N-1 was prepared under the stress created by signs that Apollo's moon landing might come far sooner than expected. None of the difficulties hoped for by the Soviets had materialized. Apollo 11 was set for a July 16, 1969, launch.

Two weeks before this date, on July 3, the second N-1 prepared to lift off its pad at Tyuratam. In the final seconds of countdown, as a



Well into the 1970s, the Soviets continued to pin their hopes on the L-1 as the spacecraft that would take them to the moon. They eventually abandoned the moon mission, judging it impractical and of dubious propaganda value.

second-stage, liquid-oxygen turbopump was being spun up to flight operational speed, it disintegrated and tore a hole in the fuel tank. Within moments, the second stage erupted in flames. Then the rocket's first stage exploded. The launchpad was destroyed. A massive cloud rose into the sky and drifted into the field of view of a passing US weather satellite.

With all eyes on Cape Kennedy, the disastrous events at Tyuratam went unnoticed. Apollo 11 amazed the world with its own smooth countdown. Soviet officials listened with a mixture of awe and dismay to Western broadcasts. (Soviet media minimized the event.) Then Neil Armstrong and Edwin "Buzz" Aldrin walked the moon and returned with Michael Collins to Earth. The race to the moon was over.

Defeated But Not Finished

Though defeated, the Soviets didn't quit entirely. They disbanded the special cosmonaut team but kept all the engineers working. The L-3 manned lunar spaceship was readied for testing, and nobody was yet prepared to kill the program.

According to Western intelligence sources, the first L-3 vehicle was launched unmanned in November 1969, but the Chelomey Proton booster failed again. It did so yet again a few months later.

Finally, on December 2, 1970, the Proton boosted what was called the Kosmos 382 satellite into orbit. The Soviet cover story had it that Kosmos 382 was a scientific research vehicle, but it soon began to conduct rocket burns simulating a manned lunar mission.

Three smaller vehicles went aloft in 1970 and 1971, likely to test the lunar module's ascent stage. Spaceships Kosmos 379 on November 24, 1970, Kosmos 398 on February 26, 1971, and Kosmos 434 on August 12, 1971, conducted large-scale rocket burns, relayed simulated manned telemetry, and showed that manned moonships had been built despite the denials.

The N-1 superbooster program continued for a while. By mid-1971, the Soviets prepared to stage a third flight. It lifted off in early summer, probably on June 27. For seven seconds the engines performed perfectly, lifting the vehicle several hundred meters into the air. Then, an unpredicted fluid dynamics effect led to a massive buildup of rolling motion, and the spin became too great for the steering rockets to fight. The booster fell back onto the newly-rebuilt launchpad, destroying it for a second time.

A fourth N-1 launch occurred on November 23, 1972. The first stage performed well, firing its full 107 seconds and shutting down on time. During the coasting period prior to ignition of the second stage, however, plumbing failures in the rocket's tail caused a massive fire. The Soviets lost control of the rocket and had to abort the mission.

In this flight Mishin's N-1 rocket engineers actually found some encouragement. By 1974, the Soviets had prepared two more tests of N-1 vehicles of greatly improved reliability and robustness. They expected to clear the booster for manned lunar expeditions beginning in 1975.

Political Support Fades

All the while, however, high-level political support was evaporating. The cost of the N-1 was appalling; Mishin says less than three billion rubles, but another source estimates four and a half billion. Outside of Mishin's own group, optimism about the value of ultimate success—when and if it ever occurred—did not exist. Glushko's attacks on Mishin's leadership and competence became more and more credible. The Soviet Union knew there would be no glory in repeating the success of Apollo so many years after the fact. What's more, any attempt would only confirm that a manned program—an inferior one—had existed all along.

Glushko and his allies steeled themselves for action. During one of Mishin's frequent hospital stays, his enemies made their move. They argued forcefully to Soviet leaders that policy and personnel had to change. They won. It was decided that Mishin would have to "retire" and that Glushko would replace him. On Mishin's first day out of the hospital, Glushko ordered him to turn in his security pass. Ustinov relieved Mishin of his duties.

Glushko was named director of the old Korolev bureau in Kalinin, replacing the disgraced Mishin. On his first day in office, he signed a decree canceling the entire N-1 superbooster program. Glushko and his staff wrote the official Soviet space histories, making sure that Mishin's name was never mentioned.

Having dispensed with Mishin and the entire lunar program, Glushko reshaped the Soviet space program to his liking. He had by 1976 persuaded Brezhnev that Russia needed a space shuttle like the one NASA was building; over the next twelve years, the USSR spent fourteen billion rubles on the Energiya/*Buran* system. In many ways, the rocket piggybacked on technology developed for the N-1 superbooster; it even used a surviving N-1 launchpad, after modifications. Today, however, the Soviets are wondering publicly what use their shuttle, Glushko's legacy, really has.

The Soviets themselves have drawn bitter conclusions about their failure in the moon race with the United States.

One recent commentary in *Izvestia* observes that the fates of N-1 and L-3 reflected painful problems common to the rest of Soviet society: "excessive politicization of science, substitution of sham goals for worthy ones, 'voluntarism' [a Soviet euphemism for wishful thinking], and lack of collective decision-making on crucial issues."

Mishin told *Pravda* not long ago that development of the Soviet space program had been obstructed by "monopolism and excessive secrecy, nepotism and political chicanery." The manned lunar program failed, he believed, largely because the motives of its organizers were inappropriate: They put political goals ahead of scientific ones and were interested chiefly in enhancing the USSR's prestige. ■

James E.Oberg, a former USAF captain, is a professional NASA space engineer now working on the space shuttle program in Houston. He is the author of many works on space topics, with more than 200 articles and eight books to his credit. Among the latter are Red Star in Orbit, Pioneering Space, *and* Uncovering Soviet Disasters. *His most recent article for* Air Force *Magazine was "The Sky's No Limit on Disinformation" in the March 1986 issue.*

The truth about Lend-Lease is well known—except to the citizens of the Soviet Union.

A Gap in *Glasnost*

By Vladimir P. Gorshenin

ONE DAY, perhaps, the truth about Lend-Lease will emerge in the Soviet Union. It hasn't happened yet. Even after nearly five years of Mikhail S. Gorbachev's *glasnost,* facts about the massive US effort to resupply Soviet forces in World War II remain carefully hidden, falsified by Soviet propagandists.

Most Soviet citizens have little or no idea how much the US contributed to the defeat of Nazi Germany in the "Great Patriotic War." It is an important gap in Soviet wartime histories.

In late 1940, with Britain standing alone against Hitler, President Franklin Roosevelt called on the US to become a "great arsenal of democracy." In response, Congress in March 1941 passed the Lend-Lease Act. It empowered the President, "in the interest of national defense," to supply military articles to nations whose defense he deemed vital to America's own security.

Initially, most Lend-Lease materiel went to Britain. When Hitler invaded Russia in June 1941, US equipment began to flow to the Soviet Union. By war's end, Washington had supplied the USSR with $11 billion worth of military goods. Soviet authorities, when pressed, will concede that, "according to American sources," the US sent the USSR 14,450 airplanes and about 7,000 tanks.

It has been nearly half a century since the US set up its "sea bridge" to the Soviet Union through the North Atlantic and an "air bridge" to the USSR through Alaska, over which moved tons of military supplies. Even so, the Kremlin continues to promote a distorted and negative view of the US effort.

"Great Britain and the United States had all the necessary conditions to invade Europe as early as the end of 1941," asserts the official Soviet *History of the Great Patriotic War,* which remains a standard reference. "However, the governments of these countries did not hurry to open a second front [to take German pressure off the USSR]. . . . Intending to assume the most favorable positions in the world arena after the war's end, the British and American capitalist ruling circles were guided in their policies by the idea of making the war a protracted

American B-25s and A-20s, such as these awaiting a ferry trip to the Soviet Union, contributed mightily to the USSR's battle against the Axis. Official Soviet histories continue to sneer, despite glasnost, at the US contribution to the Soviet war effort as totally inadequate and, for the most part, perfunctory.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one, exhausting and weakening both Germany and the Soviet Union."

That is the Kremlin's guiding ideology concerning the wartime actions of capitalist nations. On a more practical level, Soviet authorities denigrate the Lend-Lease effort by adducing considerable "proof" that the program was ineffective.

One of the main points harped on by Soviet propaganda is the assertion that much of the total number of aircraft, trucks, and tanks never reached the Soviet-German front. In Soviet eyes, of course, the Anglo-American Allies bore full responsibility for this alleged failure.

The PQ-17 Disaster

In support of this view, Soviet propagandists usually cite the story of the ill-fated resupply convoy "PQ-17," most of which was sent to the bottom by German warships. In this disaster, some 153 Allied sailors lost their lives. Kremlin leaders come up with a rather strange explanation for the demise of this convoy.

In a prominent wartime history, "The Second World War," author G. A. Deborin presents the Soviet case: "Attempting to blackmail the Soviet Union, the American and British governments agreed between themselves to cease the delivery of supplies in the period most difficult for Soviet forces. . . . The ships were en route when, . . . by order from London, all escort, support, and cover ships were recalled westward [toward Britain]. The cargo ships were told to 'disperse and head for Russian ports.' " The German Navy made short work of the defenseless vessels, continues the author, and afterward, "these cargo ship losses were constantly given as the excuse for reducing deliveries to the Soviet Union."

It should be noted that British and American naval historians view the convoys to Murmansk and Arkhangelsk as having been risky ventures, undertaken for political ends but totally unjustified from the standpoint of naval strategy. No matter what the British Admiralty tried to do, it could not evade the fact that geography favored the German fleet. A total of 829 Allied sailors were killed on the northern seas attempting to deliver military supplies to the USSR.

Such losses were of no importance to Soviet authorities. At this time, the Soviet Union was strained to the utmost in its death struggle with Germany. Just what did the lives of hundreds of sailors mean to Stalin, when hundreds of thousands of Russian soldiers, entire armies, were perishing on the Eastern Front? In the view of the Soviet dictator, the Allies simply had no choice but to do everything possible to help save the Soviet Union.

Col. Alexander Pokryshkin, shown here in front of his P-39 after receiving his third "Gold Star" medal as "Hero of the Soviet Union," garnered fifty-nine victories in US-built aircraft, most of which Soviet officials derided as being "obsolete" and of inferior quality.

Stalin made constant attempts to pressure British Prime Minister Winston Churchill into rendering more aid, demanding the dispatch of the greatest possible number of supply vessels and British warships. In the meantime, it was becoming more and more clear to Hitler that the blitzkrieg against the Soviet Union had failed and that a protracted war would be won by the side with the greatest resources.

This meant keeping American resources out of Soviet hands. In mid-April 1942, the Nazi leader confirmed his order of one month earlier: "The most important task at the moment is to attack the Murmansk convoys."

After the destruction of PQ-17, Churchill sent Stalin a telegram indicating that, under the existing circumstances, any new convoys would be sunk should they be dispatched. The British leader insisted that the Soviet Union had to play a more active role in providing air cover for the convoys.

Stalin responded angrily, saying that the British Admiralty, which had withdrawn the cruisers and ordered the cargo ships to disperse, was responsible for the convoy's destruction. The ships had thus been left completely unprotected, he said, and the USSR took no responsibility.

Stalin had forgotten or preferred not to remember that, a year earlier, the Soviet naval command had resorted to the same tactic. In August 1941, German troops had surrounded the Estonian capital and key port of Tallinn. Defending Soviet divisions had no evacuation route other than by sea. German aircraft began attacking Soviet transport ships in the Gulf of Finland. Soviet warships were then ordered to abandon the transports and cargo ships and proceed at full speed to Kronstadt. Thus, sixty-seven ships were left unprotected. The Germans sank a great number of them, with considerable loss of life.

In truth, the Soviet Union could not provide air cover for the convoys in either of the cases, not because it did not want to, but because it lacked aircraft to do so. In the first months of the war, German long-range bombers had destroyed virtually all Soviet fighters, and the German ground forces quickly

seized all the important airfields in the European part of the Soviet Union, in most cases along with associated materiel.

Inferior Equipment?

Another Soviet argument is that the US equipment which reached the Soviet Union was of inferior quality. Typical of this view was a 1987 Soviet article which maintained that "Soviet air units equipped with American aircraft suffered greater losses than units equipped with Soviet aircraft."

Soviet authorities are indeed critical of the quality of American weapons. Attempts are made to convince the Soviet people that, as a 1985 article in the Soviet monthly *USA: Economic Political Ideology* put it, "American-supplied weapons and war materiel were not always first class, and aircraft were obsolete models."

An article titled "The Boston's Last Flight," published in *Izvestia* on August 24, 1987, advanced the Soviet contention that American aircraft were of poor quality. It recounted how one American A-20 "Boston" bomber (as it was called by the RAF) flown by Soviet pilots crashed during landing at an intermediate airfield near Irkutsk in Soviet Siberia.

As the article's author notes, it is quite difficult now to establish the cause of the crash. This does not keep him from hinting darkly at a possible malfunction of the bomber's navigational equipment, for which the pilots cannot be held accountable. However, it is appropriate to ask whether Soviet wartime maintenance was up to standards, whether pilots were skilled, and whether weather conditions were unfavorable.

Clearly, Soviet pilots and airmanship were not top quality. Here is what American John Deane, a direct participant in the events, observed in his 1947 book, *The Strange Alliance:*

"Pilots warm up their motors as they taxi to the takeoff. There is never the slightest pause for 'revving up,' nor in a final check between taxiing and departure. Landings are made in accordance with which end of the field is closest to the incoming plane, and circling a field is considered a complete waste of time. Landing the aircraft is determined entirely by bulk and never by weight."

This monument on the banks of the Tanyurer River at the wartime intermediate airfield of the Alaska-Siberia supply route is one of the few Soviet acknowledgments of the help the USSR received from the US under Lend-Lease. It lists the names of Soviet pilots of US aircraft who perished "in performance of their duty in the severe climatic conditions of the Chukotka Peninsula."

The Soviet air force evidently paid only the slightest attention to preventive maintenance. "We Americans," wrote Deane, "were familiar enough with the life span of American aircraft sent to Russia to know that maintenance consisted mainly of substituting new aircraft as the old ones wore out."

It is well known that extreme weather conditions provided another cause for the crashes of American fighters and bombers in other areas of boundless Siberia. A duralumin star-topped pyramid stands on the Tanyurer River in Siberia at the site of a wartime intermediate airfield on the Lend-Lease supply route from Alaska. The metal plaque screwed to the base of the monument lists the names and ranks of Soviet military personnel who, it says, "were killed in the performance of their duty and in the severe climatic conditions of the Chukotka Peninsula."

Thus, one can discern considerable hypocrisy in the contention by the *Izvestia* article's author that Soviet pilots were forced to fly "superlong distances—thousands of kilometers over the empty tundra and taiga—[without] reliable navigational equipment."

Given the immense scale of America's Lend-Lease effort and the vagaries of Soviet aviation and Siberian weather, losses were unavoidable. What is indisputable is that, during the entire period of the operation, the Soviet Union received 7,925 American airplanes via the Alaska-Siberia route.

The United States, as most of the world learned long ago, made a major contribution to the Soviet war effort against Nazi Germany. Only the Soviet citizens themselves have yet to learn the truth. ■

Vladimir P. Gorshenin was born and educated in the Soviet Union. He received an M.A. from Patrice Lumumba University in Moscow and subsequently served in the 25th Air Defense Division, located in the Far East Military District. Mr. Gorshenin has resided in the West since 1982 and currently teaches Russian language and military studies at the US Army Institute, Garmisch, West Germany.

A lone B-24, using a novel radar bombing technique, sank a Japanese cruiser at night.

Nitemare's Secret Score

By Jack Samson

ON THE night of August 19, 1944, a lone US B-24 Liberator of the 14th Air Force, based in China, repeatedly attacked, then finally sank, a heavily armed, 5,000-ton Japanese cruiser in the South China Sea.

The Commander of the 308th Bomb Group, to which this Liberator belonged, was Col. William P. Fisher. He thought it was a special event; in fact, he regarded the attack as one of the finest combat aircrew achievements of the war.

Just as remarkably, at a time when newspapers avidly reported every US victory, coverage of the feat was virtually nonexistent. By and large, the outcome of the incredible Liberator attack attracted no public attention.

How the US press missed such an extraordinary story can be traced to two factors. One was the remoteness of the air war over China. The other, far more interesting reason was that no one in any way involved with this particular Liberator wanted to open his mouth about it.

A Well-Kept Secret

With good reason. This Liberator had only recently been equipped with a novel system that, in 1944, was one of the war's best-kept secrets. The device was called "LAB"—for low-altitude bombardment. The LAB was a sophisticated marriage of two of the day's highest technologies, radar and the Norden Bombsight. Few had any knowledge of LAB's existence. Those who didn't know certainly could not have suspected it.

To be sure, radar had been used in conjunction with the Norden Bombsight before. The two had been paired for use in high-altitude heavy bombardment of Germany. The technique was not deemed a success. Used when clouds blotted out targets on the ground, it permitted bombardiers to drop bombs in a general area. It didn't even approach the accuracy of the Norden Bombsight when used in clear weather.

By early 1944, the situation had changed. Scientists had come up with a means for mating the Norden sight to a combination of radar search scopes. The development provided the team of bombardier, pilot, and radar operator with power it had never known: It could now drop bombs on a target, with great accuracy, *from an altitude of 100 feet, and in total darkness.*

No effort was spared to cloak the existence of the new device. Training of bomber crews in use of the new system took place only at highly restricted Langley Field, Va. In early 1944, crews trained in B-24s with blacked-out nose compartments. There, the bombardiers learned to operate the LAB system in darkness, even though they were bombing targets in the nearby Chesapeake Bay in broad daylight. Crew members were ordered not to discuss their training with anyone other than fellow flyers.

How It Worked

Stacked up against the ultrahigh-technology systems of today's Air Force, LAB is primitive. In those days, however, it was truly the state of the art. In essence, it converted the delicate cross hairs of the Norden sight to horizontal and vertical radar cross hairs. These were displayed on a small scope in the nose of a B-24.

The movable cross hairs allowed the bombardier to "center" his sights on a blind target while skimming over the surface of the ground or water at low altitudes. At the

same time, the radarscope sight was tied into the directional control system of the bomber—in the same manner the conventional Norden sight enabled the pilot to make the necessary corrections by following a PDI (Pilot Direction Indicator) needle on the instrument panel.

Operational use was fairly simple. A bomber crew first would locate a distant target using a large search radar, which was operated by a radar specialist in the waist of the bomber. Once the target had been identified, the plane would turn in the direction of the target and descend to an altitude of about 1,000 feet. When the plane was ten to twelve miles away, the radar operator would transfer the target's image to the smaller bombing scope in the bombardier's nose-area compartment.

Then the bombardier would overlay his horizontal and vertical radar cross hairs on the target and endeavor to keep them there during the short bomb run. The aircraft would drop to the extremely low altitude of 100 feet. Bomb bay doors would open. When the correct position was reached for bombs to drop, they were automatically released by an electrical instrument called an intervalometer.

This was tailor-made for an Air Force eager to attack Japanese surface ships. It was the perfect weapon for Lt. Gen. Claire Lee Chennault, commanding officer of the China-based 14th US Air Force, to use against Japanese shipping in the South China Sea. The Imperial Navy was using the narrow Formosa Strait to run both commercial and naval shipping from the Japanese homeland to and from its military bases in South China, Hainan Island, and Southeast Asia.

General Chennault had been sending conventionally armed, twin-engine B-25s and four-engine B-24s from forward bases in eastern China to attack Japanese convoys and warships off China's southern coast. Though they sank some supply ships with bombs and machine-gun fire, intense antiaircraft fire from large naval vessels had prevented Chennault's bombers from sinking heavily protected warships.

Chennault Begins LAB Sorties

Hearing of LAB in early 1944, General Chennault put in an urgent request for the radar-equipped B-24s. The first one, piloted by Lt. William Cashmore, arrived in Kunming, China, in April. Several other crews followed later that month and in May. One crew was led by pilot Lt. Jay LeVan of Stroudsburg, Pa.

It is safe to assume that Japan knew nothing of the new weapon possessed by Chennault's flyers. Japanese military intelligence was excellent, but this secret had been well guarded.

The first radar-equipped LAB crews flew a number of sorties in May, June, and July from such eastern China bases as Kweilin (now Guilin) and Luichow (now Leizhou). Lieutenant Cashmore's crew sank a few supply ships in the first months, but it was always difficult to report accurately what had been sunk. It was the monsoon season, and most flights were made in rain and fog. From such a low altitude, the plane passed over the target so rapidly it was almost impossible to determine the exact identity of the vessel.

The usual bomb load was either six 1,000-pound bombs or eight 500-pounders, equipped with one-second delay fuzes. The delay was to allow the bombs to sink below the waterline of ships before detonating. Most of the time, only the tail gunner had a chance to see the result, and even he saw little other than the vague silhouette of a ship.

Even so, experience gained in these night missions soon began to pay off. The big Liberators operating out of Kweilin and Luichow in June were sinking 900 tons of enemy shipping, on average, during each mission. General Chennault even worked out a precise calculus: For every 2.5 pounds of bombs dropped and two gallons of fuel burned, the US aviators would send a ton of Japanese shipping to the bottom.

In early August, Lt. Col. William D. Hopson, commanding officer of the LAB Detachment, and his copilot, Maj. Robert G. Killam, asked for a volunteer LAB crew to fly with them on a special mission. Jay LeVan's crew volunteered. Lieutenant LeVan and his copilot, William R. McCaffery, were not needed and did not fly. Others who did were Lt. Lee O. Cunningham, navigator; Lt. John D. Shytle, bombardier; TSgt. Charles W. Hemsley, engineer; TSgt. Harry A. Niess, radar operator; and TSgt. Edward N. Odom, radio operator.

Their target was an Italian liner, *Conte Verde*, which had been built in 1922 with an 18,766-ton capacity for the Naples to New York run. At the time of the attack on Pearl Harbor, it had been caught in Shanghai and did not venture out. When Italy surrendered to the Allies on September 8, 1943, *Conte Verde*'s Italian crew scuttled it in the harbor.

The Japanese had managed to refurbish and float the ship, and it was due to be towed to Japan for further repairs when Colonel Hopson and crew attacked on August 8, 1944. With Neiss guiding the plane through the rain and fog of the harbor by radar, Shytle dropped six bombs on the liner, capsizing it and sinking it for the second time. Both Colonel Hopson and Lieutenant Shytle received the Distinguished Flying Cross for the action.

It wasn't until the night of August 19, 1944, that the radar-equipped B-24s established their worth beyond all question.

A Significant Mission

It was raining, as usual, at the eastern China forward base of Luichow. Three LAB crews were flying out of the remote advance base: LeVan's, Cashmore's, and a crew led by Lt. Folk Johnson. The monsoon season was in full swing, and the slit trenches around the makeshift wooden barracks were filled with rainwater. Mud was everywhere. Clothing in the barracks was discolored by mildew, and the crews were weary from months of late-night flying.

Moreover, Japanese bombers each night had been bombing both Kweilin and Luichow and, with each raid, the crews were forced to take cover in the cold mud and rainwater of the trenches. Men were thin from lack of food and sleep and from the constant bombing.

It was the LeVan crew's turn to fly the nightly patrol mission over the South China Sea. The crew was composed of LeVan and his copilot, McCaffery, navigator Cunningham, bombardier Shytle, engineer Hemsley, radar operator Niess, radio operator Odom, and four gunners—Sgts. Bruce L. Ludwig, Lawrence Bowar, Norman Lareau, and Thomas Murphy.

The big, olive-drab, shark-nosed B-24 known as *Nitemare* was loaded with six 1,000-pound bombs. Taking off in the drizzle from the bumpy, crushed-rock runway, the crew settled down for the grueling mission over the Strait of Formosa.

Six and a half hours later, Sergeant Niess picked up a big "blip" on the search radarscope. The size of the blip did not cause any heightened anticipation among crew members. They knew the size of a radar return did not necessarily, or even usually, correspond to the size of a target.

The crew of Nitemare's historic mission: Front, from left, Lts. Lee Cunningham, navigator; William McCaffery, copilot; John Shytle, bombardier; and Jay LeVan, pilot. Second row, Sgt. Bruce Ludwig, gunner; Sgt. Lawrence Bowar, gunner, TSgt. Charles Hemsley, engineer; and TSgt. Harry Niess, radar operator. Back, TSgt. Edward Odom, radio operator, and Sgt. Norman Lareau, gunner. Missing is SSgt. Thomas Murphy, gunner.

Lieutenant LeVan acknowledged receiving the information from Sergeant Niess and took a heading for the target. All crew members took combat positions, and the plane began to descend. When the B-24 closed to within nine miles of the still-unknown target, Lieutenant Shytle assumed control of the radar bomb run with his small scope in the nose of the aircraft. The radar trace on the screen, he later recalled, *did* seem a bit larger than usual.

It all happened in a flash. The big bomber dropped down to 100 feet above the water, closed quickly, passed over the target, and unleashed a barrage of 1,000-pound bombs. One bomb scored a direct hit on the deck of the target vessel. Sergeant Lareau, the tail gunner, reported a huge explosion and a burst of light. The B-24 banked away from the target.

Some crew members looked down. It was not until then that the crew realized they had made a run on a large Japanese naval craft—a 5,100-ton, 550-foot-long heavy cruiser of the Imperial Navy.

LeVan made a tight circle and came in for a second attack, this time at an altitude of 1,000 feet. Bombardier Shytle scored another direct hit. The cruiser had not yet begun to fire its awesome air defense armament at the bomber. Circling out some distance from the cruiser, LeVan got on the microphone and told the rest of the crew members what kind of target they had been attacking.

"We were a little leery about making the third run," LeVan said later. "We knew how tough a job it is to tackle a warship. We held a hurried crew conference with the help of the intercom and decided to stick it out until something gave out—either our bombs or that ship."

Crew talk was animated. Bombardier Shytle: "Let's plaster the hell out of it." McCaffery: "We can't pass up a chance to sink part of the Japanese Navy." Niess: "She's sure hard to sink, but let's go after her again."

The fact that the heavy cruiser had not fired on the attacking plane could only be attributed to the heavy damage it sustained in the first attacks. In time, the Japanese gained some fire control. As the big bomber began its third run, the sky erupted with enemy flares. A dense curtain of antiaircraft fire met the advancing plane.

LeVan began evasive action. Shytle scored the third direct hit of the night as the B-24 blasted through enemy fire. The B-24 flared up and away from the stricken cruiser. No one aboard the plane had been hit by the concentrated fire.

As the bomber circled the burning ship from a distance of several miles and LeVan was trying to decide whether to make a fourth and final attack, Niess suddenly issued a startling report: The big cruiser had disappeared from the radar screen. Having sustained such heavy damage, the enemy ship had capsized and sunk.

Keeping Victory Quiet

Radio Operator Odom reported that his immediate reaction to the victory was strange. "I remember being concerned about taking two bombs home and landing with them on board," he said.

Low-level radar bombardment had come into its own. No longer did the Japanese Navy feel as secure in the South China Sea as it once had. Even so, hardly anyone in the States knew of the extraordinary feat. The Associated Press wire service did crank out a brief dispatch about the mission. Included in the AP account, however, was a crucial error: It referred to Harry Niess as a "radio operator," not a "radar operator." That Sergeant Niess was a *radar* man, and not a *radio* man, was of course the secret of the LAB B-24.

Lieutenant LeVan won a Silver Star, pinned on him by General Chennault himself. Lieutenant Shytle was given the Distinguished Flying Cross, as were Lieutenant Cunningham and Sergeant Niess. All other crew members were awarded the Air Medal, their orders being signed by Chennault.

Lieutenant McCaffery died in 1988. Lieutenants LeVan, Cunningham, and Shytle, and Sergeants Lareau, Niess, Odom, and Hemsley are still alive, witnesses to a great feat of combat aviation.

What of the remaining crew gunners—Sergeants Ludwig, Bowar, and Murphy? All were judged to have been killed in action during the war. They disappeared when another LAB B-24, piloted by Lt. Folk Johnson, failed to return from a mission. It was thought that the plane had attacked a Japanese aircraft carrier. ■

Jack Samson, author of a biography of Lt. Gen. Claire Lee Chennault, was a bombardier on Lt. William Cashmore's LAB crew and flew with Lt. Jay LeVan's crew out of Luichow and Kweilin.

Everybody agrees that combat troops should be physically fit, but can we be more specific about the requirement?

Fitness and Warfighting

By Russell W. Ramsey

A NOVEMBER 1987 survey asked resident students at the Air War College, the Air Command and Staff College, the Squadron Officer School, and the Senior NCO Academy if they considered USAF's existing physical fitness standards and programs sufficient to produce a combat-ready force. Overall, 45.4 percent said "no," and 26.1 percent were uncertain. Of the 28.4 percent who responded in the affirmative, only 3.2 percent characterized their view as "strong."

The minority of Air University students who perceived the Air Force as physically fit divided about evenly on the issue of compulsory exercise. Half thought the Air Force should allocate time for exercise during training. The other half regarded exercise as a private matter and, since they believe the Air Force to be physically fit, not suitable for command attention.

Most people would agree that members of the armed forces should be in good physical condition. For most on active duty, however, compulsory organized physical activity ends after basic training. Moreover, perceptions of the connection between fitness and the operational art of warfighting vary. The connection might be rated anywhere from moderately important to decisive, depending on the evaluator's perspective.

Air Force regulations prescribe physical fitness based primarily on aerobic conditioning. While individual commanders can, and sometimes do, require on-duty physical training, the program for most of the force is individual and voluntary, with members tested annually to determine if they meet standards.

Realms of Fitness

- Aerobic fitness pertains to the development of the involuntary-muscle systems. These, in turn, equate roughly with the tissue called "slow-twitch muscle" in layman's terms. In most cases, aerobic fitness deals with cardiovascular health.
- Anaerobic fitness pertains to the development of the voluntary-muscle systems. These equate with the fast-twitch muscle tissue and, for most people, are the subject of programs to build physical strength.
- Psychomotor development is a commonly accepted fitness component. Often it pertains to improving hand-eye coordination. Generally, it deals with an external clue, usually audio or visual, and the transmission of a precise response at high speed to some part of the body.
- Teamwork applies to the development of accurate, fast, interpersonal responses to a complex array of stimuli, often seen in athletics. Spinoff psychological benefits of teamwork include *esprit de corps* and leadership.
- Integration consists of aerobic, anaerobic, psychomotor, and teamwork requirements for physical responses to a mixed array of demands.

What Does Warfighting Require?

Most analysts identify *endurance* as the first physical requirement of combat. Next in importance, in close competition, come *self-control* under stress and physical *strength* at critical moments in battle. Next come *hand-eye coordination* and physical *agility.*

Endurance is first, last, and always an aerobic function. Self-control, in physiological terms, is the ability to dissipate the chemicals in the bloodstream produced as a result of stress. Strength is built by lifting, hauling, pulling, and pushing against gradually increasing increments of resistance. Coordination's realm ranges wide: racquetball, baseball infield drill, fencing, or golf. Both aerobic and anaerobic development have little to do with some of these fitness activities that encourage high-speed coordination.

Agility may call for coordination, but the concept demands totally integrated physical activity, rather than the coordination, say, of the hand and eye. Total body motion sports such as racquetball, handball, and gym-

nastics encourage this trait; most of these have aerobic value but limited anaerobic development potential.

The sport of rugby was specifically employed during the heyday of the British Empire to teach teamwork to boys who would become leaders. Soccer, baseball, lacrosse, hockey, volleyball, and several other team sports provide development in this realm. Those teamwork-intensive sports that require continuous running also contain enormous aerobic benefits; several of the team sports develop high-speed coordination as well.

A case can be made that there is a connection between specific fitness modes and combat applications. As the chart shows, the matchups vary widely.

Choice of Activities

Based on the ACSC Class of 1989—a select group of majors, mostly aged thirty-five to forty—we can spot some preferences among those who know the importance of fitness but choose their own modes of exercise.

If we are to field a force ready to endure the rigors of war, it is important to know the relationship between various modes of physical training and the physical needs of a force in battle. Then every way possible ought to be found to encourage participation in those fitness activities that have the most value. ■

Russell W. Ramsey, Ph.D., is Professor of National Security Affairs at the Air Command and Staff College, Maxwell AFB, Ala. A nationally rated backstroker in the US Masters Swimming program, he designed Project Heartbeat, the sanctioned exercise program at ACSC. This is his first article for AIR FORCE *Magazine.*

What Fitness Training Accomplishes

Activity ▶	Aerobic	Anaerobic	Psychomotor Development	Teamwork Sport	Integration*
Cardiovascular increase	high	medium	medium	none to much, depending upon activity	high
Voluntary muscle increase	high	medium	medium		high
Dissipate tension	high	medium	none		high
Build coordination	medium	medium	high		high
Develop agility & speed	high	medium	high		high
Build group skills	none	medium	none	high	high

How Activities Relate

Aerobic, low impact	high	low	medium	low	low
Obstacle course	high	high	high	medium	high
Rowing machine	high	high	medium	low	medium
Run, medium	high	low	low	low	low
Soccer	high	low	high	high	high
Swim, medium	medium	medium	low	low	low
Unit march	medium	low	low	medium	low
Weightlifting	low	high	high	low	low

Key

- high
- medium
- low
- high to medium
- high to low
- medium to low
- none

The Matchup With Warfighting

Activity ▶	Aerobic	Anaerobic	Psychomotor	Teamwork	Esprit	Leadership
Endurance	high	medium	low	medium to low	medium to low	medium to low
Self control	high	medium	medium	high to medium	high to medium	medium to low
Strength	medium	high	low	high to low	high to low	medium to low
Coordination	low	low	high	medium to low	medium to low	medium to low
Agility	medium	medium	high	medium to low	medium to low	medium to low
Teamwork	low	low	low	—	high to medium	medium to low

*Integration presumes the performance of an integrated activity, such as a game of soccer with periodic switches of players and positions. Desultory softball, for example, may have little or no value in any of the realms and may even cause unwarranted injuries among insufficiently warmed-up players.

Viewpoint

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

A Meeting In Moscow

What our hosts had to say was impressive, but it was clear that pending economic disaster—and nothing else—is the incentive for the new Soviet defense strategy.

This past January, the International Security Council, a Washington think tank, organized a conference in Moscow for the purpose of discussing new attitudes and changing military doctrine in light of recent events. Our group consisted of a former Secretary of Defense, several distinguished civilian intellectuals, and seven retired senior military types, two of whom had been chiefs of their respective services.

The hotel in which we stayed and carried on our discussions was fifteen miles west of Moscow, in an area normally off limits to Westerners in general.

The Soviet representatives were mainly from the military, either retired or active, and those listed as retired appeared to be functioning bureaucrats. With the exception of one colonel, they all were senior in rank. An ambassador and a new member of the Supreme Soviet rounded out the Russian delegation.

Our discussions got off to a rocky start. Both sides, not yet in tune with the amicability marking present-day US-USSR public relations, used poison darts in their opening salvos. It was obvious from the outset that all of us around the table were hard-liners, conditioned by forty years of cold war tension to suspect only the worst of one another.

Curiously, these old generals—only one admiral was present—focused on the US Navy as a principal worry. They evidently felt that our ground and air forces, particularly those facing the Soviet Union in Europe, have already been discounted by the conventional force negotiations in Vienna and the even more sweeping proposals surfacing in Congress. The US Navy has thus far been excluded from force-reduction initiatives, a situation the Soviets are clearly anxious to change. Since the US Navy, for all its carrier strength, can scarcely be considered the major threat to a land power like the USSR, one might readily conclude that the Soviets still contemplate Third World mischief. Dominating the world's oceans as it does, the Navy is obviously a serious impediment to that sort of adventure.

One thing came loud and clear through all the rhetoric of that week. The ruble is almost worthless, and there is little to buy in any case. A Big Mac costs an average day's wages. Even so, the crowds passing through the Moscow McDonald's, the world's largest, find it a good way to get rid of rubles. Economic disaster and nothing else seems to be the incentive for the newly proclaimed strategy of defense. With this "New Thinking," they have announced a cut in their defense budget, the saving to be applied to consumer-goods production. This policy is easier made than carried out in a land where there is a ten-year wait for a third-rate car.

The Soviet defense budget has always been an elaborate puzzle, painfully deciphered by intelligence analysts using whatever clues they could discover. One fact, however, has never been in doubt: the Soviets' published military budget traditionally has had little relationship to the true figure.

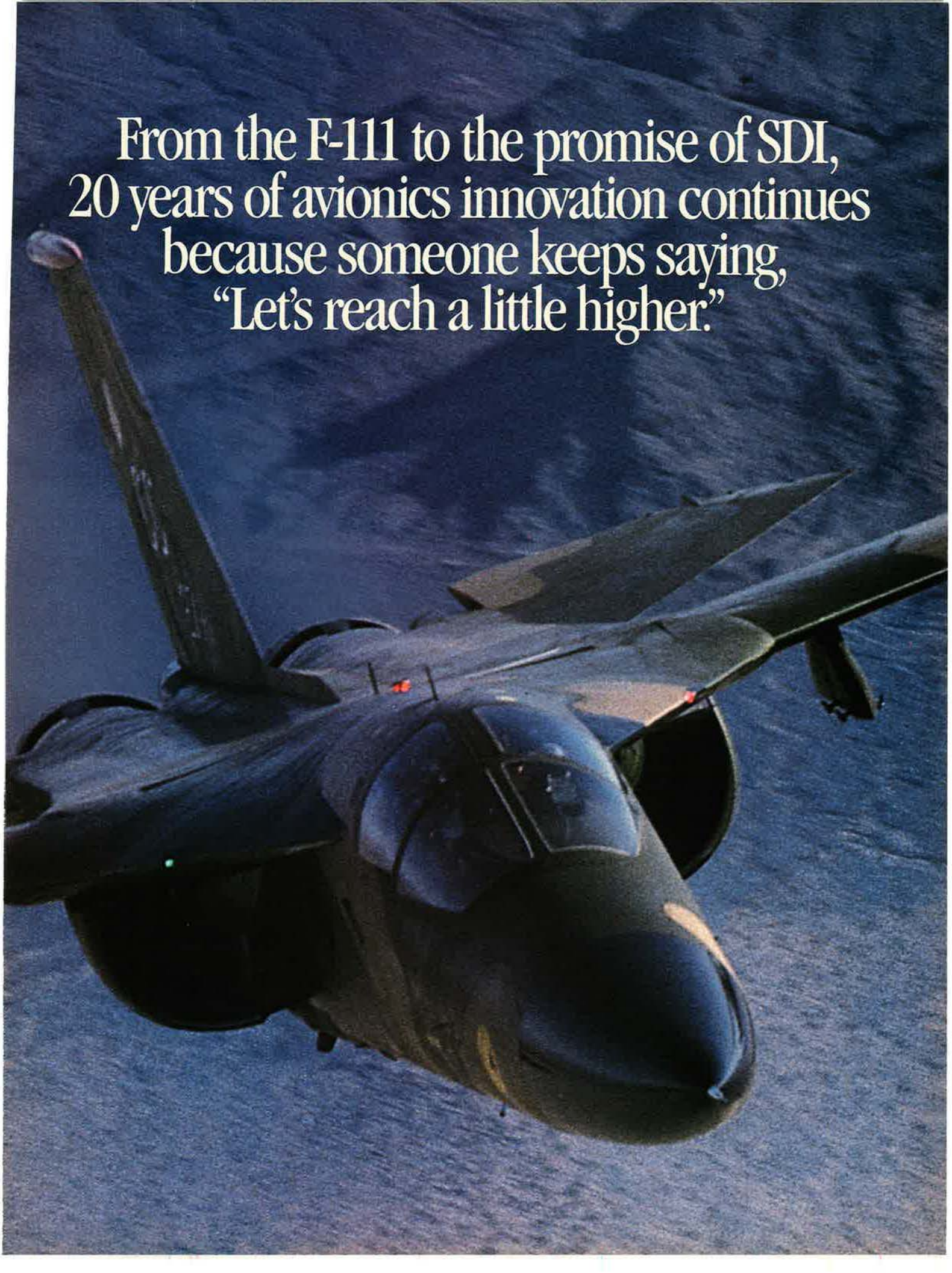
Now, they tell us, they are opening their books for all to see. There seems no doubt that some reductions are under way, but if the US analysis is correct, the reductions are statistically unimpressive, ten billion rubles out of a possible total of ninety billion. The Soviets admit only to a budget of seventy-seven billion rubles. It is an argument no one can win until that far distant day when we have reached verification procedures on each other's budgetary computations, but one thing is certain. For a nation in severe financial straits, the Soviets are still spending a very large part of their national income on the military.

Personnel costs, by Soviet admission, are a relatively small item compared with ours. Their troops are paid a pittance, and their living conditions are abominable. They intend, they say, to direct more of their budget toward improving living conditions, but it is apparent that substantial military expenditures will continue to go toward modernization and weapon sophistication. As one of the Soviet generals emphasized, in unintended support of that contention, everything—raw materials, labor—is cheaper in the Soviet Union.

The meeting was not precisely a dialogue of the deaf, but it is fair to say that no minds were changed. Nevertheless, we had a peek into the troubled workings of what was, until recently, the engine for world revolution. The Marxist-Leninist system may be in its death throes, but the Party elite is likely to survive and run whatever emerges from this upheaval. Seventy years of the dictatorship of the proletariat have produced an almost indestructible, if totally inefficient, system of centralized control and a ruling class more firmly entrenched than it was in the days of the czars. The military people with whom we met are bright, educated, and believers in their system. They are also politicians, a sideline, they said, essential for career officers.

The cold war is over, and the Warsaw Pact has been exposed as an unreliable, if not defunct, alliance. Nevertheless, the ideological struggle continues wherever Marxist revolutions can gain a foothold. There has been no diminution of Soviet support for these revolutionary movements, and world revolution, we were told, remains a part of the Communist creed.

We did not separate as friends, but it was a pleasant change to be on cordial terms with our longtime adversaries. They are civilized people who understand better than most the hideous aftermath of world war. The fact remains that the USSR and the United States are ordained to be, if not enemies, then at best, guarded acquaintances. Our aims are opposed and our expectations unrelated. ■


From the F-111 to the promise of SDI,
20 years of avionics innovation continues
because someone keeps saying,
"Let's reach a little higher."

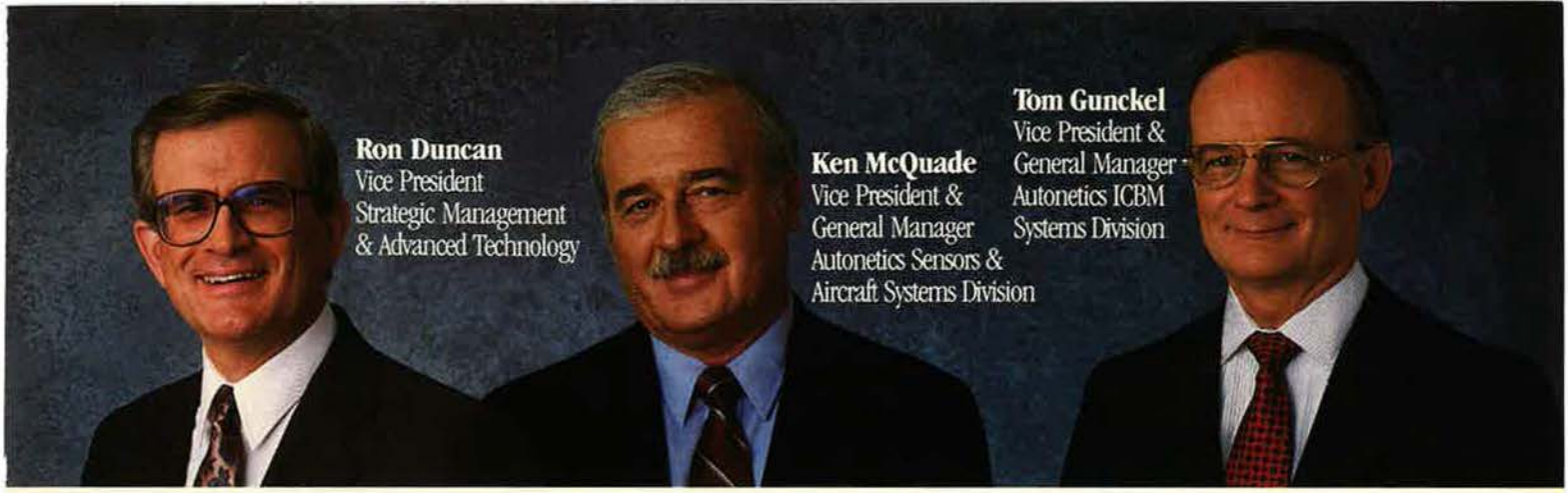
From equipping the nation's ICBM and nuclear submarine fleets with state-of-the-art electronics and software systems, to delivering tactical superiority with HELLFIRE, the Autonetics people of Rockwell International have established a legacy of performance. This heritage of quality and technology continues today—with strategic and tactical systems for land, sea, air and space. Here's the story from the people who help make it happen.

Mid 50's
G6 gas spin bearing gyro rotor.

Early 60's
Minuteman I inertial guidance system.

Late 60's
F-111D navigation set and attack radar.

Mid 70's
Laser seeker development sets stage for HELLFIRE.



Washington: Autonetics has been contributing a variety of technologies to the national defense for a very, very long period of time.

McLuckey: Starting with programs as far back as the mid-50's, teamwork and pride in quality workmanship have been driving the organization's progress.

Gunckel: In the guidance area, you can see the steady evolution of state-of-the-art technology to meet customer requirements with equipment that's smaller, lighter, more reliable and much less expensive than the prior generation.

McQuade: And there's been similar progress in the areas of processing and software.

Washington: For example in data multiplexing activities for the Navy, our system is in effect a Local Area Network. We have to interface with all the major weapon systems, command and control media and displays on board ship.

McLuckey: We've also built upon our knowledge of avionics and avionics system integration by applying research and development monies towards solving the customer's future needs in the areas of terrain following and obstacle avoidance.

Duncan: That's a characteristic of what we do. We take on these challenges to develop new products, in anticipation of the market.

McQuade: That's the case with a lot of the technology that applies to SDI. We see derivatives being very important to the tactical world. Miniature sensors. Miniature seekers. We are doing front-end work in support of both of those.

Duncan: The same can be said for our investment in IR technology, where today we're being approached by every major weapon-system supplier that uses electro-optic devices.

McLuckey: We've become one of the two preeminent suppliers of focal planes in the United States. We've won major producibility contracts that will allow us to get the cost per pixel down, which is a necessary prerequisite to sell and incorporate focal planes into numerous tactical weapons.

Smith: But success takes more than technology. We're also committed to employee involvement, communication and continuous improvement.

Gunckel: We've always been willing to adapt and change to meet the changing requirements of the customer. Both in terms of technology, and the way we do business. This approach allows us to focus not just on the lowest cost, but on the most cost-effective solution — the best-value solution.

Smith: Our customers see it. They've said that of all the businesses they work with, we're one of the best hands-on examples of real Total Quality Management at work.

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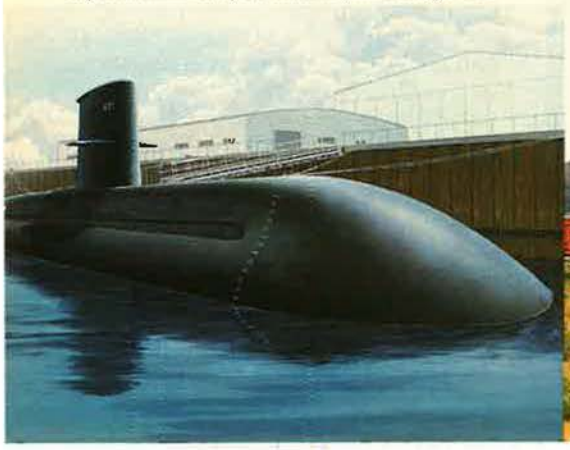
...where science gets down to business

Mid 80's
Royal Australian Navy Submarine systems integration.



Late 80's
Peacekeeper Rail Garrison launch control system.

Mid 90's
Advanced sensor technology.

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

AFA's National Committees

The makeup of AFA's National Committees for 1989–90 has been determined. The following members have been named to serve on the committees.

• **Executive Committee:** Jack C. Price (Chairman), Sam E. Keith, Jr. (Vice Chairman), Oliver R. Crawford, Charles G. Durazo, Martin H. Harris, William V. McBride, James M. McCoy, Thomas J. McKee, William N. Webb, Gerald V. Hasler, *ex officio* (nonvoting), James M. Keck, *ex officio* (nonvoting), and John O. Gray, *ex officio* (nonvoting).

• **Finance Committee:** William N. Webb (Chairman), Charles H. Church, Jr. (Vice Chairman), John R. Alison, R. L. Devoucoux, William J. Gibson, Tom Henderson, William L. Ryon, Jr., and Jack C. Price, *ex officio* (voting).

• **Membership Committee:** Walter G. Vartan (Chairman), R. Donald Anderson, Oliver R. Crawford, John E. Kittelson, Alwyn Lloyd, Robert A. Munn, Raymond W. Peterman, Jack G. Powell, Everett E. Stevenson, Kenneth C. Thayer, Roy P. Whitton, Joseph A. Zaranka, and Jack C. Price, *ex officio* (voting).

• **Constitution Committee:** Joseph A. Zaranka (Chairman), Edward J. Monaghan (Vice Chairman), William C. Rapp, Mary Ann Seibel, Herbert M. West, Jr., and Jack C. Price, *ex officio* (voting).

• **Resolutions Committee:** Thomas J. McKee (Chairman), Oliver R. Crawford, Charles G. Durazo, Martin H. Harris, Sam E. Keith, Jr., William V. McBride, James M. McCoy, Jack C. Price, William N. Webb, and John O. Gray, *ex officio* (nonvoting).

• **Audit Committee:** George M. Douglas (Chairman), George D. Hardy, Bryan L. Murphy, Jr., Jack G. Powell, Walter E. Scott, A. A. West, and Sam E. Keith, Jr., *ex officio* (nonvoting).

• **Communications Committee:** Harold A. Strack (Chairman), Donald D. Adams, Dan F. Callahan III, Michael P. McRaney, William A. Solemene, Bud Walters, Roy P. Whitton, and Jack C. Price, *ex officio* (voting).

• **Long-Range Planning Committee:** James M. McCoy (Chairman), Richard H. Becker, E. F. Faust, Lt. Col. Phillip E. Lacombe, Frank M. Lugo, Ellis T. Nottingham, William J. Schaff, William W. Spruance, Walter G. Vartan, CMSgt. Deborah S. Canjar, *ex officio* (nonvoting), Capt. Paul A. Willard II, *ex officio* (nonvoting), and Jack C. Price, *ex officio* (voting).

• **Science and Technology Committee:** Robert T. Marsh (Chairman), Thomas E. Cooper, Charles G. Durazo, Charles A. Gabriel, David Graham, H. B. Henderson, Wayne A. Schroeder, Henry C. Smyth, Jr., Charles F. Stebbins, George R. Weinbrenner, and Jack C. Price, *ex officio* (nonvoting).

• **Third-Party Financing Committee:** George H. Chabbott (Chairman), Earl D. Clark, Jr., Jan M. Laitos, and Stanley M. Umstead, Jr.

• **Under-40 Committee Rotation Schedule:** Richard Scott Cain (Membership, winter; Finance, fall), Cheryl Lynn Gary (Communications, winter; Constitution, fall), Shelly D. Larson (Long-Range Planning, winter; Communications, fall), Stephen M. Mallon (Communications, winter; Long-Range Planning, fall), Michael E. Stansell (Finance, winter; Executive/Resolutions, summer; Executive, fall), and Bruce Robin Stoddard (Constitution, winter; Communications, fall).

• **Advisors:** Ken Daly (Junior ROTC), Lt. Col. Roy A. Davis (Senior ROTC), Kenneth A. Rowe (Civil Air Patrol), Pat L. Schittulli (Civilian Personnel), and Patricia Turner (Medical).

The Birmingham (Ala.) Chapter honored long-time AFA member and aviation pioneer Glenn Messer (center) with a Scott Associate Award during a monthly meeting. Flanking Mr. Messer are Lt. Gen. Charles A. Horner (right), Commander of 9th Air Force, and Maj. Gen. Cecil W. Greene, Chief of Staff of the Alabama ANG.

Chapter Awards

The **Freedom (Pa.) Chapter** held its annual Awards Luncheon at the NAS Willow Grove Officers' Club to honor outstanding Reservists, Air National Guardsmen, and Civil Air Patrol Cadets in the area. Chapter President Roland Von Miedel led his fellow Chapter members in honoring SMSgt. Edmund W. Hoovern, Jr., of the 111th Tactical Air Support Group, Pennsylvania ANG, as the Outstand-

ing Air National Guardsman; TSgt. James E. Webster, Jr., of the 913th Tactical Airlift Group, AFRES, as the Outstanding Air Reservist; and Cadet Jeffrey W. Maund, Group 90, CAP, as the CAP Cadet of the Year. Each honoree received an AFA clock and an AFA Citation.

The **Richmond (Va.) Chapter** also gave recognition to members of the Total Force at its annual Awards Banquet and ANG Report in Richmond. Col. H. F. Coke, Chief of Staff, Virginia ANG, spoke to the gathering about an ANG unit deployment to Norway. Singled out for their special achievements were Maj. Barry W. Mountcastle, Virginia ANG Junior Officer of the Year, and CMSgt. Herbert I. Timberlake, Virginia ANG Airman of the Year. AFA National Vice President (Central East Region) R. Donald Anderson, Virginia State (East) Vice President Andrew H. Heath, and Chapter President William D. Curry, Jr., were among the dignitaries attending the banquet.

Chapter News

Rep. Sonny Callahan (R-Ala.) recently addressed a meeting of the **Mobile (Ala.) Chapter** as part of its thriving government affairs program. Representative Callahan, a Mobile Chapter member, believes firmly that a strong defense is still necessary, despite recent upheavals around the globe. Though he sees many challenges on the threshold of the twenty-first century, further Pentagon reforms among them, his most pressing concern is the need to reorder priorities in order to plan for the unknown. To those who would make drastic cuts in the military, he urges caution, pointing out that although actual defense spending has increased, defense spending as a percentage of government outlays has decreased from about fifty cents out of every dollar under President Kennedy to about twenty cents out of every dollar in President Bush's latest budget. He sees a strong national defense as the "best prevention" against any aggressive enemy.

Federal budget cuts were also the topic at a recent fund-raising dinner held by the **John W. DeMilly (Fla.) Chapter** at Homestead AFB. After installation of newly elected Chapter officials, Maj. Gen. Billy G. McCoy, Commander of the USAF Tactical Fighter Weapons Center, Nellis AFB, Nev., discussed how budget cuts would affect his command's operations and those of USAF as a whole. General McCoy is no stranger to Homestead AFB, having served there as an F-4E aircraft commander prior to service in Vietnam. He returned to Homestead more than a decade later to command the 31st Tactical Fighter Wing. Chapter President Jose Clay and Col. W. Thomas West, Commander of the 33d Tactical Fighter Wing, Eglin AFB, Fla., were among those who heard the General's informative speech.

The state of Georgia has been a hub of AFA activity recently. **Carl Vinson Memorial (Ga.) Chapter** President Jack Steed presented an $18,000 check to the Museum of Aviation at Robins AFB, bringing the Chapter's total contribution to $88,000. Accepting on behalf of the Museum at the luncheon meeting were Maj. Gen. Richard F. Gillis, Commander of the Warner-Robins Air Logistics Center; Jack Maret, Vice Chairman of the Museum Foundation; and Rose Mary McKelvey, Executive Director of the Museum. Across the state, the **Dobbins (Ga.) Chapter** went to Morrow Senior High School to honor an outstanding AFJROTC cadet. Chapter Vice President for Aerospace Education Scott Roehm presented a $500 scholarship to Cadet Patrick M. Smith before a large audience that included his family and classmates.

The **Mile High (Colo.) Chapter** marked Armed Forces Week with a luncheon at Lowry AFB. Bill Coors, Chief Executive Officer of the Adolph Coors Co., spoke to the crowd of more than 100 AFA members and friends. His address centered on the relationship between the public and private sectors. Many notables from the Denver area attended the event, including Maj. Gen. Charles Metcalf, Commander of the Air Force Accounting and Finance Center; Maj. Gen. Dale Tabor, Commander of the Lowry Technical Training Center; Col. Joseph Ramsey, Commander of the Air Reserve Personnel Center; Jack Powell, AFA National Vice President (Rocky Mountain Region); and Robert Cardenas, Mile High Chapter President.

Maj. Gen. (Lt. Gen. selectee) John B. Conaway, recently named Chief of the National Guard Bureau, spoke at a Veterans Day Luncheon cosponsored by the **General Bruce K. Holloway (Tenn.) Chapter**. The General, Vice Chief at the time of the luncheon, emphasized the large segment of national defense that is assigned to the Army and Air National Guards. He also praised the Guard for accomplishing its assigned tasks with relatively modest budgets and cited the Tennessee Guard for special commendation. He urged the civilians in the audience, particularly the employers, to be supportive of the members of the nation's oldest defense force. Chapter President Billy S. Linebaugh, past Presidents Walter J. Bacon and Jack K. Westbrook (AFA Man of the Year in 1987), Knox County Executive Dwight Kessel, and a sizable contingent of area business and civic leaders attended the luncheon. Other honored guests from around the Volunteer State were present, including Leo J. Bolster, Tennessee State President; Maj. Gen. Daniel F. Callahan, USAF (Ret.), National Director; and Daniel F. Callahan III, National Director and President of the Lt. Gen. Frank Maxwell Andrews (Tenn.) Chapter.

The **Pope (N. C.) Chapter** held its quarterly meeting at Pope AFB, featuring Maj. Gen. Donald A. Logeais, Commander of 21st Air Force, McGuire AFB, N. J., as guest speaker. The activities of 21st Air Force within Military Airlift Command and the future roles for the C-17 airlifter were highlights of his speech. Distinguished guests included Col. Daniel E. Sowada, Commander of the 317th Tactical Airlift Wing at Pope, and Morris Bledsoe, Sheriff of Cumberland County, where Pope is located.

In Lancaster, Calif., the **Antelope Valley (Calif.) Chapter** also held a quarterly meeting. After dinner, Maj. Gen. John P. Schoeppner, Jr., gave a talk on "Testing at Edwards AFB: From the Past to the Future." The General, as Commander of the Air Force Flight Test Center at Edwards, knows whereof he speaks, and the audience found his talk enlightening and entertaining. General Schoeppner is a longtime member of AFA, having joined the Association while he was an ROTC student at the University of Pittsburgh. Chapter President Sam Kilanowski thanked the General for his speech and gave him a commemorative plaque.

An AFA-sponsored Young Astronauts Program is making great strides in the cause of aerospace education. The **Del Rio (Tex.) Chapter** is proud to report that it has thirty straight-A students enrolled in the Lamar School Chapter of the program. There are forty more students on the waiting list. Showing that all is not bleak in the US educational system, these third- and fourth-graders are studying trigonometry.

Chapter Changes

The **Robert V. Pace (Mass.) Chapter** has been officially deactivated, and AFA members in the Bedford, Mass., area have been affiliated with the active chapter nearest to their residences. While the deactivation is unfortunate, AFA members will be

pleased to note that there are still 363 active chapters worldwide.

Members of the **Belle Fourche (S. D.) Chapter** have voted to rename it in honor of their pioneering traditions and the local Native Americans. The new name, Paha Sapa Waziata, translates to "the Black Hills to the North" and connotes "the place where the buffalo come from."

Have AFA News?

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

Bulletin Board

Seeking historical data, photographs, and personal anecdotes of rescue mission activities of the **10th Rescue/Air Rescue Squadron** in Alaska from 1945 to 1955. Especially interested in contacting **Lt. Richard A. Hopkins,** a glider pilot; **Lt. William A. Weed** and **Lt. Charles O. Weir,** both of whom flew H-5s; **Lieutenant Dot,** who crash-landed an F-80C on the mud flats; and any members of the WB-29 Polar Weather "Ptarmigan" flights. **Contact:** David Sternik, 13520 Diggins Dr., Anchorage, AK 99515.

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. Photographs cannot be used or returned.—THE EDITORS

Seeking the whereabouts of **Col. J. O. Modisette,** whose last known assignment was Director of Safety at Cam Rahn Bay, Vietnam. **Contact:** R. S. Richardson, 265 Flynn Dr., Gladwin, MI 48624.

Seeking **postcards** from areas surrounding US bases in the US and abroad. Prefer scenic postcards or ones with famous monuments or buildings. **Contact:** 2d Lt. Christine M. Mino, 3K Cumberland Arms Apts., Rte. 541, Burlington, NJ 08016.

Seeking the whereabouts of **"Sparky" Parks,** who was stationed at Hahn AB, Germany, in 1963–64, then reassigned to Travis AFB, Calif. He was in the fire protection field and was an A1C (E-3) in 1964 in San Francisco. **Contact:** SMSgt. Gary L. Pruitt, USAF (Ret.), 3954 Maple Hill Rd., Las Vegas, NV 89115.

Looking for a book, ***The Plane That Changed The World: Biography of the DC-3.*** **Contact:** Maj. Louis E. Droste, 105 West Bacon St., Plainville, MA 02762.

Seeking the whereabouts of members of the **5th Air Force,** Hq. and Hq. Squadron, 314th Composite Wing (formerly the 5th Bomb Command). **Contact:** L. J. Buddo, Box 35372, Louisville, KY 40232.

Seeking information on 57th Fighter Group members **Steven C. Cerena** of the 64th Fighter Squadron; **Edwin R. Weaver** and **Roy E. Whittaker,** both of the 65th Fighter Squadron; and **Raymond A. Llewellyn** and **Albert O. Zipser,** both of the 66th Fighter Squadron, in connection with the restoration of an Me-109 damaged in combat in Egypt on November 4, 1942, and combat victories on that date. **Contact:** Andy Stewart, St. Anne's School House, Westby, Preston PR4 3PL, England.

For a history of the Tornado bomber, I would like to hear from anyone who tested **North American B-45s** or took part in the transatlantic flight in June 1952. **Contact:** Herbert Foster, 58 Hammerton St., Pudsey, West Yorkshire LS28 7DD, England.

Seeking information on how to receive **permission to photograph planes at AMARC,** Davis-Monthan AFB, Ariz. **Contact:** Erwin Meier, Laurierstraat 22, 2023 NC Haarlem, the Netherlands.

Seeking to purchase **F-105 flight helmet** with mask and **MA-1 jacket from 419th TFS** (formerly 508th TFG), AFRES, Hill AFB. **Contact:** C. Paul Mardian, 5005 W. Cambridge, Phoenix AZ 85035.

Seeking information on the following crew members of "Dodgin' Don" of 706th Bomb Squadron, 446th Bomb Group, Flixton Army Air Base, Bungay, England: **Andrew F. Krempusch, George C. Harris,** and **Virgil Huff. Contact:** Marvin H. Speidel, 708 Dianne Court, Rahway, NJ 07065.

Seeking **patches** of all squadrons from 1965 to present, especially F-4 and F-105 squadrons. Also looking for mid-1970s **HGU flight helmet. Contact:** TSgt. Jordan E. Murphy, CAP, 10 Farm Pond Lane, Hollis, NH 03049-8950.

Seeking information on the whereabouts of **Wilson Douglas** and any other officers of the 32d Fighter Squadron who served in Panama during 1945–46. **Contact:** Clifford Asmus, 23134 Hull Prairie Rd., Perrysburg, OH 43551.

Seeking **pilot and aircrew handbooks** or "Dash 1" manuals or equivalents for any domestic or foreign aircraft. Also seeking **photos** of aircraft from all periods. **Contact:** Maj. T. R. Marino, USAF (Ret.), 15627 Kasota Rd., Apple Valley, CA 92307.

Seeking the whereabouts of **Capt. Charles "Corpy" Munroe,** who was an instructor pilot to the West German Air Force in the 1960s. **Contact:** Robert Sonner, Jr., 7 Prospect Dr. N., Huntington Station, NY 11746.

For its "Hall of Fame," AFROTC **Det. 850,** University of Utah, is seeking any information on KIA, POW, and MIA commissioned officers from Det. 850 since 1947. **Contact:** Cadet 1st Lt. Scott J. Scherer, AFROTC Det. 850, University of Utah Annex 2045, Salt Lake City, UT 84112-1107.

Seeking the whereabouts of personnel of the **24th Fighter Squadron,** 6th Air Force, who served in Panama between 1943 and 1945. **Contact:** James E. Thomas, 5536 Verbena, San Antonio, TX 78240.

Coming Events

April 6–7, **South Carolina State Convention,** Charleston AFB, S. C.; April 7, **Iron Gate Salute,** New York, N. Y.; May 4–5, **Tennessee State Convention,** Knoxville, Tenn.; May 5, **Montana State Convention,** Malmstrom AFB, Mont.; May 11–13, **New York State Convention,** Rome, N. Y.; May 18–19, **Maryland State Convention,** Andrews AFB, Md.; May 18–20, **New Jersey State Convention,** Cape May, N. J.; May 26, **USAFA Outstanding Squadron Dinner,** USAF Academy, Colorado Springs, Colo.; June 2, **Alabama State Convention,** Huntsville, Ala.; June 2, **Massachusetts State Convention,** Worcester, Mass.; June 8–10, **Oregon State Convention,** Portland, Ore.; June 22–23, **Arkansas State Convention,** Hot Springs, Ark.; July 6–8, **Arizona State Convention,** Litchfield Park, Ariz.; July 6–7, **Ohio State Convention,** Dayton, Ohio; July 13–14, **Texas State Convention,** Fort Worth, Tex.; July 13–15, **New Mexico State Convention,** Alamogordo, N. M.; July 13–15, **Pennsylvania State Convention,** Philadelphia, Pa.; July 13–15, **Virginia State Convention,** Hampton, Va.; July 26–28, **California State Convention,** Los Angeles, Calif.; July 27–29, **Florida State Convention,** Tampa, Fla.; August 4, **Indiana State Convention,** Indianapolis, Ind.; August 10–11, **North Dakota State Convention,** Fargo, N. D.; August 17–18, **Wisconsin State Convention,** Milwaukee, Wis.; August 18, **Mid-America Ball,** St. Louis, Mo.; August 18–19, **Illinois State Convention,** St. Louis, Mo.; August 24–25, **Utah State Convention,** Hill AFB, Utah; September 7–8, **Colorado State Convention,** Colorado Springs, Colo.; September 17–20, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C.; October 13, **North Central Regional Workshop,** Bloomington, Minn.

The 41st Flying Training Squadron, 64th Flying Training Wing (ATC), seeks information or memorabilia from past members of the **41st Pursuit Squadron (Interceptor), 41st Fighter Squadron,** and **41st Fighter-Interceptor Squadron,** to establish a memorial wall. **Contact:** Lt. Col. John R. DiPiero, Commander, 41st Flying Training Squadron, Reese AFB, TX 79489-5000.

Seeking contact with World War II veterans who served with the **47th Pursuit Squadron,** 15th Pursuit Group and were on Oahu on December 7, 1941. **Contact:** Don Dawson, P. O. Box 6955, Ketchikan, AK 99901.

Seeking contact with members of the 1955–56 Hq. 18th Air Force Antarctica "Deepfreeze" survey team, especially **Capt. John E. Tomasch, Capt. Ernest A. Schmid,** and **A2C Fay L. Young. Contact:** Art Grafe, 12121 Saraglen Dr., Saratoga, CA 95070.

Seeking contact with anyone who knew **SSgt. Melvin Elder,** a B-24 radio operator who served in the 330th Heavy Bomb Squadron, 93d Bomb Group, and was killed in December 1942 over Algiers. **Contact:** Capt. Gregory D. Elder, Qtrs. 4301-A, USAF Academy, CO 80840.

Collector seeks **patches,** especially of the 21st TFW and 43d and 54th TFS. **Contact:** Brad A. Ware, P. O. Box 2621, Redmond, WA 98073-2621.

Seeking contact with anyone who knew **Louis J. Winiecki, Jr.,** who was in the 498th Bomb Squadron, 345th Bomb Group, during World War II. **Contact:** Richard Winiecki, 3730 S. Mill Ave., Apt. K-204, Tempe, AZ 85282.

For an upcoming book, author seeks information and photos from individuals who flew or maintained the **Bell P-39 Airacobra. Contact:** Rick Mitchell, 428 Madingley Rd., Linthicum, MD 21090.

Seeking the whereabouts of **Theodore S. Porter,** who was a member of Aviation Cadet Class 43-G; had preflight training at Santa Ana Army Air Base, Calif.; Primary Flight Training at Fort Stockton, Tex.; Basic Flight Training at Pecos, Tex; and Advanced Flight Training at Williams Field, Ariz. **Contact:** Earvie T. Cloyd, 4236 N. 34th Pl., Phoenix, AZ 85018.

Seeking staff members who served from 1943 to 1945 at **Headquarters, US Ninth Air Force, ETO,** which was activated in Cairo in 1943 and made stops in England, Omaha Beach, Chantilly, and Luxembourg before winding up in Bad Kissingen, Germany, in June 1945. **Contact:** Col. C. R. Birbari, USAFR (Ret.), 3425 Wentwood, Dallas, TX 75225.

Seeking the whereabouts of **Lt. Bert O. Snow,** who was with the 490th Bomb Squadron in Burma in April 1945, or contact with anyone else who has knowledge of a B-29 that crashed on takeoff in India on May 19, 1945, when Cpl. Joseph B. Wilson was reported killed. **Contact:** James C. Mitchell, Rte. #4, Box 247, Murray, KY 42071.

Seeking the whereabouts or fates of members of Aviation Cadet **Class 43-D. Contact:** Frank J. Dutko, Editor/Historian, Pilot Class 43-D Association, Inc., 316 Florida Ave., Gulf Breeze, FL 32561.

Seeking a copy of the book ***Ninth Air Force in World War II.*** **Contact:** Ben Wright, 455 Worth Ave., Palm Beach, FL 33480.

Seeking names and addresses of officers and enlisted men who were with **Gangway Advance HG** (Ninth AF) from Normandy to Wiesbaden. **Contacts:** Col. Harold Stuart, P. O. Box 1349, Tulsa, OK 74101. Ben Wright, 455 Worth Ave., Palm Beach, FL 33480.

The Military Airlift Command's Airlift Operations School is seeking donations of **photos and memorabilia concerning airlift** for display in its new building at Scott AFB. **Contact:** Lt. Col. John S. Satterthwaite, Jr., USAF, Commandant, AOS/DTP, Scott AFB, IL 62225-5448.

Beginning collector seeks Air Force **patches and posters. Contact:** Albert Y. Surat, 412-A Manga Ave., Sta. Mesa, Manila 1008, Philippines.

Seeking contact with anyone who knew **Lt. James O. Buffington,** who was a B-25 pilot with the 500th Bomb Squadron, 345th Bomb Group, 5th Air Force, when he was shot down over central Luzon, near Angeles, the Philippines, on January 9, 1945. Especially would like to hear from the survivor of that crash. Also seeking a copy of ***Warpath,*** the story of the 345th Bomb Group in World War II. **Contact:** Helen D. Kennedy, 916 Piedmont Dr., Owensboro, KY 42301.

Seeking the whereabouts of **Doris Isabell Thompson,** who left England in October 1945 for the US to marry **Rufus Lemon Jordan,** who was in either the Marines or the Air Force. **Contact:** Muriel Thompson Gray, 8 Millbrook Gardens, Gidea Park, Romford, Essex RM2 5RP, England.

Seeking contact with Air Force personnel who were with the **506th Field Maintenance Squadron,** 506th Bomb Wing, Turner AFB, Ga., between 1953 and 1955. **Contact:** TSgt. Jesse Cook, Jr., USAF (Ret.), P. O. Box 1707, Fort Benning, GA 31905-1707.

Seeking contact with anyone who was with the **366th USAF Dispensary,** 366th TFW, Danang

AB, Vietnam, between March of 1971 and March of 1972. **Contact:** Albert Akers, 22650 Main St., #72, Hayward, CA 94541-5112.

For a history of AFROTC **Det. 195,** seeking contact with Det. 195 alumni, as well as donations of older AFROTC emblems, memorabilia, and books. **Contact:** Capt. David L. Raymer, USAF, AFROTC Det. 195, Illinois Institute of Technology, Chicago, IL 60616-3793.

Seeking contact with **Silver Wing Society** members in the Connecticut area. **Contact:** Jason Zetoff, 700 Commonwealth Ave., Box 1279, Boston, MA 02215.

The Spina Bifida Association of America is seeking **Vietnam veterans** who served in or near Vietnam between 1961 and 1972 and have disabled children, for special programs available to them. **Contact:** Spina Bifida Association of America, 1700 Rockville Pike, Suite 540, Rockville, MD 20852.

The Mid-Atlantic Air Museum of Reading, Pa., has **F-86F #51–13417,** which served with the 23d (blue) Squadron, 36th TFW, in Bitburg, Germany, and would like to hear from anyone associated with this plane. **Contact:** Charles L. Byler, RD 7 Box 444, Boyertown, PA 19512.

Unit Reunions

AFEES
Air Forces Escape and Evasion Society will hold a reunion May 24–27, 1990, at the Peabody Hotel in Memphis, Tenn. **Contact:** John Spence, 1565 Vinton Ave., Memphis, TN 38104. Phone: (901) 276-8013.

Air Rescue Ass'n
The Air Rescue Association will hold its reunion September 19–22, 1990, at the Marines' Memorial Club in San Francisco, Calif. **Contact:** Air Rescue Association, 440 Oak View Dr., Vacaville, CA 95688. Phone: (707) 448-0775.

Bolling Field
World War II veterans who were stationed at Bolling Field, D. C., will hold a reunion October 5–7, 1990 at the VFW Hall in Morningside, Md. **Contact:** William Fahr, 34 Weather Oak Hill, New Windsor, NY 12553. Phone: (914) 564-7523.

P-51 Mustang Pilots
P-51 Mustang Pilots will hold a reunion October 26–28, 1990, at the Santa Maria Museum of Flight in Santa Maria, Calif. **Contact:** Santa Maria Museum of Flight, P. O. Box 1024, Santa Maria, CA 93456.

SAC/LGM
Personnel who served at Hq. SAC/LGM (1967–77) will hold a reunion May 26–27, 1990, in Bellevue, Neb. **Contact:** Lt. Col. Walter E. Husten, USAF (Ret.), 309 Martin Dr. N., Bellevue, NE 68005. Phone: (402) 291-1545.

Swiss Internees Ass'n
US Army Air Force combat aircrewmen who were interned in Switzerland will hold a reunion September 6–9, 1990, in Colorado Springs, Colo. **Contact:** Victor Fabiniak, 2310 E. Liberty, RR 1, Vermilion, OH 44089.

1st Air Commando Ass'n
The 1st Air Commando Association will hold a reunion May 3–6, 1990, at the Holiday Inn in Fort Walton Beach, Fla. **Contact:** Bill Johnson, P. O. Box 445, Destin, FL 32541. Phone: (904) 654-5032.

7th Ferrying Group
Members of the 7th Ferrying Group will hold a reunion on September 12–16, 1990, in Omaha, Neb. **Contact:** Bill Mehlhop, 886 Poplar, Box 177, Syracuse, NE 68446. Phone: (402) 269-2477.

7th TDS/400th MMS
Members of the 7th TDS and 400th MMS will hold a reunion August 9–12, 1990, in Denver, Colo. **Contact:** MSgt. Walter E. Buck, USAF (Ret.), 531 Ursula St., Aurora, CO 80011. Phone: (303) 344-1319.

33d Troop Carrier Squadron
The 33d Troop Carrier Squadron will hold a reunion June 7–10, 1990, at the Hilton East Hotel in Wichita, Kan. **Contact:** Charles R. Mead, 1729 S. Erie St., Wichita, KS 67211. Phone: (316) 686-1248.

Class 43-D Ass'n
Members of Class 43-D will hold a reunion April 25–29, 1990, at the Hotel Monteleone in New Orleans, La. **Contact:** Jack Carlson, 3045 Silverview Dr., Stow, OH 44224. Phone: (216) 688-4848.

Class 50-E
Members of Class 50-E will hold a reunion September 13–16, 1990, at the Sheraton Gunter Hotel in San Antonio, Tex. **Contact:** F. "Nick" Nixon, 614 Pleasant Dr., Lake Charles, LA 70605. Phone: (318) 478-0174.

53d Fighter Group
Members of the 53d Fighter Group will hold a reunion May 4–6, 1990, at the Chamberlin Inn in Hampton, Va. **Contact:** Elmer E. Johnson, 1815 S. E. 6th Terrace, Cape Coral, Fla. 33990. Phone: (813) 574-4044.

75th Bomb Squadron
The 75th Bomb Squadron will hold a reunion September 6–8, 1990, at the Holiday Inn in downtown Denver, Colo. **Contact:** Gerald E. "Jerry" Berg, 6338 Kevin Ave., Cheyenne, WY 82009. Phone: (307) 632-1447.

86th Fighter-Bomber Group
Members of the 86th Fighter-Bomber Group, which included the 525th, 526th, 527th, and Hq.

Seeking information on a B-17 built in April 1944 named **"Spirit of Moses Mendelssohn."** **Contact:** Irving Spector, 1 Charlotte Lane, Randolph, MA 02368.

Seeking the whereabouts of **Capt. Larry C. Owsowitz,** who flew F-16As from 313th TFS, 50th TFW, Hahn AB, Germany, between 1983 and 1986. **Contact:** Jürgen Kara, Obergasse 3, 6380 Bad Homburg, Federal Republic of Germany.

Seeking contact with **military families** who have experienced a pregnancy or infant loss while in the military. **Contact:** Kelly J. Gonzalez, 4819E Johnson Place, Mountain Home, ID 83648.

Seeking to buy **pulp magazines** from the 1930s and 1940s. Especially seeking ***Battle Aces*** from 1932–33 and ***G-8 and His Battle Aces*** from 1933–44. **Contact:** G. C. Burns, Box 2308, Framingham, MA 01701.

Squadrons (World War II), will hold a reunion October 18–20, 1990, in Little Rock, Ark. **Contact:** Gil Hurt, 4920 Montcrest Dr., Chattanooga, TN 37416. Phone: (615) 344-6077.

107th Tactical Recon Squadron
Members of the 107th Tactical Reconnaissance Squadron (World War II) will hold a reunion April 29–May 2, 1990, at the Shem Creek Inn in Charleston, S. C. **Contact:** Ernest C. Holland, Jr., Rte. 4, Box 1240, Manning, SC 29102. Phone: (803) 478-4613.

301st Veterans Ass'n
Members of the 301st Veterans Association (1942 through the present) will hold a reunion September 20–23, 1990, at Wright-Patterson AFB, Ohio. **Contact:** Charles McKeag, 327 Johnston Rd., Gahanna, OH 43230. Phone: (614) 475-5451.

314th Composite Wing
Members of the 314th Composite Wing, 5th Air Force, will hold a reunion June 20–24, 1990, in St. Louis, Mo. **Contacts:** Bob Kendall or Mel Hiller, Box 35372, Louisville, KY 40232.

322d Bomb Group
The 322d Bomb Group, which included the 449th, 450th, 451st, and 452d Bomb Squadrons, will hold a reunion August 22–26, 1990, in Colorado Springs, Colo. **Contacts:** B. E. Forrest, 3213 Oakbrook Dr., Del City, OK 73115. Phone: (405) 677-0458. Joe Hayes, 177 Glenview Dr., New Kensington, PA 15068. Phone: (412) 337-3186.

325th Fighter Group
The 325th Fighter Group's "Checkertail Clan" reunion dates have been changed. The new dates are June 21–24, 1990, at the Sheraton Inn in Kalamazoo, Mich. **Contacts:** Dan Penrod, 69 Keswick Ave., Pittsburgh, PA 15202. Phone: (412) 766-6190. John L. Gaston, 1402 Mears Dr., Colorado Springs, CO 80915. Phone: (719) 596-5556.

Reunion Notices

Readers wishing to submit reunion notices to "Unit Reunions" should mail their notices well in advance of the event to: "Unit Reunions," AIR FORCE Magazine, 1501 Lee Highway, Arlington, Va. 22209-1198. Please designate the unit holding the reunion, time, location, and a contact for more information.

340th Fighter Squadron
The 340th Fighter Squadron, 348th Fighter Group, will hold a reunion September 20–23, 1990, in Orlando, Fla. **Contact:** John Losleben, P. O. Box 535, Fort Myers, FL 33902. Phone: (813) 334-0302.

341st Fighter Squadron
Members of the 341st Fighter Squadron, 348th Fighter Group, 5th Air Force (World War II), will hold a reunion September 20–23, 1990, in Miami, Fla. **Contact:** Orlow Johnston, 237 N. E. 141st St., North Miami, FL 33161. Phone: (305) 893-8052.

342d Fighter Squadron
The 342d Fighter Squadron will hold a reunion October 24–28, 1990, in Norfolk, Va. **Contact:** James J. Stapleton, Jr., 4605 Alabama Ave., Lynchburg, VA 24502. Phone: (804) 239-7196.

388th Bomb Group
Members of the 388th Bomb Group will hold a reunion September 19–23, 1990, at the Inn at the Park Hotel in Anaheim, Calif. **Contact:** Edward J. Huntzinger, 1925 S. E. 37th St., Cape Coral, FL 33904.

401st Bomb Group
The 401st Bomb Group will hold its reunion September 19–22, 1990, in Portland, Ore. **Contact:** Ralph "Rainbow" Trout, P. O. Box 22044, Tampa, FL 33622.

414th Bomb Squadron
Members of the 414th Bomb Squadron, 97th Bomb Group, will hold a reunion August 16–18, 1990, in Lexington, Ky. **Contact:** C. A. Merlo, 5500 Calhoun, Apt. 711, Dearborn, MI 48126.

416th Bomb Squadron
The 416th Bomb Squadron will hold a reunion September 13–15, 1990, in Seattle, Wash. **Contact:** Charles D. Boggs, E. 250 Woodland Dr., Shelton, WA 98584. Phone: (206) 426-4371.

483d Bomb Group
Members of the 483d Bomb Group (World War II) will hold a reunion September 12–15, 1990, in Buffalo, N. Y. **Contact:** John Berlin, 250 Delaware Ave., Buffalo, NY 14202.

487th Bomb Group
The 487th Bomb Group, 8th Air Force (World War II), will hold a reunion July 26–28, 1990, in Omaha, Neb. **Contact:** Don Denbeck, 128 N. 8th St., RFD #1, O'Neill, NE 68673.

674th Radar Squadron
Members of the 674th Radar Squadron who were stationed at Osceola AFS, Wis., will hold a reunion July 18–21, 1990, at Eagle Park in Osceola, Wis. **Contact:** Ric Kao, 3777 S. 15th Pl., Milwaukee, WI 53221.

MOVING?

Let us know your new address six weeks in advance so that you don't miss any copies of AIR FORCE.

Clip this form and attach your mailing label (from the plastic bag that contained this copy of your magazine), and send to:

Air Force Association
Attn: Change of Address
1501 Lee Highway
Arlington, VA
22209-1198

Please fasten your mailing label here

Please print your NEW address here:

NAME

ADDRESS

CITY, STATE, ZIP CODE

AFA's CHAMPLUS® . . . With the

Exceptional Basic Benefits

1. Four year basic benefit. Benefits for most injuries or illnesses are paid for up to a four-year period.

2. Up to 45 consecutive days of in-hospital care for mental, nervous or emotional disorders. Outpatient care for these disorders may include up to 20 visits by a physician or $500.00 per insured person each year.

3. Up to 30 days per year for each insured person confined in a Skilled Nursing Facility.

4. Up to 30 days per year (to a 60-day life-time maximum) for each insured person receiving care through a CHAMPUS-approved Residential Treatment Center.

5. Up to 30 days per year (to a 60-day life-time maximum) for each insured person receiving care through a CHAMPUS-approved Special Treatment Facility.

6. Up to five visits per year for each insured person to Marriage and Family Counselors under conditions defined by CHAMPUS.

And the New 'Expense Protector' Benefit

While CHAMPUS Supplement coverage was originally intended to cover the cost of medical services not provided by CHAMPUS, practitioners and service institutions may charge fees that are considerably greater than those approved for payment by CHAMPUS. And, because Supplement policies traditionally base their payments on the amount paid by CHAMPUS, the insured can be left with sizable out-of-pocket expenses. AFA's ChamPLUS® coverage includes a special feature which places a limit on these out-of-pocket expenses.

Called the 'Expense Protector' Benefit, this program limits out-of-pocket expenses for CHAMPUS covered charges in any single calendar year to $1,000 for any one insured person (or $2,000 for all insured family members combined). Once those out-of-pocket expense maximums are reached, ChamPLUS® will pay 100% of CHAMPUS covered charges for the remainder of that year.

An example of the way the 'Expense Protector' works follows. Assume you are hospitalized for 35 days, that the hospital charges you $330 per day and that this is $75 per day *more* than allowed by CHAMPUS. This would mean that you have an out-of-pocket expense of $2,625. With AFA's 'Expense Protector' benefit, your cost would be limited to $1,000. All covered costs over this amount—for the whole calendar year—would be paid by ChamPLUS®!

It's an important benefit that can mean significant savings to you and your family.

CALIFORNIA and HAWAII RESIDENTS—If you would like details on AFA's supplement to CHAMPUS Prime, please contact AFA's Insurance Division at 1/800/727-3337.

Who Is Eligible?

1. All AFA members under 65 years of age who are currently receiving retired pay based upon their military service and who are eligible for benefits under Public Law 89-614 (CHAMPUS), their spouses under age 65 and their unmarried

AFA ChamPLUS® Benefit Schedule

Care	CHAMPUS Pays	AFA CHAMPLUS® PAYS
For Military Retirees Under Age 65 and Their Dependents		
Inpatient civilian hospital care	CHAMPUS pays the balance of the Diagnostic Related Group (DRG) allowance after the beneficiary's cost share* is deducted.	CHAMPLUS® pays 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.
Inpatient military hospital care	The only charge normally made is a daily subsistence fee, not paid by CHAMPUS.	CHAMPLUS® pays the daily subsistence fee.
Outpatient care	CHAMPUS covers 75% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS® pays 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.
For dependents of Active Duty Military Personnel		
Inpatient civilian hospital care	CHAMPUS pays all covered services and supplies furnished by a hospital less $25 or the total of daily subsistence fees, whichever is greater.	CHAMPLUS® pays the greater of the total subsistence fees, or the $25 hospital charge not paid by CHAMPUS
Inpatient military hospital care	The only charge normally made is a daily subsistence fee, not paid by CHAMPUS.	CHAMPLUS® pays the daily subsistence fee.
Outpatient care	CHAMPUS covers 80% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS® pays 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.

NOTE: Outpatient benefits cover emergency room treatment, doctor bills, pharmaceuticals, and other professional services. There are some reasonable limitation and exclusions for both in-patient and outpatient coverage. Please note these elsewhere in the plan description.

*The beneficiary cost share is the lesser of 25% of CHAMPUS-allowable billed charges or a daily fixed amount. For fiscal year 1989, the daily limit is $210.

New 'Expense Protector' Benefit!

dependent children under age 21, or age 23 if in college.

2. All eligible dependents of AFA members on active duty. Eligible dependents are spouses under age 65 and unmarried dependent children under age 21 (or age 23 if in college). (There are some exceptions for older age children. See "Exceptions and Limitations.")

Renewal Provision

As long as you remain eligible for CHAMPUS benefits and the Master Policy with AFA remains in force, termination of your coverage can occur only if premiums for coverage are due and unpaid, or if you are no longer an AFA member. Your certificate cannot be terminated because of the number of times you receive benefits.

Exceptions and Limitations

Coverage will not be provided for conditions for which treatment has been received during the 12-month period prior to the effective date of insurance until the expiration of 12 consecutive months of insurance coverage without further treatment. After coverage has been in force for 24 consecutive months, pre-existing conditions will be covered regardless of prior treatment. 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. Coverage for these older age children will only be provided upon a) notification to AFA and b) payment of a special premium amount.

Plan 1
For Military Retirees and Dependents
QUARTERLY PREMIUM SCHEDULE

In-Patient Benefits Only

Member's Attained Age*	Member	Spouse	Each Child
Under 50	$22.97	$ 45.12	$16.34
50-54	$34.33	$ 56.21	$16.34
55-59	$50.32	$ 60.17	$16.34
60-64	$62.98	$ 69.27	$16.34

In-Patient and Out-Patient Benefits

Under 50	$33.90	$ 61.02	$40.84
50-54	$46.59	$ 69.87	$40.84
55-59	$64.41	$ 96.11	$40.84
60-64	$77.38	$102.15	$40.84

*Note: Premium amounts increase with the member's attained age

Plan 2
For Dependents of Active Duty Personnel
ANNUAL PREMIUM SCHEDULE

In-Patient Benefits Only

	Member	Spouse	Each Child
All Ages	None	$ 9.68	$ 5.94

In-Patient and Out-Patient Benefits

All Ages	None	$38.72	$29.70

Coverage After Age 65

Upon attainment of age 65, the coverage of members insured under CHAMPLUS® will automatically be converted to AFA's Medicare Supplement program so that there will be no lapse in coverage. Members not wishing this automatic coverage should notify AFA prior to their attainment of age 65.

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)
- routine care of the newborn or well-baby care
- injuries or sickness resulting from declared or undeclared war or any act thereof
- injuries or sickness 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)

APPLICATION FOR AFA CHAMPLUS*

Group Policy GMG-FC70
Mutual of Omaha Insurance Company
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 ____ Soc. Sec. No. _____
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 I (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
☐ 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 on either a semi-annual (multiply by 2), or annual (multiply by 4) basis.

Quarterly (annual) premium for member (age ____) $_____

Quarterly (annual) premium for spouse (based on member's 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 Dependents to be Insured	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 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 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 pre-existing conditions will be covered after this insurance has been in effect for 24 consecutive months.

Date _____, 19 ____ _____
Member's Signature

Form 6173GH App
4-90

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

Bob Stevens'

"There I was..."

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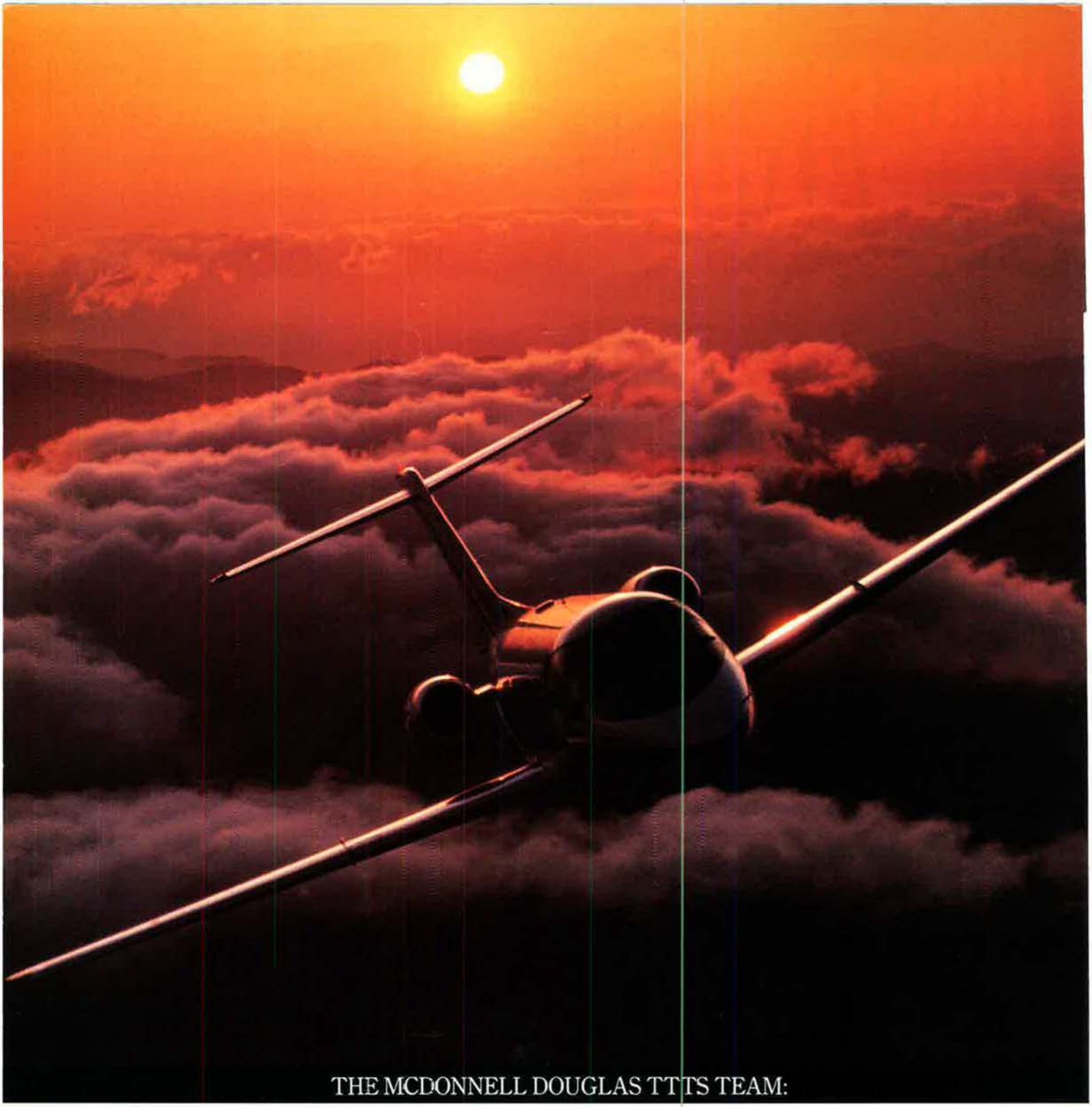

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