AIR FORCE MAGAZINE
PUBLISHED BY THE AIR FORCE ASSOCIATION

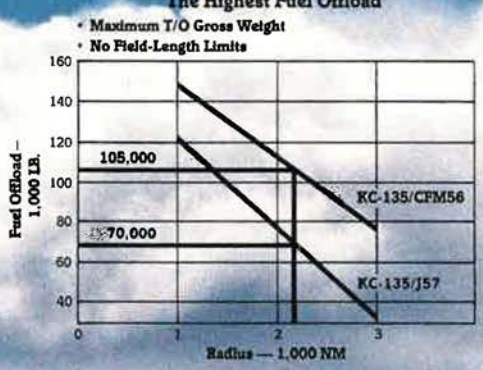
Airlift for Near and Far

Gaining on the Logistics "Gotchas"

The Air Force can now cut thi and increase fuel delivery u

By re-engining the existing Boeing KC-135As, the productivity of this tanker fleet goes sky-high. Two re-engined KC-135R tankers, for example, are now equal to three KC-135A aircraft. In addition, the Air Force will save over 150 million gallons of fuel a year once re-engining of the fleet is complete.

The KC-135R's General Electric/SNECMA CFM56 engines are the primary reason.



Higher productivity and a higher state of mission readiness

Re-engining with the CFM56 gives the KC-135R vastly superior advantages over the current tanker. It's an engine that's perfectly suited to the high-speed, high-altitude refueling of strategic bombers, fighters and airlift aircraft.

Fuel offload is up to 150% higher, or an average 50% better than the current KC-135 fleet. Thanks to a 25% reduction in fuel consumption. And thanks to a greater maximum takeoff gross weight (over 322,000 pounds) from fields that are up to 40% shorter. An increase made possible by the CFM56's 60% higher thrust.

What's more, the KC-135R will be ready to fly whenever it's needed. The reason? The experience gained from over 2 million commercial flight hours on the CFM56-2 engine by the time the first KC-135R squadron is opera al. Experience that will translate into proven reliability and low maintenance requirements.

All of which means the CFM56-powered KC-135R will deliver more fuel more efficientl more economically, more often. Well into the 21st Century.

Easier to maintain, cheap to operate

Overall, there's a dramatic 58% reduction in maintenance costs over the current KC-135A engine.

Why? There are no schedul engine overhauls or component replacements. LRU replacement on-wing are faster because of far mounted accessories. Commerci

nker's fuel usage over 25% 150%. And for good reasons.

erience shows that mean time veen maintenance is very low. engine operating costs are also — thanks to lower fuel and ntenance costs.

e right engine for other transport aircraft, too

Already, the CFM56 has been cted for the French Air Force's 3 and the U.S. Navy's Boeing In fact, it's the only engine that can handle the E-6's tough mission requirements: extended time on station, short-field operation, plus high bank-angle orbits. In addition, it meets or exceeds the strictest noise and emission standards.

A leading candidate in several other programs around the world, the CFM56 is a perfect match for large military transport and tanker platforms. For the U.S. Air Force's AWACS, for example, it means a 2 to 3.4 hour increase in time on station — depending on takeoff conditions.

e-engined with the 6, the French Air Force's will have the greatest ing range of any commercially d aircraft.

Engines that set new standards

The GE philosophy is simple: develop military engines that surpass previous standards and exceed customer requirements.

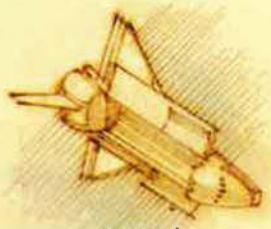
That's what the CFM56 is doing for the KC-135R. And what other GE engines — like the F404, F101, T700 and F110 — are doing for aircraft as diverse as the F/A-18, the B-1B, the Black Hawk and (in flight tests) the F-16 and F-14.

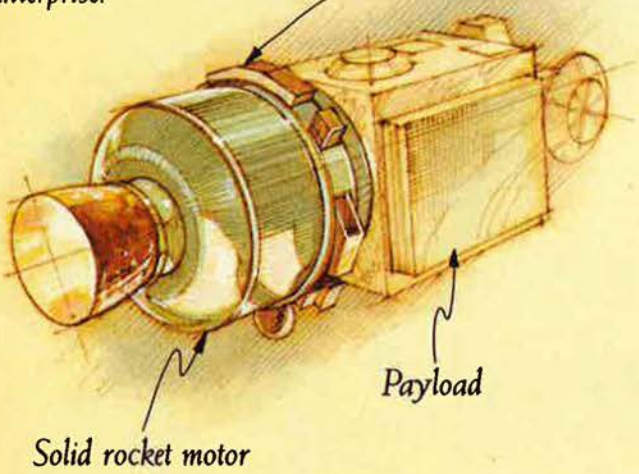
For lots of good reasons.

GENERAL ELECTRIC

The next step: a space station that means business.

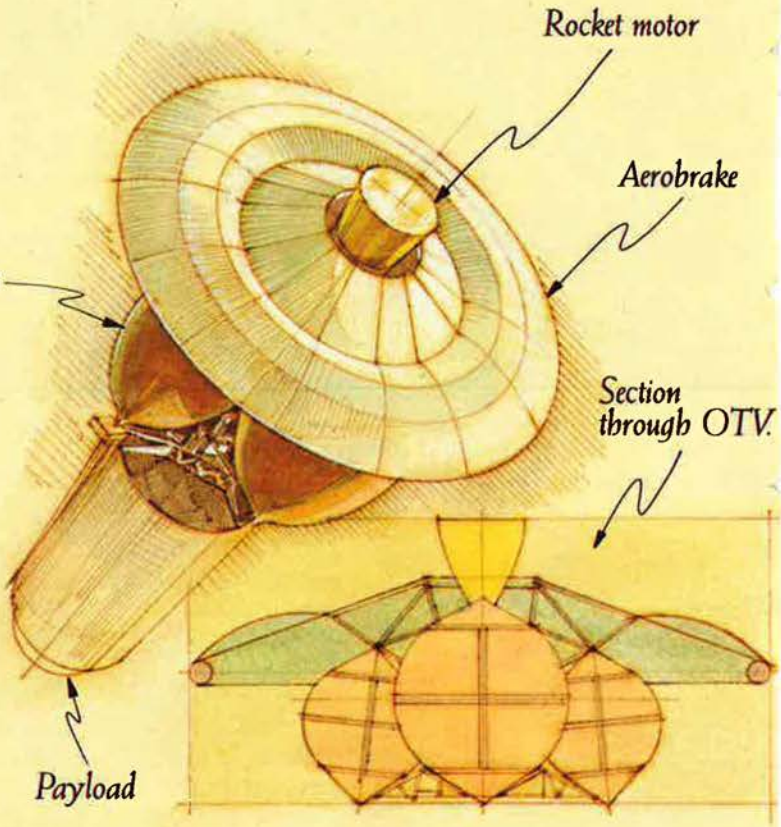
NASA has targeted the 1990s for deployment of a permanently manned space station. Martin Marietta is aiming to help NASA meet its date with advanced development of systems and spacecraft. As the permanently manned space station becomes a reality, it will open a new era of opportunity for government, science and private enterprise.





Transfer Orbit Stage (TOS)

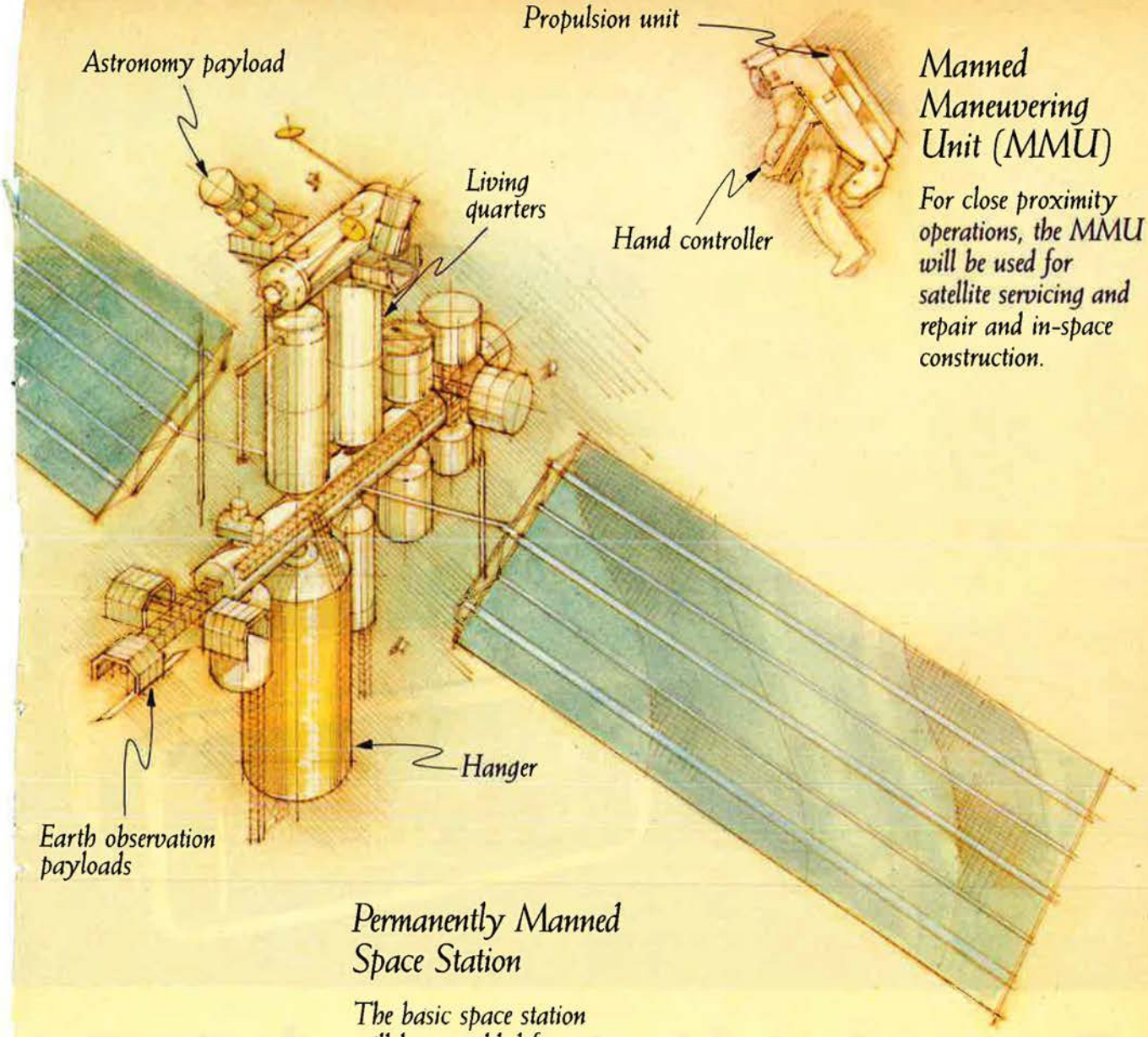
The TOS will boost spacecraft and payloads from the Shuttle's low Earth orbit to geosynchronous transfer orbit.



Orbital Transfer Vehicle (OTV)

The mission of this reusable vehicle is to boost spacecraft to high orbits, including the geosynchronous band. The OTV will fly 20 to 30 missions before refurbishment.

OUR COMMITMENT IS TOTAL. OUR CAPABILITIES



Manned Maneuvering Unit (MMU)

For close proximity operations, the MMU will be used for satellite servicing and repair and in-space construction.

Permanently Manned Space Station

The basic space station will be assembled from hardware and modules carried in the cargo bay of the Space Shuttle on successive flights. Subsequent flights will ferry crews and supplies, and deploy independently orbiting platforms.

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From ancient skies to man-made stars... Interstate's new Astrolabe II GPS Navigator.

The invention of the original Astrolabe (circa 150 B.C.) provided ancient mariners the ability to navigate on the open seas through sightings taken of heavenly bodies. This invention opened new frontiers to exploration and settlement.

Some 2000 years later, man finds himself again on the threshold of a new frontier...Space. The NAVSTAR Global Positioning System (GPS) is a space-based, 24-hour, worldwide navigation system for Land, Sea and Air.

Just as the original Astrolabe utilized positions of the stars to navigate, the Interstate Electronics' Astrolabe II GPS receiver makes use of the GPS satellite constellation's "Standard Positioning Service" to accurately pinpoint your location to better than 40 meters (CEP)* with time accuracies under 100 nanoseconds. This is a compact, rugged, easy-to-use, menu-prompted receiver with flexible interface capability.

Interstate Electronics Corporation is proud to be a pioneer in the NAVSTAR Global Positioning System and is the only company that both develops and uses GPS-based systems. For over a quarter-century, Interstate Electronics Corporation has designed and built high-performance tracking and precision trajectory determination systems. Currently, we're applying GPS to the instrumentation of the TRIDENT weapon system.

Take advantage of our experience and explore with us the new world of GPS.

For details, contact: Director of Business Development, Navigation and Range Systems, Interstate Electronics Corporation, P.O. Box 3117, Anaheim, CA 92803, Telephone (714) 758-0500, (800) 854-6979, in California (800) 422-4580, TWX 910-591-1197, Telex 655419.

*The NAVSTAR GPS is being developed by the U.S. Department of Defense. Other users are cautioned that the current system is developmental and that availability of the signals, or the accuracy possible are subject to change without advance warning.

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OCTOBER 1984
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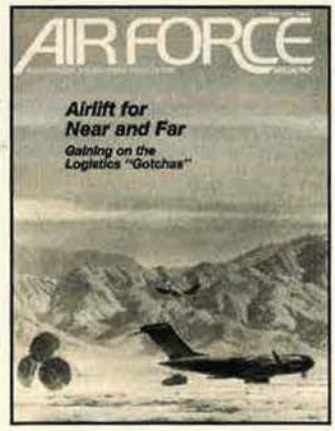
Page 72



About the cover: Artist's conception of the C-17 airlifter at work. A special section on "Airlift and Logistics" begins on page 44 of this issue.

Special Section: Airlift and Logistics

Features

Departments

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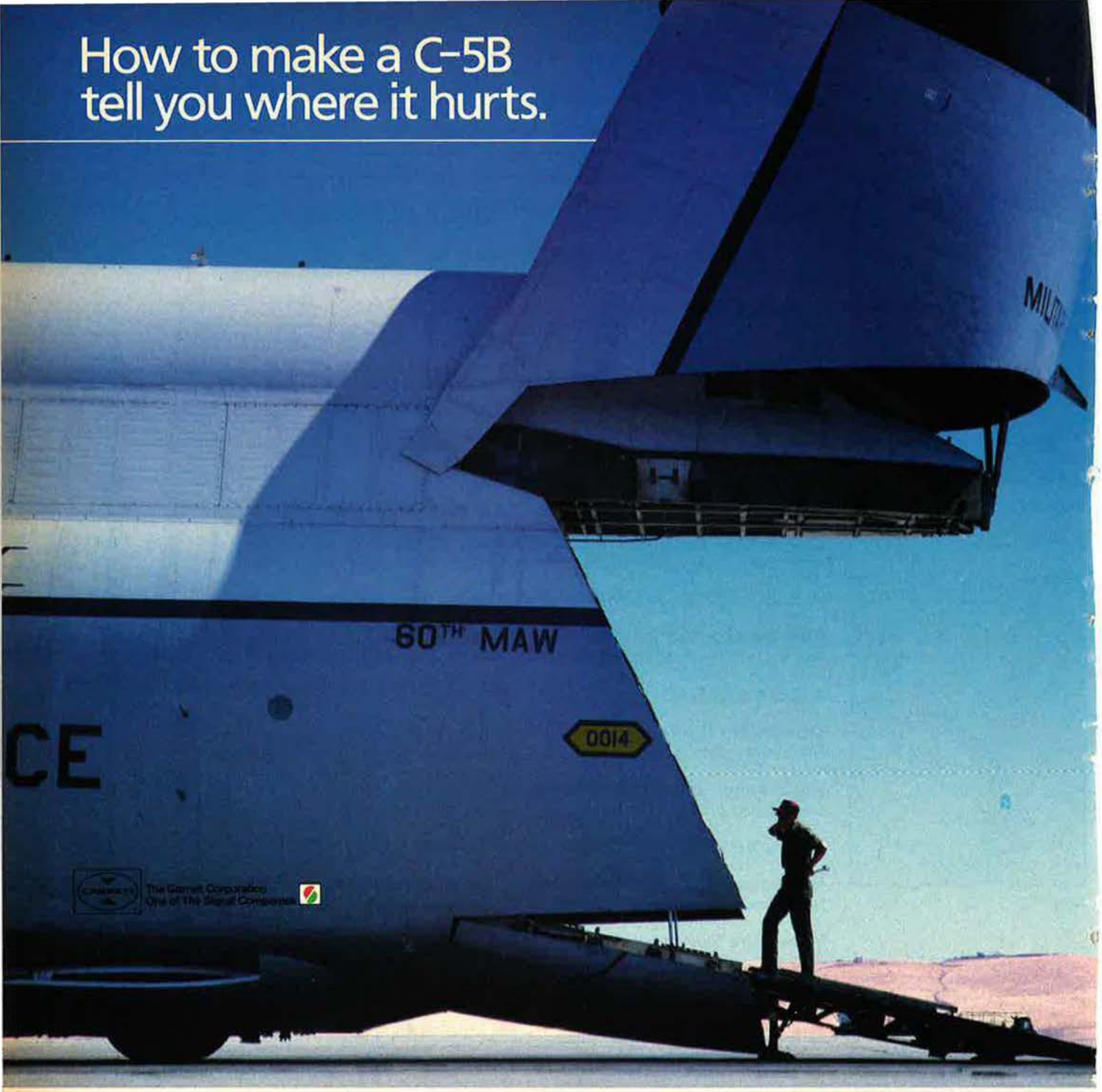
How to make a C-5B tell you where it hurts.



Transient faults from interfacing avionics or weapons systems are not always evident on the ground. That's why you should specify the Garrett Standard Central Air Data Computer

(SCADC) in your retrofit program. Or in new designs.

SCADC is already in production for the Grumman C-2A and the Lockheed C-5B. Where it will permanently record its own intermittent faults, or input faults from interface systems. Before they become catastrophic.

Even in the event of a complete power shutdown, the SCADC memory remains completely intact. So input data will be there for output. And analysis.

What's more, the Garrett SCADC is designed for growth, easily adding new systems inputs.

SCADC can be retrofitted to over 25 types of fighter, attack and transport aircraft. Extending their life. Or adding capability to new aircraft designs.

So when the time comes to specify a SCADC, remember the only one that can't forget.

For information, contact: SCADC Sales Manager, AiResearch Manufacturing Company, 2525 West 190th Street, Torrance, CA 90509. (213) 512-1025.

GARRETT

Rely on the difference.

99.4% start reliability. In rapid deployment, Solar's lightweight mobile turbine generator sets get the U.S. Air Force off to a flying start.

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Built and tested to strictest military specifications, this compact generator set really shows its muscle in the field: Minimal maintenance to assure long stretches of unattended operation. The proven ability to run as long as necessary while maintaining superior transient response, even in severest weather. Total package weight under 20,000 pounds, so more can be deployed faster, fly farther in fewer aircraft.

For nearly 40 years, the military has relied on Solar for a variety of turbine power needs. With good reason. Our extensive R&D facilities are at the leading edge of military technology.

We've built more than 20,000 gas turbine engines in use worldwide. From 10 kW to 10 MW. Logging nearly a quarter-billion operating hours on land, in the air and at sea.

Turbine systems are our specialty. Find out what a big difference that can make to you. Call on Solar.

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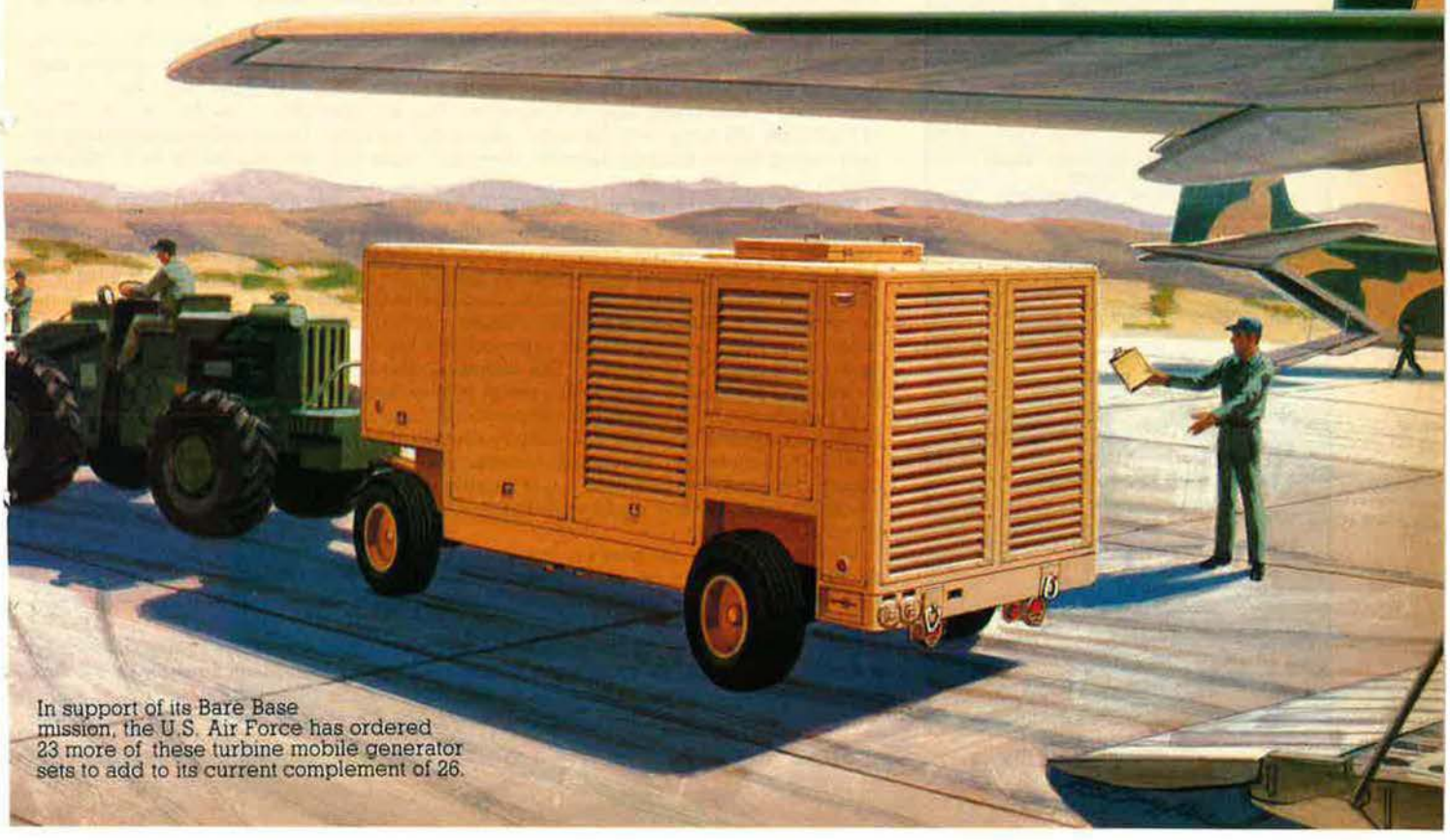

In support of its Bare Base mission, the U.S. Air Force has ordered 23 more of these turbine mobile generator sets to add to its current complement of 26.

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AN EDITORIAL

It Ain't Broke — But It Needs Some Fixing

For a variety of reasons—including such emotional scare allegations as a Prussian-style general staff, an armed forces czar, or an irresponsible generalissimo bent on leading us to Armageddon—the operational military forces of the United States have been saddled for four decades with a clumsy command structure in the Pentagon. The fact that it *has* worked is a tribute to the skill and maturity of the individuals who have occupied our top military positions over the years. The fact that it has not worked well under all circumstances is evidence of our failure to recognize and correct the organizational anomalies that tend to force a separation of military authority from military responsibility.

The House of Representatives has conducted hearings and passed legislation (H.R. 3718, "Joint Chiefs of Staff Reorganization Act of 1983") putting the Chairman of the JCS in the chain of command to the combatant commanders (the CINCs of the unified and specified commands) and making him a member of the National Security Council and advisor to the President and Secretary of Defense in his own right—and on the full range of military matters affecting the posture, readiness, and employment of combatant forces. The Chairman would be given control of the Joint Staff and the opportunity to comment on three- and four-star nominees of the services. And, importantly, the House action would place the combatant CINCs under the supervision of the Chairman (who would speak for them in Washington) and would permit them to express their views on any matter the JCS had under consideration. As Congressman Bill Nichols of Alabama said when proposing the legislation, the unified and specified commanders "are in a position to provide insight not elsewhere available concerning the proper structuring of US forces to meet national objectives."

The House has made a commendable start in proposing these corrective measures. The ball is now in the Senate's court, and its Armed Services Committee has the matter under consideration.

Though a relatively obscure issue for the American public, the legislation that results ultimately from this congressional action will be of extreme importance to the future efficiency and effectiveness of our armed forces. The full effect of the sorely needed military modernization and provisioning initiatives now under way will be diluted unless we make comparable improvements in the nation's archaic, Pentagon-level military command structure for our operational forces.

These legislative initiatives could founder on public and congressional apathy, notwithstanding their critical importance. The subject is esoteric and uninteresting to the body politic; some will charge it off as just another Potomac parlor game. Or it could be derailed by simplistic slogans, such as "If it ain't broke, don't fix it!" I submit that our current arrangements ain't broke, but they do need some legislative fixing—and the House deserves kudos for tackling the problem.

Battle lines formed soon after the House initiated its hearings on this matter in 1982. Positions hardened as to what action, if any, was needed. Motives were maligned. Counterattacks were mounted to the public pleas for change from then-retiring Chairman of the Joint Chiefs of Staff Gen. David C. Jones (with more JCS experience than any other officer), and from the then Chief of Staff of the US Army, Gen. Edward C. Meyer. We can expect repeat performances during the forthcoming Senate hearings; however, the House action may have defuzed the most explosive issues.

We must recognize that it is difficult for a uniquely democratic society such as ours, fundamentally based on a *division of powers*, to come to grips with the essential command requirement for a clear-cut, cohesive military command structure—one in which operational decisions, authorities, and responsibilities *are not divided*, attenuated, or diluted. Also, it is difficult for our complacent body politic to recognize the presence of inimical threats and the essentiality of a relevant, responsive military establishment that can *fight*. Yet, forces that would *deter* must be designed and equipped with multiple capabilities to fight effectively, in varied circumstances of combat. Their command structure at Pentagon level must be equally capable and responsive—and it must merge military authority and responsibility at this level.

In a political or moral sense, it is commendable that we, as a nation, have difficulty with these conflicting requirements; but in a military context, this difficulty has caused us to postpone needed changes in our operational planning, posturing, and command lines. The legislative changes proposed by the House would improve our situation, could save much while costing practically nothing—and would immediately enhance our worldwide military capabilities and responsiveness.

But there is at least one more key change that Congress should enact, one that will make clear the legislative intent to streamline command lines and to provide unfiltered military advice to the President and Secretary of Defense: Make the Chairman of our Joint Chiefs of Staff *a five-star position!*

These changes will go far toward establishing a responsible, responsive Pentagon command structure for advising the Secretary of Defense and the President—and for carrying out their orders in a manner worthy of the fine military forces of the United States.

—RUSSELL E. DOUGHERTY, EDITOR IN CHIEF AND PUBLISHER

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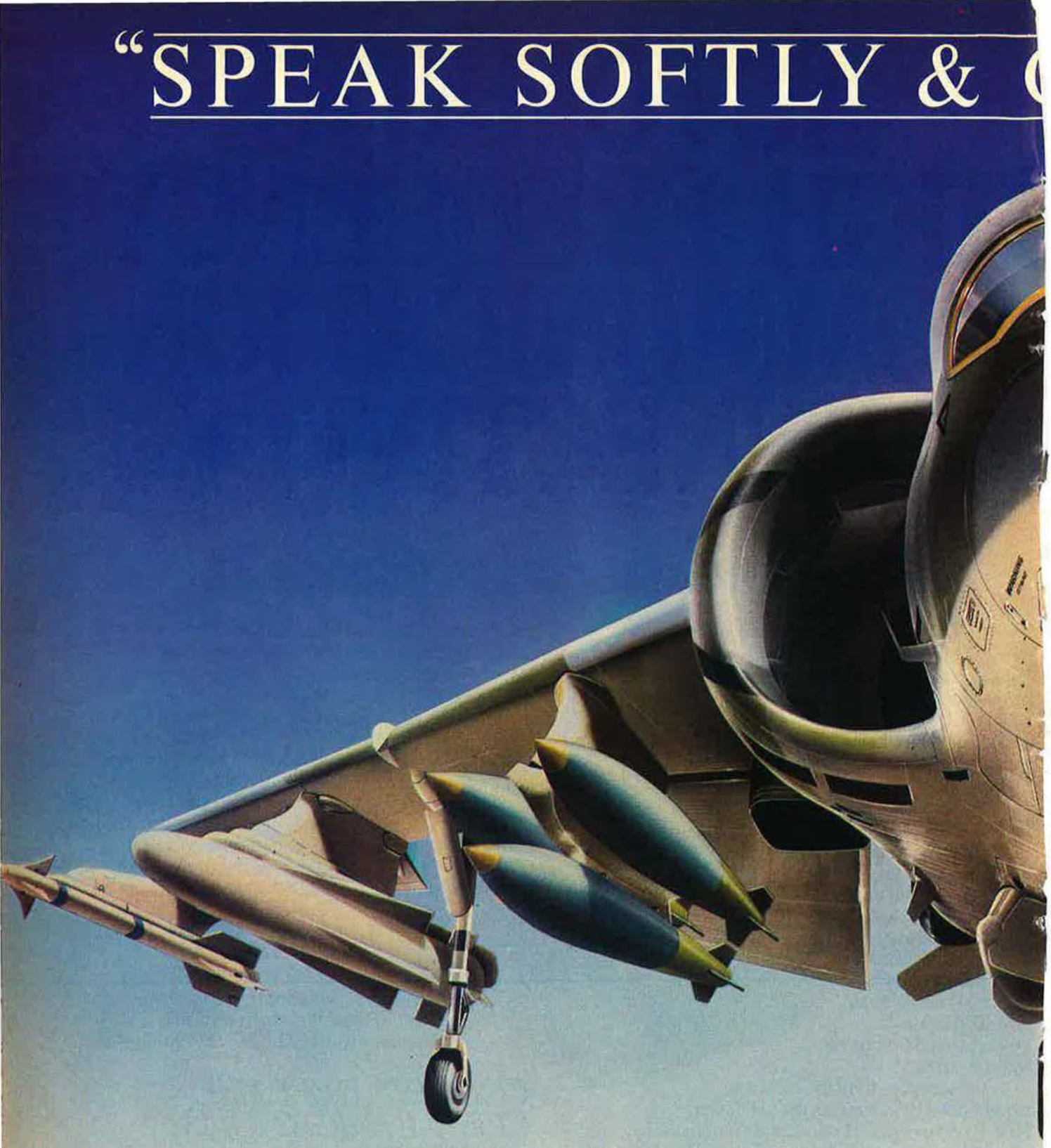

When you are first to fight, you must carry your own weapons with you. That is why the US Marines fought so hard to get the AV-8B Harrier II.

The day the Marines acquired the Harrier II, they acquired vastly more clout.

It is a unique aircraft. Period. Quite simply put, the most versatile attack aircraft in the world.

From desert wastes to urban sprawl, from the tropics to the poles, whether storming a beach or holding a hill, it goes with the Marines: ready in some nearby forest clear aboard an assault ship or by a small country road, always available to provide the additional rapid punch that can mean the difference between success and failure.

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RRY A BIG STICK"

THEODORE ROOSEVELT

This Marine machine, the Harrier II, is manufactured ' McDonnell Douglas and British Aerospace, but its ıique capabilities are made possible by a unique engine: e Rolls-Royce Pegasus F402.

The Pegasus has an exceptional thrust to weight ratio th up to 22000 lb thrust available through 4 nozzles which rect the thrust from vertically downwards to straight aft – even to some degree forward.

It is this vectored thrust capability that makes the airplane's unique basing flexibility and consequent unique rapid response possible. It also provides for unique inflight agility which, when combined with Sidewinder air-to-air missiles and the modern high velocity 25 mm gun, makes the Harrier II a dangerous airplane to attack.

Just the sort of 'Big Stick' Teddy Roosevelt had in mind way back in 1901.

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Acquisition: Train the Troops

I read your editorial in the August 1984 issue *(p. 4)* regarding the proposed formation of an acquisition superagency with interest; I quite agree with your analysis. Unfortunately, DoD and other agencies have been convinced for some time that all solutions can only come from the top.

What is really wrong with all government acquisition is the failure at the top to recognize that the base is the problem—that is, training itself. What's needed is not a centralized Defense Acquisition Agency but rather a centralized Government Acquisition Training Center to coincide with the concepts of the new federal acquisition regulations that became active on April 1 of this year.

Federal acquisition training has been in a declining state since the mid-1970s. It has been the victim of misguided cost-cutting, and the results of this are continuing to play havoc in the field, in the courts, and in industry. This was brought about, particularly within DoD, by the so-called "do more with less" philosophy that has prevailed for so many years.

Instead of students being taught at the sites already built and furnished for this difficult task, the instructors have been brought to the students to save money. No student can study in an environment where they are still subject to the many whims and dictates of nearby bosses and jobs. No instructor is going to stay around very long if they have to spend up to six months per year on the road and away from family. The consequences have to be increased failures or lower standards, less-experienced instructors because of frequent turnover, less competence in the field of work, increased problems for contractors who have to do the work, increased litigation for the courts because of the problems that do develop, and so forth. It doesn't take genius to figure it out, but it does take courage to admit to it and then to do something about it.

The machinery for doing something about it has been in place for several years now but has not, in my opinion, been properly utilized to correct the problem. The establishment of the federal acquisition regulations in April and the lessons of the past should register a clear call for a physical, campus-like "university" for all government acquisition personnel. Furthermore, it should be controlled and operated by the Federal Acquisition Institute, which is the machinery that I alluded to. . . .

Training should be the one "sacred" area the cost-cutters should be very careful about paring down. We all give lip service to its merits, but the truth is that not many of us really believe it. Training is the base. Training is what produces all of the good or the bad that is to come later and that is, in fact, here now.

The old truths are still best: A house built upon sand will not stand.

Robert E. McGhee
Dothan, Ala.

Acquisition: Pluck the Eagles

It appears from the editorial "An Acquisition Superagency?" in the August 1984 issue that you are not overly familiar with one highly successful example of a combined procurement office—West Germany's *Bundesamt für Wehrtechnik und Beschaffung* (BWB). This agency employs some of the best German scientific and engineering personnel to translate the requirements laid down by the military into service-ready, fully qualified equipment and is responsible for the training of the military to use the equipment and to maintain it. My observation of BWB has been that it performs an excellent service and has been able to function in a highly professional manner.

There are no uniformed military personnel assigned to the BWB staff; the staffing is completely civilian. Many have competent military experience, to be sure, but the decisions are made by professionals *out of uniform.* BWB works closely with the "customer" so that the end product is quite familiar to the user at the time of its delivery. In this regard, I have observed a close and cordial liaison between the engineering staff and the user's project officer. A high level of confidence is established through performance and testing of the equipment designed, produced, and delivered under the responsibility of BWB.

There are flaws in our procurement system that would be offset by such an office as BWB. The force of personality, which has been known to have been exerted in putting a not-completely-optimal (or perhaps with a thicker-than-needed covering of gold plating) system into use "because General or Admiral So-and-So directs," is lacking from the BWB concept. Another factor that causes us to fall short in giving the best bang for the buck is that high-ranking military officers within a procurement operation who are looking to vice presidencies in defense industry (a highly pervasive situation) are loathe to bite the hand that could soon feed them. Thus, defense contractors tend to be coddled more than they would be by a civilian office. This lack of objectivity alone appears to be a major factor in costs of military procurement contracts.

Still another factor is the periodic rotation of military officers through the procurement system. Decisions are made by uniforms. Civilians may be respected but more often are merely tolerated in the decision process. Before the chickens come home to roost because of an arbitrary decision or poor management by a military officer, the military officer is gone, with glowing praise, to his next assignment. The civilian staff stays on, striving mightily "to make the damned thing work." Few civilians within the procurement commands have the temerity to stand up to a star or an eagle and say, "Sir, you are wrong," or "Sir, that is illegal," even when incontrovertible evidence has been marshaled to support such advice. . . .

The easiest way to reduce costs of military procurement and military staffing would be to set up a highly competent civilian acquisition agency serving all of the armed services and to put a major share of stars, eagles, and oak leaves into fully paid

semiretirement. . . . Eagles are fine for command of major operational bases or ships, and enough should be retained in active status to assure the highest proficiency of such commands, but an eagle has no reason to be sitting at a desk directing a procurement office.

Tom E. Moore
Springfield, Va.

An Expensive Toy?

I have just read your item on Tactical Air Command's evaluation of a simulator visual system in the "Aerospace World" column of your August 1984 issue *(p. 38)*. Your description of the system and its capabilities is reasonably accurate, but I take issue with your lead-in. I understand the need for attention-getting first sentences, but I believe you have missed the point entirely and have done us a disservice by calling the device a "video game."

The device is not a "video game" but represents a serious, very exciting advance in technology sorely needed by the tactical fighter training community. This technology takes our fighter simulators out of the traditional night, heads-down training role where very few of our warfighting skills are trainable. It now offers us the capability to train heads-up missions in the simulator—very important, since we fight heads-up with the aircraft.

Calling the device a "video game" only serves to confirm in the minds of military critics the belief that the Defense Department is squandering tax dollars on expensive toys. No fair!

Lt. Col. Maston E. O'Neal III, USAF
Director, Air Superiority Simulators
Eglin AFB, Fla.

• *The characterization "video game" is a quotation from one of the three contractor firms that developed the advanced simulator. We did not intend in printing it to disparage the capabilities of this system. In fact, the item goes on to describe the simulator as "the most advanced electronic system of its type in existence."*—THE EDITORS

Arnold's Vision

I was very pleased to see General Hap Arnold's direction to Dr. Theodore von Kármán reprinted in your August 1984 issue *(p. 71)*. General Arnold's vision of the future was elegant in its simplicity. Nearly forty years later, the USAF Scientific Advisory Board (SAB) is still complying with his basic direction.

AIRMAIL

The SAB evolved from the World War II Air Force Scientific Advisory Group that General Arnold formed on December 1, 1944, under the leadership of Professor von Kármán. The advisory group's report to General Arnold was a multivolume work entitled *Toward New Horizons*. It was an extraordinary attempt to predict the long-range influence of technology on the fledgling Air Force. The *New Horizons* report was used by the Air Force in developing its approach to R&D, and it proved to be a powerful influence. . . .

Composed of more than seventy outstanding civilian scientists and engineers who report directly to the Secretary of the Air Force and the Chief of Staff, today's Scientific Advisory Board provides an important link between the Air Force and the nation's scientific community. Communicating leading-edge scientific information to the Air Force leadership, the Board supports the Air Force mission in an unparalleled fashion.

Through specifically scoped studies, the SAB reviews and evaluates long-range plans for R&D, provides advice on Air Force programs, and recommends unusually promising scientific developments for Air Force emphasis and application. These studies may assess program organization and management, the adequacy of laboratory and testing facilities, technical and operational training programs, or current and projected policies relating to technical matters. Air Force relations with civilian research institutions and similar matters are also covered. Finally, the SAB serves as a pool of independent experts who may individually or collectively advise on various Air Force activities. . . .

Maj. Christopher Waln, USAF
Executive Secretary
USAF Scientific Advisory Board
Washington, D. C.

• *For more on Dr. Theodore von Kármán and the Scientific Advisory Group, see "Von Kármán's Singular Contributions to US Aerospace Power," by T. F. Walkowicz, May 1981 issue, p. 60.*—THE EDITORS

Gas and Go!

Your August 1984 AIR FORCE Magazine article on the T-46A was most informative and timely *(see "Primary Platform," p. 82)*. Upon review, I noticed an error and would like to clarify an otherwise excellent article.

The T-46A, powered by two Garrett F109-GA-100 powerplants, is not restricted to world airports where only JP-4 fuel is available. The F109 is designed to use multiple fuels, such as JP-4, Jet A1, Jet A, Jet B, JP-5, and JP-8, to name a few.

The US Air Force requirement for this multiple-fuel capability will further enhance the T-46A's usefulness to both the US and other world services.

Ronald L. Alto
Garrett Turbine Engine Co.
Phoenix, Ariz.

Bravery the Norm

After reading the article "Bank Shot" in the August 1984 issue of AIR FORCE Magazine describing Lt. Jim Fleming's act of bravery in Vietnam that led to the award of a Medal of Honor, I have this to say.

First, I don't want to detract anything from Colonel Fleming's brave actions—he deserves the award. But in World War II, conspicuous acts of bravery were the norm.

I flew fifty missions in a B-24 Liberator over the European theater of operations. I was with the 98th Bomb Group, one of the five groups that flew the first low-level bombing mission over the Ploesti oil fields in Romania on August 1, 1943. The 98th lost two-thirds of its planes over the exploding, blazing hell called Ploesti. It was so hot that the paint peeled off the Liberators.

My commanding officer, Col. John R. Kane, was awarded the Medal of Honor. His was one of five Medals of Honor handed out for this one engagement—more than for any other single military engagement in any war.

It is my firm belief that everyone who returned from that mission—and those who died on it—should have been awarded the Medal of Honor. But I suppose that if that had been done, the Medal would have lost its meaning.

Peter K. Snitzer
Ansonia, Conn.

• *For more on the Ploesti mission, see the article "Ploesti!" by Col. William R. Cameron, USAF (Ret.), August 1971 issue, p. 57.*—THE EDITORS

Straight for the Heart

Upon receiving my AIR FORCE Magazine each month, I always turn to the back to read Bob Stevens's "There I

Neither heat, nor EMI, nor massive Gs can keep fluidic controls and sensors from their appointed mission.

There's a definite limit to how far you can depend on certain types of sophisticated electronic sensing and control systems for operation in hostile environments.

But at Garrett's Pneumatic Systems Division, our low-cost fluidic sensors and controls—operating with a wide variety of gaseous and liquid media—are performing with high reliability in even the most demanding operational environments.

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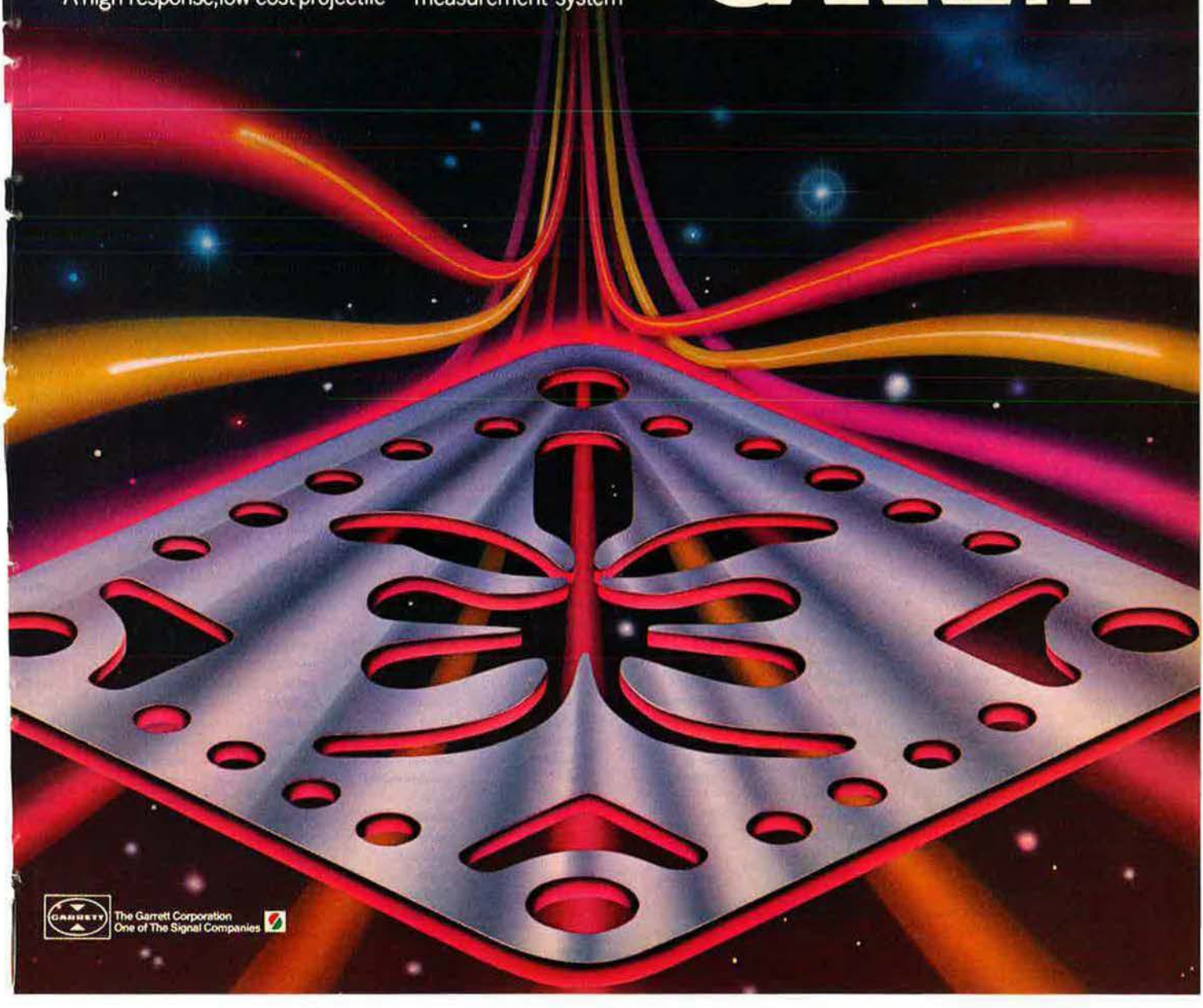
- And coming soon: A low-cost, lightweight back-up control system for fly-by-wire aircraft.

If conventional control and sensing systems could keep you from your appointed mission, contact: Advanced System Sales, Garrett Pneumatic Systems Division, P.O. Box 5217, Phoenix, AZ 85010. Or call: (602) 231-3805.

GARRETT



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Anyone could have used these 4,178 words. In the hands of William Shakespeare, they became *King Lear.*

All the writers of his day had the same elements to work with — the same words to form the same language. But Shakespeare's real talent was his ability to choose from all these elements combining them with one another flawlessly — in a unique organization of words.

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And, for the Air Force's Global Positioning System, our role will help usher in a new era of precision navigation.

Each of these is a prime example of a unique challenge met by a mastery of complex systems. We start with many individual elements, as separate as the words of Elizabethan English. And make them act as one. It isn't easy. But the more complex the task, the more we manage to make it happen.

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Was. . . ." The August 1984 issue entry is going to be long remembered in my home. Mr. Stevens's words aim straight for the heart. Those two words, "Thanks, buddy," are the most appropriate for what those men did.

I take my hat off to those men, and to you, too, Mr. Stevens.

S. G. Driscoll
Broomfield, Colo.

Riding the Keystones

Jon Donnelly's article "Last of the Keystones" in the July 1984 issue of AIR FORCE Magazine brought to mind Kelly Field in 1929–30 and my many rides in the early models of the twin-engine bomber. These rides, in the minds of a few of the faculty here at Florida State, gained me a false reputation of being a "teller of tall tales."

On several occasions, as a passenger back in the fuselage, I would remove my chute after we reached altitude and climb out through the circular Scarff ring (where the machine guns were mounted when required for combat operations). There I would ride sitting on top of the fuselage, facing forward, with my legs dangling down through the ring. At the usual cruising speed, which was no faster than my Durant roadster would go with top down and windshield flat, the ride was comfortable and not particularly dangerous.

When the pilot in the open cockpit up ahead decided to bank, you could watch him turn the wheel. The ailerons would move accordingly, and several seconds later the wing would move downward. At the speeds of that day—probably sixty or seventy mph—nothing happened very fast.

On the return trip to Tallahassee from a professional meeting several years ago, I passed on this experience to a group of my fellow faculty members. I acquired an instant stigma that was attached to my name, but my story was, and is, true—so help me!

Col. Charles Perkins,
USAF (Ret.)
Tallahassee, Fla.

Sermon from a "Peacenik"

Thank you for the wonderful editorial in the June 1984 issue of AIR FORCE Magazine, "Capability × Will = Deterrence." It is a theme that we do not stress enough, particularly the "will" portion of the formula. We talk too much about "peace" and forget the other ingredient, "freedom." Peace without freedom is an empty concept, one fraught with suffering for oppressed people who have peace but who have lost their freedom.

Your editorial brings home to our citizens their responsibility to understand why the freedom they enjoy exists. I look at demonstrators shouting for peace when, in fact, they have it. They conveniently forget that it is freedom that permits them to demonstrate.

Economic strength does not deter; military strength does. Our people must understand that military people are the biggest peaceniks in the world; we *do not* want war. But we have made a personal commitment to freedom. We are committed to die for freedom and thus guarantee peace with freedom. We perhaps should ask all of our citizens if they have made their personal commitment to freedom.

Forgive my "sermon," but your editorial hit my red, white, and blue chords. Thanks for your insight to a stronger US.

Gen. Charles L. Donnelly, Jr.,
USAF
Ramstein AB, Germany

• *For a profile of General Donnelly, see p. 83 of this issue.*—THE EDITORS

AIRMAIL

Looking for . . .

My uncle, 2d Lt. Kenneth Roehr of Plymouth, Wis., a B-17 copilot, was killed in action during a bombing mission over Hamburg, Germany, on June 20, 1944. There were three survivors from his flight crew: Lt. Clifford Evans, Sgt. Roger Beaman, and Sgt. Theo. Schmidt.

I am seeking any additional information about my uncle—where stationed, unit, number of missions, particulars about his final mission, etc. I will gladly correspond with anyone who knew my uncle and who can provide any information about him.

Jim Roehr
5460 Walker Rd.
Cheyenne, Wyo. 82009

I have a faded eight-by-ten photo of a B-17 crew that I would like to pass on to any of the crew. On the back of the photo are the following notations:

"B-17 Flying Fortress 'Old Crew 14.' First Pilot: Lt. Ken P. Dolan. Copilot: Lt. K. E. Lamer. Navigator: Lt. John Murphy. Bombardier: Lt. Charles Cooper. Ball Turret: Cpl. Oscar 'Shorty' Deman. Engineer: Sgt. Jack Marks. Tail Gunner: Cpl. Dave Nicolette. Radio Operator: Cpl. Dick Covert. Armorer-Gunner: Sgt. Larry Maxim."

Please contact me at the address below.

Milton Sheppard
670 Concord Rd.
Glen Mills, Pa. 19342

I would like to hear from anyone who knew John R. (Jack) Robinson, flight engineer on a B-29 of the Twentieth Air Force, 39th or 330th Bomb Group (I'm not sure which), 314th Bomb Wing, flying out of North Field on Guam. The pilot of his crew was named Alterman, but other crew members' names are not known. His aircraft crashed on May 11, 1945.

Anyone with a unit history or personal knowledge of their last flight should please contact me at the address below.

Paul C. Steffy
5892 Estelle St.
San Diego, Calif. 92115
Phone: (619) 582-0303

I am trying to complete a hobby collection.

Anyone who has pictures and information on the 352d Fighter Group's 486th Squadron aces—Ernest O. Bostrom, Willie O. Jackson, Earl Lazear, Jr., and Henry J. Miklajcyk—please contact me at the address below.

Dwayne M. Tabatt
5930 North "A" St.
Spokane, Wash. 99205
Phone: (1-509) 325-3395

I am trying to locate any of the following persons who were assigned to Materials/Procurement and who were attached to or through the 862d Supply Squadron at Minot AFB, N. D., between August 1968 and December 1970.

They are: Lt. Col. Renaldo Trapani, 2d Lt. Victor Jashinski, Sergeant Richardson, TSgt. Carl E. Burke, SSgt. Tony Grandys, Sgt. Douglas I. Ingram, Sgt. Ray Fimbres, and Donald Helgeson.

If they or anyone connected with them or their families could let me know of their whereabouts, it would be greatly appreciated.

Jon B. Fish
ASPC/Advanced Technology
Building 2019
P. O. Box 15699C M/S 9
Sacramento, Calif. 95813

I am trying to locate anyone with information on my uncle, John Frances Campbell. He was with the Eighth Air Force, 94th Bomb Wing, 401st Bomb Group, 613th Bomb Squadron, and was shot down on April 13, 1944, in a B-17G named *Command Performance II*. He was

Video Value

VALUE-PACKED JVC VIDEO CAMERAS

KY-310. Fourth generation KY camera with high-resolution prism optics, ultra-sensitive Saticon* tubes, 57 dB S/N ratio.

KY-1900. Low-cost, light-weight, 3-tube color camera.

VALUE-PACKED JVC 3/4"-U-FORMAT PRODUCTS

CR-8250U TapeHandler.™ Professional video cassette editing recorder with time code head for SMPTE PRECISION EDITING.

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CR-6060U RECORDER/PLAYER. High performance recording capability at an amazingly reasonable price.

CP-5200U PLAYER. High quality, extremely durable player with still frame.

CP-5000U PLAYER. Rugged, low-cost industrial player with auto repeat, two audio channels.

CR-4700U PORTABLE RECORDER/PLAYER. Professional Recorder with VideoConfidence Heads, SMPTE time code capability.

VE-92 AUTOMATIC EDITING CONTROLLER. Joystick Control, keypad entry, fade in/fade out capability, time code generator, time code readers.

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BP-5100U PLAYER. Low-cost, full function player with remote control, 3 playback speeds, 7X search, freeze frame.

BP-5300U PLAYER. Professional player with front tape load/eject, microprocessor controls, Dolby* noise reduction.

BR-7110U RECORDER/PLAYER. Low-cost, dependable recorder with four motors and heads, remote control.

BR-6400U RECORDER/PLAYER. Professional recorder with front tape load/eject, automatic assemble edit function.

BR-6400TR TRI-STANDARD RECORDER/PLAYER. Record capability in PAL or SECAM standards, playback in PAL, SECAM, NTSC 4.43 MHz.

BR-6200U PORTABLE RECORDER/PLAYER. Professional recorder with 6-hr. record, dual audio, automatic assemble edit function.

BR-8600U EDITING RECORDER. Front-loading recorder for professional, glitch-free assemble and insert edits, in stand-alone or system configuration.

RM-86U EDITING CONTROLLER. Compatible with both 3/4-in. and VHS recorders. Microprocessor-based.

HR-C3U VHS C COMPACT RECORDER. 4.4 lb. recorder/player, fits in attache case, ideal for presentations, training.

THR-63U PRESENTATION PACKAGE. HR-C3U VHS C video player and TM-63U 5 inch monitor in custom attache.

VALUE-PACKED JVC VIDEO MONITORS

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GENERAL DYNAMICS

subsequently interned in Luftstalag I.

Any information would be greatly appreciated. Please contact me at the address below.

Gary J. Martinez
Rte. 11, Box 212
Petersburg, Va. 23803

I would like to contact anyone who flew F-104s out of Webb AFB in Texas. My father was in one of the squadrons there, but I don't know which one. I have lots of questions to ask about the F-104.

Please contact me at the address below.

Eric I. Vance
V3 Div., USS *Belleau Wood*
FPO San Francisco 96623

I am looking for an old fellow Air Force pilot from Strother Field, Kan. His name is James Pospisil.

Please contact me at the address below.

Joe Popplewell
404 Wallace Ave.
Leitchfield, Ky. 42754
Phone: (502) 259-4110

I am trying to locate Maj. Richard Hardy, whose last known duty station was with the 82d Flying Training Squadron, Williams AFB, Ariz., in 1977.

Please contact me at the address below.

Lt. Col. Howard W. Shook, USAF (Ret.)
9072 Meadowdale Way
Elk Grove, Calif. 95624

Collectors' Corner

I am a member of the United States Air Force. In my various worldwide assignments, I have been associated with several Scouting programs. In each of my new assignments, I have been able to add new patches to my collection of Boy Scout patches that mention Air Force bases (there are numerous ones out there because of the Air Force's extensive involvement with the Scouts).

It is obvious that I will not be assigned to all of our Air Force bases, so I'm asking for help with my collection. I would like to hear from those Air Force Scouters out there who may have patches to trade that will fit in my collection.

I can be reached at the address below.

Maj. James F. McEvoy, USAF
211 Alder Dr.
Pittsburgh, Pa. 15202

I am hoping that other AFA members can help me to obtain POW/MIA bracelets of the 1960s and 1970s for a display I am putting together. This display will honor both those who came home and those who didn't. The collection will be put on display at Norton AFB, Calif., when it is completed.

Surprisingly, of the thousands and thousands made, I have only been able to obtain twenty-five such bracelets. I need several hundred to present the display properly.

Any help would be deeply appreciated.

Leon D. Humiston, Jr.
27776 Arta
Mission Viejo, Calif. 92692

I would like some help starting a military patch collection. I don't have any to trade, but I would like people to send me any extra patches they may have.

I am especially hoping to receive several patches from bases that I've been stationed at or visited—Greater Pittsburgh IAP, Dover AFB, and Langley AFB.

Please contact me at the address below.

Larry D. French
5895 Wickham Ave.
Newport News, Va. 23605

For several years, I have been an avid reader of AIR FORCE Magazine, a historian of postwar US military aviation, and a collector of aircraft slides. I would appreciate hearing from anyone who could spare or sell any pre-1975 slides of USAF aircraft, as well as any showing US Navy, NASA, or British types.

Of particular interest are the XB-70, X-15/NB-52, other X-planes, shots from Southeast Asia, and photographs of aircraft types no longer in service.

Terry Panopalis
6 Place Grieg
Candiac, Quebec J5R 3X4
Canada

I am a collector of buttons, badges, lapel pins, etc. I was hoping that readers would be willing to send me some of the pins and patches that are worn by Air Force pilots.

Please send any donations to the address below.

David Leonhardt
4927 St. Gabriel St.
Pierrefonds, Quebec H8Y 1Z7
Canada

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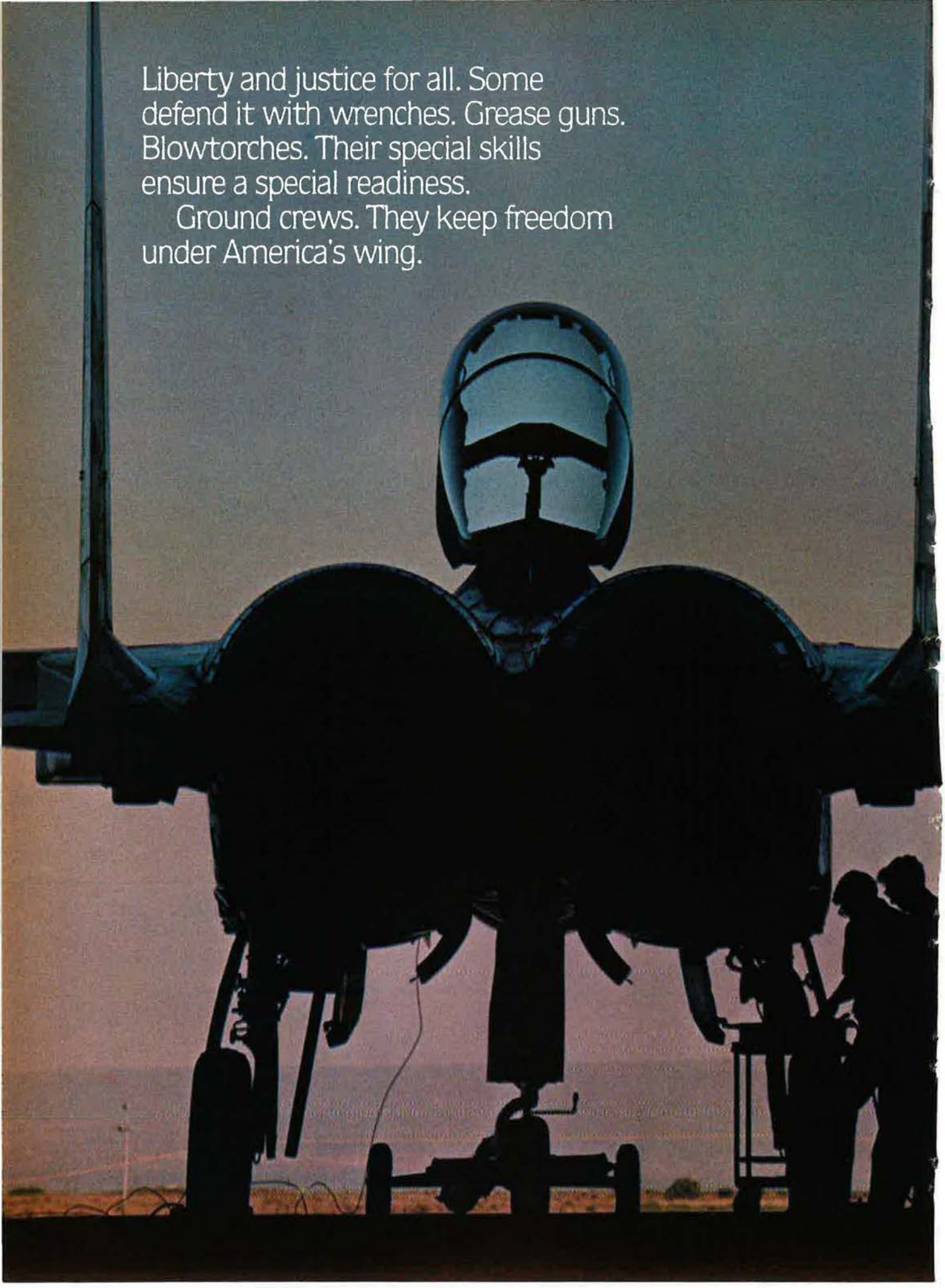
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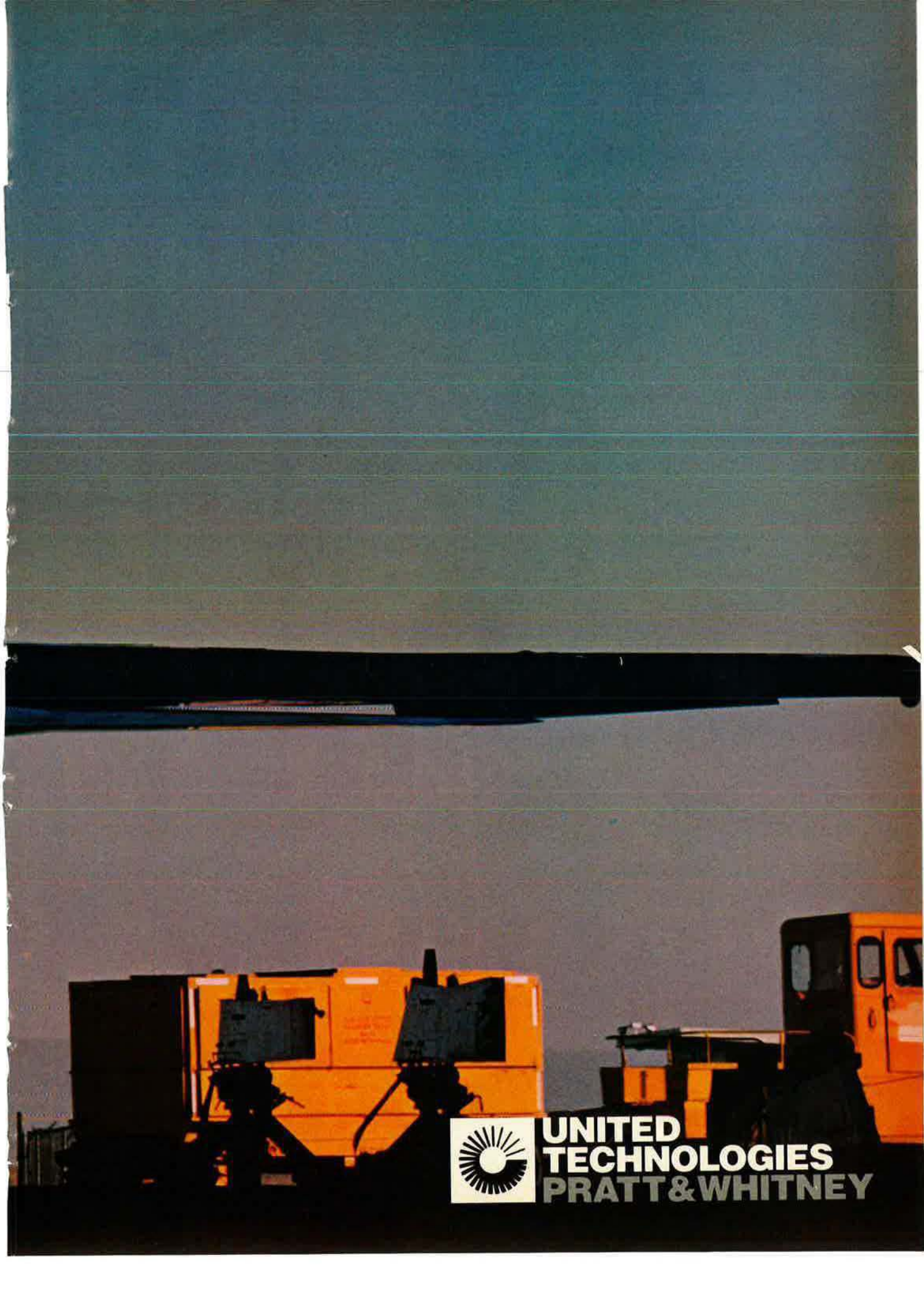
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GRUMMAN

IN FOCUS...

Disquiet for the Silent Service

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

The vaunted invulnerability and across-the-board superiority of the US submarine fleet is facing major challenges from the Soviet Union.

Washington, D. C., Sept. 4

The traditional quiescence of the underwater world is now being roiled by disquieting developments suggesting that the vaunted invulnerability and across-the-board superiority of the US submarine fleet is facing major challenges from its Soviet counterpart. A just completed comprehensive analysis juxtaposing the status and prospects of US and Soviet submarine-related technologies has led to considerable congressional concern about burgeoning Soviet submarine production and R&D efforts.

At least in a statistical sense, the evidence is alarming. Between 1964 and 1984, the Soviets built fifteen new classes of submarines involving a total of 180 boats. The US produced five new classes of submarines involving the launch of eighty-five units over the same period. Maximum speed on the Soviet side went from twenty-eight knots to forty-two knots while the force average went up from sixteen knots to twenty-four knots. On the US side, maximum speed went from thirty knots to thirty-two knots while the force average increased from eighteen knots to twenty-six knots.

The rationale underlying Soviet emphasis on speed hinges on the perceived need for rapid deployment to combat areas to carry out quickly the target search and attack phases of an operation. Speed is seen as useful by Soviet doctrine in avoiding enemy weapons and in "after-salvo maneuvering," meaning clearing out from an area before the enemy can respond and deliver his weapons. In the case of ballistic missile submarines, Soviet doctrine equates high submerged speed—augmented by low detectability—with increased survivability.

The US Defense Support Program (DSP) early warning satellites can locate the launch position of the submerged SSBN almost the moment the first SLBM is launched. Detection of the launching Soviet sub would presumably cause an instant US response—SLBM or ICBM launches, or both—against such a platform, which, because of the number of missiles it carries, presents a lucrative target. Since submarines are "soft," especially when submerged, they can be easily destroyed once located. Because it would take the US just a few minutes—probably a maximum of twenty minutes in the case of ICBMs—to return the fire, a submarine that has not cleared the area by several miles would be crushed by the overpressure generated by even a relatively low-yield warhead.

A "quiet" escape from the compromised launch area seems to make no sense to Soviet doctrine. Because SLBMs, ICBMs, and even intermediate-range ballistic missiles (IRBMs) are becoming formidable antisubmarine warfare (ASW) weapons when integrated with spaceborne remote ocean sensors, the Soviets have seemingly scuttled the concept that slow to moderate escape speeds are adequate for SSBNs.

In terms of diving capability—another critically important performance aspect of submarines—the Soviets went from a maximum depth of about 1,000 feet in 1964 to about 3,000 feet at present. While maximum depth of US submarines is classified, it is known not to have increased significantly over the past twenty years and to be markedly below current Soviet levels. Soviet emphasis on deep-diving capabilities is apparently impelled by the notion that the survival chances of combat-damaged submarines increase if they are able to remain on the bottom in deep water. Soviet submarine doctrine holds further that deep-diving submarines can maneuver easily in a vertical plane to increase their offensive capabilities.

Over the past twenty years, development by the Soviets of weapons associated with submarines has outstripped the US effort by a wide margin. The Soviets produced four new cruise-missile types and seven new ballistic missile types, including the SN-X-23, which is a new, liquid-propelled SLBM of unprecedented capability. In addition to the sea-launched cruise missiles in operation, the Soviets will soon deploy a new family of large cruise missiles—about thirty-six feet in length—with a range well above 3,000 kilometers.

In the area of hull materials, the Soviet Union has progressed from the high-yield strength steels that both countries started to use in the 1950s to titanium, thereby enabling their new subs to dive to great depths or to withstand weapon effects at shallower depths better. The US continues to use traditional HY-80 steel hulls.

Also, modern Soviet submarine hulls are reportedly coated with compliant coverings to reduce drag, as are sail, control surface, and other areas. Modeled after the mechanical characteristics of such marine animals as dolphins, this bionic approach has led to the design of coatings that incorporate suction and boundary-layer pressure equalization. Apparently, all subs built since 1965 for the Soviet Navy's own use are coated. The US has not progressed beyond research and development in the application of hull coverings.

In the area of sensors, the Soviet submarines employ links with satellites, wake homing of weapons, and possibly some acoustic towed arrays. The missile-carrying subs are linked to ocean surveillance satellites, such as the Radar Ocean Reconnaissance Satellite (RORS) and the ELINT Ocean Reconnaissance Satellite (EORS). These satellites can provide almost real-time detection and possibly some weapon-guidance capabili-

ty for Soviet missile-equipped submarines. Apparently, these subs can transmit their position covertly to the satellite. The spacecraft, in turn, provides the sub with information to attack distant mobile targets.

Far and away the most disparate approaches between the US and the Soviet Union in submarine technology revolve around "Stealth" and signature suppression. The bulk of all known US efforts centers on acoustic quieting of submarines. The Soviets, on the other hand, have focused most of their efforts on the development of remote, nonacoustic sensors aimed at detecting hydrodynamic, thermal, and electromagnetic signatures monitored from space or airborne platforms.

Among these concepts known to be under study by the Soviets are boundary layer control, which reduces the total power required to achieve a given speed, and direct-drive (meaning no reduction gears) superconducting electrical machinery (SEM) engines that reduce demands on internal volume. Other technologies of this type that Soviet submarine designers claim to be working on successfully include automatic degaussing (demagnetizing); antisonar coatings; natural-circulation and MHD-driven, liquid-metal-cooled reactors (MHD, for magnetohydrodynamics, is a sophisticated technology for translating energy into power); water-pump propulsors; and nonmagnetic materials.

IN FOCUS...

Most of these approaches touted by the Soviets don't entail increases in volume and, therefore, don't lead to increases in other signatures, such as broadband flow noise, wake, and magnetic dipole. If these Soviet concepts of low-frequency, acoustic, and other quieting techniques could be translated over time into operational reality, the payoffs could be major not only in lower detectability but also in overall combat capability.

Soviet naval experts evince rapidly increasing interest in the systematic study and exploitation of wakes of submarines and surface ships *(see also "In Focus," p. 29, September '84 issue)*. Both US and Soviet maritime experts now acknowledge that the wake behind contemporary vessels traveling at even moderate speeds remains coherent for a long time.

The "pictures" from spaceborne synthetic aperture radars show that surface ships' wakes extending over tens of kilometers can be identified and exploited with current sensor and processing technologies. Remote radars now in operation in the West probably can't detect the submerged turbulent wake caused by submarines. There is little doubt, however, that other submarines, surface ships, and homing torpedoes can detect and exploit these underwater track marks. Also, seawater is a conductor within the magnetic field of the earth, with the result that the motion of the wake can be of sufficient force to produce a detectable magnetic anomaly. Moreover, this anomaly may be easier to exploit than that generated by the metallic mass of the hull because of the relative extent of the wake.

The trail left behind submerged submarines also includes vortices produced by their control surfaces, especially those that can provide lift. Under certain circumstances, the vortices can be detected at the surface by air- or spaceborne sensors.

Lastly, when subs move through ocean areas characterized by density

variations, the displacement of fluid over the hull generates an internal gravity wave whose intensity is determined in part by the length and diameter of the hull. While the intensity of the vortices induced by the control surfaces can be moderated by slowing the submarine, the internal gravity wave is not affected appreciably by speed changes.

There is, however, a way to curtail gravity-wave generation dramatically through the use of so-called flow-through propulsors. The Soviets appear to be in hot pursuit of this technique, which involves drawing water into the bow of the ship, through the ship, and out the stern, thereby reducing both the displacement of the fluid over the submarine and the internal gravity wave. The Soviets appear to be exploring MHD ramjets for flow-through propulsion and suggest in their technical literature that submarines using the "inner mantle" as well as the "outer mantle" for propulsion will be more efficient than contemporary designs.

While US experts don't know how soon the Soviets might field such systems, they see evidence that submarines using these technologies, combined with boundary layer control, will minimize wakes, broadband noise, and internal gravity waves. These criteria will take on an added importance as wake-homing torpedoes and other wake-detecting weapons mature. The fact that the traditional US approach to sound-quieting does not help in reducing wake size and vortex generation suggests the need to pursue technologies that do.

Yet another major phenomenology that contributes potentially to the detectability of submarines involves their electromagnetic signatures. Subs generally create magnetic and electrical fields of sufficient force so that, in theory at least, the fields could be detected either directly or through their interaction with natural magnetic fields. The ferrous mass of contemporary submarines—except for the Soviet titanium-hull designs—tends to cause measurable local changes in the earth's magnetic field. There is also interaction between the sea waves and internal gravity waves and the geomagnetic field that creates electric currents in the seawater. These currents, in turn, create variable electric fields that can be measured.

Among the most innovative Soviet submarine approaches coming to light in new designs are applications of bionic lessons. These approaches appear to result from close work by Soviet submarine designers with ichthyologists. The payoffs include techniques that resemble the variable-geometry schemes under development for future combat aircraft.

Soviet researchers, for instance, say they learned a critically important lesson about "hydroelastic effects" from the killer whale's dorsal fin. That lesson is being incorporated into their new subs. The basic idea is to modify the shapes of the sub and of its appendages, such as the sailplanes, in phase with the speed that the ship is traveling. Simply by moving the sailplanes to the hull and making them fully retractable, Soviet designers were reportedly able to reduce drag on attack subs by somewhere between five and ten percent.

The stakes in the present race toward new submarine technologies are obviously enormous. Should a breakthrough in open-ocean antisubmarine warfare (ASW) occur that exploits such nonacoustic signatures as hydrodynamic wakes, the US could quickly lose the qualitative advantage its submarines have enjoyed over a numerically superior opponent.

The very murkiness that shrouds questions about submarine vulner-

ability may contribute to the problems facing the silent service. As Dr. Edward Teller warned several years ago at a National Academy of Sciences-sponsored symposium on naval challenges:

"The whole science and technology of the detectability of submarines is perhaps a deeper secret than any other branch of military technology. In this case, too, secrecy has worked to our disadvantage. Not only has it impeded genuine scientific and technical progress, it may result in an illusion of security after security may, in fact, have been lost."

Space-Based Radar Planning

Even though the Soviets have had nuclear-powered radar satellites in operation for years, chronic turf disputes and divergent definitions of requirements within the national security community have kept the US, so far, from any substantive agreement on the development and deployment of military radar satellites. Past roadblocks to agreements have included disputes between the Air Force and the Navy over requirements and between the uniformed services and senior civilian government officials over specific technical approaches. The civilian constituency, in the main, favored near-term solutions that were useful for arms-control verification and intelligence functions in peacetime but that lacked the robustness required for operational military systems.

Two important developments during the past summer justify hope that the impasse is being overcome. On the one hand, the preponderant preference is now for an approach employing phased-array rather than reflector technology. At the same time, Air Force Under Secretary E. C. Aldridge, Jr., acting in his capacity as Director of the Defense Support Project Office, formally notified the Secretaries of the Navy and the Air Force on July 10, 1984, of an interim management approach to the Space-Based Radar/Infrared (SBR/IR) Joint Development Program. Justifying his decision as essential to ensure that this program be carried forward and that "an organizational framework be established [for providing] concept development and systems planning," he urged immediate implementation to "preclude additional budget cuts by Congress."

The Defense Support Project Office (DSPO) will act in stopgap fashion as the joint program office for SBR/IR "until a longer-term agreement is reached between the Navy and the Air Force. During this interim period, the DSPO will provide funding and budget justification."

IN FOCUS...

In his capacity as DSPO Director, Secretary Aldridge requested the Navy to "support the DSPO's joint program office by providing assistance in such areas as developing overall SBR/IR system requirements derived from the JCS [Joint Chiefs of Staff] operational requirements, SBR/IR operational concepts, system concepts, and interface requirements with other wide-area surveillance sensors and other dedicated surveillance systems and user commands." The task assigned the Air Force includes support of the joint program office by "providing technical assistance in such areas as system engineering, spacecraft technology, development planning, SBR/IR performance tradeoffs, and requirements for associated ground-support systems."

Requesting the two services also to assign qualified personnel to the Space-Based Radar/Infrared Joint Development Program Office, Secretary Aldridge promised that the Defense Support Project Office will continue to work with the Navy and the Air Force to reach an agreement on a permanent management scheme for SBR/IR.

The advanced-technology approach to space-based radar satellites that seemingly received the nod recently by the scientific community centers on innovative transmit and receive (TR) modules. These devices open the door to a new generation of synthetic aperture radars.

The underlying concept is to generate the radar signal right at the face of the antenna, divide it up between many thousands of small elements, and distribute it across the array. Between 50,000 and 90,000 of these tiny radar units would be arrayed over an area some thirty meters in diameter.

For the moment, there is one fundamental problem with these modules: They are prohibitively expensive. Both Raytheon and GE have produced working examples of the TR modules and, in concert with the Defense Advanced Research Projects Agency (DARPA) and the services, are exploring ways to mass-produce them at reasonable cost.

Two other technological hurdles need to be cleared before high-performance radars of the type envisioned by both the US Navy and the Air Force can be pursued in earnest. For one, a new type of advanced onboard signal processor that can function reliably in a severe nuclear war environment has to be developed. Progress is being made toward such a device using "survivable" gallium-arsenide circuitry. However, considerably more work needs to be completed before such an onboard computer can become a hardware reality.

Also, a space-based radar system will require a lightweight, highly efficient, onboard power and power distribution system. Major efforts on such power and power distribution systems are being carried out by the new Strategic Defense Initiative organization.

A recent review of the status of the SBR/IR project by the Defense Department's all-powerful Defense Resources Board (DRB) reportedly came up with extremely rosy conclusions that might open the door to sharply accelerated technology efforts carried out on a concurrent basis. The DRB recommended that the Navy be put in charge of the joint program as DoD's executive agent.

Washington Observations

★ A new Pentagon body, the Joint Requirements Management System headed by the Vice Chiefs of Staff of the services, is revisiting the congeries of technologies and options variously known as Counter-Air '90, Assault Breaker follow-on, or, in Europe, as the "emerging technologies." The new JRMS organization is to come up with a detailed road map by October 15, 1984, on how a revised Counter-Air '90 program should be structured and carried out. The program has been stymied in the past because of divergent views by the services, conflicting recommendations by supporters of high-tech approaches, and concern among field commanders about the reliability of sophisticated and intertwined systems on the battlefield.

★ Evidence of Soviet work on antitactical ballistic missile systems meant to intercept the US Army's new Pershing II theater weapon is giving rise to thoughts of a US response in kind. The idea is to come up with ballistic missile defenses capable of intercepting the Soviet SS-20 and other intermediate-range ballistic missiles. There are indications that, on the basis of recent mission alignments between the Army and USAF, the latter might be given the task of developing and fielding such a weapon. ■

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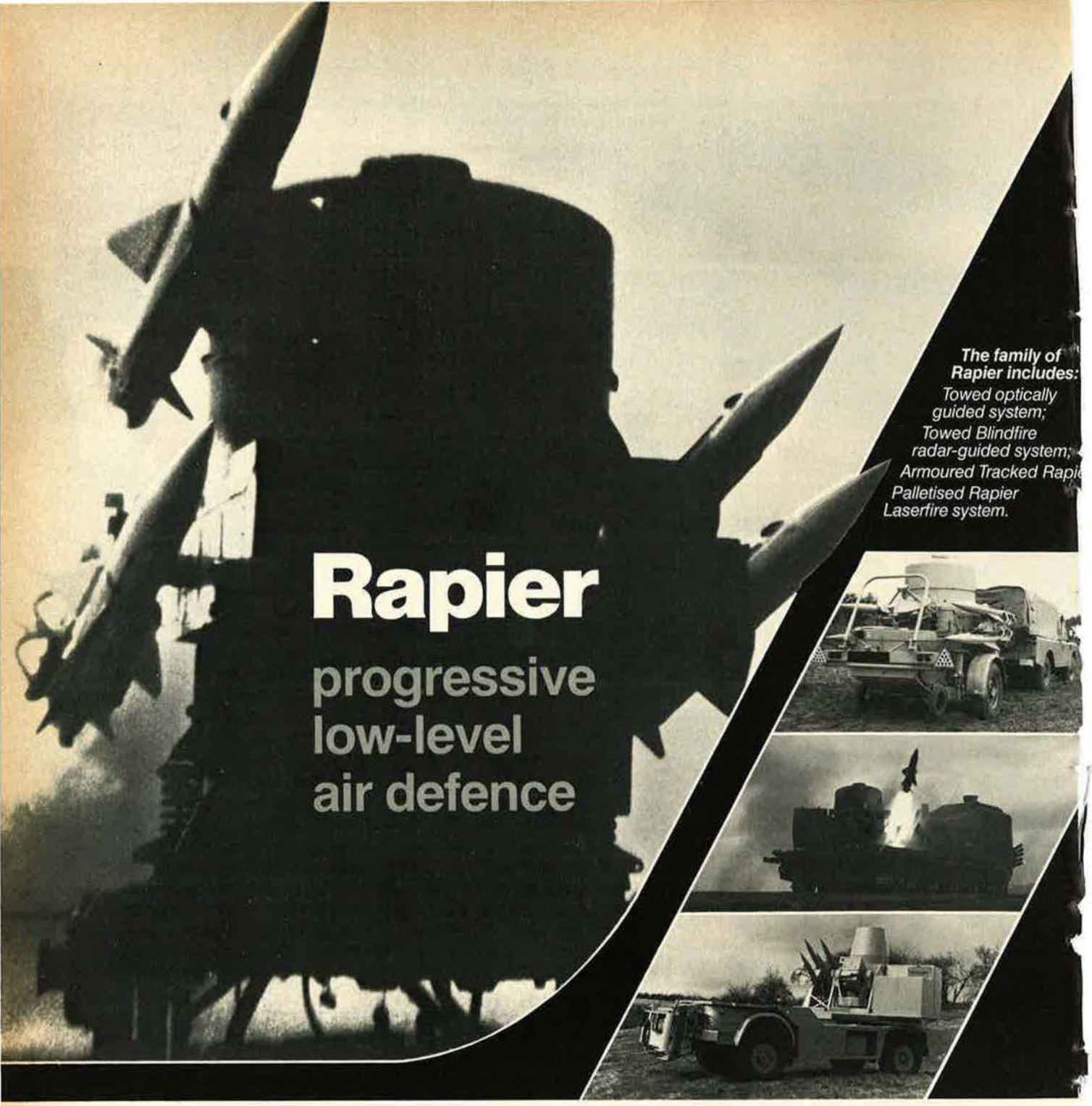

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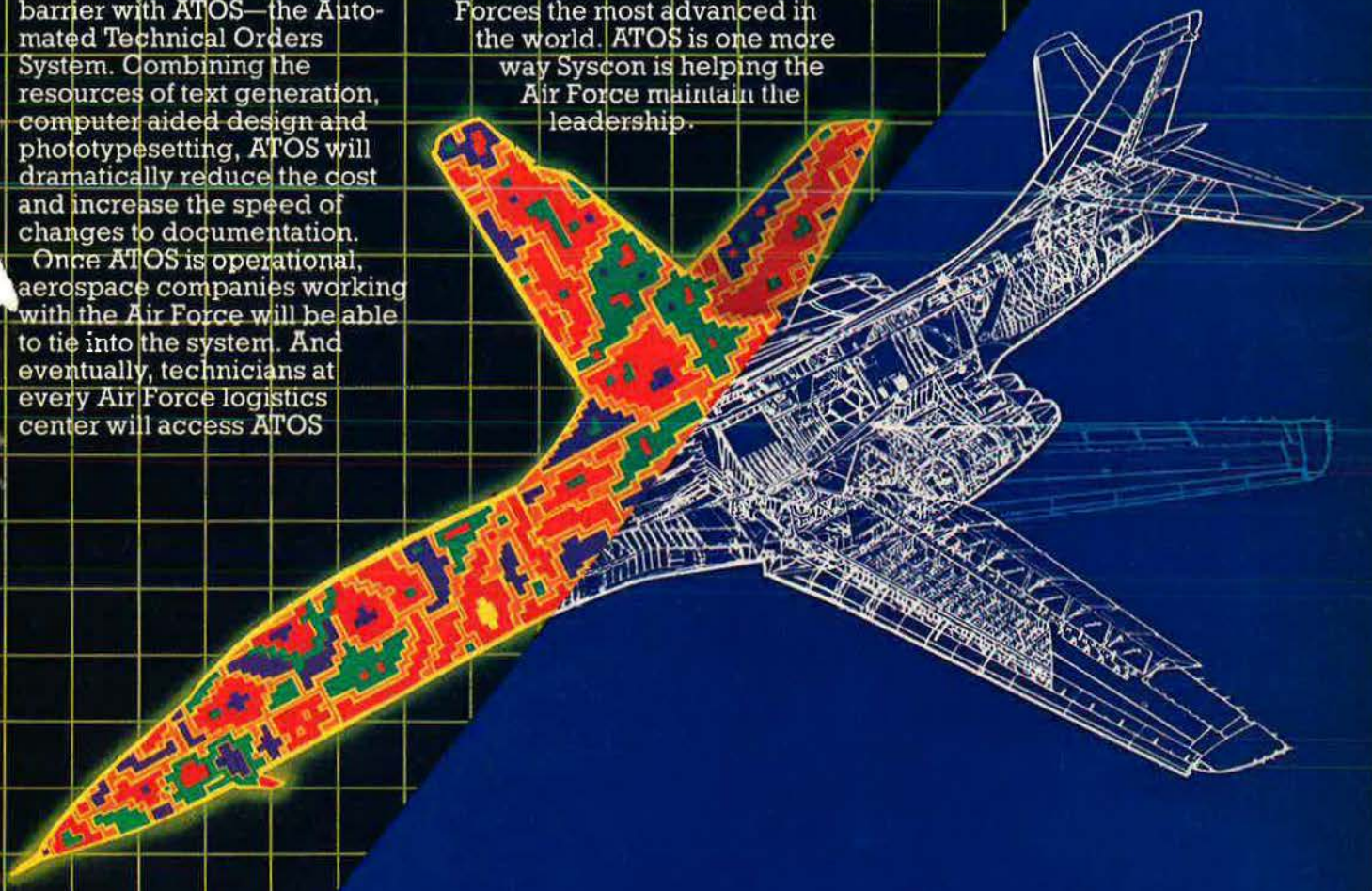

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CAPITOL HILL

By Kathleen G. McAuliffe, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Aug. 24

Defense Appropriations

The Senate Appropriations defense subcommittee has recommended a $283 billion FY '85 defense bill despite failure of the budget and authorization conferees to reach agreement on defense spending. The recommendation is in line with the Administration's so-called Rose Garden agreement allotting $299 billion for all defense, including funds for military construction and Department of Energy nuclear-weapons activities.

There were no attempts in the subcommittee—because of a lack of votes—to cut MX. When the bill is considered by the full committee, however, Sen. Lawton Chiles (D-Fla.) may offer an amendment prohibiting MX production in FY '85 and banning deployment of those missiles produced in FY '84. The plan would keep the production line open, however. Senator Chiles believes this plan would take MX out of election-year politics and allow more time for arms-control negotiations to progress. Opponents believe it would kill MX for all time. Congressional pundits predict the committee will not take up the bill until the Administration and Sen. Ted Stevens (R-Alaska), subcommittee chairman, are certain they have a majority supporting MX.

The bill may be used as the basis for a Continuing Resolution, at least the Senate version, if, as is expected, Congress fails to adopt an FY '85 Defense Department Appropriations measure by October 1.

NATO Spending Concerns

Congress again put the NATO allies on notice that they must assume a larger share of the common defense burden or risk "ever-increasing pressures to bring US forces home." The warning came as part of the conference report on a $9.1 billion military construction bill adopted by both houses.

The new pressure by Congress comes on the heels of a defeat, by a 55–41 margin, of a plan by Sen. Sam Nunn (D-Ga.) to force the allies to increase their conventional defense capabilities or face a phased reduction of US troops in Europe.

According to a DoD report to Congress detailing US expenditures for NATO, more than thirty percent of the defense budget, or about $90 billion, goes to support NATO. These expenditures cover US forces deployed in Europe and those troops that would be the first reinforcements in a conflict. The figure rises to $177 billion if one takes into account the cost of all US forces pledged to contribute to NATO reinforcement over the course of a conflict.

The DoD data added to frustrations in Congress over the allies' failure to keep their commitment to increase defense spending levels annually by three percent in real terms and to acquire a thirty-day supply of conventional munitions. DoD estimates that the average allied defense increase in FY '83 was about two percent and will be no greater than 1.7 percent in FY '84. US stocks of conventional munitions in Europe are well above the thirty-day goal. The US plans to spend $52 billion on munitions for NATO over the next five years to increase sustainability levels further. None of the allies has reached the munitions supply goal.

Spending Impasse

The impasse over budget levels for defense in FY '85 may be broken by a summit of key congressional leaders in September. Sen. Lawton Chiles, senior Democrat on the Budget Committee, proposed the meeting of House and Senate leaders and chairmen of the Budget and Armed Services Committees and the defense subcommittees.

They will try to resolve the differences between the $292 billion defense budget passed by the Democratic-controlled House and the $299 billion budget adopted by the GOP-led Senate. A likely outcome is about $296 billion, representing five percent real growth in FY '85.

Senate Republicans have been adamant about sticking to the $299 billion level. They fear that, as in the past, agreement to cut defense in the budget resolution will lead to even further reductions in the authorization and appropriations bills.

As some in Congress continue to balk at the Administration's defense spending levels, presumably because of high deficits, the Congressional Budget Office (CBO) and the Office of Management and Budget (OMB) reported lower deficit levels in revised mid-year economic projections. CBO claims the deficit will be $178 billion in FY '85, not $189 billion as earlier projected, while OMB pegs the deficit at $167 billion. Similar reductions are projected for the outyears.

Controlling Spares Costs

The Senate approved a series of proposals designed to improve the way in which DoD buys spare parts and to keep costs down. The provisions were added to a bill seeking to open further all government procurement to small firms. DoD accounts for more than eighty percent of all government purchases of goods and services.

The provisions, sponsored by Sen. Carl Levin (D-Mich.), require that a contractor charge the government the lowest commercial price for any item that is also sold commercially. Also, prime contractors are prohibited from adding overhead costs to parts obtained through a subcontractor when little or no value is added to the parts. Spares are to be bought in economic quantities, and procurement regulations are to be published. Other measures to keep defense procurement costs under control include creation of an Office of Competition Advocate General in DoD, establishment of a minimum four-year tour of duty for certain program managers, and requirement for the Pentagon to expand computer capabilities to provide detailed spare-parts procurement data.

The provisions were included in the defense authorization now deadlocked in conference. Adding them to the small-business bill ensures their enactment into law if no agreement is reached on the authorization. ■

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AEROSPACE WORLD
News, Views & Comments

Washington, D. C., Sept. 4

★ Featuring several innovations that may be incorporated in USAF's Advanced Tactical Fighter (ATF), the advanced-technology, forward-swept-wing X-29 aircraft made its debut on August 27 at Grumman Corp.'s Calverton, N. Y., facility.

The well-attended X-29 rollout ceremony was characterized by expressions of pride in US aeronautical achievement and of confidence that the nation is once again "willing to take major risks" in developing experimental aircraft.

Those were the words of Dr. Robert Cooper, Director of the Defense Advanced Research Projects Agency (DARPA), which provided Grumman with a $92 million contract for two X-29 aircraft. The X-29 program is being managed by the Air Force Aeronautical Systems Division's Flight Dynamics Laboratory at Wright-Patterson AFB, Ohio.

Vice President George Bush, a World War II Navy torpedo bomber pilot, was principal speaker at the rollout event. The X-29 program, he said, "represents an important step in the rebuilding of a [US] defense that is second to none" because "we are determined not to neglect our technological edge" over the Soviet Union.

Integrated with a "triplex" fly-by-wire flight-control system, the X-29's forward-sweptwings, made of strong, lightweight graphite composites, and its stubby canards, which act as its main control surfaces, combine to enhance lift and reduce drag. In flight, the wings' trailing edges change shape continuously in accordance with aerodynamic demands.

The X-29 flight-test program is to begin in November at Edwards AFB, Calif., and will be conducted by NASA's Ames Dryden Research Center there in cooperation with DARPA, the Air Force, the Navy, and Grumman.

Newest US test aircraft is the unusual, advanced-technology, forward-sweptwing X-29, which made its debut on August 27 at Grumman Corp.'s Calverton, N. Y., plant.

★ USAF is "taking a bum rap" on spare-parts pricing in the opinion of Dr. Thomas E. Cooper, Assistant Secretary of the Air Force for Research, Development and Logistics.

In fact, Dr. Cooper told AIR FORCE Magazine, USAF "may be reacting too intensely" to headline-grabbing allegations of gross overpayments for spares by "going out and trying to make sure we've covered every possible base" in correcting the situation.

"We will continue to push hard" for corrections, Dr. Cooper said, "but at some point we will need to decide whether all our [remedial] initiatives are really in our best interests." If pushed too long when unwarranted, some of these initiatives could prove counterproductive, he said.

Dr. Cooper emphasized that USAF did not actually buy, at producers' too-high prices, several spares that made the headlines—and indeed never intended to buy them at those prices.

Moreover, he said, the fact that all such instances were discovered by Air Force personnel "indicates that our system is working—it's not a perfect system, but I firmly believe it is a good one."

★ The Air Force received the first F-16C, latest and most sophisticated version of the Fighting Falcon, from General Dynamics Corp. in ceremonies last July 19 at Fort Worth, Tex.

The first F-16C, however, will remain at Fort Worth to support Air Force technical order validations. In December, the aircraft will be ferried to Luke AFB, Ariz., for operational test and evaluation.

Aeronautical Systems Division's (ASD) Deputy for F-16 worked with General Dynamics' Fort Worth Division over the past four years to produce the C model under the Multinational Staged Improvement Program (MSIP).

The first KC-135R tanker reequipped with CFM56 engines takes off after being delivered to USAF by Boeing in July. It'll be based at McConnell AFB, Kan., as part of SAC's 384th Air Refueling Wing.

Lt. Gen. Thomas H. McMullen, ASD Commander, says, "The F-16 program has been a history of superlatives with dramatic new solutions to long-standing problems. . . . The F-16 is a benchmark in modern aviation combat capability. For the first time, it has made the man, not the machine, the limiting factor in air-to-air combat."

Externally, the F-16C looks the same as the F-16A except for a slightly expanded vertical tail-root fairing. Internally, however, the F-16C features several improvements over the F-16A and B models. These include an APG-68 radar that offers much greater range, resolution, and modes of operation than the current APG-66 radar; an advanced cockpit; increased capacity in electrical power and cooling systems; expanded memory, speed, and reprogrammability of computers, dual avionics multiplex bus architecture, and advanced computer language; and structural changes for increased takeoff gross weight, maneuvering limits, and advanced growth.

These basic improvements, some of which will be retrofitted to F-16As now in service, will provide compatibility with advanced Air Force systems under development, including the Advanced Medium-Range Air-to-Air Missile (AMRAAM), the Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system, the Airborne Self-Protection Jammer, and the ALR-74 radar warning receiver.

★ The Air Force took delivery in July of the first KC-135R from the Boeing Military Airplane Co.

The first reengined KC-135R will be based at McConnell AFB, Kan., with SAC's 384th Air Refueling Wing.

Current Air Force plans call for reengining all KC-135s. The reengined aircraft will not only carry more fuel farther (providing one and a half times the fuel offload capacity of the present KC-135As) but will also have reduced maintenance costs, will be able to operate from shorter runways, and will fully meet federal noise and emission standards.

Boeing officials estimate that a fleet of reengined KC-135s will save about $1.7 billion in fuel costs over fifteen years of operation. These savings are equivalent to about 7,700,000 tanks of gasoline for the average car each year.

In addition to the Air Force fleet, the French Air Force operates eleven C-135F tankers, which will also be modified to the CFM56 engine configuration.

★ A twin-turboprop Convair 580, equipped with sensors and instrumentation to record the effect of lightning strikes on aircraft and aircraft

Air Force Decreasing Aircraft Markings

The Air Force has started to reduce the number of stencil markings and decals on its weapon systems.

According to Air Force officials, more than 1,500 markings have been eliminated, ranging from panel markings to fuel and oil servicing instructions. Some markings have also been simplified by replacing three-color decals with flat black stencil markings, such as the national star and command logos. They say the reduction reverses the trend of proliferating decal and stencil markings dating from the post-World War II era.

Those markings that remain are required by law, such as the national star and aircraft serial number; are for safety reasons, such as emergency access and exit markings; or bolster morale, such as pilot and crew chief names.

Air Force Logistics Command officials, who suggested the reduction, say combat readiness will be increased by reducing the number of hours an aircraft stays in maintenance for painting and by minimizing compromises in aircraft camouflage paint schemes.

The reductions also eliminate more than 100,000 man-hours required to reapply decals and repaint stencils, saving some $2.5 million annually.

According to Air Force officials, decreasing the number of decals and stencil markings also reduces the need for such items as paint, stencil boards, and decals and cuts technical order costs. For example, the technical order for F-4s was cut by fifty pages at a savings of $200 per illustrated page.

AFLC officials cited several examples in the reduction campaign. They say C-141s formerly required eight large decals. Following a review, two decals were eliminated and the other six changed to smaller stencil markings.

In addition, markings on the A-10 aircraft were cut from 681 to ninety-five, while markings on C-130B/E models were reduced from 270 to eighty-four.

systems, has been flying out of Patrick AFB, Fla., into and near thunderstorms to attract direct lightning strikes.

The FAA tests, completed in September, are the first time attempts have been made to gather data in an airplane struck by cloud-to-ground lightning.

The specially instrumented FAA airplane also records electrical and magnetic fields on the airplane skin and in the air surrounding the plane.

The aim of the project, according to FAA officials, is to investigate electromagnetic compatibility problems associated with advanced-technology airframe materials and new avionics systems. This includes effects on microelectronic solid-state devices used in flight-critical digital systems.

Air Force electrical and magnetic sensors are used to detect the storms, and weather radar is used to vector the FAA plane into the desired thunderstorm area. The plane flies at altitudes between 2,000 and 20,000 feet to encounter cloud-to-ground lightning strikes.

★ French Mirage fighter pilots will soon be able to train on modern electronic air combat ranges. This new capability will result from a $2.2 million contract awarded to Cubic Corp. by Matra, a French firm that builds the Magic 550 missile for the Mirage.

Cubic Corp. officials say the contract calls for the design, development, and delivery of special Airborne Instrumentation Subsystem (AIS) pods for the Mirage.

The AIS pods simulate the Magic 550 missile and will be placed on wing-mounted launchers. The pods relay aircraft weapons, attitude, and velocity data to system ground stations. The new pods will operate on the French Mirage F-1, F-5, and 2000 series fighter aircraft and other non-US fighters equipped with the Magic 550 missile.

Finally, Mirage pilots will be able to train on any of the thirteen Cubic-built electronic air combat ranges now in operation or under construction, as well as on any future ranges.

★ A new integrated life-support system slated for use in the F-4, F-15, F-16, F-111, and A-10 aircraft is currently under development at Gentex Corp., Carbondale, Pa.

The Integrated Chemical Defense System, or ICDS, is adaptable for use in chemical and biological defense as well as for normal flight operations. Its design features interchangeable components that allow for quick change between chemical defense and normal flight modes for more complete protection of the pilot.

AEROSPACE WORLD

According to Gentex officials, the ICDS signifies the beginning of a trend in life-support equipment toward integrated systems as opposed to individual component add-ons. Helmet shell, visors, mask, hoses, chemical defense shroud, regulator, and filters were all designed as a unit.

The ICDS is currently undergoing qualification testing and cockpit integration studies. The system requires the installation in the aircraft of a panel module that supplies filtered air/oxygen for breathing, head cooling, and visor defogging. A seat-mounted regulator, hand-carried "portapac" for pilot ground transport and communication in contaminated areas, and ground-test equipment are also part of the system.

Developmental test and evaluation flights are scheduled for March 1985 at Eglin AFB, Fla., with production targeted to begin in 1986.

Gentex Corp., Carbondale, Pa., is developing this new life-support system for use in the F-15, F-16, F-111, A-10, and other aircraft.

★ Both Piper Enforcer prototypes have arrived at Edwards AFB, Calif., for the Air Force's operational demonstration of the two lightweight, propjet-powered, close air support aircraft, according to Piper officials.

The operational demonstration, which is Phase III of the development program, will involve some sixty-five sorties. Tests will include day and night weapons-accuracy testing, low-visibility target acquisition, survivability, and surging (continuous sortie generation).

Phase II of the program was recently completed successfully at Eglin AFB, Fla. That portion of testing examined the Enforcers' weapons delivery capabilities, with the planes flying fifty-eight sorties.

Piper was awarded an Air Force contract in September 1981 for the development of two Enforcer prototypes. Based on the North American P-51 Mustang, the Enforcers, with an average cruise speed of 250 knots, have a maximum design speed of 350 knots and an altitude capability of 25,000 feet.

Armament includes 2.75-inch rockets and cluster and Rockeye bombs, and the aircraft has the capability to change weapons configurations as mission requirements dictate.

★ A new generation of Navy vertical/short takeoff and landing (V/STOL) aircraft is being studied by Lockheed-California Co. The new design employs a split-fan, cross-ducting propulsion system.

Being developed under a Navy contract, the system allows for hover control and transition between vertical and horizontal flight.

According to Lockheed officials, the twin-engine jet would have reduced takeoff and landing times, enhancing the efficiency with which carrier aircraft could be cycled on missions.

The Lockheed concept uses twin nacelles connected by a cross-duct that can deflect engine exhaust flow downward through two nozzles located in each nacelle. This provides lift during the hover operation, when the aircraft has no forward propulsion.

Control of the aircraft is provided by varying the nozzle area, which regulates the amount of exhaust flow between the nozzles.

For pitch control, engine fan air is transferred between the forward and aft nozzles of each nacelle. For roll control, the air is transferred across

the aircraft through the cross-duct that connects the forward nozzles of each nacelle.

Lockheed's V/STOL would employ standard turbofan engines and would function normally in the cruise mode. For a short takeoff, the engine thrust would be deflected downward thirty degrees; upon hovering and landing, the exhaust would be deflected straight down. A model of the propulsion system has been built for testing.

★ The Air Force has given an additional designation—AT-46A—to Fairchild Republic Co.'s T-46A trainer to identify modified versions for other missions and for the international market.

The new designation replaces the FRC 225 originally applied to the twin jet by Fairchild Republic for its non-trainer roles.

The T-46A, now in final development, will be a primary trainer for the Air Force, but the aircraft has also been designed to carry out at least three other missions—weapons delivery training, forward air control, and light attack. For these roles, the plane will be known as the AT-46A.

★ A demonstrator single-seat version of the Hawk advanced jet trainer is being developed by British Aerospace.

Designated Hawk 200, the demonstrator aircraft is scheduled to fly in 1986. According to a British Aerospace spokesman, "The single-seat Hawk will provide a solution for those air forces seeking a cost-effective combat aircraft that will be agile and highly maneuverable."

The Hawk 200 will be offered with a range of avionics and sensor equipment to suit a variety of roles, including ground attack, combat air patrol and interception, armed reconnaissance, and maritime strike, in all weather, day and night. According to British Aerospace officials, the aircraft will utilize new miniaturized low-cost avionics and be capable of carrying a payload of more than 6,500 pounds.

Current Hawks provide the mainstay of the Royal Air Force's advanced flying and weapons training. The Hawk has also been selected by the Navy (which has a requirement for 304 aircraft) as its future advanced jet trainer, designated the T-45.

★ An illustrated history of Air Force Logistics Command activities covering the past sixty years is now available, according to AFLC officials.

Titled *Logistics: An Illustrated History of AFLC and Its Antecedents, 1921–1981,* the 305-page book contains 285 graphics and photographs. Coverage ranges from establishing logistics systems for the "stick-and-wire airplanes of the 1920s" to maintaining Air Force readiness in the 1980s. The book includes photographs of AFLC commanders and charts showing AFLC personnel strengths through the years and the command's genealogy.

The book's six chapters cover the early years as well as the war years, the postwar interlude, and the Cold War and document the logistics of constant readiness, logistics in war and peace, and the logistics of deterrence and austerity. Copies may be purchased from the AFLC Office of History, Wright-Patterson AFB, Ohio 45433. Checks or money orders for $12 should be payable to AFO, Wright-Patterson AFB, Ohio 45433.

★ The 437th Aerial Port Squadron, Charleston AFB, S. C., is the 1984 National Defense Transportation Association Unit Award winner. The award recognizes the Air Force's outstanding aerial port unit.

During the past year, Charleston's aerial port moved 305,000 passengers and 85,000 tons of cargo on 26,500 military and commercial contract air-

A new concept in Navy V/STOL aircraft, developed by Lockheed-California, is shown in this artist's rendering. Unlike the British Harrier and other V/STOLs, this concept uses a split-fan, cross-ducted propulsion system.

Retrofitting the C-130 with the Self-Contained Navigation System (SCNS) demands an integration contractor with a combination of practical experience and technical expertise. Over a long and successful association with the United States Air Force, Delco Systems has acquired these credentials.

Delco's inertial navigation systems, doppler navigation systems, control and display units, and computers have proved themselves on Air Force C-141s, C-5s, C/KC-135s, E-3s, E-4s and special purpose C-130s. Delco was the integration contractor for this equipment on the C-141s and C/KC-135s. Not to mention Delco's latest integration contract for the C/KC-135 Fuel Savings Advisory/Cockpit Avionics System.

Our accumulated experience is paying big dividends. For the Air Force, the payoff will come when Delco's version of SCNS helps pilots meet mission objectives efficiently.

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craft. This included the reception of 688 student evacuees from Grenada, support of numerous special projects, such as the Polaris missile and Lebanese Task Force, and active participation in such Joint Chiefs of Staff exercises as Universal Trek and Ahuas Tara.

During a demanding operational readiness inspection, the port received high marks for the Air Passenger Terminal, Air Cargo Terminal, Transportation Control Unit, and Sub Motor Pool. The MAC Inspector General stated it was the best operation observed in the last two years.

★ The FAA has started placing computer terminals at airports in New Jersey and Pennsylvania to obtain pilots' comments on using personal computers for getting weather information and for filing flight plans.

The pilots can call up the desired flight information on the terminal's video display. Clearance of the flight plan is later given by radio to the pilot prior to takeoff.

The project, conducted by the FAA Technical Center at Atlantic City Airport, N. J., seeks to eliminate delays for pilots and to speed up service without adding more FAA employees at already busy Flight Service Stations.

Pilot reactions and comments on the new computer systems, called Direct User Access Terminal (DUAT), will be analyzed. If the demonstration-survey proves the new system practical, the FAA says, pilots may be able in the near future to use privately owned personal computers to file flight plans from their homes and offices.

★ The newest Space Shuttle, *Discovery,* launched August 30, carried a device to measure vision problems encountered by astronauts in space. Called the Visual Function Tester, the device was developed by the Air Force for a joint study with the National Aeronautics and Space Administration.

The VFT-1 was invented by two research scientists of the Aerospace Medical Division headquartered at Brooks AFB, Tex. Lt. Col. Louis V. Genco and Dr. Lee Task of AMD's Air Force Aerospace Medical Research Laboratory, Wright-Patterson AFB,

Rollout of C-23A Aircraft Follows Historic Precedent

In 1909, Orville and Wilbur Wright traveled from their Dayton, Ohio, home to England to sign a contract with Eustace, Horace, and Oswald Short. The contract called for the Short Brothers Co. to manufacture six biplanes for the Wrights, making the agreement the first production order ever placed for aircraft.

On August 8, 1984, seventy-five years later, a small delegation from Aeronautical Systems Division, Wright-Patterson AFB, Ohio, traced the Wright brothers' footsteps to a Shorts airplane facility, this time in Belfast, Northern Ireland. The event was the rollout ceremony for the first of eighteen Air Force C-23As.

The C-23A aircraft is being built for use in the European Distribution System (EDS) managed by Air Force Logistics Command, which is headquartered at Wright-Patterson AFB.

Lt. Gen. Thomas H. McMullen, ASD Commander, said at the rollout ceremony, "For the first time, the US Air Forces in Europe will have a dedicated cargo transportation system to move critical spare parts to the right place, and to do it at the right time—everytime."

Military Airlift Command's 10th Military Airlift Squadron stationed at Zweibrücken AB, Germany, is scheduled to receive the first two C-23A aircraft this month. All eighteen C-23As will be based at Zweibrücken AB, with delivery of the last aircraft scheduled for October 1985.

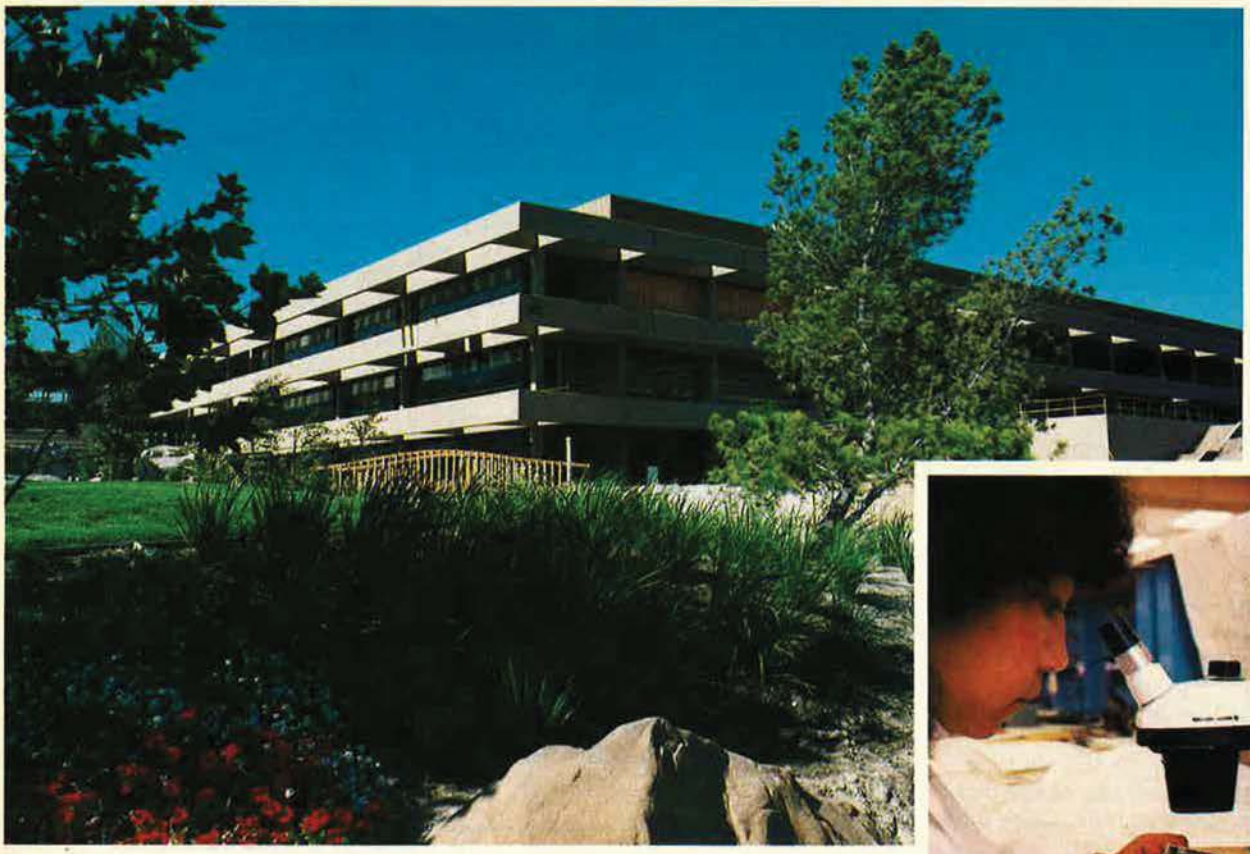
The C-23A program is one part of the EDS network to provide assured wartime and peacetime distribution of critical assets within US Air Forces in Europe. Other integrated components of the EDS network are logistics command control and communications (LOG-C^3) and forward stockage.

LOG-C^3 is a theater support system connected by redundant and survivable communications and will provide theater visibility of weapon system spares.

The forward stockage program comprises small warehouses for the storage and distribution of items considered essential to the USAFE mission.

—2D LT. RON JOY, AERONAUTICAL SYSTEMS DIVISION, OFFICE OF PUBLIC AFFAIRS

Did You Know...?



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AEROSPACE WORLD

Ohio, invented and developed the cigar-box-size device.

The VFT-1 will enable astronauts to discover if changes in vision occur due to the weightlessness of space and, if so, to measure the deviation from normal. "A good number of astronauts have commented on changes in their vision," Colonel Genco says.

Mission specialists will use the VFT-1 to check their vision several times before the Shuttle is launched, while it is in orbit, and after landing.

The device is constructed so that the test subject can peer in one end at a display made up of precision optical imagery illuminated by light-emitting diodes mounted in the other end. The displays are arranged so that a variety of vision tests can take place. The testing will detect and measure many kinds of vision changes. Using data from the tests, researchers will be able to predict such changes and will eventually be able to prescribe measures to minimize detrimental effects.

New VFTs to test different vision changes are under development and will take their place as test equipment on future Shuttle flights.

★ The Air Force conducted its first conventional high-explosive blast test in July for the Intercontinental Ballistic Missile Silo Superhardening Technology Test program at the Ballistic Missile Office's test site on the Luke Bombing and Gunnery Range. The site is located approximately eleven miles south of Welton, Ariz.

During this test, the Air Force detonated approximately 400,000 pounds of conventional explosives near a small-scale hardened missile silo to measure its structural response to airblast pressures created by high explosives.

The ISST program is designed to gather data on how superhardened silos react in a simulated nuclear-blast environment. Testing is scheduled to continue until 1987 and involves the construction and emplacement of six small-scale and two large-scale hardened silos to undergo high-explosive blast and shock testing. The testing does not involve actual missiles or nuclear weapons.

The tests are being conducted under the management of AFSC's Ballistic Missile Office, located at Norton AFB, Calif., while the H. J. Kaiser Co. of Oakland, Calif., is the site construction manager. The test site currently employs approximately 500 people.

★ USAF will soon have a better way to manage bombs and bullets.

The new Combat Ammunition System (CAS) will make it easier to keep track of a base's munitions and will boost efficiency in the areas of storage planning, inventory/accountability, tracking of in-transit material, and scheduling of munitions tasks.

A secure communications and reporting network will provide worldwide access to munitions information. This will give supporting agencies, major air commands, the Air Staff, and the Joint Chiefs of Staff an

Helicopter Mine Countermeasures Squadron 14 (HM-14) personnel load RH-53D Sea Stallion helicopters and associated equipment aboard Military Airlift Command C-5A aircraft at Naval Air Station, Norfolk, Va. Aircraft, equipment, and support people were bound for the Red Sea area to assist the Egyptians in enhancing the security of navigation in those waters. (US Navy photo)

improved way of managing day-to-day operations and will help in peacetime and wartime planning.

US Air Forces in Europe will be the first command to implement the system, followed by PACAF, Tactical Air Command, and Strategic Air Command. Future plans will unite all Department of Defense munitions activities with this system.

Osan AB, Korea, will be the first PACAF base to use the system, with a planned start-up date of June 1985.

According to PACAF officials, "The CAS marks a major improvement in Air Force munitions command and control. For the first time, all users of combat munitions will be able to speak the same language, thanks to the system's improved communications network and standard data-processing capability."

★ Development of a futuristic Air Force aircraft to operate in the upper atmosphere and along the fringes of space moved a step closer to reality in August with the award of the Phase II study contract to determine military effectiveness of the Transatmospheric Vehicle (TAV) concept.

The study, being conducted by Science Applications, Inc., of Dayton, Ohio, will provide the basis for an Air Force decision on whether or not to proceed with TAV development.

Manned and rocket-powered, the TAV would be capable of aircraft-like operations, taking off horizontally and operating from conventional airfields. Flying in the transatmospheric region (between 100,000 and 500,000 feet), the TAV would be able to reach any point on the globe within ninety minutes in order to carry out a military mission, according to Air Force officials.

These TAV concepts will now be evaluated against such alternative system solutions as advanced aircraft, according to TAV program manager Dr. Jerry Arnett.

Dr. Arnett also says that technologies critical to TAV's operational scenario—which includes rapid turnaround, multiple reuse, and minimum inspection and maintenance—will be identified. Materials, propulsion, aerothermal dynamics, flight controls, and avionics are some of the key technologies expected to be critical to TAV development.

Phase I studies, started in May 1983, resulted in fourteen concepts for a TAV vehicle. Aeronautical Systems Division officials selected six of those concepts for further refinements during Phase II.

Strategic Air Command and Air Force Space Command are providing TAV mission requirements and operational concepts to ASD's Deputy for Development Planning for use in the Phase II study. In addition, SAC, Space Command, AFSC, ASD, Space Division, Armament Division, the US Navy, and NASA are represented on a general-officer-level steering group that will evaluate the military potential for development of a transatmospheric vehicle.

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★ Engineers at McDonnell Douglas Corp. are designing new methods that will automate the curing process of composite materials used to make aircraft parts.

Their efforts are the initial step in a $2.95 million Air Force contract awarded to the McDonnell Aircraft Division of McDonnell Douglas. McDonnell Douglas officials estimate that a computer-aided curing process could save Air Force contractors hundreds of millions of dollars in the next twenty years by lowering the cost and improving the quality of composite parts.

Composites are strong, lightweight materials made of carbonfiber impregnated with an epoxy resin. Composite plies are cut from uncured composite cloth to form such parts as stabilizer and wing skins. The parts are cured in an autoclave, a large pressurized chamber that can reach temperatures of about 500 degrees Fahrenheit and pressures as high as 200 pounds per square inch. The curing process serves to harden the epoxy.

An automated process would shorten the curing cycle and thus reduce energy use, say McDonnell Douglas officials. "A computerized method also would sort parts into batches for more efficient curing," company officials say.

The computer-aided curing contract covers four years in three

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phases. Phase I calls for development and demonstration of technology; Phase II, a demonstration of automated curing control of large parts; and Phase III, the application of the process to "starter" composite materials furnished by a subcontractor. Others involved in the program are Hercules, Inc., of Magna, Utah, which will provide starter materials; Washington University of St. Louis; and the McDonnell Douglas Research Laboratory.

McDonnell Aircraft currently builds composite parts for the Air Force F-15 Eagle, the Navy and Marine Corps F/A-18 Hornet, and the Marine Corps AV-8B Harrier II.

★ **NEWS NOTES—The first E-3B** Airborne Warning and Control System (AWACS) aircraft **has been delivered to the 552d Airborne Warning and Control Division,** Tinker AFB, Okla. The E-3B, a modified E-3A, is one of twenty-four aircraft scheduled for modifications to include upgrades in computer hardware and software, additional high frequency and ultrahigh frequency radios, five additional situation display consoles, and the ability to transfer digital data to ground sites or to compatibly equipped aircraft.

ASD's Avionics Laboratory has awarded contracts for studies on the potential for **artificial intelligence applications to military systems.** Hughes Aircraft Co.'s Radar Systems Group and Bolt Beranek & Newman Inc., will determine benefits of applying artificial intelligence techniques to fire control and battle management and are to evaluate artificial intelligence applications in these areas.

Beginning with an airplane to be delivered in October, the **KC-10 will be painted a "less conspicuous" gray.** The change in paint scheme from white comes with the evolving role of the KC-10, which is now being used in supporting operations in potential combat areas. At press time, no decision had been made on whether or not the first twenty-five KC-10s already delivered to the Air Force will be repainted.

The F-104 Starfighter aircraft that appeared in the motion picture *The Right Stuff* is now on permanent display at the California Museum of Science and Industry in Los Angeles.

Died: Col. Max Henny, USAF (Ret.), World War II fighter pilot who went on to serve in a variety of positions in SAC, of complications from multiple sclerosis on Mercer Island, Wash., in August. The long-time AFA member was sixty-five. ■

Despite improvements in inter-theater and intratheater airlift, the current fleet falls short of wartime needs.

Airlift for Near and

BY MAJ. MICHAEL B. PERINI, USAF

AIRLIFT is combat capability in wars of all sizes. Operations in the Grenada rescue last year required more than 750 airlift sorties in the first twelve days, delivering 8,800 tons of supplies and equipment and moving more than 18,000 troops and American citizens.

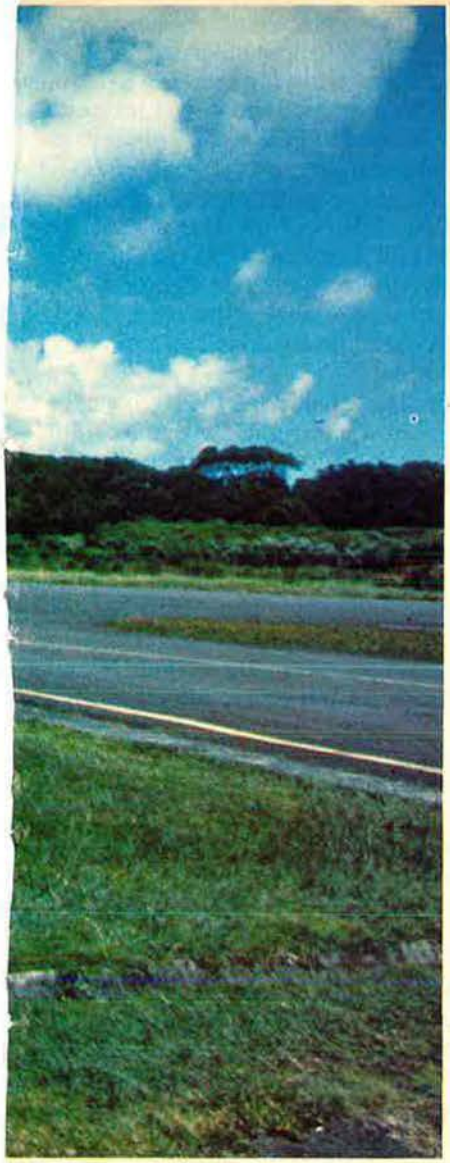
Airlift must keep pace with the growing requirements of combat forces and the demands of short-notice contingencies. Airlift must cope with reduced warning time, must accommodate the Army's larger equipment and new, highly mobile, light infantry divisions, and must be ready to operate in potential trouble spots. Add in uncertainty about overflight and landing rights and questions about airfield conditions in the crisis areas and take a look at requirements vs. capabilities, and the continuing concern about airlift is understandable.

Justifying Requirements

"This nation is woefully short of airlift," says Secretary of the Air Force Verne Orr. The US has the finest and most capable airlift force in the world—but it isn't enough.

Since 1974, at least eighteen major mobility studies have compared established airlift requirements with capabilities. In every case, these studies conclusively documented that airlift requirements far exceed capabilities. In the words of Secretary Orr, "The Air Force recognizes that current airlift forces cannot meet theater commanders' wartime requirements."

The comprehensive Congressionally Mandated Mobility Study (CMMS), prepared by the Department of Defense and submitted to Congress in 1981, quantified



A Military Airlift Command C-130 takes off on a mission in support of the Grenada operation. Growing requirements of combat forces have caused concern among airlift planners.

Far

the strategic intertheater deficiency. The CMMS recommended a "minimum"—within fiscal realities—intertheater airlift capability of sixty-six million ton-miles per day (MTM/D). This would enable Military Airlift Command to move the equivalent of sixty tactical fighter squadrons, one Marine Amphibious Brigade, and six Army divisions to Europe within ten days. Even with this increased airlift capability, Air Force officials say that extensive prepositioning would be required.

Reducing the Airlift Gap

The military airlift system blends active-duty Air Force, Air Force Reserve, Air National Guard, and Civil Reserve Air Fleet (CRAF) personnel, aircraft, and equipment into a national airlift force for peace or war.

Active-duty MAC forces form the nucleus of the military airlift system. MAC operates C-5, C-141, and C-130 aircraft in thirteen airlift wings and groups in the US, Europe, Alaska, and the Far East.

Today, the Air Force has seventy C-5As, 234 C-141s, and 218 C-130s in its Primary Aircraft Authorized (PAA) strategic and tactical inventory. MAC-gained AFRES and ANG forces provide an additional 302 C-130 PAA aircraft and will soon be operating their own C-141 and C-5 aircraft, which will be transferred from the active inventory.

Today's intertheater airlift capability has grown by thirteen percent since FY '83. Despite that increase, our total capability is still less than fifty percent of the CMMS goal of sixty-six MTM/D.

According to a DoD study on "Improvements in US Warfighting Capability FY 1980–84," strategic airlift capability has been increasing—up twenty-eight percent—since 1980. The amount of intratheater cargo that the airlift fleet could deliver during wartime is also up, by sixty-seven percent, since 1980. The improvement is a result of stretching all C-141 aircraft by twenty-three feet and modifying them for air refueling, strengthening the C-5A wings, adding two squadrons of KC-10s, and increasing spares and crews to support increased flying hours under mobilized conditions. Another contributing factor was the conversion since 1980 of one AFRES and four ANG squadrons from C-7 and C-123 aircraft to C-130Hs.

Wartime cargo-carrying capacity has increased, but that is not the only aspect of airlift that has improved. One measure of capability is the "mission capable [MC] for spares" rate, which quantifies the number of aircraft available for wartime in terms of adequate spare parts. A second measure of capability is the number of spare engines on hand, and a third is launch-reliability rates. Dramatic improvements have been made in all three of these categories since 1980 *(see chart)*.

The Trend in Wartime Cargo-Carrying Capacity

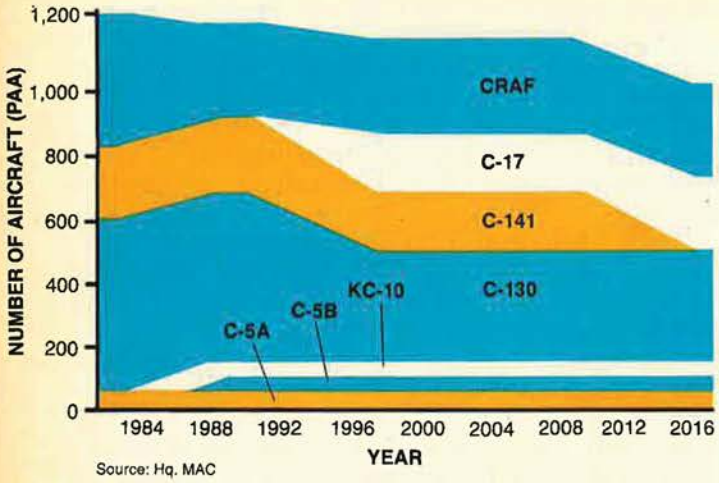
	October–December 1980		October–December 1983	
	C-5	C-141	C-5	C-141
Mission Capable for Spares*	85%	89%	87%	94%
WRM Engines on Hand	67%	108%	82%	119%
Launch Reliability	77%	86%	80%	89%

* C-5 rate increases less because of longer lead times.

The nation's airlift capability will gradually improve further with the procurement of fifty C-5Bs, an additional forty-four KC-10s, projected CRAF enhancements, and the addition of programmed spares and crews. However, even with these programs, the Air Force will be about 17.5 MTM/D short of the CMMS goal by FY '89.

How will the gap be filled? "The C-17 buy will eliminate the shortfall as well as add to the nation's intra-

Evolution of the Force



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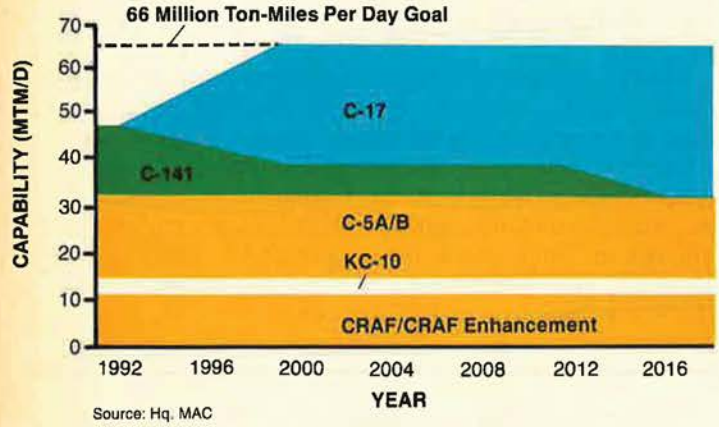
Intertheater Load Sharing



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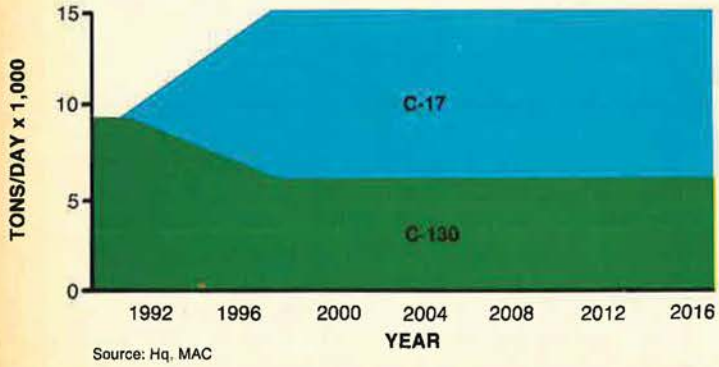
Intratheater Goals



Source: Hq. MAC

theater capability in the years ahead," says Gen. Thomas M. Ryan, Jr., MAC's Commander in Chief.

Furthermore, the Air Force is buying eighteen C-23As (the Short Brothers' Sherpa) to be the new European Distribution System Aircraft (EDSA). Expected to reach initial operational capability next year, the EDSA program will increase the sortie-generation capability of fighter forces in Europe. "We will use this aircraft to redistribute spare parts and supplies within the European theater, enabling us to increase our fighter force sortie generation by up to 800 sorties per day," says General Ryan. "EDSA could be described as a military version of Federal Express."

Even so, the Air Force is considering the basing of at least one additional C-130 squadron in Europe as soon as possible. However, such an increase in aircraft and personnel would be subject to congressional approval.

Today, the Air Force uses its Airlift Master Plan as the guide to fulfill long-range airlift needs. Presented to Congress in late 1983, the plan enjoys strong support from the JCS, DoD, and Congress. The Airlift Master Plan has become a "*de facto* contract," according to General Ryan in an interview with AIR FORCE Magazine, "a sound framework for our future military airlift force structure."

The 1998 force structure recommended in the plan will contain a balanced airlift mix of C-5s, C-141s, C-17s, KC-10s, and C-130s in the active force, ANG, and AFRES. *(For more details on the Airlift Master Plan, see* AIR FORCE *Magazine, May '84, p. 58.)*

"Even after a year, the plan is essentially on track," says General Ryan. "It is an excellent airlift road map within fiscal realities."

However, it will not be a simple task to select a force structure to meet future validated requirements. "Tradeoffs must be made among military utility, operating costs, manpower requirements, force stabilization, and force modernization to achieve the most beneficial results," General Ryan says.

Improving Existing Forces

"It wouldn't have made much sense for us to ask for C-5Bs and the C-17 until we did all we could to maximize the effectiveness of what we already own," says General Ryan. And that's precisely what MAC is doing.

Here is a brief look at major programs in progress to enhance readiness, sustainability, and capability of current airlift systems:

- Spare parts stocks are being increased (with full stock levels expected by FY '88) to permit higher utilization rates of the C-5 and C-141 aircraft.
- Aerial port personnel and airlift support equipment, including container-handling equipment, are being added. Also, Air Force and MAC officials are developing specifications for a new generation of aircraft-loading equipment to replace the 25K and 40K loaders.
- MAC C^3 systems are being upgraded. Officials hope to have thirty percent of the communications, data automation, and facility acquisitions funded by FY '85 and eighty-eight percent by FY '89.
- The C-5A wing is being strengthened, extending the lifetime of each aircraft by 30,000 flying hours and allowing greater loads up to 242,500 pounds. To date, Lockheed has completed twenty-five aircraft, with twelve

aircraft in work. Lockheed is delivering three aircraft every two months, and actual costs are under budget. Program completion date is FY '87. Also, a new camouflage paint scheme called "European 1"—a combination of mostly greens and grays—has already been applied to fifteen aircraft. The new paint will provide corrosion protection as well as a camouflage effect.

- The C-130B/E wings are being modified to correct corrosion and other problems. This program will extend the service life of the Air Force's 492 C-130B/Es and is expected to be completed by FY '88. In addition, C-130A wing repairs will allow operations into the 1990s. Other C-130 improvements include a self-contained navigation system, modernization of the station-keeping equipment that allows a pilot to fly in formation in weather, and a defensive systems program that includes IR and ECM suites.
- The C-141 fleet has undergone a fuselage stretch and the addition of an air refueling receptacle. This was completed under cost and ahead of schedule. The stretch increased the C-141's pallet capability by thirty percent. As of July 1984, 393 crews were qualified for in-flight refueling. The aircraft service life was also validated to 45,000 hours. During FY '85, additional C-141 improvements will include the upgrading of station-keeping equipment. These improvements will enable the airdrop of a brigade-size force in adverse weather. Even with all the modifications, sixty-one aircraft will have reached the end of their service life by the year 2000.
- CRAF passenger airlift is being enhanced. In September 1983, MAC awarded a $617 million contract to Pan American for conversion of nineteen Boeing 747 airliners to CRAF cargo-carrying configuration. The contract covers start-up costs of the modification line, the modification of each aircraft by Boeing and subcontractors, the cost of down-time while they are being modified, and the extra operating costs of the aircraft, which will be heavier and use more fuel after conversion, for twelve years of peacetime airline operations. The stronger cargo floors, a cargo door, and roller-and-rail systems will add almost 3,000,000 ton-miles a day of bulk and oversize capability to the CRAF. Currently, five of the aircraft are on contract, with funding for four more scheduled for release in January 1985. Funding limits may preclude the exercising of options for the remaining ten aircraft.

Transfer of Aircraft to the ARF

The Air Reserve Forces (ARF) currently provide forty-nine percent of the C-5 and C-141 aircrews, fifty-eight percent of the C-130 force, forty percent of the combat rescue aircrews, eighty-nine percent of the aeromedical crews and medical technicians, and fifty-nine percent of the wartime aerial port personnel.

C-5A Galaxy and C-141B StarLifter in flight. Air Reserve Forces (ARF) currently provide for forty-nine percent of the C-5 and C-141 aircrews and figure prominently in airlift plans.

Last year, in an effort to meet congressional end-strength limitations, MAC proposed a plan to transfer some of its C-5s to ARF units. In addition, Congress directed the Air Force to expand the force structure of the ARF further by transferring two squadrons of C-141s and to develop a plan for the transfer of additional assets.

On April 26, 1984, the Air Force submitted the initial plan to Congress, outlining the transfer of twenty-two C-5As and sixteen C-141s to the ARF over the next few years. The 433d Tactical Airlift Wing (AFRES), Kelly AFB, Tex., will convert to fourteen C-5As, and eight C-5As will go to the 105th Military Airlift Group (ANG), Stewart IAP, N. Y. The 172d Tactical Airlift Group (ANG) at Allen C. Thompson Field in Jackson, Miss.,

will receive eight C-141s in FY '86, as will the 459th Tactical Airlift Wing (AFRES) at Andrews AFB, Md.

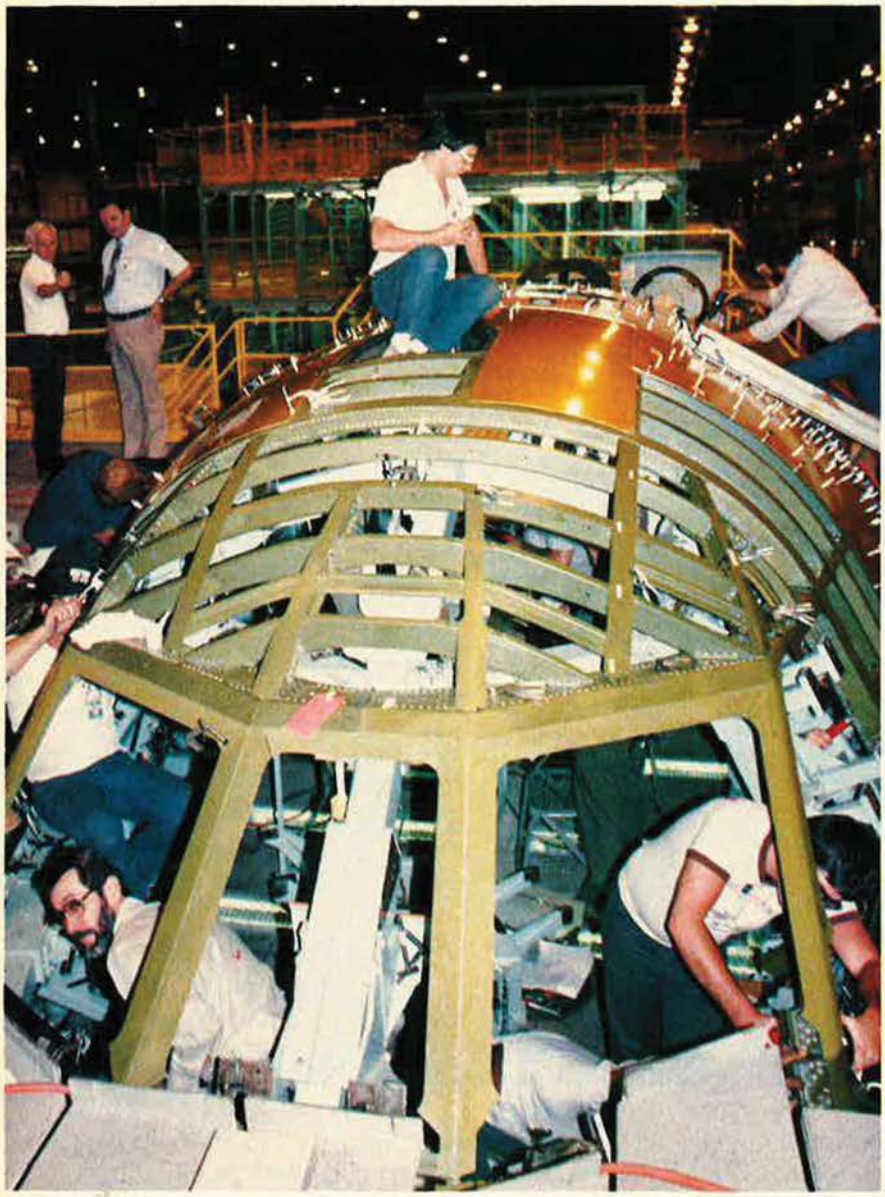
Eventually, the Air Force plans to transfer an additional twenty-two C-5s and, as the C-17 enters the inventory, an additional sixty-four C-141s to the ARF in the long term; however, beddown locations are yet to be determined.

"Placing C-5s in the reserve forces now will reduce peacetime flying costs and extend their service life as we will fly them less than the active force would," said Maj. Gen. Sloan R. Gill, Chief of the Air Force Reserve, in an interview with AIR FORCE Magazine.

"I hear the critics who say the C-5 is too sophisticated for the reserve forces. They said that about the C-119 and the C-124 when we started flying them. The results over the years show we can handle any aircraft. I am concerned, however, about obtaining the support equipment and parts we will need and about having the new facilities completed on time," General Gill said.

Another concern for the Air Force is to pick the proper time to transfer the C-141s to the ARF. "The C-141 is the most heavily tasked MAC aircraft," General Ryan told Congress. "Its peacetime commitment is occasionally above eighty percent and recently as high as eighty-eight percent. Transfer of a large number of C-141s to the ARF, prior to delivery of C-17s, would limit MAC's ability to support nonmobilized contingencies."

The only other major airlift modernization effort for the ARF is the C-17. General Gill says, "New airlift aircraft are needed as the support requirement for the ARF increases. The only thing we have on the horizon that is going to let us take some of those aging C-130s in the early 1990s and put them in the boneyard is the C-17."



Lockheed-Georgia assemblymen prepare the forward fuselage cab top for the first of fifty new C-5B military transports. Air Force officials are relying on the C-5B and the C-17 to help meet future wartime airlift requirements. The first C-5B is scheduled for delivery in December '85.

Why the C-5B *and* the C-17?

Air Force officials stress that both the C-5B and the C-17 are critical to meet wartime requirements. "It is C-5B and then C-17," says General Ryan. "An either/or approach is not satisfactory. We need both. The C-5B is available sooner, and the limited buy of fifty aircraft will permit an orderly transition to production of the C-17 to meet the long-term requirement."

The Air Force is already committed to the first five C-5Bs. However, two of ten C-5Bs to have been procured in FY '85 were slipped to FY '87. But Air Force officials say the program is on track, with the contract options allowing for variations in quantity until FY '87 (fourteen for FY '86; twenty-three for FY '87). Unit flyaway cost for each C-5B in constant FY '84 dollars is $141 million.

The C-5B is an updated C-5A, with current engineering changes including a 30,000-hour wing, GE TF39-1C engines, simplified landing gear, improved avionics, and the use of more durable, corrosion-resistant alloys. The first C-5B will be delivered in December 1985; the last is scheduled for February 1989.

Lockheed officials say production work is proceeding on schedule, with more than 30,000 engineering jobs released to production. A new computerized tracking system is now working so that Lockheed personnel can manage approximately 18,000 different types of nuts, bolts, fasteners, and rivets, valued at more than a million dollars, required to build each C-5B.

Meanwhile, structural tests, including characteristics of new alloys, durability and damage tolerance, fatigue strength, and various fastener tests, have been completed.

For the C-17, the Air Force has planned a moderately paced R&D program so that the delivery of the first aircraft follows delivery of the last C-5B. The Air Force has restated its need for 210 total (180 PAA) aircraft through 1998 in the Airlift Master Plan and the C-17 Validation Report. *(For more details on the C-17, see* AIR FORCE *Magazine, May '84, p. 61.)*

"The C-17 is our number-one aircraft acquisition program in MAC," says General Ryan.

The decision for full-scale development is due this fall. General Ryan foresees no problem with getting a green light. "We've got good support for the C-17 within the DoD and Congress," he says.

The first airplane is scheduled to be built in FY '88, with the first flight in FY '90 and initial operating capability in FY '92. Unit flyaway cost in constant FY '84 dollars is $100.3 million per aircraft. Current R&D is concentrating on wind-tunnel tests to verify aerodynamic design; is expanding cargo compartment and cockpit mockup; is analyzing and testing the zero-forward speed, high-bypass-ratio thrust reverser; and is developing a logistics support analysis program.

Perhaps most important, the manufacturer has provided strong warranties on the reliability and maintainability of the C-17.

Leasing Aircraft for the OSA Mission

Two new types of airlift aircraft are now arriving at Air Force bases to replace aging CT-39s in the Operational Support Aircraft (OSA) mission.

Rather than buying the planes outright, the Air Force obtained them through a novel leasing plan. Gates Learjet will lease eighty C-21As (Lear Model 35A) to the Air Force and Beech Aircraft will lease forty C-12Fs (Beech Super King Air B200). The contracts call for five-year leases with an option for three additional years. The Air Force can also purchase the aircraft when the leases expire.

Recognizing that leasing offers substantial write-offs to the contractors, the Air Force investigated the full extent of tax considerations thoroughly in their pre- and post-contract studies and concluded that leasing was the most cost-effective way to acquire these aircraft.

The Air Force will provide pilots (approximately 400), passengers, fuel, and cargo. The contractors provide training for the initial group of Air Force pilots and all levels of maintenance of the aircraft, including en route maintenance. Both companies must maintain an eighty-five percent MC rate (eighty percent fully MC and five percent partially MC) based on a monthly flying schedule of fifty-six hours per aircraft. The only servicing Air Force people will provide is routine support by transient alert personnel at en route bases.

The Future of Helicopters

The deficiences of current USAF helicopters are well documented. The average age, for example, of the H-1s, H-3s, and H-53s used for combat rescue, special operations, and support missions approaches twenty years. Maintaining these aging systems is getting more and more difficult. And, except for eight Pave Low III H-53s, the entire fleet is limited to visual flight operations.

"Lack of night/adverse weather and defensive countermeasures capabilities will make things more challenging," says Col. Tom Pilsch, Chief, Airlift and Training Division, Directorate of Operational Requirements, DCS/Research, Development and Acquisition, Hq. USAF.

Advances in aerodynamics, propulsion, and avionics hold promise for leading the Air Force out of its current problem.

Officials are acutely aware that fiscal and political realities tend to delay fielding of needed systems. Nevertheless, replacement efforts are in progress as part of the "Combat Helicopter Modernization Program."

Currently, the Air Force plans to procure an additional ninety HH-60A helicopters. The program has been restructured several times during the past year to reduce costs. The HH-60A will be a derivative of the Army's UH-60A Blackhawk. Current features include low-level precision navigation, extended range, cockpit integration for operations in the demanding night/low-level environments, and commonality with Army and Navy versions of the H-60. However, the aircraft will not be capable of adverse weather operations. *(See also "Jane's Supplement" item, p. 97.)*

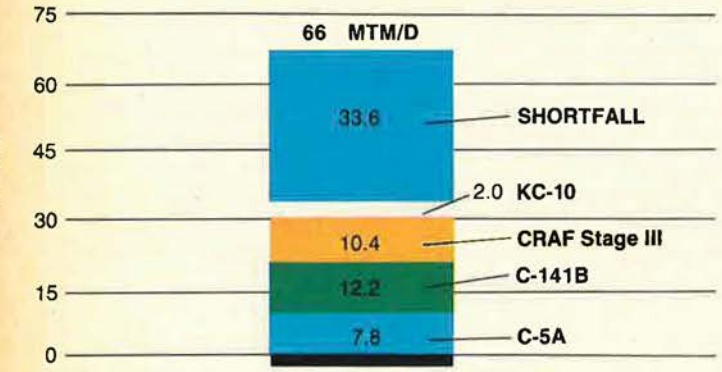
"The HH-60A will meet minimum near-term requirements while providing growth capability for the future," Colonel Pilsch says.

In another program, the Service Life Extension Program (SLEP) for the H-53s will extend the service life of the aircraft and will provide interim long-range vertical lift capability until the Joint Service Advanced Vertical Lift Aircraft Development Program (Experimental) (JVX) aircraft becomes operational in 1994.

Finally, the Air Force is in the preliminary stages of searching for a replacement aircraft for the nine Bell UH-1N and three Sikorsky CH-3E helicopters assigned to the 89th Military Airlift Wing, Andrews AFB, Md. The aircraft are used as part of the plan to ensure continuity of government in national emergencies.

As a secondary mission, the helicopters will be used for what the Air Force terms "safe, reliable, and timely transportation" of high-level military, government, and foreign officials in the Washington area. They also provide emergency humanitarian medical airlift and support the national search and rescue plan. A statement of need has been developed, allowing the program to compete for money with all other Air Force programs in the next budget cycle.

The Shortfall Today



Source: Hq. MAC

SOF: That Special Airlift Requirement

The Army and Air Force have agreed, as part of the Memorandum of Agreement (MOA) signed in May 1984, to transfer the responsibility for providing SOF rotary-wing lift support from the Air Force to the Army.

The MOA should have minimal near-term impact on Military Airlift Command, says Gen. Thomas M. Ryan, Jr., Commander in Chief of MAC. "We anticipate that the Army will develop appropriate helicopter systems and support structures to meet the short-range operations lift requirements identified by the theater CINCs," he says.

"We will take all precautions to assure that we do not degrade our nation's SOF capability during the transition of mission responsibilities," General Ryan emphasizes.

Turning to its fixed-wing SOF fleet—the AC-130, MC-130, and Air National Guard EC-130—the Air Force is going ahead with plans to modernize. On the horizon are twenty-one new MC-130H aircraft over the next several years, incorporating improved navigation, ECM, and special avionics capabilities.

Finally, what about JVX? This program is a DoD initiative, with the Navy as executive agent, the Marines providing the program manager, and the Air Force responsible for unique systems development.

The goal is to develop a common vertical takeoff and landing vehicle to satisfy service requirements. The aircraft would be used for Air Force special operations, Marine vertical lift assault, and Navy combat rescue. The Air Force requested $1.1 million during FY '85 for unique avionics for the SOF mission.

"The technology promises a substantial increase in Air Force special operations capability," says General Ryan. "The JVX will replace the SOF HH-53 and supplement the MC-130 to provide a long-range infiltration/exfiltration capability not currently available."

JVX requirements include a 700-nautical-mile unrefueled radius, ability to carry twelve to twenty-four people at night and in adverse weather, a dash speed of 275 knots, and air-to-air refueling capability.

Procurement is scheduled to begin in FY '91 with the purchase of six aircraft out of a planned eighty. The Air Force will share two test aircraft of seven with the Navy for operational testing. IOC of six aircraft is planned for FY '93.

The demands of the SOF mission require unique aircraft with special capabilities. "As the likelihood of low-intensity conflict increases, we must respond with upgrade of our special operations forces to meet growing mission requirements," General Ryan says.

The Air Force uses the OSA fleet to move critical cargo and passengers during wartime and for seasoning new pilots prior to transfer to larger aircraft.

"As an example of OSA contingency involvement, the CT-39 force flew fifty-two sorties in direct support of US operations in Grenada," says General Ryan. These priority missions involved transportation of high-ranking officials, intelligence information, classified materials, and spare parts.

Improving Crew Efficiency

"Our efforts to modernize and enhance our airlift capability will be of little value if we fail to meet the needs of our people who ensure the success of our mission," says General Ryan.

Currently, the training programs for the C-5, C-141, and C-130 are being revamped. "There is quite a bit going on in the training area, even though the command has very good programs," General Ryan says.

In the C-5 area, MAC is planning to contract out the classroom and simulator training at Altus AFB, Okla., and then upgrade aircrew training devices at Travis AFB, Calif., and Dover AFB, Del. With the C-141, existing simulators will be upgraded and trainers for a specific task added.

New simulators, with realistic, full-visual displays, are now being used at the C-130 school at Little Rock AFB, Ark.

In conjunction with the Air Force Human Resources Lab, MAC is also developing a new Model Aircrew Training System (MATS) to make full use of the new simulators and procedure trainers. The command is also studying initiatives in computer-aided instruction.

For the past several years, MAC aircrews and planners have felt the need to devise new tactics and training to counter the vulnerability of their aircraft in high-threat environments. Prior to September 1983, there was no central or formal training for airlift and special operations tacticians.

Now MAC has the Combat Aircrew Training School (CATS), located at Nellis AFB, Nev., to fill the void. This site was chosen because it is near the home of the

C-21As taxiing in at Scott AFB, Ill., for arrival ceremony. The Air Force is acquiring eighty C-21As as replacements for the aging CT-39s. The contractor will provide for maintenance and logistics under a lease contract with the Air Force.

TAC Fighter Weapons Center and existing threat training facilities. In the past year, twelve three-week classes of pilots, navigators, and intelligence people from C-130, C-141, and helicopter wings have been conducted. Graduates of CATS return to their parent wings and set up unit training programs.

But efforts to increase wartime aircrew proficiency go beyond the classroom and the simulator. MAC crews participate regularly in major JCS-sponsored exercises like Bright Star, Reforger, and Team Spirit. With the Army proposing to air-drop troops and equipment at lower altitudes to reduce exposure to any enemy, MAC crews train to keep pace with requirements.

Finally, competition serves as a readiness experience for airlift participants. Annually, MAC conducts its airlift competition of more than 1,200 people at Pope AFB, N. C. Called Volant Rodeo, the competition highlights aerial delivery and ground operations. Participants in this year's event in June included teams from the active-duty force, ANG, AFRES, and eight allied countries. An Italian Air Force crew was the overall winner. The 314th Tactical Airlift Wing, Little Rock AFB, Ark., won in 1983.

Beyond the Airlift Master Plan

The Airlift Master Plan defines airlift force structure requirements from now through the turn of the century. It provides a workable strategy for matching expected capability with long-term airlift needs. However, planning does not stop there. USAF and industry planners are actively pursuing initiatives beyond the scope of the Airlift Master Plan. Numerous studies, particularly in the intratheater arena, are under way.

Where past studies identified the need for increased airlift within the intratheater battle area, they did not quantify transport requirements. Current studies are attempting to define these requirements. The Worldwide Intratheater Mobility Study (WIMS), conducted by the DoD and JCS with service participation, is concentrating on support of a Southwest Asia force during a worldwide conflict scenario. That study, scheduled to be completed in early 1985, is tasked to determine specific intratheater mobility requirements—including airlift.

As part of a historic Memorandum of Agreement (MOA) signed this year between the Air Force and the Army, both services are working to establish a joint office to determine intratheater airlift requirements and to develop joint positions on intratheater airlift programs. This office will also invite inputs from all theater commanders and, in turn, will join with the WIMS group to provide the Secretary of Defense with the best analytical and practical assessment of intratheater and tactical mobility requirements. In joint action on the FY '85 budget, both the Senate and House Armed Services Committees have requested that such an assessment be provided by February 1985.

Planners at MAC and the Army's Training and Doctrine Command (TRADOC) have been developing joint positions on airlift for some time. Signed in August was a MAC-TRADOC memorandum of understanding further defining joint concepts in support of the Army's Airland Battle doctrine. "We want to ensure that MAC capabilities keep pace with changes in Army doctrine and that the Army does not expect more capability than we can provide," say MAC officials.

A related effort is Aeronautical Systems Division's (ASD) Mobility Mission Analysis, which began in January 1984. ASD, in concert with MAC, began this two-year study to forecast the airlift system at the turn of the century. Their goal is to determine airlift options and the timing for those options while emphasizing a high degree of survivability.

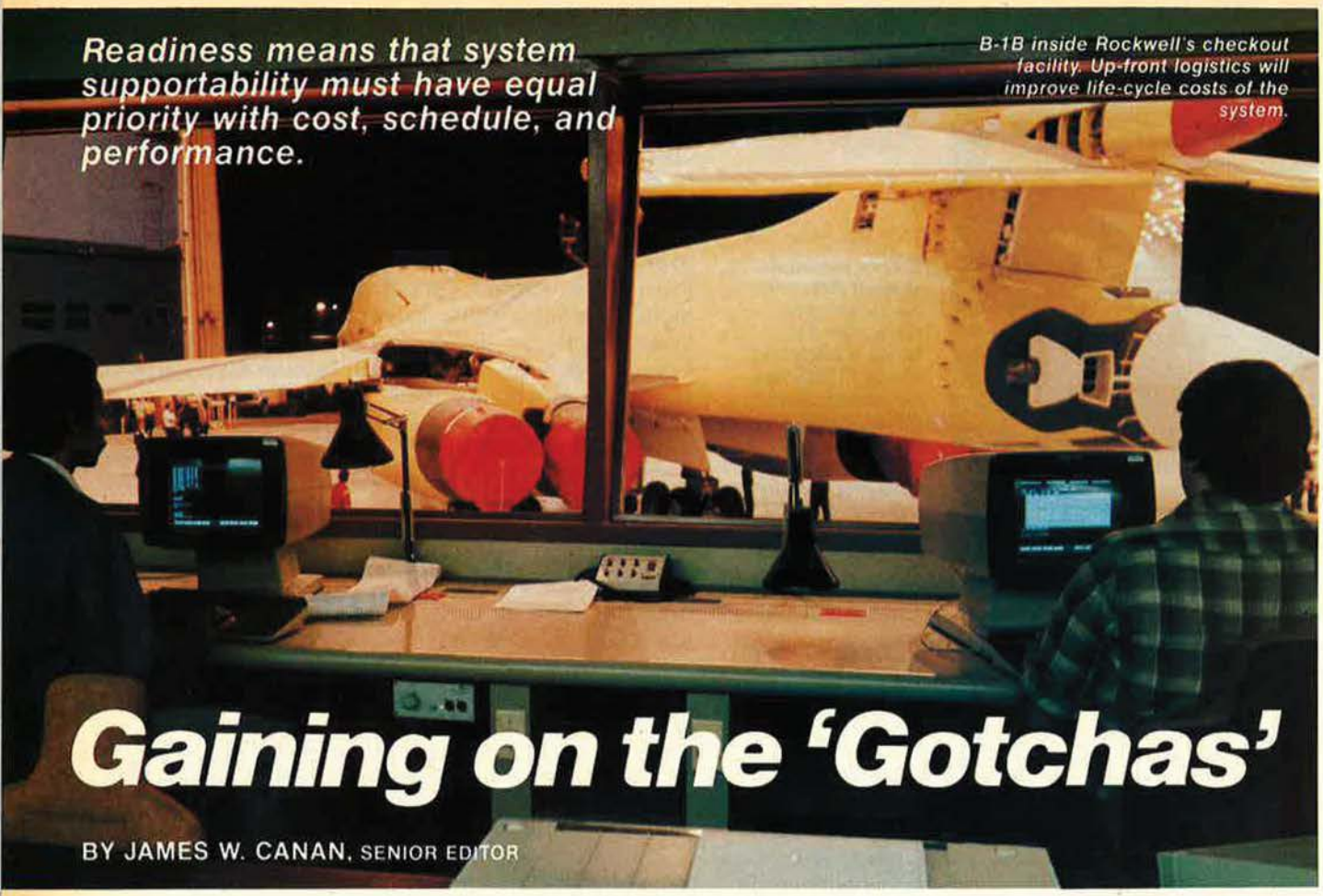
This process of concept development has historically been provided by ASD for other major Air Force commands in their acquisition of new weapon systems. But this study is a first for MAC. Even though this study is still in its infancy, a dialogue among Air Force, Army, Marine, and private-industry conceptual planners has been established that should provide positive long-range directions for airlift.

Within MAC headquarters, an Advanced Tactical Transport (ATT) working group is presently developing the basis for a statement of need that is tied to the Army's evolving doctrine and that will be coupled with results of the WIMS and ASD's Mobility Mission Analysis. The ATT working group is also comparing military efforts with those of the major aircraft manufacturers who, through independent research and development, are evaluating numerous concepts of their own.

All of these initiatives focus on the evolving tactical airlift requirements of the future and on how to quantify and support them. ■

Maj. Michael B. Perini is Deputy Chief of the Operational Forces Branch in the Secretary of the Air Force's Office of Public Affairs. An Education With Industry officer with AIR FORCE *Magazine in 1982–83, Major Perini holds a bachelor's in social studies from Washington State University and a master's in social studies/education from the University of Southern Mississippi. He served as Chief of the Public Affairs Division of the 1st Tactical Fighter Wing at Langley AFB, Va., prior to his tour as an EWI student, and has also served as a public affairs officer at Hill AFB, Utah, and Keesler AFB, Miss. He joined the Air Force in 1972 after receiving his commission through the AFROTC program.*

Readiness means that system supportability must have equal priority with cost, schedule, and performance.



B-1B inside Rockwell's checkout facility. Up-front logistics will improve life-cycle costs of the system.

Gaining on the 'Gotchas'

BY JAMES W. CANAN, SENIOR EDITOR

TO THE nonmilitary public, it must seem that the only time spare parts for USAF weapon systems draw any attention is when Air Force Logistics Command pays too much for them and takes highly publicized heat.

AFLC, headquartered at Wright-Patterson AFB, Ohio, harkens to its spare parts on that count, and accepts the heat—even while arguing that much of it is undeserved and that the situation is being corrected.

At heart, though, AFLC is really much more concerned about spare parts from a much broader, grimmer standpoint. This has to do with ripping off the taxpayers in the worst sense by denying them an adequate national defense.

The equation is simple and stark. Without spares to fix them or keep them fit, fighter aircraft in Europe, for example, don't fly for very long or at all. And if they don't, there could go western Europe.

And so, from the national security standpoint, the major spares problem that AFLC faces and is working to rectify is not one of overpayments but of supply, coordination, and distribution.

AFLC takes no heat from USAF's combat commands for its spares overpayments. Tactical fighter wing commanders in Europe would be glad to have AFLC pay any price for crucial parts to get their F-15s, F-16s, and F-4s into continuously tip-top combat shape.

The Custodian of Combat Capability

That is what it's all about—and why logistical requirements for giving the best possible support to combat units are in the forefront of just about everything USAF now does in the design, development, deployment, and upkeep of weapon systems.

All such requirements have to do either with making spares quickly available in abundance for fighters and missiles now in the field or with designing and building new fighters and missiles so that they won't need spares so quickly or so often.

The reliability of such weapons has become USAF's paramount concern. This is why AFLC, with reliability as its watchword, is on a roll as USAF's emerging custodian of combat capability.

AFLC is doing just what Gen. James P. Mullins ordained when he took command of it three years ago. It is exercising its major command leverage within the Air Force—with R&D, combat, and combat-support commands—to make sure that weapon designers, developers, and users give reliability the same regal attention they once reserved for performance alone.

There is some resistance in such commands to the increasing clout and pervasiveness of the logisticians, whose business has traditionally been regarded as necessary but mundane. Such resistance is far outweighed, however, by the increasing appreciation and support of the loggies' flowering influence.

For there is no other way to go.

USAF will be in very big trouble unless it can dramatically cut the costs and increase the efficiency of operating its weapon systems. It must not only keep those systems fit

but also *build* them fit, to go the distance—short of their destruction—in war.

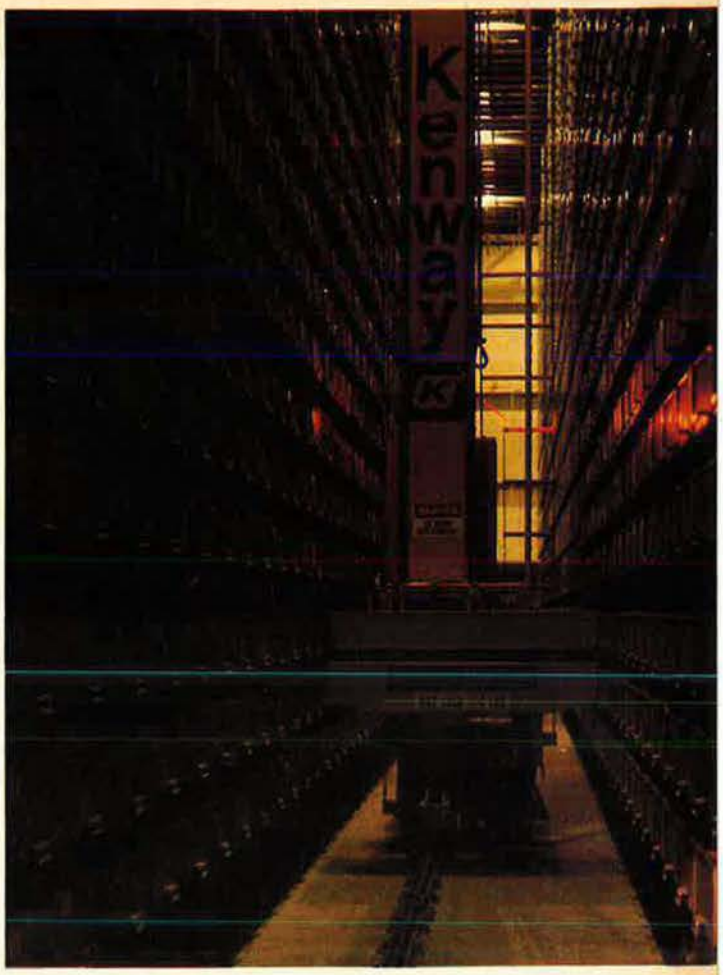
The reasons are stark enough.

New weapons cost a fortune to buy. Given their increasing complexity, their costs are unlikely to come down, and their annual production quantities and rates are unlikely to go up any time soon.

The combination of their high technology and the shrunken US defense industrial base at subcontractor and vendor levels (where spare parts are mainly made) also means that there would be no way of mass-producing them on demand, as there was with the weapons of wars gone by.

There will probably never again be enough numbers of enough types of new weapon systems to let USAF relax. Each unit of each type is already approaching the indispensable. "Keep 'em flying" carries an increasingly urgent overtone.

So the weapons simply have to be made to keep working well for as long as it will take to win the war. And they must be designed in such a way as not to daunt mechanics—to be intrinsically reliable from the drawing board forward.



Automated High Density Small Item Storage systems like this one at the Ogden Air Logistics Center at Hill AFB, Utah, have put logistics on the advanced track of automation. The total integration of computers into logistics will allow AFLC to identify parts quickly and to deliver them to field units.

Up-front Logistics

Making this happen is called "up-front logistics." It has become the name of the game for AFLC and the Air Force Systems Command (AFSC), working as a team in designing and developing weapons with, in effect, lifetime reliability warranties.

To the extent that the up-front logistics effort succeeds, all other facets of USAF's tough, nagging reliability-sustainability problem will be eased. Fewer repair and replacement parts will be needed, and their storage, identification, allocation, distribution, and insertion will, *ipso facto,* be reduced to more manageable proportions.

Those proportions are a long way from being manageable now. But AFLC is at work in several new, high-priority programs to make them so.

Some big ones are taking place at AFLC's Logistics Management Systems Center. It is developing systems for automated control and distribution of spares at the command's five Air Logistics Centers (ALCs) and for satisfying and predicting the spares requirements of combat users.

The Center also incorporates AFLC's new European Distribution System (EDS) program office. It is providing the communications, storage, and transportation wherewithal in Europe for quickly satisfying the most pressing spare parts requirements of US Air Forces in Europe (USAFE) *(see also the accompanying article on p. 80).*

The Air Force Acquisition Logistics Center (AFALC) is the agent for fostering USAF's growing emphasis on attention to logistics throughout the weapons design, development, and acquisition process.

A going concern for only a little more than a year, AFLC's Logistics Operations Center (LOC) has set up communications command and control links with all user commands and now is tied into the US World-Wide Military Command and Control System (WWMCCS). The LOC, as AFLC's prime connection with combat units and commands, has been the main instrument for clinching AFLC's latter-day status as a full-partner operating element of USAF—as a command that is now oriented more to weapons than to warehouses.

All such endeavors were initiated by General Mullins, who relinquished his command on September 27 and who is scheduled for retirement on November 1, and are being carried forward by his successor, Gen. Earl T. O'Loughlin. Before his retirement, General Mullins gave credit to the 95,000 people of AFLC for having done "a fantastic job" and said he was "very happy about what's happening."

"Six or Seven"

A great deal more needs to be done, however. On a scale of one to ten, said the General, "We were at two, and now we're at six or seven. We're gathering the momentum of the distributive capabilities that have become available to us, particularly in the data-processing and telecommunications areas, and I think this whole technology scenario will accelerate and expand.

"It gives the United States Air Force an extremely powerful tool to deal with the principal challenges of the future—the increasing threat, the declining resource base for dealing with that threat, and, consequently, the problem of setting priorities for the allocation of the available resources."

In this context, said General Mullins, the reliability of weapons, or the lack of it, will be decisive. If new weapons are no more reliable than older ones, their introduction into the force "will effectively eat our lunch," he declared.

"The Air Force deals in weapon systems," General Mullins continued. "We depend on people, strategy, tactics, and doctrine. But we focus on weapon systems because they are the means whereby we do our job.

"We know precisely what is expected of those weapon systems in terms of generic capabilities and of specific capability requirements.

"We can translate those into specific logistics imperatives. Consequently, we should be able to allocate the resources available to us against those imperatives."

But the General warned that there had better be enough logistics resources available—first to make existing weapons more reliable, and then to design and build reliability into new ones.

Logistics Operations Center

The likelihood of such availability has almost certainly improved, thanks mainly to the favorable impact that AFLC's Logistics Operations Center has made on USAF's leadership in Washington and in the combat commands.

The LOC showed its mettle during the Grenada rescue operation last October. It arranged a lot of hurry-up logistical support for that operation after the airlifting and combat had begun. Much remains secret, but one instance can be told as follows:

It's 3:00 o'clock in the morning and you're a MAC operational commander staging your unit on Barbados to go into combat over Grenada. It's pitch-dark and raining. One of your C-130s can't fly because its starter won't work, and you need every single one of your aircraft.

Urgently, you radio the JCS staff at the Pentagon. By now, that staff has become fully aware of the existence of this new setup called LOC at Wright-Patterson AFB. It gets in touch with LOC.

LOC hustles up the critical parts for the C-130 starter, puts them on a Logair aircraft, and moves it out for Barbados. The C-130 flies, and MAC, very happy, has good things to say about LOC to this day.

It could be that, at that point, AFLC earned its wings as a can-do member of USAF's combat board of directors.

LOC wasn't always so favored. In the early summer of 1983, after a Libyan aircraft bombed the capital of Chad, USAF deployed to Chad a force of AWACS and supporting aircraft.

LOC, at the time brand-new, was not given a situation report on that deployment until nearly two weeks after it had begun.

There will be no more of that, the operational loggies affirm.

The big reason there won't be is that, last May, LOC went on line in the US World-Wide Military Command and Control System Intercomputer Network (WIN). Managed by the Network Operations Center (NOC) in the Pentagon, it is a global network of "host" data-processing computers at thirty-six sites and of hundreds of terminals in the principal units of all four military services.

US military war plans are stored in the system, right down to time-phased deployment schedules for all overseas contingencies. AFLC headquarters and all five ALCs are linked to WIN from Wright-Patterson AFB through Hq. MAC at Scott AFB, Ill.

Until this took place, AFLC officials had regarded themselves, said one, as "lonely logisticians, standing off in the corner, totally disconnected from the action." This chafed them. They have always believed that if war comes, USAFE, for example, will need to talk to AFLC as much as it will to MAC or any other major command.

The C³ Guide Plan

Riding on its momentum, LOC has enlisted AFSC's Electronic Systems Division (ESD) at Hanscom AFB, Mass., to develop a C³ "guide plan." The goal is to provide AFLC, for the first time, a fully secure C³ capability—voice, data, teletype, and video—among all its command posts. The system should be operational, or nearly so, by the end of 1986.

Artist's conception of a European Distribution System aircraft being unloaded. The EDS, which is an AFLC program, will provide combat units with a better logistical support link for wartime activities.

Right now, LOC is relishing its C³ relationship with user commands.

Working with TAC, LOC can call up, as a computer display, the projected spares situation for all tactical weapon systems in any scenario, such as the defense of Europe or the defense of Southwest Asia. The computer model at the heart of this can predict for LOC the status of sortie-generating (or sortie-limiting) spares in whatever stage of combat it is asked to analyze.

SAC and MAC are now interested in adapting that model to their own weapon systems and wartime scenarios.

The model is programmed to deal with weapons, not with wings or squadrons. For example, it can quickly show—on computer display screens at LOC, at TAC headquarters at Langley AFB, Va., and at the Ogden ALC in Utah that manages spares for F-4s—the mission-capa-

ble status of all Phantoms in the Air Force at any time.

To the logisticians, a big advantage of such models is that they give LOC clout in allocating and reallocating resources within AFLC. On the basis of what it decides are combat priorities, the Air Staff in Washington directs how much money must go to support which weapon systems. It is AFLC's responsibility to see to it that such allocations are carried out or modified if they get out of line with changing needs.

LOC can do this. It can tell, in a twinkling, whether one ALC in charge of supporting one kind of aircraft is getting too much money at the expense of another ALC in charge of supporting another kind more greatly in need.

Showing AFLC's Muscle

Taking advantage of its burgeoning C^3 capability, LOC is showing AFLC's muscle throughout the Air Force. As explained by Brig. Gen. Thomas A. LaPlante, who organized LOC and led it into action, "We work with the shortfalls, with the war plans, and with the customers, and we are in position here to really understand where the wherewithal is lacking—because we can now define all [logistics] requirements in combat terms.

"If we say that the defense of Europe requires another $7 billion for spares, and the Air Staff asks what the impact would be if we got only $5 billion, we can answer: 'You'd take away forty percent of my POL and half of my tactical missile capability, and you'd cut seventeen days out of my sustainability.'

"Now, certainly, there are constrained resources and everybody is competing for them in the Air Force. But what our system now enables us to do is to let the senior Air Force leadership know exactly what they are trading off if they follow through on an arbitrary decision not to fund spares. We can tell them that the defense of Europe would be only seventy-three percent supportable—it's your choice."

Moreover, General LaPlante said: "We can go to TAC and say this is what it's going to cost you to go to war with your F-15s and F-16s. Then TAC can go to Washington and better defend what it requests.

"If TAC gets only half, we tell it we will buy the best and the most spares we can with the half of a basket it got. But now TAC knows, and the senior leadership knows, why and how TAC is going to hurt."

General LaPlante left LOC last August to become PACAF's Deputy Chief of Staff for Logistics. He was succeeded by Col. Joseph K. Spiers, who had been Vice Commander of the Air Force Acquisition Logistics Center at Hq. AFLC.

AFALC is in charge of AFLC's widening participation in Air Force Systems Command's weapons design, development, and acquisition projects. It supervises about 1,000 logisticians who work in AFSC's program offices.

The spreading influence of the "loggies" was encouraged by Gen. Robert T. Marsh, who retired July 31 as AFSC's Commander. His successor, Gen. Lawrence A. Skantze, formerly USAF's Vice Chief of Staff, will reconfirm the logisticians' place in the sun.

The evidence for this comes from a speech that General Skantze made last March at the Worldwide Air Force Pricing Conference in Oklahoma City. He had this to say, in part:

"Weapons that aren't ready when we need them, where we need them, and for as long as we need them simply won't do. Therefore, we are working to build readiness and supportability into them right from the start. . . .

"We're promoting technologies with high logistics payoffs to ensure maintainability and supportability. We're increasing our emphasis on improvements that reduce costs for the life cycle of a weapon system."

This is the responsibility of AFALC. In the past, the Center's attention was concentrated mainly on logistics in connection with the engineering development of weapon systems.

But engineering development comes late in the game, leaving little leeway for newly sprung logistical considerations.

Logistics Dons a Lab Coat

Now, in a newly created shop headed by Col. Gerald F. Saxton, the Center's Deputy for Advanced

Technology and Logistics Strategy, AFALC is moving logistics into the laboratories.

"We found," said Colonel Saxton, "that our potential to influence what is going on in acquisition programs is heavily weighted toward their front ends. Throughout the process, starting with the technology base, every time a milestone is reached, logistics options are narrowed."

AFSC's Advanced Tactical Fighter (ATF) development program supervised by Aeronautical Systems Division (ASD) at Wright-Patterson AFB is a prime example of logistics leverage from the word go.

The logisticians played a prominent role in ASD's drafting of the initial specifications for the Advanced Tactical Fighter. They are now helping to work up the contracts for the next phase of ATF development and are very much absorbed with assuring the reliability of the ATF engines.

ASD's Pave Pillar program for integrating aircraft avionics, with emphasis on the ATF, also riveted the logisticians' attention—accent on simplicity of concept so far as possible.

The Advanced Tactical Radar program at ESD is another example of the logisticians' influence and constructive assistance in early-development projects.

"We put a lot of logistics support in there," said Colonel Spiers, "and they [the engineers] saw that, from a logistics standpoint, the ATR wouldn't go, it wouldn't result in a finer machine. Their analysis showed where the 'gotchas' would be later on in the program."

AFLC has assigned logistics managers to several Air Force laboratories and to many product divisions as well. It has put together "advanced concept supportability teams" to work on top-priority programs in—or emerging from—the technology base.

Breaking into the Triangle

Moreover, it has become involved in evaluating a host of independent research and development (IR&D) programs by USAF's contractors and is spending more and more time working with the user commands.

Such commands often formulate their operational concepts of a forthcoming weapon system on the basis of the technology base and resources for that system.

On the other hand, the R&D people involved in the weapon program tend to tailor their development work to the needs of the user command as they see it. Companies in the program shape their early efforts in accordance with the requirements of the user and the developer and then, as a result of their own work over time, begin to influence those requirements.

This leaves little leeway for the logisticians.

"It's critically important to break into this R&D-user-contractor triangle early if we're going to influence the development of user requirements," Colonel Saxton declared. "So much of the up-front work is done by contractors that putting our [logistics] requirements into the contracts is critical to doing our job.

"We try to tailor our approaches to this so that we don't drive costs and schedules more than is absolutely necessary.

"We also try to begin participating in the process at the time of

The bad publicity on spare parts has had some good effects.

Horrors a

There was a time, not long ago, when a phone booth could have accommodated everyone who showed up at the Pentagon for a briefing on spare parts by those wrench-and-widget types from Air Force Logistics Command.

Around that time, if one of those AFLC officials had rung up a spares contractor to complain that prices were out of line, the contractor might very well have told him, in effect, to bug off.

How times have changed.

By now, the horror stories of alleged spares overpricing are legion (AFLC officials call them "hero stories" because workers in the system discovered the instances of overpricing and had the guts to blow the whistles first), and the uproar that they caused may never die down, particularly during this political year.

Now if there is a spare parts briefing at the Pentagon, or a hearing on Capitol Hill, the room is jammed.

Now if AFLC complains to a contractor about a price, the contractor is likely to say: "Yes, sir! What was that part again? We'll get right on it!"

As a matter of fact, spares contractors voluntarily refunded AFLC about three-quarters of a million dollars in 1983, and the tally is mounting, but has not been added up, for this year.

AFLC officials don't want anyone to get the notion that they wink at revelations of such prices as $1,118 for an AWACS navigator stool cap and $9,606 for a hex wrench.

But they do say: Hold it a minute, even though we clearly fouled up, there were some mitigating circumstances, and we're doing all we can to correct things.

Tackling the problem is the job of AFLC's Brig. Gen. Richard D. Smith, Deputy Chief of Staff for Contracting and Manufacturing. As he recounts it, there were two main causes for most of the overpriced items: proposed provisioned pricing and cost allocation.

When AFLC sets about provisioning a new weapon system, it asks the system contractor to propose a price for parts that the contractor and its vendors will supply. The contractor can only estimate that price, which is negotiated later.

The notorious $9,606 for the hex wrench was just such a provisioned price proposal. It was flagged by an AFLC worker after it was put into AFLC's stock list—but before AFLC had begun negotiating it downward with the contractor. The wrench was never, in fact, bought.

An example of that wrench showed up on the "Christmas tree" that Sen. William V. Roth, Jr. (R-Del.), displayed on Capitol Hill last December. The tree was festooned with parts that the Senator said were examples of gross military overpayments.

AFLC officials, who had had no intention of actually paying the contractor's proposed price for the wrench, were nettled by Senator Roth's display.

"It was like accusing a guy of getting robbed when he hollers, 'Hey, I'm going to be robbed!' " the General declared.

The problem of improper cost allocations resulted from AFLC's lax attention to "unit-price integrities" with respect to individual spares. This means that the costs of all the many components on an order for the repair of, say, a black box were sloppily allocated to each component on the basis of arbitrary, arithmetical subdivision—not on its actual cost.

heaviest competition among contractors."

When is that? "In the program's earliest phases, when we have the most contractors competing. By the time it gets to full-scale development, the program is usually down to one contractor, and we have our least leverage."

Over the past two years, the logisticians have moved ever more forcefully into the arena of contractor independent research and development (IR&D) programs. These are characterized by R&D that is initially funded by the companies but at least partially reimbursed by the Air Force because it relates to—and is often later folded into—particular Air Force weapons programs. The amount that the Air Force pays the companies depends on how pleased it is with their efforts. In the past, logistics—the supportability angle—was not a criterion for such judgment.

Stress on Supportability

Now it is. As a result, says Colonel Saxton, "All of a sudden, we have contractors coming to us and saying, 'What can we do for you?' "

On such occasions, the logisticians are very explicit in their responses. They do even better than that. They put out a book each year that sets forth, in detail, the logistical goals of a plethora of Air Force research endeavors.

Under the title "Air Force Logistics Research and Studies Program," the annual volume is published by the Air Force Coordinating Office for Logistics Research, which is situated at Wright-Patterson and which works closely with AFALC. An arm of the Air Staff, AFCOLR acts as a broker between the logistics community and the R&D community. It draws heavily from them and from such commands as SAC, TAC, and MAC in putting together its book, which provides the Air Force, contractors, and the academic research community with a broad, detailed view of logistics needs and thrusts.

Its message: "The Air Force is driving toward mission readiness, supportability, and sustainability. . . . Supportability must be considered equal to cost, performance, and schedule."

Indicative of the increasing clout of the loggies, this year's compendium puts 184 research projects and proposals into logistical perspective one by one. The first such book, published two years ago, embodied only a score or so.

Using the Users

The logisticians are not magicians. "We have a hard time articulating our support requirements unless the users firmly establish their operational requirements and help us," explained Col. Lewis Curtiss III, AFLC's Deputy Director for Acquisition Logistics.

So AFLC turns to the pilots and the crew chiefs. The B-1B bomber and Advanced Medium-Range Air-to-Air Missile (AMRAAM) programs are examples.

Several innovations in B-1B avionics, all leading to greater reliability and ease of maintenance, are largely credited to a team of eight maintenance NCOs that SAC assigned to the side of the logisticians during the B-1B development.

"They were top-notch," Colonel Curtiss said. "They provided a leavening throughout the [logistics] organization on the program."

ıd Heroes

The result, when this happens, is that a diode may show up on the books as costing ten times more than it actually does and a power supply unit ten times less than it does, even though the total cost of the black box comes out right.

Part of this cost-allocation problem, and indeed of all AFLC problems, is the antiquation and inadequacy of its computer resources for keeping tabs on the 800,000 items it manages and on the 80,000 it buys every year.

There were—and still are—too many humans in the soup. "Our data automation stank," General Smith declared. On all fronts, this is being addressed at AFLC.

Another side of the overpricing situation that vexes AFLC officials for having been ignored by critics is this:

Prices listed for many spares include not only the costs of hardware but also of quality control and packaging. These costs are billed for the spares by prime system contractors who act as AFLC's middlemen in dealing with vendors of spares for their systems.

The costs are legitimate, but appear not to be when they are lumped together with the cost of the hardware in a budget line item that looks way out of line.

Now AFLC is trying to cut such middleman costs by going directly to spares vendors, skirting the primes, for many kinds of buys.

This has its pitfalls too. Quality control will be more difficult, and AFLC will pay a different sort of price for the additional man-hours that it will need to spend on the effort. AFLC's people will have to do the jobs that contractors formerly did and charged off as overhead.

Up to now, however, this direct-buy, "breakout" process seems to be paying off. For example, it has saved AFLC about $500,000 in engine parts, such as elbow assemblies and tube assemblies, so far this year.

By and large, prime contractors would just as soon have AFLC deal directly with their subcontractors and vendors for spare parts that are not considered critical.

"The business of the primes is systems, not spares," General Smith said.

Last October, AFLC set up its Competition Advocacy organization under Col. William J. Hentges. Its mission is to press for greater competition among spares vendors in order to increase quality and to keep costs in check.

Nothing beats competition, in the opinion of Robert A. Sands, assistant deputy to the AFLC commander for competition advocacy. Mr. Sands, who served as a logistician on the Air Staff and who took part in this year's Air Force Management Analysis Group (AFMAG) investigation of spare parts pricing, handling, and disposal, had this to say:

"I've seen competition produce price and quality that you couldn't beat out of some sole-source contractors with a two-by-four."

The competition advocacy organization also includes a source-development office embracing about seven people at each of the five Air Logistics Centers. "What we'll do is go to those people and say, 'Find me two new sources [vendors] for this part or that one we need,' " General Smith explained.

AFLC has also hired more than 300 people, as authorized by USAF, for a new program called Pacer Produce. It was created for the specific purpose of setting stringent target prices for spares and of following through with tougher contracts.

As General Smith put it: "When we apply pressure to contractors, they tend to show interest."

Input from SAC personnel also enabled the logisticians to influence the redesign of hydraulic motors aboard the bomber.

Fighter pilots and missile-maintenance NCOs helped greatly in defining the supportability requirements for AMRAAM.

Assembled as a team, several pilots who had fought in Vietnam gave the AMRAAM program the benefit of their sometimes unhappy experiences with previous generations of radar-guided air-to-air missiles.

"Those guys remembered their frustration, and it led them to have logistics supportability as one of the key elements of their approach," Colonel Curtiss said.

With their assistance, the logisticians brought off a redesign of the electronic innards of AMRAAM that makes it easier to maintain or to modify.

AMRAAM is a "software-intensive" missile. This means that its microcomputer programs, embedded in semiconductor chips, can be changed in accordance with changing operational requirements. But in the beginning, its key software components were somewhat scattered—and some were buried—in the electronic section of the missile.

So, on the advice of maintenance personnel, those components were consolidated on a circuit board that was then positioned for felicitous access.

This will come in handy when the AMRAAMs begin arriving in Europe in a year or two for carriage aboard USAFE's F-15s and newer variants of F-16s especially wired for them. USAFE is short of all types of air-to-air missiles and urgently needs AMRAAMs. The less time it takes its mechanics to modify and repair them, the better.

The European Distribution System

Before the AMRAAMs arrive, AFLC will have set up something else to gladden hearts throughout USAFE. It is called the European Distribution System (EDS)—a C^3, airlift, and forward stockage setup that will keep an estimated 304 fighter aircraft from being grounded for lack of logistics repositioning capability during war.

EDS should enable USAFE to put so many more bombs on so many more targets, and so many more cannon rounds and missiles into so many more enemy aircraft, that it could well mean the difference in winning or losing the war, should the Warsaw Pact attack.

EDS is coming along so nicely that AFLC is already thinking about a comparable system for PACAF and other commands.

As of now, it can take ten to twenty days for a fighter base in USAFE to come up with a spare part it needs to get a fighter back into action. The span of time depends on whether or not the part is available elsewhere in Europe and, if not, on how long it takes to dig the part out of a depot in CONUS, assign it to USAFE, and get it to the proper base.

This problem is severely aggravated by the airlift shortfall in Europe and is compounded by the fact that USAFE has no special call on intratheater airlifters. They are common-user assets assigned to Allied Command Europe (ACE) headquarters in Belgium.

All too often, USAFE must resort to trucks or divert its own aircraft, even fighters, to transport parts that are stocked out of position in Europe or that come in from CONUS.

EDS will fix all that. The EDS office has contracted with Short Brothers of Belfast for eighteen turboprop C-23A cargo aircraft that will be dedicated to carrying crucial spare parts, including the biggest fighter engines, back and forth in Europe.

The spares will be loaded aboard those aircraft at USAFE bases and from a forward-based EDS warehouse in England, which will go into operation in December, and from others in the central and southern regions of Western Europe.

Sooner Is Better

The EDS C^3 network will tie all such European supply depots into operational bases and into AFLC headquarters and Stateside depots. If an EDS supply site in Europe does not happen to have an urgently needed part, it will be able to find and order that part quickly from the States.

The hub of the C^3 network will be the Logistics Readiness Center at USAFE headquarters at Ramstein AB, Germany. Its role will be crucial in wartime. It will make real-time decisions on which bases to send parts and which to draw parts from, depending on how the combat is going and which tactical wings direly need, or happen to be overstocked with, particular parts.

The EDS C^3 system is designed to allow for decisions within two hours on where parts are and where to send them and for transportation of those parts to their destinations in no more than thirty-six hours, usually only twelve. The extreme case would be accessing a part in Norway and delivering it to Turkey.

The whole EDS program—fully automated communications nets, aircraft, and warehouses—appears to be one of the best buys USAF has made in a long, long time. It will cost less than $90 million to acquire, most of that in aircraft. Six will be ready to go in Europe by next March—and USAFE is going to breathe a whole lot easier.

Looking ahead, EDS planners at Wright-Patterson are gearing for an extension of the program later in this decade.

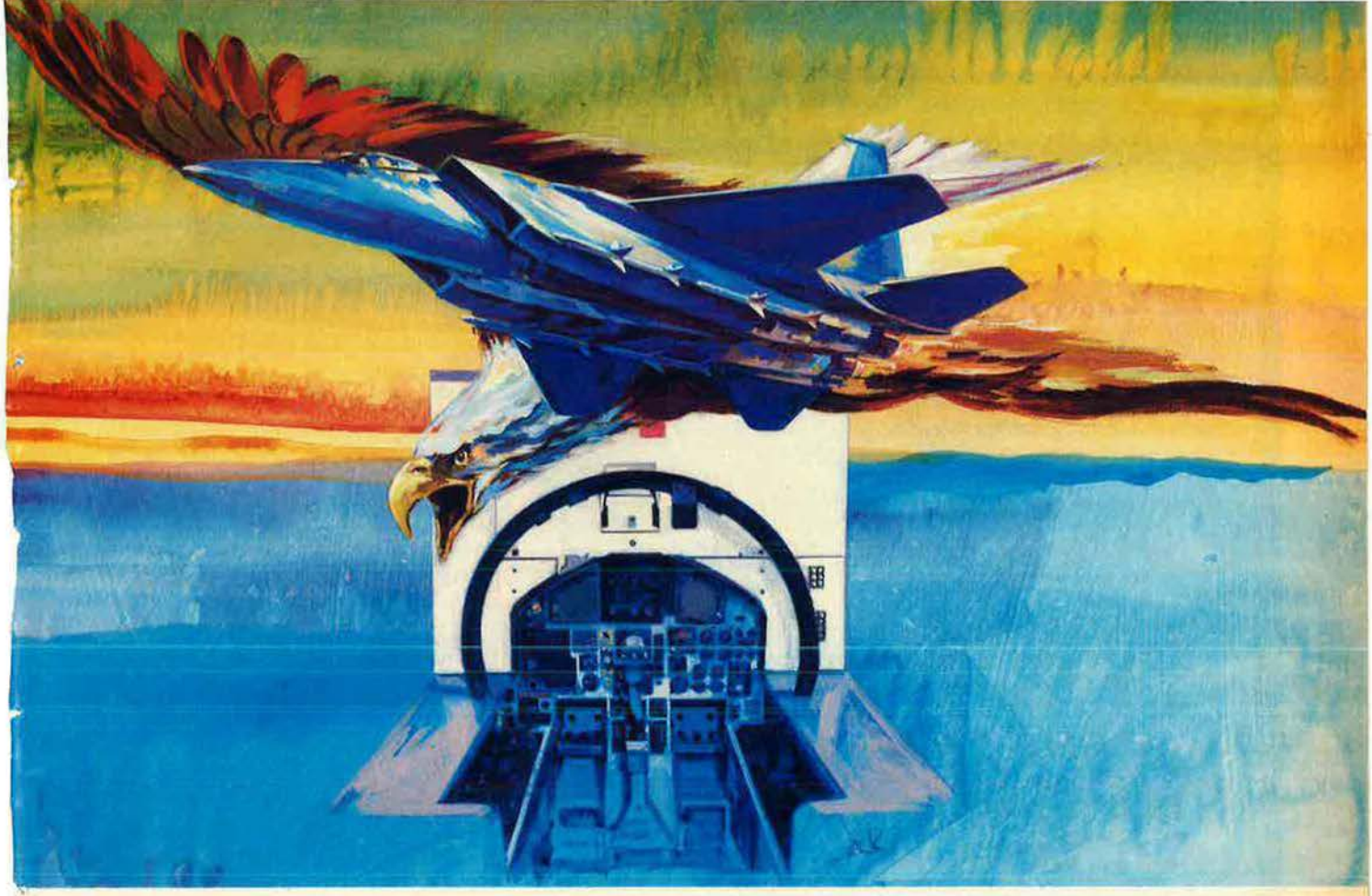
For example, says Ron Chalecki, Director of the EDS program office: "We are looking at such things as what happens when all those TAC units deploy to Europe and bring their kits and spares. How will we tie them into the EDS system? Some of those guys may be putting their units right on an *Autobahn* or at a forward location where we don't have adequate communications. How do we communicate? Via satellite or wireless digital."

The astounding thing about Mr. Chalecki's shop, considering its brisk achievement, is its size: twenty people.

It may well have to grow. It aspires to the institution of a Pacific Distribution System (PDS) and has attracted the interest of SAC, US Central Command (CENTCOM), and Alaskan Air Command.

Sooner is better for the system in Europe. There isn't a doubt in the world that, if war breaks out there, the critical spares will be in the wrong places. USAFE is simply not capable of receiving them and redistributing them in time.

There are only enough critical spares now positioned in Europe (and only enough storage space in Europe for them) to return forty



How Honeywell helps America's Eagles leave the nest fully feathered.

F-15 Simulated Aircraft Maintenance Training System.

Every aircraft pilot knows his mission and his life depends on how well his aircraft is maintained on the ground. Ground support personnel must be highly proficient in their knowledge of complex aircraft systems.

Soon, aircraft maintenance technicians will begin their training on Honeywell developed F-15 Simulated Aircraft Maintenance Training Systems. The F-15 Integrated Avionics System Trainers and Electrical Power and Lighting System Trainers will provide organizational-level training on specified job guide checkout and fault isolation procedures for 800 aircraft malfunctions.

In fact, Honeywell recently sent the first group of trainers to Luke Air Force Base Field Training Detachment 527 for advanced training course development... well in advance of contractual requirements. As a result, the Air Force will be able to maximize use of the system. Instructor workload forecasting and instructional course development from hands-on experience and input from all levels will be accomplished well before final delivery and acceptance.

Already, reaction from the course instructors has been very favorable. F-15 SAMTs will dramatically improve the proficiency of aircraft maintenance technicians, free up operational aircraft, improve instructional efficiency, and provide students with practical experience in the classroom.

F-15 SAMTs will help make sure America's Eagles have had the best possible ground support.

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The Sidewinder missile is the most successful air-to-air combat missile ever made. And Ford Aerospace is the world industry leader in complete Sidewinder missile systems experience.

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- Ford Aerospace is a principal contractor for the Sidewinder AIM-9M guidance and control section.
- Ford Aerospace is the developer and only supplier of the all-up-round Sidewinder AIM-9P missile system.
- Ford Aerospace has extensive experience in complete integrated logistics support and training, and has designed and built nearly every Sidewinder depot in the world.

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Improvements to a "super cooler" used with infrared sensors in space will extend the life and boost the efficiency of the device. The cooler, vital to defense applications and geological surveys, is a Vuilleumier cycle cryogenic refrigerator. It is designed to chill sensors near absolute zero to increase their sensitivity to thermal radiation. These coolers are ideal for use in space because the low internal forces required by this kind of cooling cycle cause little wear on bearings and seals. Hughes Aircraft Company is working under a U.S. Air Force contract to extend the unattended operating life of the cooler beyond five years. The cooler will use less power, so smaller and fewer batteries are needed to power the device during eclipse periods—a savings of hundreds of pounds.

By providing accurate and timely data in an instant, a new command and control information system (CCIS) helps military commanders better manage air defense and battlefield operations. CCIS eliminates the need to manually transmit and display data on plotting boards while making sure that commanders won't base their decisions on outdated or inaccurate information. The Hughes system consists of advanced computers and displays. It generates and distributes messages and reports, monitors operational data and thresholds, and alerts operators of critical situations.

In the last 20 years, over $611 million in savings have been negotiated by Hughes and the Department of Defense as a result of engineering proposals for cutting costs of military systems. Since the inception of the Value Engineering program, Hughes has had 675 proposals accepted in 50 programs. The changes stemmed from advanced technology that was not available at the time the original contracts were signed. They resulted in substantial improvements in quality, reliability, producibility, and life-cycle costs. Savings amounted to 3% of Hughes sales during the period, with the U.S. government's share amounting to nearly $500 million. The Value Engineering program is designed to encourage employees to look at the functions of a product and develop alternatives that cost less, perform better, and improve reliability.

Norway's new Acquisition Radar and Control System, which combines 18 mobile radars and fire distribution centers for the Adapted-Hawk antiaircraft missile program, draws on technology from other programs. Kongsberg Vaapenfabrikk of Norway provides computers it had developed for the Norwegian armed services and multicolor display consoles it is developing for the Norwegian-West German submarine program. Hughes provides the new Low Altitude Surveillance Radar (LASR). The radar uses a mechanically rotated antenna to provide 360-degree coverage with phase scanning for elevation coverage and frequency for back scanning.

A manufacturing philosophy called group technology holds far-reaching implications for improving productivity. The underlying concept, relatively simple and not particularly new, brings together related components or processes to take advantage of similarities in design or manufacture. Hughes is applying the idea to two manufacturing divisions that do batch manufacturing, an operation involving many projects that typically use large numbers of parts with many variations. The groups will focus initially on two aspects of manufacturing—metal parts fabrication and circuit card assembly. Research indicates potential impact of a 70% reduction in production make span, a 20% reduction in floor space, a 10% reduction in direct labor, and an 82% improvement in on-time deliveries.

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HUGHES
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percent of USAFE's grounded fighters to service at any one time—and it often takes at least three days, using trucks, "borrowed" cargo aircraft, and combat aircraft, to get those parts where they need to go.

Back on the Automation Track

A major part of USAFE's problem—applicable to all other commands as well—is that it takes forever to find parts and get them shipped in the half-man, half-computer system that now dogs AFLC's depots.

In its new programs for automated stock control and distribution and for a fully computerized spare parts requirements data bank, AFLC is moving fast to replace its antiquated setup. It is finally doing, with computers, what it set out to do seventeen years ago with the Advanced Logistics System (ALS) that was called off because it just didn't work. The hardware technology and the software were not then ready for the ALS concept.

AFLC has had to live with the stigma of the ALS failure, and its officials claim that fear of a repeat performance is the main reason it has taken so long to get back on the automation track.

In any case, the hardware technology and software techniques now stand ready to do the job, these officials claim.

What's the job? In the case of controlling and distributing stocks and spares, for example, it means telling the chief of supply at Bitburg AB, Germany, within minutes that his requisition for an F-15 vertical stabilizer has been received, that the vertical stab has been found in the supply system, and that it will shortly be on its way.

It takes forty-eight to seventy-two hours to do all that now. Meanwhile, the frustrated chief of supply at Bitburg is making phone calls all over the place trying to find a vertical stabilizer. He is getting heavy pressure from his wing commander, who cares only about getting that fighter flying and not a whit about playing the game of warehouse, warehouse, where's the warehouse.

Col. Richmond E. Johnson, director of the stock control and distribution program, sums up the problem: "Too many of our requisitioning and receiving processes are manual and very labor-intensive. It's time to modernize our business practices."

Several large electronics companies are competing for AFLC's contract to install the automated stock control and distribution system. It will feature one multipurpose computer system performing straight-line processing of spares requisitions and accessions instead of the current system with its two loosely coordinated computer systems performing circuitous batch processing—sometimes aided by, but sometimes fouled up by, humans in charge of each.

The contract award is scheduled for next August, the IOC for April 1986. The whole affair—connecting AFLC headquarters and its five Air Logistics Centers (ALCs)—is expected to cost less than $200 million.

The Requirements Data Bank

The requirements data bank (RDB) will make an automated, coherent whole of the twenty-one separate computer systems that AFLC now must use to determine how many and what kinds of parts to buy for USAF and to project the magnitude and rate of repairs that can be expected for all Air Force systems—aircraft, vehicles, communications equipment, radar, you name it—each year.

Very big bucks are involved. USAF spent about $18 billion on such parts in FY '83. The way the system works now (or doesn't), big problems, too, are involved, such as imprecise pricing and allocation.

"We hope to solve a lot of those problems with the requirements data bank," says Col. William Goerges, Director of AFLC's RDB program office.

Last January, that office selected Computer Sciences Corp. and BDM Corp. to compete for the RDB contract, which is expected to be in the $150 million to $200 million range. Each is trying out parts of its proposed system at ALCs. The winner will be chosen next January.

It's a big job. AFLC has almost two million items in its supply and parts categories. It wants not only to make sense of them but also to sort them out with regard to their relevance to USAF's hundreds of weapon systems and subsystems.

In keeping with the theme of all AFLC endeavors these days, says Colonel Goerges, "We are gearing our efforts toward the weapons instead of buying items for their own sakes. One item may go on ten different aircraft, so it has ten different usage factors that have to be brought together in the new system."

Phased Implementation

Thus the RDB program has been divided into nine phases, each called a Logical Application Group (LAG), for the purpose of bite-size implementation over five years or more.

As Colonel Goerges explains: "What we're doing in the first LAG is to get us some quick capability to eliminate many of the manpower-intensive things we must do in preparing our spares budget. One ALC, for example, spent 25,000 overtime man-hours on its last budget. It takes so long to run the budgets that there isn't time to go back and correct errors. We're stuck with it. With the RDB system, we won't be."

The second phase will involve setting up the huge data base for the entire range of AFLC parts and supplies. It will contain hundreds of millions of bits of information.

After that, the program will focus on changing the way AFLC computes spare parts. Using a Wartime Assessment and Requirement Simulation (WARS) model, "We will compute our spares the way we fight a war—and that is by squadron," the Colonel said.

"In this model, which is up and running very successfully, we load in the flying hours of, say, an F-15 squadron deployed to combat. Then we calculate what's happening to it and what it needs.

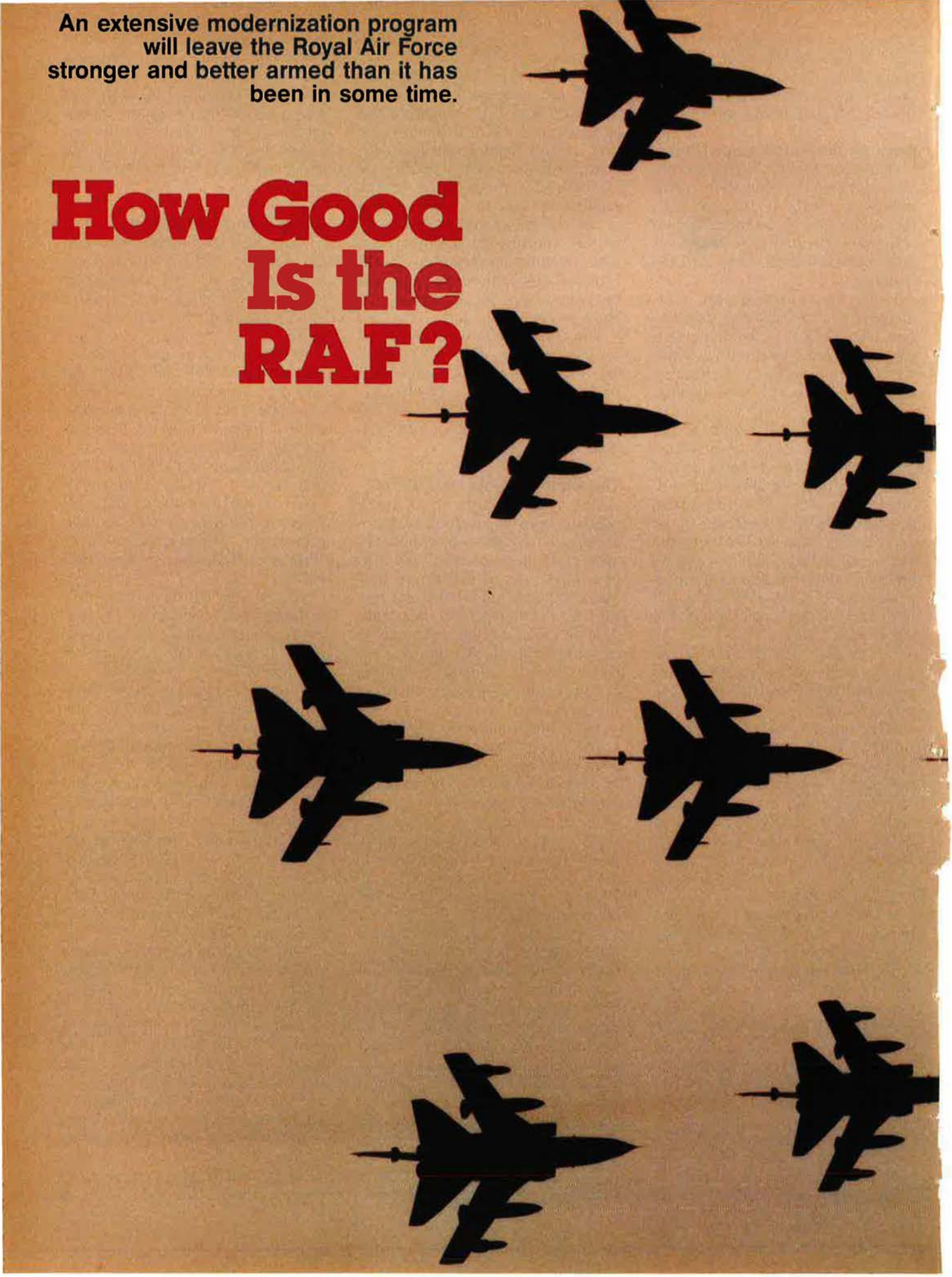
"If you take all the fighter squadrons in the Air Force and their flying hours in combat, spares requirements multiply very quickly."

That is what it is all about. At AFLC, the logisticians have long been convinced that you can have the very best aircraft in the world and the greatest, best-trained pilots, but if you don't have adequate logistical support for them, you're going to lose.

AFLC is attracting converts to this premise all the time. ■

An extensive modernization program will leave the Royal Air Force stronger and better armed than it has been in some time.

How Good Is the RAF?



The new shape of RAF airpower: Tornados of Nos. 9 and 27 Squadrons rehearse their flypast to celebrate the Queen's birthday.

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

The Russians were underestimating the resource and resolution of the Western Allies and the Western Sector Germans. Hugh McManus, the little Scottish platoon sergeant, had told his German wife, Irmgard, that whatever the Russians did the British would do something better, and he was right.

—Robert Rodrigo, *Berlin Airlift*

THE author of the above quotation was more right than his Sergeant Hugh McManus. The British certainly outperformed the Russians during the Berlin Airlift, but only as a component of a mighty force that involved the Western allies and the Germans in the Western Sector of the city. Today, that interdependence is more vital than ever, and must be borne in mind when studying any national military service in isolation.

Eight years have gone by since the Royal Air Force was last studied in detail in AIR FORCE Magazine (February 1976). At that time, the RAF still retained six first-line squadrons of Vulcan four-engine strategic nuclear bombers. Now that force has gone to the scrapyard, after playing a small but significant role in a totally unexpected nonnuclear war that had to be fought 8,000 miles from home bases.

The Falklands campaign of 1982 required closely integrated operations by Britain's naval, land, and air forces. None could have succeeded alone. The same is true when we consider the broader scene of NATO forces in Europe, East vs. West worldwide, or any other scenario of the "unthinkable" that military leaders spend their lives thinking about.

Quality of the Force

In 1945, the 9,200 aircraft of the Royal Air Force could simultaneously defend the UK from attack, hammer German cities with 1,000 heavy bombers at a time, harry retreating enemy troops in theaters of war from Germany to Southeast Asia, hunt submarines and surface raiders at sea, help to feed and supply an entire army by air in Burma, and perform countless other tasks.

Today, all the NATO air forces combined have fewer than 3,000 combat aircraft in Europe, confronting an estimated 7,430 Warsaw Pact fighter-bombers, ground attack aircraft, interceptors, reconnaissance aircraft, and bombers *(US Department of Defense statistics).* Four out of five of those NATO aircraft are provided by America's European allies. Of these, several hundred wear the national insignia of Britain. How good are they, and the men who fly, service, and command them?

The importance of the answer was emphasized by the US multistar general who commented that a good feature of international participation in TAC's Red Flag exercises is that it reveals the quality of America's allies in the air. "And who needs an ally who cannot do his job effectively?" The RAF's impressive results in Red Flag, reflecting years of emphasis on combat flying at minimum altitude and maximum speed, are matched by its day-to-day operations in Europe.

This does not mean there are no weak points in its armor. Until the Nimrod AEW.3 enters service, its tac-

tical squadrons will lack modern AWACS support in some areas. As we know, the Falklands fighting would have been less costly in terms of ships and lives if either the RAF or the Royal Navy had been able to deploy early warning cover. On the credit side, the same campaign confirmed the unique capabilities of the Harriers and Sea Harriers that had always been claimed by their protagonists.

When a US brigadier general says, "VTOL fighters simply do not have the performance, speed, range, and load-carrying capability to do most tac air missions" *(see* AIR FORCE *Magazine, June '84, p. 57),* the layman must respect his views. But everything in aviation is a compromise. It is worth remembering that some Harriers were ferried all the way from the UK to a carrier off the Falklands, with the help of flight refueling. Others are stationed permanently in Belize, Central America, after crossing the Atlantic to get there.

If, as seems possible, a high proportion of all front-line runways were taken out by air or missile attack in the opening minutes of a conflict in Europe, only aircraft able to dispense with airstrips might be able to operate. As for performance and load-carrying capability, it is worth noting that weapon loads for the Harrier can be increased by simple devices like the British carriers' ski-jump ramp and by using STOL rather than VTOL take-off—retaining the all-important VTOL capability for landing among craters at a damaged air base. Also, there were few, if any, genuine air-to-air combats over the Falklands. An alert Harrier pilot can ensure, by thrust vectoring, that he never remains in front of the missiles or guns of an enemy fighter.

The Harrier's load-carrying potential is good enough for the US Marine Corps to have selected it—in modified AV-8B form—as that service's next "bomb truck." The Navy's new jet advanced trainer will be a version of the British Hawk, mount of the RAF's Red Arrows aerobatic display team. Thousands of American lives have been saved by Martin-Baker ejection seats developed originally for the Royal Air Force. All of this should be sufficient to testify to the quality of British aerospace products.

It would be good to add that such purchases by the US reflect much improved standardization of NATO arms and equipment since 1976, but it would be untrue. In contrast, virtually all combat aircraft operated by Warsaw Pact air forces are of Soviet origin, a policy that ensures standardization at a price.

$19 Billion Reequipment Program

There has been some progress within NATO since 1976. Instead of single-nation Vulcans, the RAF's primary attack squadrons now fly Tornados—designed, built, and flown by Germany, Italy, and the UK in partnership. The Jaguar, too, represented an international collaborative program, and the RAF is one of many air forces operating US Phantom fighters, Hercules transports, and Chinook helicopters. It will also equip from 1987 with sixty Harrier GR.5s, basically similar to the Marines' AV-8Bs and built by McDonnell Douglas/British Aerospace team effort.

Over Niagara Falls, an interdictor/strike Tornado demonstrates the maximum-speed, minimum-height flying for which RAF combat squadrons in Europe are renowned.

Such reequipment will maintain the RAF's effectiveness through the next decade in terms of quality. Quantity is a different matter and something that must cause great concern to any NATO commander who thinks in terms of a war lasting longer than a few minutes, hours, or days. Economics affect more than numbers of aircraft purchased. This becomes clear when we study the proportion of NATO front-line aircraft that would be capable of fighting day and night, throughout the year, in the kind of weather that afflicts central Europe. The RAF's Tornados and Buccaneers are equipped for all-weather operations, but its Harriers and Jaguars are no better in this respect than US A-10s and current F-16s.

Maybe the current opposition is equally restricted, but the next generation of Soviet fighters, spearheaded by the Su-27 and MiG-29, has pulse-Doppler look-down/shoot-down fire control and navigation radar from the start. Even if this is inferior to its Western equivalents, a reasonably good radar in the nose of an air-superiority fighter is better than a very good one considered too costly to install.

The need for "enough" as well as "good enough" is apparent when we consider the enormity of the RAF's

responsibilities outside the central front area in Europe.

Its air defense cover has to extend over the entire United Kingdom Air Defense Region (UKADR), one of four such regions under the direction of SACEUR. It shields the western flanks of NATO's Northern and Central Regions and includes the UK itself (vitally important as a base for the flow of US reinforcements bound for Europe), UK home waters, the North Sea, and an area of the eastern Atlantic measuring 1,000 miles from north to south. In this airspace, Phantoms and Lightnings intercept and shadow marauding Soviet reconnaissance aircraft several times in an average week. Others, supported by tankers, provide cover from shore bases for naval forces.

Within NATO's EASTLANT and Channel areas, RAF Nimrods keep watch on Soviet fleet movements. Some Phantoms are assigned specifically to protect shipping from air attack. In war, also, the Nimrods' antisubmarine potential would be matched by the ability of RAF strike/attack aircraft, dedicated to SACLANT, to strike at hostile missile-armed surface ships that were beyond the range of naval weapons.

Flight refueling plays an increasing part in all such long-range missions, as it did during the Falklands campaign. For this reason, the RAF's air tanker fleet is being renewed and expanded by conversion of ex-airline VC10s and TriStars. Air defenses are being strengthened further by adapting seventy-two Hawk trainers to carry AIM-9L Sidewinder missiles, with introduction of the Tornado F.2 scheduled for 1987–88.

On the ground, aircraft shelters and key buildings at air bases have been hardened and camouflaged. Surface-to-air defenses have been improved by supplementing long-range Bloodhound missiles with battle-proven Rapier close-range missiles manned by the RAF Regiment.

New airborne weapons include laser-guided bombs, JP233 cratering and area-denial weapons, BL755 cluster bombs, Harpoon antiship missiles, Sky Flash air-to-air missiles, and Stingray acoustic homing torpedoes—claimed to be the world's most advanced antisubmarine torpedoes—as well as Skyshadow ECM pods. Soon to follow are Sea Eagle antiship missiles and ALARM antiradiation missiles.

All of this adds up to the most extensive modernization program for twenty years, involving the expenditure of some $19 billion on major projects over a decade. The result will leave the RAF far stronger and better armed than it has been for a long time.

Deployment and Organization

The Royal Air Force has, in 1984, an official total of 86,100 trained personnel, of whom 5,300 are women. A map published last spring by the British journal *Aviation News* identified seventy-three RAF stations and units in the UK. Overseas, there are fourteen squadrons at Bruggen, Gutersloh, Laarbruch, and Wildenrath in Germany and assigned to the Second Allied Tactical Air Force in NATO's Central Region; detachments of Wessex helicopters in Cyprus and Hong Kong; Harriers, Puma helicopters, and Rapier fire units in Belize; and a small RAF presence in Gibraltar to operate the airfield. As a component of the Falklands garrison, Harriers, Phantoms, Hercules transports, Chinook and Sea King helicopters, and Rapier missiles are deployed on the islands, with Victor and Hercules tankers at Wideawake Airfield on Ascension Island to support the airbridge from the UK.

In 1977, the former RAF Training Command was merged into Support Command. Thus, the Royal Air Force is now divided into just three main operational commands—Strike, RAF Germany, and Support. It has fifty-two front-line operational squadrons of fixed-wing aircraft and helicopters, a photo-reconnaissance unit of Canberras, and two squadrons of Bloodhound missiles, plus two RAF Regiment squadrons of Rapier missiles in the UK and four in Germany.

The supreme advantage of small field operation and concealment is used to good effect by an attack/reconnaissance Harrier in Germany.

Consolidation of the service was continued in 1983, when No. 38 Group (formerly responsible for providing air support for land forces) was merged into No. 1 Group of Strike Command. On January 2, 1985, Britain's central organization for defense will itself be streamlined with the creation of a new unified Defense Staff. This will not only assume the functions of the existing mili-

tary central staffs but also the majority of those now assigned to the single service staffs which report to their respective Vice Chiefs of Staff. The post of Vice Chief of the Air Staff will, therefore, disappear, together with the equivalents in the Royal Navy and Army.

Although overall responsibility for directing the work of the Defense Staff will rest with the Chief of the Defense Staff (CDS), day-to-day direction will be the responsibility of a Vice Chief of the Defense Staff (VCDS) at four-star level. The Defense Staff will consist of four groupings, covering respectively Strategy and Policy, Programs and Personnel, Systems, and Commitments. Except for the first, which will be headed by a Deputy Secretary, each will be headed by a service Deputy Chief of the Defense Staff (DCDS) at three-star level.

The service Chiefs of Staff will remain fully responsible for the fighting effectiveness, management, overall efficiency, and morale of their services and will retain their right of direct access to the Prime Minister and Secretary of State for Defense.

The current RAF command structure is as follows:

Strike Command. AOCINC: Air Chief Marshal Sir David Craig, GCB, OBE, MA. NATO CINC United Kingdom Air Forces (CINC UKAIR). Hq.: RAF High Wycombe, Buckinghamshire. Operates 850 aircraft, mostly committed to Allied Command Europe (ACE) and SACLANT.

- **No. 1 Group.** Provides Tornado GR.1s and Jaguars for strike/attack; Harriers and Jaguars for offensive support; Jaguars for reconnaissance; VC10s and Hercules, Chinook, Wessex, and Puma helicopters for transport; and Victor and VC10 tankers for flight refueling.
- **No. 11 Group.** Responsible for all-weather air defense of the UK and within its assigned NATO area, in association with air defense radar and control and reporting systems. Equipped with Phantom and Lightning interceptors, Shackleton early warning aircraft, Bloodhound missiles, and Rapier missiles manned by the RAF Regiment.

Sea King search and rescue helicopters of No. 202 Squadron fly past St. Michael's Mount, where the Archangel is said to have appeared to local fishermen in AD 495.

- **No. 18 Group.** Responsible for the safety of sea communications in the Atlantic, North Sea, and home waters, in association with the Royal Navy and other NATO forces. Equipped with Nimrod long-range maritime reconnaissance aircraft, Buccaneers for maritime strike/attack, and Canberras for reconnaissance and target duties. It also provides the RAF contribution to the UK SAR force, using Sea King and Wessex helicopters. Although established primarily for military duty, most peacetime calls on the nine SAR flights involve civilians, with more than 700 rescues in a typical year.

Royal Air Force Germany. CINC: Air Marshal Sir Patrick Hine, KCB, FBIM. Hq.: RAF Rheindahlen, BFPO 40.

CINC RAF Germany is also Commander, Second Allied Tactical Air Force (2d ATAF), of which RAF units constitute a major part. They provide conventional and nuclear attack/strike, reconnaissance, and air defense forces for immediate support of NATO land operations or peacetime exercises. To help ensure access to Berlin

in the three air corridors, they also police the northern half of the Air Defense Identification Zone running the length of the East German border. Equipment comprises Tornado GR.1s, Harriers, Jaguars, Phantoms, Chinook and Puma helicopters, Pembroke communications aircraft, and Blindfire Rapier surface-to-air missiles manned by the RAF Regiment.

Support Command. AOCINC: Air Marshal Sir David Harcourt-Smith, KCB, DFC. Hq.: RAF Brampton, Huntingdon, Cambridgeshire PE18 8QL. Two main functional groups are embodied in Command Hq., for training and maintenance, as well as the RAF College Cranwell and RAF Staff College Bracknell. Support Command has nearly 500 aircraft and 48,000 personnel, including 12,500 civilians and 9,000 trainees, in 212 units. These include five flying training schools, seven maintenance units, three hospitals, sixteen University Air Squadrons (UAS), thirteen air experience flights, twenty-seven gliding schools, and seventy-one career information offices. It is responsible for administration of thirteen US bases in the UK.

• **Training.** All potential officers undergo initial training at RAF College Cranwell, side by side with students from foreign air forces. Those who are RAF university cadets then receive basic flying training in Bulldog aircraft at a University Air Squadron. Most other potential pilots go to the Flying Selection Squadron at RAF Swinderby for fourteen hours of assessment flying on Chipmunks before proceeding, with UAS cadets, to basic training on Jet Provosts at one of three FTSs. Those selected as fast-jet pilots for air defense and ground attack squadrons then go to RAF Valley to fly Hawks; multiengine training is given on Jetstreams at RAF Finningley; helicopter training, on Wessex and Gazelles, is centered at RAF Shawbury. Operational conversion to particular squadron aircraft is undertaken by Strike Command. Navigators, air engineers, and air electronics operators fly in Dominies and Jet Provosts during training at RAF Finningley.

The RAF also provides elementary flying training for Royal Navy helicopter pilots; many aircrew of foreign air forces pass through its training system. The schools for training engineering and supply officers, as well as the RAF College of Air Warfare, are at Cranwell. Other officer training centers specialize in air traffic control, education, secretarial duties, catering, and RAF Police duties.

Recruits for noncommissioned service are accepted from the age of 16½ (17½ for women) for training in 150 separate trades. After recruit training at Swinderby, many go to specialized technical training schools at Halton, Cosford, and St. Athan, or the radio school at Locking.

Many training courses are held for experienced personnel. Best known are those at the **Central Flying School,** RAF Scampton, which is responsible for training all flying instructors for the RAF, Royal Navy, and Army Air Corps, as well as for other air forces. The rotary-wing element, based at RAF Shawbury, also houses the RAF Helicopter Flying Training School. Examining Wing of the CFS is responsible for quality control of flying training throughout the RAF, and on behalf of overseas air forces. Also part of CFS is the Royal Air Force aerobatic team, the Red Arrows.

• **Support.** This second major function of Support Command involves performance of those electrical and mechanical engineering operations that are beyond the capacity of stations, communications, storage and supply facilities, medical services, and administrative services throughout the RAF.

Manpower and Budget

The UK continues to spend more on defense than any other European member of NATO, both in absolute terms and per capita (on the basis of average market exchange rates). It also spends a higher proportion of its GDP on defense than does any European ally except Greece. Its 1984/85 defense budget amounts to £17,033 million, of which twenty percent goes to air force general-purpose forces, compared with 15.4 percent to European theater ground forces, 1.2 percent to other army combat forces, and 14.6 percent to naval general-purpose combat forces. Some forty-six percent of all expenditures goes on equipment, nineteen percent on forces pay and allowances.

Paragraph 222 of the 1984 *Statement on the Defense Estimates,* presented to Parliament in the spring of this year, states: "The Royal Air Force is implementing recommendations of its Support Area Economy Review Team, set up in 1981/82 to identify less costly ways of supporting the front line. The aim is to release engineering and other manpower from training and support units for service on operational stations and to achieve reductions in establishments. Follow-on studies are being conducted into ways of reducing manpower establishments in headquarters by improving the management of training, supply and engineering. Our aim will be to hold RAF manpower steady as the number of front-line aircraft increases by fifteen percent over the decade."

Bearing in mind the greatly increased technological complexity of aircraft like the Tornado F.2 and Nimrod AEW.3 that will be introduced in that decade, the achievement of such an aim will not be easy. Perhaps we should remember that the RAF's motto is *Per Ardua ad Astra* (through difficulties to the stars). The late King George VI certainly did so in a letter to the then Secretary of State for Air in 1943, on the twenty-fifth anniversary of the RAF's formation. Commenting on a long record of achievement, he wrote: "Its prime cause, beyond question, is the spirit which inspires each and every member of the force—the spirit that attains the stars, however hard the way may be." ■

John W. R. Taylor celebrates his twenty-fifth anniversary this year as editor of the world-renowned Jane's All the World's Aircraft *and is a regular contributor to* Air Force *Magazine through his bimonthly "Jane's Supplements" and other feature articles* (see also "All the World's Source," September '84 issue, p. 191). *In addition, he compiles or edits the galleries of aerospace weapons for both the USAF Almanac and Soviet Aerospace Almanac issues of this magazine. Mr. Taylor was trained as an architect and later worked as an aircraft designer under Hawker's legendary Sydney Camm. He has written more than 200 books and thousands of articles on aviation subjects and is a Fellow of the Royal Aeronautical Society, the Royal Historical Society, and the Society of Licensed Aircraft Engineers and Technologists.*

ORGANIZATION

UK defense policy is controlled by the Cabinet's **Defense and Overseas Policy Committee,** which is chaired by the Prime Minister and includes senior Ministers who have responsibilities relating to defense. The Chief of the Defense Staff attends as required, as do the Chiefs of Staff when necessary. Under the Secretary of State for Defense, **the Defense Council** exercises powers of command and administrative control. From January 2, 1985, its members will be the Secretary of State for Defense and his Ministers, the Chief of the Defense Staff, the Permanent Under Secretary of State, the three service Chiefs of Staff, the Vice Chief of the Defense Staff, the Chief of Defense Procurement, the Chief Scientific Advisor, and the Second Permanent Under Secretary of State.

The Royal Air Force is administered by the **Air Force Board** of the Defense Council, which will be unchanged by the reorganization, except for the loss of the Vice Chief of the Air Staff. The members of this group in August 1984 were as follows:

Secretary of State for Defense: The Rt. Hon. Michael Heseltine, MP.

Minister of State for the Armed Forces: John Stanley, MP.

Parliamentary Under Secretary of State for the Armed Forces: The Lord Trefgarne.

Parliamentary Under Secretary of State for Defense Procurement: J. Lee, MP.

Chief of the Air Staff: Air Chief Marshal Sir Keith Williamson, GCB, AFC, ADC.

Air Member for Personnel: Air Chief Marshal Sir Thomas Kennedy, KCB, AFC, ADC.

Air Member for Supply and Organization: Air Marshal Sir Michael Knight, KCB, AFC, BA.

Controller of Aircraft: Air Chief Marshal Sir John Rogers, KCB, CBE.

Vice Chief of the Air Staff: Air Marshal Sir Peter Harding, KCB, FBIM.

Second Permanent Under Secretary of State: Sir Ewan Broadbent, KCB, CMG.

Controller R&D Establishments and Research: C. C. Fielding, CB.

Deputy Under Secretary of State (Air): D. C. Humphreys, CMG.

A Gallery of RAF Aircraft

Hawker Siddeley Buccaneer S Mk 2.

SEPECAT Jaguar GR Mk 1.

British Aerospace Harrier GR Mk 3s.

Panavia Tornado GR Mk 1: Interdictor/strike aircraft; crew 2. Operational with RAF since June 1982. Three squadrons (9, 27, 617) with 1 Group, Strike Command (STC); two squadrons (15, 16) with RAF Germany. Six more squadrons to be based in Germany, one with reconnaissance as its primary role. (Tornado F Mk 2 long-range interceptor variant will begin reequipping Lightning and Phantom squadrons in 1987–88.) Power Plant: Two Turbo Union RB199-34R Mk 101 afterburning turbofans; each 16,000 lb st. Span: 45 ft 7¼ in spread, 28 ft 2½ in swept. Length: 54 ft 9½ in. Gross weight: 60,000 lb. Max speed: Mach 2.2 at 36,000 ft. Typical attack radius: 863 miles. Two 27-mm IWKA-Mauser guns; total weapon load more than 18,000 lb.

Hawker Siddeley Buccaneer S Mk 2: Low-level strike/attack aircraft; crew 2. Entered service with RAF in 1970. Two squadrons (12, 208) with 18 Group STC will continue in maritime role until late 1980s, eventually with new Sea Eagle antiship missiles. Power Plant: Two Rolls-Royce Spey 101 turbofans; each 11,100 lb st. Span: 44 ft. Length: 63 ft 5 in. Gross weight: 62,000 lb. Max speed: 645 mph at 200 ft. Typical strike range: 2,300 miles. No guns; up to 16,000 lb of internal and external stores.

SEPECAT Jaguar GR Mk 1: Tactical support aircraft; pilot only. Operational since 1974. Two offensive support squadrons (6, 54) and one reconnaissance squadron (41) with 1 Group STC. Four strike/attack squadrons (14, 17, 20, 31) and one reconnaissance squadron (2) with RAF Germany. The five squadrons in Germany will be reequipped eventually with Tornado GR 1s. Power Plant: Two Rolls-Royce/Turboméca Adour 104 afterburning turbofans; each 7,900 lb st. Span: 28 ft 6 in. Length: 50 ft 11 in. Gross weight: 34,000 lb. Max speed: Mach 1.5 at 36,000 ft. Attack radius: 357–818 miles. Two 30-mm Aden guns; 10,000 lb of external stores.

British Aerospace Harrier GR Mk 3: V/STOL close support and reconnaissance aircraft; pilot only. Entered service 1969. One squadron (1) with 1 Group STC. Two flights in Belize (1417) and the Falkland Islands (1453). Two squadrons (3, 4) with RAF Germany, one (4) having added reconnaissance role. The squadrons in Germany will reequip with McDonnell Douglas/BAe Harrier GR 5s in 1987; their existing GR 3s will equip a second squadron in the UK. Power Plant: One Rolls-Royce Pegasus 103 vectored-thrust turbofan; 21,500 lb st. Span: 25 ft 3 in. Length: 45 ft 7 in. Gross weight: more than 25,000 lb. Max speed: Mach 0.95 at low altitude. Up to 5,000 lb of external stores, including two 30-mm Aden gun packs.

McDonnell Douglas Phantom FGR Mk 2: Air defense fighter; crew 2. In RAF service since 1969. Two squadrons (29, 56) and two squadrons of former Royal Navy Phantom FG 1s (43, 111) in 11 Group STC are being supplemented by one squadron (74) of ex-USN F-4J Phantoms. One squadron (23) in the Falkland Islands. Two squadrons (19, 92) in RAF Germany. Four of these squadrons (19, 56, 92, 111) are under NATO command. Nos. 43 and 111 Squadrons provide air defense in support of the Royal Navy. Power Plant: Two Rolls-Royce Spey 202 afterburning turbofans; each 20,515 lb st. Span: 38 ft 5 in. Length: 57 ft 7 in. Gross weight: 58,000 lb. Max speed: Mach 2.2 at 36,000 ft. Up to 11,000 lb of external stores.

BAC Lightning F Mk 6: Air defense fighter; pilot only. Operational since 1966. Two squadrons (5, 11) of Lightning F 6s, supplemented by generally similar Lightning F 3s, continue to equip 11 Group STC under NATO command. They will be the first squadrons reequipped with Tornado F 2s in 1987–88. Power Plant: Two Rolls-Royce Avon 301 afterburning turbojets; each 16,360 lb st. Span: 34 ft 10 in. Length: 55 ft 3 in. Gross weight: approx 50,000 lb. Max speed: Mach 2 at 36,000 ft.

Two 30-mm Aden guns; two Red Top air-to-air missiles.

British Aerospace Nimrod MR Mk 2: Long-range maritime patrol aircraft; crew 12. Began reentering service 1979 after uprating from MR 1 standard. Four squadrons (42, 120, 201, 206) with 18 Group STC. Three Nimrod R Mk 2 electronic reconnaissance aircraft also in service, with No. 51 Squadron. Power Plant: Four Rolls-Royce Spey 250 turbofans; each 12,140 lb st. Span: 114 ft 10 in. Length: 126 ft 9 in. Max gross weight: 192,000 lb. Max speed: 575 mph. Typical endurance, without flight refueling: 12 hours. No guns; up to 13,500 lb of disposable stores, including Stingray torpedoes and Harpoon antiship missiles.

British Aerospace Nimrod AEW Mk 3: AWACS aircraft. Now entering service, this aircraft will greatly enhance NATO's radar surveillance of airspace to the north of Greenland, Iceland, and the UK gap. Eleven Nimrod AEW 3s are being produced by conversion of former MR 1 airframes. They will replace the Shackletons of No. 8 Squadron in 11 Group STC. Power Plant: as Nimrod MR Mk 2. Span: 115 ft 1 in. Length: 137 ft 8½ in. Performance generally similar to MR Mk 2.

Avro Shackleton AEW Mk 2: Airborne early warning aircraft; crew 10. Entered service 1972. One squadron (8) of these veteran aircraft serves with 11 Group STC to improve low-level radar cover around the UK and to provide early warning support for maritime surface forces. Replacement with Nimrod AEW 3s is beginning. Power Plant: Four Rolls-Royce Griffon 57A piston engines; each 2,455 hp. Span: 119 ft 10 in. Length: 92 ft 6 in. Gross weight: 98,000 lb. Max speed: 260 mph. Patrol endurance: 10 hours. No weapons.

English Electric Canberra PR Mk 9: High-altitude photographic and electronic reconnaissance aircraft; crew 2. Operational since 1960. All RAF Canberras are now based at RAF Wyton. The PR 9s equip No. 1 Photo Reconnaissance Unit (PRU). One is being fitted by Shorts with a modified Searchwater radar, as in Nimrod MR 2, for evaluation in an airborne surveillance role under the CASTOR (Corps Airborne STand-Off Radar) program. A squadron (100) of Canberra B 2s, PR 7s, E 15s, and TT 18s provides target facilities. Another (360), with Canberra T.17s, provides ECM support. Power Plant: Two Rolls-Royce Avon 206 turbojets; each 11,250 lb st. Span: 67 ft 10 in. Length: 66 ft 8 in. Gross weight: 55,000 lb. Max speed: (PR 7) 580 mph at 40,000 ft. No weapons.

Handley Page Victor K Mk 2: Flight refueling tanker; crew 5. Entered service 1974. Victor K 2s are operated by two squadrons (55, 57) of 1 Group STC. Converted from former strategic bombers, they are three-point tankers, able to trail one hose underbelly and two underwing. Power Plant: Four Rolls-Royce Conway 201 turbofans; each 20,600 lb st. Span: 117 ft. Length: 114 ft 11 in. Gross weight: over 170,000 lb. Max speed: over 600 mph at 40,000 ft. No weapons.

British Aerospace VC10 K Mk 2: Flight refueling tanker; crew 4; provision for 18 ground personnel when deployed away from base. Entered service 1983. No. 101 squadron of 1 Group STC is equipping with 5 VC10 K 2 and 4 VC10 K 3 tankers, converted from ex-airline Model 1101 VC10 and Model 1154 Super VC10 transports, respectively. All are three-point tankers/receivers. The RAF also operates one squadron (10) of VC10 C Mk 1 transport aircraft in 1 Group STC. Each carries up to 150 passengers or 76 litters and six medical attendants. Power Plant: Four Rolls-Royce Conway 550B turbofans; each 21,800 lb st. Span: 146 ft 2 in. Length: 158 ft 8 in (excl probe). Weights and performance not available. No weapons.

Lockheed Hercules C. Mk 3: Medium tactical/strategic transport; crew 5 and 128 troops, 92 paratroops, or seven cargo pallets. Entered RAF service in C Mk 1 form 1967. Four squadrons of Hercules transports (24, 30, 47, 70) serve with 1 Group STC. All were delivered in C Mk 1 form, with standard fuselage accommodating 92 troops, 64 paratroops, or 74 litters and two attendants. Marshall of Cambridge is "stretching" 29 to C Mk 3 standard, following a prototype conversion by Lockheed. Six others were converted to C Mk 1K single-point flight refueling tankers. Power Plant: Four Allison T56-A-15 turboprops; each 4,508 ehp. Span: 132 ft 7 in. Length: 112 ft 9 in. Gross weight: 175,000 lb. Max cruising speed: (C Mk 1) 386 mph. Range: with max payload (C Mk 1) 2,500 miles. No weapons.

Boeing Vertol Chinook HC Mk 1: Medium transport helicopter; crew 4 and 44 troops, 24 standard NATO litters, or internal/external freight. Entered RAF service 1981. One squadron (7) with 1 Group STC. Some with 1310 Flight in the Falkland Islands. One squadron (18) with RAF Germany. Early HC 1s had T55-L-11E engines. All are being retrofitted with glassfibre rotor blades. Power Plant: Two Avco Lycoming T55-L-712 turboshafts; each 3,750 shp standard rating. Rotor dia: (each) 60 ft. Fuselage length: 51 ft. Gross weight: 50,000 lb. Average cruising speed: 138–150 mph. Mission radius: 35–115 miles. No weapons.

Westland/Aérospatiale Puma HC Mk 1: Assault helicopter; crew 2 and 16 troops, 6 litters, or 5,500 lb underslung cargo. Entered RAF service 1971. One squadron (33) operates with 1 Group STC. Some equip No. 1563 Flight in Belize. One squadron (230) is with RAF Germany. Power Plant: Two Turboméca Turmo IIIC4 turboshafts; each 1,320 shp. Rotor dia: 49 ft 2½ in. Fuselage length: 48 ft 1½ in. Gross weight: 14,110 lb. Max speed: 174 mph at sea level. Max range: 390 miles. No weapons.

Westland Wessex HC Mk 2: Tactical support helicopter; crew 2 or 3 and 15 troops, 7 litters, or 3,600 lb of freight. One squadron (72) supports the UK garrison in Northern Ireland. Another (22) operates SAR missions through six detached flights around the UK coastline. Power Plant: Two Rolls-Royce Gnome 112/113 turboshafts; total 1,550 shp. Rotor dia: 56 ft. Fuselage length: 48 ft 4½ in. Gross weight: 13,500 lb. Max speed: 132 mph at sea level. Max range: 478 miles. Provision for carrying machine guns, rocket launchers, and air-to-surface missiles.

Westland Sea King HAR Mk 3: SAR helicopter; crew 4 and up to six litters or 19 seated persons. Entered service 1979. Single squadron (202) provides search and rescue missions through three detached flights, as part of 1 Group STC. Power Plant: Two Rolls-Royce Gnome H.1400-1 turboshafts; each 1,660 shp. Rotor dia: 62 ft. Fuselage length: 55 ft 9¾ in. Gross weight: 21,000 lb. Cruising speed: 129 mph at sea level. Max range: 764 miles. No weapons.

McDonnell Douglas Phantom FGR Mk 2.

British Aerospace Nimrod MR Mk 2.

Boeing Vertol Chinook HC Mk 1.

Westland/Aérospatiale Puma HC Mk 1.

Westland Wessex HC Mk 2.

The Ballistic Missile Office looks at better ways to penetrate defenses and attack hard targets.

Artist's conception of Soviet Galosh anti-ballistic missile firing from surface launcher. Soviet ABM advances may require that US ballistic missiles be equipped with penetration aids.

Countering the Soviet Strategic Shield

BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

A MAJOR long-term challenge for the Air Force's ICBM designers is to find ways to go after Soviet mobile and imprecisely located targets—which are increasing at a high rate and are becoming more of a challenge to the SIOP (single integrated operational plan)—while at the same time increasing the ability to penetrate sophisticated defenses. The Air Force program that probes these important, distant technological horizons is ASMS, for Advanced Strategic Missile Systems, the successor to ABRES, the Advanced Ballistic Reentry System. Like its predecessor, ASMS is a tri-service program run by AFSC's Ballistic Missile Office at Norton AFB, Calif.

For more than a decade, the provisions of the SALT I Antiballistic Missile (ABM) accord have kept Soviet ballistic missile defenses confined to a legal ceiling of 100 launchers, all located on Moscow's periphery, thereby obviating the need to provide US ballistic missiles with such devices as penetration aids, defense suppression systems, and MaRVs, maneuvering reentry vehicles that either can be used to evade defensive interceptors or to increase accuracy by incorporating terminal-fix sensors. But in order to reduce Soviet incentives to break out from the SALT I ABM accord or to be prepared with countervailing capabilities if they do, BMO's ASMS program is continuing to examine various technologies to boost the "penetrativity" of US ballistic missiles in the years ahead.

Defense Suppression and Decoys

This summer, BMO Commander Maj. Gen. Aloysius G. Casey told this reporter, the Air Force launched a new project aimed at defining defense suppression vehicles that would do for "ballistic missiles what HARM [the high-speed antiradiation missile] does for our tactical fighter." The new defense suppression project is confined for the moment to concept definition studies—carried out under Air Force contract by Avco and McDonnell Douglas—of small reentry vehicles that can home on and destroy ABM radars with small, low-yield nuclear or nonnuclear weapons.

By carrying forward work done by ABRES, ASMS is scoring significant technological advances in penetration aids for ICBMs, in the main passive and active decoys. Both types of decoys are scheduled for three flight tests, one in 1984 and the other two in 1985. These devices will be launched by Minuteman ICBMs, he said. Eventually, BMO hopes to test these new decoys on MX.

Passive decoys attempt to simulate real RVs but do so without on-board generation of signals or other actions that would mask their actual, inert nature. All decoys slow down noticeably compared with real RVs as they reach a certain depth in the atmosphere and become subject to "atmospheric sorting," meaning they either burn up or their behavior in terms of speed or other factors makes it possible for the defense to distinguish them from actual warheads. Active decoys use various technologies to replicate the signatures of actual RVs. There has been major progress recently in active decoy design, according to the BMO Commander.

One of the toughest questions associated with decoys centers on their relative value in the target area—the so-called end game. The dilemma stems from weighing the high cost of decoys that can withstand the severe atmospheric sorting encountered at lower altitudes, on the one hand, against the probability that the enemy's ABM radars will be put out of commission when the first real warheads detonate, on the other. In short, decoys may not be needed. In addition, there is at least the theoretical possibility to "salvage-fuze" ICBM warheads in the future. The purpose of salvage fuzing is to make a warhead detonate during the later phases of reentry, after its sensors detect an approaching ABM interceptor. Rather than fizzle uselessly, a salvage-fuzed warhead would detonate away from its target but close enough to the ground either to destroy the "soft" radars of the enemy's ABM defenses or at least to blind them temporarily.

MX test launch. Analysis of the first phase of the MX's flight-test program spells out a resounding success story. The MX is needed to provide a counter to the 800 deployed Soviet MX-equivalent ICBMs.

MaRVs and Terminal Guidance

Under certain scenarios, General Casey explained, it might be more cost-effective to use MaRVs rather than expensive, high-fidelity decoys. He stressed, however, that US ICBMs will probably be able to penetrate to their targets in the Soviet Union for some time to come, and that, therefore, MaRVs, defense suppression systems, and advanced penetration aids won't be needed unless Moscow decides to break out from the ABM Treaty and deploys large numbers of advanced ABM systems.

Recent budget pressures caused the Administration and Congress to stretch out ASMS and its subordinate program elements and activities. As a result, the initial operational capability (IOC) of terminal-fix guidance systems as well as of MaRVs slipped from 1995 to 1998. These technologies could point the way toward equipping ICBMs with the capability to destroy relocatable and mobile targets.

Terminal-fix guidance approaches under study by BMO include variants of TERCOM, the terrain contour matching used by cruise missiles, and radar correlation. These systems use radar sensor information for "scene-matching," meaning they register the altitude variations and undulations of the terrain that they fly over and compare them for guidance purposes against data stored in their computer memory. Linked to a MaRV, terminal-

fix guidance would make it possible to "give us whatever accuracy we want," according to General Casey.

In spite of BMO's positive outlook concerning MaRVs equipped with terminal-fix sensors, there are concerns. Key is the uncertainty of how well such sensors would work in a severe nuclear environment. The ability of radar beams to go through the ionized layers of air associated with nuclear detonations is "difficult to establish," the BMO Commander said. Also, an RV descending through the atmosphere at hypersonic speeds is surrounded by a sheath of plasma, or ionized gases, that radar might not be able to penetrate. While these limitations are real and significant, BMO is confident that the radar of terminal-fix guidance systems would work at certain altitudes and thus be able to do its job.

The Air Force has traditionally been chary of guidance approaches that make ICBMs dependent on external influences, such as the enemy's electronic countermeasures, position-fixing links with satellites that may be perishable, or disruptions by nuclear effects. For this reason, BMO has recommended against making any of its ICBMs dependent on the Navstar Global Positioning System (GPS), General Casey explained. No GPS link, therefore, is planned for either MX or the small, single-warhead ICBM (SICBM). On the other hand, the Strategic Air Command, which is working very closely with BMO on all aspects of ASMS, supports the terminal-fix guidance research project.

Other work carried out by BMO under the ASMS advanced development program includes countermeasures to directed-energy weapons, advanced penetration and defense suppression systems, and sophisticated RV designs, including those with nosetip features that can withstand severe environmental conditions. In addition, BMO's research and development work on guidance systems, its general development planning effort, and such joint service activities as testing new RVs for the Navy's SLBMs and launching the US Army's HOE (Homing Overlay Experiment, potentially an element of ballistic missile defense) are carried out under the ASMS program. The Defense Department reduced the Air Force's FY '85 funding request for ASMS earlier this year from $108 million to about $95 million as part of a broad cutback aimed at lowering the federal budget deficit. BMO plans to seek increased funding for ASMS in future budget requests.

MX—A Technological Success Story

Congress, at this writing, seems determined to scuttle or defer the MX program. Partisan politics, far more than doubts about the need for and cost-effectiveness of the weapon, appear to motivate the leadership of the House in their attempt to stall the program with a raft of legislative strictures.

It is bitterly ironic that MX would be threatened with termination at a time when the analyses of the first phase of the missile's flight-testing spell out a resounding success story. The MX's *raison d'être* is to provide a counter to the 800 deployed Soviet MX-equivalent ICBMs. This boils down to a limited hard-target kill capability. MX's first five test flights, General Casey said, exhibited accuracies "far greater than anybody ever expected. This means that enough Soviet prompt hard targets can be held at risk to provide effective deterrence."

Stressing that MX represents a "revolutionary improvement" in inertially guided long-range missiles, the BMO Commander expressed regret over recent misleading reports by the General Accounting Office and the Surveys and Investigations Staff of the House of Representatives. The GAO report suggested, on the basis of dated information, that MX would not be able to destroy hard targets. In fact, General Casey reiterated that the new missile's hard-target capability is more than adequate for even the hardest known targets. The congressional staff report implied that the MX program's management is not getting things done on time and uses equipment on an operational basis before it is properly tested. The BMO Commander rejected these charges categorically: "We are extremely rigorous about fielding any systems and maintain severe standards in all regards."

The series of five MX flight tests that ended in June of this year produced a wealth of data proving that all aspects of the missile's performance—from shock loads and vibration levels to subsystem reliability—are better than anticipated. These thoroughly positive findings, he added, are the "key to ensuring that we don't stand on the edge of failure every time we want to launch. We know that we are putting the right missile hardware into production." With the exception of a component of the rocket motor on the missile's fourth stage, the test article is identical to the production hardware.

The New Mk 21 RV

In addition to the flawless performance of the missile itself, the fifth MX launch included the successful flight-testing of the new Mk 21 reentry vehicle developed by the Department of Energy. The information produced by the RV's test flight was "within the planned envelope, [including the performance of] the RV's shell structure, its clean release from the [post-boost vehicle], and proper spinup before lofting" for reentry. All interfaces with the simulated warhead were maintained throughout the flight.

The Mk 21 RV will serve as the standard warhead for both MX and the new small ICBM and may be used by the US Navy's new D-5 SLBM. The Mk 21 weighs slightly more than the Mk 12A used on Minuteman III but, in its initially planned configuration, will have about the same yield. The principal advantage of the new warhead developed by DoE's National Laboratories is that it makes more efficient use of the scarce Special Nuclear Materials (SNM, which serve as the fission trigger of a fusion weapon), thereby permitting the government to save some money on the total cost of building the RV and warhead when compared to the Mk 12A.

There is also the option to increase the yield of this warhead appreciably, but this would entail a greater use of SNM. Under those conditions, the yield of the Mk 21 would exceed that of the Mk 12A yet would require no more SNM than the older warhead. Another plus associated with the Mk 21 is that its advanced fuzing system works with greater precision and, hence, greater effectiveness than the Mk 12A, according to the BMO Commander. At this time, the Defense Department does not see an immediate need to boost the yield of the Mk 21 to a level above that of the Mk 12A, even though the option to do so exists.

One-eighth scale MX silo model prior to silo test. Prospects look good for increasing silo hardness. Current funding will allow ten missiles to be deployed at F. E. Warren AFB, Wyo., by December 1986.

Warranties for MX

In consonance with a new law sponsored by Sen. Mark Andrews (R-N. D.), BMO is negotiating warranties on the FY '84 MX production buy, with plans to extend them to all subsequent acquisitions. General Casey believes that "we will be able to get warranties on all operable equipment on the missile." BMO is trying to write these warranties so that they will cover all components that "are up and operating when the missile stands alert." He predicted that the warranties will increase production costs only moderately, probably "in the neighborhood of one percent." In case of equipment failure, the warranties give the Air Force the options of either sending the defective component to the manufacturer, who will fix it at no additional cost, or of following a course where "we fix it ourselves in a depot and reduce the contractor's payment by a given amount."

The taxpayers are going to get "a good bargain" as a result of the warranties BMO is negotiating on the FY '84 MX production program, General Casey suggested: "If failures occur at a much higher rate than the government expects, the government doesn't pay any more and the contractor has to keep fixing them up to a ceiling, which in our case is three to four times higher than the government's investment in the warranties. It is unlikely that we would get such a failure rate. The bottom line is that we are paying no more than we would have [without warrantics], yct wc run less risk." While the government's up-front cost goes up slightly under this approach, that increase will probably be made up—or exceeded—by the savings that accrue over the life of the system.

MX is to attain IOC—consisting of ten missiles deployed in ten silos at Francis E. Warren AFB, Wyo.—by December 1986. This timetable has been put in question by Congress. In order to meet this schedule, the Air Force needs the R&D funds of the full FY '85 MX appropriations right now. While the MX opponents have concentrated their efforts on withholding the program's production funds—until after April 1, 1985, and on the provision that Congress can vote up or down on the program at that time—the prospects for Congress passing a defense appropriations bill before the November elections are growing dimmer. This could affect the FY '85 MX funding and hence the IOC.

The Small ICBM Program

The President's Commission on Strategic Forces headed by Lt. Gen. Brent Scowcroft, USAF (Ret.), suggested in its formal report last year that a single-warhead missile weighing about fifteen tons "may offer greater flexibility in the long-run effort to obtain an ICBM force that is highly survivable, even when viewed in isolation, and that can consequently serve as a hedge against potential threats to the submarine force." The Commission recommended that full-scale development of such a missile start in 1987 and that the weapon "should be provided with sufficient accuracy and yield to put Soviet hardened military targets at risk."

A subsequent study commissioned by the Pentagon suggested that the effectiveness of the small missiles could be boosted if they are deployed in hardened fixed silos as well as in hardened mobile launchers. General Casey told this writer that no decision has been made as yet on whether the small missile will be split-based or deployed solely in fixed silos or mobile launchers. Suggesting that both basing modes will be expensive because of the associated different R&D efforts, he predicted that the ultimate decision will be influenced by both budgetary factors and the prevailing threat.

Hard mobile basing appears to be the most flexible basing mode for the small missile, according to BMO's initial studies. A study group convened by the Defense Department and chaired by former AFSC Commander Gen. Bernard A. Schriever, USAF (Ret.), recommended last year that hard mobile launchers capable of withstanding overpressures of at least twenty-five pounds per square inch without damage or being over-

turned be treated as the design "base line." The panel acknowledged at the same time that recent advances in silo hardening show considerable promise and that, therefore, the option to dual-base these missiles should be kept open.

Silo Hardening and Accuracy Considerations

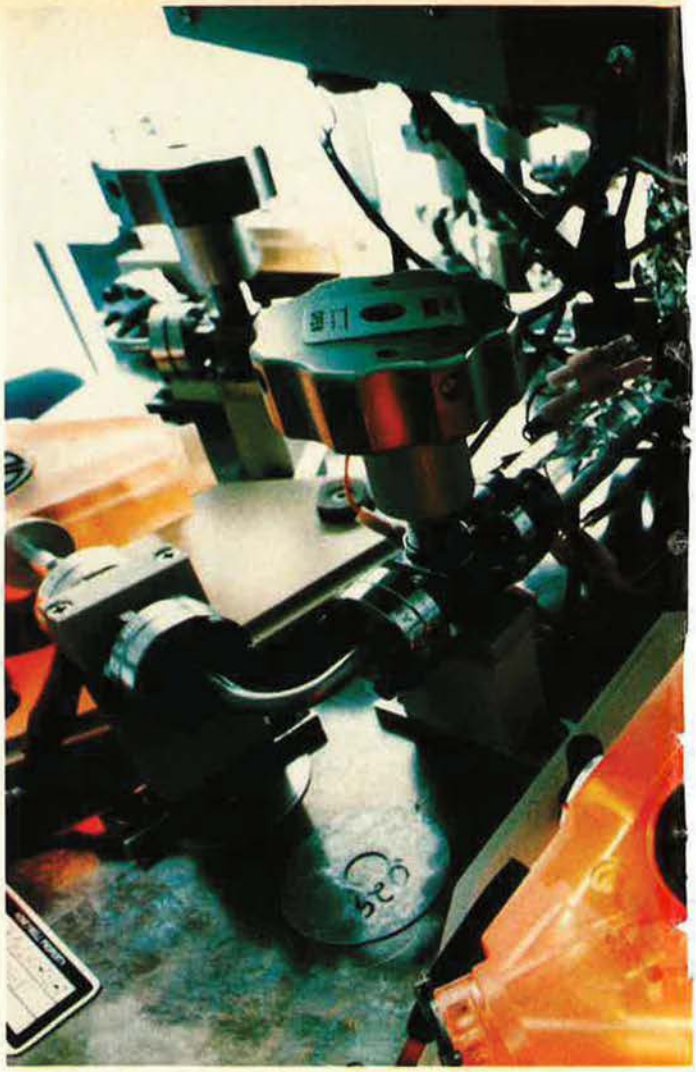
The prospects are good for increasing the hardness levels of ICBM silos to about twenty-five times the structural survivability of the hardest Minuteman silos. Continuing tests of superhard silo technologies show that the original findings and forecasts by the Air Force and the Defense Nuclear Agency (DNA) are "holding up and justifying our optimism," General Casey said. *(See also "The Prospect for Superhard Silos," January '84 issue, p. 74.)* The consequence of such superhard silos is major for the Soviet strategic war planner. DNA calculations show that Soviet strategic forces at present could not achieve a reliable P_k (probability of kill) against such silos and the ICBMs they house. The Soviets would have to change their force structure and weapon types to be effective against such superhard silos. Such a pervasive revamping would eat up much of their ICBM throw-weight, take a long time, and cost vast amounts of money.

If the small missile is deployed in a mobile mode, its accuracy will probably be slightly less than that of a silo-based MX or silo-based small ICBM. The reason, General Casey said, is that there is a greater chance to refine the geodetic and launch region gravity models in the case of a fixed launch point. In the case of a mobile system, even with the enormous calculation power "that is at your fingertips in today's world, you probably won't be able to have all these data instantly available for all possible launch stations." The result may be some small degradation in accuracy for a mobile system. The land navigation problem, the BMO Commander predicted, will be solved within an accuracy range of about two feet, which "is trivial." The accuracy of a small missile might also be affected by the fact that the guidance alignment probably can't be performed with the same precision as with a silo-based weapon. In the case of MX, "we sit there for almost a full day aligning the guidance by taking full advantage of the fact that the location is known in relation to the earth's rotation." This process, he added, won't be quite as rigorous in the case of a mobile system.

This problem could be eased, however, if stellar navigation is used to align the missile's guidance in flight, which is a technique used by the Navy's SLBMs. This approach is under consideration for second-generation guidance systems of the small ICBM, General Casey pointed out. Alignment problems also might be alleviated if a ring laser gyro guidance system were used.

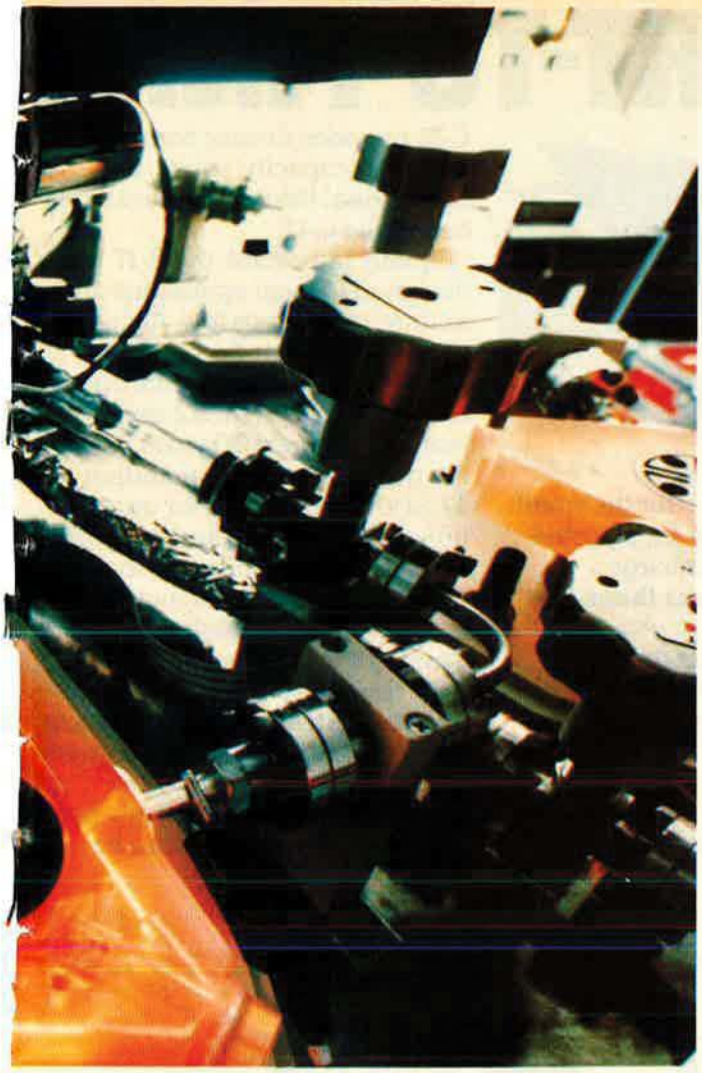
Guidance and C^3

Initially, the small ICBM might use a lightweight version of the Advanced Inertial Reference Sphere (AIRS) guidance of the MX. This system, General Casey pointed out, is a known quantity and has been designated the base-line guidance system for the small ICBM: "We know we can do it, and we know we can cut its weight by deleting the in-flight cooling that is not needed in the case of a single RV [compared to the MX's ten]." BMO plans to use AIRS on both MX and the small missile to take advantage of the economies of scale.



Honeywell's ring laser gyros are filled with helium/neon gas, which produces laser beams when energized. Future applications of this technology include missiles, submarines, and surface ships.

The reason why the Air Force also explores other approaches to the small missile's guidance system is to reduce unit cost, he said. Originally, there were indications that a ring laser gyro system might weigh less than AIRS. Competitive research has shown, however, that the weight reductions would be marginal, according to the BMO Commander. BMO's recently completed source selection competition led to contract awards to three suppliers for follow-on guidance systems for the small ICBM. Litton and Honeywell are working on ring laser gyro designs while General Electric is to pursue stellar guidance approaches patterned after the Navy's



guidance systems, General Casey said. All three "promise lower unit costs, eventually, as well as different advantages in terms of tolerance for dormancy and quicker start-up for the mobile mission." The question of which of the three systems will be most cost-effective, he said, can't be answered "until we have built and tested these alternate guidance systems."

For the time being, BMO has deferred fixing the number of small ICBMs that will be needed eventually: "Until we have worked out the basic concept rigorously enough to know the number of surviving warheads in a variety of scenarios, we are not likely to choose the right number." There are indications that the "right number" might be somewhere between 250 and 1,000 missiles, he suggested, but cautioned that "we won't settle on a final figure until we start full-scale engineering development."

Command control and communications (C^3) does not pose any major problems for the small missile, since BMO sees this challenge "basically as a stepoff from [the C^3 arrangement of the] Multiple Protective Shelter concept proposed" for MX several years ago. The current notion is to provide "ground-based launch control centers at a flexible ratio that can be varied." The plus that accrues from such an approach is that "if one launch control center survives, it probably will be able to handle all the force elements it is in contact with. We want the LCCs [launch control centers] to function just as long as possible"; yet, the ground-based C^3 link will be backstopped with airborne command and control in case all of the LCCs are destroyed. In addition, there will be provisions for launch control arrangements of last resort, meaning linkups through whatever C^3 assets remain available to the NCA (the National Command Authorities). The fixed-silo Minuteman and MX command and control systems, by contrast, rely on a fixed ratio of ten launchers per launch control center and are combined with an airborne launch control capability.

Soviet Reactions to SICBMs

The small single-warhead ICBM concept is not without detractors in the defense community and on Capitol Hill. There is no getting around the fact that large, MIRVed ICBMs are more effective hard-target killers than single-warhead designs. There also is reason to doubt that a US shift to a force of small single-RV weapons would cause the Soviets to scrap their 800-plus MX-equivalent ICBMs and to "mirror-image" the US ICBM force. If the US fails to persuade the Soviets to reduce their high level of "large, heavily MIRVed ICBMs on instant alert, it's going to be tough to decide what this country should field in terms of MX Peacekeepers and/or small ICBMs," General Casey acknowledged.

At the same time, General Casey is unwilling to write off fundamental Soviet interests in arms control: "We have about 7,700 warheads in our missile force, compared to about 8,900 for the Soviets. The US has about 2,000 on instant alert [on ICBMs] and the rest at sea. The Soviets have about 6,300 on instant alert [on ICBMs] and the rest at sea." The fact that the two superpowers are at opposite ends in this split between instant-alert ICBMs and SLBMs poses a problem that needs to be dealt with, General Casey suggested: "All recent US Administrations have tried to [propose arms-control formulas that would] reduce the strike forces on instant alert. I believe both countries are interested in solving this crucial problem."

He suggested that it is probably "not acceptable for our country to put more and more weapons on instant alert. The small mobile missile can be made more survivable [than silo-based missiles, with the result] that it would take several Soviet warheads to take it out. We have tried to allow for this fact in our analyses, recognizing that we need stability in arms control almost as much as offensive capability" in the strategic forces. US deployment of the small ICBM might show the way to how such stability can be achieved, he believes. ■

C-17: THE START-TO-FINISH

The C-17 can carry a full range of Army and Marine Corps equipment from the U.S. directly into small, austere fields in a combat zone.

Currently, large airlifters deploy equipment from *major* bases in the U.S. to *major* overseas airfields. Once there, smaller planes take the shipment to small, remote airfields close to the forward battle area. Outsize combat equipment too large and heavy for the small airlifter is driven or transported forward by truck or barge.

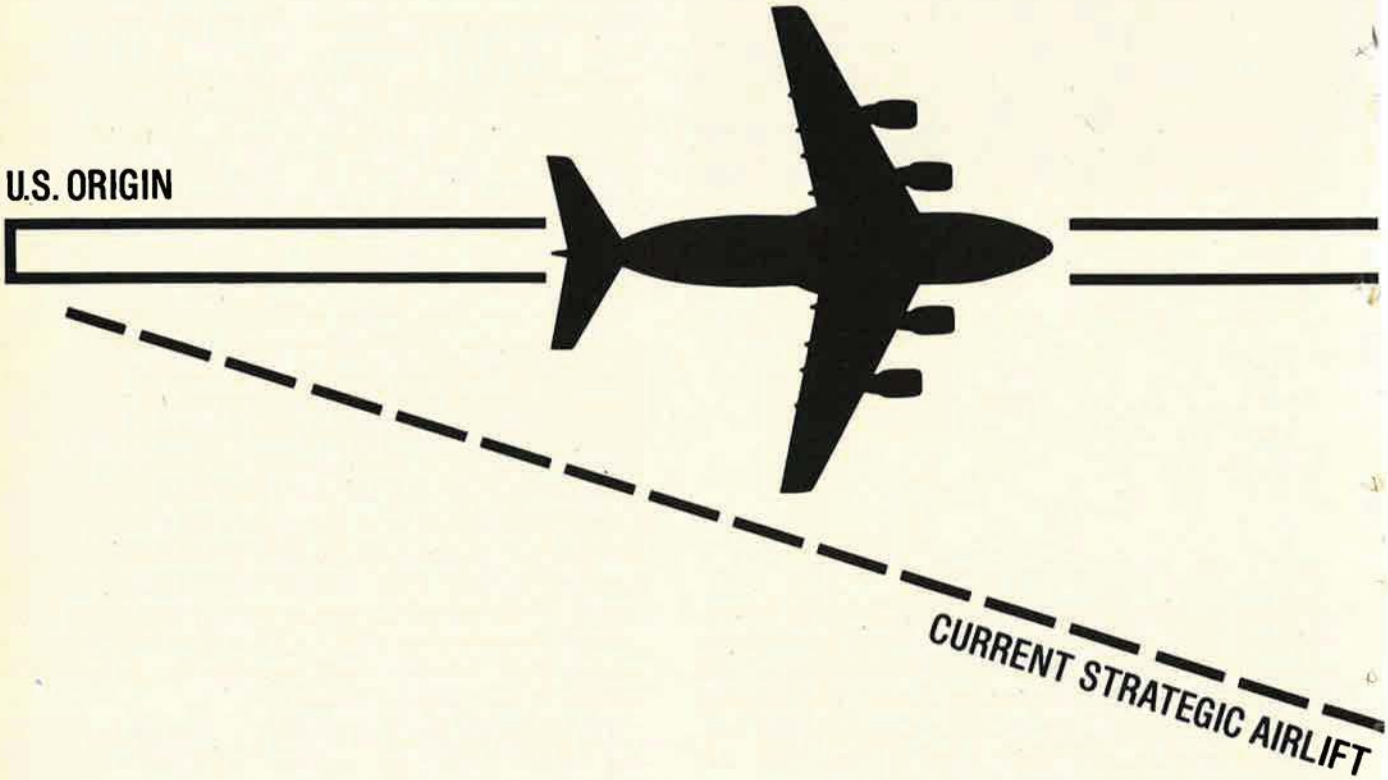
The C-17 combines these two airlifter jobs.

In addition to direct delivery from the U.S., the C-17 augments the existing force of intratheater airlifters. The C-17 can fly short routes, deploying troops and cargo from small or major airports into forward areas. In this role, the C-17 provides theater commanders with capacity, speed, and operational flexibility unavailable before the C-17.

Equally important, the C-17 is designed to keep operations and maintenance costs low. According to the U.S. Air Force Airlift Master Plan, the C-17 force option costs $16 billion (FY '82 dollars) less over the next 30 years than the next best option, including 14,800 fewer people for operations, maintenance and support. It will add 35% more intertheater and 78% more intratheater airlift to the existing capability.

The C-17 can carry more than four times the load carried by existing intratheater transports but operate into the same small airfields.

The equipment of the Army's new Light Infantry Division can be



AIRLIFTER.

carried efficiently by the versatile C-17. In fact, major weapons systems, vehicles and equipment of all Army units fit aboard. With the C-17, they aren't left behind for time-consuming overland shipment.

The commander can move fast with the flow of battle. The C-17 swells the ranks of airlifters available to the commander. He can "mix and match" loads to deliver exactly what's needed to forward battle areas. And, what's most important for troops in combat, the C-17 lets the commander deliver outsize cargo when and where it's needed.

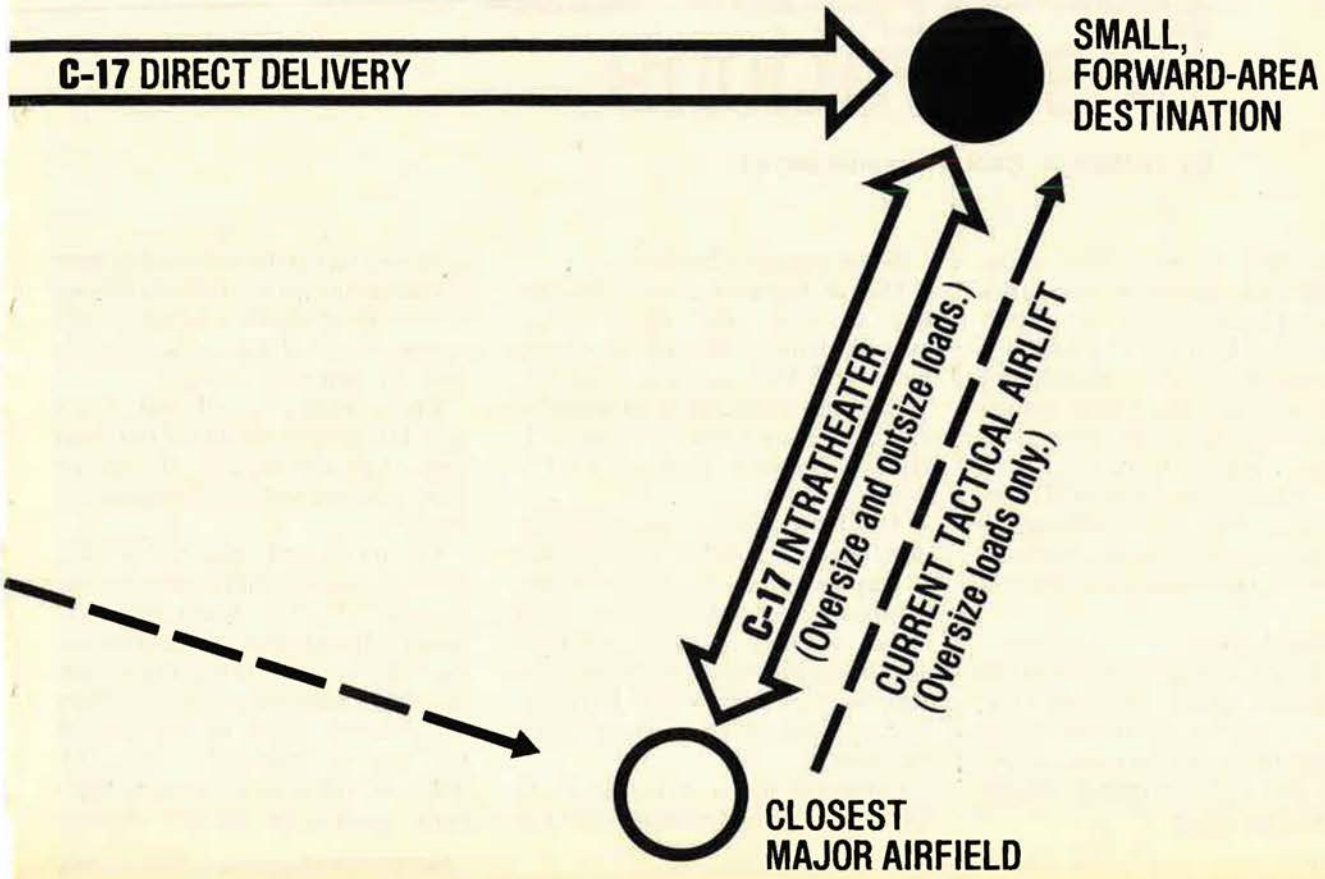
Modern, proven technology is used in the new C-17 airlifter.
The key elements of the C-17 design are based on modern technology already proven in commercial and military operations or in extensive prototype test programs.

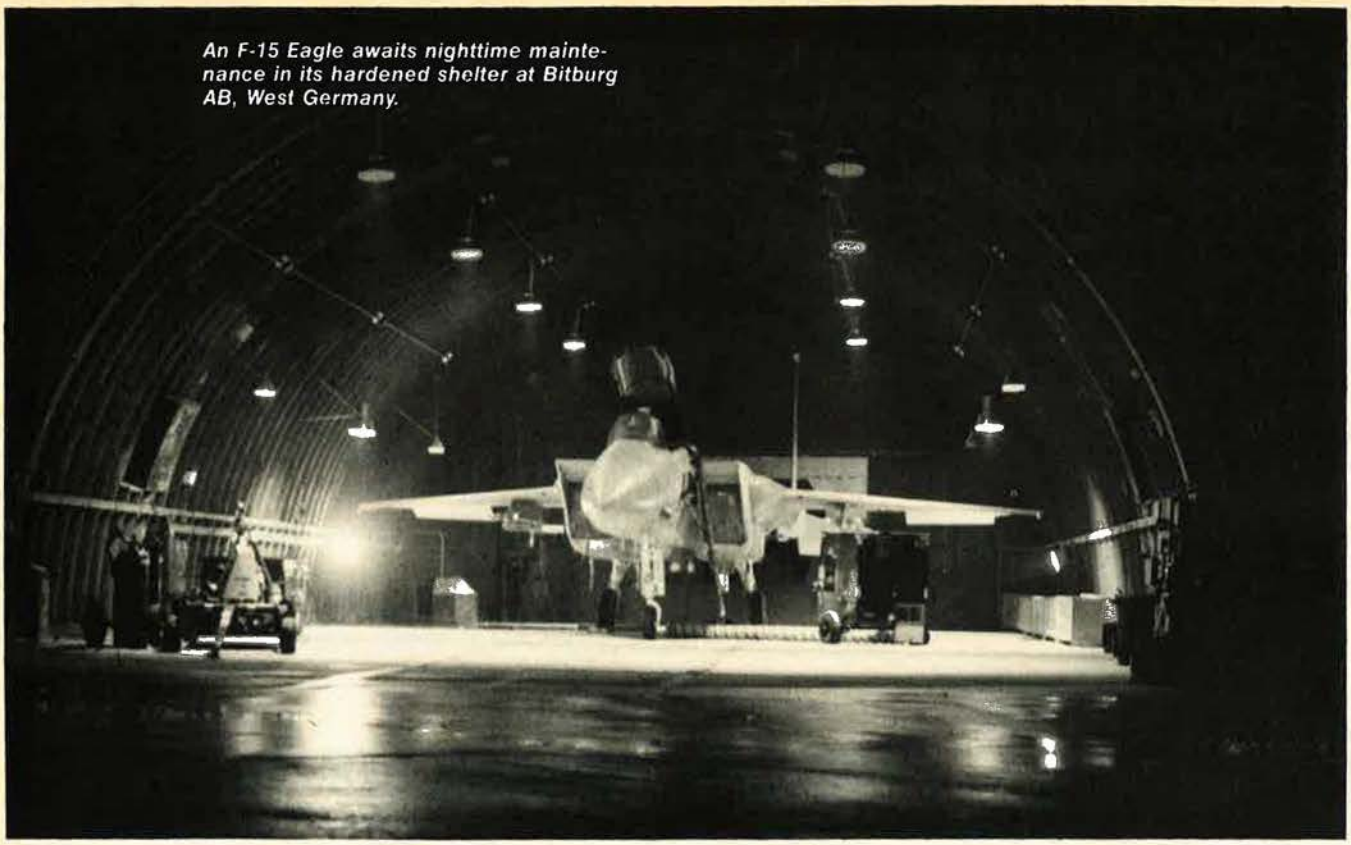
McDonnell Douglas backs its belief in the C-17 with a three-part warranty.
Specified structural life, aircraft performance, maintainability, reliability, and availability levels will be met or corrections will be made at no increase in price to the Air Force.

The C-17 long and short airlifter. If mission reliability, capability and low cost of ownership are essential, the C-17 is the one that's all in one.

These results warranted:	
Reliability	93% system mission completion success probability.
Maintainability	18.6 aircraft maintenance manhours per flight hour.
Availability	74.7% full mission-capable rate. 82.5% partial mission-capable rate.

MCDONNELL DOUGLAS





An F-15 Eagle awaits nighttime maintenance in its hardened shelter at Bitburg AB, West Germany.

USAFE has made impressive gains these past few years, but the problems aren't all solved yet.

Resurgence and Reservations

BY JAMES W. CANAN, SENIOR EDITOR

"If it flies, it dies." This is the unofficial motto of US Army antiaircraft missile crews in western Europe. It is laudable in what it reveals about those crews' morale and deadly purpose. But it also casts a shadow should combat come.

What it means is that US Air Forces in Europe (USAFE) aircrews may find it as difficult to come home safely as to penetrate Warsaw Pact air defenses in the first place.

Consider this:

A USAFE F-16 gets shot up on an interdiction sortie over East Germany. Its pilot needs to get to the first friendly airfield he knows about and as fast as his crippled aircraft will take him there.

So he makes a beeline.

He has, however, a very big problem, an ironic one. While he has made it, barely, through the enemy belts of SAMs and radar-guided antiaircraft guns, looming ahead is yet another such belt—this one of I-HAWK missiles manned by US Army crews.

The F-16 contains an identification, friend or foe (IFF) system that is supposed to respond, when queried electronically by such crews, with an electronic countersign that will give the F-16 safe passage back through NATO territory. The system is not very reliable, however.

Gingerly nursing his aircraft along, the F-16 pilot knows that the only way he can be reasonably sure of identifying his aircraft as a friendly is to fly it inside a certain "safe haven" corridor at a certain altitude that will denote it as such.

The corridor is well out of his way. His aircraft could fall out from under him any minute. He has no time. The hell with it—he'll take his chances.

On the ground, near the border, and beneath his flight path are the remains of a US Army I-HAWK battery. It had been attacked by Soviet air. Its surviving crews are shook-up and very skittish. They are going to shoot at any aircraft that does not respond to their IFF query or that is on a wayward flight path—such as the one now showing

up as a track on their radar—and ask questions later.

They signal the oncoming aircraft but get no response. They have less than two minutes to shoot, and they do. Finishing the job that a Soviet SAM had begun over East Germany, an American I-HAWK shoots down a US F-16.

Uppermost Need

Of all the many pressing needs of USAFE and its brother air forces and antiaircraft units in Allied Command Europe (ACE), an improved, common, electronic IFF system is probably uppermost.

Lacking it, such situations as the foregoing are almost inevitable, and many others, just as dire, can be forecast.

For example, without a sure-fire "technical" IFF system, in contrast to the often unworkable and time-consuming "procedural" system, USAFE's and NATO's air-superiority fighters would be sorely constrained in combat. They would not be able to use their beyond-visual-range (BVR) air-to-air missiles against aircraft because they might be friendly, even though they had not identified themselves as such.

This takes the edge off tactics built around the BVR missiles, most notably around the Advanced Medium-Range Air-to-Air Missile (AMRAAM) that USAFE covets for its F-15 Eagles and for the F-16C and F-16D Fighting Falcon variants the command is destined to receive.

Absent a standard, reliable IFF system for all NATO aircraft, AMRAAMs—and even the Sparrow radar missiles now aboard USAFE air-superiority fighters—would have limited utility in clear-sky engagements and even less in combat at night or in weather.

All too often, unless radar tracks were positively identified as targets, USAFE's fighters would lose their best advantage. They would have to hold their fire at ranges out of harm's way for themselves and best suited for easy kills.

Nontechnical IFF methods based on airspace control require a relatively settled air scenario. This is highly unlikely in the melee that can be expected during the first day or two of an air war over Europe.

Thus, the IFF deficiency could be fatal at precisely the time when the very first order of business for USAFE and all ACE fighter forces is to establish air superiority.

"We desperately need a common IFF within NATO," declared Maj. Gen. William L. Kirk, USAFE's Deputy Chief of Staff for Operations. "We need to be able to shoot beyond visual range, at night and in any weather, with our airplanes."

No Airtight Solution

Shortly before he retired as USAFE Commander in Chief last August 13, Gen. Billy M. Minter told AIR FORCE Magazine that he was "not looking for an airtight solution" to the IFF problem.

"If I have ninety percent confidence that we could positively identify eighty-five percent of the airplanes up there, that would be a very good IFF system," General Minter declared. "We're looking for something that will enable us to do a better job of managing airspace and give us reasonable assurance that we have air targets sorted out."

Acknowledging his "frustration" with the drawn-out IFF dilemma, General Minter declared: "In this day and age, we ought to be able to come up with a technical solution."

NATO is involved in an eighteen-month study of IFF that is scheduled for completion early next year. Aimed at a consensus on a common frequency for IFF, the study has involved much debate on which wave band should be used in a new "question-and-answer" NATO Identification System (NIS).

For example, the US and France favor a D-band operating frequency, the one both now use. It characterizes the US Mark XII IFF system and also a follow-on system, the Mark XV, that has been developed.

West Germany, however, prefers the E/F band, which it now uses. Along with the United Kingdom, it has criticized the US for moving ahead with design of the Mark XV before the IFF issue is resolved.

The UK also uses the E/F band and has been undecided about keeping it or switching to the D-band.

The stakes in this are high from a budgetary as well as a military standpoint. Switching to another wave band would cost any NATO nation big dollars, and the US would be hurt the most.

It has been estimated that the US would have to shell out more than $3 billion to procure and install the electronic gear for an E/F wave band IFF system in its European ground stations and in its aircraft deployed in, or destined as reinforcements for, NATO.

Susceptibility to electronic countermeasures is another important consideration in the debate. All parties agree that an E/F band system is inherently more conducive to resisting ECM. But the US claims that an improved D-band system, such as the US Mark XV, will do the trick.

NE-3A Relieves Problem

For the time being, the NE-3A AWACS aircraft in the fast-growing NATO Airborne Early Warning Force (NEAWF) provide a large measure of relief. They greatly enhance the execution of NATO's Airspace Control Plan for "indirect" IFF, and much of their electronic and signal equipment was devised for just that purpose.

Some military leaders in Europe question, however, whether even the highly capable NE-3As would be up to the job of discriminating among the swarms of fighters in the donnybrook that is anticipated for the early days of an air war over the Continent. Their problem would be compounded by the high-density jamming environment and the MiGs they would undoubtedly encounter.

The Soviets practice jamming on a daily basis as a premier part of their air-to-air and air-to-ground fighter tactics and have become disquietingly adept at it, USAFE officers say.

Unconstrained by environmental or political considerations, Soviet combat aircrews also routinely practice firing their missiles over Warsaw Pact territory. USAFE crews cannot do this over NATO territory.

USAFE is now working out an arrangement with the Navy to launch missiles against Navy drones over the Mediterranean, but until this comes to pass, US European-based aircrews will have to continue to come back to the States for such realistic training.

USAFE officers also see signs that the Soviets—who are increasingly equipped with sophisticated combat aircraft and C^3I—are mov-

ing away from hidebound, centrally controlled tactics. They are giving their units in the air more leeway to improvise in accordance with situations.

Enough Difficulties

This could complicate things for USAFE, which has enough problems already.

Such problems include, to name a few, big shortfalls of air-to-air and standoff air-to-ground munitions, a dearth of storage space for all kinds of supplies, badly congested parking for reinforcing aircraft, not enough intertheater and intratheater airlift, lack of ability to fight at night, questionable survivability for air bases, and a highly restrictive ceiling on numbers of US personnel in Europe.

All such problems are being earnestly addressed, but the going is slow on many.

As General Minter put it just prior to his retirement: "Our requirements far exceed our ability to meet them all."

Even so, USAFE, now commanded by Gen. Charles L. Donnelly, Jr., *(see box on the opposite page)* gets better all the time and is, if not cocky, confident of its crews and their machines.

Its F-16s, recently arrived in Germany and Spain and with many more to come to the Continent, make a big difference in its ability to interdict enemy rear echelons in keeping with the new NATO Follow-On Forces Attack (FOFA) concept *(see "NATO on the Upbeat," AIR FORCE Magazine, p. 134, September '84 issue).*

Moreover, USAFE's F-15s in Germany and the Netherlands are inarguably the best air-superiority fighters in existence, and they would get plenty of help in that mission from the Sidewinder-armed F-16s and from USAFE's much-improved F-4s as well.

There are many other examples of steady progress in the command.

Training is more intense all the time and is producing highly gratifying results. Aircraft maintenance capability has improved dramatically from the shockingly low level of just a few years ago. The electronic-battlefield Warrior Preparation Center at Einsiedlerhof AS—near USAFE headquarters at Ramstein AB, Germany—is doing wonders for Air Force-Army interplay in the planning and execution of combined tactics and should lead to more of the same among all NATO air and ground forces.

Combat Lineup

No one doubts that USAFE will give a very good account of itself, its problems notwithstanding, if it is called upon to fight.

What happens if it is?

With the exception of two units, all USAFE forces—seventeen wings with about 790 aircraft—are in place and will be able to go to war in less than twelve hours.

USAFE's A-10s would perform strictly in the close air support role. But all the rest of USAFE's tactical aircraft would be devoted, at the outset of combat, to the counterair role—to gaining and maintaining air superiority. This means defensive counterair against enemy aircraft, offensive counterair against enemy airfields, and suppression of enemy air defenses.

Once air superiority has been established, some of the fighters can be used to help the A-10s and Army attack helicopters support ground forces at the forward edge of the battle area (FEBA) and to carry out deep interdiction.

Thus, it is easy to see why USAFE craves the F-15E dual-role fighter and wants the F-16Cs and F-16Ds that will be wired for, and armed with, AMRAAMs.

The earlier models of F-16s at Hahn AB, Germany, and in Spain have already demonstrated not only a remarkable proficiency at precision interdiction ("They may still be dropping dumb bombs, but they make up for it by being very smart airplanes," says one USAFE officer) but also a great talent in air-to-air combat with their short-range, heat-seeking Sidewinders.

"We can absolutely roll the F-16s into the air defense role," General Minter asserted. "They are very, very capable airplanes."

Their versatility, which will increase when the C and D variants come along, is a very big plus for an outnumbered Air Force in Europe. Add the dual-role F-15Es, the USAFE F-111s now positioned in the UK, and the Tornado aircraft coming into the German, Italian, and British air forces, and the sum is formidable firepower, air-to-air and air-to-ground, in Europe.

Then there are the F-4 Phantoms. USAFE is phasing them out. For example, the 86th Tactical Fighter Wing at Ramstein will convert from F-4Es to F-16s in 1986.

But the Phantoms, their avionics greatly upgraded, still hold a high place in USAFE's battle plans. They stand with the F-16s as USAFE's air-to-ground mainstays. In addition, USAFE's lethal defense suppression efforts are now centered on the F-4E/G Wild Weasel aircraft, which, it is hoped, will be armed with HARM missiles as soon as possible.

Electronic Combat

In general, electronic combat (EC) capability is on the rise. Even EC suites on USAFE's newer airframes, such as the A-10s, the F-15s, and the F-16s, are being upgraded.

Moreover, USAFE is in the process of deploying two new EC assets—the EC-130H Compass Call and the EF-111 Raven aircraft. The mission of the Compass Call aircraft is to jam enemy voice and data link communications; of the Ravens, to locate and jam enemy radars—the eyes of their C^3 system.

Training for EC has always been a problem in Europe. USAFE is meeting it by expanding its EC ranges and making them more sophisticated.

In sum, says one USAFE briefer, while the EC threat from the Warsaw Pact is "dynamic—always improving," USAFE's EC readiness "is higher today than at any point in USAFE's history."

USAFE's EC tacticians have no intention of destroying the enemy's entire C^3 system, even should that be possible. "It is to our advantage, in fact, to ensure that certain modes of an enemy's C^3 net remain operable," another briefer says.

The reason: "One of the inherent weaknesses of a C^3 system, as with any electronic means of transmission, is its susceptibility to exploitation through interception and intrusion.

"There are many bits and pieces of both written and electronic communications that, when put together by intelligence experts, add up to

significant amounts of valuable information.

"By intercepting and injecting false inputs back into any enemy's C^3 system, we may be able to add confusion and degrade operations more than if we destroyed the entire net."

Reconnaissance Up

Recce capability is also on the rise. Out of Zweibrücken AB, Germany, and RAF Alconbury, UK, RF-4Cs equipped with the Pave Tack imaging infrared/laser target-designating pod provide USAFE with primary, all-weather, day-night reconnaissance. They also carry TEREC, an electronic intelligence system that, according to one USAFE briefer, "takes full advantage of the versatility and flexibility of the fighter airframe."

The RF-4Cs will receive an all-weather side-looking radar as well. It is being field-tested by USAFE, and "our experiences with it will help us take full advantage of the more advanced TR-1 radar downstream," a USAFE briefer says.

The TR-1s are destined to carry an advanced, synthetic-aperture, side-looking radar and the Precision Location Strike System (PLSS) for picking out targets and coordinating fire against them well behind enemy lines. Nearly half again as large as the U-2 spy aircraft from which they are descended, the TR-1s can cruise at 430 mph at altitudes exceeding 70,000 feet. They have a range of more than 3,000 miles.

Flight-testing of PLSS in conjunction with TR-1 avionics began last December. It has been highly successful, bearing out the claim that it will be able to detect and fix the location of targets in a matter of seconds and then direct strike aircraft to precisely computed points for the release of free-fall or guided weaponry against those targets.

Out of RAF Alconbury under the control of the Strategic Air Command, one squadron of TR-1As is now flying more than twenty sorties a month over the Continent. RAF Alconbury is also the home of the 10th Tactical Reconnaissance Wing's one squadron of RF-4Cs and one squadron of F-5Es.

What all this means is that USAFE is much better off than it was five, or even two, years ago. Its modern weapon systems are much more effective than their predecessors.

Its training is also much more realistic, heavily involving the exercising of "dissimilar" air combat tactics against various other NATO aircraft. This has been made possible, in large measure, by stepped-up funding for flying hours.

USAFE crews flew 223,847 hours in 1983, in contrast to 184,892 hours in 1979. They are expected to approach 235,000 hours this year. Their "mission-capable" rate has improved by fourteen percent since 1979.

USAFE still cannot fight at night as confidently as it would like. With the Pave Tack system, it has taken a big step forward. What it needs—and urgently—in order to go all the way, its officials claim, are the Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system, the Imaging Infrared (IIR) Maverick air-to-ground standoff missile, and the F-15E dual-role fighter.

At Hq. USAFE and throughout the three numbered Air Forces at its command—the Third Air Force at RAF Mildenhall, the Sixteenth Air Force at Torrejon AB, Spain, and the Seventeenth Air Force at Sembach AB, Germany—another urgent call is for more effective munitions all across the board.

Critical Shortages

The command is "critically short," says one officer, of both short-range and BVR air-to-air missiles. It badly needs AMRAAM and the Advanced Short-Range Air-to-Air Missile (ASRAAM) now being developed by Germany and the UK.

It also needs, for defense suppression, the High-Speed Anti-radiation Missile (HARM) and such weapons as the GBU-15 glide bomb, the Low-Level Laser-Guided

To Continue the Initiatives

Gen. Charles L. Donnelly, Jr., took command of USAFE last August 13 determined to "continue the initiatives and the programs that make it one of the finest commands in the Air Force."

General Donnelly had been Commander, US Forces, Japan, and Commander, Fifth Air Force, Yokota AB, Japan, embracing USAF units in Japan and the Republic of Korea, since August 1981. For two years previously, he had been Chief, US Military Training Mission, Saudi Arabia.

The General received his fourth star in keeping with his assignment as CINC USAFE. He also commands NATO's Allied Air Forces Central Europe (AAFCE).

Headquartered at Ramstein AB, West Germany, USAFE is one of USAF's thirteen major commands and is the air component of the US European Command (EUCOM), one of the unified commands.

USAFE is made up of more than 60,600 military personnel at twenty-nine major installations and many additional smaller ones in West Germany, the United Kingdom, Spain, Greece, Belgium, Italy, the Netherlands, and Turkey.

The command's area of responsibility extends throughout the Mediterranean, the Middle East, and portions of Africa.

General Donnelly told AIR FORCE Magazine that he faces "a lot of challenges" in his new assignment.

"There are problems," he said, "but the momentum is in the right direction. In my opinion, NATO has held together amazingly well."

As General Donnelly sees it, a major reason for optimism is the manifestation of "higher morale and patriotism wherever you look" in USAF.

"My goal," he added, "is to make sure that the people in USAFE live well and are treated well. If you don't take care of your people, you detract from their ability to fly and fight."

A native of Barberton, Ohio, General Donnelly entered the Air Force in January 1951 as an aviation cadet and was commissioned in March 1952. As an F-4C pilot and flight commander with the 555th Tactical Fighter Squadron in Thailand, he flew 100 combat missions over North Vietnam and twenty-seven over Laos during eight months of 1966–67.

General Donnelly has also served as Commander, 401st Tactical Fighter Wing, Torrejon AB, Spain; as Deputy Director, Plans, USAF's Office of the Deputy Chief of Staff for Plans and Operations at the Pentagon; and as Commander of Sheppard Technical Training Center, Sheppard AFB, Tex.

He is a command pilot with more than 7,000 hours of flying time in twenty-four types of aircraft. His decorations and awards include the Distinguished Service Medal (Air Force), Legion of Merit with two oak leaf clusters, Distinguished Flying Cross, Air Medal with twelve oak leaf clusters, and Air Force Commendation Medal with one oak leaf cluster.

Bomb (LLLGB), the Gator mine, and the Combined Effects Munition (CEM), as specified by its weapons experts.

"We are deficient in air-to-air missiles, antiradiation missiles, and offensive counterair weapons [for airfield denial]," one USAFE officer says. "We don't have standoff weapons worth a damn, and we won't for some time. We're just now getting around to launch-and-leave air-to-surface munitions that will enable our aircraft to stay back about fifty miles. Even if we get that up to one hundred miles, we're still vulnerable. The Pact has SAM systems that can go out 140 to 150 miles.

"We're getting great airplanes, but we've got to have better stuff to hang on them. We're much better off than we were five years ago because we have greater quantities of munitions. But too many of them can be spooked, or aren't 'smart.' "

"I think we can meet the threat with what we have. We are close to meeting the thirty days' [of war] requirement. The problem is we'd have to deliver a whole lot of ordnance on the targets, and that exposes our aircrews. It also forces us into a big [munitions] storage problem."

Receiving Reinforcements

USAFE is in a box. Unless it can quickly establish air superiority right out of the starting block through defensive counterair, offensive counterair, and defense suppression operations, its reinforcements cannot hope to arrive—or to arrive anywhere near intact—from CONUS.

USAFE's goal is to "close" all of its reinforcing fighter squadrons in less than two weeks. This is in keeping with the NATO Rapid Reinforcement Plan promulgated under the direction of US Army Gen. Bernard W. Rogers, the Supreme Allied Commander Europe (SACEUR).

What it means for the US is the rapid deployment from CONUS of six Army divisions and at least sixty USAF squadrons.

In return, as part of the "long-term defense program" that NATO allies agreed to in 1976, those allies provide host-nation support of the US reinforcements in the form of collocated operating bases and forward storage sites.

In keeping with SACEUR's priorities, air-superiority fighters, most notably F-15s, are number one on the lengthy list of weapons that must be rushed to Europe and into combat. Complementing them are intratheater airlifters, such as USAF's C-130s.

There is a severe hitch in all this. The fighters would arrive in Europe on time. But they would not have adequate support, and their parking problems on USAFE's main and collocated operating bases would rival those in downtown Manhattan during rush hour.

Malpositioned Stocks

As described by USAFE officials, here is the situation:

Although USAFE has enough munitions to sustain operations for thirty days, much is malpositioned. Munitions are stockpiled in three central storage facilities—in Italy, the UK, and "Central Europe"—and must be transported to the bases that would need them. USAFE officials know full well that the Warsaw Pact has pegged these facilities as prime targets.

Until munitions can be much more widely dispersed to minimum essential facilities (MEFs)—storage facilities for seven days' worth of fuel and munitions, plus dispersed parking for aircraft—on collocated operating bases, USAFE must have much greater capability to airlift large quantities within the theater.

Although host-nation support efforts in this regard will be of some help, "they can't help much," says one USAFE briefer, "when we consider the enormous tonnage that must be moved—for example, from Italy to other [NATO] Southern Region bases, or from England to the Northern Region."

USAFE Improvements in Quality of Maintenance Training 1982–84

UNIT	1982 PASS RATE	1984 PASS RATE
20th Tactical Fighter Wing	44.3%	86.1%
36th Tactical Fighter Wing	28.9%	76.5%
48th Tactical Fighter Wing	59.1%	61.7%
50th Tactical Fighter Wing	58.0%	75.8%
52d Tactical Fighter Wing	48.7%	51.8%
81st Tactical Fighter Wing	58.1%	66.0%
86th Tactical Fighter Wing	75.9%	81.7%
10th Tactical Reconnaissance Wing	48.8%	77.1%
26th Tactical Reconnaissance Wing	51.1%	86.3%
406th Tactical Fighter Training Wing	54.0%	63.5%
601st Tactical Air Support Group	46.4%	84.2%

This table shows the great improvement in aircraft and missile maintenance capability and training in eleven USAFE units over the past two years. The low marks in 1982 are attributed largely to prior attrition of top-notch maintenance NCOs. The average pass rate for 1982 was 53.5%; for 1984 the rate was up to 71.1%.

Source: USAFE

USAFE has an aggregate storage space shortfall of more than 2,200,000 square feet for sortie-generating assets. It needs more than 1,000 storage igloos, yet would be hard pressed to find space for them.

So if war comes, says one official: "We are going to have a massive, a tremendous, problem. We can't fight a war for very long with the airplanes we've got here now. We can get the additional airplanes into the theater, but we may not be able to refuel them, and we may not have anything to hang on them."

USAFE eagerly awaits the arrival of its first complement of F-16Cs, heralded here by the recent first flight of F-16C No. 1 over Texas. The "C" variants are wired for the Advanced Medium-Range Air-to-Air Missile (AMRAAM) and will greatly enhance USAFE's air-to-air and air-to-ground capability.

The problem has still another facet. Many of USAF's big airlifters and tankers, the C-5s and the KC-10s, are unable to land at many main operating bases (MOBs) and COBs. This means that the equipment they carry will have to be transferred to intratheater airlifters at the large military and civilian airfields where they can land and that the supplies will have to be flown once again to the tactical airfields from which the fighters fly.

This is why USAFE is pushing hard for quick and big production of the C-17 transport aircraft, which could double as a strategic airlifter and an intratheater airlifter.

The deployment of reinforcing and resupplying aircraft from CONUS would raise the risk of congestive chaos within USAFE, the way things stand now.

The picture is not entirely bleak.

USAFE is vigorously pursuing its Prepositioning Procurement Package (PPP) program to alleviate the massive resupply problem. PPP is the Air Force version of the Army's POMCUS program for positioning equipment and supplies in Europe to support units arriving from Stateside.

The PPP program could not possibly accommodate every single item that the reinforcing tactical air squadrons would need. Nevertheless, it is expected to provide enough supplies for eighteen fighter squadrons—and every little bit helps.

Flight-line support equipment and vehicles procured in the program will be stored and maintained at eighty-five European locations. Quantities of supplies covered by the program would fill 703 C-141B stretched StarLifters.

This translates into a tremendous boon for US wartime logistics.

More than ninety percent of all PPP equipment has been requisitioned. Such equipment began arriving in Europe in February 1983, and keeps coming at a steady rate.

USAFE also takes heart from the C-5B and KC-10 production programs and from the reengining of KC-135 tankers. All this "will significantly increase our capability to reinforce and resupply NATO," one official notes.

European Distribution System

USAFE's capability for forward stockage and distribution of critical fighter aircraft spares, including entire engines, is on the rise, too. The reason: USAF's new European Distribution System (EDS) *(see also "Gaining on the 'Gotchas' " on p. 52 of this issue).*

EDS has three elements: logistics command control and communications for requesting, searching out, and allocating spares; three warehouses for storing them; and organic airlift in the form of eighteen turboprop cargo aircraft to be at USAFE's beck and call.

As of now, USAFE has no direct control of any intratheater airlifters for any purpose. All are at the disposal of Allied Command Europe and are allocated at the CINCEUR level.

On March 2, USAF awarded a $54 million contract to Short Brothers of Northern Ireland for the eighteen C-23 EDS aircraft, each capable of transporting a fully assembled fighter engine. The first two C-23s are to be delivered to Zweibrücken AB on October 26 of this year. All are scheduled for delivery over the next twelve months.

Operational Next June

The Logistics C^3 element of EDS will be in operation next June. It will interconnect and integrate logistics communications among all USAFE MOBs, arrange inventories in computers, and permit quick-time search of, and selection from, those automated files.

The first of the three EDS warehouses, at RAF Kemble in the UK, will be ready for business this coming December. The other two, at Zweibrücken and at Torrejon AB, will be built and stocked up in short order thereafter.

USAFE's Collocated Operating Base program is coming around as well. "It is today very dynamic, and the pace of its development is picking up," says a USAFE briefer.

USAFE gains access to Allied airfields for use as COBs through binational Memoranda of Understanding (MOU). Nine such agreements have established the COB program in nine European nations, where more than seventy bases, large and small, are now available to USAF aircraft.

Storing Explosives

Storage space is a bugbear everywhere in Europe. USAFE officials are fascinated by the potential for easing that problem through the substitution of insensitive high explosives (IHEs) for existing, touchier types.

Conventional weapons now embody high-explosive (HE) Tritonal fillers. Stocks of them blow up at the blink of an eye when attacked. IHE fillers are vastly less sensitive. This is an important consideration when it comes to their intratheater transportation as well.

It is estimated that IHE fillers would cost only about sixty cents a pound apiece—less than half the cost of HE fillers.

If USAFE could switch to IHE fillers for its munitions, it could greatly reduce its requirement for

additional storage igloos, its officials claim.

Why? Given their relative insensitivity, IHE munitions can be stored to the full capacity of a storage structure, whereas storage space requirements for HE munitions are based not on their bulk but on what their detonation would do to their environs.

For example, an igloo containing 500,000 pounds of HE munitions must be 4,000 feet from the nearest inhabited building. With the IHE munitions, that distance can be cut to 635 feet.

As part of its Airbase Survivability Program (ASP), USAFE is also procuring precast concrete slabs to provide parking space at cramped COBs.

Such reinforced slabs are now being considered, and will probably be used, for rapid repair of USAFE runways. The Soviets have used concrete slabs to build and repair their runways for many years. So have the Swiss.

USAFE's Stateside units destined for Europe in wartime regularly deploy to, and exercise from, USAFE's COBs. There have been nearly fifty such deployments, including exercises under Tactical Air Command's Checkered Flag program and Military Airlift Command's new Volant Partner program. More than twenty such exercises are scheduled for 1985.

Communications Needs

The communications links between USAFE and its collocated operating bases leave a lot to be desired. Without such links, USAFE would be hard put to provide operational tasking and logistics and administrative support to its Stateside augmentation forces.

Here again, things are looking a little rosier. USAFE has received funding for communications at fifty-two COBs and has set up communications at sixteen of them. Funding for networks to keep in touch with an additional twenty-one COBs is being requested in USAF's FY 1987–91 Program Objectives Memorandum (POM).

Moreover, a new initiative, the NATO Airbase Satellite Communications program, will enhance the reliability and survivability of all such communications assets. The first satellite terminals to ensue from that program are scheduled for installation at some COBs in late 1988.

Throughout USAFE, and indeed Allied Command Europe, the upgrading and hardening of C^3 assets is getting major attention. Sensors and C^3 facilities that worked just fine and that were secure in previous years are now highly vulnerable to the threat from the Pact air arm and intermediate-range missiles.

To counter this, NATO's Air Command and Control System (ACCS) team, heavily involving USAFE C^3 specialists, is looking hard at remedial measures for existing C^3 facilities and equipment. It is also designing a new, fully integrated command and control system for the year 2000 and beyond.

C^3 Initiatives

As part of the ACCS program, USAFE has undertaken the following endeavors:

- Hardening Central Region Allied Tactical Operations Centers (ATOCs) at Sembach and Kalkar.
- Increasing its ability to process and pass information without danger of enemy exploitation. A major part of this is the incorporation of secure voice and data systems such as Parkhill and the Joint Tactical Information Distribution System (JTIDS).
- Expanding EIFEL-1, the primary Automatic Data Processing (ADP) system at the ATOC level for NATO command and control of Central Region offensive air units.

EIFEL-1 evolved as the West German Air Force command and control system, starting in 1970. USAFE began incorporating the system at the Sembach ATOC in 1980, and the UK, Belgium, and the Netherlands picked up on it—for the ATOC at Maastricht—a year later.

All five nations came to a formal agreement last December for a multinational EIFEL-1 management structure, including a center at Birkenfeld, Germany, for a configuration control board and software development. Much more is happening.

Crucial to the functions of air tasking and reporting, EIFEL-1 is being expanded through connections between all four ATOCs and all main operating bases, standby bases, fixed and mobile operations centers, and logistics/intelligence support centers.

The two German ATOCs at Kalkar and Messtetten have hooked up with about eighty-five percent of their bases and centers; the UK-Belgium-Netherlands ATOC at Maastricht, with about fifty-five percent; and USAFE's ATOC at Sembach, with about half.

Lowering the Vulnerability

Meantime, USAFE is intent on lowering the vulnerability of its on-base communications. It is installing digital switches in semihardened facilities for its European Telephone System (ETS) lines and is providing a second communications cable from each of its bases to the commercial telephone systems of their host nations.

Those backup cables take a different direction from the primary cables and are hooked up to a different commercial exchange. Thus, an attack would have to knock out both cables to disrupt communications.

Aircraft shelters are being equipped with a special-purpose communications setup, including a telephone launch-control system, a public-address system, and a buried, redundant cable system. Radar operations shelters and airfield surveillance radar electronics shelters are being hardened.

USAFE already has two fully hardened avionics shelters at RAF Lakenheath and RAF Upper Heyford. A third one is under construction at Bitburg AB, Germany, the home of F-15s, and others are under design for Hahn AB and Ramstein AB, the present and future homes of F-16s. Design of other hardened avionics shelters will begin at Spangdahlem AB and at Zweibrücken AB late this year.

With NATO funding in store, comparable programs will take place in the near future at eight additional air bases in Denmark, Germany, Italy, the Netherlands, Norway, and Turkey.

USAFE's electronic countermeasures maintenance and repair shops will be situated in all such hardened facilities. For now, however, some such shops are being moved right into the hardened TAB-

V (Theater Air Base Vulnerability) aircraft shelters on the fighter bases.

Maintenance Much Better

Of all the improvements that are newly noticeable or being planned within USAFE, none stands out more than the success of the command's hard-nosed moves to improve its maintenance of aircraft and missiles, which is what sortie generation is all about.

Two years ago, the USAFE command set out to find out just how good its maintenance personnel were and how much training was needed to improve them. The answers: terrible, and a whole lot.

An appalling number of maintenance men simply did not know how to fix aircraft or missiles, even though they were supposed to be specialists in such fixing. They did not even know where certain parts were supposed to go on the weapons. Even worse, many of the people who were supervising them, or in charge of training them, didn't know either.

"It was criminal," says one USAFE official. "The results were disastrous. So we came up with what we called the Aircraft Maintenance Qualification Program—the AMQP—where we actually took the people and put them in classrooms, and then put them on airplanes with dedicated instructors, to ensure that they had been properly taught how to do particular tasks and had learned their lessons.

"And then we did evaluations on them, we audited them, we made sure.

"The results were good. On our first visits to seven bases when we started our initial inspection, the average pass rate for those bases was somewhere in the thirty percent category. When we went back a year later, after the training program, we found the pass rates were running as high as eighty percent. You can't really ask for a helluva lot more than that. You can ask for 100 percent, but you'll never get it."

USAFE officials give several reasons for the sad state of their maintenance personnel as discovered in 1982. One was the attrition of "middle management"—senior staff sergeants and technical sergeants—during prior years. Another was the steady drawdown of operations and maintenance (O&M) funding for the Air Force and all the services in the mid to late 1970s, and even into the early 1980s.

USAFE officials regard O&M funding as the lifeblood of their command. The figures bear them out, and also bear watching.

The Austere Years

In the austere years of FY '78 through FY '80, USAFE's backlog of maintenance and repair projects grew by $28 million, or seventy-four percent. Flying programs were cut back. USAFE squadrons did not even have the wherewithal to participate in US Red Flag or NATO squadron exchanges.

European inflation stood at twenty to thirty percent, yet USAFE was funded at inflation rates that were, as calculated by the Office of Management and Budget, much lower than either the European or the actual US rates.

Amid such fudging by Washington on actual buying power for USAFE, the command had no money for upkeep of its bases and quality of life for its personnel.

In FY '81, a dramatic, two-year upswing of O&M funding began. All scheduled flying training was accomplished during that period, and the backlog of maintenance and repair was cut by $30 million, to a level of $53 million. Bases were spruced up. Personnel got prouder and better.

Now there may be a danger sign. O&M funding growth was relatively small in FY '83 and has leveled off in the current fiscal year. Even so, all scheduled aircrew training is being accomplished, and all new tasks have been fully funded.

Notable among such missions are the deployment of the TR-1As and the EF-111s in the UK and the deployment of the ground-launched cruise missiles (GLCMs) at USAFE bases in the UK, Italy, and Germany.

Backlog Dwindles

The maintenance and repair backlog also keeps dwindling. But if Congress or the Pentagon or both revert to the old ways of sacrificing O&M funding to accomplish a slower rate of growth in total defense spending, the day may come again when USAFE's mechanics don't know how to fix airplanes, and the airplanes won't fly as often as they should.

There is another angle to all this. USAFE officials are very pleased with advances in simulators for training aircrews. They take advantage of them. They worry a little, however, that their success with simulation may be seized upon by budget-cutters as a way out of providing them sufficient funds for actual flying hours—for which, when you're facing the Russians, there is really no substitute.

"I fervently hope we never get into a box where we do everything in simulators because we can't afford to fly our airplanes anymore," asserts one USAFE colonel.

Right now, USAFE is taking a beating from the congressionally imposed ceiling on US troop strength in Europe. This year's USAF posture statement calls it "the most serious near-term problem faced by our Air Force in Europe."

It means that in juggling manpower slots to make room for its fledgling TR-1A and EF-111 units, USAFE has had to cancel slots for its RED HORSE squadron in the Southern Region and for its two squadrons of OV-10s in the 601st Tactical Control Wing at Sembach AB.

The transfer of those squadrons back to CONUS was completed on October 1. The OV-10s were responsible for forward air control of USAFE and other NATO aircraft involved in offensive and defensive air operations in central Europe. Ironically, their departure detracts from the workability of NATO's Airspace Control Plan, and thus of procedural IFF.

Protecting the Bases

Even as USAFE moves a bit to protect and disperse sortie-generating assets on its bases, it also sees more daylight ahead in the protection of those bases.

Such point air defense systems as the Vulcan guns and Chapparal missiles may be adequate but inspire no great confidence. Now, after years of negotiations, Germany has agreed to join with USAFE in the addition of Roland and Patriot air defense fire units—the Roland for

point defense, the Patriot for area defense in replacement of old Nike missiles. In addition, the Rapier system will provide point air defense at seven USAFE bases in the UK.

Defense against chemical weapons, which the Soviets possess in abundance, train constantly with, and have shown they are not above using, is also improving bit by bit. Flight-line crews and other personnel on USAFE bases train earnestly in defending against chemical attack.

USAFE officials wish, however, that the US Congress could see its way clear to approve the Reagan Administration's long-running request for an up-to-date arsenal of US binary chemical offensive weapons. Those weapons are regarded by the US commanders in Europe as the best possible deterrent to a decision by the other side to wage chemical warfare in an offensive counterair operation.

"The Soviets pose a significant chemical threat to our air bases, and our lack of progress in improving our chemical retaliatory forces will encourage Soviet first-use of chemical weapons," one USAFE briefing paper says flatly.

Working with the Army

Obviously, waging and winning a war in Europe would not be a function of airpower alone. But because Allied Command Europe forces would be outnumbered, and because the enemy would choose the time and place of attack, the flexibility of airpower could well be the key to deterring such an attack, or to defeating it.

This is why USAFE and the US Army in Europe, which has two corps on the line in West Germany, are working together as never before under the auspices of US European Command (EUCOM). Headed by General Rogers, EUCOM's day-to-day operations are supervised by USAF Gen. Richard L. Lawson, its Deputy CINC, at Stuttgart.

"The idea, always, is to have the two services resolve their differences for the sake of ensuring the effective use of our theater air resources," one EUCOM official explains.

Both are heavily engaged in working up tactics in keeping with SACEUR's Follow-On Forces Attack concept—to defeat the enemy in his rear before he can reinforce his front-line assault formations.

USAFE buys the concept. "We believe the FOFA concept as envisioned by General Rogers would help win the war," a USAFE briefer flatly states.

Notes a USAFE document: "We are doing our interdiction mission very well in support of Army ground-gaining forces. [But] developing the joint Army and Air Force capability to stop an attack as far forward as possible, while simultaneously engaging enemy forces in depth, will require careful exploitation of our latest technological advances in order to provide the architecture for striking deep.

"We demonstrate proficiency in attacking follow-on forces in our annual exercises. However, there is always room for improvement, and we will continue to refine joint NATO procedures."

Warrior Preparation Center

A great place for doing this is the new Warrior Preparation Center, a combined Army-Air Force facility at Einsiedlerhof AS just outside Hq. USAFE at Ramstein AB.

The brainchild of USAFE's General Kirk and Col. Richard (Moody) Suter (who was also instrumental in devising USAF's Aggressor and Red Flag programs), the Center consists of a fully computerized—and rapidly expanding—electronic battlefield and threat-training facility.

The electronic battlefield setup combines air-war and ground-war computer models with a newly created electronic intelligence model. What it adds up to is the very first Airland Battle computer model.

Last May, commanders from the Army's VII Corps at Stuttgart and from USAFE's ATOC at Sembach joined forces in a week-long full-scale command-post tactical exercise—the Center's first—called Joint Warrior 84-1. The main players were Maj. Gen. Harry A. Goodall, Commander of Seventeenth Air Force and of the ATOC at Sembach (now Lieutenant General Goodall, Deputy CINC of USREDCOM at MacDill AFB, Fla.), and VII Corps Commander Lt. Gen. John R. Galvin.

Alongside them for one full day were the Corps's division commanders and the Seventeenth Air Force's wing commanders. Afterward, General Galvin was quoted as describing it as "perhaps the best day I've had as a Corps commander—nothing can be more important to the capability of the armed forces than the interoperability of the Army and Air Force. We learned volumes."

In such exercises, all manner of tactical situations are literally sprung on USAFE and Army battle commanders, taking shape on computer screens in the form of, for example, three MiG-25E Foxbats taking out after an NE-3A AWACS aircraft, or a Soviet armored column moving up to reinforce the line.

"With computer simulation," said Colonel Suter, "we can do just about anything the players need us to do to enhance their capabilities to prosecute any future war in Europe."

Training at All Levels

The electronic battlefield at the Center can conduct training exercises at all tactical-unit levels, from squadrons and companies up through corps and wings to major NATO commands.

Officers of allied nations are taking part as well. Joint Warrior 84-1 involved German, Canadian, and UK air and land officers, and, as far as USAFE is concerned, the more the merrier.

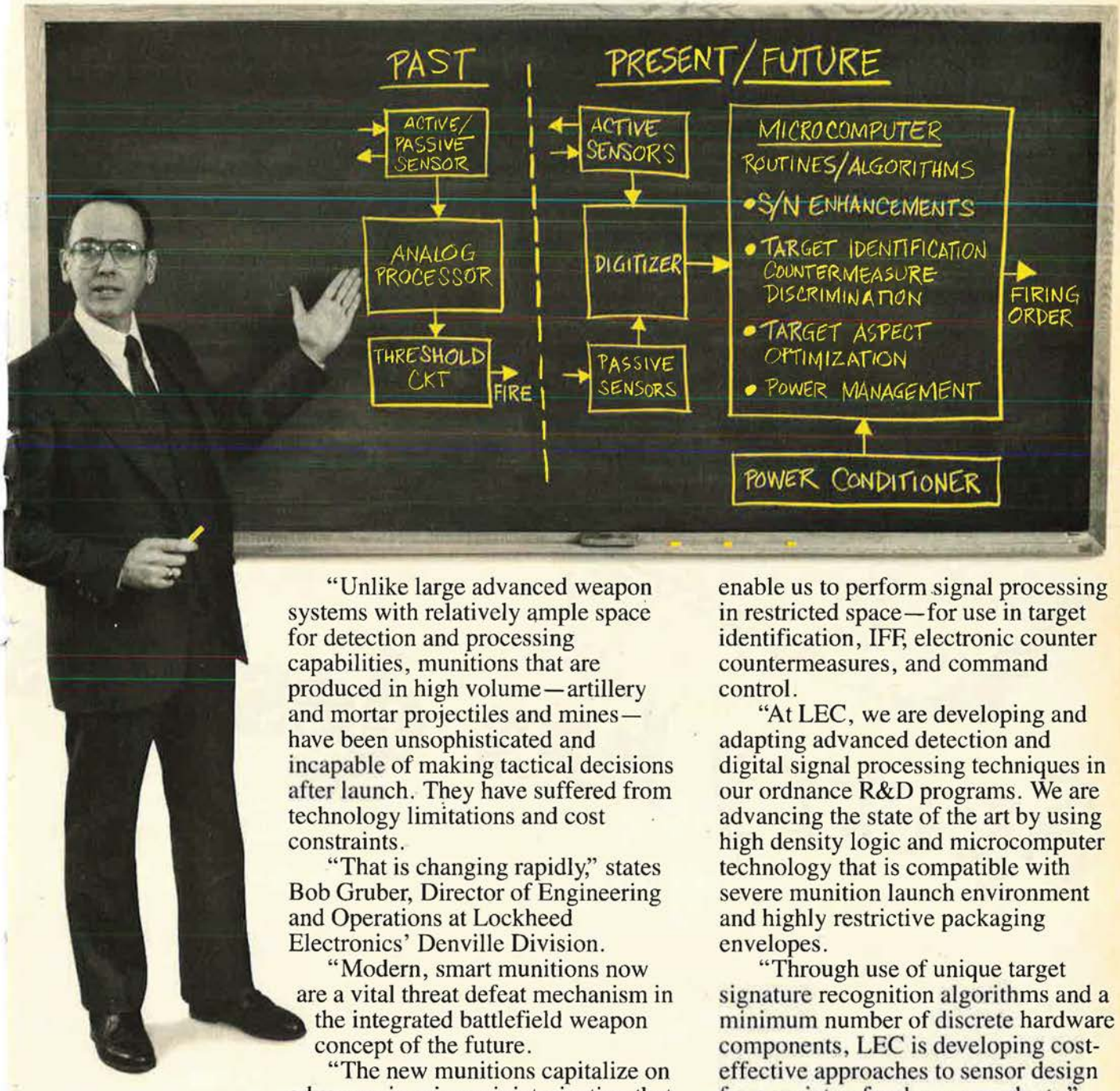
Air Force Systems Command's Electronic Systems Division (ESD) pitched in to help bring USAFE's electronic battlefield into being. ESD-Europe's program office for this effort was set up during the Center's early development stage. It installed computer equipment and programs together with the graphic displays that simulate air and land battle arenas.

Says USAF Maj. Larry Simmons, director of the ESD-Europe program office: "During exercises, we stress the importance of the players cooperating with and complementing each other. We hope to help them make better use of combat weapons available to carry out their duties.

"If they want to back up and try it again, using a different strategy, they can." ■

Ordnance technology on the move:

Bob Gruber on smart munitions.



"Unlike large advanced weapon systems with relatively ample space for detection and processing capabilities, munitions that are produced in high volume—artillery and mortar projectiles and mines—have been unsophisticated and incapable of making tactical decisions after launch. They have suffered from technology limitations and cost constraints.

"That is changing rapidly," states Bob Gruber, Director of Engineering and Operations at Lockheed Electronics' Denville Division.

"Modern, smart munitions now are a vital threat defeat mechanism in the integrated battlefield weapon concept of the future.

"The new munitions capitalize on advances in microminiaturization that enable us to perform signal processing in restricted space—for use in target identification, IFF, electronic counter countermeasures, and command control.

"At LEC, we are developing and adapting advanced detection and digital signal processing techniques in our ordnance R&D programs. We are advancing the state of the art by using high density logic and microcomputer technology that is compatible with severe munition launch environment and highly restrictive packaging envelopes.

"Through use of unique target signature recognition algorithms and a minimum number of discrete hardware components, LEC is developing cost-effective approaches to sensor design for a variety of ordnance products."

Engineers interested in contributing to advanced electronic systems are invited to write Employment Manager at LEC, Plainfield, New Jersey 07061.

Lockheed Electronics
Leadership in Technology

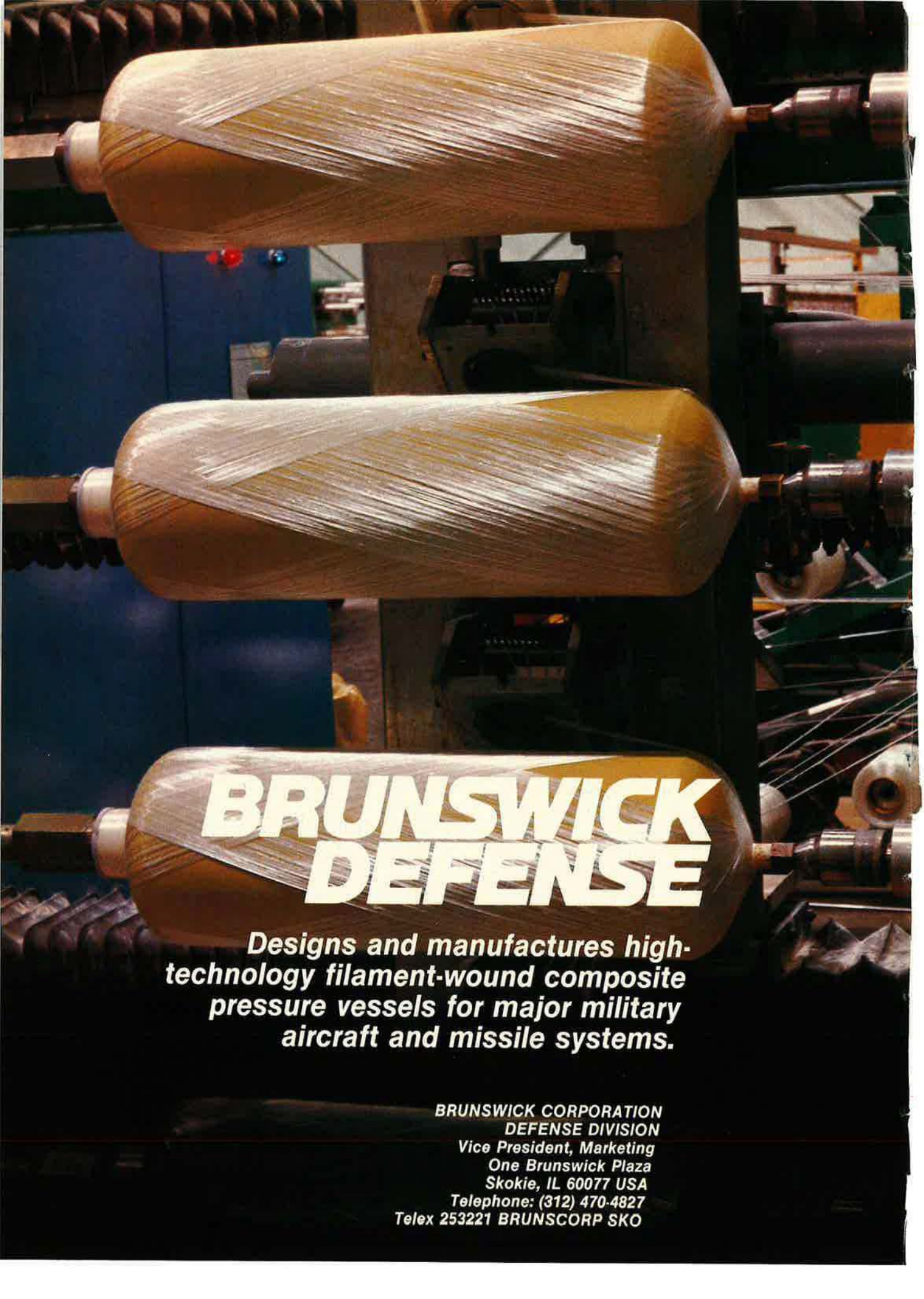
Sperry has designs

on the C-17 cockpit.

Sperry is actively supporting Douglas Aircraft Company in designing an advanced avionics system with color CRT displays for the USAF McDonnell Douglas C-17 long-range, short-field multipurpose transport that will give U.S. forces a new dimension in quick reaction strategic airlift.

To match the C-17's advanced propulsion, aerodynamics and load capacity, Sperry is refining flight-proven technology to integrate the latest digital flight control, display and mission management systems in a two-pilot cockpit. Sperry, P.O. Box 9200, Albuquerque, NM 87119. Phone (505) 822-5000.

SPERRY



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ALL THE WORLD'S AIRCRAFT SUPPLEMENT

OCTOBER 1984

BAe Hawk T. Mk 1A in new Royal Air Force war role camouflage

BRITISH AEROSPACE

BRITISH AEROSPACE PLC, Aircraft Group, Weybridge Division, Richmond Road, Kingston upon Thames, Surrey KT2 5QS, England

On 20 June 1984 British Aerospace announced that it is developing a single-seat version of its Hawk advanced jet trainer. A demonstrator aircraft, designated Hawk 200, is expected to fly for the first time in 1986.

Starting as a dedicated trainer, to meet a Royal Air Force requirement for a Gnat replacement, the Hawk has been upgraded progressively in the following stages:

Hawk T. Mk 1. Basic two-seater for RAF flying and weapon training. Total of 175 delivered, starting November 1976. Adour 151 turbofan, rated at 23.13 kN (5,200 lb st). Two underwing hardpoints. Underbelly 30 mm gun pack. Simple sight. No external fuel tanks.

Hawk T. Mk 1A. Many RAF Mk 1s are being modified to this war role standard for airfield defence and limited attack. Capable of carrying two AIM-9L Sidewinder air-to-air missiles or BL755 cluster bombs on underwing hardpoints.

Hawk Mk 50. Initial export version. Adour 851 turbofan, rated at 23.75 kN (5,340 lb st). Max operating weight increased by 30 per cent. Max disposable load increased by 70 per cent. Max range increased by 30 per cent. Five weapon pylons; wing stations configured for single or twin store carriage. 'Wet' inboard pylons for 455 litre (100 Imp gallon) fuel tanks. Improved nav/com. Improved cockpit, with AOA, slim seat head boxes, and weapon control panel. Optional brake-chute. Suitable for ground attack in day VMC, and armed reconnaissance with camera/sensor pod. Sold to Finland, Indonesia, and Kenya. US Navy's carrier-capable T-45 undergraduate jet pilot trainer to similar basic, unarmed, standard, but with derated Adour 861.

Hawk Mk 60. Improved development of Mk 50 with Adour 861 turbofan, rated at 25.35 kN (5,700 lb

Artist's impression of Hawk Mk 200 armed with Sea Eagle sea-skimming anti-ship missile

Hawk 200 equipped for night operation with FLIR and laser rangefinder

st). Wing lift improvements. Drop tanks of 592 or 864 litre (130 or 190 Imp gallon) capacity. Air-to-air missile capability. Max operating weight increased by further 17 per cent, disposable load by 33 per cent, and range by 30 per cent. Improved field performance, acceleration, rate of climb, and turn rate. Sold to Abu Dhabi, Dubai, Kuwait, and Zimbabwe. Entered service 1982.

Hawk Mk 100. Enhanced ground attack version, announced mid-1982. Still basically two-seater, but with added head-up display/weapon aiming computer, inertial navigation system, data bus, and HOTAS (hands on throttle and stick) controls.

Hawk Mk 100*. As Mk 100, plus laser rangefinder and FLIR, extending capability to night VMC.

Hawk Mk 200. New single-seat version, described below.

BAe HAWK Mk 200

This single-seat combat version of the Hawk will be identical with the current production two-seater aft of the cockpit, giving 80 per cent airframe commonality. Built-in twin-cannon armament will free the centreline pylon for other stores. Each of the four underwing pylons is capable of carrying 907 kg (2,000 lb), within the max external load of 3,084 kg (6,800 lb). The wide range of missions that such capability permits can be illustrated by six typical examples:

Airspace denial. Carrying two Sidewinder-type missiles and two 864 litre (190 Imp gallon) drop tanks, the Hawk 200 could loiter for four hours on station at 9,150 m (30,000 ft), 100 nm (185 km; 115 miles) from base; or for one hour on station 600 nm (1,110 km; 690 miles) from base. Max intercept radius is 770 nm (1,425 km; 885 miles).

Close air support. Four 1,000 lb and four 500 lb bombs could be delivered with precision up to 135 nm (250 km; 155 miles) from base in a lo-lo mission.

Battlefield interdiction. In a hi-lo-hi operation, the Hawk 200 has a radius of action of 540 nm (1,000 km; 620 miles), carrying four 1,000 lb bombs and two 592 litre (130 Imp gallon) drop tanks.

Long-range photo reconnaissance. A wide area of search is made possible by the mission range of 1,950 nm (3,610 km; 2,240 miles) offered by two external tanks, carried with a pod containing cameras and infra-red linescan. A rapid role change could then precede follow-up attack.

Long-range deployment. Ferry range is 2,200 nm (4,075 km; 2,530 miles), unrefuelled and with 864 litre (190 Imp gallon) tanks retained. Reserves would allow 10 min over destination at 150 m (500 ft).

Anti-shipping strike. Armed with a Sea Eagle sea-skimming anti-ship missile, and carrying two 864 litre (190 Imp gallon) tanks, the Hawk 200 could attack a ship more than 800 nm (1,480 km; 920 miles) from base and return with 10 per cent fuel reserves. This puts ships almost anywhere in the North Atlantic within range of the Hawk from shore bases. Weapon release could be beyond the target's radar envelope.

Three standards of equipment are envisaged, depending on the customer's mission requirements, as follows:

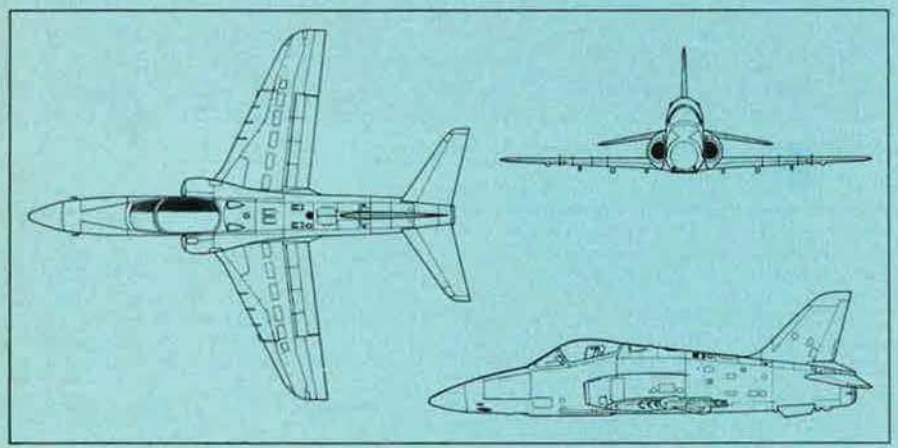
Day operation. The most simple equipment fit would comprise a gyro stabilised attack sight and attitude heading reference system, with navigation by radio aids. Navigation and weapon aiming capabilities could be extended by adding an inertial navigation system, head-up display, and weapon aiming computer. Other options are HOTAS controls, laser rangefinder, IFF, and radar warning receiver.

Night operation. With a FLIR and laser rangefinder mounted in a modified nosecone, the Hawk 200 could carry out precision ground attacks and tactical reconnaissance by day and night.

All-weather operation. Installation of an advanced multi-mode radar, such as the Sea Harrier's Ferranti Blue Fox, would add all-weather target acquisition and navigational fixing capabilities. Weapons like the anti-shipping Sea Eagle and air-to-air Sky Flash could also be employed.

The following outline specification applies to the Hawk 200 as currently planned, with the same Adour 861 non-afterburning turbofan as the two-seat Hawk Mk 60:

DIMENSIONS, EXTERNAL:	
Wing span	9.39 m (30 ft 9¼ in)
Length overall	11.05 m (36 ft 3 in)
Height overall	4.01 m (13 ft 2 in)
AREA:	
Wings, gross	16.69 m² (179.6 sq ft)
WEIGHTS:	
Weight empty	3,969 kg (8,750 lb)
Max internal fuel	1,360 kg (3,000 lb)
Max T-O weight	8,620 kg (19,000 lb)
PERFORMANCE (estimated):	
Max permissible speed in dive	Mach 1.2
Max level speed	560 knots (1,037 km/h; 644 mph)
Service ceiling	15,250 m (50,000 ft)
g limits: with max internal fuel, or with 1,360 kg (3,000 lb) military load and 60 per cent internal fuel	+8/−4



BAe three-view drawing of basic day operation Hawk Mk 200

EUROCOPTER

MESSERSCHMITT-BÖLKOW-BLOHM GmbH, Postfach 801109, Ottobrunn bei München, 8000 München 80, Federal Republic of Germany; and AÉROSPATIALE, 37 boulevard de Montmorency, 75781 Paris Cédex 16, France

EUROCOPTER HAP/PAH-2/HAC-3G

Following approval of a Franco-German co-operation programme on the basis of industry proposals, the defence ministers of West Germany and France signed on 29 May 1984 a memorandum of understanding covering the development of a new anti-tank helicopter for service with their two armies in the 1990s. Systems leadership lies with MBB, with Aérospatiale as co-contractor, although the work will be shared between these two companies on an equal basis.

MBB and Aérospatiale have set up a joint company known as Eurocopter, with headquarters in Paris, to execute this programme, which will involve a total of 400 or more aircraft for the two countries. Eurocopter is controlled by a joint board, but the executive authority for the programme is the *Bundesamt für Wehrtechnik und Beschaffung* (German federal defence technology and procurement agency).

The co-operation programme involves a single basic helicopter design, from which three versions will be developed. These are:

HAP (*Hélicoptère d'Appui et de Protection*). Escort and fire support version for French Army, for delivery from 1992. Armed with a 30 mm GIAT AM-3078 automatic cannon in undernose turret. Releasable weapons, on outboard underwing pylons only, comprise four Matra Mistral infra-red homing air-to-air missiles; or two pods each with twenty-four 68 mm rockets; or two Mistrals and one rocket pod. Roof-mounted sensors.

PAH-2 (*Panzerabwehr Hubschrauber*, 2nd generation). Anti-tank version for West German Army, for delivery from 1993. No nose gun turret. Wings further forward than on HAP, with four underwing