OCTOBER 1987/$2

AIR FORCE MAGAZINE

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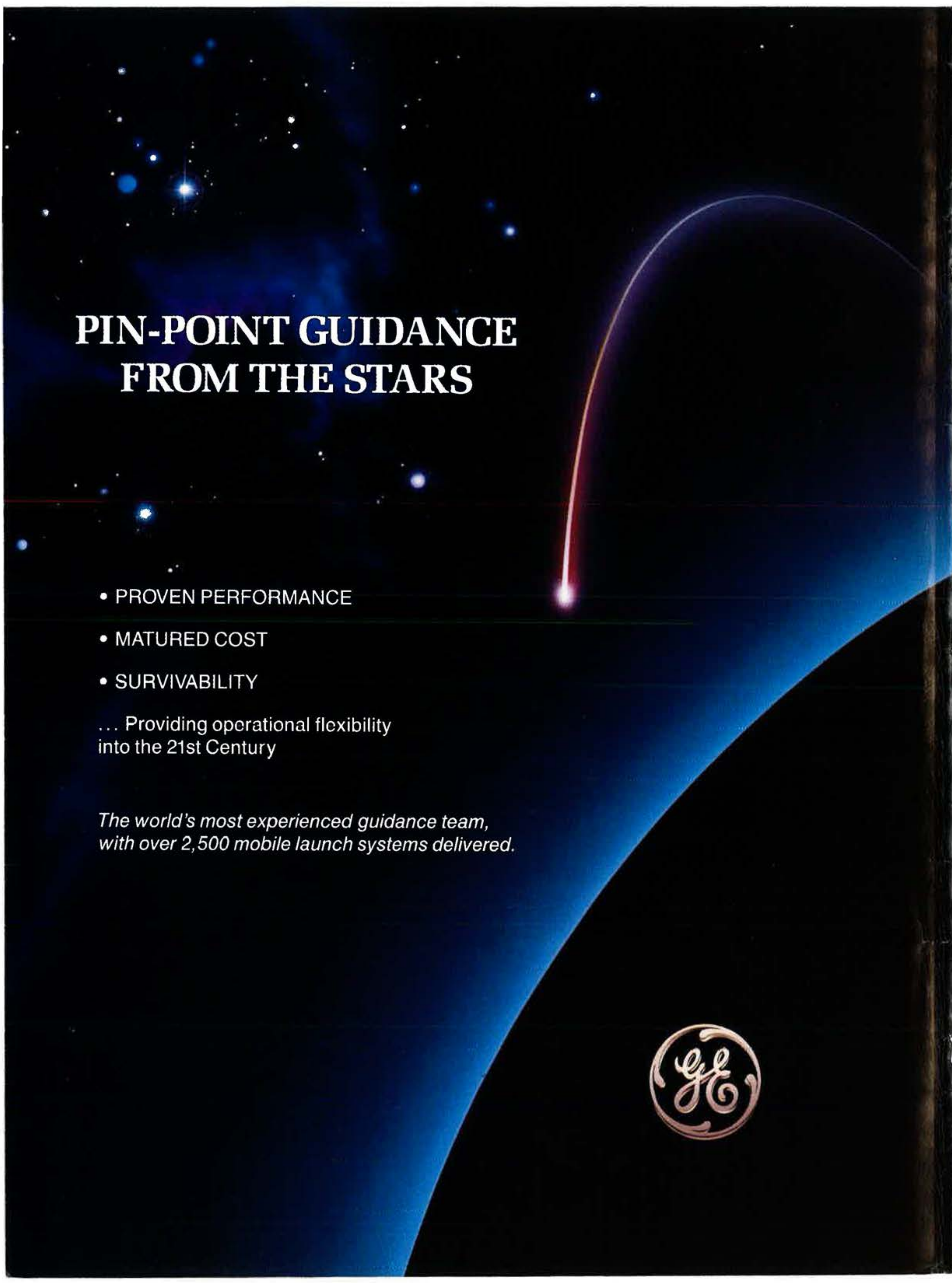
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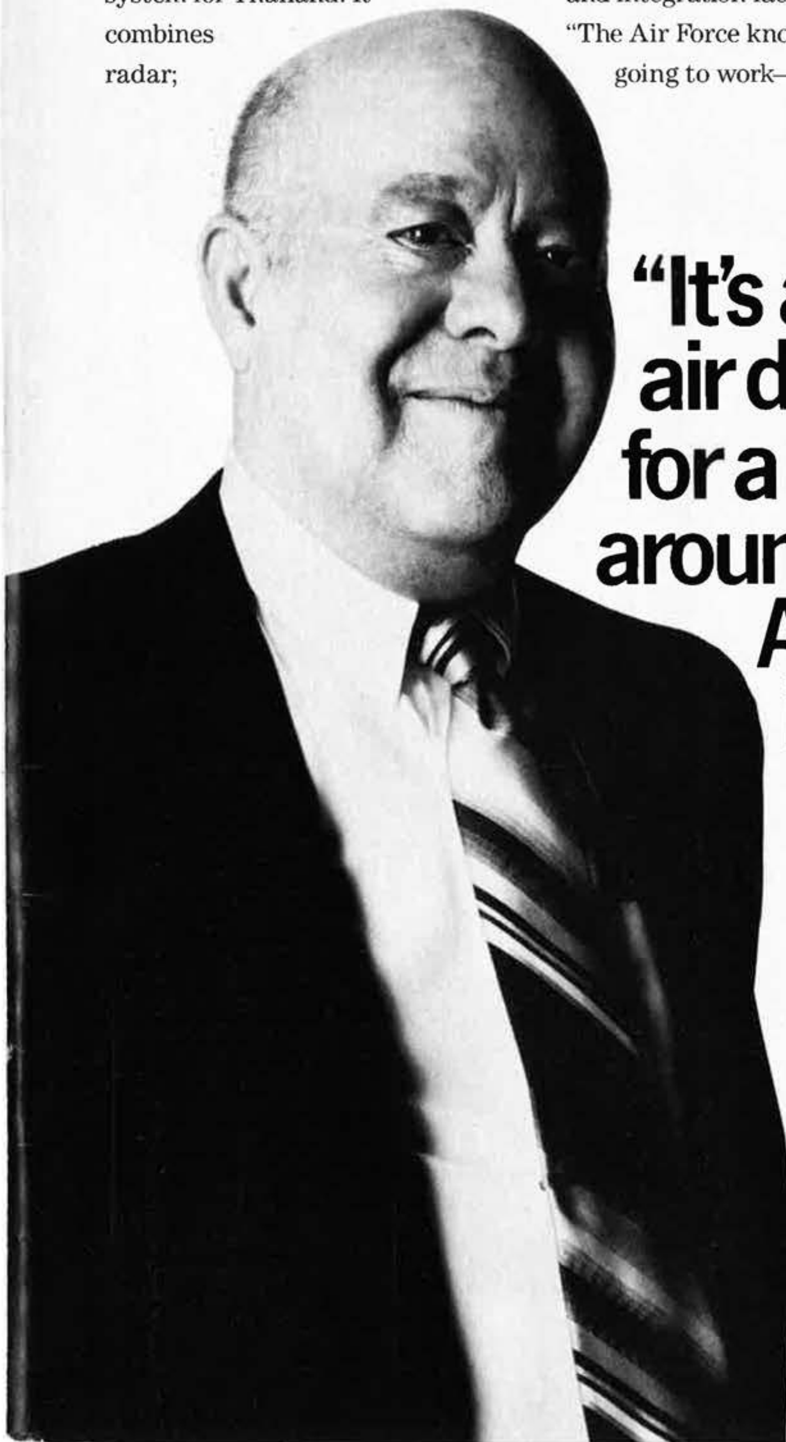

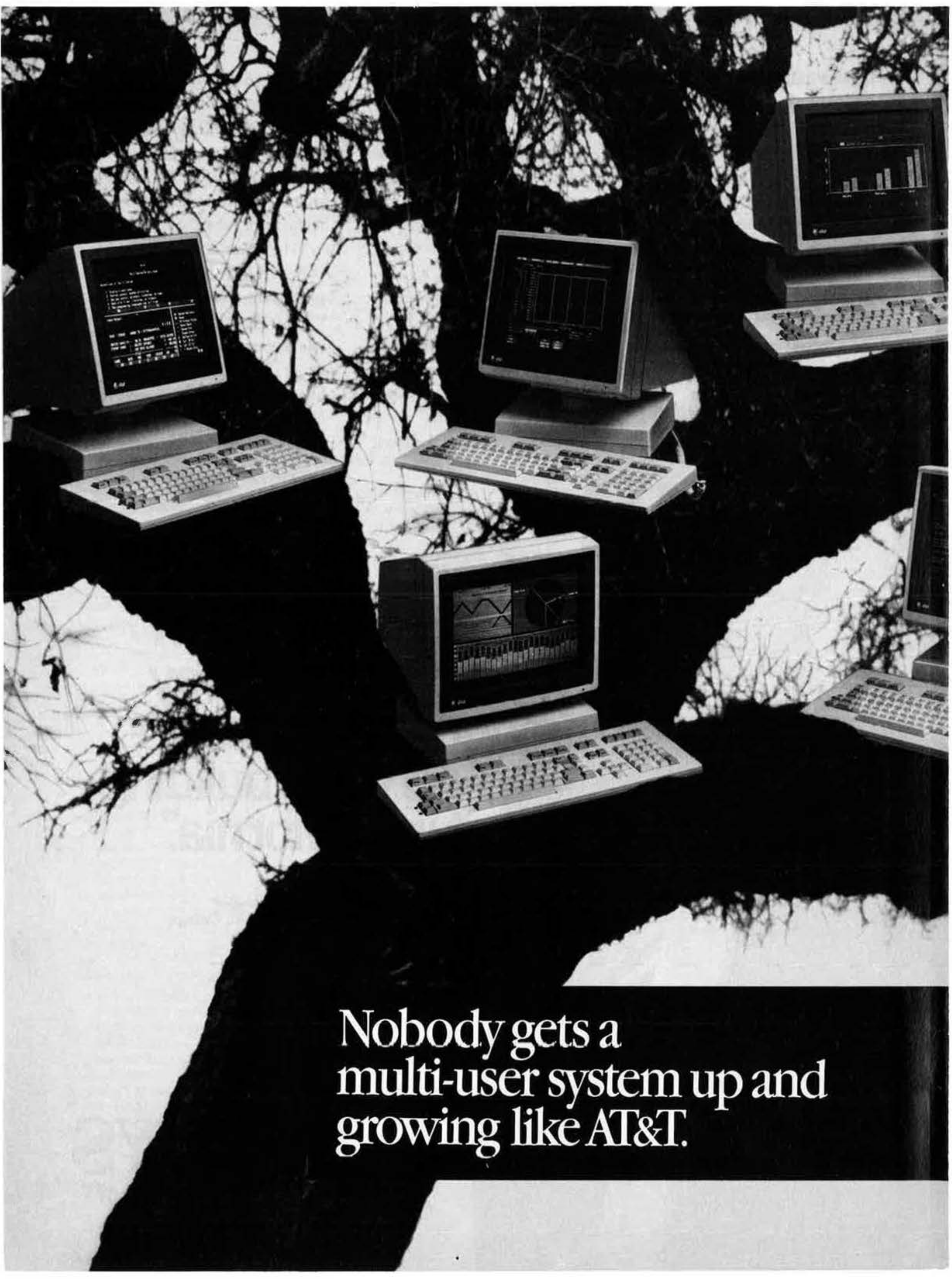
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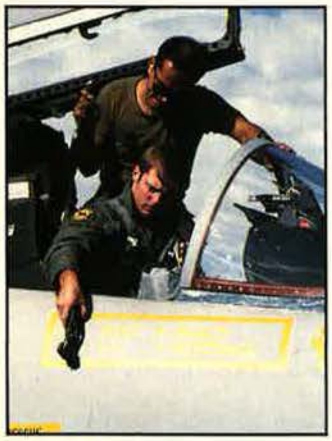
Page 48



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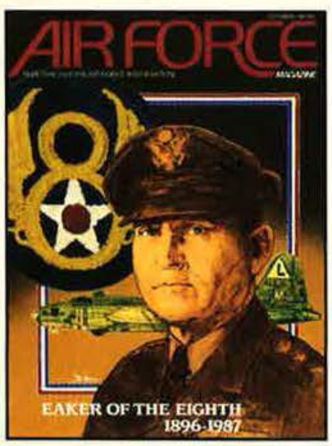

About the cover: Gen. Ira C. Eaker (1896–1987), an aerospace pioneer whose name was synonymous with Eighth Air Force, is memorialized by AFA in this Jim Sharpe portrait. Gen. T. R. Milton's tribute to General Eaker starts on p. 36.

Special Section: Power Projection/Combat Sustainability

Features

Departments

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AN EDITORIAL

Our Endangered Industrial Base

By John T. Correll, EDITOR IN CHIEF

THE nation's defense industrial base is in serious trouble. Warning lights have been flickering for the past ten years, and now one of them has begun to glow in earnest. Leadership in the design and manufacture of electronic components is moving overseas rapidly. If this trend continues, US military forces will be dependent—within the next decade—on foreign suppliers for critical capabilities they need to maintain their technological superiority.

This is the alarming conclusion reached by a Defense Science Board task force, whose report earlier this year deserves more public attention than it has gotten. The problem revolves around the tiny silicon semiconductor chips that make electronics the dominant technology in modern weapon systems. In the early 1980s, Japan overtook the United States in the semiconductor market and has been pulling further ahead ever since.

The most advanced semiconductor today is the one-megabit Dynamic Random Access Memory (DRAM) chip, which stores about a million bits of information on a single wafer. DRAMs were invented in the United States, but the US has been beaten out by the Japanese in the ability to produce these chips in large quantities at very low cost and now supplies less than five percent of world consumption.

It appears that Japan will develop as well as produce the next generation of DRAM chips. If so, the task force says in terse language, the United States in the 1990s will have only two choices: either buy foreign semiconductors or settle for second best in its weapon systems. These alternatives assume, of course, that the chips would be available. The task force also observes that "as Japanese firms evolve from the role of merchant semiconductor manufacturers into computer/telecommunications system builders, it would not be an illogical strategic business policy to delay release of the most advanced chips to competitors in the systems market, including those residing in the United States."

It is true that the Japanese have gotten some of their advantage by means of trade barriers and dumping their products on the world market. But, says the task force, Japan is ahead in semiconductors mainly because of its industrial policies. The Japanese invest more heavily in plants, equipment, and research and development. They work toward long-term goals, effectively integrating the resources of government, industry, and academia. Over time, this gives them the edge in high-volume production, from which nearly all else follows.

The Defense Department is not situated that well to head off the problem. The armed forces, once the primary customers of the semiconductor industry, now buy just three percent of the total quantity produced. The market is driven by commercial demand, not by military considerations.

The best idea the task force could think up was the creation of a semiconductor manufacturing institute by a consortium of US firms. Its first task, underwritten with substantial Pentagon funding, would be developing the technology to build a sixty-four-megabit DRAM. This is a good idea. If the institute is established, and depending on what else happens in conjunction with its efforts, it could moderate or even correct the drift toward semiconductor dependence. This idea, however, is not a complete solution to the decline of the defense industrial base. That problem is much broader and more complex. Military-industrial first aid will not be enough to set it straight.

The legendary "Arsenal of Democracy" passed into history many years ago. It has been a long time since the US industrial base had a capacity for wartime surge production. As demonstrated by the case of the semiconductors, it cannot always be relied on to meet even peacetime requirements. Between the 1960s and the 1980s, the number of firms doing defense work dropped by more than forty percent. Some, such as foundries, simply folded when environmental requirements became more stringent. Others, especially suppliers of specialized components, shifted their energies to the commercial market, where profits were better and where there was less red tape.

Most of the developed nations of the world are in the process of deindustrialization, and this is one race that the US leads by a furlong. About seventy percent of American workers are employed in the delivery of services rather than goods. Meanwhile, US defense budgets have decreased as a percentage of GNP, so a Pentagon with relatively less money to spend also commands less attention from an industrial base that is itself shrinking in absolute terms.

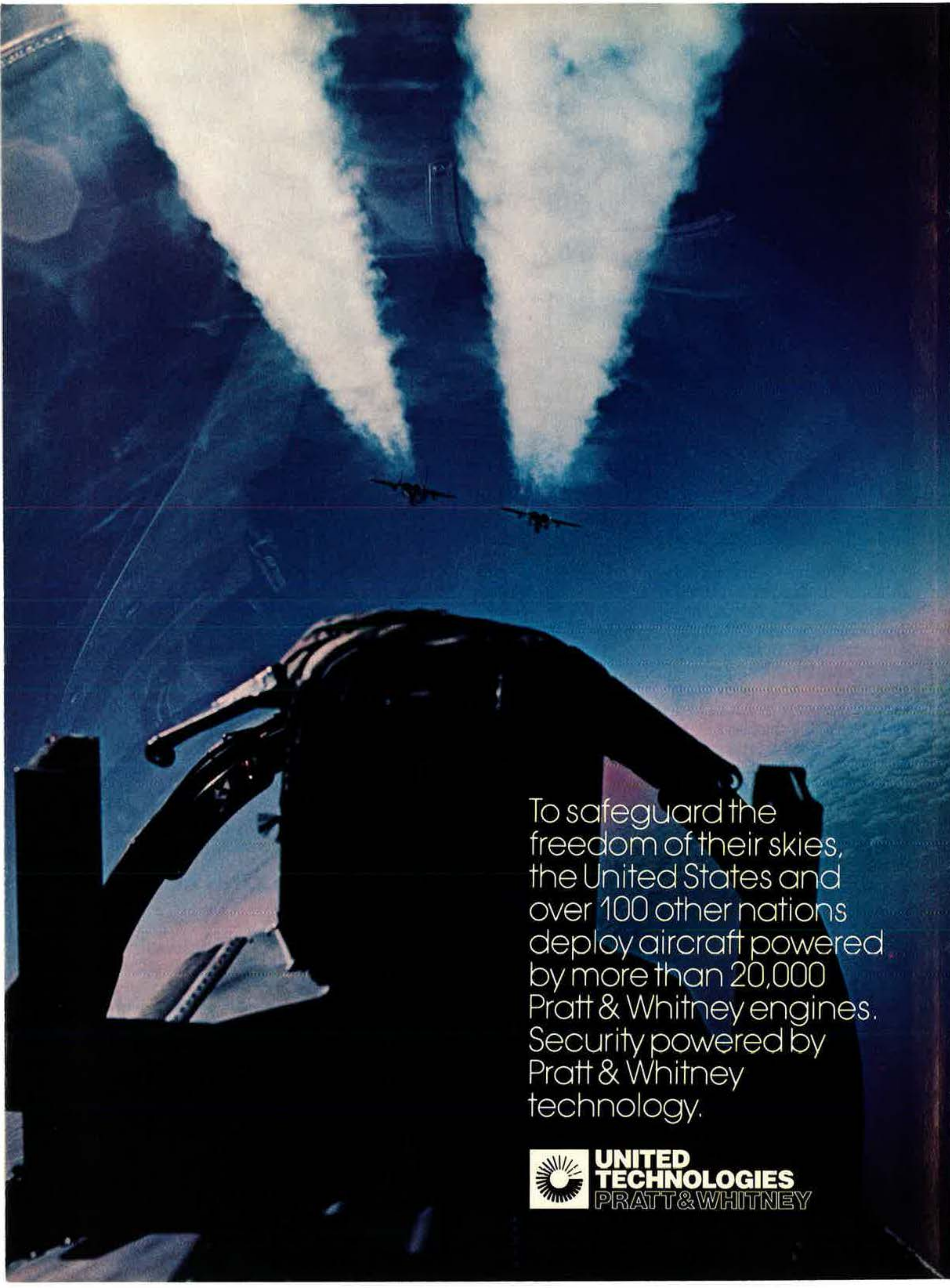
As if all this were not enough, pressures have built for industry to emphasize short-term profit over long-term development. From the mid-1970s on, a corporation that allowed its dividends to sag became a target for a hostile takeover attempt, with stockholders cheering the sudden boost in share values. In the semiconductor industry, the task force found, "equivalent ownership" of firms turned over completely—meaning that shares of stock traded equaled total stock outstanding—every six to nine months on the average. Stockholders are intolerant of companies that invest for payout five years hence. They want profits in six to nine months. Congress is investigating, but takeovers in US industry increased by a third between 1984 and 1986.

Converging with these events was the notion—which arose from the politics of dissent in the 1960s and soon became pandemic—that the defense budget is climbing on a runaway course and that defense firms are a bunch of crooks and profiteers. Few people check deeply enough into the facts to learn that these conclusions are wrong. Industry bashing is a popular sport in which no penalties are assessed for fouls. The news media, politicians, and self-styled reformers all play with enthusiasm. Unfortunately, so do some of the more zealous investigators and regulators on the government payroll, who cultivate attitudes that border on contempt. An industry kept in an adversarial, defensive crouch does not serve the nation as well as it otherwise might. During the long slide of the industrial base, government policies and rules have often worked to inhibit R&D and productivity investments by defense contractors.

The overall industrial-base problem is so big that no one is able to describe it completely, much less offer a comprehensive solution. The United States should count itself lucky if it can stem the most pressing industrial base issue, the looming dependency on foreign semiconductors.

Even the "domestic" semiconductor industry has moved much of its advanced production capability overseas. Many defense systems already contain components available only from foreign sources. Few military program offices keep records of dependency that look beyond the country of origin of finished devices. The worst part of the problem may be that we do not yet know how bad it is. ■

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Defending NATO

Your article "Why NATO Needs a Conventional Defense" by John T. Correll in the August 1987 issue was outstanding, most timely, and of extreme importance to the free world.

Like Gen. Bernard W. Rogers, former NATO commander, I certainly hope you will continue to articulate this most vital subject to the peoples of the free world.

Lt. Col. Wayne J. Guidry,
USAF (Ret.)
Prescott, Ariz.

In reference to your August 1987 article "Why NATO Needs a Conventional Defense," I recommend that you examine Dr. Jerry E. Pournelle's proposal for an orbit-based, kinetic-energy weapon system dubbed "Thor." This proposal was first published by the L-5 Society in 1981 and was then republished for general release in the book *There Will Be War.*

As envisioned, the system would consist of a thousand cheap satellites, each made up of a bundle of "smart crowbars," a guidance and communications system, and a simple rocket engine. Overall command and control would be provided by an operations center using a radar/computer system to track each satellite's position. This capability already exists in the NORAD control center, and the technology now available is much improved.

Placed in random-inclination, 200-mile orbits, a satellite would pass over any given point on the earth's surface every thirty minutes. This would ensure the capability of quick response during a time of crisis.

In such a situation, the Thor command center would send a signal to the appropriate satellite, providing target identification and location. The satellite would then orient itself and fire its motor. When the burn was complete, the bundle of projectiles would disperse and, being sharp-nosed, would survive reentry with minimal loss of mass or velocity. A small, "smart" seeker (each bundle could carry a variety to cover most options) would then locate the target, and a rudimentary steering vane would make the necessary course corrections. Each projectile would strike at a velocity of nearly four miles per second and with the kinetic-energy equivalent of a 200-pound bomb.

Thor would be effective against almost any class of target: massed armor, runways, bunkers, guerrilla camps, naval vessels, etc. The entire system could be built with present-day, off-the-shelf hardware.

I strongly recommend that you explore this concept and perhaps contact Dr. Pournelle for an update. With the push to remove tactical nuclear weapons from Europe, we need a defense that is flexible, quick to respond, effective, and survivable. Thor can meet all these requirements.

Edward A. Brault
Plattsburgh AFB, N. Y.

Neel Kearby

The title of the August 1987 "Valor" article, "Giant in a Jug," was a most fitting description of fighter pilot Neel Kearby. He was as fearless against the Japanese in his P-47 as little David, with his slingshot, was against the giant Goliath.

In "MiG Hunter," your "Valor" article in the May '84 issue (p. 207), Contributing Editor John L. Frisbee wrote, "There are two kinds of fighter pilots—the hunters and the hunted." Colonel Kearby was a hunter. Not content with his victories in the skies over New Guinea in his P-47, he borrowed a P-38 to accompany a sweep over the Admiralties. Later he told me, "I really got cooled off over Rabaul when an engine quit on me."

Kearby's untimely end while he was one of the leading American aces brought a sudden shock to the 348th Fighter Group. He had written a letter dated November 20, 1943, to its officers and enlisted men expressing his pride in and appreciation of every member and his confidence in their future accomplishments.

His confidence was not misplaced. Vivid memories of his leadership and contagious enthusiasm lived on to inspire those he left behind.

In a letter such as this, it is possible to mention only a few of the 348th's accomplishments. While flying from ten different strips between Australia and Japan, it received two Presidential Unit Citations for fighter coverage. Near Leyte, the 460th Fighter Squadron sank 50,000 tons of shipping during a three-week period, and a convoy carrying 10,000 Japanese reinforcements was sunk off Ormoc Bay by skip-bombing. On Luzon, it dropped a record for any group, fighter or bomber—2,091 tons of bombs in one month. And commendations were received from infantry divisions for close strafing and firebomb (napalm) support.

George A. Davis, a squadron commander with seven victories, went on to Korea to gain fourteen more victories and a Medal of Honor. Charles MacDonald, a squadron commander, early on became the commander of the 475th Fighter Group and earned twenty-seven victories. Bob Stevens, the cartoonist for Air Force Magazine, was a member of the 460th Fighter Squadron.

Charles P. Schubert
Melbourne, Fla.

Return of the Airship

Re: Your August 1987 "Aerospace World" item on the Navy airship program.

I was excited to read that the Navy has decided to build and test a blimp. I am also glad to see that the Air Force has taken an active interest in airships. The airship offers the potential to act as a complementary system to current aircraft. In the future, a system-of-systems approach should be

Do you have a comment about a current issue? Write to "Airmail," Air Force Magazine, 1501 Lee Highway, Arlington, Va. 22209-1198. Letters should be concise, timely, and legible (preferably typed). We reserve the right to condense letters as necessary. Unsigned letters are not acceptable, and photographs cannot be used or returned.

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used to take advantage of the unique capabilities of each type of vehicle while minimizing the disadvantages of each type.

An airship would offer the Air Force a long-endurance, stable platform for use as a surveillance platform, command post, transport, test-bed, weapon carrier (missiles or directed-energy weapons), or base for remotely piloted vehicles.

I am interested in contacting persons interested in the role of airships in the Air Force. Please contact me at the address below.

Ed Berghorn
2331 Fieldstone Circle
Fairborn, Ohio 45324

What's in a Name?

I was very disappointed to read about the changes in name and direction of the late and lamented *Air University Review (see "Aerospace World," August '87 issue, p. 37).* The name change I can live with if it attracts the attention of a larger segment of the USAF community. But the idea that the new *Airpower Journal* "will concentrate on issues related directly to the operational level of war" bothers me.

Even a casual reading of the history of the Air Force will show how many lessons learned have often become lessons forgotten. A concentration on operational topics, to the exclusion of broader issues of airpower, seems like encouragement to act without debate or previous thought. I believe that's the wrong way to broaden the views of those who may have to apply airpower in future conflicts.

I hope my reading of the purpose of the *Airpower Journal* is wrong, for all of our sakes, and that the journal will continue to publish the thoughts and arguments of airpower theoreticians as well as those of its practitioners.

David A. Anderton
Ridgewood, N. J.

The Great Outdoors

I must disagree with William R. Peake's contention that MiG killer F-4 66-7463 will be subject to deterioration from being displayed outdoors at the US Air Force Academy *(see "Airmail," August '87 issue, p. 13).*

Having served more than four years at the Academy, I can safely say that the display aircraft there are some of the best-cared-for static birds anywhere. They're always maintained in good, clean condition. The F-4 is also much too heavy for the cadets' favorite prank—moving the display aircraft, something the smaller planes are constant victims of.

Besides, wasn't the F-4 designed to be outside?

TSgt. William C. Cate, USAF
Colorado Springs, Colo.

First Black Astronaut

In "Aerospace World" in your August 1987 issue, the caption accompanying the photograph on page 37 states that Col. Guion Bluford was America's first black astronaut. However, Gen. Chuck Yeager says in his autobiography that Capt. Ed Dwight was the nation's first black astronaut.

Is the difference that Captain Dwight was the first black to complete an astronaut school or course while Colonel Bluford was the first black actually to fly in space?

R. Edward Junk
Lafayette, La.

• *Though Capt. Ed Dwight entered the astronaut program, he failed to complete the course. The first black astronaut was Maj. Robert H. Lawrence, Jr. He was selected for the Manned Orbiting Laboratory program on June 30, 1967, but was killed in the crash of an F-104 on December 8, 1967. Col. Guion Bluford is the first black American astronaut to fly in space.*—THE EDITORS

Spies and the Paper Flood

With respect to Gen. T. R. Milton's "Viewpoint" column deploring the recent outbreak of espionage by US citizens *(see "The Swallows and Their Friends," June '87 issue, p. 101),* I would like to suggest that the recent increase in spying by Americans has in part been prompted by a corresponding increase in the volume and accessibility of classified information that has resulted from the policies of the Reagan Administration. I think it is no coincidence that so many traitors have sprung up since 1981.

In a 1986 report, the Information Security Oversight Office, which monitors the application of the government's classification system for the National Security Council, stated that, in 1980, the government placed secrecy classification on *16,000,000* pieces of information. Between 1982 and 1985, the number of documents classified by the government rose from 17,000,000 to 22,000,000. For a 2,000-hour business year in 1985, documents were being classified at an average rate of *three per second.*

AIR FORCE

Today, standing in the way of every Air Force advance in technology, is a paperwork barrier.

But the Air Force and Syscon are breaking through that barrier with ATOS—the Automated Technical Orders System. Combining the resources of text generation, computer aided design and phototypesetting, ATOS will dramatically reduce the cost and increase the speed of changes to documentation.

Once ATOS is operational, aerospace companies working with the Air Force will be able to tie into the system. And eventually, technicians at every Air Force logistics center will access ATOS through terminals for instant information on systems operation and maintenance.

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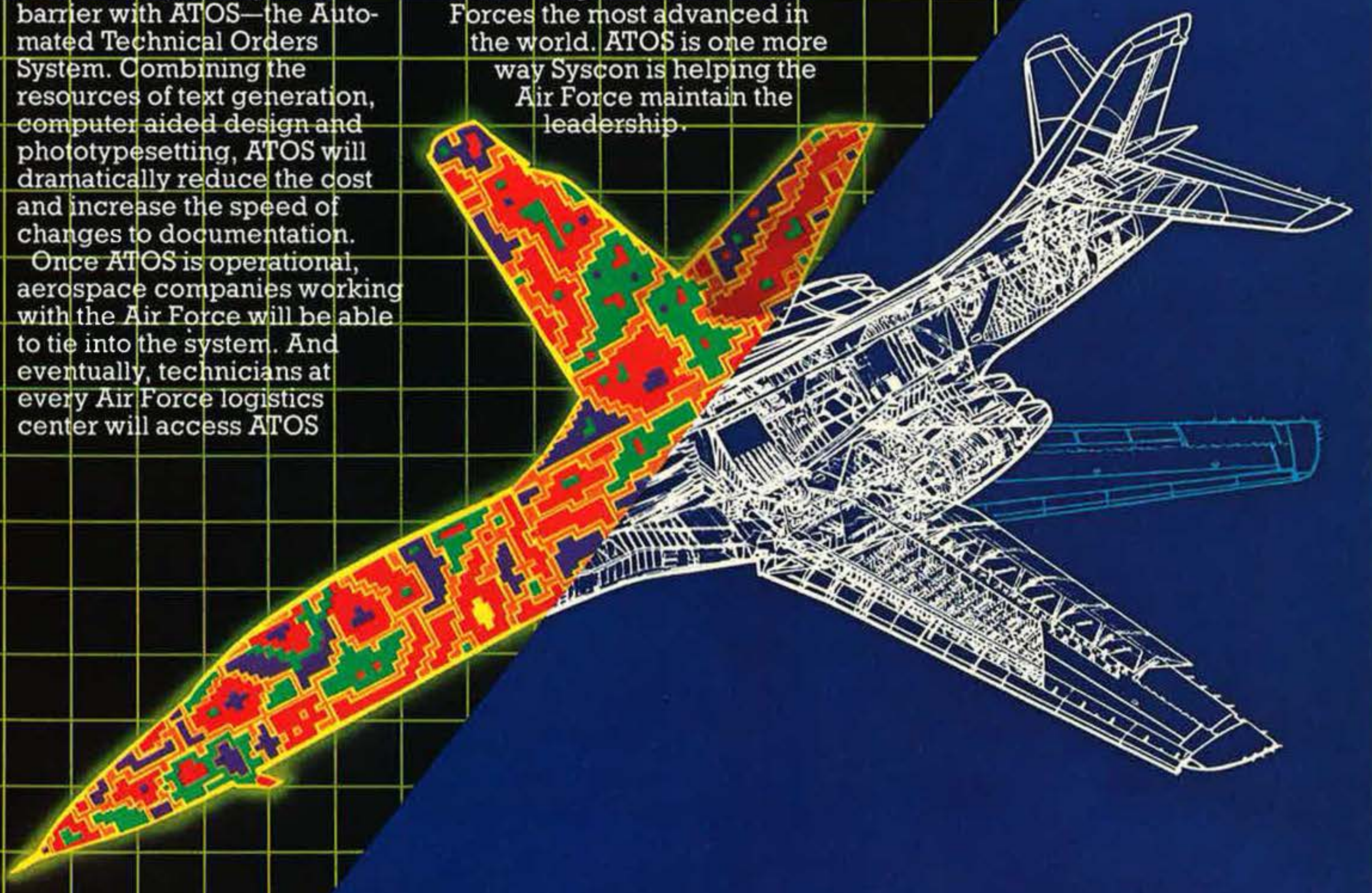

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Innovation

COMPUTATIONAL AERODYNAMICS. HOW TO FLY THROUGH THE AIR WITH THE GREATEST OF EASE.

A new aircraft design is tested at hypersonic speeds, generating volumes of data to help engineers analyze the airflow around it. Such a study used to require extensive, expensive hours in a wind tunnel with many restrictions.

But now engineers and scientists at Lockheed-Georgia are able to perform most aerodynamic studies without so much as making a breeze.

Using the incredible capabilities and speed of a Cray supercomputer, along with advanced techniques for solving fluid-flow equations, they can numerically simulate almost any condition a wind tunnel can produce.

They can even model complex flow fields real wind tunnels find hard to create. These flow fields have subtle characteristics that may strongly influence aircraft performance. Predicting them is essential to evaluating subsonic and supersonic designs, and it's critical for hypersonic flight where frictional heating can cause air molecules to dissociate, ionize, and react chemically in unusual and perhaps detrimental ways.

Lockheed's researchers analyze it all in less time and at less cost than ever possible before.

Lockheed-Georgia is helping accelerate the science of aerodynamics; so future aircraft will not only fly faster, but sooner.

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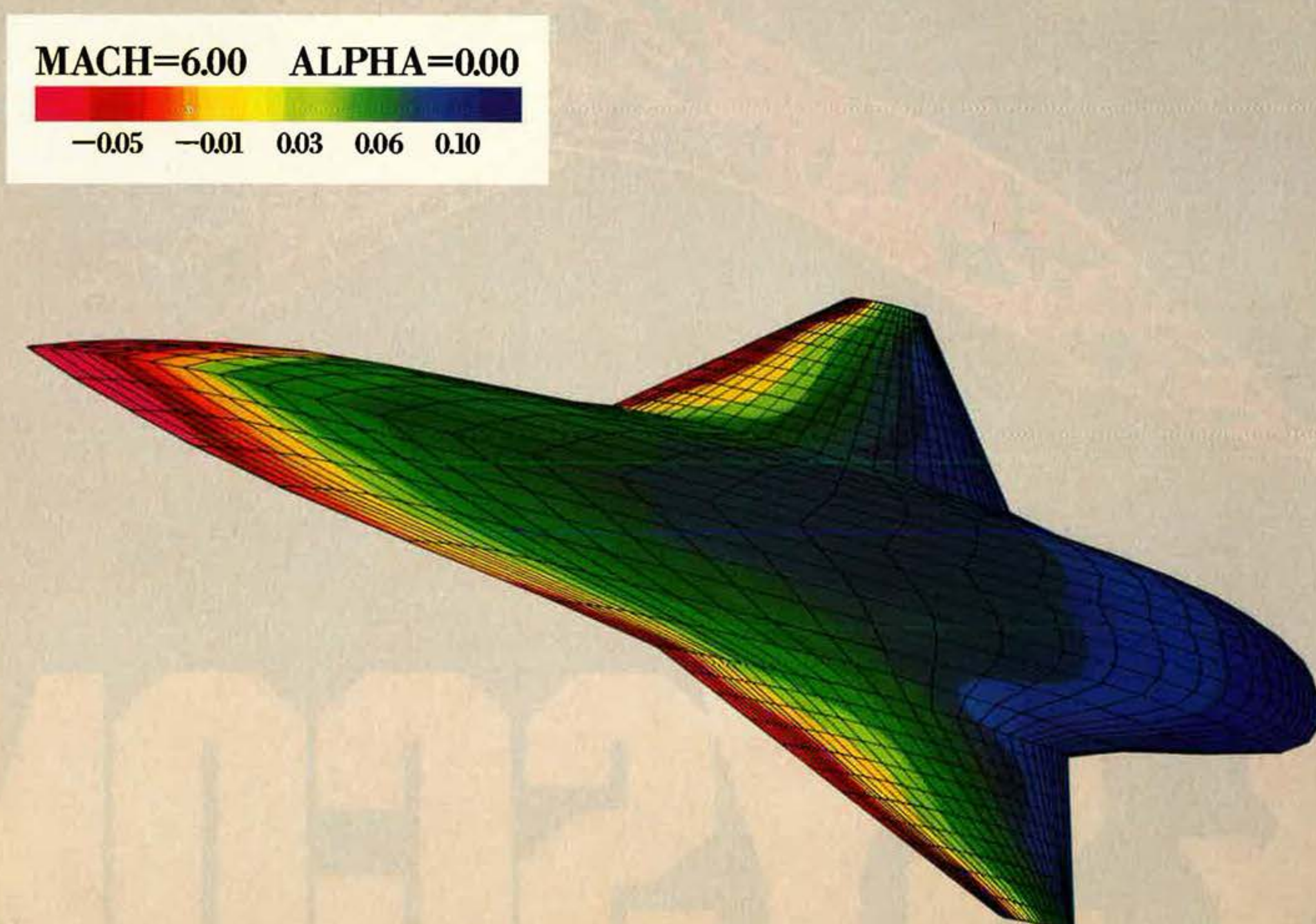

(In a random check in 1980, the oversight office found that 600,000 papers had been classified without authority and that another 800,000 were classified unnecessarily; a total of 3,400,-000 documents, more than twenty percent of the 16,000,000 total for 1980, had been classified improperly.)

One of the most unpleasant and unfortunate side effects of this increase in the number of classified documents has been a corresponding increase in the number of Americans engaged in espionage since the current Administration took office. Classified documents have become a marketable commodity to be bought, sold, and traded like grain, oil, or weapons.

The government's response to the "Year of the Spy" in 1985 was to announce sweeping new security clearance procedures, including more thorough background investigations for new clearances and more frequent investigations for clearance renewals, a reduction in the number of persons holding clearances, and a "crackdown" on civilian contractors and military agencies handling classified information. The most sensible solution—a wholesale reduction in the overwhelming number of classified documents—was neither mentioned nor apparently contemplated.

The fewer documents that are classified, the fewer people who need access to them and the easier it will be to keep track of the documents' whereabouts (both Northrop and Lockheed facilities in Southern California have been in the news recently for "losing" classified papers). Several government intelligence agencies claim that Soviet spies believe that information appearing in the American press is not credible and that it is merely "disinformation" planted by the government to mislead them. In this Soviet view, only classified data is credible. How does the US respond to this situation? By creating even more classified documents! This makes sense only if we are trying to drown Russian intelligence analysts in a flood of paper. . . .

I suspect that if the government intended to reduce espionage, it would reduce the number of agencies classifying information, stop issuing security clearances, and make a drastic reduction in the amount of classifiable information.

Until one or more of these steps is taken, it is very difficult to take the government's cries of alarm, including such statements as those by General Milton, very seriously. Reducing temptation and ease of treason is far simpler, more politically palatable,

AIRMAIL

and much less costly than imposing death penalties.

Chuck Hansen
Sunnyvale, Calif.

Siege of Khe Sanh

The Eisenhower Center for Leadership Studies at the University of New Orleans was founded under the directorship of Alumni Distinguished Professor of History Stephen E. Ambrose, the noted Eisenhower biographer. The original task of the Center was to collect oral histories from participants in the D-Day Normandy invasion of June 6, 1944.

This initial task is well under way, and the response from those veterans has been heartwarming. While this project is progressing, the Eisenhower Center has begun a new project—to collect oral histories, photographs, artifacts, etc., from those veterans who participated in the siege of Khe Sanh in Vietnam in 1968 and who fought in the hill fights around Khe Sanh in 1967.

The siege was an event that kept the world glued to the edge of its seat for an agonizing seventy-seven days. We want the stories of the men at the base, those on the hills, those who flew combat and resupply missions, and those who were face to face with the NVA.

Interested parties should write to the address below.

Director
Eisenhower Center for Leadership Studies
Metro College
University of New Orleans
New Orleans, La. 70149

C-130 Tac Airlift

I am presently in the process of writing a book about the role of the C-130 as it was employed in the troop carrier/tactical airlift role in TAC, PACAF, USAFE, and, to a limited extent, AAC and Southern Command prior to July 1975, when all airlift became a MAC responsibility.

In order to add further personalization to my work, which is to be an informal history, I would like to include inputs from former airlifters who served in the C-130 mission during the period from December 1956 through June 1975. I would like to hear from pilots, navigators, flight mechanics, loadmasters, crew chiefs, aerial port personnel, and command and control personnel who would like to contribute personal experiences or other material, including personal photographs.

My book will be devoted exclusively to the airlift role, with the inclusion of certain peripheral roles that were flown by airlift crews. Gunships, rescue, etc., are beyond the scope of my work at this time.

The utmost care will be taken with materials sent to me, and photographs and other materials will be returned after copying. Credit will be given to contributors, and everyone who does contribute will be compensated with a copy of the finished product.

Anyone who wishes to contribute to my work should contact me at the address below.

Samuel E. McGowan
HC 61, Box 65
Argillite, Ky. 41121
Phone: (606) 473-5174

AAF Bases in Florida

The Collier County Museum is researching the Army Air Forces bases at Naples, Fla., and Immokalee, Fla., for an exhibit on World War II for the Museum's new exhibit gallery.

The Naples base was built in 1942 as an auxiliary base to the Buckingham Flexible Gunnery Training School at Fort Myers, Fla. In May 1944, the Naples base was redesignated NAAF, 2119th AAF Base Unit. Under the command of Lt. Col. Harrison Thyng, the Naples squadron flew numerous daily attack missions in P-39, P-40, and P-63 aircraft against gunnery trainees in B-17 and B-24 bombers from the Buckingham school and trained experienced fighter pilots in advanced combat skills in preparation for overseas duty.

The Immokalee base was built in 1942 as a part of Hendricks Field, Sebring. It was an emergency landing base, also used by the Buckingham school.

We are interested in corresponding with anyone who was stationed at or who trained at either of these bases. We are especially interested in obtaining any photographs, memorabilia, uniforms, insignia related to these bases, names of servicemen stationed at these bases, and information about the above aircraft that could be used in our exhibit and for our research files.

Any assistance from readers will be acknowledged and appreciated.

Elaine Gates
Collier County Museum
3301 Tamiami Trail East
Naples, Fla. 33962

Follow-Me Trucks

I am researching the appearance of the follow-me trucks. These trucks lead transient aircraft to empty parking spaces at host air bases. The trucks are rigged with signs that read "Follow Me." The letters on the signs are large enough to be read easily by a pilot as he taxis in after landing.

The idea of such a truck seems ingenious and effective despite—or maybe because of—its simplicity.

The use of the follow-me truck is also a bit humorous. The first time I saw the operation, I smiled to myself. The follow-me truck seemed to be running for its life from a fighter airplane.

I would like to gather any information about the origin of the follow-me trucks. I would also like to hear from any readers who have humorous stories related to the trucks.

I can be contacted at the address below.

SSgt. Keith Walker, USAF
1361st AVS
1221 S. Fern St.
Attn: DOOJ
Arlington, Va. 22202

Lifting-Body Programs

I am gathering information on the lifting-body research programs carried out by USAF and NACA/NASA. These research programs were started in the late 1950s with NACA's M-1 and then concluded with the Air Force's X-24B in the mid-1970s.

I am particularly interested in the Air Force's Start program, which included the Asset, Prime, and Pilot projects, and NACA/NASA's M-1/M-2 series of vehicles and the HL-10. However, any information concerning related research projects would be appreciated as well. Photographs and slides of these lifting-body vehicles would be very helpful in my research. The photographs and slides will be copied and promptly returned.

I am preparing to write a book on the vehicles, which have received little or no public attention despite their impact on the Space Shuttle program. I can be reached at the address below.

Frank E. Daloisio
914 Pinecrest St.
Girard, Ohio 44420

Bell P-400 Airacobra

I am seeking to determine the outfit of a Bell P-400 Airacobra that was recovered from the "Bulldog" area of New Guinea. The pilot was Everett Van Patten, and the aircraft serial number was AP 335.

Anyone who has any information on what unit this aircraft served with or on the whereabouts of the pilot should contact me at the address below.

E. F. Furler, Jr.
105 Datonia St.
Bellaire, Tex. 77401

AIRMAIL

Collectors' Corner

During the years 1943 through 1945 during World War II, I served as an enlisted man in both the famed Second Infantry Division and the Seventy-fifth Infantry Division. At one time, I was in possession of a treasured shoulder patch of each unit. However, sometime during my subsequent twenty-four years and twenty-two moves in the Air Force, those shoulder patches disappeared.

If there is a shoulder patch collector among readers who has a spare of either or both of these patches, I would be happy to pay a fair price, plus postage, to receive them.

Please contact me at the address below.

Col. Edward H. Curtis,
USAF (Ret.)
3208 Sheffield Dr.
Arlington, Tex. 76013

I am a veteran of World War II who served in the South Pacific with the 63d Bomb Squadron, 43d Bomb Group, Fifth Air Force.

I am looking for a Fifth Air Force shoulder patch and a regular Air Force shoulder patch, and I am willing to pay for them. Also, our squadron had its own emblem—a hawk with the logo "Air Hawks." If any reader out there has one of these, I would certainly like to purchase it.

I would also like to hear from any former members of our old bomb group. Please contact me at the address below.

Rocco Arruzzo
P. O. Box 12
Hazleton, Pa. 18201

I am a serious USAF historian and collector of USAF memorabilia. In particular, I am seeking items from the combat control, tactical command and control, pararescue, Air Weather Service, and special operations fields of USAF operations, especially patches, pins, badges, crests, and headgear.

I am willing to buy or trade for these items. All donations are gladly accepted. I will answer all correspondence promptly, and I can be reached at the address below.

A1C Richard W. Gray, Jr.,
USAF
801A Sandpiper Dr.
Ladson, S. C. 29456-5420

I am an aviation photographer specializing in military aircraft. I would be very interested in obtaining slides or prints of B-52G or H aircraft. I would be willing to trade for them or pay for postage.

Anyone who can help me out is urged to write to me at the address below.

James R. Benson, Jr.
969 Ave. E N. W.
Great Falls, Mont. 59404

I am starting a collection of Air Force patches and photographs of aircraft. I am most interested in patches and photos for the years 1947–79.

If you have any such items to sell, donate, or trade, please contact me at the address below.

Mark Earnest
1401 S. Adams Ave.
Roswell, N. M. 88201

I am a cadet sergeant in the Civil Air Patrol and have recently begun collecting military patches. I would really appreciate the donation of any spare patches that readers might have.

Please send any donations to the address below.

Joe L. Illing, Jr.
3002 Country Club Loop N. W.
Olympia, Wash. 98502

I am trying to begin a collection of unit patches from all regular Air Force, AFRES, and ANG units. I am soliciting donations of any such patches from any readers who might have them. This collection will be well-kept and of museum quality. All donations will be greatly appreciated.

Please contact me at the address below.

Bret Felske
2 Pine Ridge Lane
Geneseo, Ill. 61254

I am looking for anyone interested in back issues of Air Force Magazine. I have a complete collection from 1947 to the present, with some in binders. I also have available six years' worth of issues of *Airman* magazine.

Please contact me at the address below.

Ray G. Smith
2181 North 850 West
Provo, Utah 84604
Phone: (801) 375-4568

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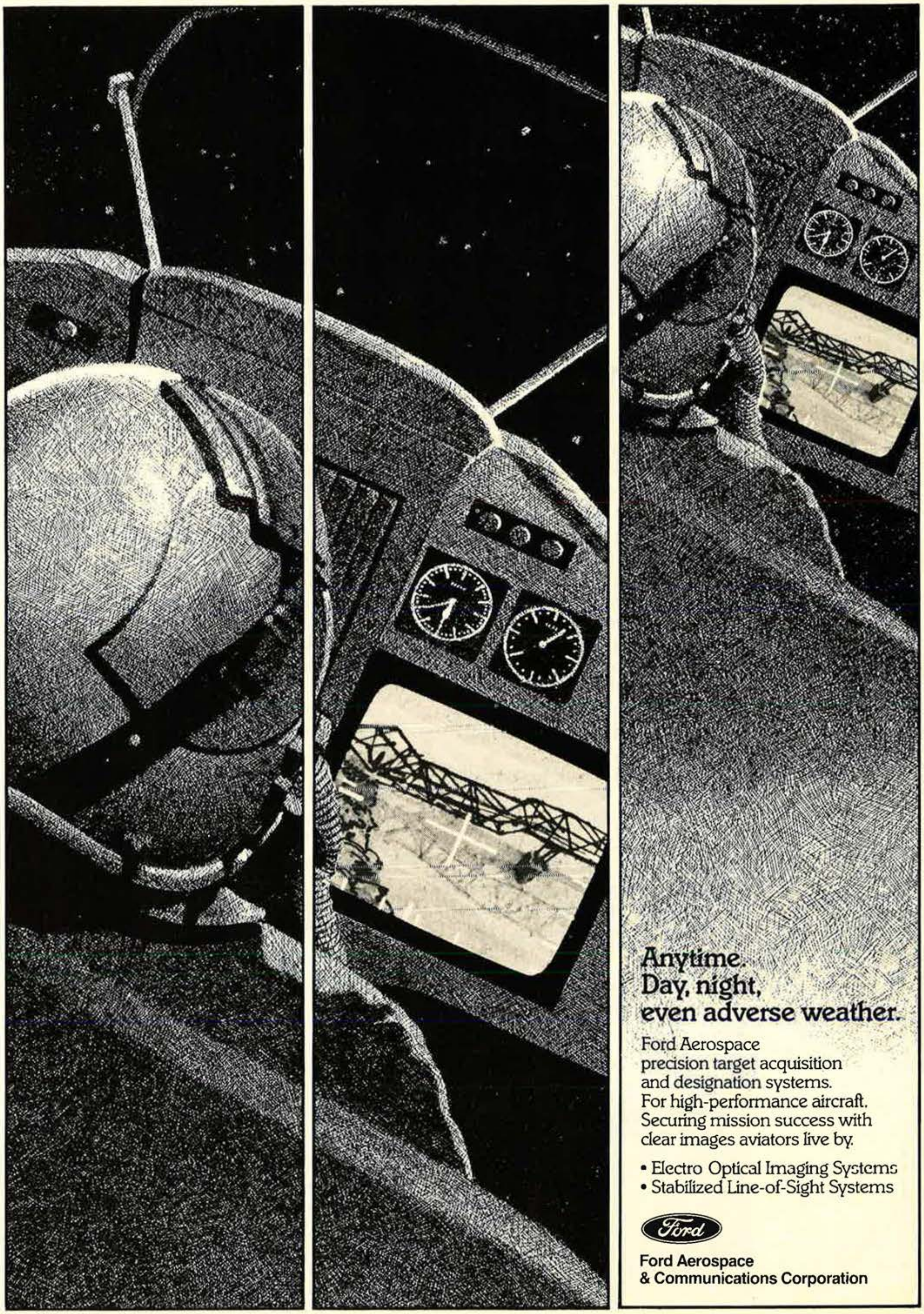
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IN FOCUS...

AirLand Versatility

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

As USAF and the Army see tomorrow's tactical battle, alert fighters must be ready to perform either interdiction or close air support. Combined requirements point to the "Agile Falcon" variant of the F-16.

Washington, D. C., Sept. 2
Recent analyses by the US Army of the AirLand Battle of the future suggest that battlefields in the coming decades will be violent, chaotic, and deadly, with the dynamics of modern high-intensity conflict invalidating the traditional distinctions between rear, close, and deep battle zones. As the Army doctrine shifts toward a "nonlinear battlefield," the traditional tactical air support missions of CAS (close air support) and BAI (battlefield air interdiction) will tend to merge.

In the future, tactical air commanders will have no way of knowing whether their alert aircraft will be assigned to CAS or BAI missions. Aircrews scrambled for CAS missions will face threats and requirements comparable to BAI sorties. It follows that the threat and mission requirements for classic CAS aircraft could meet neither the new CAS performance standards nor those associated with BAI or other theater missions. Key performance criteria for an aircraft equally capable of performing the extended CAS and BAI missions appear to be high acceleration, cruise, and top-end speeds coupled with excellent sustained turn-rate capabilities to ensure survivability.

In the avionics realm, a dual-capable CAS/BAI aircraft must be able to cope with the demanding target acquisition and discrimination requirements associated with such evolving AirLand Battle concepts as deep maneuvers in the face of intense rear-area threats. An ancillary requirement is the ability to employ smart standoff weapons to enhance survivability and to deliver "dumb" gravity weapons to bolster sustainability. In the context of survivability, CAS/BAI aircraft in the future will probably have to be compatible with other theater aircraft to operate as integrated "force packages."

With the vulnerability of airfields located near combat zones bound to increase in the future, a CAS/BAI aircraft's ability to stage from as far away as reasonably possible is at a premium. Concomitantly, responsiveness in the form of quick scramble and high cruise and top-end speeds is essential. This confluence of mission and performance requirements tends to validate the commitment by the Air Force and the Army to the concept of an F-16 Plus, known also as the "Agile Falcon."

The Agile Falcon, which is in fact an unsolicited proposal submitted to the Air Force by General Dynamics, "looks very attractive," according to Secretary of the Air Force Edward C. Aldridge, Jr. At a recent breakfast meeting with defense writers, he explained that the Agile Falcon concept was consistent with a Defense Department directive to examine "upgrades" of existing aircraft to keep them "up to or ahead of the threat" to the maximum extent possible.

The Air Force, Secretary Aldridge announced, is also probing the possibility of upgrading the F-15 in a similar fashion. These upgrades, he stressed, do not eliminate the need for the Advanced Tactical Fighter (ATF), which remains the service's "number-one tactical R&D program." But these proposed upgrades offer economical options for improvements "that we need to handle the Fulcrum and Flanker aircraft the Soviets are introducing" into their tactical air inventories, according to Secretary Aldridge.

The Agile Falcon, he said, quoting contractor estimates, would improve the performance of the F-16C by about twenty percent, mainly in range and maneuverability. These improvements will be realized through aerodynamic and structural changes as well as the use of improved-performance engines that he suggested the Air Force would probably have bought anyway.

Not counting the cost of the new, higher-performance engine, the Agile Falcon modification appears to be attainable at a cost of about $2 million per aircraft. The performance of the Agile Falcon in terms of maneuverability, payload/range factors, and G loading would be on a par with that of the F-16A. He explained that in the transition from the F-16A to the F-16C, weight and wing loading had to be increased at the expense of aerodynamic performance in order to accommodate avionics add-ons and other new capabilities that boosted overall combat performance. The Agile Falcon configuration would retain these features of the C model while achieving the flight performance of the A model, Secretary Aldridge suggested. He added that AFSC's Aeronautical Systems Division is evaluating the Agile Falcon concept in depth.

Aldridge Opposes ALS Approach

In his wide-ranging discussion with defense writers, Secretary Aldridge asserted that he did not support NASA's recommendation that two separate Advanced Launch System designs (ALS, once referred to as the Heavy Lift Vehicle) should be developed and operated. The Pentagon's position is that "we will work with NASA to get the ALS contracts awarded—we [just] awarded seven—to look at [possible systems] concepts, [with the central objective of getting] launch costs down."

The Defense Department view, he stressed, is that "you [can't] just go out and build one of those things and achieve this goal" of drastically reduced launch costs. Development of ALS, he suggested, might occur on an evolutionary basis. The need for ALS, he explained, might become acute before a mature system is operational.

NASA, he acknowledged, might want ALS by the mid-1990s for the on-orbit assembly of the Space Station, and the Defense Department might require such a heavy lift vehicle at about the same time to launch elements of the Strategic Defense Initiative (SDI). He cautioned, however, that there is no clear-cut requirement as yet with regard to SDI and pointed out that Congress prohibited the use of ALS in support of SDI requirements. The long-term DoD requirements driving the ALS design, he pointed out, center on the development of a vehicle with a payload capacity significantly greater than that of the Space Shuttle or Titan IV. Such a system is not likely to enter operational service before the late 1990s.

From DoD's point of view, the ALS's make-or-break feature is the ability to cut launch costs and boost payload capacity. Saying the hope is for a tenfold reduction in the cost of orbiting space payloads, he conceded however that "I would be happy to get a [threefold] reduction from ALS," along with increases in payload weight and volume. He explained that having to "shave every last pound" off the design of national security satellites because of the constraints imposed by the present generation of launch vehicles is costing "hundreds of millions of dollars." The need for new concepts, he added, is not confined just to launch vehicles but must include their operation: "We can't afford those standing armies to launch the Shuttle—it takes 6,000 people to launch a Shuttle—compared to about 600" for an ELV (expendable launch vehicle) of comparable capacity.

While the Defense Department and the Air Force—as DoD's executive agency for the ALS program—will not support development of two different heavy lift vehicle variants and believe that the "objective," meaning mature, ALS won't be needed before the late 1990s, they have not closed the door on the possibility of spinning off an interim design if that becomes necessary. Such a vehicle could be produced earlier to meet pressing requirements of the Defense Department or NASA by "using components of existing technologies, such as [the] Shuttle." Such a vehicle would not fully meet the objectives of lower launch costs, Secretary Aldridge suggested. He termed it "kind of silly" that congressional strictures preclude the use of ALS in any form for SDI support missions but permit the vehicle's use for the Space Station.

Secretary Aldridge also expressed reservations about plans to shift from the traditional US approach of relying

IN FOCUS...

on a limited number of sophisticated, long-lived, multisensor satellites to an approach centered on swarms of low-cost, lightweight, single-purpose satellites. This concept, known as "Cheapsat" or "Lightsat," is being explored by the Defense Advanced Research Projects Agency (DARPA) by means of small technology demonstration designs carrying a limited number of sensor systems. DARPA's work on Lightsat goes hand in glove with research on new, low-cost launch concepts, including the use of such surplus ballistic missiles as Pershings.

Asserting that he was "skeptical" about this proposed approach, Secretary Aldridge suggested that the increasing requirements for antijam capability, redundant sensor systems, survivability, wide coverage, and the ability to accommodate more and

ALS's make-or-break feature is the ability to cut launch costs and boost capacity.

more users that future military satellites will have to meet militate against Lightsat. The trend, therefore, is likely to go in the opposite direction, toward fewer, more costly, and long-lived satellites. He also pointed out that current high launch costs vitiate the economic rationale behind Lightsat. The notion of paying about $200 million every few months "just to launch a single satellite" makes for poor economics. Reconstituting on-orbit capabilities by means of Lightsat might make sense, he conceded, if "you [could] get a very cheap ride to space, in the $10 million range."

By way of a plausible scenario, he speculated that under conflict conditions, it might become necessary to put up some limited sensor capabilities after Soviet ASATs have put out of commission critically important, sophisticated US satellites. Secretary Aldridge cautioned, however, that the ability to reconstitute on-orbit sensors must be supported by a "survivable launch capability" in order to yield significant operational value. This requirement, in turn, necessitates regular peacetime training. Without such training, it would be unrealistic to expect such a system to work dependably on the first try. Unless trained crews practice launches of survivable "reconstitution assets" from special launch bases "over and over"—which creates problems of its own—the national command authorities could not be sure that such a capability would be available when it was needed under wartime conditions, Secretary Aldridge suggested.

Another possible use for Lightsat, he explained, might involve specialized, short-lived, single-purpose satellites tailored to the needs of individual commanders in chief, "provided the CINCs can live with short-lived [designs, accept] failures once in a while, and can afford to launch three or four [satellites] every few months." The Air Force, he pointed out, is willing to concede that there "might be a pearl [associated with Lightsat], and we are supporting DARPA's efforts to find that pearl."

(Other Pentagon space experts are known to be chary of using Lightsat to reconstitute orbital surveillance assets on grounds that there are alternatives that are more cost-effective and more survivable. Their contention is that long-endurance stealthy drones using advanced sensors and communications technologies are better suited for the reconstitution mission under wartime conditions than are low-altitude satellites.)

In spite of the lengthy Shuttle standdown and two Titan-34 failures in 1985 and 1986, respectively, "we have no real national security problem at this point, because the satellites we have on orbit are performing flawlessly," Secretary Aldridge said, adding, "I cannot applaud the contractors enough who have built the satellites that are currently on orbit. They are far exceeding their lifetime expectations and performance" specifications.

There has been no need to resort to the emergency use of "unreliable boosters" during the standdown in US spacelaunch systems that is about to come to an end with the imminent resumption of Titan-34 launches. Following an exhaustive test program, two stored Titan-34Ds, Secretary Aldridge reported, were found to be without any flaws whatsoever. These vehicles are being stacked for flight, with the first one likely to be launched by October. Some blemishes showed up in the case of the other four remaining vehicles, causing the Air Force to tear one of them apart to make sure that there was no inherent aging problem in terms of the system's solid-rocket motors. The remaining three will be used eventually,

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Raytheon

Where quality starts with fundamentals but might require some repouring of the propellants, he predicted.

Over the next few years, the ATB (advanced technology or "Stealth" bomber) will unavoidably shift from its present semiblack to a "light gray" status, Secretary Aldridge predicted. There is "no way that we can hide [that] strategic bomber" once ATB becomes operational in the 1990s. The public will be able to see it operating from Whiteman AFB, Mo., its home base, he acknowledged. Stressing that ATB is not a covert program in the sense of "lots" of other projects that "we don't talk about at all," Secretary Aldridge asserted that certain aspects of the Stealth bomber program—such as radar cross section and other technologies associated with the aircraft's penetration capabilities—will always remain "compartmented."

Media claims about cost overruns associated with the ATB program are incorrect, according to Secretary Aldridge. "The cost of the program remains at $36.6 billion . . . to the best of our knowledge, based on our cost estimates," even though there has been some redistribution of funds between the production and development phases of the program. The Air Force, he said, is getting "a lot of pressure to compete [ATB by means of a] second source." The service is examining production "aspects" of the ATB program that might lend themselves to competitive arrangements in the future, Secretary Aldridge explained. He added that the development contractor, Northrop, was selected on a competitive basis.

Northrop, he pointed out, has "put a lot of [its] own money [into the program based on the assumption that] the return on the investment was [going to be] high. So what he has done is put his money in, he has won the competition, and now [the government is] going to ask for competition for the follow-on buy." The contractor, he suggested, must be asking himself why he spent all the up-front money, why he took "all that risk, when now another company that didn't take that risk is going to benefit from not doing anything. That's kind of a false way to do business, I think."

Secretary Aldridge also expressed reservations about some of the plans and views of Richard P. Godwin, the Pentagon's first Under Secretary of Defense for Acquisition. Asserting that Mr. Godwin had been on record as wanting to separate "the acquisition community in the Defense Department [and the services] from the operational community," Secretary Aldridge termed it "a terrible, terrible mistake to separate those people who have acquisition responsibility from those people who have the responsibility of operating the forces once they get into being." Rather than restricting the services to operating weapons and systems turned over to them by a centralized acquisition agency, the Air Force believes that the services—as the "users"—are best qualified to integrate operational requirements into the acquisition function, he stressed.

Secretary Aldridge added that all the services had objected to the tendency by the USDA (Under Secretary of Defense for Acquisition) not only to set centralized acquisition policies and ride herd on efforts to prevent duplicative efforts by the services but actually to manage individual programs. He said that Mr. Godwin had wanted "a computer on the back of his desk that gets all the information, [for example], from the B-1 Program Office or the F-15 Program Office on the day-to-day execution of the programs." This would have created the temptation for him to manage individual programs from his desk rather than to encourage decentralized program execution.

Secretary Aldridge emphasized that "he drew the line [when USDA sought the authority] to direct my service acquisition executive and . . . the responsibility for determining the organizational structure under my service acquisition executive." He added with feeling, "That got fixed."

The controversy over the power of the Under Secretary to assert his authority over the military services came to a head in September. The issue was who, in official terms, would be subordinate to whom on matters of arms acquisition. Mr. Godwin, for his part, had been determined to gain official blessing for his efforts from Secretary of Defense Caspar Weinberger. The three military departments, through their respective Secretaries, were equally intent on thwarting Mr. Godwin's efforts. Rarely, however, had the Defense Secretary ever sided with DoD against the services on matters of procurement or operations. Secretary Weinberger's management style, said insiders, made it all but inevitable that Mr. Godwin would eventually feel compelled to depart.

The Strategic Defense Initiative (SDI), Secretary Aldridge reported, is progressing at the component level at an accelerating, faster-than-expected rate, especially in the case of BSTS (boost surveillance and tracking system) and SSTS (space surveillance and tracking system). These programs—which cover Air Force requirements beyond SDI and were initiated by the service originally—received increased funding and were accelerated upon transfer to SDI. BSTS, he added, is needed as a follow-on to USAF's early warning satellite system known as the Defense Support Program (DSP) and, in terms of its full-scale development phase, is part of the Air Force budget. He predicted that BSTS could be deployed by the mid-1990s.

IN FOCUS...

Questions About SS-24 Deployment

Acting Assistant Secretary of Defense for Security Policy Frank J. Gaffney, Jr., recently acknowledged on the record that the US doesn't have the "foggiest notion" whether the Soviet claim that its Peacekeeper-size SS-24 is now operational is correct. The Soviets, he stressed, have gone to "extraordinary lengths" to keep the US NTM (national technical means, mainly space-based intelligence sensors) from observing tests of these rail-mobile weapons. He termed it an "ironic situation" that the Soviets would trumpet the deployment of this important new ICBM at a time when US sensors can't yet gauge its deployment status or the number of missiles involved.

He stressed that the Soviets kept the US from identifying the railroad cars used to move these weapons over the 160,000-mile Soviet rail net, that mating of the ICBM with its rail-mobile launchers apparently has occurred in railroad tunnels and sheds to preclude observation, and that telemetry data has been heavily encrypted. By implication, it would appear that the US NTM and other sensors are unable to detect covert deployments occurring at night or under cloud cover, a condition that—if true—would keep the US from effectively monitoring the pending INF accord that involves much smaller and more mobile SS-20, SS-22, and SS-23 missiles.

Secretary Gaffney used these facts to advance the Administration START proposal that seeks to ban all mobile ICBMs. This proposal—which the Administration tabled formally last year and still supports as a going-in position for START—would probably outlaw the rail-garrison Peacekeeper as well as the small, road-mobile ICBM. ■

CAPITOL HILL

By **Brian Green**, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Sept. 2

USAF on IMU

Brig. Gen. Charles E. May, Jr., Deputy Director of Advanced Programs in the Secretary of the Air Force's Acquisition Office, defended the MX Peacekeeper program against charges leveled in a report issued by the House Armed Services Committee (HASC) by arguing that the missile exceeds specifications for reliability and accuracy, that it will be fully deployed on schedule, and that "we're being criticized for not being absolutely perfect."

The HASC report was extremely critical of the performance of the MX Peacekeeper and its Inertial Measurement Unit (IMU), a key component of its guidance and control system. The report also blasted Northrop Electronics Division, the IMU manufacturer, for management deficiencies and the Air Force for failure to disclose problems to Congress and ineffective program monitoring.

HASC Chairman Les Aspin (D-Wis.) argued that the five MX tests conducted with the production version of the IMU (as opposed to the R&D version) rated a grade of "D." Rep. Sam Stratton (D-N. Y.) charged that the Air Force hid IMU problems behind technicalities in its reports to Congress.

General May responded at a press conference that the Peacekeeper "is the most successful missile program in our history—on time and on budget." He noted that the capability and accuracy of the missile are "what we would have expected three to five years after deployment and numerous operational flights." All reentry vehicles have hit within the designated target area on the seventeen test flights to date, General May said. The tests have also greatly exceeded the Peacekeeper's Circular Error Probable (CEP) requirement that defines the smaller target area in which fifty percent of the reentry vehicles must fall. Eighty-two percent have fallen in this CEP circle.

He stated that the five tests criticized by Representative Aspin were ten percent more accurate than specifications required. While conceding that the Peacekeeper tests using early production models of the IMU have been less accurate than those using R&D models, he also said that this development was not unexpected, since other missile programs had experienced a similar loss of accuracy.

General May denied that the Air Force failed to inform Congress adequately of problems with the IMU. He noted that Congress seemed aware of the difficulties and cited as evidence legislation that referred to problems with production of MX guidance systems in both FY '86 and FY '87 and the Air Force request for funding to qualify as second-source contractor for IMU production. "My staff and I have spent a great deal of time over the past eighteen months talking with members of Congress, their staffers, and the news media about the IMU situation," he said.

Sequestration Report

As required by the Gramm-Rudman-Hollings balanced-budget law (or GRH, named for its sponsors Sens. Phil Gramm [R-Tex.], Warren Rudman [R-N. H.], and Ernest Hollings [D-S. C.]), the Office of Management and Budget (OMB) and the Congressional Budget Office (CBO) released a report that details the need for $45 billion in outlay cuts to meet the law's $108 billion FY '88 deficit limit. Defense would absorb half the cuts prescribed by the report—almost $23 billion in outlays.

A reduction of that magnitude would reduce the "baseline" defense budget authority (BA) of about $289 billion by $44 billion. Outlays would be reduced to about $262 billion from the outlay baseline of $285 billion. Adjusted for inflation, defense spending authority and outlays would fall about seventeen percent compared to FY '87.

The automatic budget-cutting procedures of GRH, known as "sequestration," were declared unconstitutional last year. Last-minute efforts, just prior to Congress's summer recess, to reinstate a constitutional form of sequestration collapsed.

The proposed revisions also included a relaxation of deficit targets. A proposal by Sens. Pete Domenici (R-N. M.) and Phil Gramm would have set the new FY '88 deficit target at $150 billion. Efforts to revise GRH are expected to continue after recess.

Violations Alleged

Sen. Jesse Helms (R-N. C.), during a recent colloquy on the defense authorization bill, accused the Soviet Union of new violations of the SALT II Treaty. Senator Helms stated that the Soviets "have at least 823 MIRVed ICBM launchers [launchers of ICBMs equipped with multiple, independently targetable reentry vehicles], and the SALT II sublimit . . . is 820." He also accused the Soviets of exceeding the sublimit of 1,200 on MIRVed ICBMs and SLBMs (submarine-launched ballistic missiles). The deployment of the fifth Typhoon-class ballistic-missile-carrying submarine, he argued, put the Soviets at 1,211 MIRVed strategic missiles.

Congressional critics of the Reagan Administration are trying to impose funding constraints that would limit US strategic forces to the SALT II-prescribed levels. Recent US deployment of air-launched cruise missiles (ALCMs) on B-52s have exceeded the third SALT II sublimit of 1,320 MIRVed missiles and ALCM-equipped bombers. The House-approved defense authorization bill would deny funding for any program that violates the SALT II sublimits. A similar amendment is expected to be offered on the Senate floor.

Many Senators have been critical of efforts to attach arms-control amendments to the defense authorization bill. Some argue that such amendments should be attached to the State Department authorization bill or introduced as independent legislation. Others maintain that such amendments undermine the President's ability to negotiate new agreements with the Soviets or to enforce Soviet compliance with existing ones and exceed the constitutional role assigned to Congress with respect to treaties—specifically, that the Senate has the power to "advise and consent." ■

DEFENSE DIALOG

MILLIMETER-WAVE RADAR SENSOR. A recent test of the Flexible Lightweight Agile Guided Experiment (FLAGE) missile verified its guidance and control accuracy required for the intercept and destruction of tactical ballistic missile targets within the atmosphere. Traveling at hypervelocity speed, the FLAGE missile intercepted the targeted Lance missile at an altitude of 12,000 feet. It utilized the Autonetics Sensors and Aircraft Systems Division's homing radar sensor, developed for LTV Missiles & Electronics Group, the prime contractor. Ground-launched Kinetic Kill Vehicles similar to FLAGE are considered one of the most promising technologies for theatre defense.

ELECTRONIC WARFARE. Rockwell DEL is developing multi-bit Digital RF Memories (DRFMs)—key components in advanced deceptive electronic countermeasures systems. DRFMs are capable of storing and replicating in real-time, complex radar and communications signals which are modified and retransmitted to the threat, producing the deception. Developments using Rockwell's ultra-high speed, A/D-D/A multi-bit gallium arsenide integrated circuits will improve jammer deception capability and enhance survivability against today's increasingly sophisticated threats.

SMALL MISSILE GUIDANCE AND CONTROL SOFTWARE. Rockwell International is advancing technology in its development of ground and flight control software in the Ada high-order language for the research and development phase of the Small Missile program. The use of Ada in an embedded MIL-STD-1750A missile computer application by Autonetics ICBM Systems Division includes performance of navigation system calibration, terminal countdown and missile flight control functions in a nuclear weapons system environment.

PEACEKEEPER RAIL GARRISON. Rockwell has been an integral part of the Peacekeeper missile development team from its inception and will continue to support the ICBM in its new Rail Garrison basing mode. The Rockwell team is combining a unique set of technical skills and experience—railroad operations and control systems, rail security operations, guidance and control, land navigation, launch control system integration, nuclear hardness and survivability, and advanced strategic communications systems—directly applicable to the new ICBM basing concept.

For more information, please call: Science and Technology, Rockwell International, Autonetics Electronics Systems, (714) 762-7775.

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AEROSPACE WORLD

. . . PEOPLE . . . PLACES . . . EVENTS . . .

By Jeffrey P. Rhodes, AERONAUTICS EDITOR

Washington, D. C., Sept. 4

★ In mid-July, Secretary of Defense Caspar W. Weinberger sent a message to Air Force Secretary Edward C. Aldridge, Jr., and Navy Secretary James H. Webb that directed them to study potential early 1990s upgrades to the Air Force's F-16 and to the Navy's F/A-18. These upgrades are necessary, the Secretary said, in effect, because it would be many years before the Air Force's Advanced Tactical Fighter (ATF) and the Navy's Advanced Tactical Aircraft (ATA) would be available in sufficient numbers. In addition to meeting US needs, the modified aircraft would also be suitable for allied air forces.

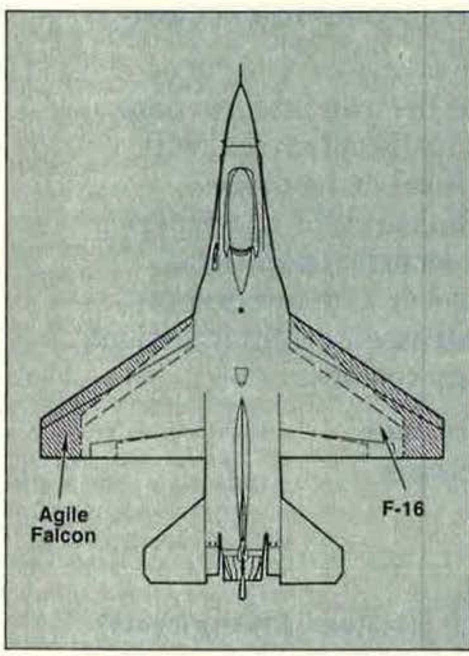
Secretary Weinberger said he was "particularly interested in considering upgrades that would meet the future fighter needs of the European Participating Governments [EPG] that coproduced the F-16A. These countries are now reviewing their options for replacing these aircraft. I believe that upgraded F-16s could prove very attractive relative to other aircraft that might be available to the EPG." The Secretary called for a final report to be submitted by March 1988, in time for use during preparation of the Fiscal Year 1990–91 budget.

A little more than a week after the memo was sent, General Dynamics came to the Air Force with an unsolicited proposal for an F-16 upgrade program designated "Agile Falcon." The proposal calls for the Agile Falcon to be designed, developed, and produced as a joint multinational program by the US and the EPG—Belgium, Denmark, the Netherlands, and Norway—under a fifty-fifty, shared-funding arrangement. GD had been studying the Agile Falcon concept as an in-house exercise for about three years.

The Agile Falcon program upgrades include uprated engines and avionics systems (already in the works as part of the preplanned F-16 Multinational Staged Improvement Plan) and aerodynamic and structural improvements, of which the most prominent is a larger wing. This will allow the F-16 to regain some of the maneuverability it had lost as heavier electronic equipment was added during the plane's evolution.

The new wingspan will be seven and one-half feet greater than that of the F-16C (bringing it to forty feet, three inches, including the missiles), increasing the wing area from 300 square feet to 375. The wing will give the Agile Falcon a three degree per second increase in turn rate and make the landing distance 500 feet shorter than that of the F-16C. The new wing would have added 1,200 pounds of weight, but by using graphite composites and thermoplastics, it was possible to shave that amount by 614 pounds. The larger wings will also allow for greater weapons carriage.

GD estimates that the upgrade development, testing, and production tooling will cost about $600 million, depending on the final configuration and system options. Pending Air Force approval, GD expects to start the upgrade program in 1990, which



General Dynamics has made an unsolicited proposal to the Air Force for a significantly upgraded version of the F-16. The most visible improvement in this project, which is dubbed "Agile Falcon," is a twenty-five percent larger wing. At left is a schematic of the new wings, while on the right, the new wings give a different look to an artist's model of the F-16.

AEROSPACE WORLD

★ For obvious reasons, it is not easy for the US services to obtain Soviet equipment to use as training aids. The Navy and Air Force "aggressor" squadrons use authentic Soviet-bloc camouflage schemes, but the aircraft are still F-5s and A-4s. The Army, however, is taking the next logical step—a contract has been let to obtain copies of Mil Mi-24 Hind-E helicopters.

The US Army Missile Command at the Redstone Arsenal in Alabama has awarded Orlando Helicopter Airways a $6.5 million contract to modify fifteen Sikorsky H-19 and S-55 helicopters into "Hind Look-Alikes." They can be piloted or used as drones and will be used in battlefield training, recognition, and as targets.

The modifications, which will be done at Orlando Helicopter's Sanford, Fla., facility, include a new nose and tail boom, installing shoulder-mounted winglets, and adding blisters, pods, and weapons shapes. The three-blade main rotor of the H-19s will also be replaced by a five-blade rotor like the Soviet attack/assault helicopters use.

The nose modifications for the helicopters are being designed and the molds for the fuselage panels and transparencies are being provided by 3D Industries of Madison Heights, Mich. Honeywell's Sperry Defense Systems Division in Albuquerque, N. M., is providing the drone control system. This will be the first time a full-scale helicopter has been converted into a drone.

Flight testing of the Hind Look-Alikes is scheduled to begin next spring, and all of the helicopters are to be delivered by next November.

In a related note, Sperry Defense Systems Division has also received a contract from Mitsubishi Heavy Industries in Tokyo to modify two F-104J aircraft into drones for the Japanese Defense Agency, with an option to modify twenty-nine other F-104Js into full-scale aerial targets. The contract has a potential value of $25.5 million.

★ The AIM-120A Advanced Medium-Range Air-to-Air Missile (AMRAAM) program hit another snag on July 17 when one of the missiles suffered loss of control in a test conducted at the White Sands Missile Range in New Mexico. The miss was later attributed to an autopilot failure.

This marked the second consecutive control failure in the nearly twelve-foot-long missile's test program. In June, the test missile lost a control fin. This latest miss occurred when the AIM-120 rolled uncontrollably after the autopilot breakdown. A change in the autopilot's software is viewed as the likely fix.

The test was a repeat of a miss that occurred in the spring. An F-15C flying at Mach 0.9 fired the unarmed AIM-120 in a head-on aspect shot against a maneuvering QF-100 drone traveling at Mach 0.85. The missile acquired the target and made a solid track through most of the flight. As the missile approached the drone, though, the QF-100 executed a diving maneuver and turned on its electronic countermeasures. The AMRAAM then went out of control.

The software problem that caused the April miss was not at fault in this latest test. The software fix for the earlier miss was completely successful.

The AMRAAM scoreboard now stands at thirty successes in thirty-seven attempts for an eighty-one percent success ratio.

In other AMRAAM news, a joint-venture company, EURAAM Ltd., has been formed to compete for the European manufacture and in-service support of the AIM-120As. The consortium consists of British Aerospace and Marconi Defence Systems in England and Messerschmitt-Bölkow-Blohm and AEG in Germany. The new company will be headquartered in Hatfield, England.

The AIM-120, which will replace the AIM-7 Sparrow missile, is planned as the next beyond-visual-range (BVR) air-to-air missile for the Royal Navy's Sea Harriers, the RAF's Panavia Tornado F.3s, Germany's F-4Fs, the multinational Eurofighter that is now in development, and other NATO users.

European manufacture of the AIM-120 is covered under the terms of the AMRAAM/ASRAAM Memorandum of Understanding (MOU) signed in 1979. This MOU provided for US development and European coproduction of the AIM-120 and European development and US coproduction of the AIM-132 Advanced Short-Range Air-to-Air Missile (ASRAAM). West Germany, Great Britain, and Norway are developing ASRAAM.

EURAAM Ltd. will produce European AIM-120As under license from Hughes, AMRAAM's American prime contractor. Delivery of European AMRAAMs would not likely begin until late 1989 or early 1990. Raytheon is the 335-pound missile's second-source contractor in the US.

★ **AWARDED**—The National Aeronautic Association (NAA), the US representative to the Fédération Aéronautique Internationale (FAI), the international aviation authority, will present its Elder Statesmen of Aviation awards and its Frank G. Brewer Trophy in Washington during October.

The winners of the Elder Statesmen of Aviation awards are **Harold D. Hoekstra,** eighty-four, who designed

After more than forty-three years of active duty, Col. (Dr.) Thomas J. Tredici retired on August 25. Dr. Tredici, who was chief of the ophthalmology branch of the Human Systems Division's USAF School of Aerospace Medicine at Brooks AFB, Tex., is a combat veteran of a unique sort. Dr. Tredici was the last remaining World War II B-17 pilot still on active duty.

would allow for delivery of production aircraft to start by 1995, almost a year ahead of when France's new tactical aircraft (the Rafale follow-on) is expected to be ready.

The Agile Falcon upgrade would be incorporated in the existing USAF F-16 procurement plan, and no additional US aircraft quantities would be required. The upgrade is expected to add $2 million to the F-16C's flyaway cost of about $13 million each. This unit price will still likely be less than that of the Rafale's progeny or the multinational Eurofighter, and it will be considerably less than the $35 million baselined cost of each ATF.

While the Air Force will probably support the Agile Falcon program, the Navy will likely not back any radical, additional improvements to the McDonnell Douglas F/A-18 in the near future. The Navy already has several major upgrades for the Hornet under way, including new, faster computers, provisions for AMRAAM, ASRAAM, and AAAM (all of which are new air-to-air missiles in development or in the concept stage), an uprated electronic suite, and a night attack package. There is talk in West Germany about pulling out of the Eurofighter program and opting for the F/A-18 instead.

In a related F-16 note, the first of 160 aircraft for Turkey was delivered on July 20. The first eight F-16C/Ds will be built in Fort Worth, Tex., while the remainder will be built in Turkey under license. Turkey is the eleventh nation and the twelfth air arm to operate the multimission F-16.

★ Dr. Sally Ride, America's first woman astronaut in space and NASA's Acting Associate Administrator for the Office of Exploration, submitted a report on the space agency's long-range study to NASA Administrator James Fletcher on August 12. In the report, Dr. Ride, who left the space program in September to accept a fellowship at Stanford University, cites the need for a sensible space strategy as NASA's primary goal.

The panel's report named four areas where NASA should be focusing its attention—using space to study Earth, exploring the solar system, setting up an outpost on the moon, and a manned Mars mission.

The findings added, though, that the US should not select a single objective (like the space race to the moon in the 1960s), nor should the country try to lead the world in all areas of space (a frequent criticism before the *Challenger* accident). The report says "a strategy of evolution and natural progression" that is "consistent with NASA's capabilities" is what is needed.

However, the summary also says, "The most critical and immediate needs are related to advanced transportation systems to supplement and complement the Space Shuttle and advanced technology to enable the bold missions of the next century. Until we can get people and cargo to and from orbit reliably and efficiently, our reach will exceed our grasp . . . [and] the realization of our aspirations will remain over a decade away."

A manned mission to Mars now, the report states, would force a tripling of NASA's budget, would take away funds from the Space Station, and would put undue stress on the Space Transportation System. After establishing a moon base, "the natural progression of human exploration then leads to Mars."

In other NASA news, Rockwell International was awarded a $1.3 billion contract on August 1 to build a replacement Shuttle Orbiter for the lost *Challenger*. Additional contracts for engines and other components for the new Orbiter (OV-105) will raise the total contract value to more than $2 billion. Rockwell will fabricate, assemble, test, check out, and deliver the new Orbiter within forty-five months, or by April 1991.

To put into perspective how complicated a machine the Shuttle Orbiter is, $2 billion is, in rough terms and discounting other factors, the equivalent of about 154 F-16s, sixty-three F-15Es, between seven and eight B-1Bs, or eighty-one percent of a new nuclear-powered aircraft carrier.

—Photo by Erik Simonsen

Another Air Force aircraft that will have a new look is Strategic Air Command's Boeing KC-135 Stratotanker. The first camouflaged KC-135 arrived at McConnell AFB, Kan., early in the summer, and the rest of the tankers will be repainted as the aircraft go through periodic depot maintenance. Unlike other wrap-around camouflage schemes, the tankers' new coats have a lighter bottom, which helps the receiving aircraft during night refueling.

★ Pilot retention continues to be a problem for the Air Force. According to Lt. Gen. Thomas J. Hickey, the Air Force's Deputy Chief of Staff for Personnel, retention rates continue to "hover around fifty percent, [and] I don't see any turnaround yet on the horizon."

The pilot-retention rate dropped from a high of seventy-eight percent in FY '83 to fifty-six percent in FY '86, and the rate is predicted to fall below fifty percent by the end of FY '87. A fifty-five to sixty percent retention rate is considered necessary to sustain the force.

In an attempt to build up the retention rate, the Air Force is reviewing several items, including changing promotion and assignment policies, reducing additional duties for pilots, and making quality-of-life improvements for the pilots. The Officer Effectiveness Report (OER) system is also being reviewed. The main item on the Air Force's agenda, though, is increasing aviation career incentive pay (ACIP), commonly known as flight pay.

Flight pay is currently capped at $400 per month and was last increased in 1981. Despite Air Force efforts, an increase in ACIP was not included in the latest Defense Department budget request.

A recent survey of Air Force pilots indicated that their biggest concerns were length of the duty day and excessive amounts of nonflying duties. The survey also showed that the pilots were most pleased in their present positions when camaraderie and job satisfaction were high.

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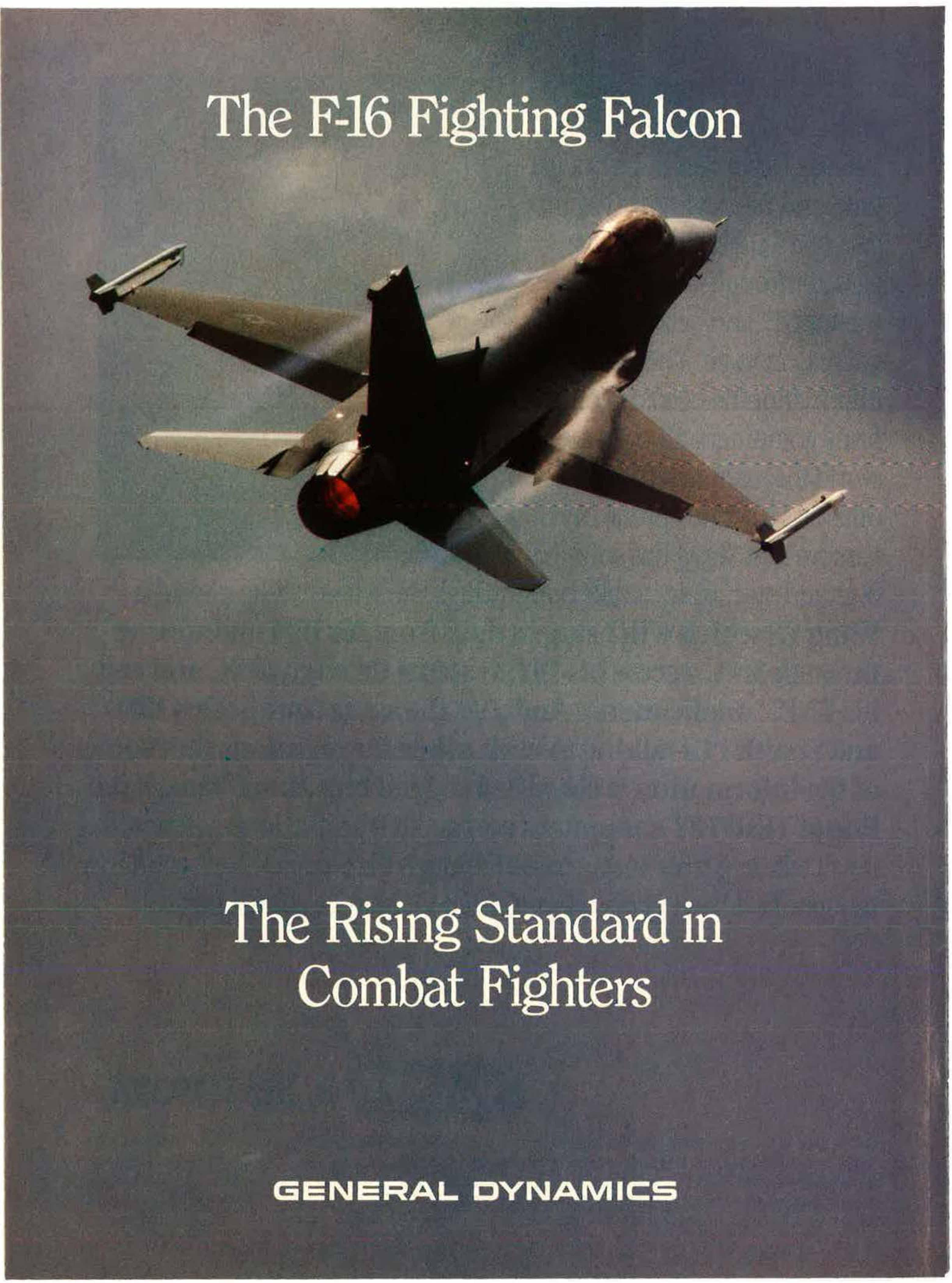
The F-16 Fighting Falcon
The Rising Standard in Combat Fighters
GENERAL DYNAMICS

and tested spoilers as lateral control devices on the Crosley biplane and who had an influential thirty-five-year career with the CAA and FAA; **Douglas T. Kelley,** eighty-six, a Ryan flight instructor and test pilot who taught Douglas "Wrong-Way" Corrigan how to fly and who also helped to construct Charles Lindbergh's *Spirit of St. Louis* and was responsible for writing the names of the Ryan laborers on that plane's spinner; and **Frank N. Piasecki,** sixty-seven, builder of the second successful helicopter in America and developer of the tandem rotor configuration for transport helicopters.

Others who are to receive the Elder Statesmen awards include **Paul H. Poberezny,** sixty-five, the authoritative voice in Washington concerning safety and research programs in civil aviation and coordinator of the annual EAA show at Oshkosh, Wis.; **Crocker Snow,** eighty-two, writer of the first comprehensive aeronautical law for Massachusetts, commander of the North Atlantic Sector of the Air Corps's Ferry Command, and later Assistant Chief of Staff to Gen. Emmett "Rosy" O'Donnell in World War II; and **John A. Winant,** sixty-four, author and administrator who served as chairman of the General Aviation Council to the FAA Administrator and past president of the National Business Aircraft Association.

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The Frank G. Brewer Trophy, awarded annually for significant contributions of enduring value to aerospace education in the US, will be presented to **Dr. Paul A. Whelan.** Dr. Whelan, a retired Air Force command pilot who has taught at Air University, the Air Force Academy, and four other colleges, is now Vice President and Chief Executive Officer of Parks College of St. Louis University in Missouri.

The first Grumman A-6F Intruder II flew for the first time on August 26 from the company's facility in Calverton, N. Y. The A-6F is a significantly upgraded version of the veteran attack aircraft and features a sharper, more powerful radar, an air-to-air capability, five new multifunction cockpit displays, and General Electric F404-GE-400D engines.

★ **DELIVERIES**—The Air Force accepted its **4,000th McDonnell Douglas Advanced Concept Ejection Seat** (ACES II) on July 15. The seat, built by Douglas Aircraft Co. in its Long Beach, Calif., plant, will be fitted into an F-16. The seat is designed to enhance survival of crews forced to eject from aircraft at altitudes ranging from zero to 50,000 feet and speeds from zero to 690 mph. There are twelve versions of the ACES II, each tailored to fit its aircraft. The seats, which are also used in the Air Force's A-10, F-15, and B-1B aircraft, have been credited with saving the lives of 125 airmen worldwide.

In late July, **Tracor Aerospace and Tracor Flight Systems** of Austin, Tex., **delivered to the US Army the first EH-60A helicopter** modified with the "Quick Fix" system. The Quick Fix modifications include an electronic countermeasures/electronic surveillance measures system that will provide tactical signal intelligence, electronic warfare, and direction-finding capabilities. The EH-60 has secure

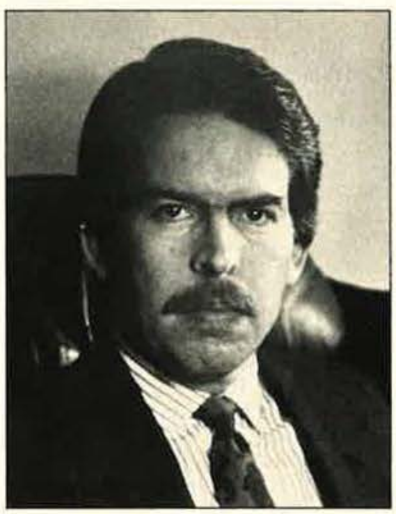
Robert S. Dudney Joins Staff

Robert S. Dudney has joined the staff of AIR FORCE Magazine as a Senior Editor. He assumed his new position in September after two years of managing his own firm, Columbia Publications Corp., and working on a book.

Prior to starting his own company, Mr. Dudney was the Associate Editor for National Security Affairs at *U.S. News & World Report* magazine for six years, and he covered defense and foreign affairs as the Washington correspondent for the Dallas *Times Herald* from 1976 to 1979. In 1986, he launched (and continues to chair) the Defense Writers Group of Washington, an assembly that brings together defense officials and journalists to meet on a regular basis.

Mr. Dudney has received numerous awards from such organizations as the Associated Press, the Robert F. Kennedy Foundation, and from Sigma Delta Chi, the professional journalism society. He is also a past winner of the New York Overseas Press Club Citation.

Born in Harlingen, Tex., and reared in Dallas and Houston, Mr. Dudney is a 1972 honor graduate of the University of Missouri's School of Journalism, and he holds a master's degree in international public policy from The Johns Hopkins University's School of Advanced International Studies in Washington, D. C.



Robert S. Dudney was recently named as AIR FORCE Magazine's new Senior Editor.

voice and data links, and it also has the capability for intercept direction-finding and jamming. Tracor will be providing eighty EH-60s to the Army under an $87 million contract.

The **first of 720 Large Aircraft Start Systems (LASS) carts was delivered to the Air Force** on August 5 at the Libby Corp.'s Kansas City, Mo., plant. LASS is powered by a Garrett GTCP85-180C turbine engine, and it produces 147 pounds per minute of airflow at forty-eight pounds per square inch. It can operate at temperatures ranging from minus forty degrees to plus 125 degrees Fahrenheit and is two and one-half times quieter than the MA-1A, which LASS will replace. LASS will be used to start B-1B, B-52, FB-111, KC-10, KC-135, C-5, C-141, and C-130 aircraft. Air Force Systems Command's Aeronautical Systems Division at Wright-Patterson AFB, Ohio, manages the LASS program.

The **first E-8A Joint Surveillance and Target Attack Radar System (Joint STARS) aircraft was delivered** to Grumman's Melbourne, Fla., plant on July 31. The aircraft, a modified Boeing 707-300, is the first of two preproduction prototypes. Grumman will complete the aircraft's conversion to the Joint STARS configuration by integrating all of the plane's electronic surveillance systems and by installing the various subsystems.

First engineering flight test of the full-up Joint STARS aircraft will be next April. The E-8A will provide wide-area surveillance of a battlefield, including moving and fixed target detection from long range. Real-time radar data will be displayed at the consoles aboard the E-8 and at Army mobile ground stations to allow for effective weapons direction and employment.

British Aerospace (BAe) delivered the first two Hawk Mk. 65 advanced trainers to the Royal Saudi Air Force on August 11. After conversion of Saudi pilots at BAe's Dunsfold, England, facility, the trainers will be flown to Dhahran to provide advanced training for RSAF pilots graduating from Pilatus PC-9 primary trainers at the King Faisal Air Academy at Riyadh. The RSAF will receive thirty Hawk Mk. 65s. The Saudi Hawks will have provisions for normal practice armament.

The **US Marine Corps accepted its first five Israel Aircraft Industries (IAI) Kfir ("Lion Cub") C-2 "aggressor" aircraft** at MCAS Yuma, Ariz., on August 13. The Kfirs, designated F-21A, are used for dissimilar air combat training for Marine aviators. The aircraft are provided under a no-cost lease arrangement, although IAI did receive a contract for maintenance and support of the F-21s. The Marines will eventually get thirteen aircraft. The Navy has been flying a squadron of Kfirs at NAS Oceana, Va., for the past two years.

October Anniversaries

• *October 18, 1922:* Gen. Billy Mitchell sets a world speed record of 222.97 mph over a closed course in the Curtiss R-6 racing plane at the annual Pulitzer Trophy air race near Detroit, Mich.

• *October 15, 1937:* Boeing XB-15 makes its first flight at Boeing Field in Seattle, Wash., under the control of test pilot Eddie Allen.

• *October 1, 1947:* North American XP-86 Sabre takes to the air for the first time at Muroc Dry Lake in California.

• *October 14, 1947:* Capt. Chuck Yeager becomes the first man to break the sound barrier in level flight. After release from a B-29, Captain Yeager pilots the Bell XS-1 rocket plane to a speed of Mach 1.015 (670 mph) over Muroc.

• *October 21, 1947:* First flight of the Northrop YB-49 Flying Wing jet bomber. The Air Force's new Advanced Technology Bomber is thought to bear some family resemblance to this plane.

• *October 4, 1957:* The space age begins when the Soviet Union launches Sputnik I, the world's first artificial satellite, into low-earth orbit.

• *October 3, 1962:* Navy Commander Wally Schirra becomes the fifth American into space when his *Sigma 7* capsule lifts off aboard Mercury-Atlas 8. The flight lasts nine hours and thirteen minutes.

• *October 3, 1967:* Maj. William "Pete" Knight flies the North American X-15A-2 to the absolute world speed record of Mach 6.72 (4,534 mph) over Edwards AFB, Calif.

• *October 1, 1977:* Volant Oak begins. Volant Oak is the quarterly rotation of six Air Force Reserve and Air National Guard transports to Howard AFB, Panama, for in-place tactical airlift in Central and South America.

SENIOR STAFF CHANGES

RETIREMENT: M/G Robert A. **Rosenberg.**

CHANGES: Col. (B/G selectee) Michael J. Butchko, Jr., from Dep. Cmdr. for Tactical Systems, ASD, AFSC, Wright-Patterson AFB, Ohio, to Dep. Cmdr. for C-17, ASD, AFSC, Wright-Patterson AFB, Ohio . . . **B/G James E. Chambers,** from Dep. Dir., Ops. (J-3), Hq. USPACOM, Camp Smith, Hawaii, to DCS/Ops. & Intel., Hq. PACAF, Hickam AFB, Hawaii, replacing M/G James B. Davis . . . **B/G Keith B. Connolly,** from Cmdr., 313th AD, PACAF, Kadena AB, Japan, to Vice Cmdr., 5th AF, PACAF, Yokota AB, Japan, replacing B/G Charles F. Luigs . . . **B/G (M/G selectee) Hugh L. Cox III,** from Cmdr., E-3A Comp. Cmd., NATO AEW Force, Geilenkirchen AB, Germany, to Dir., Ops. (J-3), Hq. US Spec. Ops. Cmd., MacDill AFB, Fla. . . . **M/G James B. Davis,** from DCS/Ops. & Intel., Hq. PACAF, Hickam AFB, Hawaii, to Vice CINC, Hq. PACAF, Hickam AFB, Hawaii, replacing M/G (L/G selectee) Hansford T. Johnson.

B/G George B. Harrison, from DCS/Plans, Hq. USAFE, Ramstein AB, Germany, to C/S, Hq. USAFE, Ramstein AB, Germany, replacing M/G Michael A. Nelson . . . **B/G Larry R. Keith,** from DCS/Ops., 2ATAF, AAFCE, Moenchen-Gladbach, Germany, to Cmdr., 836th AD, TAC, Davis-Monthan AFB, Ariz., replacing B/G Lester R. Brown, Jr. . . . **B/G Charles F. Luigs,** from Vice Cmdr., 5th AF, PACAF, Yokota AB, Japan, to Dep. Dir., Ops. (J-3), Hq. USPACOM, Camp Smith, Hawaii, replacing B/G James E. Chambers . . . **B/G Billy G. McCoy,** from Cmdr., 832d AD, TAC, Luke AFB, Ariz., to DCS/Ops., 2ATAF, AAFCE, Moenchen-Gladbach, Germany, replacing B/G Larry R. Keith.

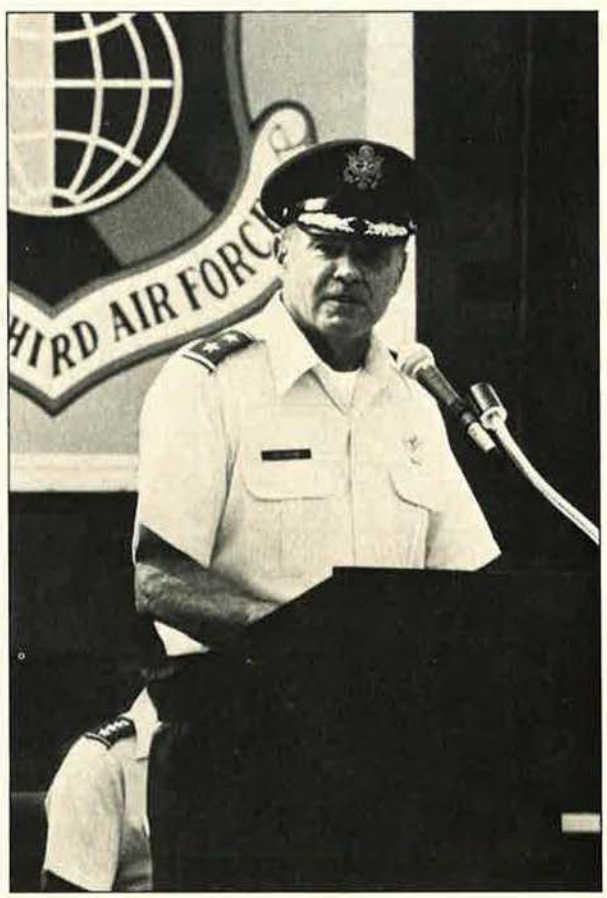
M/G Michael A. Nelson, from C/S, Hq. USAFE, Ramstein AB, Germany, to DCS/Ops. & Plans, SHAPE, Mons, Belgium, replacing M/G Randall D. Peat . . . **M/G Randall D. Peat,** from DCS/Ops. & Plans, SHAPE, Mons, Belgium, to C/S, Hq. SAC, Offutt AFB, Neb., replacing M/G (L/G selectee) Robert D. Beckel . . . **Col. (B/G selectee) Peter D. Robinson,** from Cmdr., 36th TFW, USAFE, Bitburg AB, Germany, to Cmdr., 313th AD, PACAF, Kadena AB, Japan, replacing B/G Keith B. Connolly . . . **Col. (B/G selectee) Hanson L. Scott,** from Cmdr., 1st SOW, MAC, Hurlburt Field, Fla., to Vice Cmdr., 23d AF, MAC, Hurlburt Field, Fla., replacing B/G Floyd E. Hargrove. ■

Although not yet delivered to its end user, **the first MH-53J Enhanced Pave Low III helicopter was rolled out** at the Naval Air Rework Facility at NAS Pensacola, Fla., on July 17. The project, which is managed through the Warner Robins Air Logistics Center at Robins AFB, Ga., involved the installation of secure voice, data burst, and satellite communications systems, titanium armor plating, an advanced electronic countermeasures system, global positioning system terminals, and mounts for .50-caliber machine guns and/or 7.62-mm miniguns, among other things. In all, forty-three major mission systems were integrated or upgraded. After six months of tests, the MH-53J (the first of thirty-three HH-53 helicopters to be modified) will be delivered to the 1st Special Operations Wing at Hurlburt Field, Fla.

★ **NEWS NOTES**—Secretary of Transportation Elizabeth H. Dole recently announced **stiffer regulations requiring airlines to exercise increased control over carry-on baggage.** The new regulations require airlines to establish an "approved program" to control the quantity of carry-on baggage and also requires that aircraft boarding doors remain open until a crew member verifies that all luggage is safely stored. This regulation is intended to give flight attendants time to unload excess carry-on baggage and send it to the cargo hold. The new rules go into effect on January 1, 1988.

The International Maritime Satellite Organization **(INMARSAT) reports that whirling helicopter rotor blades do not interfere with satellite communication signals.** INMARSAT, the forty-eight-member-country international cooperative that operates a global satellite system, confirmed this fact in a series of July tests with helicopters flying over the North Sea. The experiment was designed to demonstrate the effectiveness of low-speed satellite data transmissions for helicopters in remote areas or under low-flying conditions that would limit VHF radios.

Hurlburt Field, Fla., officially became the home of the Twenty-third Air Force on August 1. The numbered air force was moved from Scott AFB, Ill., to consolidate and streamline command and control of Air Force Special Operations. Twenty-third Air Force consists of 16,250 people in fifty-eight geographic locations with approximately 360 aircraft in twelve different types and models. In addition to Special Operations, Twenty-third Air Force is also responsible for



Twenty-third Air Force pulled up stakes at Scott AFB, Ill., on July 31 and opened up shop the next day at Hurlburt Field, Fla. Here, Maj. Gen. Robert B. Patterson, Commander of Twenty-third Air Force, addresses an audience outside the new headquarters building at Hurlburt.

—USAF photo by TSgt. Lee Schading

AEROSPACE WORLD

combat rescue, continental US aeromedical airlift, weather reconnaissance, atmospheric sampling, SAC missile site security, target drone recovery, and Air Force Survival Schools, along with other taskings.

The **552d Airborne Warning and Control Wing** out of Tinker AFB, Okla., **logged its 5,000th mission** in support of the Elf-One deployment to Riyadh, Saudi Arabia, on August 2. Elf-One was begun on October 1, 1980, at the request of the Saudi government after war broke out between Iran and Iraq. Since then, the crews manning the Boeing E-3A Sentry aircraft have flown more than 67,500 hours of continuous air surveillance for the Royal Saudi Air Force. The milestone mission aircraft commander was Lt. Col. Thomas Gualdi, and mission crew commander was Lt. Col. Harold Phillips.

Gates Learjet of Tucson, Ariz., was awarded a $14.6 million contract on August 3 for **four additional C-21A aircraft.** These aircraft are to be assigned to Andrews AFB, Md., and will be used by the Air National Guard. The C-21As are used for personnel transport, pilot proficiency flights, and high-priority cargo transport. The eighty C-21s in Air Force use have accumulated well over 100,000 hours of flying time and have achieved a mission-capable rate in excess of ninety-six percent.

★ **DIED—Lt. Gen. Richard M. Montgomery,** who served as Chief of Staff of Strategic Air Command from 1952–56 and later as Assistant Chief of Staff of the Air Force, on August 29. He was seventy-five. During his thirty-three years of service in the Air Force, he logged more than 11,000 hours in eighty-four different types of aircraft. Prior to his retirement in 1966, he served as Vice Commander in Chief of United States Air Forces in Europe and then became Executive Vice President of the Freedoms Foundation, an educational organization, for a year. ■

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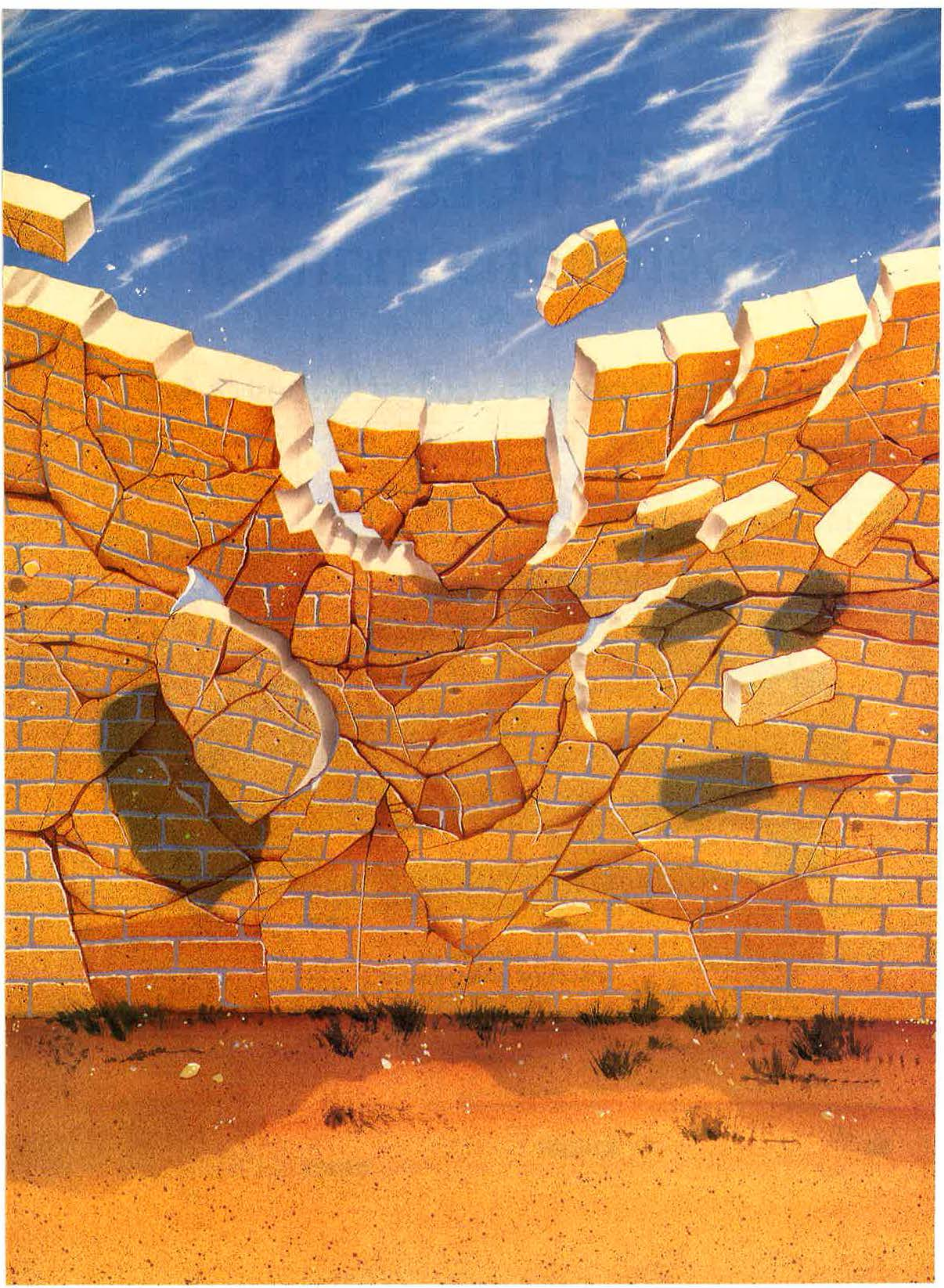

What's The Word From Westinghouse On Producibility?

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It was hard to believe that Ira Eaker had retired. It is even harder now to believe that he is gone.

EAKER OF THE EIGHTH

BY GEN. T. R. MILTON, USAF (RET.)
CONTRIBUTING EDITOR

Gen. Ira C. Eaker was probably best known as the wartime commander of the Eighth Air Force, but he was truly an aeronautical pioneer. In the photo above, then Brigadier General Eaker is the center of attention at an outdoor press conference in England, while at right, the General is caught in a reflective mood with "Winston" at Wycombe Abbey School, near London, which served as headquarters for the Eighth.

ONE way or another, all great men hold to a deep belief in something. Greatness does not come to those who tailor their views according to the pressures of the moment. Ira Eaker believed in airpower from the day he soloed, and he never wavered in that belief.

Ira Eaker, who died August 6, will be best remembered as wartime commander of Eighth Air Force, and rightly so, but there was a great deal more than that to this remarkable man.

It all began for him in 1919, the year he received his pilot's rating in the US Army. World War I had provided the first scenario for military aviation. Duels in the sky were the glamour stories of that bloody war, and names like Rickenbacker, Immelmann, Luke, and the Red Baron himself, von Richthofen, were the well-known stars of the day. The curtain had gone down on wartime heroics when young Ira Eaker came onto the scene.

The next two decades were to be decidedly less glamorous for the Army Air Corps he had joined. The air duels over France had caught the public eye, but they had also been peripheral to the result of that war of attrition. Ground soldiers had paid little attention to the air sideshow of World War I, and they were not inclined to spend much of their meager postwar budgets on marginal functions like the Air Corps. Airplanes were seen to have some usefulness in observation and courier duty, but the concept of airpower

was neither understood nor accepted by the men who ran the Army.

Most of the 200,000 pilots and technicians the United States had trained for World War I drifted off into civilian life to become the nucleus of commercial aviation. Some, like Hap Arnold, Tooey Spaatz, and Ira Eaker, stayed on to fight the battle for airpower. It does not bear thinking what might have happened had they not.

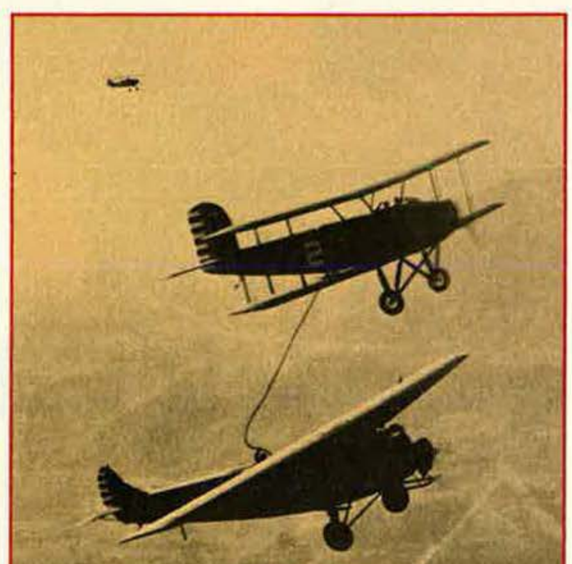
When Billy Mitchell taunted the Army General Staff into preferring charges against him, Ira Eaker was an executive officer to the Assistant Secretary of War. Maj. Gen. Mason Patrick, Chief of Air Corps, assigned Eaker the task of providing Mitchell with whatever documents he might require for his defense. We had Eaker's word for it that Patrick and Mitchell were not enemies, as has been widely reported, but rather two men on good terms who simply differed as to the best way to advance the cause. And while Eaker never said so in so many words, one gets the impression he admired Patrick's tactic of working within the establishment rather more than Billy Mitchell's tactic of challenging it.

In any case, the quiet intellectual approach was the one that suited Eaker's personal style, not that he didn't do some pretty spectacular things in the air. He was a pilot on the Pan American flight in 1926–27, a 22,065-mile goodwill tour of Central and South America. He was chief pilot of the *Question Mark* when it set a world endurance record of 150 hours, forty minutes, and fourteen seconds in 1929, demonstrating how airpower—and in-flight refueling—would someday shrink the world. In 1930, he made the first transcontinental flight using in-flight refueling, and in 1936, was the first to fly coast-to-coast on instruments alone. Eaker was an intellectual, but he was also a superb pilot.

Meanwhile, he studied law at Columbia University and, later, journalism at the University of Southern California, solid preparation for the days to come when logic and an ability to express that logic would be crucial to the future of airpower.

A superb pilot, then Captain Eaker flew one of the four Loening OA-1A amphibian aircraft that were used on the 1926–27 Pan American Goodwill Tour of Central and South America. Captain Eaker is shown in the photo at left with Lt. Muir S. Fairchild (right), his plane's other crewman. In the photo below, Captain Eaker was chief pilot of* Question Mark*, a Fokker C-2 that was flown nearly 151 hours in January 1929 to set an endurance record and to demonstrate the effectiveness of aerial refueling.

In 1936, then Major Eaker became the first pilot to fly coast to coast on instruments alone, a testimony to his skills and a benchmark in the development of flight instruments. Shown in the picture at the right, in Los Angeles, are Major Eaker and Maj. William E. Kepner (standing), who flew the chase plane, at the completion of the blind transcontinental flight.



ABOVE: Then Lieutenant General Eaker flew on the first shuttle raid on Germany. He is shown here after landing in Russia, where he is welcomed by General-Lieutenant (Maj. Gen.) Alexander R. Perminov (far left), US Ambassador Averell Harriman (second from right), and Capt. Henry Ware (far right), who was attached to the US Military Mission in Russia.

RIGHT: General Eaker retired in 1947 and became an aerospace executive and a syndicated columnist. This 1965 photo shows the General at Hickam AFB, Hawaii, prior to a tour of PACAF bases and combat units.

It was in December 1942 that he became commander of the Eighth Air Force in England, the legendary organization that put American theories on airpower to the test. The first results were inconclusive, for Eaker's forces were too limited to risk against the important targets deep inland. The real test was to come in 1943, when the Eighth Air Force at last reached a respectable size. It was arguably the most critical year in the history of what is now the United States Air Force, a year when the whole concept of strategic airpower almost went by the boards.

As losses mounted and the cost of maintaining the Eighth began to be challenged both in Washington and in London, the decision as to the Eighth's future rested on the ability of Ira Eaker to make his case. When he went to the Casablanca Conference to present arguments for a continuation of strategic daylight bombing, there was good reason to think he would lose. Churchill was dubious, as was the RAF, Roosevelt was not committed, and the US Navy wanted resources diverted from the Eighth to its own enterprises in the Pacific. This was the time for calm and reasoned logic, not impassioned rhetoric.

Ira Eaker came back from Casablanca with a mandate to continue doing what he believed in and with the promise of the forces he required. It was an astonishing performance, one that only a gifted man could have carried off. A less convinced advocate or a less intelligent one would surely have lost the day and, with it, the American Air Force's principal role in the war against Hitler.

As the Eighth grew, it began to reach targets in the heart of the Third Reich, even, on occasion, recovering on Soviet bases. Ira Eaker went on the first of these shuttle missions, just as on August 17, 1942, he had flown on the first heavy-bomber raid on occupied Europe by the fledgling Eighth, and while, as always, he shunned publicity about anything he did, the Russians had to be impressed by that square-jawed American general.

It is hard to realize that Ira Eaker retired from the Air Force in 1947, for he never really retired at all. He went on to other careers as an aerospace executive and a syndicated columnist, but he remained, heart and soul, an Air Force officer. The talent for logical and marvelously clear exposition that had won out at Casablanca was used for thirty years longer in countless newspaper columns, magazine pieces, and lectures, all, one way or another, in furtherance of his unwavering belief in airpower and its indispensable role in this country's security.

In 1979, Congress presented Eaker a special gold medal in appreciation of his lifetime of achievements. And in April 1985, President Reagan, with the concurrence of the Senate, promoted him to the grade of four-star rank on the retired list.

It was hard to believe Ira Eaker had retired, and it is even harder to believe he is gone. Like his dear friend Tooey Spaatz, whose last years were eased by daily visits from Ira, Eaker of the Eighth is a figure of history. ■

On October 1, military airlift, sealift, and ground transport began merging into a new unified command. This should solve the coordination gaps of the previous arrangement—but the consolidated operation will be an almighty handful to manage.

Can TRANSCOM Deliver?

BY JAMES W. CANAN, SENIOR EDITOR

FOR the United States, going to war would be a herculean task. A welter of forces, weapons, vehicles, ammunition, and other supplies would have to be ferried by air and sea to faraway places and by air and land at home and abroad. The logistics would be enormously complex and would have to be handled without a hitch on short notice under great stress.

There have been disturbing signs in recent years that the US may not be up to that task. Its military airlift, sealift, and land transportation commands do their jobs in isolation from one another extremely well. But mobilization and deployment exercises have revealed potentially fatal shortcomings of coordination and command and control when all the commands are called on to work together as they would in prewar or wartime deployments.

Now the Defense Department has taken a major step toward solving the problem. On October 1, it activated the new US Transportation Command (USTRANSCOM) at Scott AFB, Ill., where USAF's Military Airlift Command has long been headquartered.

A unified command, USTRANSCOM is responsible for consolidating all US strategic air, sea, and land transportation during war or a buildup to war and for exercising centralized command of the whole affair.

The Commander in Chief of USTRANSCOM is Air Force Gen. Duane H. Cassidy, who will continue to serve as CINCMAC as well in a dual-hatted role that could become daunting.

General Cassidy is decidedly upbeat about it all. "The United States Transportation Command will give this country capabilities we have never had before," he declares. "As an organization that senses how much is needed and can advocate the right balance of assets, it will ensure that America has the world's best system to project forces."

MAC is now a USTRANSCOM component and will no longer be a Defense Department specified command once USTRANSCOM becomes fully operational on October 1, 1988. Other USTRANSCOM components are the Navy's Military Sealift Command and the Army's Military Traffic Management Command. MTMC has charge of ground transportation and operates seaports for military embarkations and debarkations at home and abroad.

General Cassidy describes MAC's melding into the new unified command as its "biggest challenge since we were made a specified command ten years ago."

Cassidy's Challenge

The General himself faces quite a challenge. It will be no mean trick for him to run USTRANSCOM and MAC at the same time if a national emergency looms or erupts, or even to give MAC the attention that he has been in the habit of giving it while getting USTRANSCOM over its growing pains and into maturity.

General Cassidy will have to shoulder the concerns of MSC and MTMC as well as those of MAC, which are demanding enough.

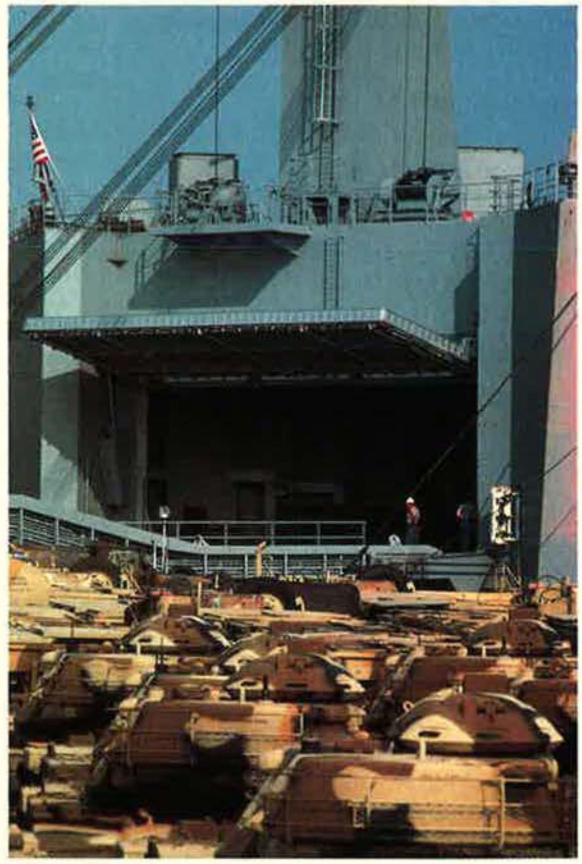
As Commander in Chief of USTRANSCOM, he will be the main man on the spot in promoting and protecting MAC, MSC, and MTMC programs and priorities—which he will also be ultimately in charge of setting—on Capitol Hill and in the rigorous arenas of the Office of the Secretary of Defense, the Joint Chiefs of Staff, the Air Force Staff, the Army Staff, and the Navy Staff.

General Cassidy is known as an action-oriented CINCMAC, one who shows up at his command's bases as often as he can to see for himself how things are going and to take a hand. Some of this activity will almost certainly have to give way, to be handled by MAC subordinates, as he becomes embroiled in the command of USTRANSCOM.

In Air Force circles, there is high confidence that General Cassidy will wear his two hats with style. Such confidence stems from the high regard in which his stewardship of MAC is held and from MAC's reputation as a command with a self-sufficient head of steam and no insurmountable operational problems.

Even so, the possibility that MAC would be diminished by the very fact of its incorporation into a larger unified command caused the Air Force to take a guarded view, in the beginning, of the move to create USTRANSCOM. The Army, the Navy, and the Marine Corps were equally protective of MTMC and MSC respectively at the outset.

All the services came around and had approved USTRANSCOM by the time DoD created it last April. But all will be watching for signs that their initial reservations about it were on the mark.



US combat vehicles are rallied for loading aboard a Military Sealift Command Roll-on, Roll-off (Ro/Ro) ship. Now a component of the new US Transport Command, MSC has greatly improved the capacity and speed of its sealifter fleet through the acquisition of eight such vessels. They form MSC's Fast Sealift Squadron, and each can make way at more than thirty knots.

A Military Airlift Command loadmaster supervises the passage of cargo out of a C-5B airlifter. MAC is the key, quick-response element of the new USTRANSCOM, which is commanded by CINCMAC Gen. Duane H. Cassidy, is headquartered at Scott AFB, Ill., along with MAC, and will control all forms of military transportation in crises and wars.

The services were mollified by DoD's decision to permit them to continue to operate MAC, MSC, and MTMC autonomously under peacetime conditions. Moreover, the Navy stood fast, and won, in insisting that its fleet commanders be given the final say in routing sealift ships to accommodate the routes of the warships assigned to defend them.

The Navy never had to worry about that so long as MSC was under its full control.

USTRANSCOM will bring no changes in the way intratheater military traffic is controlled. CINCs in charge of theater operations will retain full authority over cargo and troops that have arrived in their domains.

The most important consideration for such CINCs is that the cargo and troops get there in the first place—on time and ready to fight. This is why the CINCs are said to have hailed the creation of USTRANSCOM as a good bet to make it happen.

Under a four-star general, USTRANSCOM will undoubtedly have clout. But it will also have a very tall order.

Phaseout of JDA

It will operate and maintain the Joint Deployment System that had been administered, under a two-star commander and with faltering results, by DoD's eight-year-old Joint Deployment Agency, which will be absorbed by USTRANSCOM and then phased out.

USTRANSCOM is charged with managing all transportation aspects of US worldwide strategic planning and with ensuring that the automatic data-processing systems of its three operational components are thoroughly harmonious.

"If we do nothing more than pull off the consolidation of ADP efforts under one command, we will have justified our existence and have saved the American taxpayers untold dollars," asserts Air Force Col. David S. Hinton, USTRANSCOM's Chief of Staff.

The discouraging disparity of data stored in a plethora of different types of computers operated by MAC, MSC, MTMC, and the commands that they support around the world is the reason why those commands have been unable to work together in a winning way in real time when the chips have been down. The JDA was established as the means of making the commands conform to its standards and with one another in data-processing criteria and capabilities, but never did so.

USTRANSCOM's first and most urgent task will be to create an ADP master plan for all its components to adopt and to implement. MAC, which boasts one of the best ADP systems anywhere, will serve as the model.

In fact, MAC's ADP setup and its relatively new, exceptionally sophisticated command control and communications facilities had a great deal to do with DoD's decision to headquarter USTRANSCOM at Scott AFB right alongside MAC.

The new command will be the keystone of DoD's worldwide military command and control system (WWMCCS) in keeping track of every last transportation asset to be deployed or already on the move and in deciding how each should be used in relation to the others.

None of this will happen overnight. USTRANSCOM is not scheduled to become fully operational until a year from now—on October 1, 1988. Meanwhile, JDA personnel from MacDill AFB, Fla., will be brought aboard, operating directives and memoranda of agreement will be worked out with other unified and specified commands, the ADP master plan will come to pass, and planning, programming, and budgeting will pick up momentum.

Taking Stock

From July through September of next year, General Cassidy will take stock of progress and problems and will recommend to the JCS any changes of course that he concludes will be necessary.

At this writing, it is not certain whether the command of USTRANSCOM will be rotated—or how often—among Air Force, Navy, and Army four-stars. For openers, many of MAC's Deputy Chiefs of Staff will do double duty with USTRANSCOM.

Once it gets into the swing of things, General Cassidy's new unified command will have a great deal more going for it than it would have had at the beginning of this decade. The 1980s have brought striking improvements of the command's airlift and sealift elements—the essence of US strategic mobility.

Far distant from places where it may have to fight in the name of national security or to fulfill treaty obligations, the US is at the mercy of its strategic mobility. Lacking such mobility, US military strategy would be worth little more than the paper on which it is written. US forces—those already deployed where the fighting may start and those destined for such deployment as spearhead units or as reinforcements—would soon be toothless and in big trouble.

Strategic airlift would be crucial right off the bat. Its job is to take troops, weapons, and supplies from the US to hot-spot theaters during the early days of a crisis or a war. Then would come sealift, carrying the great bulk of the equipment needed to sustain combat beyond the first days and weeks of the fighting.

Having satisfied the surge requirements, airlift and sealift would continue pumping troops and equipment into combat zones.

Airlift means everything in terms of the US's ability to keep an overseas crisis from culminating in combat and to win the fight if it starts. Classic examples are the Berlin Airlift of 1948–49 on the one hand and, on the other, the US airlift of supplies to Israel during the Israeli-Arab war of 1973.

The first US airlifter carrying combat equipment for Israeli forces landed in Israel within forty-eight hours of the US decision to get involved. The first US sealift ship arrived there nearly two weeks later.

US sealift is a lot faster these days and is counted on to carry ninety percent of all cargo and ninety-nine percent of all petroleum products that US forces would need in fighting abroad.

The Advantages of Airlift

No matter how fast it becomes, sealift will never come anywhere near matching the speed of airlift, however. Airlift also has the advantages of versatility and flexibility. It can deliver forces and their means of firepower to inland airstrips, which vastly outnumber seaports around the world.

Delivering troops and gear to such airstrips near battlefronts is now the job of MAC's C-130 intratheater transports. But the Air Force would like to be able to handle that job with much larger and faster intertheater airlifters as well and has developed the McDonnell Douglas C-17, just now entering initial production, for exactly that purpose.

The C-17 is designed to do double duty as a strategic and tactical airlifter—capable of ferrying troops and equipment from the US to austere airstrips not far from fighting fronts anywhere in the world.

The C-17 is the centerpiece of the Airlift Master Plan that USAF devised five years ago to close the gap—more like a chasm—between US strategic airlift capabilities and requirements. The sobering size of that gap became apparent in a 1981 Defense Department study, mandated by Congress, of the situation in strategic mobility.

The study concluded that MAC needed to be capable of transport-ing cargo at the rate of 66,000,000 ton-miles per day (MTM/D) over intercontinental distances but was capable of fulfilling less than half of that requirement.

The Air Force was already on the move, ordering C-5B airlifters and KC-10 tankers convertible to cargo-carrying, stretching C-141s, and enhancing its Civil Reserve Airlift Fleet (CRAF). By the end of 1989, when all fifty C-5Bs will have been delivered, MAC's strategic airlift capability will stand at nearly forty-nine MTM/D in contrast to the twenty-nine MTM/D of only five years ago.

The 210 C-17s that USAF plans to buy for MAC over the next ten years will be "the key to our long-term program to reduce strategic and theater airlift shortfalls, especially in the area of intratheater delivery of outsize Army equipment," the Air Force says.

The C-17 is seen by USAF as "the final increment" of its plan to meet the ton-miles-per-day goal of the 1981 strategic mobility study. The C-17's costs will be high in acquisition but compensatorily low in operation.

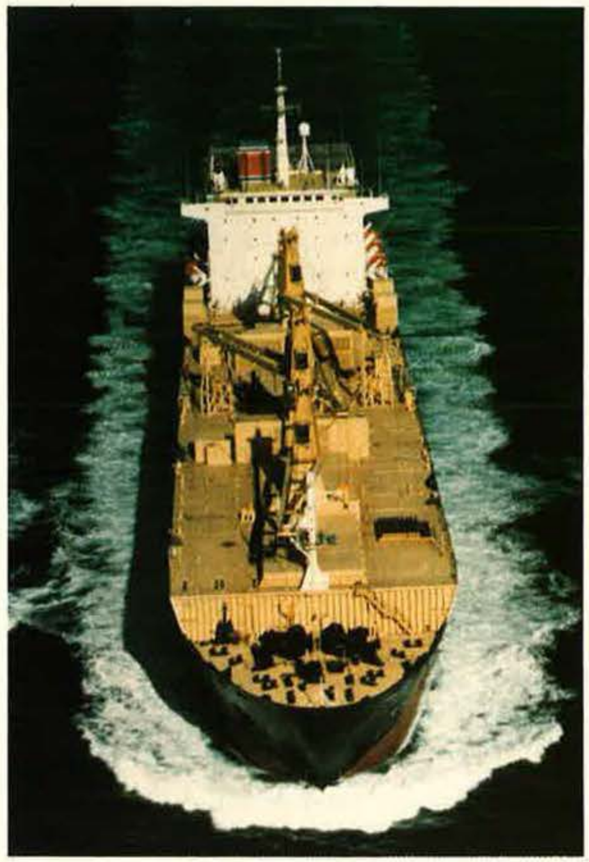
Boosting the C-17

Early this year, the US General Accounting Office, the flinty-eyed auditing agency of Congress, gave the C-17 program a big boost. It concluded that "the cost-effectiveness of the C-17 has been sufficiently demonstrated" by the Air Force and that "over a thirty-year period, the C-17's lower operating and support costs should more than offset its higher acquisition costs."

GAO also noted that US theater commanders regard the C-17 as crucial to their future warfighting prowess.

With only its fleet of C-130s now available to move troops and gear from main operating bases to forward airfields in Europe, MAC can transport about 9,000 tons of intratheater cargo per day—only half of what it would probably be called on to move should war break out.

Moreover, says General Cassidy: "The more we deliver to main operating bases, the greater the intratheater-movement requirement becomes. This complicates the demands on the C-130s. Theater commanders tell me that the additional



The Dewayne T. Williams is one of thirteen ships that make up Military Sealift Command's Maritime Prepositioning Force. Stationed in the Atlantic, Pacific, and Indian Oceans, these ships are laden with fuel, food, water, ammunition, and wheeled and tracked vehicles for Marine Corps amphibious forces. MSC began building up its seaborne prepositioning force in the early 1980s in response to ominous events in Southwest Asia.

time needed to move forward could make the difference between a quick victory and a protracted struggle.

"Surface movement takes too long, and airlift may not be available due to other demands on the C-130 fleet. Additionally, if heavy forces must be airlifted today, half of their combat firepower has to be left behind because the C-130 lacks outsize [cargo] capability."

In this regard, MAC and the Army have come a long way in resolving mismatches of equipment and aircraft. The Army has set up an office at Fort Leavenworth, Kan., to make sure that the equipment it is now developing will fit into MAC's transports. At MAC headquarters, the joint Army-Air Force Airlift Concepts and Requirements Agency (ACRA) has been established "to ensure that the services are speaking the same language in joint airlift concepts, doctrine, and training procedures," General Cassidy notes.

The bottom line, he declares, is that "the C-17 will provide intercontinental and theater delivery of the full range of Army and Marine Corps equipment, including outsize cargo."

As the CINC of USTRANSCOM, General Cassidy will undoubtedly continue to concentrate on furthering the C-17 program. But he will now have to weigh its importance in the context of USTRANSCOM priorities—not just MAC priorities—that enfold the elements of sea and land transportation as well.

Even so, says one Air Force official, "You can bet that the C-17 will remain at the top, or very near the top, of TRANSCOM priorities." The reason given for this is that "as MAC goes, so goes TRANSCOM."

MAC practically fills the sky. Every day, from 150 to 250 of its aircraft traverse global flyways. Its intertheater airlift fleet now boasts 314 aircraft—234 C-141s, sixty-six C-5As, and fourteen C-5Bs. It also has access to fifty-seven KC-10 tanker/cargo aircraft and can call on 227 passenger aircraft and seventy-eight cargo aircraft in its civil fleet, through the courtesy of the CRAF program.

Sealift Surges

But Military Sealift Command is no slouch, either. Its capability has been improving right along. MSC's fleets can now carry eighty-five percent of the one million tons of unit equipment per voyage that the strategic mobility study established as its long-term goal.

MSC's cargo capacity and quickness of delivery have been greatly enhanced in the past few years through its acquisition of eight roll-on, roll-off vessels that form its Fast Sealift Squadron. These 946-foot container ships can make way at more than thirty knots, can reach Europe from the US in five days, and can get to the Persian Gulf via the Suez Canal in two weeks.

All told, MSC can call on 108 cargo ships and thirty-three tankers for strategic sealift. It also has access to about 125 rather aged, but still seaworthy, ships in its National Defense Reserve Fleet, and can draw about 200 cargo ships and 120 tankers from the civil maritime fleet.

MSC has created a permanent Maritime Prepositioning Force of thirteen ships loaded with enough equipment and supplies to support three Marine brigades—about 50,000 men—for a full month. Five of these ships are at Diego Garcia in the Indian Ocean, four are deployed in the eastern Atlantic Ocean, and four are at sea in the vicinity of Guam and Tinian in the western Pacific Ocean.

The prepositioning technique first caught on in the 1970s when the Army began stockpiling equipment in Europe for US-based divisions that would be airlifted there in the event of crisis or war. Plans for such prepositioning were subsequently expanded to include equipment for Air Force and Marine Corps units as well.

The US now has 472 tons of equipment prepositioned in Europe and is well along toward its goal of enough such equipment to supply six Army divisions in full, support ten Army divisions altogether, supply an entire Marine Amphibious Brigade (MAB) in Norway, and provide the means for USAF to build up to sixty-squadron fighting strength in relatively short order.

MSC began establishing its seaborne prepositioning force in the early 1980s after ominous events in Southwest Asia had made it obvious that the US might have to go into combat there.

MSC maintains 7,000 tons of Army equipment aboard sealifters in the event of a US deployment to Southwest Asia.

A commercial airliner in USAF's Civil Reserve Air Fleet (CRAF) is readied for extra duty as a MAC troop carrier during wartime or prewar contingencies. CRAF enhancements in recent years have made MAC much more capable of carrying enough troops and cargo to meet such contingencies anywhere in the world as part of USTRANSCOM.

The scheduling of sealift ships to carry certain loads to specific ports is handled by four MSC area commands. These make their assignments on the basis of information provided by the Military Traffic Management Command (MTMC), now also a part of USTRANSCOM.

A major Army command, MTMC is subdivided into four subordinate commands staffed by personnel of all four military services. Its three main jobs are managing ground transportation, operating ocean terminals everywhere that the US military operates, and providing transportation engineering services throughout the Defense Department.

MTMC also develops plans for mobilization, wartime operations, major readiness exercises, and domestic emergencies. It is responsible for routing all military cargo going into and coming out of the US, for booking military cargo with commercial carriers, and for designating how all Army international cargo will be carried.

Unlike MAC and MSC, MTMC owns no aircraft or ships. But it is the traffic-management link between them.

In peacetime, MTMC will continue doing all these things, just as MAC and MSC will keep on operating autonomously in their particular spheres. But if war looms or begins, USTRANSCOM will take control of everything.

TRANSCOM's Genesis

Steps to improve the management and coordination of US military transportation had been recommended and debated since World War II. A dozen times or more, various Presidential, congressional, and Pentagon panels proposed remedial measures, most of them aimed at greater centralization of transportation command and control. On each occasion, however, one or more of the military services registered such stern objections that nothing happened.

In 1981, for example, the Joint Chiefs of Staff came out in favor of consolidating MSC and MTMC under one command. The Air Force, following much internal discussion and debate, favored this. But the Navy and the Army fought against it on Capitol Hill and within the Office of the Secretary of Defense—and prevailed.

The 1981 JCS recommendation marked a sharp departure from the stance the JCS, made up of different service chiefs and under a different chairman, had taken four years earlier—in 1977—that the military transportation system was good enough and needed no tinkering.

That conclusion was shattered one year later by Nifty Nugget, the first full-scale mobilization and deployment exercise that the US had conducted in a long time. It was a JCS command-post exercise; no troops or equipment actually moved. It involved twenty-four military commands and thirty civilian agencies in the computerized reinforcement of US forces in Europe.

Nifty Nugget was a disaster of such dimensions that it had to be abandoned in disarray only one-third of the way through the three weeks that it was scheduled to be in effect. It exposed severe shortfalls of US airlift and sealift capacities, catastrophic breakdowns in the dissemination of data and communications among MAC, MSC, and MTMC, and a paralyzing lack of coordination in executing mobilization and logistics plans.

In the main, the grim message of Nifty Nugget was that US deployment requirements and capabilities were grossly mismatched and that US forces in Europe would have gone begging for reinforcements of men and materiel—and would have wound up the losers—in a war with the Warsaw Pact.

At the root of all this was the lack of a central mechanism for implementing the well-laid plans that went wayward, resulting in ships and airlifters idling in ports and at airfields for cargo and troops that never got there and in troops and cargo biding time at airfields and ports for want of ships and planes.

"Nifty Nugget may stand as the one event that eventually created USTRANSCOM," says the new command's Colonel Hinton. "It definitely created the Joint Deployment Agency."

Established at MacDill AFB, Fla., in 1979 along with the US Readiness Command, the JDA was regarded at the time as the most important legacy of Nifty Nugget. In the short term, this turned out to be an exaggeration. At least as important was the attention that Nifty Nugget directed in US political circles to correcting airlift and sealift shortfalls, with salutary results that are already abundantly evident.

Air Force officials tip their hats to Nifty Nugget for having shocked political leaders into an awareness of the equipment shortcomings of air mobility and airlift that USAF had known about and had tried to tell them about for some time. This gave the Air Force political leverage in perpetuating and justifying a wide range of corrective programs—C-141 stretch, C-5A wing modification, C-5B development and production, KC-135 reengining, KC-10 production, and C-17 development and production.

Falling Short

Meanwhile, JDA turned out to have been a nice try that fell short.

Its job was to integrate the resources and plans of MAC, MSC, and MTMC into a single transportation management entity called the Joint Deployment System, which would match MTMC's movements of military units and materiel to embarkation air bases and seaports with MAC's and MSC's schedules for departures and arrivals of airlifters and sealifters.

JDA made the matches all right, but it couldn't make them stick. Its insurmountable problem—as a JCS agency with authority to coordinate, but not to command—was its lack of clout with MAC, MSC, and MTMC, which are commanded by general and flag officers of higher rank than that of JDA's two-star general in command.

In the Grenada rescue operation of October 1983, the JDA was not even brought into play by the Pentagon. Its sidelining exposed its nonvarsity status on a logistics team that cried out for a strong quarterback to call the signals.

Two years ago, the landmark Senate Armed Services Committee report on "Defense Organization: The Need for Change" took note of the success of the Grenada operation in rescuing American medical students and in dispatching Cuban personnel from the island. However, the report was harshly critical of the logistics and communications of the US combined-arms force that took part in it.

In discussing the operation's "serious logistics problems," the report described JDA's exclusion as "distressing" in view of its creation as the means of preventing or solving just such problems. The report also found it odd that JDA "was not included because it did not have adequate communications gear to process highly classified material."

Said the report: "It is clear that whatever the JDA had been doing for those four years [since its inception], it had not solved the fundamental problem of the inability of the services to work together jointly."

The Senate report, which criticized US joint operations in general and on many other counts, laid the groundwork for the Nunn-Goldwater-Nichols DoD Reorganization Act of 1986.

That law, in turn, had a great deal to do with the formation of USTRANSCOM. It paved the way by repealing a 1983 congressional mandate against consolidating MSC and MTMC, the move that had been recommended by the JCS in 1981.

John F. Lehman, Jr., the Secretary of the Navy at the time, fought hard against such consolidation. He argued that it would erode the Navy's authority over its own operations. Congress went along.

Five years later, Mr. Lehman returned to the fray in opposition to USTRANSCOM. "To take the Military Sealift Command and put it out in Illinois under an Air Force commander has to be taking the process of reorganization for its own sake to an absurd extreme," he asserted on Capitol Hill.

The Marine Corps stood with him in this. Its leaders worried that USTRANSCOM might someday decide to take the sealift ships that have long been dedicated to Marine amphibious operations and use them in joint deployments instead.

Air Force Concerns

The Air Force and the Army were less vocal in their misgivings about USTRANSCOM, but had several nonetheless. Each was concerned that the proposed command would usurp single-service planning and

A MAC C-5B disgorges cargo from its huge maw. By the end of 1989, MAC will have taken delivery of the last of the fifty C-5Bs it ordered. Now in production are the new C-17s for both intertheater and intratheater airlift. USAF plans to buy 210 C-17s over the next ten years.

execution and that it would be less responsive—as a result of the collegiality of its unified command structure—to particular Army and Air Force requirements.

Air Force Chief of Staff Gen. Larry D. Welch reportedly raised many tough questions in the JCS "tank" about the impact that the new command would have on MAC itself, notwithstanding the fact that it would be based at Scott AFB and would rely on MAC as its most responsive element.

General Welch made the point that MAC, operating as an autonomous specified command and free to use its assets as best it saw fit, had always done a good job and had demonstrated its quick, effective reaction to crises and to wars time and time again. He questioned the wisdom of risking the smoothness of the well-oiled MAC machine by enfolding it in a unified command, even in one to be commanded by CINCMAC.

There was also concern in the Air Force, including MAC, about creating a unified command in contradiction of the traditional doctrine that each military service is responsible for its own logistics. Some Air Force officials claimed that the Joint Deployment System as presently constituted should be given more time to prove itself and that better management and fine-tuning of that system—not the creation of a unified command—was the way to go.

General Welch, the other service chiefs, and "even John Lehman," says a Pentagon official, came around, however, after having been convinced that USTRANSCOM's time had come—for the good of the military community and the nation at large.

A major reason for their turnaround was its strong backing in the end by Adm. William Crowe, Chairman of the Joint Chiefs of Staff, who had been a little leery of it in the beginning. Another was the recommendation by the President's Commission on Defense Management—the Packard Commission—early in 1986 that the Secretary of Defense establish "a single, unified command to integrate global air, land, and sea transportation."

President Reagan issued a National Security Decision Directive to that effect shortly thereafter, and the die was cast.

The JCS already had the jump, however. Admiral Crowe had formed a team under Air Force Lt. Gen. Alfred G. Hansen, the Joint Staff's boss of logistics, who last August 1 became the four-star commander of Air Force Logistics Command, to study the unified-command idea and come up with a plan to implement it.

As General Hansen's team put the USTRANSCOM concept together, Admiral Crowe became persuaded that the unified command was needed and was influential in bringing the service chiefs to the same view.

All the players came under another influence too—that of Port Call, a worldwide JCS command-post mobilization and deployment exercise of late 1985 that came out somewhat better than Nifty Nugget had, but by no means as well as it should have.

As part of its study, General Hansen's Joint Staff team put Port Call under a microscope and was disappointed in what it perceived. The exercise had shown once again that the US military transportation system could not handle multiple, simultaneous deployments of troops and equipment. Mismatches of carriers and cargoes had been rife. Responses to contingencies had been laggard, to say the least.

In Port Call, the JDA played its assigned role as coordinator of logistics and transportation and demonstrated that it was not—through no special fault of its own—capable of coming through.

"It became evident in Port Call that the JDA simply lacked authority," recalls one official who had been involved. "It also became evident that the military transportation data base was not up to the job of deploying forces on a large scale."

Those two deficiencies went hand in hand. One of the main tasks assigned to the JDA in the very beginning was to make sure that the computers of MAC, MSC, and MTMC stored and could disseminate all the data about units, equipment, ports, airfields, routes, and the like that they would need in order to talk the same language in their communications with one another and with the JDA. This did not happen.

USTRANSCOM is charged with seeing that it does happen, and the command's four-star CINC has the rank and the reputation needed to pull it off. ■

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SHORTS

B-52 aircrews from Loring roam the Atlantic, armed with sea-skimming Harpoon missiles.

SAC's Sea Patrol

BY JEFFREY P. RHODES, AERONAUTICS EDITOR
Photography by Guy Aceto, Art Director

"OUR job is to keep the bad guys out of the Atlantic," said Maj. James A. Myers, chief of the 42d Bomb Wing's offensive systems branch. "The assumption is made that you are not going to use Harpoons against an oil tanker, but you are going to use them to take out surface combatants."

It may sound odd that an Air Force officer is talking about operations at sea, but the conventional maritime tasking of the wing at Loring AFB, Me., is a significant mission for Strategic Air Command and one of its most exciting. Part of the job is aerial minelaying and sea surveillance, but SAC's heavy maritime tasking is for B-52G bombers to attack surface ships with AGM-84A Harpoon antiship missiles. The 42d Bomb Wing and the 43d Bomb Wing at Andersen AFB, Guam, are the only Harpoon units in the Air Force.

The effectiveness of antiship missiles was seen in the sinking of the HMS *Sheffield* during the Falkland War and in the attack on the USS *Stark* in the Persian Gulf earlier this year. A small number of these sea-skimming, high-speed missiles can wreak a great deal of havoc, and in the world of antiship missiles, the Harpoon stands out.

First fielded by the Navy in 1977, the Harpoon is the US fleet's basic antiship missile. It can be launched from submarines and surface ships as well as by a variety of aerial platforms. McDonnell Douglas Astronautics Co. builds the missiles in its plant in St. Louis, Mo., and has delivered well over 4,000 of them to the Navy, Air Force, and the services of nineteen allied countries. Even Iran received some before the fall of the Shah.

The B-52, with its unrefueled range of more than 7,500 miles, and the Harpoon, with its own range of greater than sixty-seven miles, make an excellent combination for hunting surface vessels. "At first it was like a novelty," said Col. Gary L. Ryser, the 42d Bomb Wing's Director of Operations. "But we have delineated, and then have grown with, the mission."

New Materials, Old Mission

"The Air Force has always had the collateral mission of supporting sea lines of communication," noted Major Myers. "There was no real way of doing it, though, until the Harpoon came along. Before too long, people began to realize the Harpoons are very good weapons. They also recognized that the B-52 has long legs and proper air refueling support and that you can load a lot of missiles [up to twelve] on them. That changed some attitudes."

The Air Force began thinking in a

With a training Harpoon missile mounted on one pylon, this B-52G from Loring AFB, Me., is approaching the business end of one of the 42d Bomb Wing's KC-135 tankers. The combination of the B-52 and the Harpoon gives SAC's maritime mission a potent sting. These pictures are unusual in that most training missions are conducted without the drag-inducing pylons and missiles.

nautical way in September 1982, when Air Force Chief of Staff Gen. Charles A. Gabriel and Chief of Naval Operations Adm. James D. Watkins signed a memorandum of agreement entitled "Joint USN/USAF Efforts to Enhance USAF Contribution to Maritime Operations." This agreement covered aerial minelaying, antisurface warfare (ASUW), and surveillance and targeting as well as providing for joint training.

By March 1983, the first B-52G had been modified to launch Harpoons, and three test launches were conducted at the Navy's Pacific Missile Test Center range at Point Mugu, Calif. Two of the launches were from high altitude (up to 30,000 feet above ground level) while the other was from low altitude (700 feet AGL) and was directed by an E-3A AWACS (airborne warning and control system) aircraft.

Six months later, Loring achieved limited operational capability (LOC) with three modified B-52s and seven crews that had undergone ground training. Initial operational capability (IOC) at Loring (fifteen aircraft) came at the end of 1984. By June 1985, both Loring and Andersen were fully Harpoon-capable.

"It was very simple to integrate the Harpoon," noted Major Myers. "The Navy wanted a minimum of stuff put in their airplanes, and when it came to the B-52, there was just a minimum number of changes to make. The Navy helped us with answers to a lot of the technical questions."

The modifications were divided into two groups. Group A modifications involved running the wiring bundles from the "black boxes" out to the wing pylons. This modification was performed by the Oklahoma City Air Logistics Center at Tinker AFB. The relay assemblies in the pylons are interconnected with the wiring for the AGM-69 Short-Range Attack Missiles (SRAMs). As a consequence, the Harpoon-firing B-52s can no longer launch SRAMs from the wing, although internal SRAM capability is retained.

Group B modifications included the installation of a data-processing computer, a decoder/encoder, and a junction box in the aircraft and relay assembly units in the heavy stores adapter beams on the underwing pylons. The equipment was designed and built by McDonnell Douglas and was installed and integrated by Lear Siegler, Inc.

The B-52Gs at Mather AFB, Calif., and at Barksdale AFB, La., also have the Group A modifications so the planes can be periodically rotated among the four bases. This prevents the B-52s from constantly being exposed to the weather extremes of long, cold winters at Loring and the heat and humidity at Andersen.

The actual weapons-release units (what holds the Harpoon to the beam) also had to be modified with the addition of a metal "beaver tail." This minor addition is needed to ensure that the initiator cable pulls out from the missile when the Harpoon is launched.

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Before operations with the new missiles could begin, though, there were many details to work out, including training for load and munition maintenance crews, a site-planning survey, and a plan for flight-training the crews.

"All we had when we started was the tech data for the missile and the wiring guidebook," said MSgt. Raul Luna, a line supervisor for the 42d Munitions Maintenance Squadron. "By working with the missiles and the contractor, we can now troubleshoot, fix, and maintain the systems pretty easily. It's a lot easier for us now."

All of the systems on the aircraft involved with launching the missiles are now completely checked out every 180 days, while the missiles themselves are subjected to a BIT (built-in test) check after an upload and download. They are also taken out for a periodic table inspection, which is a more detailed examination. Every three years, the Harpoons go back to McDonnell Douglas for overhaul.

Loading the 1,145-pound missiles is an intricate operation. It takes a five-man crew (there is one woman in the seven load crews on base), two mechanical loaders (an RT forklift and a "jammer"), and about twenty minutes to get one missile out of its casket and onto the B-52. The Harpoons are packed two to a casket, and because of its relatively soft skin, the missile is susceptible to damage during removal from its container. Standard Air Force load equipment is used, but the cast-iron load harness comes from the Navy. The AGM-84s are powered by an air-breathing J402 turbojet engine that uses JP-10 liquid fuel, so both

Loading the Harpoons onto the B-52 takes up to twenty-five minutes per missile. After being removed from its casket with a forklift, the Harpoon is transferred to the "jammer" and put on the airplane. Shown in this picture is one of the 42d Munitions Maintenance Squadron's seven load crews. This one includes A1C Jeffrey Andrews, Amn. Peggy Jo Therrien, A1C Joseph Dobel, and A1C Matthew Giacobbe.

Once the Harpoon is mounted on the heavy stores adapter beam, the missile's fins are attached, which is what load crew team chief SSgt. John Osborne is doing here. Because the missile is liquid-fueled, both the Harpoon and the load equipment must be electrically grounded during loading.

the missile and the loaders have to be grounded to prevent static discharge and inadvertent firing.

Capt. John Melendez, the wing's weapons safety officer, drew up the site-planning survey. He had to make sure the missiles could be handled safely. "The Harpoon is a forward-firing munition, so we had to find a place to load the missiles so they would be pointed away from buildings and populations. Because of the quantity distance needed [the amount of space that must be kept between two aircraft so that a missile exploding prematurely will not damage or destroy both planes], there are only eight spots the bombers can be parked to be loaded."

Since SAC was in the early stages of its maritime mission, the units in Maine and on Guam started from scratch in establishing their training needs.

"The training requirements were determined by many people examining the problems," noted Colonel Ryser. "It was a process of the people in the field [along with the SAC staff] deciding what would work—configuration of the cell [bomber formation], how to safely ingress and egress an area and get the weapons delivered, things like that. Training is still evolving, though, just as a result of what we've seen and what we need to do to accomplish the mission."

As part of their training, the crews of the 69th Bomb Squadron make simulated Harpoon runs on a radar shack located on an island cryptically named J-54. "We make our runs on the guy in the radar house rather than on a ship," said Capt. Dan Gnagey, one of the aircraft commanders from the 69th Bomb Squadron. "We've developed a procedure to score our simulated releases, and it has really helped us in the initial training of crews. They are able to find out exactly what they are doing [on their runs]."

In addition to the Harpoon training requirements, the crews must also complete the training events specified in SAC Regulation 51-52, which is the command's training manual. These include pulling alert duty (the 42d Wing's primary tasking is still to the nuclear mission) and low-level flights to hone their skills for conventional weapons release. Aerial mines are dropped just like conventional bombs, except into the sea.

Ironically, one thing that had not been a training event until recently was navigating from a star or a sun shot taken with the B-52's sextant. "If worse comes to worst, I run the sextant," said 1st Lt. Paul Roberts, the electronic warfare officer (EWO) on Captain Gnagey's crew. "The INS [inertial navigation system] is so reliable [and there are two independent INS systems on the B-52], I don't even use the sextant. I think I used it once while going through training at Castle." Castle AFB, Calif., is the training center for B-52 aircrews. SAC is now in the process of working celestial navigation back into the training regimen, however.

"We take every chance we get to do some training with the Navy, the Air Force, and even the British," noted Colonel Ryser. Loring B-52 crews get about thirty hours of training time per month, and as many training events as possible are packed into each flight. "We had a long 'drive' down to Florida for some simulated Harpoon firings on the USS *Coral Sea,* so we practiced high-level bombing on the way down there," added Captain Gnagey. A typical Harpoon training flight lasts about eight hours or longer.

One area of training that could be considered somewhat lacking at Loring is simulation. Both the KC-135 and B-52 simulators are old, and many of their added features like seat bounce and engine noise have become too expensive to

Before the Harpoon-armed B-52s go hunting for an enemy surface action group, they stop at the local KC-135 for a fill-up. Much of the responsibility for getting the bombers and tankers together falls on the shoulders of the tanker's navigator, who in this case is 1st Lt. Franklin C. Huhn.

Maj. John Rogacki (right) and Lt. Craig Thomas go over their preflight checklist before a Harpoon training sortie.

fix. The much-modified aircraft are far ahead of the simulators, so the simulators are now used only for cockpit-procedures training.

"The simulators are a problem, but they are not a major problem," Col. Thomas C. O'Malley, the 42d Bomb Wing's commander, said. "We are programmed to get a new KC-135 simulator in two years, but in the interval, we keep the -135 simulator running. It can still do what we need it to do." The new simulator will have computer-generated images and will be run under contract maintenance.

There are no plans for a new B-52 simulator, but the bomber crews regularly go to Griffiss AFB, N. Y., to spend time on the weapon system trainer (WST) there. "The six B-52 crew members can work problems and tactics together in the WST," said Colonel O'Malley. "That is something we had never been able to do before."

Loring's bomb squadron will be getting some Harpoon cockpit panel models by the time winter really sets in (which, at Loring, is in November). "They won't be very elaborate, but they'll be something the crews can touch and feel," noted Colonel Ryser.

Concept of Operation

One possible—but unlikely—scenario for a ship-hunting mission envisions a single B-52 with a full complement of Harpoons taking off to go look for targets. More probable would be a cell of BUFFs (as B-52s are called) going after a specific surface action group (SAG) under the control of either a Navy E-2C Hawkeye shipboard AWACS aircraft, a P-3 Orion, or a British Nimrod patrol bomber, or a USAF or NATO E-3A Sentry.

Communications were a major hurdle to overcome, especially at first. "There was a period of uncertainty when we had to get it across to the Navy that we all needed to be on the same frequency," said Colonel Ryser. "There was a language barrier, but I think we've pretty much worked it out."

"A lot of it was finding out what the others could do," added Captain Gnagey, whose crew is among the finalists to conduct the next live Harpoon launch. "It was a real education for both of us."

The arrangement seems to be working quite well. When Captain Gnagey's crew was "shooting" at the *Coral Sea,* that particular mission was mainly for the benefit of the E-2C crew, which had never had a Harpoon tasking before. The B-52 crew got valuable training experience, too.

One thing that helped the Navy and the Air Force overcome the language barrier is what the crews call "the tactic," or launch profile, which has some shared characteristics in all of the different launching aircraft.

In the case of the B-52, after a briefing on the surface action group, or SAG, the crew is gunning for, a typical mission begins at high altitude where the eight J57 engines are more fuel-efficient. The plane descends to low level to prepare for the target run.

"The target information is passed on to us, and I put the information into the system," said Capt. Jim Quinlan, the radar navigator for Captain Gnagey's crew. "This allows us to tell the missile where the target is and to program the aircraft for launch."

Most Harpoon training sorties take eight hours or longer, so a thorough preflight inspection of the aircraft is a must. The procedure also gives the crew a last chance to stretch their legs before the mission.

The missile is on its way with the punch of a button. The twelve-foot, seven-and-a-half-inch-long Harpoon, its seeker able to course forty-five degrees to either side of the boresight, skims along at low level and high speed (Mach 0.85) to the target. The missile can make midcourse corrections, because its fins have thirty degrees of plus or minus movement.

Once near the target, the missile generally pops up to get a steeper trajectory on impact and homes in on the ship's superstructure. The 488.5-pound blast-charge warhead is designed to remain intact until it penetrates the ship's hull, thus generating secondary explosions.

"The Harpoon is not designed or built to sink the ship, nor do we care if it does," stated Major Myers. "To sink a ship is a waste of assets you could better use someplace else. If you take out the ship's electronics, the ship is a sitting duck and, at worst, a navigational menace. The Navy can then come in and sink the ship by using a fighter-bomber or a torpedo."

After launching the Harpoon, the B-52 executes a combat break and a getaway. This, along with the launching range of the missile, makes counterattack by the target ship's defenders improbable.

Once at the point of safety, the B-52 regains altitude, otherwise it would never have enough fuel to complete the mission. Even with their long legs, tanker support of the Harpooners is critical.

Launching live rounds is a rare experience for the crews. In fact, they don't even normally carry training missiles (ATM-84s, or Harpoons without warheads) on practice sorties. The pylons the missiles are hung on create so much drag that the B-52's fuel efficiency is degraded by a significant amount, and it is just too costly to run with them on.

Thus, when a crew does get to fire a missile, it is a Big Deal. In late May, a Loring B-52 deployed to RAF Fairford, England, as part of the "Giant Squid" exercise, which is follow-on testing for the Harpoon. Two days before the test, the crew made a dry run on the target ship, the decommissioned HMS *Nubian*, and the systems worked well. On May 27, the day of the launch, the missile checked out perfectly during preflight and in-flight inspections. The crew made a live practice run to check system accuracy and then turned back for the start of the run-in.

"We got information from the RAF controller, put it into the system, and it was pretty automatic after that," said Capt. Bryant Scarborough, the navigator and trigger man on this exercise. "The controller cleared us, and I pushed the but-

The Moose Is Loose

The 42d Bomb Wing has a unique mission, and along with the mission is the unique experience of being stationed at Loring AFB, Me.

"The decision to reduce Loring to a forward operating location was made in 1976," said Col. Thomas C. O'Malley, Commander of the 42d Bomb Wing. "But by 1979, that decision was reversed for a variety of reasons, but mainly because of the base's geographic location."

Indeed, the base is situated strategically in the middle of Aroostook County in the northern tip of Maine. It is 300 miles nearer Europe and the Soviet Union than any other base in the US is. Sixty percent of the taskings for Loring's two KC-135 tanker squadrons comes from higher headquarters, mainly to refuel folks heading over the ocean.

While the location is strategic for operations, the base *is* pretty isolated. The locals call the area "occupied Canada." "The Moose Is Loose" is the base slogan, and a moose's head with a bomb in its mouth adorns the vertical stabilizers of the Loring aircraft (although in a subdued version on the European II camouflage scheme of the bombers).

Indeed, moose (real ones) are loose on the base's 9,000 acres. Loring legend has it that if one sees a moose, reassignment orders will soon be coming. The people who maintain the wing's munitions, though, report seeing Bullwinkle or one of his relatives at least once a week.

"There is a potential problem with the moose," said Maj. Michael Pendergast, the wing's flying safety officer. "We have just awarded a contract to clear the brush back around the ramps and hangars, and there are plans for a security fence around the runway to keep them off."

At Loring, the civil engineers are a mission-critical organization. The CE squadron is a three-time winner of the prestigious Bernt Balchen Award, which is given to the Air Force's best snow-removal unit. The winter (snow falls from mid-October to April, usually with a slight thaw in January) of 1986–87 dumped 100 inches of snow on the base—and that was fifty inches below average. More than 150 people are involved in snow removal.

While the snow and the isolation are real negatives, the Morale, Welfare, and Recreation (MWR) folks at the base work overtime to make up for the lack of shopping malls. If you can't find something to do at this base, you are not looking. The base has its own ski chalet, complete with bunny slope, cross-country skiing trails, and snowmobiles to rent. When the weather warms up, there is golf, archery, and paddleboats on the base's lake. The clean air and low humidity in the summer are other pluses. MWR plans weekly events, bus trips to Bangor, for example, and with a recently renovated NCO Club and movie theater, a modern bowling alley, and a gym with an indoor pool, it is no wonder the Loring MWR program was named best in SAC this year.

"We are spending a great deal of money in the 1980s to overcome the neglect of the 1970s," said Colonel O'Malley. "We are awfully proud of what has happened here." Construction or renovation is going on everywhere. Within the last two years, a new commissary, a new enlisted dormitory complex, and a new hospital have been built. A $3.5 million renovation to the alert facility (one would be hard-pressed to call it a "shack") has quadrupled the size of the building. What isn't being built new is being remodeled.

"People may not want to come here initially," said CMSgt. S. D. Tribble, the wing's senior enlisted advisor. "But once they get here, they like to stay." A number of people have been at Loring for most of their eighteen- or twenty-year careers. "We do not appear to be a choice location," added Col. Gary L. Ryser, the wing's director of operations. "There are all kinds of people, though, requesting to come up here and fly our mission. We feel that Loring is at the hub of the Air Force mission."

"Enthusiasm is high," noted Colonel O'Malley. "We have some unique things here, and people are excited about doing them."

ton and heard the engine start. Once the engine got to speed, the missile dropped, and it was off."

Instead of breaking and egressing the area, the B-52 followed the missile for a few minutes to watch what happened. The shot, the first in a day-long exercise, tore a gaping, twenty-foot hole in the side of the *Nubian* and generally performed as advertised. "So often, like on practice bombing missions, we don't know if we hit the target until we get back," said Captain Scarborough. "This time it was immediate feedback. It was great, and I was psyched up about it for days."

The British also took a turn at the *Nubian*, and at the end of the day the ship-*cum*-hulk was sunk. But "the tactic" was proven conclusively.

"The employment tactics are still evolving, but it is stabilizing somewhat," said Captain Gnagey. "We haven't used the Harpoon for real yet, so we don't know for sure if this is the right way. If somebody gets shot down, has problems, or misses the target, we would have to look at [the procedure], and we may have to change the way we are launching the missiles."

Even the weather forecasters are helping shape tactics. "We are on the lookout for where two air masses come together," said 2d Lt. Kathlene Dowdy, Loring's wing weather officer. "These masses create 'ducts' that are super refractive areas for radar, or, in turn, countermeasures. We get the pilots to fly above these ducts where radar can 'see' very little, and thus hide the planes. We are getting into this kind of thing more and more."

Long Arm of SAC

The Loring and Andersen wings are tasked not only to the National Command Authorities for the nuclear, or Single Integrated Operational Plan (SIOP), mission, but they are also responsive to the conventional operational plans of CINCLANT and CINCPAC (Commanders in Chief/Atlantic and Pacific).

"Providing theater CINCs B-52s to do their warfighting with them required a bit of a change of thinking, not only on our part but on the part of the theater CINCs themselves," noted Colonel O'Malley. "We have to convince the Navy—not the Admiral [CINCLANT] I'm sure, as General Chain [CINCSAC] has already done that, but the lieutenants, lieutenant commanders, and commanders—that we'll be there when they need us. Once we get those folks convinced, we can push harder to do more, and our capability will increase."

A B-52 fully loaded with Harpoons has more missiles than many small- to medium-size Navy ships. Its range and rapid deployment time give the B-52 a big edge in the anti-shipping business.


—RAF photo courtesy of the 42d Bombardment Wing

A visible testament to the accuracy and power of the Harpoon and the training of the Loring crews is the hulk of the HMS* Nubian. *This live-fire test was conducted last spring and also tested the coordination of the US launchers and the British controllers.

The long arm of the 42d Bomb Wing reaches to every point in the Atlantic. The first live Loring Harpoon launch took place off Puerto Rico, and there have been exercises off the coast of Spain where bombers launched out of Loring and returned.

"Ideally, we would catch the bad guys in the North Atlantic," said Major Myers. "If we bottle them up coming out of the North Sea, we only have to worry about the North Atlantic. If we don't succeed in that, we will have to go where they are. But we can do that, too. There's just more ocean to cover."

If the shooting actually started, the enemy ships would be fighting back, and the B-52s would attack in teams. A self-defense gun or missile could defeat a single Harpoon or, with good shooting, perhaps two Harpoons. But, Major Myers notes, "with two or three BUFFs firing off missiles all against the same convoy, there are going to be quite a few Harpoons screaming in. With four more coming twenty seconds later, it is certainly going to make their day very interesting."

Another reason the B-52s are ideal for the Harpoon mission is the ability to reload, a big advantage over surface ships and submarines. The B-52s can go out, conceivably cripple seven or eight ships, and come back and reload. The Navy would lose up to a couple of weeks steaming missiles out to resupply an Aegis cruiser that had shot all its Harpoons.

When the B-52/Harpoon program started, the objective was to have fifty missiles at each base. Although the exact number on hand now is classified, missiles could be airlifted to Loring from other sites that operate with the missiles, and the 42d Bomb Wing would be ready to roll again.

"The capability is proven," concluded Colonel O'Malley. "We have the weapon system, we can deliver it, and we are working with our NATO and Navy counterparts to ensure we are employing the weapons correctly. Together, we can overwhelm any surface action group." ■

By the turn of the century, fighters may operate around the clock without grounding for electronics failure—and with support requirements consisting mainly of munitions and fuel.

More Sorties—Less Support

BY BRIG. GEN. FRANK S. GOODELL, USAF

SPECIAL ASSISTANT FOR RELIABILITY AND MAINTAINABILITY TO THE MILITARY DEPUTY FOR ACQUISITION AND TO THE DEPUTY CHIEF OF STAFF FOR LOGISTICS AND ENGINEERING

THE Chinese tactician, Sun Tzu Wu, said it in 500 B.C.: "Rapidity is the essence of war. Take advantage of the enemy's unreadiness, make your way by unexpected routes, and attack unguarded spots."

Irrelevant thinking for conventional forces in today's technological era of ICBMs, supersonic fighters, and satellite surveillance? I think not. Through World War II, Korea, and Vietnam, the United States has, in the main, operated from sanctuaries, our bases free from attack and our forces supported by the full might of our industrial strength. Growth in Soviet combat capability has put these sanctuaries at risk. Recent arms-reduction proposals invoke the possibility of greater reliance on conventional forces. And in line with Sun Tzu Wu's thinking, the Soviets are adapting their experiences from World War II and are fielding Operational Maneuver Groups (OMGs) to conduct mobile warfare in the enemy's rear area. Use of the OMGs would be preceded by massive air strikes. At particular risk are the unexpected routes and unguarded spots represented by our basing support system, a crucial element in traditional aircraft sortie production.

The recent Salty Demo exercise highlighted this danger, pitting the USAF Air Order of Battle (AOB) against a simulated Eastern European AOB. The exercise made it clear that significant turbulence at base level can be expected if hostilities begin. It also showed what happens when elements of the air base support complex—facilities, equipment, supplies, and people—are lost or degraded. Specific vulnerabilities include such intermediate-level field operations as liquid oxygen (LOX) facilities and unhardened Avionics Intermediate Shops (AISs). These assets represent the vestiges of planning to operate repeatedly from a safe haven in a conventional environment.

With this developing threat, our air assets and support equipment must be ready to generate sorties rapidly and unfettered by reliance on a vulnerable support structure. To outpunch the enemy, our systems must continuously perform sortie after sortie while reducing to a minimum the need for LOX facilities, AISs, and the like. The way to attain these goals is defined in the Air Force's R&M (Reliability and Maintainability) 2000 initiative. R&M 2000 seeks increased combat capability by acquiring or upgrading systems that perform over time and are easy to maintain. This initiative holds the potential for getting more combat capability while saving scarce people and money.

Operator Calls the Shots

With momentum flowing from the top, the Air Force has geared up for this effort. Foremost in this process are the needs of the operator. The operator, through Statements of Operational Need (SONs), locks in the prime requirement: "Design my system to perform over time and make it easy to maintain." Today, R&M requirements are stated in terms of performance.

The F-15E and Advanced Tactical Fighter (ATF) reflect this new emphasis. A dual-role fighter, the F-15E embodies several significant changes from its predecessor, the F-15C/D. The F-15E will retain its air-superiority features while adding extensive ground-attack capabilities. Achieving the F-15E's full combat capability, as measured by increased sortie rates, requires systems to perform longer, be easier to fix, and have reduced airlift support. As we shall see, a logical, structured approach to technological advances will result in a system that answers the operator's needs.

This new philosophy culminates in the requirements for the Advanced Tactical Fighter. The ATF will be built

—Photo by Paul Kennedy

The Air Force's Reliability and Maintainability 2000 initiative seeks increased combat capability by acquiring or upgrading systems that perform over time and are easy to maintain. As proof that this plan is working, a number of systems no longer have to be brought in and hooked to a bulky Avionics Intermediate Shops (AIS) test set (right), but can be checked and fixed on the flight line. The Line-Replaceable Unit (LRU) that Sgt. Patrick S. Westura and Amn. Ronald E. Lewis are demonstrating in the picture on the left is used for this.

with twice the reliability and half the maintenance (two R/one-half M) of the system—the F-15C/D—it replaces. In performance terms, doubling F-15C/D reliability means the ATF must fly ten consecutive combat sorties before unscheduled maintenance. If grounded, half of the aircraft should be fixed and ready to fly in two hours, using fewer than half the maintainers demanded by present fighters. Supporting airlift for a squadron should be slashed by more than half, to only eight C-141Bs. And this reduced airlift must be sufficient for that ATF squadron to sustain wartime-sortie-rate operations for thirty days at a Third World operating base or austere operating site without additional support.

Based on Air Force Systems Command (AFSC) Project Forecast II projections, the operator of the next century might require systems that operate around the clock for thirty days without experiencing electronics failures that result in grounding of the system. Further, support for these aircraft should consist primarily of vehicles carrying only munitions and fuel.

Requirements that once were no more than a gleam in a war planner's eye now have the solid ring of possibility, if not probability. Technology has already begun to move us away from excessive dependence on vulnerable support assets.

In September 1984, the Secretary and Chief of Staff of the Air Force made R&M coequal with cost, schedule, and performance in systems acquisition. This bold stroke, coupled with such advances as VHSIC, fiber optics, and high-temperature thermoplastics, sets the stage for unshackling combat capability from support complexity. Recent source selections for the Advanced Tactical Fighter and the SRAM II acquisitions demonstrate the Air Force's resolve to implement this concept in consonance with developing technologies.

The Message to Industry

Since February 1985, Air Force R&M requirements have been stated in terms of performance over time and the notion of "if it breaks, make it easy to fix." In this regard, the customer to satisfy becomes the weapon system operator. The designer must realize that for the operator, all performance parameters are zero if a system is broken and not easily repaired due to basic design flaws.

Aerospace industry, when asked to do so, has designed systems that perform when called on for as long as needed. In fact, industry has shown it can go beyond the requirements when given the incentive. Examples range from jet engines to electronics.

For example, the analog scan converter in the B-52's forward-looking infrared system had an expected life of 250 hours. Boeing Military Airplane Co. was awarded a fixed-price contract to develop a replacement system with an expected life of 1,500 hours. Boeing identified high-failure-rate parts. It used digital technology in conjunction with proven off-the-shelf components. By proceeding through an iterative approach, which optimized cost and R&M factors, the company designed a winner. Boeing blew by the 1,500-hour requirement and provided a digital scan converter with a warranted life of 4,000 hours, at a cost of thirty-one percent less per unit, and at a savings of $47 million in ten-year support costs. Furthermore, the system was designed to be easier to maintain.

Products that work when called on for as long as needed while meeting the needs of the customer demand a fully integrated approach. We are seeing managerial realignments in industry that cut across vertical departments and integrate product planning, design, manufacturing, assembly, sales, and service into a team that guides product development throughout its life. The days of tossing the ball over the wall are numbered.

Within the Air Force, we have employed the horizontal approach in designing certain aspects of the C-17 transport aircraft. "R&M quality teams" are being used by Douglas Aircraft, with impressive results in areas ranging from hydraulics to control panel electronics. Many advances occurred simply because the horizontal structure of the team brought together individuals from different functional departments.

As we design our future weapon systems, we must also grapple head on with one of the endemic problems of our manufacturing process. In this country, with some exceptions, we have tended to design to engineering tolerances. Progressive companies design to point target values. We have tried to "inspect in" quality at the end of the production line. The more progressive company adopts a total product development view, where at each step of the manufacturing process they reduce to zero deviations from target values. As our own industry embraces this "variability reduction program," production lines of the future will maintain our carefully designed-in R&M.

Finally, incentives and warranties will ensure design for performance over time and integrity of that design in manufacturing. One strategy promotes increased performance levels during design that would then become the warranted levels during production. For example, the Air Force might include a contract incentive clause that encouraged the designer to go beyond minimum essential requirements of 2,000 hours Mean Time Between Maintenance Action (MTBMA) to, say, 3,000 hours. If the contractor accepts the incentive at Critical Design Review (CDR), then the production contract would warrant the 3,000 hours MTBMA.

The warranty program will take the view that any maintenance action counts as a failure. A "fixed-price repairs warranty" forms the cornerstone. Failure to meet warranted minimum performance levels invokes delivery of consignment spares while repairs are made. This avoids loss of combat capability in the meantime. In addition, failure to meet warranted minimum performance levels would trigger no-cost Engineering Change Proposals (ECPs), with retrofits and forward fits to ensure corrections for the entire inventory.

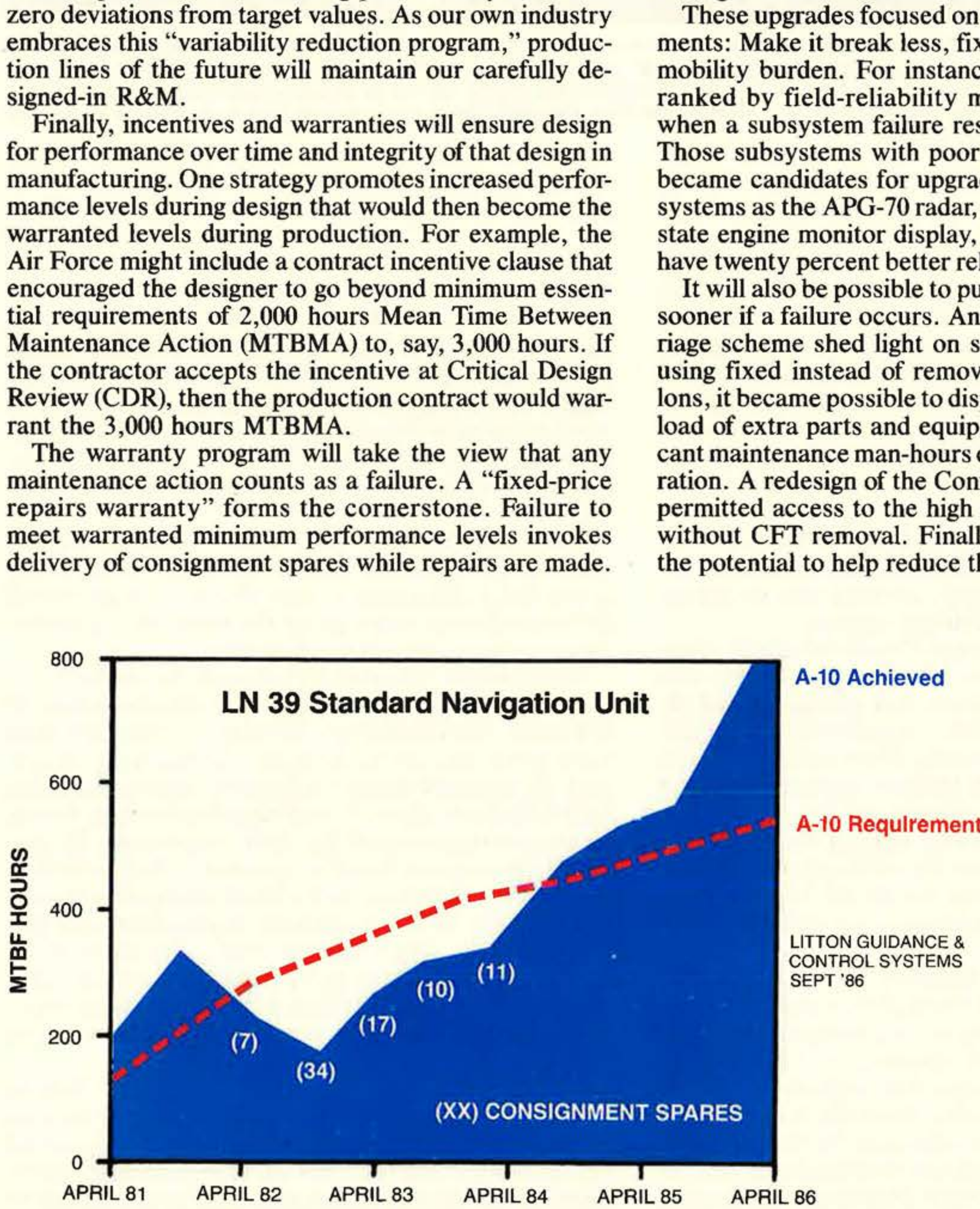
Potentially, everyone wins from these approaches. Because of the fixed price, the greater the actual system reliability, the greater the contractor's profit. The taxpayer gets more national defense for his dollar. The Air Force eliminates Sun Tzu Wu's "unexpected routes and unguarded spots." Excessive reliance on a complex and vulnerable support system will become a thing of the past. Our weapons will stand ready when called on to press the attack as long as needed.

Examples From the F-15E

F-15E upgrades and future electronics innovations illustrate both near-term and future implications of such managerial and technical innovations.

These upgrades focused on three operational requirements: Make it break less, fix it sooner, and reduce the mobility burden. For instance, F-15 subsystems were ranked by field-reliability measures, which indicate when a subsystem failure results in an aborted sortie. Those subsystems with poor field-reliability measures became candidates for upgrading. With such new subsystems as the APG-70 radar, ring-laser gyro, and solid-state engine monitor display, the F-15E is projected to have twenty percent better reliability than the F-15C/D.

It will also be possible to put the F-15E back in the air sooner if a failure occurs. Analysis of the weapons carriage scheme shed light on some real time-savers. By using fixed instead of removable weapon stations pylons, it became possible to dispense with an entire C-141 load of extra parts and equipment and to avoid significant maintenance man-hours during weapons reconfiguration. A redesign of the Conformal Fuel Tanks (CFTs) permitted access to the high maintenance components without CFT removal. Finally, Built-in Test (BIT) has the potential to help reduce the chronic sortie-stoppers



The warranty program takes the view that any maintenance action counts as a failure. Failure to meet warranted minimum performance levels invokes delivery of consignment spares while repairs are made. This avoids loss of combat capability in the meantime. As this chart shows, between April 1982 and April 1984, the LN 39 standard navigation units for the A-10 did not meet the standards of the warranty, and consignment spares had to be issued. Since April 1984, the units have met and exceeded the reliability requirement and are now up to near 800 hours' mean time between failures.

described as Could Not Duplicate/Retest OK (CND/RTOK). The payoff will be speedier and more accurate "on-aircraft" troubleshooting, with the F-15E getting back on the flying schedule faster.

Salty Demo exposed our extensive reliance on fixed combat support equipment in avionics intermediate shops. A portable Mobile Electronic Test Set (METS), based on US Marine Corps equipment, is an interim answer to this situation for new F-15E electronics. Small and two-man portable, the METS contrasts sharply with AIS stations, which must be moved by forklift. Furthermore, METS is five times more reliable, processes broken systems six times faster, and doesn't require stringent environmental controls. As a result, better support is provided by more mobile equipment.

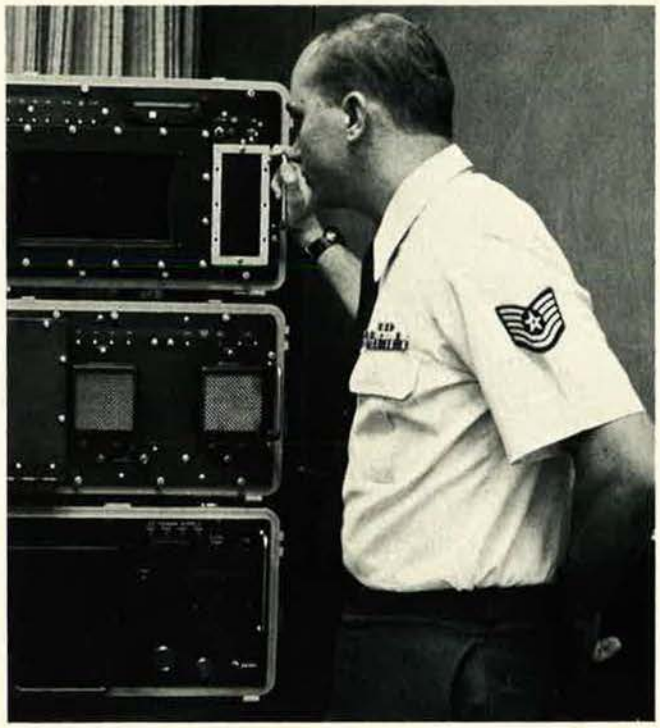
In these ways, the F-15E system gains additional flexibility by cutting its dependence on vulnerable combat support logistics. Such upgrades now and in the future will deny our adversaries those "unexpected routes and unguarded spots."

Transformation on the Ramp

A remarkable transformation is in progress as upgrade programs revitalize the combat capability and staying power of such older systems as the B-52 and F-111 and such newer ones as the F-15 and F-16. C^3I systems are being improved in similar ways. Line-replaceable units exhibiting ten to 100 hours of reliability are being replaced by electronics that achieve thousands of hours of reliability through VHSIC technology. Aircraft ring-laser gyros provide for reliability up to ten times that of a spinning mass inertial gyro. Installation of the On-Board Oxygen Generating System (OBOGS) on the F-15E eliminates dependence on vulnerable LOX-generating plants and storage tanks. It also reduces mobility and manpower requirements. Along with the glamorous enhancements, ongoing PRAM (Productivity, Reliability, Availability, and Maintainability) initiatives continuously improve the overall R&M of systems on the ramp. Simple things, such as replacing a soft seal on infrared cooling systems, can, in this case, increase reliability fivefold while saving $14 million over the system's life.

Modifications that pair today's technology with yesterday's airframes extend to a varied mix of aircraft dating back to 1963. Many of these older systems will still be with us twenty years from now. Yet some of the original design technologies—avionics, engines, and structures—are from the 1950s and 1960s. AFLC and AFSC, in coordination with the operating commands, have been steadily improving the overall readiness and sustainability of this fleet. Several examples will illustrate the story.

The first concerns the modular air data computer, which converts analog pressure and angle of attack information to digital airspeed and attitude inputs used by numerous on-board avionic systems. In early 1981, AFLC item managers determined that the air data computers on various aircraft were unreliable and becoming unsupportable. To correct this situation, the Air Logistics Center at Oklahoma City, Okla., began the search for a reliable modular air data computer for use on several types of aircraft. A competition was held, and GEC Avionics Ltd. won with a system now called the Standard Central Air Data Computer (SCADC). Reliability has been increased tenfold, leading to the spares requirements being slashed to less than one-fourth of what was needed for the old air data computer. We also project a procurement savings of $43.6 million.



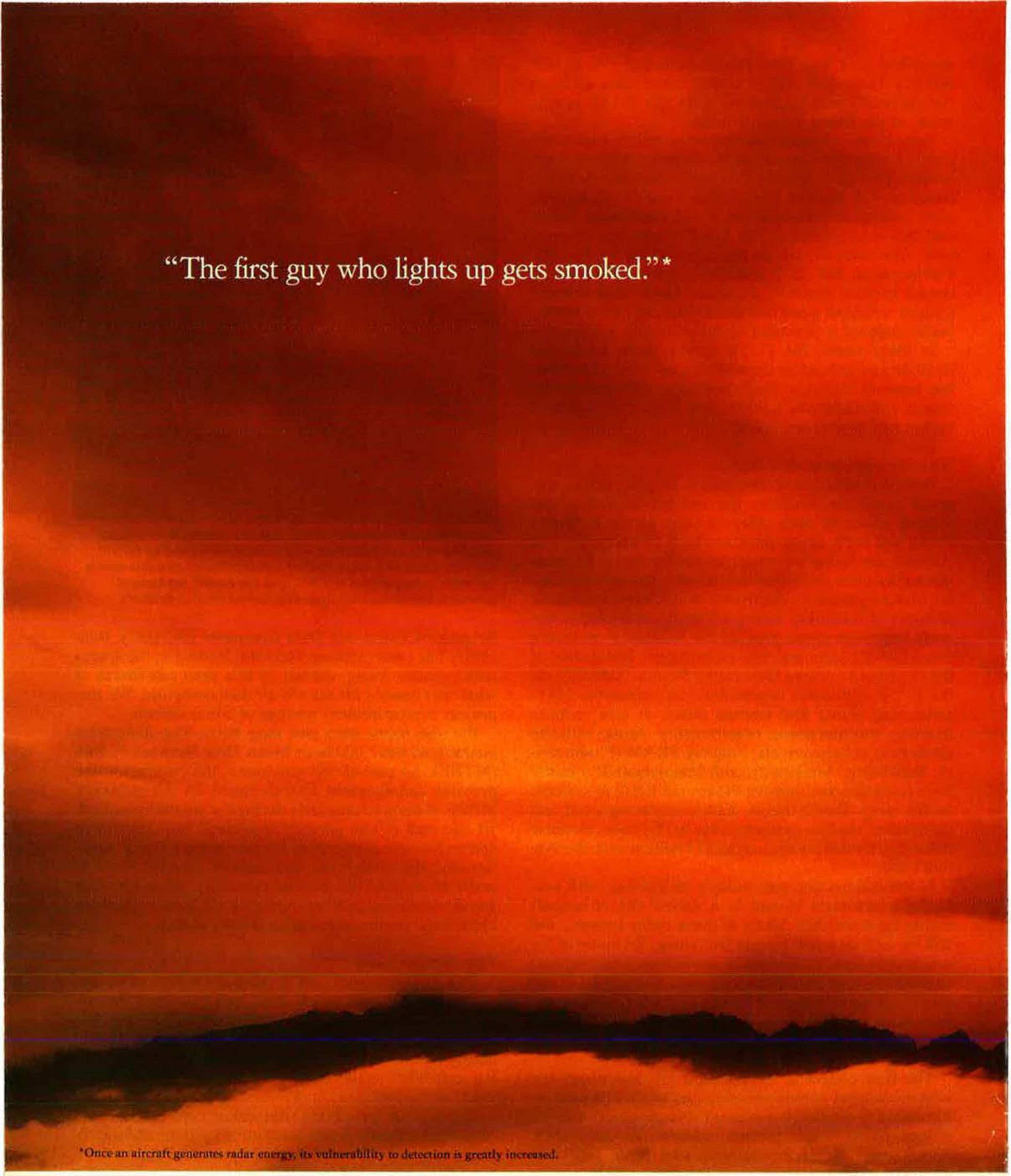
The portable Mobile Electronic Test Set (METS) is an interim solution to the AIS stations, which must be moved by forklift. The METS doesn't require strict environmental controls and is far more reliable than the AIS, and the newer equipment provides better support than equipment used previously.

But the story does not stop here. The contractor guaranteed the 2,000-hour Mean Time Between Failure (MTBF). As part of this guarantee, the contractor will provide consignment spares based on the achieved MTBF, measured quarterly during the guarantee period. At the end of the guarantee period, any calculated spares become property of the procuring activity. Additionally, the contractor may submit no-cost ECPs in order to achieve the desired reliability. This approach avoids degrading combat capability while motivating the contractor to identify and fix design flaws.

The Bottom Line

The bottom line: Air Force operators now use SCADCs that are much more reliable than the old ADCs, which decreases projected field failures and thus substantially decreases required spares. Increased reliability means aircraft break less often, increasing combat capability while freeing monies for other defense uses.

The SCADC processes information conveyed to it via electronic signals. Some computing systems and microprocessors of today—and certainly those of tomorrow—require transmission rates that exceed electrical capabilities. In time, fiber-optics technology will move communication from electrons to light. Fiber optics will offer not only increased bandwidth over existing communication lines but also advantages in R&M and increased combat capability.



Shown slightly enlarged, this 16,384 cell focal plane array will provide current day-only sensor systems with day/night and adverse weather capabilities.

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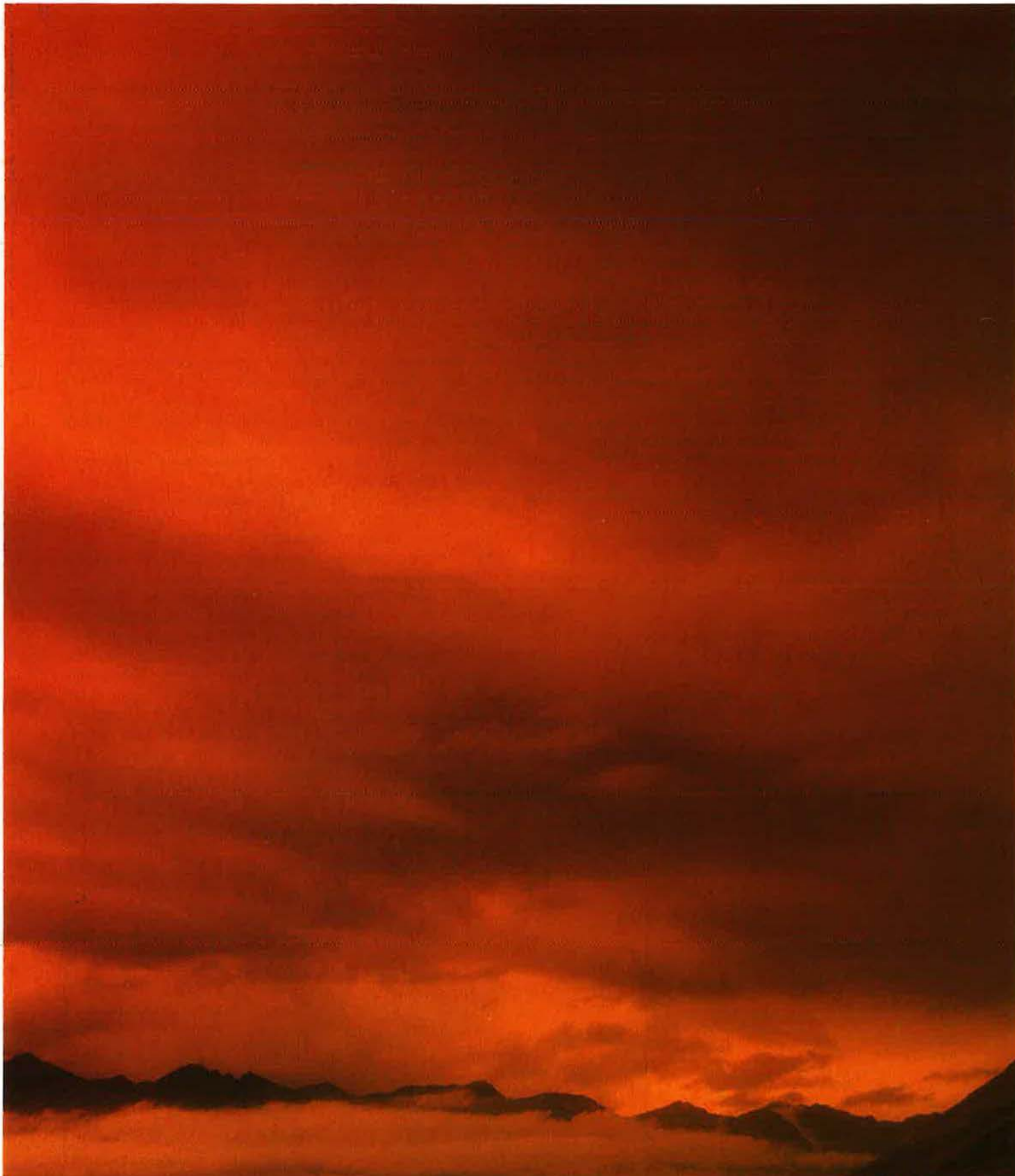

gies. Among the most sophisticated in existence, these now include high speed image processing and "staring" focal plane arrays. Technologies that extend pilot awareness into new areas of the electromagnetic spectrum.

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For example, in ground communication, such systems as the 407L are burdened with heavy coaxial cabling, with its attendant limitations in cable transition lengths. A typical 600-foot coaxial cable weighs about 400 pounds. The same length of fiber-optic cabling weighs only about eighty pounds and takes up considerably less space. The real advantage, however, is that the fiber-optic cable can reach out more than 6,000 feet, thus allowing dispersal of the control vans from the antenna and taking the people away from the potential hazard areas. The transition will be achieved with a fiber-optics "radar remoting kit."

Not all information paths must be lengthy to take advantage of photon-encoded information, though. A new flare-and-chaff system deployed on A-10 and F-111 aircraft demonstrates the dramatic gains of this new technology. The original system, designed with 1960s technology, suffered from corrosion and inadvertent activation at inopportune times. The primary culprit turned out to be electromagnetic interference (EMI), with external signals coupling into the copper coaxial cabling.

Traditional methods for correcting this problem would have included shielding and filtering, which, in turn, add new problems of complexity and weight. In this case, a novel approach was taken. Boxes were redesigned and linked via fiber optics, which are immune to EMI. The number of system boxes decreased from forty to twenty-eight, primarily as a result of using fiber optics. Of much greater significance, the new system has been flown on test missions without a single failure.

Downstream, we can envision internal data transmission rates 1,000 times greater than what's possible with conventional copper coaxial cable. Systems will be freed from the heavy shielding and filtering components necessary for EMI and nuclear-induced electromagnetic pulse (EMP) protection. Equally important, fiber-optic transmission lines will function one hundred times longer than copper co-ax.

Transmittal Takes Many Forms

Information transmittal takes many forms. Hydraulic systems, for example, convey information through differences in hydraulic pressure. But present central hydraulic systems pose several problems, ranging from the use of high-pressure/low-viscosity fluids (to reduce the risk of fire) to extensive vulnerable plumbing. Research into electrohydrostatic activation systems holds the promise of a day when hydraulic lines may become an obsolete mode of information transmission.

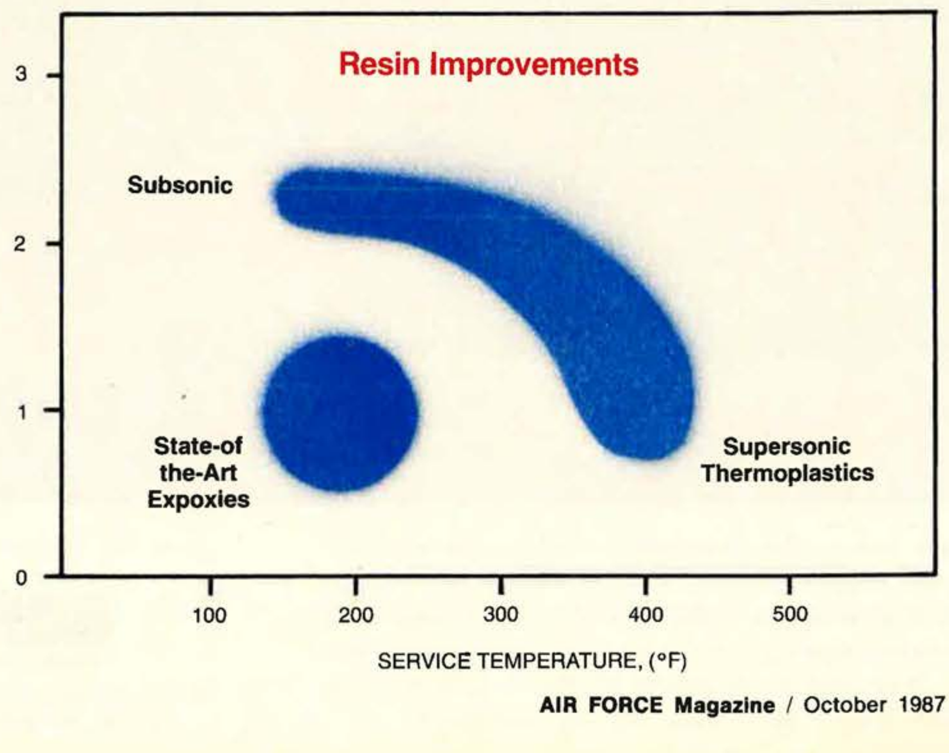
These self-contained flight-control actuators could receive pilot-initiated control inputs transmitted over fiber-optics pathways. Synergistic fallout from this combination will include reduced cost, size, and weight. And, as with so many applications of new technologies, systems built this way should achieve significantly higher R&M than their predecessors. Prototypes show a threefold improvement in actuator reliability while concurrently eliminating maintainability headaches associated with hydraulic lines and couplings.

External advances in structural materials also hold great promise. Several aerospace firms, including Boeing, are already realizing the potential of advanced thermoplastic composites. This material is not some researcher's dream. Low-temperature thermoplastics will be used extensively in the Navy's A-6 Replacement Wing Program.

The material has many unique properties. The thermoplastic resin matrix, which holds the graphite filaments, can be repeatedly softened and hardened. This contrasts with such thermoset composites as graphite epoxy, whose molecules are irreversibly crosslinked. As a result, maintenance and repairability will be enhanced through such techniques as electromagnetic welding, resistance welding, and hot-knife lamination. The service lifetimes of wings and other systems will be extended, too. For example, the A-6 wing's estimated useful life will jump from about 2,000 flight hours to 8,800.

Because of weight, toughness, repairability, and other

Current research indicates that thermoplastics (synthetic materials that can be repeatedly softened by heat and rehardened) can be extended into the high-temperature supersonic regime. In the temperature realm of supersonic flight, conventional epoxies fail. Thermoplastics, however, retain their integrity well beyond temperatures induced by supersonic heating. "Supersonic thermoplastic" is a candidate material for the Advanced Tactical Fighter.



attributes, thermoplastics will be employed increasingly in the future. Thermoplastics have almost twice the toughness of state-of-the-art epoxies at wing temperatures generated by the A-6 in subsonic flight. Current research indicates that thermoplastics can be extended into the high-temperature supersonic regime. In the temperature realm of supersonic flight, conventional epoxies fail. Thermoplastics, however, retain their integrity well beyond temperatures induced by supersonic heating. This property, among others, makes "supersonic thermoplastic" a candidate material for the Advanced Tactical Fighter (ATF).

Future uses of the material will certainly appear if accelerating corporate expenditures are any indication. Boeing Corp. alone increased its investment in this field by more than 700 percent between 1982 and 1986.

Another technology that lends itself to big gains in R&M and combat capability is Very-High-Speed Integrated Circuitry, or VHSIC. An example of such an upgrade is the Programmable Signal Processor (PSP) in the APG-68 radar of the F-16 fighter. Progress thus far on this PSP shows an increase in reliability of ten times, thus achieving the Air Force's new standard of 2,000-hour MTBF for avionics. We can now foresee the possibility of detecting and isolating faults in Shop Replaceable Units (SRUs) of the entire radar system without the use of intermediate-level maintenance test equipment.

VHSIC technology, when applied to this PSP, will allow enough room in the original box for new modes and electronic counter-countermeasures in the future. We estimate that the PSP will save about $100 million in acquisition costs and yield life-cycle savings of $200 million.

Capability: Time After Time

Today, smart applications of new technologies are increasingly making it possible for weapon systems to get the job done, time after time, with minimal maintenance.

Composite materials extend the life of highly stressed structural members of aircraft. Breakthroughs in engine design make reliable high-thrust engines a reality. Very few areas, however, have changed more radically than electronics. We will soon see the first totally integrated avionics suite, integrating fire-control, flight-control, and propulsion systems. Concurrent with increased performance, this suite will elevate reliability and maintainability to unprecedented levels. Behind these advances are the Very-High-Speed Integrated Circuitry (VHSIC) and Microwave Millimeter-Wave Monolithic Integrated Circuits (MIMIC) programs.

We envision chips with 100 MHz speed and capacities of 30,000,000 devices. Chips with these densities bring immediate improvement in reliability by reducing the number of interconnects. In fact, 25,000,000-hour VHSIC chips are already the norm.

These mind-boggling statistics only hint at the revolution just around the bend. First, VHSIC chips are so capable that a single "circuit card" bearing different standardized chips will contain all the circuitry necessary to perform a complete digital data or signal-processing function. This single card will fit in your hand. You can build up a set of thirteen such cards, which individually perform such functions as processing, bulk memory, and interfacing. These common cards can then be appropriately integrated to form ECM or radar processing systems. Finally, systems composed of common and standardized cards will be tied together under the Pave Pillar architecture. Suddenly we have highly reliable, standardized VHSIC cards that can be exchanged among functional systems.

The Integrated Communications Navigation Identification Avionics (ICNIA) illustrates the improvements resulting from VHSIC line-replaceable modules. Currently, the combined reliability of the separate systems works out to approximately forty hours. However, ICNIA's reliability will jump to more than 4,000 hours—with the potential to reach more than 10,000. We gain not only this phenomenal increase in reliability but also project that costs will drop by fifty percent.

Even if a module in the ICNIA suite does fail, the system instantly switches that function to a different module, any number of which are capable of taking over. Depending on the circumstances, the system may signal a human operator to choose priorities among functions the rerouted system must perform, but the weapon system itself has "fail-soft" redundancy. The mission continues, even with a key communications processor on the blink. That's combat capability.

Furthermore, accumulated history of avionics failures will make it possible to know when a module enters the zone of probable failure so that it can be replaced before it goes out.

A New Age

We stand at the threshold of the third generation of avionics systems. VHSIC, built-in testing at the chip level, common modules, "fail-soft" distributed redundancy, and estimated remaining useful life—all these go to form the Modular Avionics Systems Architecture (MASA). Now the practice of using electronic components until they fail can be eliminated. Aircraft equipped with MASA systems should rarely experience in-flight avionics failures for reasons other than battle damage.

The impact on combat capability of MASA and upgrade programs such as those seen with the F-15E becomes clear. We could fill pages with the cascading effect. We are about to enter a new age: improved system performance over time and reduced combat support.

With full adherence to the goals of the R&M 2000 initiative, the Air Force will turn Sun Tzu Wu's warning about unreadiness, unexpected routes, and unguarded spots to our full advantage. Even in the face of a very fluid battlefield, where the Forward Edge of the Battle becomes ill-defined, our forces will possess the flexibility, mobility, and staying power necessary to carry the day. The challenge lies before us, and the way is clear. ■

Brig. Gen. Frank S. Goodell is the Special Assistant for Reliability and Maintainability to the Military Deputy for Acquisition and to the Deputy Chief of Staff for Logistics and Engineering, Hq. USAF, Washington, D. C. General Goodell received his bachelor of science degree from Ohio State University and a master of business administration degree from Auburn University. A command pilot with some 4,000 flying hours, he has flown more than 600 combat and support missions in Africa, the Dominican Republic, and Southeast Asia.

Most of the aircraft that will be in service in the year 2000 are on the ramp today. It's no longer possible to upgrade combat capability through new acquisitions alone.

Modernization Through Modification

BY BRIG. GEN. (MAJ. GEN. SELECTEE) RICHARD D. SMITH, USAF
DEPUTY CHIEF OF STAFF FOR MATERIEL MANAGEMENT, AIR FORCE LOGISTICS COMMAND

BETWEEN eighty and eighty-five percent of the weapon systems that will be in Air Force service beyond the year 2000 are already on the ramp today.

New military aircraft are no longer introduced with the frequency they once were, and the number of aircraft produced annually has been declining steadily for some time. When a system does enter the force, it will have to handle its share of the threat for quite a while because there will probably be a considerable wait before the follow-on system rolls out.

One consequence of this pattern is that the Air Force cannot achieve through acquisition of new systems alone the updated combat capabilities it needs to keep abreast of the threat. This, in turn, has led to greater reliance on modernization through modification of existing systems.

Lt. Col. Vince Lewis, Chief of AFLC's Modification Policy and Financial Management Branch and a former B-52 bomber pilot, cites the seemingly ageless B-52 as the prime example of modernization through modification. Gen. James P. Mullins, a former AFLC Commander, recently stated that "about all a current B-52 has in common with one from the 1950s is the silhouette on the skyline." Further, it contains one of the best and most tangible success stories in Logistics Command—the Offensive Avionics System (OAS). The vacuum-tube technology of the bombing/navigation system rarely flew more than one sortie without a significant failure or degradation. This system suffered immensely from low reliability and high support costs. Historically, the "BUFF" always finished last in the SAC bombing competitions. But last year, with the OAS in place, the B-52 took the first seven places. And still, this aged craft remains the most powerful single air-breathing weapon system on the face of the earth.

Modernization, however, has its price. The total bill for B-52 Class IV and Class V modifications and associated costs reaches just over $8.6 billion. And how does this compare to purchasing a new weapon system? A few years ago, the Boeing Military Airplane Co. estimated B-52 replacement costs at around $100 million per equivalent aircraft with few of the enhancements listed above. If the B-52 were to be replaced one for one with B-1Bs, the costs for the aircraft and associated new support equipment would soar to $250 million per copy. Even using the lower $100 million figure, the cost to modify compared to acquiring a new weapon system yields at least a three to one advantage.

New Discipline Emerges

As the modification program becomes more important, a new discipline is emerging in the way modifications are developed and executed. Traditionally, modifications have tended to fall into separate and specific categories, such as safety, performance, or reliability and maintainability (R&M). These distinctions—driven largely by financial planning and programming schemes to allow an organized means of conveying requirements

—Photo by William A. Ford

The venerable Boeing B-52 Stratofortress has been modernized numerous times throughout its lengthy career to keep abreast of technology and ahead of the threat. By 1984, the B-52Gs (such as the one shown here at Griffiss AFB, N. Y.) had been modified to carry air-launched cruise missiles; by 1986, the much more accurate, much more compact, digitally based Offensive Avionics System (OAS) had replaced this collection of analog avionics boxes (below) in the nearly thirty-year-old B-52Gs and Hs.

to the Air Staff, DoD, and Congress—have often led to missed opportunities. From a technical perspective, there is no reason why safety, performance, and R&M modifications cannot complement each other. Opportunities to increase combat capability at dramatic reductions in support costs are there for the taking, and the potential synergism is too strong to ignore. We also know that modifications can be done much quicker by employment of "form, fit, and function" spare parts.

The vehicle for the new modification discipline is the Weapon System Master Plan (WSMP) process, with Logistics Command, Systems Command, and the operating commands all in the loop. Conceived by AFLC and now a recognized Air Force program, WSMP is a long-term "contract" between the combat commands and Logistics Command. It starts with a view of what Air Force planners expect each weapon system to do for the next ten years. System program managers specify the current capabilities of the system. In between these two points is a "delta"—a void that must be filled. Defining the technology, performance, and R&M options to fill the voids will set modification requirements in the years ahead. WSMP further lets the commands involved express their requirements credibly, with a single voice.

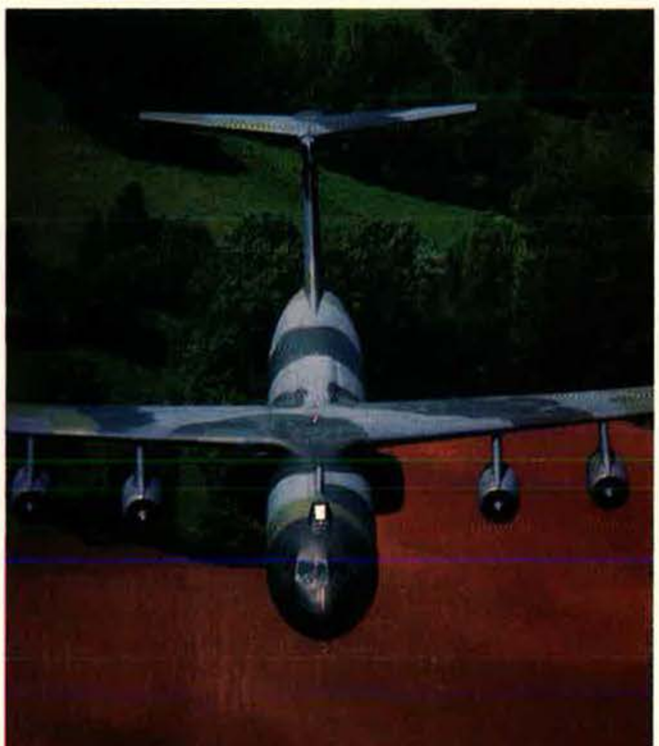
Modifications originate from many different sources. The most common of these are accident investigations, materiel-deficiency reports, inspections, new technology applications, R&M opportunities, and even the Air Force Suggestion program. External to the materiel system are modifications generated by mission area analysis or enemy threat changes, which may demand a whole new capability.

Each need, whether generated by the system's users, such as Military Airlift Command, Tactical Air Command, Strategic Air Command, and Air Force Communications Command, or by supporting commands (AFLC or AFSC), follows a dual track for approval and funding. Sooner or later, every modification must pass both a technical evaluation and a funding authorization/appropriation process. The technical evaluation assesses the adequacy of the fix through a formal process known as the Configuration Control Board. However, funds are obtained through the completely separate Air Force Planning, Programming, and Budgeting System, where modifications compete with each other and against the total needs of the service for limited financial resources. Successfully passing these milestones, which usually takes two to three years, results in official Program Management Direction from Hq. USAF to execute the modification.

The Results of Modification

The B-52 example cited earlier demonstrates how the bomber force has been modernized through modification. The process has also been applied to upgrade airlifters, trainers, and fighters.

While the C-5, C-130, and C-141 constitute the majority of our airlift capability and the C-130 consumes the most resources at $1.99 billion, the C-141 probably provides the best example of why modifications are done. In the Fall 1986 issue of the *Air Force Journal of Logistics*, Dr. William Head, Deputy Chief, Office of History, Warner Robins Air Logistics Center, says that "the inability of its primary cargo transport to refuel while in flight nearly cost America her foremost Middle East ally." During the 1973 Yom Kippur War between Israel and several Arab states, our Western European allies initially refused to grant landing rights to US supply flights destined for Israel. Dr. Head asserts that "the time and expense of producing a new cargo plane, as well as training new crews, made the development of a new series of transports prohibitive."



A real force-multiplier was the modification program done to the Air Force's fleet of Lockheed C-141 StarLifters. Adding twenty-three feet to the fuselage of the planes provided a thirty percent increase in volumetric capacity, and an in-flight refueling capacity gave the "StarLizards" global range.

Stretching the C-141 fuselage and adding an air-refueling capability became the optimum solution. In the end, the Air Force gained a thirty percent increase in volumetric capacity in the 270 C-141s for approximately $500 million and in less than half the time it would have taken to develop and acquire a new transport. Furthermore, the modified aircraft could be flown by the same crews and picked up an added force-multiplier in the new air-refueling capability. The increased cargo space added an equivalent volume of ninety additional aircraft!

While much smaller in size, the T-38 trainer is just as critical to this nation's military might because it is the sole aircraft used to teach advanced jet flying to virtually all the USAF fixed-wing pilots. Twenty-five years of use have taken their toll. Cracks and other signs of fatigue began showing up in early 1970s, and eighty-nine of the aircraft had to be grounded. A program to replace the T-38's thin-skinned wings gave the aircraft new life, but by the end of that decade, fatigue problems began to show up in the main fuselage structural components on all the T-38s. By then it was recognized that the T-38 would be an excellent candidate for a complete Service Life Extension Program (SLEP). Nicknamed "Pacer Classic," the T-38 SLEP integrated ten modifications into one program.

Pacer Classic literally helps to double the service life of the 851 T-38s, projecting their use beyond the year 2010. At a modification cost of $359.2 million, the price pales in comparison to that of purchasing a new aircraft.

Age, however, is not the primary reason to modify a weapon system. This nation's top-of-the-line fighter, the F-15 Eagle, consumes $2.7 billion from the overall modification account. Unlike other aircraft, eighty percent of the F-15 modification money goes for Class V mods to make the world's best fighter aircraft even better. A relatively new concept, known as the multistage improvement program (MSIP), has been allotted $1.8 billion worth of the F-15 modification program. The MSIP is a preplanned, logically grouped, and integrated set of phased improvements to incorporate new capabilities and technologies after production and deployment.

Age Less Important Now

MSIP reverses the traditional thinking of managers who have tended to treat modifications as a "fix after failure" solution. Now, during the design and full-scale-development phases of acquisition, space provisions and interface components are designed into the production aircraft for modifications that may not even be available for years. For the first time in military aviation history, MSIP causes the age of a weapon system to lose some of its significance as a measure of capability. The vast performance and capability differences between

—USAF photo by SSgt. Fernando Serna

The Boeing KC-135 Stratotanker first flew in 1956, and—with modification programs such as those being done in the KC-135R reengining program—the KC-135s will still be pumping gas well into the twenty-first century. This KC-135R has just topped off an F-16C (an excellent example of evolutionary modernization while still in production) from the 50th Tactical Fighter Wing at Hahn AB, West Germany.

first production models and the latest C/D series of the F-15 are prime examples of how modifications contribute to our fighter superiority.

The air-refueling mission may not have the glamour of fighters, but it does have the single most expensive modification in the Air Force. The $10 billion reengining program provides such enhancement for the KC-135 Stratotanker that it can be likened to buying new aircraft for the price of the engines. In fact, the KC-135R makes up much of the Air Force air-refueling shortfall generated by termination of the KC-10 procurement. Refitting the KC-135 with commercial CFM56-2 (F108-CF-100) engines provides for an up to fifty percent increase in fuel-offload potential, shorter takeoff distances, and twenty-seven percent lower fuel consumption—yet it meets or exceeds all noise and pollution standards. Aside from increased capabilities, fuel savings alone on the 640 KC-135s to be modified will go a long way toward defraying the total cost. This, together with the reliability and maintainability benefits, distinguishes the KC-135R program as a model of fiscal responsibility, performance enhancements, and R&M synergism.

The CFM56 engine reliability and maintainability track record has allowed SAC to advance to a centralized intermediate maintenance concept. This will enable SAC to redistribute ninety manpower positions to meet other critical command requirements. In effect, this modification has internally generated a net increase in available SAC manpower. It should not be any mystery why SAC has taken this action, since the McConnell AFB, Kan., unit flew all of its aircraft for more than a year and never changed an engine.

The KC-135R is just one of more than 800 ongoing modifications in various stages of planning and execution throughout the command. In all, this year's Air Force budget alone contains $3.2 billion for aircraft, missile, and ground communications and electronics modifications. In constant dollars, there has been a quadrupling of the modification account in the last ten years. The President's budget for FY '88 projects Air Force spending of $36.8 billion between FY '85 and FY '94 for the modernization of aircraft through modifications. Given the real growth in the modification account, the unchanging number of systems in the inventory, and the increasing age of military aircraft, it can be seen that a definite pattern has developed.

One Fighter in Two Decades

During the 1940s and 1950s, the Air Force developed at least six new fighter systems per decade—the P-47, P-51, P-59, P-61, F-80, F-82, F-84, F-86, F-89, and F-94 in the '40s and the F-100, F-101, F-102, F-104, F-105, and F-106 in the '50s. During the 1960s and 1970s, two new systems per decade were acquired in quantity—the F-4 and F-111 in the '60s and the F-15 and F-16 in the '70s. It appears that in the 1980s and 1990s only one new fighter will be developed—the Advanced Tactical Fighter. This means that older systems will be kept in the inventory longer, and they will have to be upgraded with new technology modifications to meet the threat.

Throwing billions of dollars at costly new replacement aircraft in order to counter the threat is simply not a viable alternative in today's defense-spending plan. Keeping aircraft in the inventory for thirty years or more is becoming the rule rather than the exception. Such workhorses as the F-4, B-52, KC-135, C-130, C-141, and F-15 are stable design types that will carry the load for many years to come. Despite their ages, each of these aircraft has been and continues to be a significant part of this country's powerful arsenal because of their ability to accept modifications. Given this importance, newer aircraft designs have incorporated space for preplanned—and in some cases as yet unknown—product improvements and new technology modifications that could alter the course of a battle.

At the heart of these modifications is the reliability and maintainability factor. Its contribution to the military power of this country is aptly cited by Gen. Robert D. Russ, Commander of Tactical Air Command: "It doesn't do any good to have a superior airplane that can only fly once if the enemy's got one that flies three times unopposed. To match the Soviet threat, we need to fly sortie after sortie, again and again." Further, Gen. John T. Chain, Jr., Commander in Chief of Strategic Air Command, says that "combat capability on the ground doesn't do me any good if I can't get it in the air—each time, every time."

Leaps in Reliability

In the Air Force Logistics Command, a program called "R&M 2000" is putting new emphasis on the importance of reliability and maintainability in modifications. No longer are planners limited to fractional advances. An educational process, just beginning, will demonstrate the availability of quantum leaps in both reliability and maintainability. Just a few examples will illustrate how the aggressive goal of 2,000 hours' mean time between failures (MTBF) is an achievable task with some surprising cost paybacks.

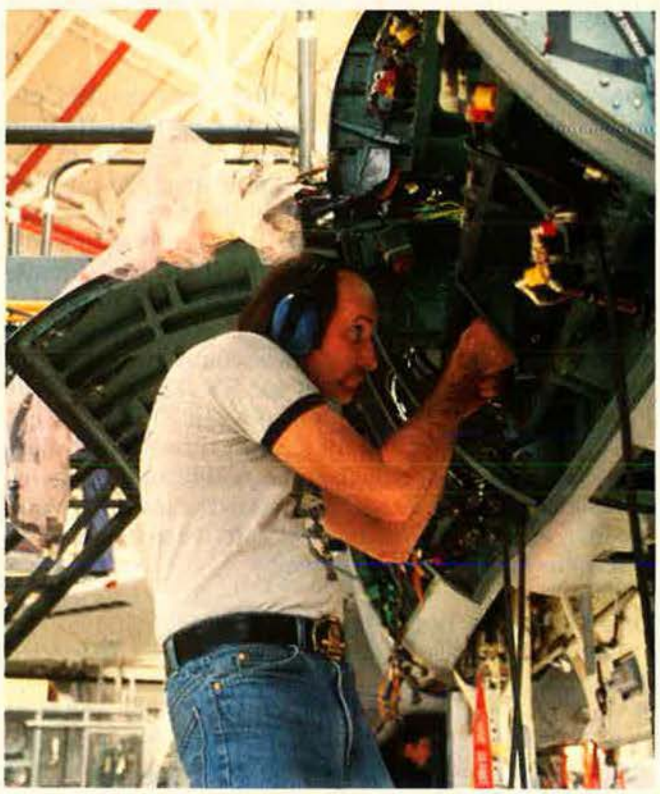
An item as small as the oil-quantity-indicating system on the A-7 costs $11,000 and has a 200-hour mean time between maintenance (MTBM). It is unrepairable when it breaks, and it produces hazardous waste. More than 100 aborted missions per year are attributed to this item. A modification can now be purchased for $2,500–$3,000. It produces no hazardous waste and has an 18,000-hour MTBM. Cost avoidance over five years is estimated to be $7 million.

The new ring-laser-gyro inertial navigation unit (INU) on the F-15 boasts a mean time between failures of 2,000 hours. It replaces an INU that has failed, on an average, at 100 hours and that costs $39,000 more than the new INU. Based on its reliability, the savings in spares alone amounts to $94.2 million.

The Central Air Data Computer (CADC) used on the A-7, C-5, C-141, F-4, and F-111 fails at 200 hours and exists in nineteen different configurations. Spares for the CADC are calculated at 872 units for the C-141 alone. Its replacement, the standard CADC, has a guaranteed MTBF of 1,200 to 2,100 hours and uses eighty percent common modules in all the above aircraft. In addition, the standard CADC costs $31,900 compared to $56,900 for the older versions. The lower costs and reduced spares requirement (187) lead to an investment avoidance of $43.6 million in spares for the C-141 alone. Add the other aircraft, and the investment avoidance is staggering.

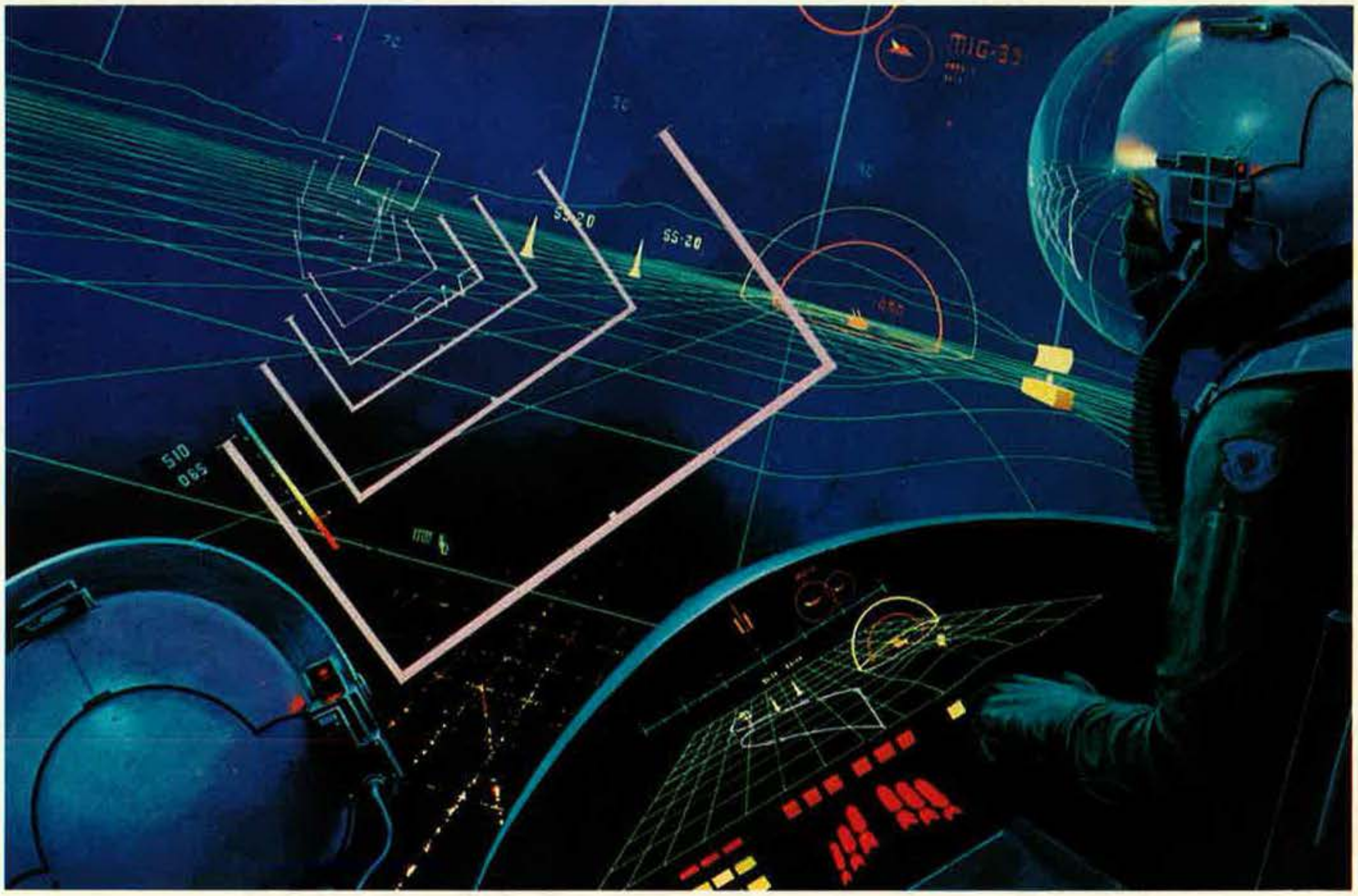
In theory, sufficiently high R&M levels can negate the need for much of the maintenance work that both AFLC and field units do today. This opportunity prompted Gen. Earl T. O'Loughlin, then AFLC Commander, to challenge corporate executives in May 1987 to "put AFLC out of business if you possibly can."

Modernization through modification is a logical means of countering a growing threat while living with shifting national priorities along with manpower and funding constraints. Force structure growth will occur only when ways are discovered internally to finance the people and resources required. One of the prime means of developing and fielding additional combat capability will be the modification program. In the stark reality of today's world, modernization through modification may very well be the single most viable alternative in creating a force structure that can win, if called on to fight. ■



Preplanned modernization programs—such as the F-15 Multistage Improvement Plan, where internal space and interface components are built in to allow for future systems or upgrades—make incorporation of new capabilities much easier and more economical than previously.

Brig. Gen. (Maj. Gen. selectee) Richard D. Smith, DCS for Materiel Management at Hq. AFLC, Wright-Patterson AFB, Ohio, is responsible for wholesale support of all USAF aircraft and missile systems, ground vehicles, and communications, electronic, and meteorological equipment. An Oklahoma native, General Smith graduated from the Air Force Academy in 1961 and holds advanced degrees from both Texas Tech and the University of Oklahoma.



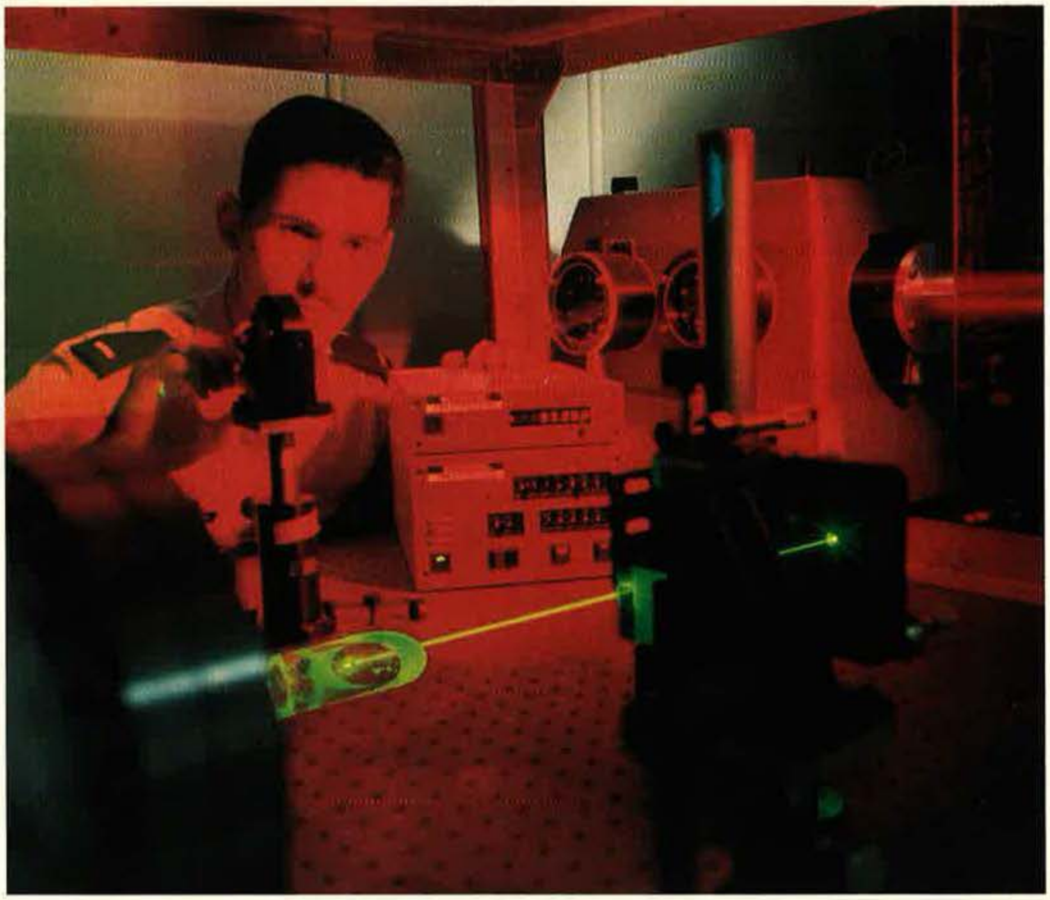
—Artist's concept for USAF by Attila Hejja

The yield from Forecast II is surprising even the optimists. Many of the systems may be ready for demonstration—and some for operation—before the turn of the century.

Shortcuts to the Future

BY JAMES W. CANAN, SENIOR EDITOR

LEFT: The supercockpit, depicted in this artist's concept, will be made up of many technologies selected for intensive development as part of the Air Force's Project Forecast II to help future pilots handle their demanding work loads. RIGHT: At Rome Air Development Center, the site of much Forecast II research activity, 1st Lt. Andrew E. Chrostowski, a physicist in RADC's Surveillance Directorate, aligns optical components for laser experiments bearing on space communications and sensors.



—USAF photo by Mark Bateman

THE Air Force's Project Forecast II is looking a lot less radical than it did at its unveiling early last year. The distant future that the study foreshadowed has turned out to be visible to the naked eye.

Evidence is mounting throughout Air Force Systems Command's research and engineering shops that many of the thirty-nine new and nascent technologies identified in Forecast II as essential to Air Force systems of the future are more manageable and more mature than they seemed.

In consequence, many of the thirty-one air and space systems that Forecast II portrayed as representing "the art of the possible" in USAF combat capability beyond the year 2000 are shaping up instead as the art of the probable.

Those systems were billed in Forecast II as having the potential to "revolutionize the way the Air Force carries out its mission in the twenty-first century, guaranteeing continued technological supremacy over any potential adversary."

They were the stuff of science fiction not all that long ago. Among them are aerospace planes, hypersonic aircraft and strategic missiles, engines driven by antiprotons and by other exotic fuels, tactical missiles that see and think for themselves, aircraft with multimode sensors built into their "smart skins," and unjammable, speed-of-light communications.

In the advanced materials and fuels that are prerequisite to much of this, scientists and engineers will rearrange the molecules, atoms, and electrons of nature's own materials and gases. And they know how.

It now seems likely that many of Forecast II's technologies and systems will be ready for demonstration and even for operation before the turn of the century. These include the supercockpit, the National Aerospace Plane (NASP) in the form of its X-30 test-bed aircraft, autonomous missiles, advanced materials, hypersonic strategic missiles, highly energetic rocket propellants, and at least some elements of a battle management and command control communications and intelligence (C^3I) setup using artificial intelligence and photonics.

Rome Air Development Center (RADC) of AFSC's Electronic Systems Division has already built tiny sensing and processing devices that represent the first step—in the form of hardware—toward aircraft smart skins studded with sensors of several descriptions.

In all such examples of the foreshortening of the future as envisioned in Forecast II, history seems to be repeating itself. The same thing happened the last time the Air Force marshaled its technological assets and force-marched them forward.

The First Forecast

Nearly a quarter of a century ago, the Air Force stepped back and surveyed all available technologies, identified those of brightest promise, tagged them as top priority, and pictured the air and space systems to come of them.

The vehicle for this was a 1963–64 study called Project Forecast. Its conclusions turned out to be truer and timelier than anticipated.

Project Forecast paid off handsomely and quickly. The technologies of aerodynamics, propulsion, materials, and sensors that it earmarked for special grooming led to, among other systems, the B-1 bomber, the C-5 transport, the Space Shuttle, and laser-guided and

TV-guided weapons—all of them the products of the following decade.

In some cases, even where Project Forecast was off the mark, it was eventually redeemed. For instance, it set store by advanced materials to be reinforced with boron filaments. Boron never made it as an aircraft body builder—but Project Forecast's emphasis on the need to develop new structural materials in general resulted in the graphite epoxies of wide application in modern airframes.

The Air Force reexamined the Project Forecast report after it was issued and found that "virtually across the board, it had been extremely conservative," says Maj. David Glasgow, chief of AFSC's Project Forecast II program control office. "Much more had happened than the study had predicted would happen—and we perceive the same coming true with Project Forecast II.

"We see terrific synergism between where we are now and where we are going in technologies and in systems concepts. Avenues are already opening up that we never thought of. I believe the results will be revolutionary and that we will be much farther ahead twenty years from now than we thought we would be."

The original Forecast study was somewhat off the mark in one important arena. It did not recommend that the Air Force invest heavily in developing advanced computers and software.

The reason for this was that the Air Force expected the US electronics industry to make sure that its research and development would be in tune with future military requirements for increased speed and computational capability in mainframe computers. This happened, but the industry's companion development of integrated circuits for microprocessors was oriented much more to commercial markets than it was to the military market. This is why the Defense Department eventually had to strongarm it to undertake such vital projects as the one to develop very-high-speed integrated circuitry (VHSIC) for small data and signal processors aboard weapon systems.

VHSIC is the key to the integration of all avionics aboard USAF's Advanced Tactical Fighter and to the success of a great many Forecast II endeavors in electronics, some of which, such as the supercockpit, may well wind up in the ATF.

Flagship of the Project

Computational capability is pervasive in Forecast II technologies and systems concepts and is fundamental to just about everything. The National Aerospace Plane (NASP) program makes the point.

At an Air Force Association symposium on space earlier this year, Brig. Gen. Eric B. Nelson, AFSC's Deputy Chief of Staff for Plans and Operations, described the NASP as "the flagship" of Forecast II and of the entire Air Force science and technology program, which has come to be dominated by Forecast II initiatives.

The NASP program was made possible by the advent of supercomputers for calculating the hypersonic aircraft/spacecraft's extremely complicated fluid dynamics and for designing its airframe and engines accordingly as a thoroughly integrated system. Furthermore, supercomputers with software oriented to artificial intelligence will almost certainly be central to the aerospace plane's avionics.

There is no longer any doubt that supercomputers can be made small enough for carriage aboard aircraft and spacecraft. RADC is fashioning one that will look lilliputian alongside the mainframe supercomputers that are today's standards for size.

The RADC supercomputer will be made up of a stack of superthin silicon wafers in a container the size of a three-pound coffee can. It will be capable of performing more than one trillion computational operations per second and will need only thirty watts of power. Thus, it will be up to 100 times quicker than existing supercomputers and will require only about one eight-thousandth of their power.

RADC began devising the "wafer-stack"—or "3-D"—supercomputer last August after Hughes Aircraft delivered a proof-of-concept model.

"We're developing new architectures for building 3-D computers in a variety of ways," explains Col. Charles E. Franklin, RADC's Commander. "We're excited. We expect tremendous capability to come of our work."

RADC is also heavily involved in work on photonics. This has to do with replacing electrons and electrical wiring with light beams—made up of photons, which are also the essence of lasers—and optical fibers in computational and communications systems. Photonics research and development got a big boost from Forecast II and is being funded to the hilt.

The Air Force has no intention of scrapping electronic systems and replacing them with photonic systems. It intends, instead, to develop hybrid systems of electronics and photonics that will take advantage of the best of both.

The first step will probably be to replace electronic switches and circuitry interconnections, both of which slow down transmissions, with optical varieties, which would permit the transmissions to proceed through such intersections at the unimpeded speed of light.

Photonic systems are awfully tempting, though, largely because they can't be jammed and are impervious to radiation and to electromagnetic pulse (EMP). Thanks to Forecast II's having focused on them, they are moving rapidly toward reality.

Photonics research and development under the auspices of RADC, four other AFSC laboratories, and the Air Force Office of Scientific Research (AFOSR) is expected to result in an optical phased-array antenna communications processor in 1990, a memory-storage system of massive capacity in 1991, a digital optical computer in 1993, and an optically implemented surveillance and communication system in 1994.

Protected Funding

Such research is far from singular among Forecast II initiatives as an example of aggressive Air Force funding. USAF can now prove that it meant what it said nearly two years ago about giving those initiatives strong and sustained shots of budgetary support across the board.

At the outset, AFSC committed ten percent of its Fiscal Year 1988 science and technology budget, which now stands at $1.5 billion, to

Forecast II projects. It plans to compound that ten percent each year through Fiscal Year 1992.

Things are working out even better than anticipated. Impressed by Forecast II, the Air Force leadership granted AFSC an additional $147 million for its science and technology budget for Fiscal Year 1988. Even though that budget took a net cut of $19 million as a result of congressional actions, the Air Force insulated Forecast II programs against harm.

Having taken notice of USAF's earnest money in support of Forecast II, the US aerospace and electronics industries are demonstrably bullish about their own undertakings attuned to Forecast II projects.

Not long ago, AFSC contacted twenty-four companies with a combined investment of $2 billion in independent research and development (IR&D) for the Air Force to find out how much of that investment is being committed to the furtherance of Forecast II projects. The answer: nearly $870 million.

Major examples of programs receiving big industry IR&D money are the supercockpit, photonics, knowledge-based systems (AI), battle management/C^3I, space-based wide-area surveillance, information processing, ultrareliable software, advanced materials, high-performance turbine engines, autonomously guided ("brilliant") weapons, hypersonic missiles and aircraft (a family of them, not just the NASP), and advanced VTOL and STOL aircraft for just about every conceivable tactical mission.

—Artist's concept for USAF by Keith Ferris

Foreseen in this artist's rendering, the National Aerospace Plane is Project Forecast II's "flagship" program. Embodying a host of Forecast II's choice technologies, the NASP program is expected to lead to a family of hypersonic aircraft/spacecraft for military and civilian purposes early in the twenty-first century. The program's X-30 test-bed aircraft is now being developed.

The Supercockpit

The supercockpit is a prime example of near-term payoff. Prior to his retirement last July, Gen. Lawrence A. Skantze, who as AFSC's Commander headed the Forecast II study, had this to say:

"At international air shows, it's obvious that the performance of other nations' fighters is approaching ours. The one area where we can leave them in the dust is cockpit battle management. Our distinct lead in computers, avionics, and sensors will culminate in the supercockpit."

The supercockpit is a melding of the latest technologies of sensors, computers, artificial intelligence, and three-dimensional displays into a system that the Air Force calls the "virtual world." In this, aircrews will wear helmets that will display virtually everything they need to see inside and outside the cockpit. They will also be able to direct their aircraft and its systems to do certain things simply by means of voice commands and to train their weapons on targets by looking in the direction of the targets.

The purpose of all this is to help aircrews manage their increasingly difficult and demanding work loads without having to look all around their cockpits at an assortment of dials and displays while also looking around the sky and trying to fly and fight.

The Air Force expects to have a full "virtual cockpit" with artificial intelligence around 1996. Vital elements of it will be in existence long before then, however. AFSC's timetable calls for introduction of a head-aimed fire-control system in 1989 and of an all-aspect head-up display (HUD) in 1991. Both will be built by AFSC's Human Systems Division into helmets that will actually be lighter than those now in service. Both are also expected to be available for dovetailing with the full-scale development of the ATF.

For the fighters of the next century or even for those of the next decade, Forecast II is providing much additional stimulus in research on autonomous missiles. These will acquire and track targets all by themselves. Requiring no postlaunch communication with their launching aircraft, they will make it possible for those aircraft to stay out of the range of enemy guns and missiles.

In the air-to-air mode, the Advanced Medium-Range Air-to-Air Missile (AMRAAM), now in low-rate production, is the first of such launch-and-leave weapons. It does a good job, but its successors as seen in Forecast II may make it look rather primitive by comparison.

Autonomous missiles of the future are expected to be capable of finding and hitting targets by means of "multispectral sensors," using, for example, millimeter-wave radar to spot and approach targets and then switching to active or passive infrared sensors to strike them where they stand or move. Such versatility would confound countermeasures.

The sensors will be teamed aboard the missiles with extremely compact and swift signal processors—possibly photonic, someday—of the supercomputer class in terms of their computational prowess. The prodigious sensing and signal-processing capabilities being worked up for those missiles will also be applicable to the identification, friend or foe (IFF) systems of the future.

The Air Force knows full well that it can make autonomously guided bombs. It has built and successfully tested the seekers needed in them.

Recent tests of such seekers aboard aircraft have shown that they have the ability, for example, to pick out, image, and track halfway down on the left hand side of the third strut of a bridge and to do the same at precisely the point where a runway and a taxiway intersect.

Among near-future milestones scheduled in the development of autonomous missiles are the completion next year of technology work on an advanced seeker-processor for air-to-air weapons and captive flight tests in 1989 of a seeker embodying synthetic aperture radar (SAR).

As is the case with most Forecast II projects, work on autonomous missiles cuts across many AFSC product divisions and laboratories. Armament Division is a big player, of course, but so are Aeronautical Systems Division and Electronic Systems Division.

In the supercockpit program, ASD and Human Systems Division and the Aeromedical Research Laboratory have a great deal of the work. But RADC is in charge of developing the supercockpit's computerized 3-D visual displays of flight paths together with systems that will enable aircrews to activate aircraft and weapons with voice commands, that will eliminate background noise and interference in air-to-ground voice communications, and that will even translate from one language to another when US crews talk to crews or ground controllers of other nationalities.

RADC is the cynosure of Forecast II's endeavors in the arenas of battle management/C^3I, ultrareliable software, AI, airborne surveillance—in which the development of aircraft smart skins is a high-priority program—and space surveillance, for which highly promising sensors—small, light, and capable of spotting "cold bodies" in space—are already coming to the fore.

Ultrareliable Software

Forecast II officials concede that software could be a show-stopper. All modern Air Force systems are now dependent on computer programs and have increasing need of them in greater quantity and complexity. Such software has all too often been troublesome in terms of capability and reliability.

A major thrust of Forecast II's research on ultrareliable software is the development and standardization of a high-order computer program language for writing the operational software of computers for Air Force systems. Such software-writing software would greatly help—or even replace—human programmers, who tend to perform ingeniously but streakily in their individualistic approaches to programming and who are too few in number in the military software-writing world.

RADC has already demonstrated some of the technologies needed to transfer human operations to computers in software development.

More and more, artificial intelligence will pervade the computer programs to be required for Air Force systems, just as it will be enfolded in the programs of the computers that will write that software.

AI is, for example, essential to the super-sophisticated battle management/C^3I systems that Forecast II is fostering. Evidence of success in the development of such systems abounds at RADC, where actual hardware has become the hallmark of Forecast II's progress.

RADC has modified its command and control laboratory to test and demonstrate its work at building and interlacing sensors and communications—all aimed at making future combat commanders aware of situations at every turn.

Forecast II has captured fancies all over the place. It has engendered several joint programs with the National Aeronautics and Space Administration and the Defense Advanced Research Projects Agency (DARPA). Army and Navy research officials have taken long looks at its initiatives for possible adaptation to their services.

Boost-Glide Vehicles

DARPA and NASA have been involved in the NASP program since its inception. Now the Air Force is pursuing a joint program with DARPA to develop hypersonic boost-glide vehicles and build a prototype.

These would be quite different from the runway-takeoff aircraft/spacecraft that the NASP program is expected to bring about. The boost-glide vehicles would be unmanned weapons and breathtaking ones at that.

They would almost certainly revolutionize strategic warfare. The Air Force sees them as capable of reaching speeds up to fifteen times that of sound, of ranging farther than ballistic missiles, and of approaching targets at relatively low altitudes.

It is possible that a prototype could be built and test-launched by the early 1990s. Initial plans involve launching the prototype atop a Minuteman ICBM booster, now in storage, for a test flight from Vandenberg AFB, Calif., to the Kwajalein Missile Range in the Pacific Ocean.

The hypersonic vehicles would not go into space. They would level off in the upper atmosphere and head toward their targets oceans and continents away. They are being designed to be so maneuverable on their approaches that they would be difficult to bring down—even if it were possible to detect and track them in the first place.

There is a passing similarity between the boost-glide vehicle and the X-20 Dyna-Soar, which was conceived by AFSC in the late 1950s as a manned, winged craft to be launched into space by a Titan booster and then to glide back through the atmosphere. That project was dropped in the early 1960s, but the work done on it led to the development of the Space Shuttle in the 1970s, most especially with regard to advanced materials for absorbing the heat of reentry.

The concept of the hypersonic boost-glide vehicles was promoted by Forecast II and is an outstanding example of how research in materials, propulsion, electronics, and

The Air Force's V/STOL transport aircraft of the future may well resemble these products of an artist's imagination. Given the rapid progress and high promise of propulsion and aerodynamics technologies fostered by Project Forecast II, it now seems likely that such aircraft will be built for a wide range of missions in the next century, maybe sooner, and will transform the way the Air Force fights.

optics has progressed to the point where the Air Force can pull it all together to begin developing—with confidence—a full-blown system for testing.

Materials for Tomorrow

On the wings of Forecast II, research on advanced materials is flying high. In the offing are lightweight, highly ductile, superstrong materials of supreme resistance to heat. New processes have been introduced in rapid solidification rate (RSR) powder metallurgy for producing awesome alloys. Extremely strong and heat-resistant "intermetals"—for example, titanium aluminide—are coming forth, as are advanced carbon/carbon materials and ceramic composites.

ASD's Materials Laboratory is learning how to rearrange the molecules and atoms of a broad range of materials to endow them with properties that greatly improve upon those offered by nature itself.

Forecast II calls these "ultrastructured materials." Some are already in existence.

Whatever their compositions, these highly advanced materials are destined for optical computers and switches and for high-performance turbine engines.

Capable of holding up under terrific heat, those engines will not need the complex cooling techniques required by today's turbine engines and, in consequence, will be far smaller, lighter, more powerful, and more reliable.

It is increasingly likely that such advanced engines will come to pass by or around the turn of the century, thanks to Forecast II's having underscored their research.

They are expected to double—at least—the thrust in relation to the weight of the ATF's advanced engines. This would be a startling—even revolutionary—advancement.

The ATF's engines will improve upon the performance of powerplants in modern fighters in many ways, particularly by providing the capability for supersonic speed and persistence without using afterburners. But in terms of thrust to weight, the ATF's engines will be only about twenty percent—one-fifth—superior to the best of the currently operational fighter turbine engines.

With the exceptionally high thrust-to-weight engines in Forecast II's future, the Air Force will be able to build Mach 4 aircraft and—by converting thrust into lift—V/STOL aircraft for a wide variety of missions.

Most likely, the ATF will have entered production—in the mid-1990s, if all goes well—before the turbine engines foreseen in Forecast II are ready to be flown. However, the ATF will undoubtedly evolve into increasingly capable variants as it goes along, so it is possible that those engines will become available for it as its production approaches or crosses the cusp of the centuries.

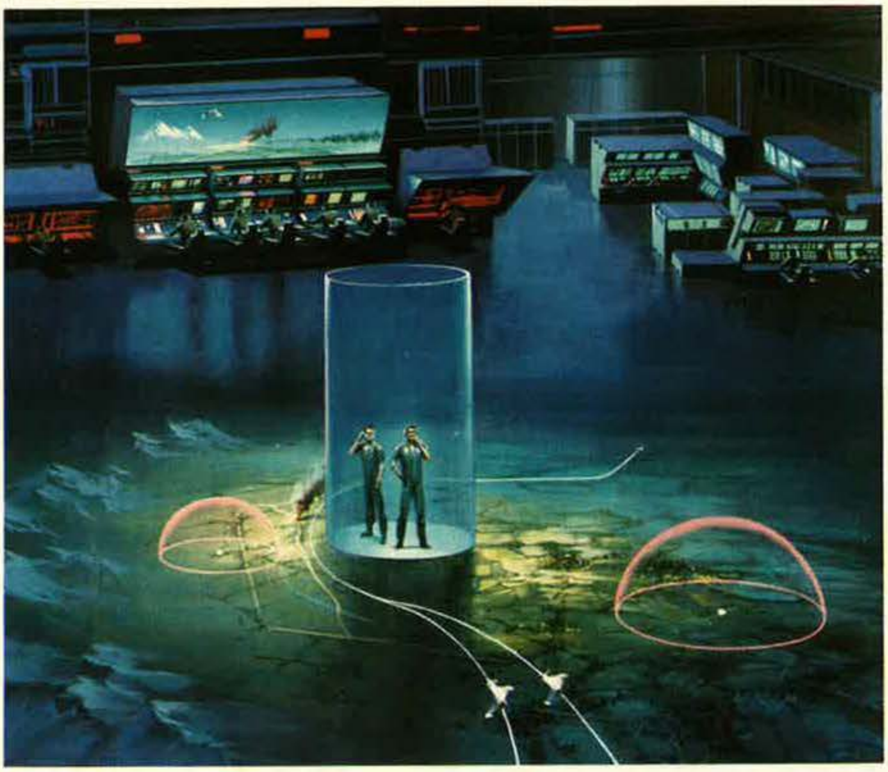
Smaller Boosters, Bigger Loads

Rocket engines are also in for a big shot of change as a result of research rallied by Forecast II. Such research is generating a new class of fuels—"high-energy-density propellants"—that are expected to double the thrust of existing solid and liquid propellants in space boosters.

Their energy density—thrust per unit of mass—may be ten times or more that of current propellants. This will make them amenable to containment in boosters of dwarfish dimensions and of puny poundage in comparison with the boosters that now loom like skyscrapers on planetary launchpads.

The implications for the US space program are profound. It has always been plagued by the extraordinarily high cost of boosting payloads into orbit. Smaller boosters capable of carrying larger and more numerous payloads at the same total system weight will translate into far greater cost-effectiveness, capability, and versatility for the US space program, which is currently short on all such attributes.

Forecast II sees the advanced fuels as powering the heavy-lift launch vehicles of the future. USAF has a crying need for such lifters. The Space Shuttle fleet has a limited and uncertain future, and the Strategic Defense Initiative program, the Space Station program, and others to involve outsize payloads will make strong demands on US space-


—Artist's concept for USAF by Attila Hejja

Forecast II places considerable emphasis on developing battle management/command control communications and intelligence (C^3I) systems that will make combat leaders acutely aware of all situations at all times. This artist's concept captures the light-speed communications and visual-display vistas that will be fundamental to such systems.

launch capabilities in the 1990s and beyond.

The first of the heavy lifters—the Advanced Launch System (ALS)—is being developed and will be operational well before Forecast II's futuristic propellants come on the scene—but maybe not all that long before.

The Air Force plans to demonstrate the technologies of such fuels by 1990. Experiments on them began this year, and researchers believe that the technologies will be under control in relatively short order.

Such work stands as yet another example of going nature one better in Forecast II research. It involves exciting the outer-shell electrons of such inherently stable chemical elements as argon and krypton to make them unstable. Once this state is reached, the agitated electrons are "bound" in ionic or covalent compounds that expend enormous, pent-up energy upon combustion.

Air Force Astronautics Laboratory (formerly Rocket Propulsion Laboratory) and AFOSR have awarded twelve contracts to universities to master the chemistry and the "excited-state physics" involved in producing the powerful propellants.

Forecast II officials are confident that such mastery is well within reach. Supercomputer calculations have told them so.

To the Stars and Back

They are also increasingly upbeat about the prospect of developing an antiproton space-drive system in the twenty-first century, perhaps much closer to the beginning of it than they once believed possible.

In such a system, negatively charged particles called antiprotons and protons—positively charged particles in the nuclei of atoms—would annihilate one another in mixture and release enough energy to make a hydrogen bomb blush—and do it, moreover, with no sound, no radiation, and hardly noticeable heat.

This mutual destruction would release one hundred times more energy than that of a fusion reaction and one hundred million times more than that of current chemical propellants.

Forecast II officials estimate that it may take until the year 2015 to generate antiprotons at the rate of one gram a year—but that the single gram should be enough to power all the space missions that the US anticipates undertaking.

If the research on antiprotons lives up to its promise, such missions may be downright galactic. Antiproton drive could take spaceships through the solar system in no time flat, as gauged by today's standards for spaceflight, and out to the stars and back before their crews had aged much at all.

The European Center for Nuclear Research (CERN) in Geneva, Switzerland, is now catching antiprotons in "collector rings" and storing them for experimentation. At CERN, a University of Washington research team has now demonstrated that it can capture the elusive particles in a football-size container—not in the huge collector rings—and can hold them there for minutes on end.

The team is confident that it will be able to store antiprotons indefinitely. Its work has revolutionary implications for future spaceflight.

The Soviet Union is building a facility that Air Force officials expect to be capable of collecting far more antiprotons per year than the CERN facility can now collect. Now, the US science establishment, with the Air Force involved, is planning to modify a major research center—possibly Los Alamos National Laboratory or the Fermi Laboratories—for the same purpose.

Air Force researchers see "no significant technological hurdles" in developing antiproton propulsion and "should be able to begin working on practical applications in the foreseeable future," AFSC's Major Glasgow says.

Not all Forecast II projects are hurtling ahead. For example, the Air Force has struck a measured pace in developing its concept of relatively small surveillance satellites that would carry internetting "distributed sparse arrays" of sensors and would function altogether—just as effectively as, but less vulnerably than, today's few relatively large, multisensor satellites.

Many Forecast II projects are "black," and a goodly number of these have to do with low observables—stealth—technologies and future systems. ■

After thirty years, NORAD's responsibility for warning, attack assessment, and air defense is increasing—and was not diminished by the creation of US Space Command.

The North American Partnership

BY GEN. JOHN L. PIOTROWSKI, USAF
COMMANDER IN CHIEF, NORTH AMERICAN AEROSPACE DEFENSE COMMAND
AND COMMANDER IN CHIEF, US SPACE COMMAND

WHEN Canada and the United States agreed in 1957 to establish NORAD as a binational command for air defense of the northern half of the Western Hemisphere, they finalized a series of collective efforts that had been in progress since the early 1950s. The antecedents of defense cooperation between the two countries date back to World War II.

In August 1940, President Franklin Roosevelt and Canadian Prime Minister W. L. Mackenzie King issued the "Ogdensburg Declaration." It advocated the concept of joint defense and sanctioned the establishment of an apparatus to carry it out—the US-Canada Permanent Joint Board on Defense, a binational working group for continuous high-level consultations on common defense matters, which has continued to this day. At war's end, collective security for continental defense remained a vital concern to both nations. In February 1947, Ottawa and Washington announced the principles of future military cooperation, which included consultation on air defense issues.

The growth of Soviet long-range aviation in the late 1940s and the explosion of a Soviet atomic bomb in 1949 brought both countries for the first time under the direct threat of a Soviet air attack and hastened closer cooperation in continental defense. In the early 1950s, Canada agreed to the construction of a series of radar lines within its borders with US assistance.

The first undertaking was the Pinetree Line of thirty-three stations built across southern Canada and completed in 1954 at a cost of about $50 million. The Pinetree Line provided continuous atmospheric warning and intercept control from coast to coast, but low-altitude gaps in the line and its shallow coverage remained major concerns. To address these concerns, the joint Canada-US Military Study Group recommended in 1953 that two more lines be built.

By 1957, a Mid-Canada Line, or McGill Fence, was completed about 300 miles north of the Pinetree Line, generally along the fifty-fifth parallel. The Mid-Canada Line consisted mainly of Doppler radars that created a microwave fence for detection (but not tracking) of low-flying aircraft. This line, financed entirely by Canada, cost about $227 million (Canadian dollars).

DEW Line—The Final Tier

The third and most challenging joint air defense undertaking of the 1950s was construction of a transcontinental line along the seventieth parallel, about 200 miles north of the Arctic Circle. This network of fifty-seven stations, completed in July 1957, was called the Distant Early Warning (DEW) Line. The US paid the approximately $350 million construction cost. Completion of the three-tiered radar defenses gave the population centers of the US and Canada two to three hours of warning in case of bomber attack, sufficient time to identify and intercept the enemy aircraft.

If the enemy had attempted to circumvent the three lines and approach from either the Pacific or Atlantic Oceans, they would have encountered offshore barriers composed of airborne early-warning aircraft, Navy picket ships, and offshore radar platforms called "Texas Towers." Since the operation of this extensive and complex network required daily coordination on tactical matters and the merging of plans to a greater extent than ever before, the next logical step was to establish a formal structure for operational control.

Joint planning had long been practiced by Canada and the US. In 1949, the Joint Military Cooperation Committee prepared an outline plan for emergency defense, which included provision for more detailed plans by the air defense commands of the two countries. The first of these was written in 1952 and updated every year thereafter. Early in 1951, the Royal Canadian Air Force (RCAF) placed a liaison group at Ent AFB, Colo., at the home of USAF's Air Defense Command (ADC), to facilitate matters. During the course of this work, it became increasingly obvious that truly effective air defense required common operating procedures, deployment according to a single plan, the means for quick decision, and authoritative control of all weapons and actions.

In the spring of 1954, the RCAF Chief of Staff, Air Marshal C. Roy Slemon, and the head of USAF's Air Defense Command, Gen. Benjamin Chidlaw, discussed means for providing the best defense for North America. On the basis of these talks, their staffs prepared a plan that called for a combined air defense organization under a single commander. In late 1954, Gen. Earle E. Partridge, Commander in Chief of the newly formed joint US command, Continental Air Defense Command (CONAD), directed another detailed study along similar lines. Over the next two years, consultations at various

The North American Aerospace Defense Command celebrated its thirtieth anniversary in September. In this photo, taken during NORAD's twentieth anniversary in 1977, then-Brig. Gen. John L. Piotrowski (standing) explains the intricacies of AWACS radar to Canadian Minister of National Defence Barnett J. Danson. General Piotrowski has since added three stars and now heads NORAD and the new US Space Command.

levels of the military hierarchy of both countries finally culminated on August 1, 1957, with an announcement by the US Secretary of Defense and the Canadian Minister of National Defence that the two nations would soon set up a system of centralized operational control of air defense forces under an integrated command located in Colorado Springs, Colo.

On September 12, the North American Air Defense Command was activated at Ent AFB, with General Partridge named Commander in Chief and Air Marshal Slemon as his deputy. A formal NORAD agreement between the two governments was not reached until May 1958 because Canada's new government wanted to examine carefully the ramifications of the agreement as it pertained to Canadian national sovereignty.

The next several years saw dramatic growth in air defenses. A quarter million Canadian and US personnel operated a multilayered and interlocking complex of sites, control centers, manned interceptors, and surface-to-air missiles that constituted probably the best defense ever erected against bomber attack. It cost about $2 billion a year to operate and maintain this air defense force.

The Character of the Threat Changes

During the decade of the 1960s, the character of the threat began to change as the Soviets focused on creating and deploying intercontinental and submarine-launched ballistic missile forces and a fractional orbiting bomb and achieved an antisatellite capability. The northern warning lines could now be, as one commentator put it, "not only outflanked but literally jumped over." In response, the US built a space surveillance and missile warning system and expended considerable sums on research and development of a practicable ballistic missile defense. Canada declined to participate in ballistic missile defense projects, but did make a contribution to the US establishment of a worldwide space detection and tracking system to search space and catalog objects and activity there. When these systems became operational during the early 1960s, they came under the control of CINCNORAD.

The evolving threat of the 1960s broadened NORAD's mission over the years to include integrated tactical warning and attack assessment of a possible air, missile, or space attack on North America. Both the 1975 and the 1981 NORAD Agreement renewals acknowledged these extensions of the command's mission and in 1981 resulted in the name change from North American "Air" Defense Command to North American "Aerospace" Defense Command.

The ballistic missile threat caused US policymakers to examine closely the needs and expense of the air defense system. Economy moves begun in 1963 reduced interceptor forces and closed portions of the radar network. There were, however, some improvements made, including hardening, redundancy, and dispersal that reduced vulnerability to ICBM attack. Consequently, in the early 1960s, NORAD constructed a hardened combat operations center inside Cheyenne Mountain, near Colorado Springs. However, other defense-investment

An increasing threat, not only from Soviet manned bombers but also ballistic missiles, prompted construction of Ballistic Missile Early Warning System (BMEWS) radars, with the result that in 1981 the "Air" in NORAD was changed to "Aerospace." The BMEWS radar at Thule AB, Greenland, was completely rebuilt in 1985.

priorities precluded any real emphasis on widespread modernization of the forces during the 1960s.

By the early 1970s, as a result of changes in US strategic policy that had come to reflect the concept of mutual vulnerability to ICBM attack, the need to spend about $1 billion a year on air defense was challenged. In 1974, Secretary of Defense James Schlesinger stated that the primary mission of air defenses was to ensure sovereignty of airspace during peacetime. This shift in mission was accepted by Canada and confirmed with the 1975 NORAD Agreement renewal. There followed further reductions in the size and capability of the air defense system and delays in its modernization. By the late 1970s, the remaining components—some 300 interceptors and about 100 radars—were obsolescent and becoming uneconomical to operate.

—Photo by Al Lloyd

A major part of the modernization of NORAD was the addition of new types of interceptor aircraft, such as the F-15 and CF-18, both made by McDonnell Douglas. These Eagles are from the 318th Fighter Interceptor Squadron at McChord AFB, Wash.

Master Plan for Modernization

In May 1978, at the recommendation of the Canadian Minister of Defence, the two nations undertook a Joint US-Canada Air Defense Study (JUSCADS) to forecast the air defense threat from 1978 to the end of the twentieth century and also to evaluate what technologies might be available to counter those threats. The study, completed in October 1979, identified weaknesses in the existing system, emphasized the need for incremental improvement, and offered various alternatives for doing so through the next twenty years. As a follow-up to the JUSCADS study, the US Congress in 1979 directed USAF to prepare an Air Defense Master Plan. Later modified, it became the current Administration's blueprint for modernization of air defenses and the basis for cost-sharing discussions with Canada over the next several years.

The salient features were similar to those recom-

Millions of tons of earth and stone had to be removed before construction of NORAD's hardened combat operations center inside of Cheyenne Mountain, near Colorado Springs, Colo., could begin in the early 1960s. All of NORAD's activities are overseen by the personnel who work the consoles on the other side of this immense blast door.

—Photo by Jeff Smith

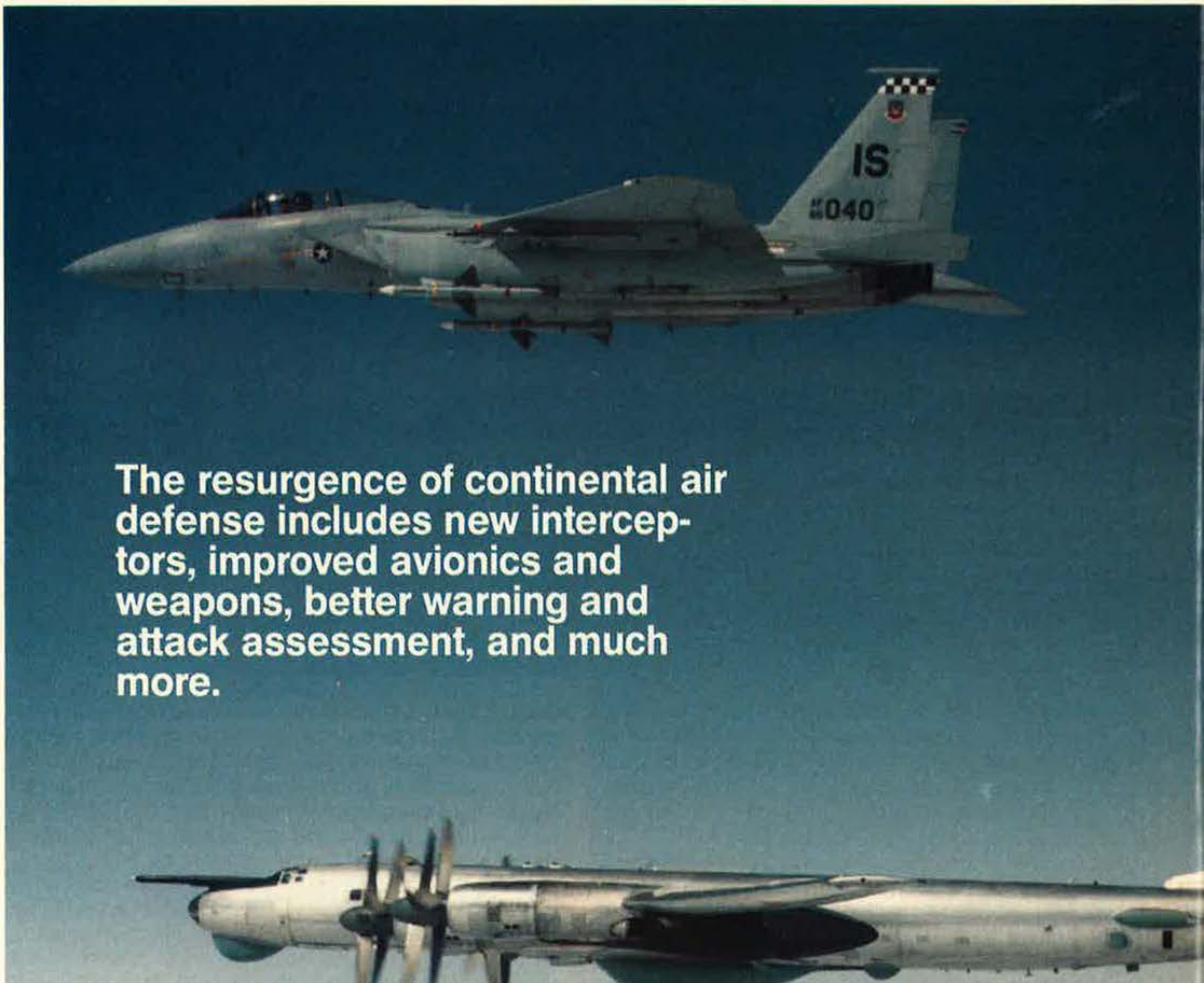
mended in the JUSCADS: replacement of the DEW Line with an improved Arctic radar line called the North Warning System, deployment of over-the-horizon radars on the US east and west coasts, increased reliance on airborne warning and control system (AWACS) aircraft, and buying more F-15s for forces assigned to NORAD. After several years of negotiations, US Secretary of Defense Caspar Weinberger and Canadian Minister of Defence Erik Nielsen concluded on March 18, 1985, a memorandum of understanding in Quebec City on air defense modernization that contained most of the recommendations of the previous studies. Joint financing called for the US to pay sixty percent and Canada forty percent of the $1.29 billion cost of the North Warning System.

The Reagan-Mulroney 1985 Summit established the foundation for continued Canadian-US partnership in North American air defense, particularly with regard to countering the bomber and cruise missile threat. Cooperation, however, in the increasingly important area of space-based surveillance, warning, and defense against bombers and ballistic missiles was less clear. What role Canada would play in evolving space technologies and their application remained speculative. On the one hand, in February 1986, the Canadian Special Committee of the Senate on National Defence (SCEAND) called for long-term planning and recognition of the value of updating Canada's participation in NORAD by pursuing a Canadian military space program. On the other hand, substantial concern existed that Canadian sovereignty would be diminished by Canada's collaboration with the US on such space projects as the Strategic Defense Initiative, and thus, while endorsing US SDI research, the Canadian government declined collaboration.

Canadian concerns about space defense and ballistic missile defense were addressed during the creation of the new United States Space Command (formed in September 1985). The new Space Command would provide NORAD with missile warning and space surveillance, but would not be—as the Aerospace Defense Command had been—a component command. Nor would NORAD have ballistic missile defense responsibilities unless such changes gained future approval by both governments. The activation of the US Space Command, however, in no way diminished CINCNORAD's responsibility to provide warning and assessment of an aerospace—air or space—attack on North America directly to the national command authorities of both Canada and the United States. Nor has NORAD's responsibility to defend North America's airspace in any way been diminished. Rather—in an era when Soviet air-launched cruise missiles pose a real and present danger—it has dramatically increased in importance.

NORAD reaches its thirtieth anniversary in 1987 on sound footing and with a bright future ahead of it. Both the 1985 accords on cost-sharing and modernization and the May 12, 1986, renewal of the NORAD Agreement for another five years signaled continuing Canadian-US defense cooperation. Each nation remains convinced that today and for the foreseeable future the common defense is best secured by mutual dependence. ■

Gen. John L. Piotrowski is the Commander in Chief of the North American Aerospace Defense Command and the United States Space Command. He was previously the Vice Chief of Staff of the United States Air Force. General Piotrowski has served in a variety of operational and key staff assignments throughout the United States and in South Korea, Japan, Germany, Italy, and Vietnam. He received his commission and navigator wings in 1954 as a distinguished graduate of the aviation cadet program. He completed pilot training in 1957. During the Vietnam War, he flew 100 combat missions.



The resurgence of continental air defense includes new interceptors, improved avionics and weapons, better warning and attack assessment, and much more.

The Return of Air Defense

BY DAVID F. BOND

more of the nation's technical ingenuity and resources into defenses against heavy ICBMs. One year's worth of SDI budget proposals would pay for much of the Air Force's planned continental air defense interceptor and radar modernization—perhaps all of it, depending on how the costs are allocated. The challenge of detecting and intercepting bombers or even cruise missiles represents only a fraction of the challenge of SDI. But the air defense modernization now under way is nevertheless wide and deep. It will reshape US forces, tactics, and capabilities into the next century.

The US moved in the second half of the 1970s to introduce the cruise missile into the strategic equation that the Soviet Union must solve, and in 1981 it restored the B-1 bomber to its strategic force plans. The Soviets have moved in parallel. The US fielded 1,500-mile-range AGM-86B air-launched cruise missiles (ALCMs) on B-52G and H bombers, and the Soviets countered with 1,800-mile-range AS-15 ALCMs on new-production Bear-Hs. The US deployed Tomahawk sea-launched cruise missiles, similar to the AGM-86B in size and range, and the Soviets responded by developing a submarine-launched variant of the AS-15 and a larger SLCM. As the Air Force fields the B-1B, it awaits the Soviet Union's Blackjack bomber, expected to be a bit larger and faster than the B-1B and with about the same combat radius. As the Air Force develops SRAM II, a successor to the AGM-69A SRAM (short-range attack missile), the Soviets replace the slower AS-3 air-to-surface missile with the supersonic AS-4.

Bear hunting, 1980s style. An F-15 from the 57th Fighter Interceptor Squadron at NAS Keflavik, Iceland, armed with live AIM-7 Sparrow missiles, escorts a Soviet Tu-142 Bear-G away from a sensitive area (left). Bear intercepts are almost a game, albeit a deadly serious one, as the Soviet bombers fly close enough to US areas to alert the interceptors, but not close enough to violate US airspace.

The Air Force, in the midst of what will turn out to be a decade of modernizing its continental air defense forces, is finding out that it acted none too soon. An equally modernized Soviet threat, of cruise missiles as well as bombers, will put a premium on pushing air defenses outward and engaging enemy forces farther and farther from their targets in the United States. The capabilities offered by the US modernization may make the difference between credible air defenses and a perception—perhaps the reality—of vulnerability.

The US has come full circle from the late 1960s, when more than 2,500 interceptor aircraft defended against what came to be regarded as a threat of diminishing size and priority. This assessment has not changed fundamentally. The Strategic Defense Initiative is ample evidence that the Defense Department is putting much

Different Defenses

The two nations defend against these similar threats differently. The US has put a greater percentage of its strategic nuclear weapons on bombers than the Soviet Union has. The Soviets must defend a greater area with longer borders. In addition to strategic bombers based in the US, the Soviets must consider US and allied tactical aircraft deployed in Europe, which can reach their territory and that of their allies. As in other missions, the Soviets seem to add new weapons to their force structure without retiring old ones. Whatever the reasons, Soviet air defense forces are numerically staggering. There are more than 10,000 Soviet air surveillance radars and about 2,250 interceptor aircraft dedicated to strategic defenses, with 2,100 more interceptors available if needed. The Soviets also rely heavily on surface-to-air missiles, weapons that have no place in defending the US. They have more than 9,000 strategic SAM launchers and continue to develop new missiles and improve existing ones.

By contrast, the Air Force counts on superior equipment and modernization as it plans and carries out the continental air defense mission. With the E-3 Airborne Warning and Control System (AWACS) fleet limited in numbers and shared with other, worldwide missions, the service is establishing a network of over-the-horizon backscatter (OTH-B) radars to extend surveillance as far as 2,000 miles beyond US borders. Unable to use OTH-B facing north because of polar atmospheric conditions, the US and Canada, linked through the North American Aerospace Defense Command (NORAD), are replacing the thirty-year-old Distant Early Warning (DEW) Line radars with the new North Warning System (NWS). The Federal Aviation Administration will gather and share with the Air Force data from an upgraded Joint Surveillance System (JSS) of long-range radars along the border of the continental US. And in a remarkable infusion of modern hardware into the interceptor forces, the Air Force will modify 270 of its F-16A and B multirole aircraft for Air National Guard fighter-interceptor squadrons currently equipped with F-106s, F-4s, and unmodified F-16As.

The F-16 program is estimated to total $633 million, not counting the cost of the aircraft being modified or the new-production F-16s that will replace the ones being shifted to air defense from other Tactical Air Command forces. The Air Force established the program in November 1986, after choosing it over two new-production aircraft options judged to be far more expensive—purchase of F-20 aircraft or F-16Cs adapted for air defense. The modification plan had the additional advantage of modernizing the forces losing aircraft to the Guard—they will get new, current-model F-16s—as well as the Guard itself.

The Air Force will buy F-16 air defense equipment kits from the producer of the aircraft, General Dynamics Corp., and install them in the F-16As and Bs at Ogden Air Logistics Center, Utah. This work will be made to coincide with previously scheduled operational capability upgrades (OCUs) and other engineering changes. The F-16 OCU program includes provisions for the AIM-120A Advanced Medium-Range Air-to-Air Missile (AMRAAM), additional capacity for the avionics computer, a mission data load capability, low-altitude flight improvements, and updated avionics software.

Improved Radar

A principal item in the air defense kit is a continuous wave illuminator to be added to the antenna of the aircraft's Westinghouse APG-66 radar. The change will enable the radar to illuminate targets for AIM-7 Sparrow air-to-air missiles. Current F-16s lack a radar missile. F-16C/Ds and suitably modified A/Bs will be able to use AMRAAM when the new missile is available, but the air defense F-16s will get an AIM-7 capability as well. As scheduled originally, AMRAAM was to have been available by now as Sparrow's successor. The air defense kit also includes an interface unit compatible with the infrared-guided Sidewinder missile as well as Sparrow and AMRAAM.

In another radar modification, the APG-66 will get a software change to improve its ability to detect and track small targets, such as cruise missiles, and a cockpit switch to engage it. A high-frequency radio, an identification, friend or foe (IFF) system, a drag chute, and a night identification light will be installed, and avionics

Air defense interceptors, like these McDonnell Douglas F-15 Eagles from the 5th Fighter Interceptor Squadron at Minot AFB, N. D., are kept on five-minute alert to launch and chase away or—if need be—shoot down any intruders into US airspace. Air defense units frequently rotate fighters to other bases so that greater coverage can be provided.

The shape of air defense to come: The General Dynamics F-16 was chosen last year as the Air Force's new interceptor to replace the F-106s and eventually the F-4s now used. This F-16 is armed with two AIM-9 Sidewinder missiles and four AIM-120 AMRAAM missiles, which will replace the AIM-7 Sparrow.

reliability improvements will be made. Development of a Joint Tactical Information Distribution System (JTIDS) variant with size and weight reductions for F-16 use is a NATO codevelopment initiative, so no AWACS data link is in the current F-16 air defense plan.

General Dynamics is scheduled to deliver a prototype air defense modification kit to the Air Force in February 1988 for installation and testing in an F-16A flight-test aircraft. The Air Force is to begin installing production kits in F-16s at Ogden ALC in October 1988. The modification will continue through February 1991.

When the Air Force conducted its air defense aircraft competition, the average ages of F-106s and F-4s in fighter-interceptor squadrons were twenty-six years and twenty years, respectively. There were three F-15 fighter-interceptor squadrons in the active forces, averaging 8.3 years of age, and this brought the average for all air defense aircraft down to 19.5 years. Five- to ten-year-old F-16s were picked for the air defense modifications.

The youth of the F-16s being added to the air defense forces and the advance in technology that went into their design and upgrade figure prominently in the plane's ability to do some of the things the Air Force will want increasingly to accomplish as the cruise-missile threat develops further. In particular, the service is expected to rely more and more on the use of austere forward operating locations in northern Canada to place its interceptors where they can engage bombers more quickly, before the bombers can launch their cruise missiles.

Stopping Them Early

Intercepting a Bear-H north of the Arctic Circle is a much more straightforward proposition than looking for its cruise missiles, provided that the interceptor can get to the Arctic quickly enough. The payoff in attacking a single weapon carrier rather than many weapons is increasingly applicable across service and mission lines. Navy plans for the outer air battle have centered for years on intercepting enemy aircraft at greater distances from the fleet, before they can launch antiship missiles. The SDI Organization has emphasized the leverage of engaging an ICBM in the boost phase of its flight, before it can dispense individual reentry vehicles and penetration aids.

In continental air defense, forward operating locations may be small civilian airports or bare bases. Their numbers and locations, chosen to cover major ingress routes for Soviet bombers, are classified. Detachments of fighter-interceptor squadrons deploy to them in exercises, and there is a constant tradeoff between training at them and exposing their locations to watching Soviets. Whether in training or during an alert, they are occupied only briefly. Planning for the specific locations to which aircraft would be deployed in an alert changes as assessments of the threat change.

Streamlining the Organization

Partly because modernization made it possible, partly because modernization demanded it, the Air Force has streamlined its air defense organization in recent years. There were several steps.

In 1983, the six remaining vacuum-tube-technology Semi-Automatic Ground Environment (SAGE) centers were replaced by four Joint Surveillance System Region Operations Control Centers. ADTAC (Air Defense, Tactical Air Command), which was part of TAC headquarters but functioned like a numbered air force, was responsible for air defense support (resource management, logistics, training, and the like). NORAD, which controlled operations, functioned through commanders of four continental US (CONUS) regions, which ran the ROCCs, and Canada and Alaska regions. The CONUS region commanders also headed air divisions responsible to ADTAC.

In December 1985, the TAC side was simplified with the reactivation of First Air Force to succeed ADTAC. Instead of acting like a numbered air force, ADTAC's successor really would be a numbered air force. The support chain of command ran from TAC through First Air Force to the four air divisions. The NORAD side wasn't changed.

In October 1986, First Air Force received an operational role when it became NORAD's CONUS region. NORAD's Canada and Alaska regions remained, but the four former regions in CONUS became air defense sectors in the newly unified CONUS region. The TAC side wasn't changed, so the air divisions now coincided with the air defense sectors.

In July 1987, TAC compressed First Air Force's four air divisions into two, each comprised of two sectors. The four TAC sectors are the same as NORAD's and coincide with the former air divisions.

F-15s, F-16s, and Canada's CF-18 interceptors are much better suited than the aircraft they replace to operations at austere locations with minimal facilities. Older aircraft need more support equipment and maintenance personnel, particularly in the cold weather and difficult conditions of the Arctic north. Even when they can be supported, their inherent disadvantages in reliability and maintainability make them less likely to generate the sorties necessary for success. The older planes are capable and are made to do what they must do—one of the first deployments to a forward operating location was by an Air National Guard detachment of F-106s—but the Air Force is counting on the newer ones to be able to do it faster, better, and more often. The more interceptors the Air Force can put in the air and the longer it can keep them there, the more likely it is to succeed.

Beyond increased reliability and reduced support needs, the modern radars, weapons, and electronic counter-countermeasures of modern interceptors broaden the ways in which they can be used. In Copper Flag exercises against jamming penetrator aircraft and in other air defense exercises, the Air Force is developing tactics for using the new planes and is finding that the F-16 can use many of the tactics devised for the F-15. The newer aircraft are easier to fly and their equipment is easier to operate, so less-experienced pilots can fly them successfully and with increased safety.

Identifying the Penetrators

Unless the US is unambiguously at war, air defense commanders demand certainty in identifying potential threats. With radars as one source of data, the confirmation usually has to be a pilot flying an interceptor. While the F-106 performs well at high speed and high altitude, the F-15 and F-16 have broader envelopes and are better suited in this respect for the tactical warning and attack assessment that are required of interceptors. New equipment will contribute also—the air defense F-16's high-frequency radio, for example, will enable a pilot flying over Greenland or northern Canada to communicate with NORAD in Colorado or continental US (CONUS) region commanders at Langley AFB, Va. The F-15 and F-16 flying envelopes also are better suited to the peacetime air defense missions of enforcing the sovereignty of US and Canadian airspace, assisting in drug interdiction by law enforcement authorities, and helping lost pilots or disabled aircraft.

The two principal air defense radar system programs, NWS and OTH-B, are intended to give air defense forces by the early 1990s an ability they have never had before—the ability to detect bomber attacks on North America soon enough, and at a distance great enough, for well-placed interceptors to challenge them before they can launch cruise missiles against strategic targets in the US. Further, the Air Force believes OTH-B will be capable against the cruise missiles themselves or can be made capable against them, even though it was designed to detect and track aircraft.

OTH-B high-frequency radar transmissions are bounced off the ionosphere to cover sectors of a circle at

Lt. Col. Richard E. Coe is an old-hand interceptor pilot, having been a commander of the 5th FIS. Now at the Pentagon, Colonel Coe is shown mounting an F-15 at Langley AFB, Va.

Up From Knobville

Lt. Col. Richard E. Coe, former Commander of the 5th Fighter-Interceptor Squadron, an F-15 unit at Minot AFB, N. D., and currently Chief of the Weapon Systems Branch, Tactical Division, DCS/Plans and Operations, Hq. USAF, fields questions on air defense.

• *On exercises:* "We run some very, very stringent exercises, NORAD-generated exercises. They're both real-time operational and computer-generated. For example, what if you have a guy who throws a satchel charge in your generator? . . . Well, we do these [things] to ourselves when we exercise. We destroy parts of the system. We knock out command and control. We go from the region operations control center being nonfunctional [to the point where] the fighter squadron has to go . . . autonomous and fight the war by itself. The squadron commander at Base X has to talk to the squadron commander at Base Y. We have built these different ways of communicating, and we go all the way down to using the phone lines if we have to. In the end, we use radios, phone lines, we use anything we can get our hands on. . . ."

• *On engaging cruise missiles instead of aircraft, if need be:* "We practice that. One of the targets that we use is the 'state-of-the-art' T-33, which is a low observable, 'very low.' Although it's not as small as a cruise missile, we've been using it for a long, long time as a target. . . so our pilots have been practicing tactics and radar discipline that put us on the leading edge of all this. When we started worrying about an ALCM, it was kind of like, OK, it's a smaller T-33, and we just don't have two lieutenants in it."

• *On pilots and controllers:* "At the same time we were [modernizing equipment], we built a very robust and strong career field for radar controllers, which includes the people who work the scopes in the regional ops control centers [as well as] the AWACS controllers. . . . There had always been a very close camaraderie between the pilots and the controllers, and I think it's building even more and more because we each begin to understand the other, and understand that there's a symbiotic relationship between the two, and also a force-multiplier effect if we use the controller properly."

• *On the need for aircraft and equipment that operate well in cold weather:* "Let's face it. . . . The quickest route to the United States is not through Texas, not through Mexico. It's going to come through Canada, or it's going to come through Alaska, or it's going to come through the Northeast United States."

• *On the F-106 Delta Dart:* "It was a grand old lady. It just got very old. There are probably a lot of guys out there who would still like to be flying that grand old lady, because it was a nice airplane. It was a real Cadillac."

• *On the F-106's "very manual" radar:* "They kept adding things to the -106. It wasn't that when it was built in 1959 it went out and sat on the ramp and didn't do anything. In fact, they added knobs in some of the strangest places. You would try to find them at night, and it was knobville inside. There were knobs all over the place. . . . It had great capability, but it required numerous switch changes to do some of the things that an F-15 or an F-16 will do automatically for you. The F-15 and the F-16 are heads-up systems that the pilots can work with very few switch changes. They've given us a tremendous increase in capability, and they've made it much simpler to acquire targets."

ranges between 500 miles and 2,000 miles. Targets within this surveillance area reflect the radar signals back up to the ionosphere, where they are bounced back to the OTH-B receiver. The Air Force plans four OTH-B systems, facing east, west, and south. An East Coast system, in use now and to be fully available next year, and a West Coast system, under construction for 1990, will monitor the areas in which Bear-Hs are known to have practiced attack runs up to their cruise-missile launch points. A third system is planned for coverage to the south to monitor SLCMs launched within the 500-mile minimum range of the coastal systems. A fourth installation, in Alaska, is to watch the Aleutians.

NWS, which uses conventional radars, was chosen for surveillance directly to the north because the aurora borealis interferes with OTH-B signals. By 1992, the thirty-one-year-old, deficient, hard-to-maintain DEW Line radars are to be replaced by NWS, which consists of thirteen minimally attended long-range (200 miles) radars from Alaska's Seek Igloo system and thirty-nine unmanned short-range radars. NWS and Seek Igloo coverage will link up with the OTH-B systems to provide a circle of surveillance around North America.

cates of the US system believe, however, that they couldn't predict performance specifically enough, for a specific date and time, to launch missiles against the US with confidence.

If OTH-B is judged to be deficient in this winter's cruise-missile tests, the Air Force will be able to double the East Coast system's sensitivity by increasing the size of its receiving antenna array to match that of the West Coast installation. Other hardware and software improvements under consideration for development could double sensitivity several times over if needed. Increasing the sensitivity of the system would increase its capabilities against small targets.

Air Force leaders acknowledge that all of their current and planned radar systems will be vulnerable and might be among the first assets lost in an attack on the US. They note, however, that even in this case the system still would have contributed to its main job, warning of an attack, and that to neglect defenses against bombers or cruise missiles is to invite an attack by such forces.

Satellite-based warning systems—which might or might not be less vulnerable than large radar installations on the ground—aren't realistic alternatives to

The Air National Guard plays a big role in air defense. Although more units are converting to the F-16, the F-4 Phantom II is still the Guard interceptor mainstay. This F-4C is from the 123d Fighter Interceptor Squadron at Portland IAP, Ore., and in a previous life, this Phantom was used as a MiG hunter.

© Joe Cupido

The Cruise-Missile Problem

OTH-B capabilities against cruise missiles are suspect because the system's performance against small targets falls off at frequencies below about fifteen megahertz (MHz). The OTH-B systems are operated in six bands between five MHz and twenty-eight MHz, but the ionosphere fails to reflect higher-frequency transmissions when temperatures are low and during times of low sunspot activity. OTH-B performance against cruise missiles will be tested this winter when a drone modified to have a signature similar to that of the AS-15 is flown against the East Coast system.

The Soviets, themselves experienced with OTH-B technology, may be able to predict statistically how the performance of the system would decrease as targets get smaller and as atmospheric conditions worsen. Advo-

OTH-B or NWS. The Air Force has said that a space-based radar test satellite is a prospect for the year 2000 and that an operational constellation couldn't be available before 2005. Space-based infrared coverage, which could be obscured by cloud cover, is a late-1990s prospect. The Teal Ruby satellite experiment, intended to demonstrate IR sensor capabilities, was scheduled last year, but was delayed because of the Shuttle *Challenger* accident. Satellite systems are considered to be part of the Air Defense Initiative, seen as a high-technology counterpart to SDI against air-breathing rather than ballistic missile threats. ■

David F. Bond is a Pentagon correspondent with Aerospace Daily. *This is the first time that his by-line has appeared in* Air Force *Magazine.*

This Florida Guard unit was first in the force to field F-16s in the air defense role. The Fighting Falcon scrambled against its first Bear just a few days later.

The First Intercept

BY CAPT. CAROLYN C. HODGE, USAF

—FlaANG photo by Maj. Bruce Toma

A new era in air defense has begun. This picture shows Lt. Col. Gene Quick of the 125th Fighter Interceptor Group escorting a Soviet Tu-142 Bear-F in international airspace near Jacksonville, Fla. This was the first intercept made using F-16s. Photographer for this photo was Colonel Quick's wingman, Maj. Bruce Toma, who later visually identified another Bear-F.

LAST April 1, the 125th Fighter Interceptor Group of the Florida Air National Guard became the first unit in either the ANG or the active Air Force to fly F-16s in the air defense role.

Having made the transition from F-106 Delta Darts, the pilots of the 125th FIG quickly found out that their new Fighting Falcons serve them much better.

On April 4, the unit's F-16s intercepted an aircraft suspected of carrying contraband drugs. And then, on April 17, came a couple of challenges with even more serious overtones.

Before dawn on that date, controllers at the Southeast Sector Operations Control Center at Tyndall AFB, Fla., picked up the track of an unidentified aircraft on their radarscopes. At 5:30 a.m., the 23d Air Division scrambled two F-16s of the 125th FIG at Jacksonville International Airport to head out over the Atlantic Ocean and intercept the aircraft.

Flying the F-16s were Lt. Col. Gene Quick and Maj. Bruce Toma. Their target turned out to be a Soviet Tu-142 Bear-F antisubmarine warfare (ASW) aircraft.

"We climbed to an altitude of 28,000 feet and—with the assistance of weapons controllers—located the target about 350 miles offshore in international airspace," said Colonel Quick. "At this point, we dropped down to about 3,500 to 4,000 feet to get a good look at the aircraft."

Colonel Quick rolled in to make visual identification. Major Toma took a supporting position. The two F-16s flew alongside the Bear-F for about thirty minutes.

"When I pulled up on the wing," said Colonel Quick, "I saw two guys in the back of the aircraft behind a Plexiglas window at the end of the fuselage—one at the gunnery position and the other in some sort of observation area.

"We waved at each another. Then one of them made a point of showing me the magazine he was reading, letting me know he was pretty bored with all this and not terribly concerned—but not before he snapped my picture and Major Toma photographed him."

Just as the F-16s were about to break off the intercept, they got word from an E-3A airborne warning and control system (AWACS) aircraft on patrol that there was another Soviet aircraft fifty to sixty miles to their west and at about the same altitude.

So the F-16s headed there on the double. They came upon another Bear-F. This time, Major Toma moved into position for visual identification and Colonel Quick stayed back.

The crew of this Bear-F seemed unperturbed by the sudden presence of the F-16s. "They knew where they had to be to do their job, so they just continued about their business," said Major Toma.

The Major had a good, close look at submarine-detection sonobuoys being dropped out of the Bear-F's bomb bay.

As all the aircraft moved northward, the F-16s handed off both Bear-Fs to a pair of F-4D Phantom II interceptors of the 107th Fighter Interceptor Group, operating at the time from Charleston AFB, S. C., but home-based at Niagara Falls International Airport, N. Y.

The F-16 pilots had high praise for their fighter interceptors. "This aircraft is just perfect for our mission," Major Toma said. "The systems all work together so well at feeding information into the computer that we don't have to work as hard at flying as we did before, and we can spend more time assessing the situation."

The F-16 has it all over the F-106 in processing and correlating the directional data needed to seek out and track down targets in vast expanses of sky. This is a major reason why the first intercept of Soviet aircraft by F-16s in their new air defense role went so smoothly.

As Colonel Quick put it: "Oakgrove [call sign of the Southeastern Sector Operations Control Center] did an excellent job of controlling the mission, but it was the teamwork of everyone that really impressed me. From intelligence, air traffic control, maintenance, Oakgrove, and the E-3 weapons controllers, all were in sync with one another and provided perfect support. It just couldn't get any better."

Describing the F-16 as "just great," Colonel Quick said that "its radar—an integral part of success in our business—is far better than what we had on the F-106." The 125th FIG keeps two fully armed F-16s on five-minute scramble alert at the Jacksonville Airport and two more at Homestead AFB, Fla. Its pilots are responsible for intercepting unidentified aircraft flying within the Air Defense Identification Zone (ADIZ) off the southeastern coast of the US, from Savannah, Ga., around the Florida peninsula to a point halfway between MacDill AFB and Tyndall AFB.

The unit began preparing its transition from F-106s to F-16s in August 1985 and was off its alert status from January 2 until March 31 of this year while completing the changeover. Two other ANG units—the 119th FIG at Fargo, N. D., and the 177th FIG at Atlantic City, N. J., filled in for the 125th FIG at Jacksonville and at Homestead AFB respectively.

On April 1, the 125th FIG was back in business with its newly assigned F-16s. "The resumption of the critical alert mission by our pilots with the F-16 signals the end of nineteen months of intensive aircraft conversion preparation and training and the beginning of a new era of enhanced air defense technology and capability for the Florida Air National Guard," said Col. Frank W. Kozdras, the unit's acting commander.

Added Lt. Col. Sam Carter, acting deputy commander for operations: "We needed the new aircraft badly. The F-106 is thirty years old."

As of now, the F-16As being assigned by USAF to the air defense mission carry only the AIM-9L Sidewinder heat-seeking, infrared missiles. All the fighters will eventually be equipped to carry the latest variants of the longer-range AIM-7 Sparrow radar-guided missiles and then the launch-and-leave, radar-guided AIM-120A Advanced Medium-Range Air-to-Air Missiles (AMRAAMs).

For the 125th FIG, converting to the F-16s was quite an undertaking. Its pilots took a six-week course at Tucson International Airport, Ariz. Its avionics, maintenance, and ground-support personnel were retrained. All of its facilities were expanded in order to enlarge the engine shop, add a missile storage area, and upgrade the avionics and weapons work areas, among other projects. ■

—USAF photo by Larry Smith

Comings and goings took on a new meaning earlier this year at the Jacksonville (Fla.) International Airport, as the 125th FIG was in the process of converting from their Convair F-106s (taxiing and at left) to the newer General Dynamics F-16As (right). The Florida Air National Guard unit's F-16s are not yet capable of firing AIM-7 Sparrow missiles, but they will be equipped to do so later.

Capt. Carolyn C. Hodge, USAF, is the Chief of Media Relations for the Air Defense Weapons Center, Tyndall AFB, Fla. She is also the public-affairs liaison for the Southeast Air Defense Sector (formerly the 23d AD). Her previous assignments have included Chief of Public Affairs for the 8th Tactical Fighter Wing at Kunsan AB, Korea, and Chief of the Media Support Branch at Hq. TAC's Office of Public Affairs at Langley AFB, Va.

The first F-15s from Holloman scrambled within hours of arrival at Gilze Rijen. The aircrews are good, but it takes much more than that to make a fighter deployment click.

When a Squadron Deploys

BY CAPT. (MAJ. SELECTEE) NAPOLEON B. BYARS, USAF

Crew chief Sgt. Gabe Hernandez straps Capt. Chuck Dixon into his F-15 prior to the ten-hour flight from Holloman AFB, N. M., to Gilze Rijen Air Base, the Netherlands. Captain Dixon's aircraft is one of twelve F-15s from the 8th TFS that took part in the tactical deployment Coronet Scout, part of the larger program known as Checkered Flag.

As the ninety-five-degree heat rose in waves from the floor of the Tularosa Basin, a dozen F-15 Eagles from the 8th Tactical Fighter Squadron, Holloman AFB, N. M., prepared to launch. Unlike most training missions, though, this one would not be local. This time, they would fly more than ten hours nonstop, 4,680 nautical miles, to Gilze Rijen Air Base in the Netherlands as part of a tactical deployment called Coronet Scout.

The twelve F-15s from the 8th TFS were accompanied across the Atlantic by an EC-135 tactical control aircraft. More than 300 maintenance and support personnel also made the trip aboard four C-141 StarLifters in support of the deployment, which required several in-flight refuelings.

This month-long operation was part of a larger program called Checkered Flag, in which US-based tactical air units deploy to Europe, to Alaska, and to bases in the Pacific. These deployments are often made in support of larger theater exercises.

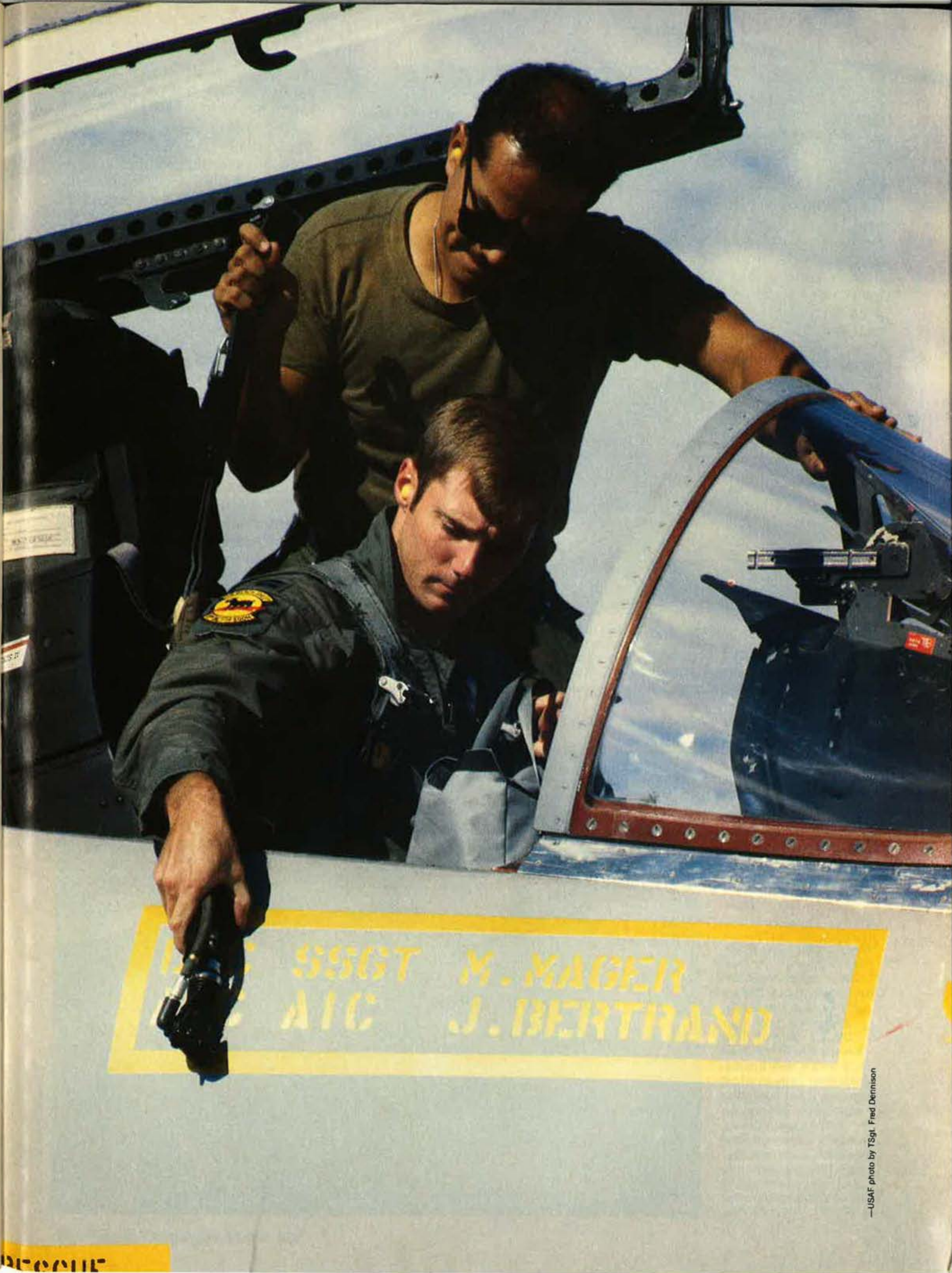
Since the program began in 1975, Checkered Flag has been an eye-opener for Air Force planners and operators.

"The program has really been an education for the Air Force," said Maj. Randy W. May of the Tactical Division, Deputy Chief of Staff for Plans and Operations at the Pentagon. "The most difficult aspect of a deployment is getting the force marshaled and proving that it can be done. Occasionally, a unit will deploy to a bare base with only an 8,000-foot runway and a source of water. When that happens, whatever the unit needs—maintenance packages, war reserves, spare parts, etc.—must be flown in. Almost eighty-five percent of the cost of Checkered Flag is airlift. The importance of airlift can't be overemphasized."

It is no secret that the Warsaw Pact flexes a large amount of military muscle along its borders with Western Europe. If hostilities were to break out, NATO units would have to be rapidly reinforced to prevent a Pact breakthrough. In his 1988 Report to Congress, Secretary of Defense Caspar Weinberger said that initial reinforcements would include sixty tactical fighter squadrons in addition to other combat units.

For that reason, Checkered Flag has a decidedly European tilt.

Fighter deployments require a lot of planning. Details are exact and exhausting—covering everything from aircraft generation to refueling schedules, aircraft configuration, and command and control. "We don't send our people in there cold," Major May said.



—USAF photo by TSgt. Fred Dennison

Ready to Go

Mobility plans require that a squadron be ready to deploy with minimum notification. When the call to deploy is given, one squadron goes into crew rest. Another begins loading on C-141s. The remaining two squadrons help pack pallets and support equipment. First to depart are C-141s carrying personnel and supplies. Next, the first squadron of fighters launches, normally forming up into flights of four. On their way over the ocean, command and control shifts from TAC to the gaining theater commander.

Once the first squadron is off, a second one is turned, and then a third. After the tankers turn, the fourth squadron launches. Within days, a whole wing can be deployed.

"There's not another air force in the world that can move as fast as ours," said one Checkered Flag program manager.

Each wing commander visits his Checkered Flag base for orientation one year before unit deployment. As deployment time nears, an advance team is sent over for a planning conference. When the unit arrives at its Checkered Flag base, it will be met by advance personnel who have worked to get everything cranked up and set to go.

Well ahead of time, aircrews update their knowledge on local operating conditions in the deployment area, geography, probable enemy targets, employment bases, the effects of climatology, and more.

Enemy forces, surface-to-air threats, interceptors, and electronic jamming capabilities quite naturally receive in-depth analysis. How the enemy employs his forces—scramble procedures, engagement tactics, egress profile, as well as escape and evasion tactics—all get a careful going over.

Coronet Scout was designed to familiarize aircrews and support personnel with combat employment in the European environment. Immediately upon arrival at Gilze Rijen AB, 8th TFS personnel were inbriefed and aircraft were quickly turned to a combat-ready status with all aircraft mission-capable. For the next five days, the squadron participated in the NATO Central Region exercise Central Enterprise. Central Enterprise was primarily a command and control exercise in which fighters scrambled off alert to defend NATO airspace against low-altitude intruders.

When a unit deploys in Checkered Flag, it must regenerate its forces and be ready to fly sorties as quickly as it can refuel and rearm.

"We demonstrated our ability to fight by scrambling our jets just a few hours after arrival," Lt. Col. Jerry Coy, 8th TFS Commander, said.

Challenging weather conditions, often at pilot minimums, hampered operations throughout the exercise, but the 8th TFS successfully completed one hundred percent of its fragged missions anyway. No sooner had exercise Central Enterprise ended than the squadron was tasked to participate with the Royal Netherlands Air Force in exercise Grey End, a three-day simulated combat scenario.

The Weather Factor

"The flying we did during exercise Grey End was very beneficial training because of differences in weather conditions," Capt. Scott Fasholtz, an 8th TFS F-15 instructor pilot, said. "At Holloman, the weather is generally sunny and clear, while at Gilze Rijen, the weather was generally cloudy and rainy. Weather conditions tested the response and flexibility of aircrews. Diverting to other bases because of weather often had a real impact on the mission. Exercise Grey End really provided the opportunity to learn how to fly in a different environment."

The severity of the weather factor is put into perspective by a comparison.

—USAF photo by TSgt. Fred Dennison

Here, Captain Dixon proceeds through the final check at Holloman before blocking out. Before pilots reach this stage, they must have thoroughly updated their knowledge of the area to which they are deploying. They must be aware of local operating conditions, geography, employment bases, probable enemy targets, weather, and more, because they are turned to a combat-ready status almost immediately after they arrive.

"If you took all the major cities in the US and ranked them according to weather, Pittsburgh has the worst weather for flying," Major May said. "Now, if you took all the airfields over here and ranked them and then threw Pittsburgh in, Pittsburgh would have the best weather."

Another F-15 pilot pointed to geographical differences: "Flying from a base in New Mexico, there's a lot of desert where visibility is almost always fifty miles-plus, and it's nearly impossible to get lost. You go over to Europe and suddenly visibility on a good day may be only ten miles. In Europe, the landscape is often confusing—every little town looks like every other from above. It really gets to be a challenge to figure out where you are. It's a whole different environment over there."

Although pilots are quick to point to weather and terrain adjustments they make, commanders emphasize that the most beneficial aspects of Grey End, and similar exercises, are the opportunity to man, operate, and become familiar with host country facilities and procedures in wartime scenarios. Air Force officials say the goal is to deploy each active-duty squadron once every two years and Air Force Reserve and National Guard squadrons every three years.

Clad in his somewhat cumbersome—but potentially life-saving—protective suit, one of the more than 300 maintenance and support personnel who made the trip from New Mexico refuels an F-15 at Gilze Rijen in a simulated chemical-warfare environment, one of several scenarios that tested ground-crew response to a variety of threats.

Unlike deployments to European bases where US personnel are stationed permanently, during exercise Grey End the 8th TFS unilaterally supplied the entire wing, squadron, and support staff for the air defense operation at both Gilze Rijen and Eindhoven Air Bases. Additionally, the squadron was prepared to support, staff, and equip a wing operation center in the event the primary facility were "destroyed."

A nonstop, 4,680-nm flight is thirsty work. Here, an F-15 prepares to take on fuel from a KC-135 during one of the several in-flight refuelings required during the journey. Refueling schedules are just part of the planning that must be covered in exact detail for a successful fighter deployment.

"The diverse tasking for our squadron during Grey End really gave us the opportunity to interact with the Dutch military," Maj. Buff Fairchild, 8th TFS ramp baron, said. "We worked with them, coordinating everything from communications to refueling aircraft."

"Exercise Grey End was a comprehensive training event that paralleled the third and final phase of our deployment, the NATO Tactical Evaluation," Colonel Coy said.

In this first-ever evaluation of combined, multinational defensive and offensive units, the 8th TFS proved why it is one of the top-rated

An F-15 touches down at Gilze Rijen on an unusually clear day (the weather there has been unfavorably compared to that of Pittsburgh, which has the worst weather for flying in the US). A hardened hangar—rare in the US, common in NATO Europe—can be seen in the background, testimony to the immediacy of the Warsaw Pact threat.

units in the Air Force. For three days, during round-the-clock operations, the squadron flew 115 of 115 tasked sorties for a perfect sortie-effectiveness rate. Missions primarily consisted of base combat air patrol, lane defense, and low-altitude intercepts.

"The toughest thing about the Tactical Evaluation was the pace of the flying," Captain Fasholtz said. "The pace never slowed from the moment the evaluation began. Some aircrew members flew four sorties in a day. The maintainers met regenerating goals, and we were able to fly all mission taskings."

A Tactical Evaluation is conducted in two phases. Phase one, the readiness phase, is a no-notice recall and load-out of squadron aircraft systems. Phase two, or the battle phase, is a three- to four-day, round-the-clock simulated combat operation.

Changing Combat Conditions

As one USAFE evaluator explained: "The battle begins at less than full wartime conditions on the morning of Day One. Throughout the remainder of the war, as scenarios develop, participants are challenged to respond to simulated biological, chemical, and nuclear attacks by the enemy.

"Scenario development is segmented with battle lines advancing arbitrarily rather than progressively. It is as if each day of the war were several weeks or even months apart instead of consecutive days. This allows for a more realistic evaluation of a squadron's reaction under changing combat conditions."

"The 8th TFS was well prepared, having just completed an Operational Readiness Inspection [ORI] at home," said Col. Joseph Merrick, Commander of the 49th Tactical Fighter Wing, the squadron's parent organization. "A TAC combat-employment ORI is about the maximum amount of pretraining that can be done, with the exception of aircrew study for plans and intelligence testing."

Because of differences in facilities and in theater procedures, though, only a certain amount of training can be accomplished Stateside.

"The Coronet Scout deployment package consisted of aircrews and maintenance members of the 8th TFS, and it also consisted of hundreds of other people from the 49th TFW and 833d Air Division who were vital to the success of the deployment," Brig. Gen. James Record, 833d Air Division Commander, said.

Not to be forgotten are people from the security police, weather, and commissary service, and many more. Additional support was provided by the Air National Guard, the 117th Communications Flight from Birmingham, Ala., and the 178th Communications Flight from Springfield, Ohio.

Upon completion of their deployment, the twelve Eagles from Holloman lifted off the runway at Gilze Rijen for the long trip home. But the readiness training was not over yet.

Immediately upon arrival back home, the 8th Aircraft Maintenance Unit began regenerating aircraft. All twelve aircraft were on status within hours. ■

Capt. (Maj. selectee) Napoleon B. Byars, USAF, is currently assigned to the Office of the Chairman of the Joint Chiefs of Staff as a Special Assistant for Public Affairs. Prior to that, he was assigned to the Secretary of the Air Force Office of Public Affairs. He holds a bachelor's degree in journalism from the University of North Carolina and a master's degree in communications from the University of Northern Colorado. He was a Contributing Editor to AIR FORCE Magazine in 1984–85 under the Air Force's Education With Industry program and continues to write regularly for this magazine. *(Special thanks to Capt. Betsy L. Wells, 833d Air Division Public Affairs Officer, and the personnel of the 8th Tactical Fighter Squadron, Holloman AFB, N. M.)*

JANE'S
ALL THE WORLD'S AIRCRAFT SUPPLEMENT

OCTOBER 1987

First prototype of the Avanti landing at the Paris Air Show *(Brian M. Service)*

PIAGGIO

INDUSTRIE AERONAUTICHE E MECCANICHE RINALDO PIAGGIO SpA, Via R. Piaggio, 17024 Finale Ligure (SV), Italy

PIAGGIO P.180 AVANTI

First details of this new turboprop powered business aircraft were announced in October 1983, at the NBAA annual meeting at Dallas, Texas. It was decided subsequently to specify Pratt & Whitney Canada PT6A-66 engines to power the aircraft, instead of the lower rated PT6A-61s originally selected. This was done to improve and ensure the initial performance goals, including particularly the aircraft's speed in a climb.

All research and development leading to the present design was begun by Piaggio in 1979. Gates Learjet became a partner in the programme in 1983, but withdrew for economic reasons on 13 January 1986. All of Gates's tooling, together with the forward fuselages of the first three development aircraft (two flying prototypes and one for static tests), were transferred to Piaggio.

Construction began in late 1984, and the first Avanti (I-PJAV) made its first flight on 23 September 1986. First flight of the second aircraft took place on 15 May 1987, and RAI/FAA certification to FAR Pt 23 is planned for mid-1988, followed by the start of deliveries in early 1989. Piaggio expects to build an initial production batch of about 12 aircraft.

As can be seen from the accompanying illustrations, the Avanti is of advanced aerodynamic configuration, the major design features being the adoption of a 'three lifting surfaces' concept, to reduce cruise drag and fuel consumption, and placement of the engines aft of the rear pressure bulkhead to minimise engine noise levels in the cabin.

Primary lifting surface is the main wing, which is situated just above the mid position (to avoid drag-inducing bulges in the circular-section fuselage) and, by virtue of the 'pusher' engine installation, has an unbroken leading-edge except for the nacelle inlets. The second lifting surface is the horizontal T tailplane and elevator, which provides orthodox control from a conventional location. The third is the foreplane, which serves as a forward wing rather than a traditional canard surface, by producing a positive component of lift that not only assists the main wing in supporting the aircraft but allows the latter to be reduced in size, thereby also reducing cruise drag and fuel consumption.

In assembly, fuselage skins are stretch-formed in unusually large panels to minimise seams, maintaining precise contour tolerances to ten one-thousandths of an inch. Structural members are then shaped to conform exactly to the skin, rather than the conventional reverse.

While most of the Avanti is of conventional metal

The Avanti's Pratt & Whitney Canada turboprops drive five-blade counter-rotating propellers *(Brian M. Service)*

construction, the nosecone, tailcone, tail unit, engine nacelles, wing moving surfaces, and landing gear doors are built of composite materials: graphite/epoxy (carbonfibre) in areas of high stress and Kevlar/epoxy elsewhere. Most of these parts of the airframe—48 components in all, representing about 10 per cent of the aircraft's operating weight empty—are manufactured under subcontract by Sikorsky Aircraft.

TYPE: Twin-turboprop corporate transport.

WINGS: Cantilever non-swept mid-wing monoplane, tapered on leading- and trailing-edges. Piaggio PE 1491 G (modified) section at root, PE 1332 G section at tip; thickness/chord ratio 13%. Dihedral 2° from roots. Incidence 0°. Sweep 0° at 15 per cent chord. Integrally machined skins and spars of aluminium alloy; main spar forms an integral fail-safe structural unit with rear pressure bulkhead and main landing gear. Trailing-edge flaps (outboard of engine nacelles), balanced ailerons, and wingtips are of all-composite construction. Flaps are actuated electrically, as is trim tab in starboard aileron. Hot air anti-icing of outboard leading-edges.

FOREPLANE: All-composite fail-safe fixed incidence (+3°) foreplane at tip of nose, with 5° anhedral, fitted with electrically actuated all-composite single-slotted auxiliary trailing-edge flaps. Foreplane has Piaggio PE 1300 G aerofoil section, thickness/chord ratio 13%, and 0° sweep at 50 per cent chord. Electric anti-icing of foreplane leading-edges. Auxiliary flaps do not control the aircraft in pitch, but are primarily to assist lift, being coupled with the main wing flaps and deflecting with them to offset changes in trim.

FUSELAGE: Circular-section pressurised fail-safe structure of mainly metal construction (machined and bonded aluminium alloy), with rear pressure bulkhead in line with wing main spar. Nosecone, tailcone, baggage door, and landing gear doors are built of composite materials. Two small metal ventral fins under tailcone.

TAIL UNIT: All-sweptback, all-composite T tail, with variable incidence, 5° anhedral tailplane, balanced elevators, and rudder. Trim tab in rudder and each elevator. No tail unit anti-icing.

LANDING GEAR: Dowty Rotol hydraulically retractable tricycle type, with single-wheel main units and steerable, self-centring twin-wheel nose unit. Main units retract rearward into sides of fuselage; nose unit retracts forward. Dowty hydraulic shock absorbers. Tyre sizes 6.50-10 (main) and 5.00-4 (nose). Multi-disc carbon brakes.

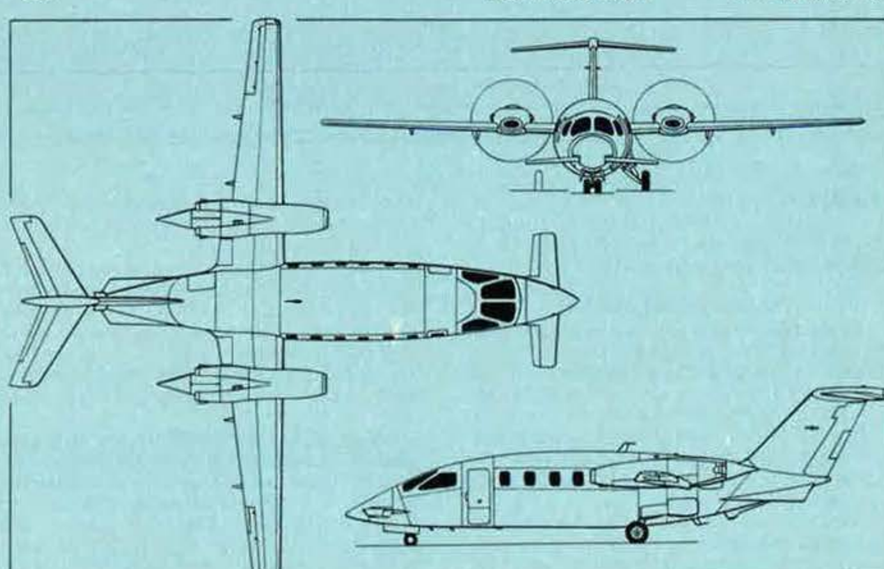
POWER PLANT: Two 597 kW (800 shp) Pratt & Whitney Canada PT6A-66 turboprops, each mounted above the wing in an all-composites nacelle and driving a Hartzell five-blade constant-speed fully-feathering reversible-pitch pusher propeller with metal spinner. Propellers counter rotate. Propeller blades de-iced by engine exhaust. Fuel in two fuselage tanks totalling 700 litres (185 US gallons; 154 Imp gallons) and two 450 litre (119 US gallon; 99 Imp gallon) wing tanks; total fuel capacity 1,600 litres (423 US gallons; 352 Imp gallons). Dual gravity refuelling point in upper part of fuselage.

ACCOMMODATION: Crew of one or two on flight deck. Seating in main cabin for five to nine passengers, with galley, fully enclosed toilet, and coat storage area. Passenger seats are armchair type, which can be reclined, tracked, and swivelled, and locked at any angle. Hardwood trimmed foldaway tables can be extended between facing club seats. Rectangular cabin windows, including one emergency exit at front on starboard side. Indirect lighting behind each window ring, plus individual overhead reading lights. Passenger airstair door at front on port side. Baggage compartment aft of rear pressure bulkhead, with door immediately aft of wing on port side. Entire accommodation pressurised and air-conditioned.

SYSTEMS: Garrett AiResearch bleed air environmental control system, with max pressure differential of 0.62 bars (9.0 lb/sq in). Single hydraulic system, driven by electric motor, with handpump for emergency backup. Electrical system powered by two starter/generators and a 25V 38Ah nickel-cadmium battery. Basic version has 0.62 m³ (22 cu ft) oxygen system. Hot air anti-icing of main wing outer leading-edges; electric anti-icing for foreplane and windscreen.

AVIONICS AND EQUIPMENT: Standard com/nav equipment (Collins Pro Line or other, to customer's requirements). Collins APS-65 digital autopilot systems. Blind-flying instrumentation standard. Landing and taxying lights on nosewheel leg.

DIMENSIONS, EXTERNAL:	
Wing span	13.84 m (45 ft 5 in)
Foreplane span	3.28 m (10 ft 9¼ in)
Wing chord: at root	1.79 m (5 ft 10½ in)
at tip	0.63 m (2 ft 0¾ in)
Foreplane chord: at root	0.79 m (2 ft 7 in)
at tip	0.55 m (1 ft 9⅔ in)
Wing aspect ratio	11.8
Foreplane aspect ratio	4.9
Length overall	14.17 m (46 ft 5¾ in)
Fuselage: Length	12.53 m (41 ft 1¼ in)
Max width	1.95 m (6 ft 4¾ in)
Height overall	3.89 m (12 ft 9¼ in)
Tailplane span	4.18 m (13 ft 8¾ in)
Wheel track	2.84 m (9 ft 4 in)
Wheelbase	5.79 m (19 ft 0 in)
Propeller diameter	2.16 m (7 ft 1 in)
Propeller ground clearance	0.78 m (2 ft 6⅔ in)
Distance between propeller centres	4.13 m (13 ft 6½ in)
Passenger door (fwd, port):	
Height	1.30 m (4 ft 3¼ in)
Width	0.61 m (2 ft 0 in)
Height to sill	0.58 m (1 ft 10¾ in)
Baggage door (rear, port):	
Height	0.64 m (2 ft 1¼ in)
Width	0.70 m (2 ft 3½ in)
Height to sill	1.38 m (4 ft 6½ in)
Emergency exit (stbd):	
Height	0.67 m (2 ft 2¼ in)
Width	0.48 m (1 ft 7 in)
DIMENSIONS, INTERNAL:	
Cabin: Length	6.00 m (19 ft 8¼ in)
Max width	1.83 m (6 ft 0 in)
Max height	1.75 m (5 ft 9 in)
Volume	10.48 m³ (370 cu ft)
Baggage compartment volume	1.19 m³ (42 cu ft)
AREAS:	
Wings, gross	15.76 m² (169.64 sq ft)
Ailerons (total, incl tab)	0.66 m² (7.10 sq ft)
Trailing-edge flaps (total)	1.60 m² (17.23 sq ft)
Foreplane	1.61 m² (17.30 sq ft)
Foreplane flaps (total)	0.585 m² (6.30 sq ft)
Fin	3.68 m² (39.62 sq ft)
Rudder, incl tab	1.05 m² (11.30 sq ft)
Tailplane	2.485 m² (26.75 sq ft)
Elevators (total, incl tabs)	1.35 m² (14.52 sq ft)
WEIGHTS AND LOADINGS:	
Weight empty, equipped	3,039 kg (6,700 lb)
Operating weight empty	3,130 kg (6,900 lb)
Max fuel load	1,224 kg (2,700 lb)
Max payload	907 kg (2,000 lb)
Payload with max fuel	453 kg (1,000 lb)
Max T-O weight	4,767 kg (10,510 lb)
Max ramp weight	4,808 kg (10,600 lb)
Max landing weight	4,529 kg (9,985 lb)



Piaggio P.180 Avanti five/nine-passenger business aircraft *(Pilot Press)*

The 'three lifting surfaces' concept of the Piaggio P.180 Avanti is illustrated clearly in this view *(Brian M. Service)*

Max wing loading 302.3 kg/m² (61.95 lb/sq ft)
Max power loading 4.0 kg/kW (6.57 lb/shp)

PERFORMANCE (preliminary, pending certification, at max T-O weight except where indicated):
- Max operating Mach number 0.67
- Max operating speed 260 knots (482 km/h; 299 mph) IAS
- Max level and max cruising speed at 8,230 m (27,000 ft) 400 knots (740 km/h; 460 mph)
- Econ cruising speed at 12,500 m (41,000 ft) 320 knots (593 km/h; 368 mph)
- Stalling speed, power off:
  - flaps and landing gear up 100 knots (185 km/h; 115 mph) CAS
  - flaps and landing gear down 78 knots (144 km/h; 90 mph) CAS
- Max rate of climb at S/L 1,112 m (3,650 ft)/min
- Rate of climb at S/L, one engine out 381 m (1,250 ft)/min
- Service ceiling 12,500 m (41,000 ft)
- Service ceiling, one engine out 9,750 m (32,000 ft)
- T-O to 15 m (50 ft) 736 m (2,415 ft)
- Landing from 15 m (50 ft) at max landing weight 759 m (2,490 ft)
- Range with 4 passengers, NBAA reserves, at 320 knots (593 km/h; 368 mph) 1,800 nm (3,335 km; 2,072 miles)

MIL

MIKHAIL L. MIL DESIGN BUREAU: USSR

MIL Mi-34

Exhibited in public for the first time at the 1987 Paris Air Show, the Mi-34 is a lightweight two/four-seat helicopter intended primarily for pilot training and international competition flying. Like the Polish PZL-Swidnik SW-4, it is offered as a replacement for DOSAAF's veteran Mi-1 helicopter trainers; but, whereas the SW-4 is turboshaft powered, the Mi-34 has a Vedeneyev piston engine of the same basic type as that fitted in DOSAAF's current family of Yakovlev fixed-wing training aircraft and Kamov Ka-26 helicopters. Other applications for which the Mi-34 is suited include light utility, observation and liaison duties, and border patrol.

Two prototypes and a structure test airframe had been completed by mid-1987. The first flight took place in 1986, and certification is expected by mid-1988. A decision on whether or not the Mi-34 will be produced under the next five-year plan is scheduled to be made in 1988–89. If it is ordered, manufacture is likely to be centred at WSK-PZL Swidnik in Poland, which has produced some 7,000 light helicopters of Mil design since 1955.

TYPE: Light general-purpose helicopter.

ROTOR SYSTEM: Semi-articulated four-blade main rotor, with flapping and cyclic pitch hinges but with natural flexing in the lead/lag plane. Blades are made of glassfibre with carbonfibre reinforcement, and are attached by flexible steel straps to a head similar to that of the McDonnell Douglas (Hughes) MD 500. Two-blade tail rotor of similar composites construction, on starboard side of tailboom.

FUSELAGE: Simple riveted light alloy structure of pod and boom configuration.

TAIL UNIT: Sweptback fin, mid-mounted on port side of tailcone, with small constant chord unswept T tailplane.

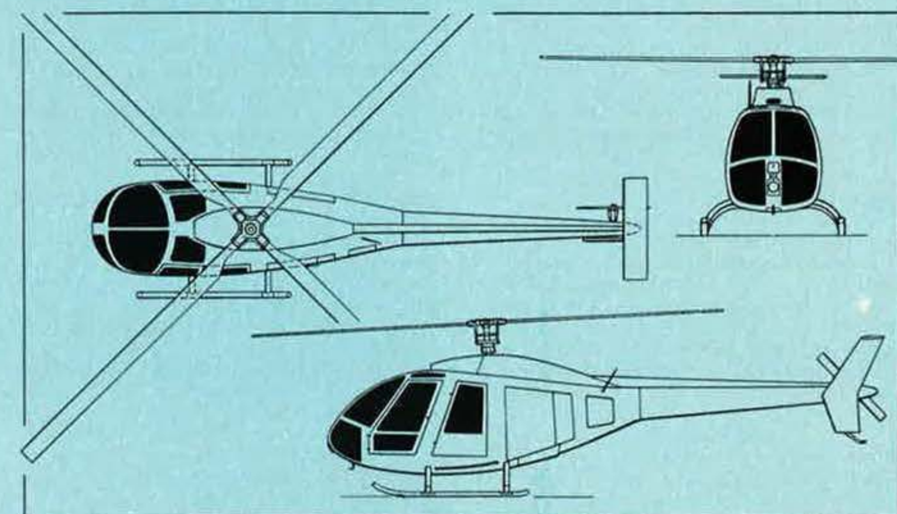
LANDING GEAR: Conventional non-retractable skids on arched support tubes. Small tailskid to protect tail rotor.

POWER PLANT: One 242 kW (325 hp) Vedeneyev M-14V-26 nine-cylinder radial aircooled engine mounted in the centre-fuselage with its cylinders fore and aft. Fuel consumption 45 kg (99 lb)/hour.

ACCOMMODATION: Normally one or two pilots, side by side, in enclosed cabin, with optional dual controls. Rear of cabin contains low bench seat, available for two passengers and offering a flat floor for cargo carrying. Forward hinged door on each side of flight deck and on each side of rear cabin.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.00 m (32 ft 9¾ in)
Tail rotor diameter	1.48 m (4 ft 10¼ in)
Length of fuselage	8.71 m (28 ft 7 in)
Width of fuselage	1.42 m (4 ft 8 in)
Skid track	2.06 m (6 ft 9¼ in)



Mil Mi-34 general-purpose light helicopter *(Pilot Press)*

First prototype of the Mil Mi-34 training and competition helicopter

WEIGHTS:
Normal loaded weight, training mission 1,020 kg (2,249 lb)
Max T-O weight 1,250 kg (2,755 lb)

PERFORMANCE (at T-O weight of 1,020 kg; 2,249 lb, except where indicated):
Max level speed 113 knots (210 km/h; 130 mph)
Max cruising speed 97 knots (180 km/h; 112 mph)
Service ceiling 4,500 m (14,765 ft)
Hovering ceiling 1,500 m (4,920 ft)
Range at max T-O weight:
with 165 kg (364 lb) payload 97 nm (180 km; 112 miles)
with 90 kg (198 lb) payload 243 nm (450 km; 280 miles)
g limits at AUW of 1,020 kg (2,249 lb) and speeds of 27–81 knots (50–150 km/h; 31–93 mph) +2.5/−0.5

HARBIN

HARBIN AIRCRAFT MANUFACTURING CORPORATION, Harbin, Heilongjiang Province, People's Republic of China

Harbin had its origin in the plant of the Manshu Aeroplane Manufacturing Company, one of several aircraft and aero engine factories established in Manchukuo (Manchuria) by the Japanese in 1938. After the Communist regime came to power in mainland China in 1949 it was re-established and re-equipped with Soviet assistance and in recent years has been responsible for production of the Soviet Ilyushin Il-28 jet bomber (Chinese designation H-5) and the nationally designed Y-11 and Y-12 agricultural/utility light twins. These have been described in the *Jane's Supplements* of April 1978 (Y-11), August 1980 (H-5), and April 1983 (Y-12). Harbin is also the chief centre for helicopter production, which began with the Mil Mi-4 (Chinese Z-5). It is currently responsible for the Aérospatiale Dauphin 2 (Z-9/-9A) assembly programme, and is manufacturing components for China's Mil Mi-8s.

Latest known Harbin product is the SH-5 maritime patrol amphibian.

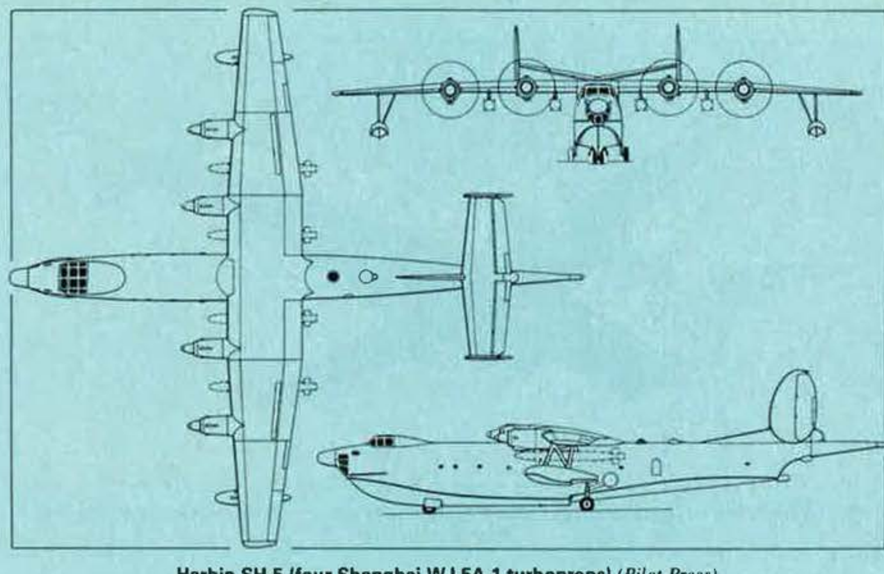
HARBIN SH-5

Chinese name: Sui Hongzhaji 5 (Maritime bomber 5)

First indications of the existence of this four-turboprop flying-boat amphibian came during a visit to China by US aerospace industry representatives in 1980, when two examples were reported to be under construction. The SH-5 was designed by the No. 605 Design Office of the Ministry of Aviation Industry in Jingmen City, Hubei Province, but its development has been somewhat protracted, first flight being said to have taken place in April 1976. It is believed that three prototypes were completed, production not starting until about 1984. Referred to also by the Westernised designation **PS-5** (indicating patrol seaplane), the aircraft's entry into PLA Navy service was announced by the *Liberation Army Daily* on 3 September 1986, following a demonstration to Premier Zhao Zhiyang on 30 August. At least four were then in service with a senior seaplane unit at Qingdao naval air station.

The SH-5 is said to be capable of a wide range of maritime duties including anti-submarine and anti-surface-vessel warfare, patrol and surveillance, minelaying, search and rescue, and the carriage of bulk cargo. Estimated dimensions suggest that it is a large aircraft, bearing a close resemblance to the Japanese Shin Meiwa US-1A. In particular, the hull shape, and the method of retracting the single mainwheels/twin nosewheels landing gear, show similarities to the US-1A, including the spray suppressing strakes on each side of the nose and fuselage-side slots almost in line with the propellers. The dihedral tailplane and twin oval fins and rudders, mounted on a fairing above the rear fuselage, clearly owe their configuration to the Soviet Beriev Be-12 'Mail', although they are proportionately larger.

The Chinese are reportedly seeking an ASW and avionics upgrade, possibly similar to that now under way for the Dassault-Breguet Atlantique 2.



Harbin SH-5 (four Shanghai WJ-5A-1 turboprops) *(Pilot Press)*

TYPE: Maritime patrol and anti-submarine bomber, surveillance, SAR, and transport amphibian.

WINGS: All-metal cantilever high-wing monoplane. Constant chord centre-section; outer panels tapered, with anhedral outboard of outer engine nacelles. Non-retractable stabilising float, on N struts with twin I struts inboard, beneath each wing near tip.

FUSELAGE: Unpressurised all-metal semi-monocoque hull, with high length/beam ratio and single-step planing bottom. Curved spray suppression strakes along sides of nose; spray suppression slots in lower sides, aft of inboard propeller plane. Small water rudder at rear of hull. 'Thimble' radome on nose; MAD in extended tail 'sting'.

TAIL UNIT: High mounted dihedral tailplane, with oval endplate fins and rudders.

LANDING GEAR: Retractable tricycle type, with single mainwheels and twin-wheel nose unit. Oleo-pneumatic shock absorbers. Main units retract upward and rearward into wells in hull sides; nose unit retracts rearward.

POWER PLANT: Four 2,349 kW (3,150 ehp) Shanghai WJ-5A-1 turboprops, each driving a four-blade propeller with spinner.

ACCOMMODATION: Flight crew of five (pilot, co-pilot, navigator, flight engineer, and radio operator), plus systems/equipment operators according to mission. Three freight compartments in front portion of hull. Mission crew cabin amidships, aft of which are two further compartments, one for communications and other electronic equipment and the rear one for specialised mission equipment. All compartments connected by corridor, with watertight doors aft of flight deck and between each compartment.

ARMAMENT AND OPERATIONAL EQUIPMENT: Search radar in 'thimble' radome forward of nose transparencies. Magnetic anomaly detector in extended tail 'sting'. Four underwing hardpoints for C-601 anti-shipping or other missiles, torpedoes, or other stores. Depth bombs, sonobuoys, SAR gear, or other mission equipment and stores, in rear of hull as required.

DIMENSIONS, EXTERNAL (estimated):
Wing span 29.00 m (95 ft 2 in)
Wing aspect ratio 7.0
Length overall 31.00 m (101 ft 8½ in)
Height overall 7.50 m (24 ft 7 in)
Span over tail-fins 9.00 m (29 ft 6 in)
Wheel track 3.05 m (10 ft 0 in)
Wheelbase 8.60 m (28 ft 2½ in)
Propeller diameter 3.05 m (10 ft 0 in)

AREA (estimated):
Wings, gross 120.0 m² (1,291.7 sq ft)

WEIGHTS AND LOADINGS:
Max internal weapons load 6,000 kg (13,228 lb)
Max payload (bulk cargo) 10,000 kg (22,045 lb)
Max T-O weight 45,000 kg (99,208 lb)
Max wing loading approx 375 kg/m² (76.8 lb/sq ft)
Max power loading 4.79 kg/kW (7.87 lb/ehp)

PERFORMANCE:
Max level speed at 5,400 m (17,715 ft) 262 knots (485 km/h; 301 mph)
Touchdown speed approx 108 knots (200 km/h; 124 mph)
Typical patrol radius 1,200 nm (2,225 km; 1,380 miles)
Range with max fuel 2,850 nm (5,280 km; 3,280 miles)

LEADER'S

LEADER'S INTERNATIONAL INC, 212 North Mecklenburg Avenue, South Hill, Virginia 23970, USA

This company is responsible for what are claimed to be the first 'minimum' aircraft designed from the outset for low-cost military use. The first version of which details were released, in the Autumn of 1985, was the single-seat AM-DSI. Although it appeared to be a fairly conventional microlight, its pilot's module was made of Kevlar for resistance to ground fire and crash damage, as well as for low radar signature, and was fully enclosed by a large one-piece transparent canopy. The seat was moulded integrally with the shell of this module. Use of a more powerful engine than is usual in aircraft of this kind was said to offer a speed range from 26 to 200 knots (48–370 km/h; 30–230 mph), with a maximum useful load of 453 kg (1,000 lb). This could include two machine-guns or rocket pods. Missions that could be performed by the AM-DSI were reported to include surveillance, infiltration, anti-helicopter combat, liaison, and ground support, and an RPV version was projected.

Development of the concept is continuing with the AM-DSII, which first flew in prototype form in July 1986. Manufacture of two pre-production AM-DSIIs started in January of this year. Leader's International plans to market the aircraft in kit form and to offer separately components such as wings, control surfaces, pilot modules, and power plants.

LEADER'S INTERNATIONAL AM-DSII

TYPE: Single-seat military aircraft, conforming to ARV and Experimental regulations.

AIRFRAME: Cantilever high-wing monoplane. Double surface constant chord wings, with 13% thickness/chord ratio. Dihedral 3°. Incidence 3°. No sweepback. Airframe of moulded Kevlar composites construction. Tailboom supports conventional tail unit, with control cables di-

Two views of the Leader's International AM-DSII, claimed to be the first 'minimum' aircraft designed from the outset for low-cost military use

rected clear of the propeller arc by ventral boom-mounted pylon. Three-axis control (full span auxiliary aerofoil flaperons, rudder, and elevators), with tab on elevator adjustable from cockpit. Recovery parachute optional.

LANDING GEAR: Non-retractable tailwheel type, with shock absorbers on main units. Mainwheel size 15 × 6.0; tyre pressure 1.52 bars (22 lb/sq in). Mainwheel brakes.

POWER PLANT: Up to 56 kW (75 hp). Prototype has one 40.25 kW (54 hp) Rotax 503 two-stroke two-cylinder engine, driving a Competition Props plastics six-blade fixed-pitch SCAT pusher propeller via 3:1 reduction gearing. Single fuel tank, capacity 95 litres (25 US gallons; 20.8 Imp gallons).

ACCOMMODATION: Pilot only, in an enclosed Kevlar ground-fire resistant cockpit.

ARMAMENT: Hardpoint on each wing for weapons.

DIMENSIONS, EXTERNAL:	
Wing span	7.62 m (25 ft 0 in)
Wing chord, constant	1.22 m (4 ft 0 in)
Wing aspect ratio	6.25
Length overall	6.40 m (21 ft 0 in)
Height overall	1.78 m (5 ft 10 in)
Tailplane span	2.44 m (8 ft 0 in)
Wheel track	1.68 m (5 ft 6 in)
Propeller diameter	1.68 m (5 ft 6 in)
AREA: Wings, gross	9.29 m² (100.0 sq ft)
WEIGHTS AND LOADINGS:	
Weight empty	215 kg (475 lb)
Pilot weight range	61.5–113 kg (135–250 lb)
Max T-O weight	363 kg (800 lb)
Max wing loading	39.06 kg/m² (8.00 lb/sq ft)
Max power loading	9.02 kg/kW (14.81 lb/hp)
PERFORMANCE:	
Never-exceed speed	95 knots (177 km/h; 110 mph)
Max level speed at S/L	74 knots (137 km/h; 85 mph)
Max cruising speed	65 knots (121 km/h; 75 mph)
Stalling speed:	
flaps down	28 knots (52 km/h; 32 mph)
flaps up	32 knots (58 km/h; 36 mph)
Max rate of climb at S/L	198 m (650 ft)/min
Ceiling	2,440 m (8,000 ft)
T-O run	76 m (250 ft)
T-O to 15 m (50 ft)	198 m (650 ft)
Landing from 15 m (50 ft)	228 m (750 ft)
Landing run	61 m (200 ft)
Range with max fuel	312 nm (579 km; 360 miles)
Range with max payload	173 nm (321 km; 200 miles)
Endurance	5 h
g limits	+5/−2

DORNIER

DORNIER GmbH, Postfach 1420, 7990 Friedrichshafen/Bodensee, Federal Republic of Germany

DORNIER 328

Dornier is finalising the design of its model 328 for introduction in mid-1992 as a high-speed, high-comfort twin-turboprop regional transport aircraft with pressurised accommodation for up to 30 passengers. The Dornier 328 is intended to offer take-off, climb, and landing characteristics comparable to those of the company's earlier utility and commuter aircraft, including the capability to operate from STOLports and rough unprepared airstrips. Other criteria include a 78 dBA noise level in 75 per cent of the passenger cabin, 'stand-up' cabin height, and a seat width per passenger better than that in the average Boeing 727 or 737.

The basic 'TNT' wing profile of the Dornier 228 is retained, with an enlarged centre-section housing more fuel, and a new flap system incorporating ground and flight spoilers. This is combined with a new and enlarged circular-section fuselage, developed using data from the Federal Ministry of Research and Technology's NRT (Neue Rumpftechnologien: new fuselage technologies) programme, and a T tail unit of new design. Much use will be made in the structure of various composites materials and some aluminium-lithium alloy.

Some aspects of the Dornier 328's design had yet to be finalised in mid-1987, including engine selection, but the company expects to begin flight testing the first of three development aircraft in late 1990 or early 1991. LBA certification to FAR Pts 25 and 135 standards is planned for mid-1992, with deliveries beginning shortly after this and FAA type approval following in Autumn 1992.

TYPE: Twin-turboprop pressurised regional transport.

WINGS: Cantilever high-wing monoplane, essentially scaled up from that of Dornier 228 by enlarging centre-section, enabling it to accommodate an additional fuel tank. Flight spoiler (outboard) and two ground spoilers added forward of trailing-edge flaps on each wing. Wing skins of aluminium alloy forward, Kevlar/CfK sandwich at rear. Flaps, ailerons, and wingtips of CfK.

FUSELAGE: Circular-section semi-monocoque pressurised structure, with conical nosecone and tailcone. Primary structure is of aluminium alloy, with aluminium-lithium used for longerons, stringers, window frames, and skin panels. Rear fuselage of CfK, tailcone of Kevlar/CfK sandwich; nosecone of GfK sandwich. Doors of superplastic formed aluminium alloy. Long Kevlar/CfK wing/fuselage fairing, offering space for systems installation outside main pressure shell.

TAIL UNIT: Cantilever T tail, comprising sweptback fin and rudder and tapered, non-swept horizontal surfaces. Entire structure of CfK except for dorsal fin (Kevlar/CfK sandwich) and tailplane leading-edge (aluminium alloy). Trim tab in rudder and each elevator.

LANDING GEAR: Retractable tricycle type, with twin wheels on each unit. Nose unit retracts forward, main units into long Kevlar/CfK sandwich unpressurised fairings on fuselage sides. Tyre pressures 3.72 bars (54 lb/sq in) on nose unit, 6.55 bars (95 lb/sq in) on main units.

POWER PLANT: Two 1,268 kW (1,700 shp) class turboprops (not yet selected), each driving a four-blade spinnered propeller with synchrophasing. Nacelles of superplastic formed aluminium-lithium alloy. All fuel in wing tanks, total capacity approx 500 kg (1,102 lb) greater than that of Dornier 228.

Model of the Dornier 328 thirty-passenger regional transport for the 1990s

Venga's TG-10 trainer/light attack aircraft, shown in model form, is claimed to have attracted interest from five countries before its first flight

ACCOMMODATION: Flight crew and cabin attendant(s). Main cabin seats up to 30 passengers, three-abreast at 79 cm (31 in) pitch, with single aisle. Galley and toilet to rear of passenger seats. Large baggage hold between passenger cabin and rear pressure bulkhead, with access from cabin and externally via baggage door in port side. Additional overhead and underseat baggage stowage in main cabin. Crew/passenger airstair door at front on port side, with Type II emergency exit door opposite; Type III emergency exit door on each side at rear of cabin.

SYSTEMS: Air-conditioning and pressurisation systems standard. Hydraulic and electrical systems housed in main landing gear fairings.

AVIONICS: Not yet finalised. Will vary according to customer's requirements.

DIMENSIONS, EXTERNAL (provisional):	
Wing span	20.00 m (65 ft 7½ in)
Wing aspect ratio	10.3
Length overall	21.00 m (68 ft 11 in)
Fuselage: Length	20.00 m (65 ft 7½ in)
Max width	2.40 m (7 ft 10½ in)
Height overall	6.60 m (21 ft 7¾ in)
Propeller diameter	3.20 m (10 ft 6 in)
Propeller/fuselage clearance	0.80 m (2 ft 7½ in)
DIMENSIONS, INTERNAL:	
Cabin: Max width	2.20 m (7 ft 2½ in)
Width at floor	1.595 m (5 ft 2¾ in)
Max height	1.83 m (6 ft 0 in)
Baggage hold volume	6.0 m³ (211.9 cu ft)
AREA:	
Wings, gross	approx 39.0 m² (419.8 sq ft)
DESIGN WEIGHTS:	
Max payload	3,400 kg (7,496 lb)
Max T-O weight	11,000 kg (24,251 lb)
DESIGN PERFORMANCE:	
Cruising speed at 7,620 m (25,000 ft)	310 knots (575 km/h; 357 mph)
Required runway length	945 m (3,100 ft)
Range with 30 passengers, with reserves	701 nm (1,300 km; 808 miles)

VENGA

VENGA AIRCRAFT INC, 666 Sherbrooke Street West, Suite 700, Montreal, Quebec H3A 1E7, Canada

Venga Aircraft was incorporated in May 1985 to develop, manufacture, and market a new, all-composites high-performance jet trainer known as the TG-10. The company combines more than 20 years' experience in developing composite aircraft prototypes and airframe materials, by the Thunder Group of Phoenix, Arizona, and Ecomcon (Empire Composite Consultants) of Vancouver, Canada.

VENGA TG-10

An all-composites airframe and modular construction are intended to give the TG-10 an estimated flying life of about 10,000 hours, due to a considerable reduction in the corrosion and fatigue problems associated with aircraft of metal construction. Its configuration, broadly resembling the Northrop F-5E and McDonnell Douglas F/A-18, also incorporates low-observables design features intended to further improve its survivability. The TG-10 will be repairable in the field using major components and quick-change engine modules, and operable from roads, grass, or unprepared airstrips, with mission capability not only for its primary role as an 'all-through' trainer but also, in single-seat form (with the rear cockpit module removed), as a light ground attack aircraft.

Up to April 1987 Venga had reportedly received letters of interest from five countries, involving approximately 160 aircraft. Rollout of the TG-10 prototype is scheduled for the late Autumn of 1987.

TYPE: Fully aerobatic two-seat 'all-through' jet trainer or single-seat light attack aircraft.

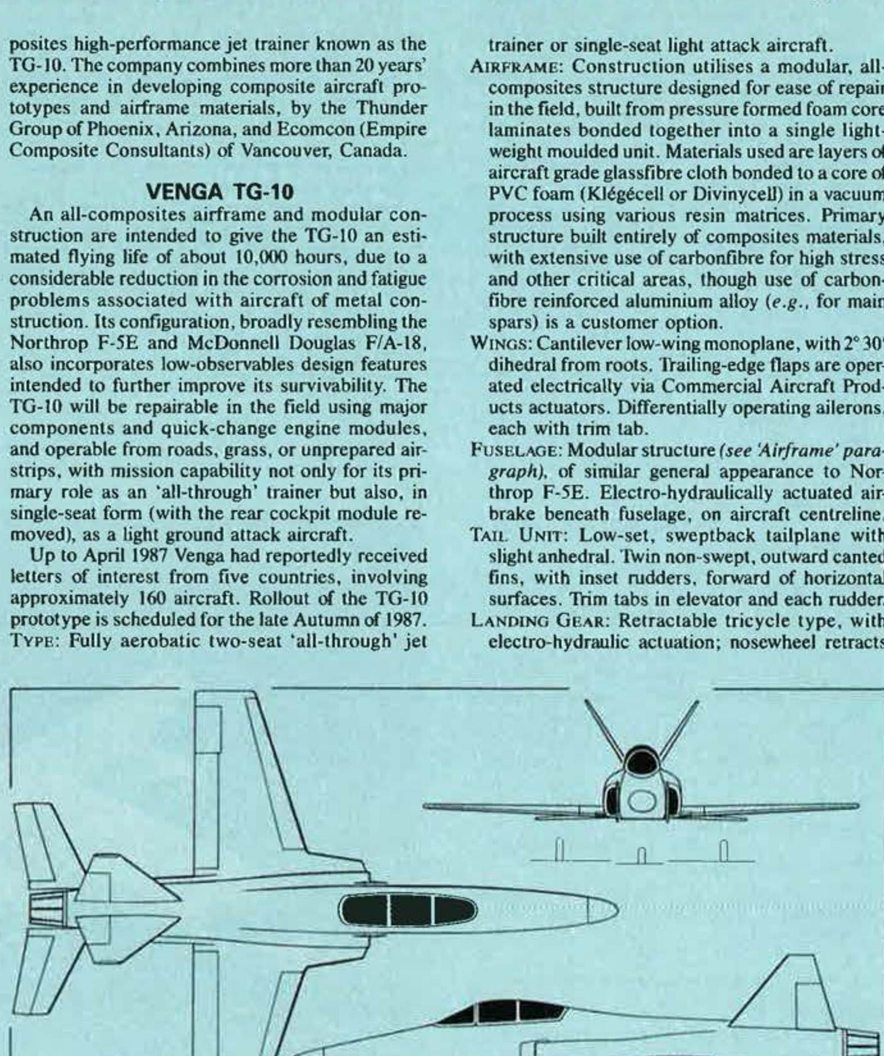
AIRFRAME: Construction utilises a modular, all-composites structure designed for ease of repair in the field, built from pressure formed foam core laminates bonded together into a single lightweight moulded unit. Materials used are layers of aircraft grade glassfibre cloth bonded to a core of PVC foam (Klégécell or Divinycell) in a vacuum process using various resin matrices. Primary structure built entirely of composites materials, with extensive use of carbonfibre for high stress and other critical areas, though use of carbonfibre reinforced aluminium alloy (*e.g.*, for main spars) is a customer option.

WINGS: Cantilever low-wing monoplane, with 2° 30′ dihedral from roots. Trailing-edge flaps are operated electrically via Commercial Aircraft Products actuators. Differentially operating ailerons, each with trim tab.

FUSELAGE: Modular structure *(see 'Airframe' paragraph)*, of similar general appearance to Northrop F-5E. Electro-hydraulically actuated airbrake beneath fuselage, on aircraft centreline.

TAIL UNIT: Low-set, sweptback tailplane with slight anhedral. Twin non-swept, outward canted fins, with inset rudders, forward of horizontal surfaces. Trim tabs in elevator and each rudder.

LANDING GEAR: Retractable tricycle type, with electro-hydraulic actuation; nosewheel retracts



Venga TG-10 two-seat 'all-through' jet trainer or single-seat light attack aircraft *(Pilot Press)* forward, mainwheels inward into fuselage. Wheel sizes 5.00-5 (nose), 6.00-10 (main). Nosewheel steerable through 30°. Mainwheels have hydraulic brakes and parking brake.

POWER PLANT: Prototype powered by one 13.01 kN (2,925 lb st) General Electric J85-GE-5 turbojet; standard engine for basic production version will be an 11.12 kN (2,500 lb st) Pratt & Whitney Canada JT15D-4C turbofan, but customer options will include General Electric CJ610, or Rolls-Royce Viper 632 or 680 turbojets. Intakes are each fitted with a large splitter plate, and are designed to inhibit foreign object damage. Fuel system, designed to permit fully aerobatic manoeuvres, comprises three fuselage cells with total usable capacity of 1,223 litres (323 US gallons; 269 Imp gallons). A 265 litre (70 US gallon; 58 Imp gallon) drop tank can be carried on the fuselage centreline station in the single-seat attack configuration.

ACCOMMODATION: Standard trainer has tandem accommodation for pupil (in front) and instructor on Stencel zero/zero ejection seats under jettisonable bubble canopy, with internal screen between cockpits. Seats are reclined, adjustable horizontally and vertically, and can accommodate back type parachutes. Dual controls standard, except for switches for fuel pumps, weapon control panel, and parking brake; in lieu of these, rear panel has a full set of indicators for the weapons system, an override switch to prevent firing, and a parking brake indicator. Rail mounted rear seat and rear instrument panel module are easily removable to permit quick conversion to single-seat light attack configuration. Cockpit(s) fully air-conditioned, but not pressurised; latter may be offered later as a customer option.

SYSTEMS: 28V DC electrical system, powered by a standard starter/generator and Gates Energy Products lead-acid battery, with second battery for emergency backup. Power sources are coupled to three busbars in front cockpit (main, avionics, and emergency) containing trip-free circuit breakers. NATO type external ground power socket. Normalair-Garrett diluter demand oxygen system, capacity 225 litres (8 cu ft).

AVIONICS AND EQUIPMENT: Avionics include two VHF com, intercom, VOR/ILS/marker beacon receiver (front), VOR/LOC nav (rear), ADF, transponder, and DME. Full IFR capability, with electrically driven gyro instruments; main directional gyro is a King slaved type unit. Provision for HUD, radar altimeter, nose radar, or other avionics to customer's requirements. Standard cockpit instrumentation and equipment includes ASI (two), VSI (two), encoding altimeter, standard altimeter, clock (two), horizon gyro (two), turn and slip indicator (two), accelerometer (two), angle of attack indicator, pictorial navigation indicator, magnetic compass (two), DME indicator (two), ADF information display (two), first aid kit, IFF transponder, fire extinguishing system, and internal/external lighting. Pitot static system and alternate static source in front cockpit; pitot static head in nose mounted probe.

ARMAMENT: One centreline and four underwing hardpoints, each stressed for loads of up to 181.5 kg (400 lb), for weapons, fuel tank (centreline only), survival or rescue packs, or other stores, subject to a max external load of 845 kg (1,864 lb) in single-seat attack version. Weapons specified at present include up to three Portsmouth Aviation 7.62 mm FN gun pods with 450 rds/gun; up to three HMP 0.50 in Browning gun pods with 250 rds/gun; two GIAT 20 mm M621 gun pods with 150 rds/gun; various rocket launchers (Matra F2 with six 68 mm, Aerea AL 18-50 with eighteen 2 in, AL 8-70 with eight 2.75 in FFAR, AL 6-80 with six 81 mm, LAU-32 with seven 2.75 in FFAR, SNIA 2 in, Brandt 7 with seven 68 mm, or SURA-D 81 mm); SAMP 32 kg or 50 kg general purpose or 120 kg fragmentation bombs; 11 kg Mk 76 practice bombs; or a 70 mm automatic panoramic IRLS reconnaissance pod.

One of the surprises of the 1987 Paris Air Show was news that a prototype of the Venga TG-10 is scheduled for rollout this year *(Brian M. Service)*

DIMENSIONS, EXTERNAL:

Wing span	8.23 m (27 ft 0 in)
Wing chord at root	2.29 m (7 ft 6 in)
Wing aspect ratio	5.4
Length overall	11.89 m (39 ft 0 in)
Fuselage: Max width	1.42 m (4 ft 8 in)
Height overall	4.04 m (13 ft 3 in)
Tailplane span	3.96 m (13 ft 0 in)
Wheel track	3.05 m (10 ft 0 in)

AREAS:

Wings, gross	12.54 m² (135.0 sq ft)
Trailing-edge flaps (total)	1.30 m² (14.0 sq ft)
Rudders (total, incl tabs)	1.11 m² (12.0 sq ft)
Tailplane	1.67 m² (18.0 sq ft)
Elevators (total, incl tab)	1.67 m² (18.0 sq ft)

WEIGHTS (A: two-seat trainer, B: single-seat attack):

Weight empty, equipped (incl unusable fuel):	
A	1,288 kg (2,840 lb)
B	1,047 kg (2,308 lb)
Max usable internal fuel:	
A, B	908 kg (2,002 lb)
Max external stores load: A	277 kg (610 lb)
B	845 kg (1,864 lb)
Max T-O weight: A	2,645 kg (5,832 lb)
B (without external stores)	2,041 kg (4,500 lb)
B (with max external stores)	2,886 kg (6,364 lb)

PERFORMANCE (estimated: prototype with J85 engine at 2,645 kg; 5,832 lb max T-O weight):

Max level speed:	
at S/L, ISA	485 knots (899 km/h; 558 mph)
at 9,145 m (30,000 ft), ISA	450 knots (834 km/h; 518 mph)
Stalling speed	78 knots (145 km/h; 90 mph)
Max rate of climb at S/L, ISA	2,134 m (7,000 ft)/min
Time to 9,145 m (30,000 ft)	7 min 12 s
T-O run at S/L, ISA	186 m (610 ft)
T-O to 15 m (50 ft) at S/L, ISA	402 m (1,320 ft)
Ground turning radius, all wheels rolling	6.10 m (20 ft 0 in)
Max range:	
internal fuel only, 10% reserves	950 nm (1,760 km; 1,094 miles)
with c/l drop tank, no reserves	1,271 nm (2,355 km; 1,463 miles)
Max endurance at 9,145 m (30,000 ft)	2 h 30 min

IAI

ISRAEL AIRCRAFT INDUSTRIES LTD (Bedek Aviation Division), Ben-Gurion International Airport, 70100 Lydda, Israel

Modular upgrading programmes have been developed by IAI's Bedek Aviation Division for a

IAI Super Phantom re-engining programme will be made available to F-4 operators worldwide *(Air Portraits)*

New PW1120 turbofans give this Israeli Phantom spectacular performance gains

number of combat and training aircraft including the Mirage, Kfir, A-4 and TA-4 Skyhawk, F-4 Phantom II, Northrop F-5, and various MiG designs. Of particular interest at the present time is the joint IAI/Israeli Air Force programme to upgrade the latter's fleet of about 140 Phantoms.

IAI/IAF PHANTOM 2000 and SUPER PHANTOM

Major objectives of the Israeli Air Force's **Phantom 2000** F-4 upgrade programme are to extend service life, enhance mission capability, improve flight safety, and improve reliability and maintainability. These are being achieved by structural modifications, complete rewiring, and upgrading the avionics.

Three or four Phantom 2000 prototypes are being completed by the Israeli Air Force, the first of which was due to fly during the Summer of 1987. They are being strengthened structurally (reinforced skins and fuel cells in fuselage and wings), to improve flight safety and fatigue life and to extend their service life well into the next century. The aircraft are completely rewired, using fewer harnesses, simplified routing, and new generation hardware, and are equipped with 1553B dual redundant digital databuses. Hydraulic lines are selectively replaced and rerouted, built-in test features added, and the number of line-replaceable units reduced. Small strakes above the intake flanks improve stability and manoeuvrability, and cockpit comfort and instrument layout embody the latest human engineering data. Canards (not yet specified for the IAF programme) and a conformal underfuselage fuel tank are optional.

More important, the Phantom 2000s are being given a new, advanced, and fully integrated avionics suite, the major items of which are a Norden/UTC multimode high-resolution radar, Elop (Kaiser licence) wide-angle diffractive-optics head-up display, Elbit multifunction CRT displays for both crew members, a computerised weapon delivery and navigation system, HOTAS (hands on throttle and stick) systems selection, Orbit integrated com and com/nav systems, and improved electronic warfare and self-protection (ECM) systems. Elbit Computers Ltd is overall integrator for the avionics refit, the core of which is a data processor derived from the company's ACE-3 currently fitted to all IAF F-16C/Ds. 'Production' conversions of IAF aircraft to Phantom 2000 standard will be undertaken by IAI's Bedek Aviation Division.

First step in the **Super Phantom** programme was taken in 1986, when an IAF F-4E (serial number 334) was refitted with a Pratt & Whitney PW1120 turbofan (approx 91.2 kN; 20,600 lb st with afterburning) in place of one of its J79 turbojets, for use as an engine testbed in the Lavi development programme. It flew for the first time in this form on 30 July 1986, subsequently having the other J79 similarly replaced and flying for the first time with two PW1120s on 24 April 1987. Structural changes necessary for this installation included modifying the air inlet ducts; new engine attachment points; new or modified engine bay doors; new airframe mounted gearbox with integrated drive generators and automatic throttle system; modified bleed management and air-conditioning ducting system; modified fuel and hydraulic systems; and an engine control/airframe interface.

By mid-1987 flight test results with this Super Phantom demonstrator (all in 'clean' condition and at speeds of Mach 0.98 or below) had indicated significant performance improvements over the J79 powered F-4. Take-off distance is reduced by 21 per cent, from 1,006 m (3,300 ft) to 793 m (2,600 ft); sustained turn rate improved by 15 per cent (232° instead of 206° in a 40 s turn at Mach 0.9 at 9,145 m; 30,000 ft); rate of climb increased by 33 per cent; acceleration improved by 17 per cent; and penetration speed-with-load capability increased from 545 knots (1,010 km/h; 627 mph) with a 2,154 kg (4,750 lb) bomb load to 595 knots (1,102 km/h; 685 mph) with a 4,082 kg (9,000 lb) load. Other advantages of the PW1120 installation include a decrease in aircraft basic gross weight, and lower specific fuel consumption. The supersonic flight envelope is being explored during the second half of 1987.

For IAF F-4s, only the Phantom 2000 stage has been authorised, re-engining with PW1120s being considered too costly.

Super Phantom showing jetpipes, on exhibition at the 1987 Paris Air Show *(Brian M. Service)*

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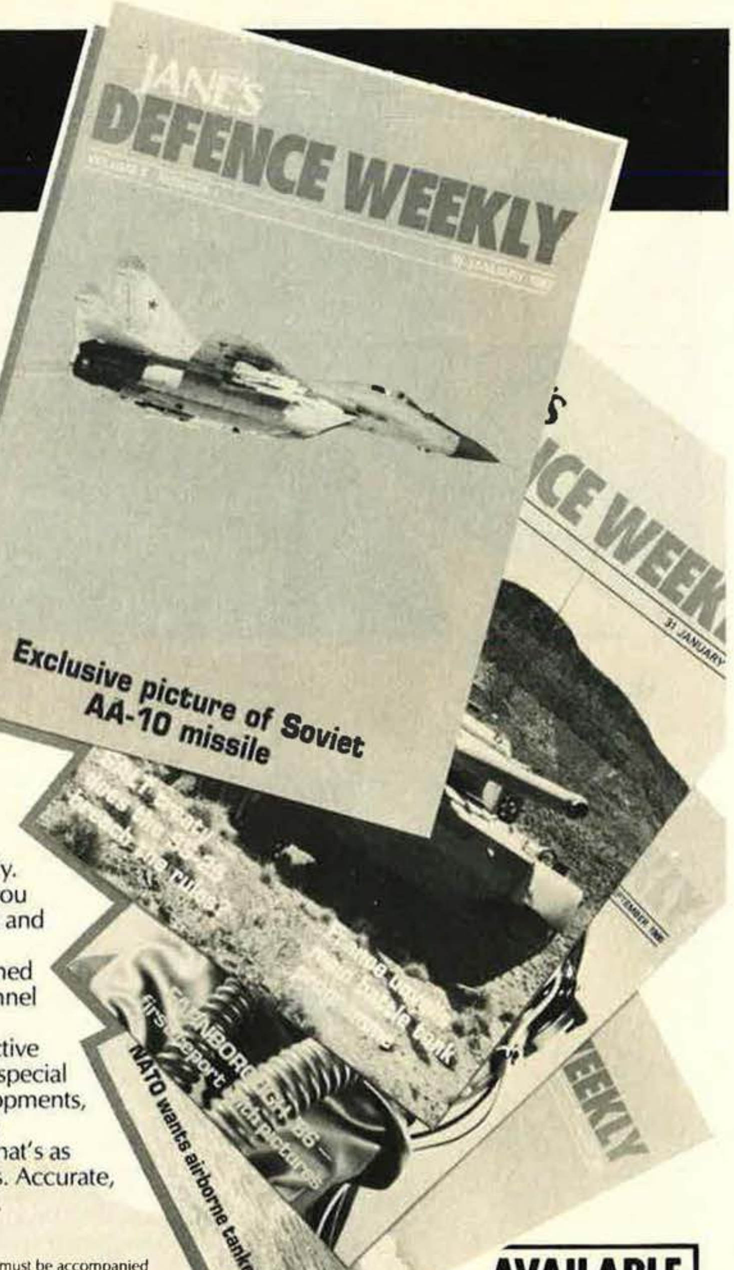

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VIEWPOINT

Sandinista Chic

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

Engulfed by our own doubts and vacillation, we forget the lesson of El Salvador. Intelligent programs of US aid can work in Central America. Uncertainty is a bad foreign policy.

As a measure of how the world has changed since Mick Jagger replaced Benny Goodman, it is now acceptable to consort with the enemy. Tokyo Rose went to jail; Hanoi Jane's fitness books are continually on the best-seller lists, and she is otherwise accorded the deference reserved for the rich and famous.

Another entertainment figure, Kris Kristofferson, was in Managua cheering on the Sandinistas while the Iran-Contra hearings were going on in Washington. There are hundreds more American Sandinista supporters in Nicaragua. Just as in the early days of Castro's Cuba, wide-eyed innocents and the not-so-wide-eyed radical chic have found a new playground.

In all fairness, a country with which we maintain diplomatic relations, like Nicaragua, cannot be considered enemy territory. And now, with our objectives in Central America further confused by a US-blessed peace initiative—one that appears to favor the Sandinistas—maybe we have concluded that there is no enemy. Nevertheless, unless there has been a most remarkable change of heart, the aims of Daniel Ortega and his comrades remain fixed on a Marxist Central America.

While our Congress dithered over whether or not to supply aid to the Contras, Soviet arms shipments to Nicaragua in the first half of 1987, according to reports, exceeded 17,000 tons. The conflict in Central America, not only between the Sandinistas and the resistance movement but also in El Salvador, is essentially a surrogate battle between the United States and the USSR. If the Contras expire for lack of support, the conflict will surely spread. A poll taken recently in Costa Rica—a small, neutral democracy without even an army—identified Nicaragua as the principal menace to Costa Rican security.

As recently as 1983, the Marxist FMLN appeared to be on the verge of winning the revolution in El Salvador. The Salvadoran Army was dispirited, badly led, and unwilling to challenge the guerrillas in their strongholds. It was difficult to find a hotel room in San Salvador as the world press maintained its deathwatch on the Salvadoran government. The irony of the fact that reporters and television crews spent their days with the FMLN and their nights comfortably ensconced in the Camino Real under the protection of the Salvadoran Army never seemed to be the subject of a news story.

The expected end never came, thanks to an intelligent US program of training and logistic aid. Watching the handful of US advisors at work in El Salvador was reassuring evidence that, given responsibility and a job to do, the American military can excel at the task. At the same time, there was a shake-up in the Salvadoran armed forces, and the old-boy network was disrupted by an infusion of new junior officers who had been trained in the United States. The Salvadoran Air Force already had spirited leadership and needed only new airplanes and spare parts.

A few years ago, the flight line at Ilopango Airport looked more like a museum than like the home of an operational force. Those aircraft that could fly, such as the Ouragan jet fighters and the C-54 relics from the days of the Berlin Airlift, were ill-suited to guerrilla warfare. Today, Salvador's Air Force, scarcely more than a couple of squadrons, is better off, although still somewhat inadequately equipped. The most significant improvement has been in the med-evac area, where choppers can now give the wounded a proper chance at survival.

The momentum in El Salvador, however, appears to be slowing, if it has not been lost altogether. The FMLN is once again showing signs of renewed strength, and the Duarte government impresses some observers as irresolute and without real public support.

Colonel Sigifredo Ochoa, one of the most effective of the Salvadoran combat comanders, resigned from the service in July, discouraged by the way things were going. Because he intends to enter politics in opposition to the Duarte government, his remarks to an El Salvadoran newspaper should be judged in that context. However, one thing he said struck home. "The US changes its policy every four years. It is not a consistent policy like that of the Soviet Union, which has a single line for a prolonged period." In other words, no Boland Amendments complicate Soviet policy in Nicaragua.

Ochoa had other things to say, among them that considering the destruction and the number of dead and wounded, he resents our use of the term "low-intensity war." And he commented on the transient nature of our military advisors. They come and go too fast, he said. As soon as an American begins to know the country, he leaves. Given the critical importance of Latin America to our future security, the creation of area military specialists does seem a sensible thing to do. The Army has gone about this more vigorously than the other services, but tours in places like El Salvador are still too brief to counter Colonel Ochoa's charge.

Ochoa is plainly bitter about the social experiments in land reform initiated under President Jimmy Carter, and that may color the remainder of his comments. He is correct, nevertheless, in maintaining that our policy vacillates, that the aid comes too often through an eye dropper, and that the war in El Salvador is winnable if we really want to win it.

For that matter, so is the whole Central American contest, if we really want to win it. Whatever the underlying purpose of the congressional hearings, they have at least succeeded in lending credence to Colonel Ochoa's words. Our future in Central America is, at this point, unpredictable. ■

Top Gun

Nearly half his victories came as a volunteer, after he had completed a 158-mission combat tour.

BY JOHN L. FRISBEE
CONTRIBUTING EDITOR

QUIET, modest, with a turned-up nose and the face of a cherub, he was far from Hollywood's vision of a fighter pilot. But looks can be deceiving. Maj. Richard Ira Bong was the leading American ace of World War II, of all-time, for that matter, with forty victories in the Pacific.

Dick Bong's career was shaped by his association with Gen. George Kenney, who, in June 1942, reprimanded him for a P-38 buzz job in the San Francisco area. Kenney took an immediate liking to the farm boy from Poplar, Wis. A few days later, Hap Arnold sent Kenney to Australia to command Fifth Air Force, with a promise of P-38s and pilots to go with them. Kenney asked for Bong. Planes and pilots arrived during August 1942.

In early November, Dick Bong, with virtually no Stateside training in tactics or gunnery, joined the 39th Fighter Squadron on New Guinea. On December 27, after two months of uneventful patrols, the P-38s saw their first combat. Bong got separated from his flight in a battle with forty Japanese fighters, dived into a gaggle of enemy planes, and shot down two of them. An overjoyed Kenney predicted that this young lieutenant would become the top ace in the Pacific.

For days at a time, the Japanese didn't show over New Guinea. When they did, the hunting was good, but unlike some Pacific aces—Neel Kearby, for example, who had six victories in a single mission *(see "Valor," August '87 issue, p. 105)*—Bong's string grew slowly but steadily. Most of his scores while with the 49th Fighter Group were singles or doubles, with one four-victory mission on July 26, for which he was awarded the Distinguished Service Cross. Ten days later, another kill put his score at sixteen, making him the top ace in the theater. At the end of his first combat tour in November 1943, he had twenty-one victories and five probables in 158 missions. Kenney sent him home on R&R.

Bong undoubtedly could have stayed in the States, but that was not his way. He was glad finally to escape media attention and return to the Pacific as assistant to Tom Lynch, the operations officer of Fifth Fighter Command. General Kenney gave orders that the two be allowed to fly combat as often as they wished; hence, nearly half of Bong's victories came on volunteer missions. Lynch and Bong frequently flew together as a two-man team.

On March 8, Bong suffered "the worst single blow I took while flying combat." He and Lynch, finding no enemy aircraft, strafed enemy barges along the coast. Lynch, a twenty-victory ace, was shot down by flak. A saddened Bong scored three more kills in April, passing Eddie Rickenbacker's World War I record of twenty-six to become the all-time top American ace. Kenney promoted Bong to major and again sent him home to make public appearances and then to attend gunnery school. Bong admitted to being a poor shot.

By early September, Bong was back in New Guinea. He was allowed to fly missions of his choice "to observe the results of a gunnery training program" he was setting up, but was told not to engage in combat unless attacked. Apparently, he was "attacked" frequently, as on a ten-hour mission, escorting the first bombers to hit oil refineries at Balikpapan, Borneo, when Bong felt obliged to down two enemy fighters.

American forces returned to the Philippines in late October 1944. General Kenney was not surprised to find Bong with the first element of the 49th Fighter Group to touch down at Tacloban on Leyte. Since the Americans were greatly outnumbered in the air and on the ground, Kenney agreed to let Bong fly combat regularly. On Pearl Harbor Day, Bong's score stood at thirty-eight.

Back home on May 11, 1945, Maj. Dick Bong, AAF's top ace and Medal of Honor winner, gets Gen. "Hap" Arnold to sign his "short-snorter" bill outside the Pentagon. Bong died three months later.

Kenney had recommended him for the Medal of Honor, which was presented at Tacloban by General MacArthur. Kenney also decided that when Bong's score reached forty, he would go home for good. That day arrived December 17, and on New Year's Day, 1945, Dick Bong landed at San Francisco, a national hero.

After many public appearances and his marriage to Marjorie Vattendahl (for whom his P-38 *Marge* was named), Dick was assigned to the Lockheed plant at Burbank, Calif., to do test and acceptance flights on the then-trouble-plagued Lockheed P-80 fighter. On August 6, after a little more than four hours in the new jet, Dick Bong, who had survived 200 combat missions, crashed and was killed, an ironic fate that befell several other noted combat veterans.

It was doubly ironic that his tragic death shared the headlines with an event of the same date that took place half a world away at Hiroshima—an event that was to change the world Dick Bong fought for, in ways that neither he nor others could have imagined. ■

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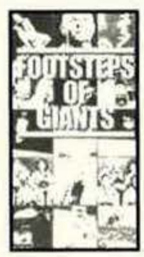

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By Robin Whittle, AFA DIRECTOR OF COMMUNICATIONS

AFA President Keith Visits Overseas Chapters

AFA National President Sam E. Keith, Jr., was effusive about the high morale and spirited enthusiasm he encountered during a recent trip to Europe that included visits to ten of AFA's thirty-four overseas chapters and the chartering of AFA's newest chapter, in Brunssum, the Netherlands.

"I got caught up in their spirit, and it did my AFA heart good to witness such enthusiastic dedication," Mr. Keith said upon returning to the States.

On a fast-paced schedule that took half a month, Mr. Keith met with top Air Force officials and AFA chapter leaders, attended AFA functions and key command briefings, and addressed formal and informal gatherings on the subject of AFA's top concerns.

"I was also very impressed with the dedication of our Air Force men and women at the bases I visited. Many of the young airmen spend their off-duty time fixing up base facilities, using their personal time to take care of things that need to be done. The troops in Europe are first-rate, and their involvement in AFA can't help but improve our Association," Mr. Keith said.

The chartering of AFA's new Charlemagne Chapter culminated six months of planning under the leadership of Maj. Gen. Thomas R. Olsen, the senior USAF officer at Allied Forces Central Europe. The new Chapter serves a NATO headquarters and major subordinate command of SHAPE and the NATO E-3A multinational component at nearby Geilenkirchen AB, Germany.

Mr. Keith met with AFA Chapter President Lt. Col. Mike Hogan, Vice President CMSgt. Kenneth Witkin, and other Chapter officers to discuss the new Chapter's development and future plans.

During a luncheon hosted by Brig. Gen. Larry R. Keith, Deputy Chief of Staff for Operations, 2d Allied Tactical Air Force, Mr. Keith discussed the Soviet political leadership, potential

During his recent European tour, AFA National President Sam E. Keith, Jr., presented members of AFA's newly formed Charlemagne Chapter with the Chapter's charter. With Mr. Keith are Charlemagne Chapter officers (from left) Lt. Col. Jim Love, Secretary; Lt. Col. Mike Hogan, President; and CMSgt. Ken Witkin, Vice President.

AFA National President Sam E. Keith, Jr., congratulates Army Capt. Randy Garibay, a Pershing II liaison officer with USAF's 501st Tactical Missile Wing at RAF Greenham Common, UK, on the occasion of Captain Garibay's enrollment as the RAF Greenham Common/RAF Welford Chapter's newest member. While at RAF Greenham Common, Mr. Keith toured the base and attended a base mission briefing. (Photo by TSgt. Jack Siebold)

cuts in the defense budget, acquisition policies, and the vital role of the Air Force in preserving freedom. The guests included allied officers from Germany, the Netherlands, the United Kingdom, and Canada. Afterward, Mr. Keith officially recognized the Charlemagne Chapter, presented Chapter officers with their charter, and encouraged them to seek out new members and stimulate active participation.

Mr. Keith had begun his ten-chapter tour of Europe with a visit to Ramstein AB, Germany. After meeting with 7th Air Division Commander Brig. Gen. Loring Astorino, Rheinpfalz AFA Chapter President Lt. Col. Emerson Byrd, and Chapter Vice President Capt. Sam Roberts, Mr. Keith received a command briefing. Chapter leaders Lt. Col. Richard Lightfoot, Membership Drive Chairman; Vice Presidents Capt. Karen Poinsett and Capt. Sam Roberts; Special Programs Chairmen Capt. Frank Swords and TSgt. David Johnston; Secretary TSgt. Rosemary Johnston; and Treasurer MSgt. Dave Babock met with Mr. Keith to discuss Chapter activities.

At Zweibrücken AB, Germany, Lt. Col. Jim Shirley, President of the Zweibrücken AB Warrior Chapter, met with Mr. Keith and escorted him on a base tour.

During Mr. Keith's visit to Hahn AB, Germany, he met with Hahn AB Chapter President Capt. Ken Mandley, toured the base, and attended a Chapter dinner that evening.

Next, Mr. Keith visited Lindsey AS, Germany, where he met with Wiesbaden Chapter President Capt. Mike Sullenger.

Afterward, Mr. Keith departed for Sembach AB, Germany, home of the Sembach AFA Chapter. Mr. J. F. Steinbauer is the President of this relatively new chapter. While at the base, Mr. Keith met with Maj. Gen. Richard Pascoe, Commander of Seventeenth Air Force.

At Torrejon AB, Spain, Mr. Keith attended the NCO Preparatory Course graduation luncheon hosted by new AFA Red Raider Chapter President Col. Lawrence P. Farrell, Jr. Colonel Farrell is also the Vice Commander of the 401st Tactical Fighter Wing.

At a Red Raider Chapter dinner, Mr. Keith presented Red Raider certificates to Mr. Charles B. Sicelof, SrA. Louise M. Dawson, AFJROTC Cadet Capt. David R. Poli, Jr., SSgt. Ricardo Febles, and Col. Thomas H. Kirk, Jr., USAF (Ret.). In addition, Mr. Keith was presented with a 401st Tactical Fighter Wing plaque.

While at Ankara AS, Turkey, Mr. Keith met with then-Ankara AFA Chapter President Lt. Col. Janice Hornbrook and Col. Lloyd Muller, TUSLOG AFA advisor. At a Chapter breakfast address, Mr. Keith reported on the growing number of AFA chapters throughout the world, AFA's goal of informing Americans about the need for a strong defense, and the role of AFA in promoting aerospace power. Afterward, Colonel Hornbrook and Colonel Muller presented Mr. Keith with a print of an oil painting that depicts every type of aircraft that has been in the inventory of the Turkish Air Force.

Mr. Keith also visited Hellenikon AB, Greece, and met with AFA Athens Chapter President Maj. Leonard Bates. His visit included a base mission briefing and tour.

Finally, Mr. Keith visited RAF Green-

SSgt. Kari L. Sims gets the picture from AFA National President Sam E. Keith, Jr., during Mr. Keith's stop at Torrejon AB, Spain. Mr. Keith presented a framed copy of a page from the April '87 issue of Air Force Magazine that featured Sergeant Sims at work with an F-16 assigned to the 401st Tactical Fighter Wing at Torrejon AB.

During his stay at Ramstein AB, Germany, AFA National President Sam E. Keith, Jr., visited with the members of the Executive Board of AFA's Rheinpfalz Chapter. With Mr. Keith are Chapter officials (from left) Capt. Karen Poinsett, Vice President; TSgt. Dave Johnston, Special Programs Chairman; Mr. Keith; Capt. Frank Swords, Special Programs Chairman; TSgt. Rosemary Johnston, Secretary; and Lt. Col. Richard Lightfoot, Membership Chairman. (USAF photo)

The oldest and newest members of AFA's Red Raider Chapter at Torrejon AB, Spain—Charles B. Sicelof (left) and SrA. Louise B. Dawson (right), respectively—received Certificates of Appreciation from AFA National President Sam E. Keith, Jr., during a Chapter dinner at the base.

ham Common and there met with Lt. Col. Stephen Boyd, RAF Greenham Common/Welford AFA Chapter President, toured the base, and attended a base mission briefing.

On the Scene

Southern Indiana Chapter President **Marcus R. Oliphant** reports that **Rev. Bob Lorimer** delivered a stirring address at the Chapter's POW-MIA Recognition Ceremony held at Indiana University at Bloomington, Ind. Following his remarks, participants conducted a candlelight vigil and march. Another Southern Indiana Chapter meeting featured **Cy Sherrill,** who showed a videotape on this year's Paris Air Show that featured commentaries by Bob Hoover and Brig. Gen. Chuck Yeager, USAF (Ret.). Following the presentation, AFA's "Gathering of Eagles" videotape was shown to members.

Louisiana AFA Vice President **Dr. Gerard E. Nistal** took exception to several letters in the New Orleans *Times-Picayune* that were critical of the presentations by briefers from AFSC's Foreign Technology Division and that called the appearances, in one instance, the "Air Force's road show." In his own letter, Dr. Nistal explained the program's objectives and the reason the briefers dress as Soviet air officers. He concluded by saying that "we should not decry the exposure of our high-school students to the harsh truths of *Realpolitik* as it exists in today's shrinking world.

Members of AFA's Everett R. Cook Chapter in Memphis, Tenn., recently enjoyed a special address by Louis L. Carruthers, a decorated World War I fighter pilot and a guiding force behind the establishment of the Memphis International Airport. Chapter members honored Mr. Carruthers with an AFA Presidential Citation for his "lifetime of extraordinary achievement in the field of aviation and civic activities." With Mr. Carruthers is Cook Chapter President Dr. Everett E. Stevenson (left).

While we all want and pray for peace—particularly the combat veterans of the Air Force Association—we concur with Teddy Roosevelt's advice: 'Speak softly and carry a big stick.'" His letter was published in the April 23 edition.

Eugene, Ore., Chapter President **Harry Hance,** an AFA National Medal of Merit award winner, wrote an opinion piece on the Strategic Defense Initiative entitled "SDI Research Effort Striding Ahead." In his article, Mr. Hance outlined some of the technical advances that have resulted from research work so far. The editorial appeared in the June 29 Eugene *Register-Guard.*

Louis L. Carruthers, a decorated fighter pilot during World War I who was awarded the Purple Heart and helped establish the Memphis International Airport, was honored by AFA's Everett R. Cook Chapter last spring with a special Presidential Citation for a "lifetime of extraordinary achievement in the field of aviation and civic activities," reports Chapter President **Dr. Everett E. Stevenson.** "Now at age ninety, Mr. Carruthers is still deeply involved in his companies, goes to the office every day, and leads a real-estate holding company," Dr. Stevenson said. He was one of the original founders of the Order of Daedalians (exclusively for World War I-era military pilots) and remains active in encouraging young people to undergo flight training.

AFA National Director **Jan Laitos** presented a plaque on behalf of AFA to the 28th Bomb Wing at Ellsworth AFB, S. D., for its continued demonstration of outstanding operations in maintaining the highest level of strategic deterrence. **Col. Harold B.**

AFA State Contacts

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

ALABAMA (Birmingham, Gadsden, Huntsville, Mobile, Montgomery, Selma): **Robie Hackworth,** 206 Dublin Circle, Madison, Ala. 35758 (phone 205-539-4920).

ALASKA (Anchorage, Fairbanks): **Theron L. Jenne,** 2501 Banbury Dr., Anchorage, Alaska 99504 (phone 907-377-3360).

ARIZONA (Green Valley, Phoenix, Sedona, Sierra Vista, Sun City, Tucson): **Robert A. Munn,** 7042 Calle Bellatrix, Tucson, Ariz. 85710 (phone 602-747-9649).

ARKANSAS (Blytheville, Fayetteville, Fort Smith, Little Rock): **Thomas P. Williams,** 4404 Dawson Dr., North Little Rock, Ark. 72116 (phone 501-758-6885).

CALIFORNIA (Apple Valley, Edwards, Fairfield, Fresno, Los Angeles, Merced, Monterey, Novato, Orange County, Pasadena, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, Sunnyvale, Vandenberg AFB, Yuba City): **Robert L. Griffin,** P. O. Box 5008, Vandenberg AFB, Calif. 93437 (phone 805-866-3501).

COLORADO (Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Littleton, Pueblo): **Jack G. Powell,** AFAFC/AJ, Denver, Colo. 80279-5000 (phone 303-370-4787).

CONNECTICUT (Brookfield, East Hartford, Middletown, Storrs, Stratford, Torrington, Waterbury, Westport, Windsor Locks): **Joseph Zaranka,** 9 S. Barn Hill Rd., Bloomfield, Conn. 06002 (phone 203-242-2092).

DELAWARE (Dover, Milford, Rehoboth Beach, Wilmington): **Horace W. Cook,** 112 Foxhall Dr., Dover, Del. 19901 (phone 302-674-1051).

DISTRICT OF COLUMBIA (Washington, D. C.): **Denny Sharon,** 1501 Lee Highway, Arlington, Va. 22209-1198 (phone 703-247-5820).

FLORIDA (Avon Park, Brandon, Broward County, Cape Coral, Daytona Beach, Gainesville, Homestead, Jacksonville, Leesburg, Miami, Naples, New Port Richey, Orlando, Palm Harbor, Panama City, Patrick AFB, Port Charlotte, Redington Beach, Sarasota, Tallahassee, Tampa, West Palm Beach, Winter Haven): **Donald T. Beck,** 1150 Covina St., Cocoa, Fla. 32927 (phone 305-636-7648).

GEORGIA (Athens, Atlanta, Columbus, Rome, Savannah, St. Simons Island, Valdosta, Warner Robins): **Robert W. Marsh, Jr.,** P. O. Box 542, Springfield, Ga. 31329 (phone 912-964-1941, ext. 254).

GUAM (Agana): **Michael C. Wilkins,** Box CV, Agana, Guam 96910 (phone 671-646-5259).

HAWAII (Honolulu, Puunene): **Don J. Daley,** P. O. Box 3200, Honolulu, Hawaii 96847 (phone 808-525-6296).

IDAHO (Boise, Mountain Home, Twin Falls): **Chester A. Walborn,** P. O. Box 729, Mountain Home, Idaho 83647 (phone 208-587-7185).

ILLINOIS (Belleville, Champaign, Chicago, Elmhurst, Moline, Peoria, Springfield-Decatur): **Walter G. Vartan,** 230 W. Superior Court, Chicago, Ill. 60610 (phone 312-477-7503).

INDIANA (Bloomfield, Fort Wayne, Grissom AFB, Indianapolis, Lafayette, Marion, Mentone, South Bend, Terre Haute): **Bill Cummings,** 12031 Mahogany Dr., Fort Wayne, Ind. 46804 (phone 219-672-2728).

IOWA (Des Moines, Sioux City): **Carl B. Zimmerman,** 608 Waterloo Bldg., Waterloo, Iowa 50701 (phone 319-232-2650).

KANSAS (Garden City, Topeka, Wichita): **Cletus J. Pottebaum,** 6503 E. Murdock, Wichita, Kan. 67206 (phone 316-683-3963).

KENTUCKY (Lexington, Louisville): **Bryan J. Sifford,** % Ronnie W. McGill, 3409 Brunswick Rd., Lexington, Ky. 40503-4310 (phone 606-234-1642).

LOUISIANA (Alexandria, Baton Rouge, Bossier City, Monroe, New Orleans, Shreveport): **Paul J. Johnston,** 1703 W. Medalist Dr., Pineville, La. 71360.

MAINE (Bangor, Loring AFB, North Berwick): **Alban E. Cyr, Sr.,** P. O. Box 160, Caribou, Me. 04736 (phone 207-496-3331).

MARYLAND (Andrews AFB area, Baltimore, Rockville): **William T. Reynolds,** 11903 Chesterton Dr., Upper Marlboro, Md. 20772 (phone 301-249-5438).

MASSACHUSETTS (Bedford, Boston, East Longmeadow, Falmouth, Florence, Hanscom AFB, Lexington, Taunton, Worcester): **Leo O'Halloran,** 420 Bedford St., Suite 290, Lexington, Mass. 02173 (phone 617-264-4603).

MICHIGAN (Alpena, Battle Creek, Calumet, Detroit, Kalamazoo, Marquette, Mount Clemens, Oscoda, Petoskey, Southfield): **William Stone,** 7357 Lakewood Dr., Oscoda, Mich. 48750 (phone 517-724-6266).

MINNESOTA (Duluth, Minneapolis-St. Paul): **Earl M. Rogers, Jr.,** 325 Lake Ave., S., Duluth, Minn. 55802 (phone 218-727-8711).

MISSISSIPPI (Biloxi, Columbus, Jackson): **R. E. Smith,** Rte. 3, Box 282, Columbus, Miss. 39701 (phone 601-327-4071).

MISSOURI (Kansas City, Richards-Gebaur AFB, Springfield, St. Louis, Whiteman AFB): **Raymond W. Peterman,** 11315 Applewood Dr., Kansas City, Mo. 64134 (phone 816-761-7453).

MONTANA (Bozeman, Great Falls): **Ed White,** 2333 6th Ave., South Great Falls, Mont. 59405 (phone 406-453-2054).

NEBRASKA (Lincoln, Omaha): **Ralph Bradley,** 3902 Davenport, Omaha, Neb. 68131.

NEVADA (Las Vegas, Reno): **Victor Hollandsworth,** 3720 Falcon Way, Reno, Nev. 89509 (phone 702-826-1326).

NEW HAMPSHIRE (Manchester, Pease AFB): **Robert N. McChesney,** Scruton Pond Rd., Barrington, N. H. 03825 (phone 603-664-5090).

NEW JERSEY (Andover, Atlantic City, Belleville, Camden, Chatham, Cherry Hill, East Rutherford, Forked River, Fort Monmouth, Jersey City, McGuire AFB, Middlesex County, Newark, Old Bridge, Trenton, Wallington, West Orange, Whitehouse Station): **Jim Young,** 513 Old Mill Rd., Spring Lake Heights, N. J. 07762 (phone 201-449-8637).

NEW MEXICO (Alamogordo, Albuquerque, Clovis): **Louie T. Evers,** P. O. Box 1946, Clovis, N. M. 88101 (phone 505-762-1798).

NEW YORK (Albany, Bethpage, Brooklyn, Buffalo, Chautauqua, Griffiss AFB, Hudson Valley, Nassau County, New York City, Niagara Falls, Patchogue, Plattsburgh, Queens, Rochester, Rome/Utica, Suffolk County, Syosset, Syracuse, Westchester, Westhampton Beach, White Plains): **Maxine Z. Donnelly,** 18 Jackson Place, Massapequa, N. Y. 11758 (phone 516-795-2746).

NORTH CAROLINA (Asheville, Charlotte, Fayetteville, Goldsboro, Greensboro, Kitty Hawk, Raleigh): **J. E. Smith,** P. O. Box 765, Princeton, N. C. 27569 (phone 919-936-9361).

NORTH DAKOTA (Concrete, Fargo, Grand Forks, Minot): **Ruth Ziegler,** #5 16th St., N. W., Minot, N. D. 58701 (phone 701-839-2465).

OHIO (Akron, Cincinnati, Cleveland, Columbus, Dayton, Mansfield, Newark, Youngstown): **John Boeman,** 10608 Lake Shore Blvd., Bratenal, Ohio 44108 (phone 216-249-8970).

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OREGON (Eugene, Klamath Falls, Portland): **Hal Langerud,** 10515 S. W. Clydesdale Terrace, Beaverton, Ore. 97005 (phone 503-644-0645).

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RHODE ISLAND (Warwick): **Thomas R. Portesi,** 102d Tactical Control Squadron, North Smithfield ANG Station, Slatersville, R. I. 02889 (phone 401-762-9100).

SOUTH CAROLINA (Charleston, Clemson, Columbia, Myrtle Beach, Sumter): **Harry E. Lavin,** 28 Little Creek Rd., The Forest, Myrtle Beach, S. C. 29577 (phone 803-272-8440).

SOUTH DAKOTA (Rapid City, Sioux Falls): **Jim England,** Rte. 8, Box 3980, Rapid City, S. D. 57702 (phone 605-342-2200).

TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tri-Cities Area, Tullahoma): **Jack K. Westbrook,** P. O. Box 1801, Knoxville, Tenn. 37901 (phone 615-523-6000).

TEXAS (Abilene, Amarillo, Austin, Big Spring, College Station, Commerce, Corpus Christi, Dallas, Del Rio, Denton, El Paso, Fort Worth, Harlingen, Houston, Kerrville, Laredo, Lubbock, San Angelo, San Antonio, Waco, Wichita Falls): **Ollie R. Crawford,** P. O. Box 202470, Austin, Tex. 78720 (phone 512-331-5367).

UTAH (Brigham City, Clearfield, Ogden, Provo, Salt Lake City): **Marcus C. Williams,** 4286 S. 2300 West, Roy, Utah 84067 (phone 801-627-4490).

VERMONT (Burlington): **Ralph R. Goss,** 8 Summit Circle, Shelburn, Vt. 05482 (phone 802-985-2257).

VIRGINIA (Arlington, Charlottesville, Danville, Harrisonburg, Langley AFB, Lynchburg, Norfolk, Petersburg, Richmond, Roanoke): **Charles G. Durazo,** 1725 Jefferson Davis Highway, Suite 510, Arlington, Va. 22202 (phone 703-892-0331).

WASHINGTON (Seattle, Spokane, Tacoma, Yakima): **Charles Burdulis,** N. 5715 Sutherlin, Spokane, Wash. 99208 (phone 509-327-8902).

WEST VIRGINIA (Huntington): **Ron Harmon,** 1600 Core Rd., Parkersburg, W. Va. 26101 (phone 304-485-2088).

WISCONSIN (Madison, Milwaukee): **Gilbert Kwiatkowski,** 8260 W. Sheridan Ave., Milwaukee, Wis. 53218 (phone 414-463-1849).

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

"**Buck" Adams,** 28th Bomb Wing Commander, accepted the honor from Mr. Laitos and South Dakota AFA President **James England.**

AFA's Thunderbird Chapter near Nellis AFB, Nev., recently honored the top airman, NCO, and senior NCO of the quarter at a luncheon at the NCO Club. Awarded complimentary one-year AFA memberships by Thunderbird Chapter leader **Stanley R. Janesik** were **A1C Richard J. Hageman,** 474th Component Repair Squadron; **SSgt. Jose J. Longoria,** 57th Component Repair Squadron; and **MSgt. Jeffrey A. McCormick,** 554th Security Police Squadron.

AFA's Charlottesville, Va., Chapter has been renamed in honor of a longtime Charlottesville resident, the late **Lt. Col. William A. Jones III.** "Colonel Jones was awarded the Medal of Honor for action over North Vietnam while flying an A-1H rescue mission in 1968," Chapter President **Wayne E. Whitlatch** said. "He died in a light-aircraft accident in 1969." The chapter-renaming ceremony took place at a special dinner meeting that featured **John W. Huston,** former Chief of the Office of Air Force History, as speaker. Special guests were **Mrs. William A. Jones III** and **Mrs. Elizabeth Boehlert,** one of the couple's three daughters. During the evening, Mr. Whitlatch read letters from **Sen. John W. Warner** (R-Va.) and **Rep. D. French Slaughter, Jr.** (R-Va.), who congratulated the Chapter for honoring Colonel Jones's heroic actions by taking his name.

Colorado AFA honored four outstanding Air Force members of the year at its state convention at Lowry AFB, July 31–August 1, reports Colorado AFA President **Jack Powell. Capt. Melissa R. Kallett,** an instructor in behavioral sciences and leadership at the Air Force Academy, was named the top junior officer; **CMSgt. James C. Wright,** Security Police Manager, 3415th Air Base Group/Security Police Squadron, was selected the outstanding senior NCO of the year; **SSgt. Thomas C. Anders,** a systems accountant specializing in travel entitlements with the Plans and Systems Directorate, AFAFC, was honored as the outstanding NCO; and **SrA. Kelly J. Witkowski,** a personnel specialist with the Directorate of Individual Reserve Programs at ARPC, was the top Airman of the Year, reports Mr. Powell.

AFA's New England and South Central Regions have begun publishing regional newsletters to keep states and chapters better informed about each other. **Joe Falcone,** National Vice President for the New England

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Region, acquired software for his computer to print labels and design a newsletter. The goal, according to Mr. Falcone, is to encourage a stronger regional team and to help New England grow toward greater accomplishment. *The Dixie Flyer,* developed by **James P. LeBlanc,** National Vice President for AFA's South Central Region, will be sent to all AFA members in the region. The first issue included a report from Tennessee AFA President **Jack Westbrook,** AFA's 1987–88 "Man of the Year." Future issues will include reports from other states in the region.

Excellent media coverage resulted from **Lt. Gen. Truman Spangrud's** address to a joint meeting of the Knoxville, Tenn., Kiwanis Club and AFA's General Bruce K. Holloway Chapter last summer. The purpose of General Spangrud's visit was to give the Air Force a higher profile in what is per-

In honor of its sustained excellence in maintaining the highest levels of strategic deterrence, AFA recently presented a special plaque to the 28th Bomb Wing, a B-1B unit at Ellsworth AFB, S. D. AFA National Director Jan Laitos (left) and South Dakota AFA President Jim England (right) presented the plaque to Wing Commander Col. Harold B. "Buck" Adams.

AFA's Charlottesville Chapter in Virginia recently changed its name to honor Vietnam-era Medal of Honor recipient Lt. Col. William A. Jones III. Among those present at the renaming ceremonies were Chapter President Wayne E. Whitlatch and Colonel Jones's widow, Mrs. William A. Jones III.

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ceived to be a nonmilitary city. The Air University Commander sought to dispel a number of myths surrounding national defense issues, including manpower levels, morale, defense costs and their share of the national budget, troop deployment, the Soviet threat, and the like, reports Mr. Westbrook. One attendee was heard to say that the General's speech was "the best speech I've heard in the past decade" on the subject. General Spangrud's appearance in Knoxville was arranged by Holloway Chapter President **Sidney G. Hatfield** and Mr. Westbrook. ■

UNIT REUNIONS

Reunion Notices

Readers wishing to submit reunion notices to "Unit Reunions" should mail their notices well in advance of the event to "Unit Reunions," AIR FORCE Magazine, 1501 Lee Highway, Arlington, Va. 22209-1198. Please designate the unit holding the reunion, time, location, and a contact for more information.

No. 1 BFTS Ass'n
American instructors and cadets of the No. 1 British Flight Training School will hold a reunion on October 14–18, 1987, in Dallas and Terrell, Tex. **Contact:** Nickey Naumovich, P. O. Box 38527, Dallas, Tex. 75238. Phone: (800) 527-3454 or (800) 441-0324.

4th Tow-Target Squadron
Members of the 4th Tow-Target Squadron who served in World War II will hold a reunion on November 5–7, 1987, in Savannah, Ga. **Contact:** Lawrence Raynor, R. D. 1, Box 34, Woodcrest Way, Conklin, N. Y. 13748. Phone: (607) 775-1274.

318th Fighter Interceptor Squadron
The 318th Fighter Interceptor Squadron will hold its fifteenth D. B. Cooper Practice Dining-In on November 20, 1987, at the Officer's Mess at McChord AFB, Wash. **Contact:** Capt. Hugh A. Miller, USAF, 318th FIS/DO, McChord AFB, Wash. 98438. Phone: (206) 984-2171.

325th Bomb Squadron
Members of the 325th Bomb Squadron will be hosting a Dining-In on October 17, 1987, at Fairchild AFB, Wash. **Contact:** Capt. David G. Smith, USAF, 325th BS/92d BW (SAC), DO-24, Fairchild AFB, Wash. 99011. Phone: (509) 244-5418. AUTOVON: 352-5418.

450th Bomb Group
Members of the 450th Bomb Group, Fifteenth Air Force (WW II), will hold a reunion on October 14–18, 1987, in Colorado Springs, Colo. **Contact:** Arnold Daniels, 228 Holley Rd., Sweet Home, Ore. 97386.

B-57 Weapons Personnel
I am trying to organize a reunion for former personnel who served with my husband, Sgt. John R. Red, between 1970 and 1972 in the B-57 Weapons Department at MacDill AFB, Fla.

Please contact the address below for additional information.

Mrs. John R. Red
6050 E. White Tie Rd.
Coal City, Ill. 60416
Phone: (815) 634-4781

Muroc Bombing Range
I would like to hear from those interested in holding a reunion of former personnel from the Army Air Corps and AAF who were assigned to the Muroc Bombing Range from 1933 to 1949.

I am particularly interested in the men of the Bombing and Gunnery Detachment who served in the 2d Air Materiel Squadron, 4th Air Base Group, March Field, Calif., and also personnel from the 44th Air Materiel Squadron, 32d Air Base Group, who served in the late 1930s through WW II.

Please contact the address below.

James L. Ballance
2756 Franklin St.
San Francisco, Calif. 94123
Phone: (415) 928-3826

79th AEW&C Squadron
I am trying to organize a reunion for former members of the 79th Airborne Early Warning and Control Squadron, which flew EC-121 "Pregnant Whales" and operated from Homestead AFB, Fla.

Please contact the address below.

Laurie A. Haire
1505 N. W. 113th Ave.
Pembroke Pines, Fla. 33026
Phone: (305) 432-9314

6003d Base Flight Squadron
I would like to hear from members of the 6003d Base Flight Squadron based at Haneda AB, Japan (1950–54), for the purpose of planning a reunion.

Please contact the address below.

Alfred E. Troop
2330 Lantana Rd., #9D
Lantana, Fla. 33462
Phone: (305) 964-9073


SPECIAL
DELIVERY


CLASSICS
PHOTOGRAPHY BY MARK MEYER
INTRODUCTION BY WALTER J. BOYNE

PLEASE RETAIN THIS MEDICAL INFORMATION BUREAU PRENOTIFICATION FOR YOUR RECORDS

Information regarding your insurability will be treated as confidential. United of Omaha Life Insurance Company may, however, make a brief report thereon to the Medical Information Bureau, a nonprofit membership organization of life insurance companies, which operates an information exchange on behalf of its members. If you apply to another Bureau member company for life or health insurance coverage, or a claim for benefits is submitted to such a company, the Bureau, upon request, will supply such company with information in its file.

Upon receipt of a request from you, the Bureau will arrange disclosure of any information it may have in your file. (Medical information will be disclosed only to your attending physician.) If you question the accuracy of information in the Bureau's file, you may contact the Bureau and seek a correction in accordance with the procedures set forth in the Federal Fair Credit Reporting Act. The address of the Bureau's information office is P.O. Box 105, Essex Station, Boston, Mass. 02112, Phone (617) 426-3660.

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APPLICATION FOR AFA
GROUP LIFE INSURANCE

Full name of member ______ Rank ______ Last ______ First ______ Middle

Address ______ Number and Street ______ City ______ State ______ ZIP Code

Date of Birth (Mo. / Day / Yr.)	Height	Weight	Social Security Number	Flying Status ☐ Yes ☐ No

This insurance is available only to AFA members

☐ I enclose $18 for annual AFA membership dues (includes subscription ($14) to AIR FORCE Magazine).

☐ I am an AFA member.

Name and relationship of primary beneficiary ______

Name and relationship of contingent beneficiary ______

Please indicate below the Mode of Payment and the Plan you elect:

Plan of Insurance

Mode of Payment	Standard Plan: Member Only	Standard Plan: Member and Dependents	High Option Plan: Member Only	High Option Plan: Member and Dependents	High Option PLUS Plan: Member Only	High Option PLUS Plan: Member and Dependents
Monthly government allotment (only for military personnel). I enclose 2 months premium to cover the necessary period for my allotment (payable to Air Force Association) to be established.	☐ $ 10.00	☐ $ 12.50	☐ $ 15.00	☐ $ 17.50	☐ $ 20.00	☐ $ 22.50
Quarterly. I enclose amount checked.	☐ $ 30.00	☐ $ 37.50	☐ $ 45.00	☐ $ 52.50	☐ $ 60.00	☐ $ 67.50
Semi-Annually. I enclose amount checked.	☐ $ 60.00	☐ $ 75.00	☐ $ 90.00	☐ $105.00	☐ $120.00	☐ $135.00
Annually. I enclose amount checked.	☐ $120.00	☐ $150.00	☐ $180.00	☐ $210.00	☐ $240.00	☐ $270.00

Names of Dependents To Be Insured	Relationship to Member	Dates of Birth Mo. Day Yr.	Height	Weight

Have you or any dependents for whom you are requesting insurance ever had or received advice or treatment for: kidney disease, cancer, diabetes, respiratory disease, epilepsy, arteriosclerosis, high blood pressure, heart disease or disorder, stroke, venereal disease or tuberculosis? Yes ☐ No ☐

Have you or any dependents for whom you are requesting insurance been confined to any hospital, sanatorium, asylum or similar institution in the past 5 years? Yes ☐ No ☐

Have you or any dependents for whom you are requesting insurance received medical attention or surgical advice or treatment in the past 5 years or are now under treatment or using medications for any disease or disorder? Yes ☐ No ☐

IF YOU ANSWERED "YES" TO ANY OF THE ABOVE QUESTIONS, EXPLAIN FULLY including date, name, degree of recovery and name and address of doctor. (Use additional sheet of paper if necessary.)

I apply to United of Omaha Life Insurance Company for insurance under the group plan issued to the First National Bank of Minneapolis as Trustee of the Air Force Association Group Insurance Trust. Information in this application, a copy of which shall be attached to and made a part of my certificate when issued, is given to obtain the plan requested and is true and complete to the best of my knowledge and belief. I agree that no insurance will be effective until a certificate has been issued and the initial premium paid.

I hereby authorize any licensed physician, medical practitioner, hospital, clinic or other medically related facility, insurance company, the Medical Information Bureau or other organization, institution or person, that has any records or knowledge of me or my health, to give to the United of Omaha Life Insurance Company any such information. A photographic copy of this authorization shall be as valid as the original. I hereby acknowledge that I have a copy of the Medical Information Bureau's prenotification information.

Date ______, 19 ____ ______ Member's Signature

Application must be accompanied by a check or money order. Send remittance to: Insurance Division, AFA, 1501 Lee Highway, Arlington, Virginia 22209-1198.

AFA Air Force Association

United of Omaha

Group Policy GLG-2625
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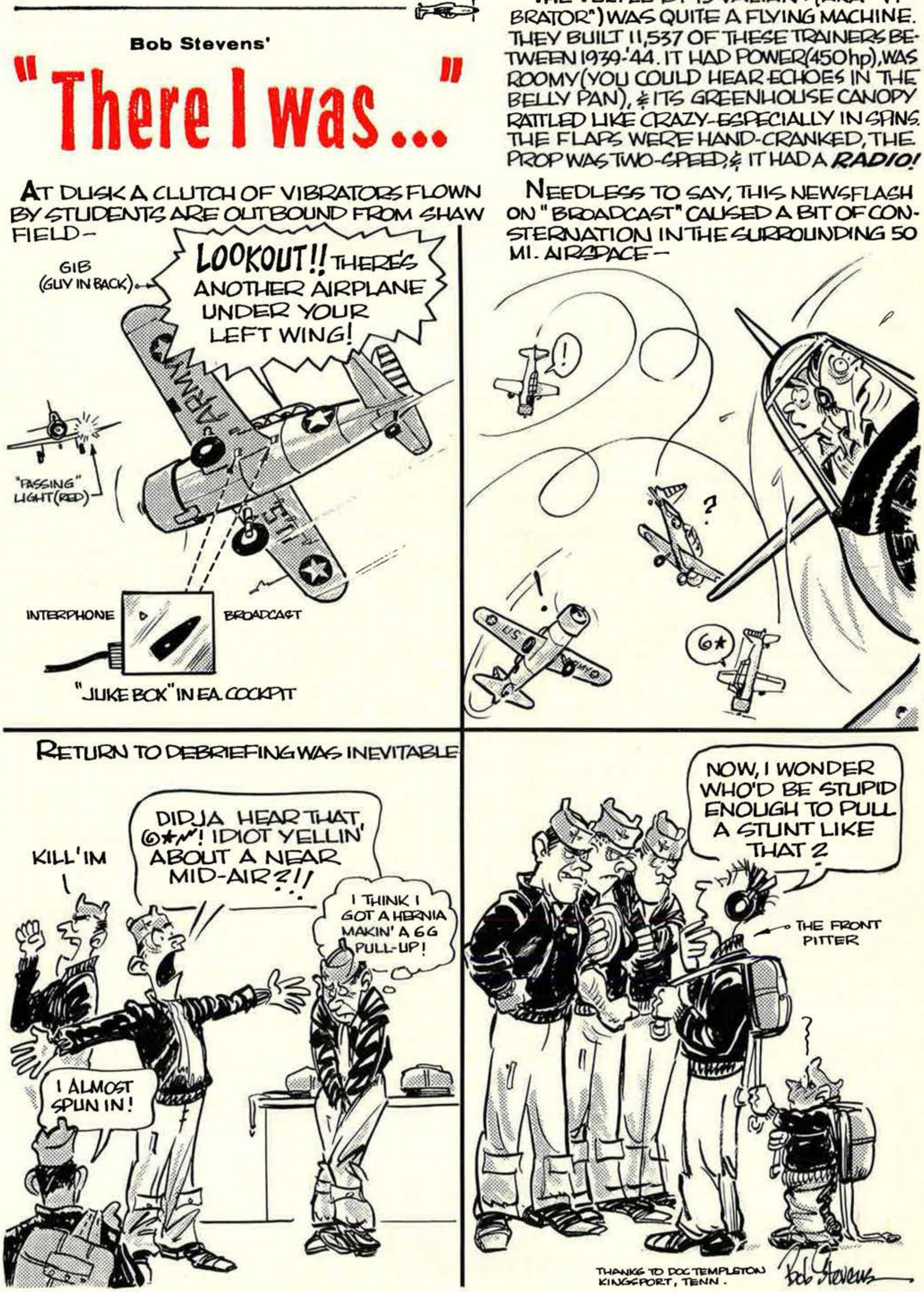
FORM 3767GL App REV. 10-79

10-87

Apply Today! If You Have Questions, Call TOLL FREE: 1-800-858-2003.


Bob Stevens'
"There I was..."
THE VULTEE BT-13 VALIANT (AKA "VIBRATOR") WAS QUITE A FLYING MACHINE. THEY BUILT 11,537 OF THESE TRAINERS BETWEEN 1939-'44. IT HAD POWER (450hp), WAS ROOMY (YOU COULD HEAR ECHOES IN THE BELLY PAN), & ITS GREENHOUSE CANOPY RATTLED LIKE CRAZY-ESPECIALLY IN SPINS. THE FLAPS WERE HAND-CRANKED, THE PROP WAS TWO-SPEED & IT HAD A RADIO!
AT DUSK A CLUTCH OF VIBRATORS FLOWN BY STUDENTS ARE OUTBOUND FROM SHAW FIELD-
GIB (GUY IN BACK)
LOOKOUT!! THERE'S ANOTHER AIRPLANE UNDER YOUR LEFT WING!
"PASSING" LIGHT (RED)
INTERPHONE
BROADCAST
"JUKE BOX" IN EA. COCKPIT
NEEDLESS TO SAY, THIS NEWSFLASH ON "BROADCAST" CAUSED A BIT OF CONSTERNATION IN THE SURROUNDING 50 MI. AIRSPACE-
!
?
!
6★
RETURN TO DEBRIEFING WAS INEVITABLE
KILL'IM
DIDJA HEAR THAT, 6★#! IDIOT YELLIN' ABOUT A NEAR MID-AIR?!!
I THINK I GOT A HERNIA MAKIN' A 6G PULL-UP!
I ALMOST SPUN IN!
NOW, I WONDER WHO'D BE STUPID ENOUGH TO PULL A STUNT LIKE THAT?
THE FRONT PITTER
?
THANKS TO DOC TEMPLETON KINGSPORT, TENN.
Bob Stevens