AUGUST 1983/$1

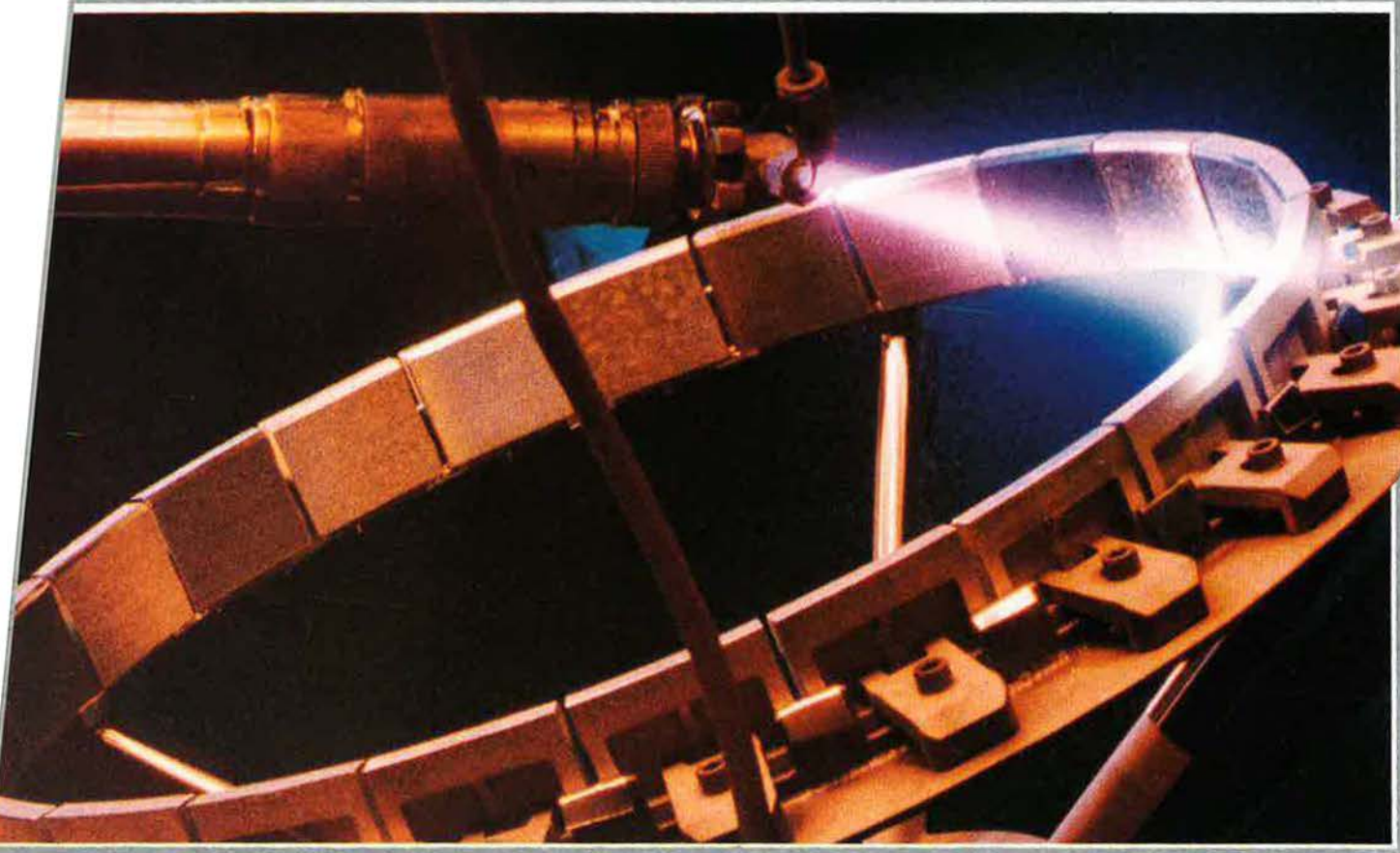
AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

R&D

The Ups and Downs Of Building Systems

Aircraft engine innovations that bring technology to life:



We took a vacuum and filled it with the future of manufacturing.

General Electric has gone far beyond traditional forging and casting to develop a system that fabricates advanced jet engine parts literally in a flash. With an impressive name, Rapid Solidification Plasma Deposition (RSPD), it's an impressive futuristic manufacturing process that rapidly achieves the near final net shape of complex aircraft engine parts.

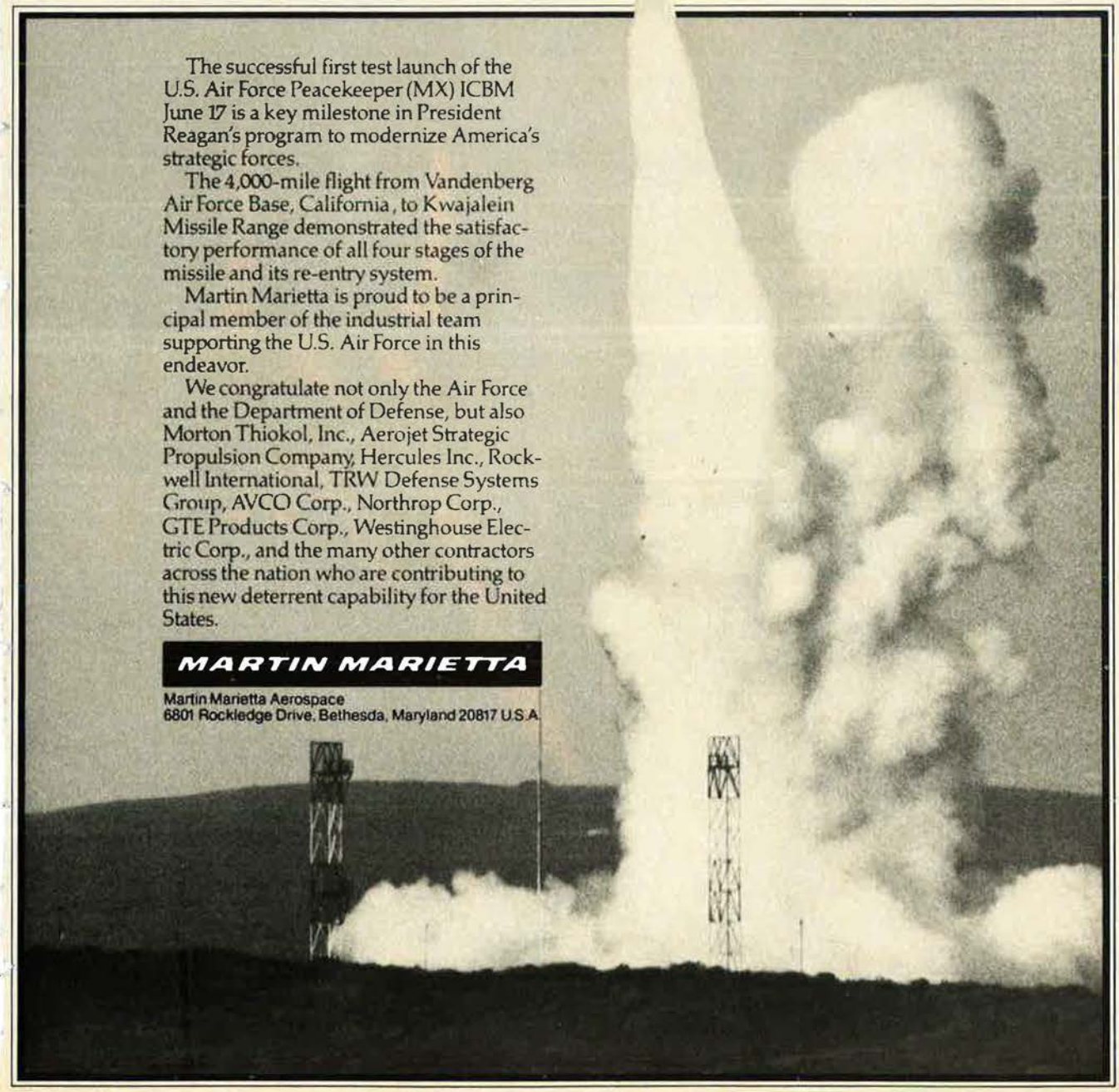
In addition to saving time, RSPD saves money and brings new levels of quality and reliability to parts manufacturing. Starting in GE's advanced RSPD vacuum chamber, Space Age alloys in the form of ultra-fine powder are melted by being shot through a 50,000°F plasma gun at speeds approaching Mach 3. The liquid metal sprays onto a prototype form and cools at nearly one million degrees per second. This rapid cooling produces a nearly fully dense, virtually flawless metal structure.

Parts formed by GE's innovative computerized spray gun reach a precision that's far beyond any hand-guided operation. RSPD parts are exceptionally strong and heat resistant, potentially adding thousands of hours to engine life, reducing labor, maintenance, and downtime. More than just forging ahead in aircraft engine manufacturing, General Electric is shaping the future.

We bring good things to life.

GENERAL ELECTRIC

Keeping America first in peace.



The successful first test launch of the U.S. Air Force Peacekeeper (MX) ICBM June 17 is a key milestone in President Reagan's program to modernize America's strategic forces.

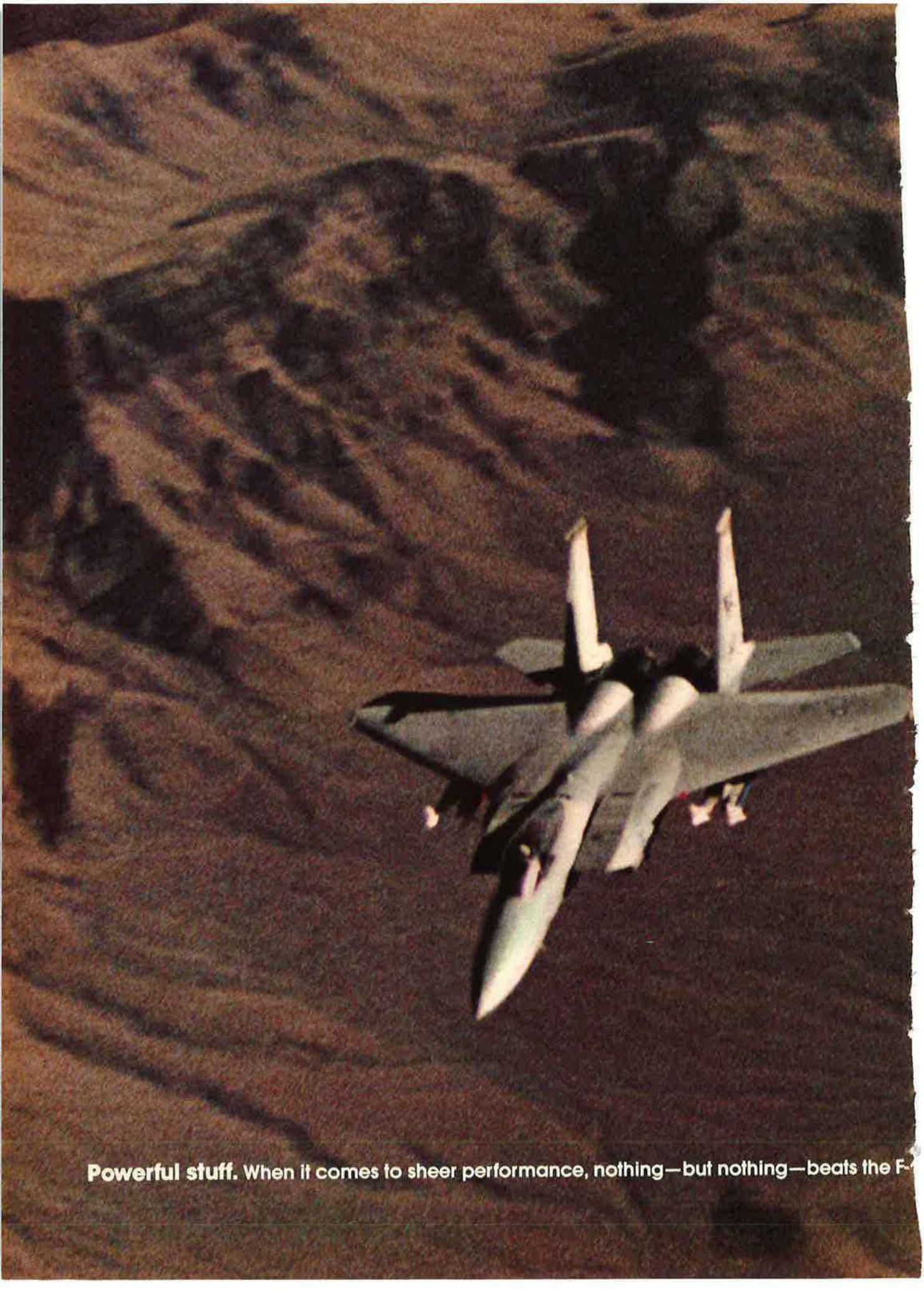
The 4,000-mile flight from Vandenberg Air Force Base, California, to Kwajalein Missile Range demonstrated the satisfactory performance of all four stages of the missile and its re-entry system.

Martin Marietta is proud to be a principal member of the industrial team supporting the U.S. Air Force in this endeavor.

We congratulate not only the Air Force and the Department of Defense, but also Morton Thiokol, Inc., Aerojet Strategic Propulsion Company, Hercules Inc., Rockwell International, TRW Defense Systems Group, AVCO Corp., Northrop Corp., GTE Products Corp., Westinghouse Electric Corp., and the many other contractors across the nation who are contributing to this new deterrent capability for the United States.

MARTIN MARIETTA

Martin Marietta Aerospace
6801 Rockledge Drive, Bethesda, Maryland 20817 U.S.A.



Powerful stuff. When it comes to sheer performance, nothing—but nothing—beats the F-


nd F-16 fighters and their F100 engines from Pratt & Whitney, a division of United Technologies.

The F-16: Standard of excellence in air-to-surface fighter performance.

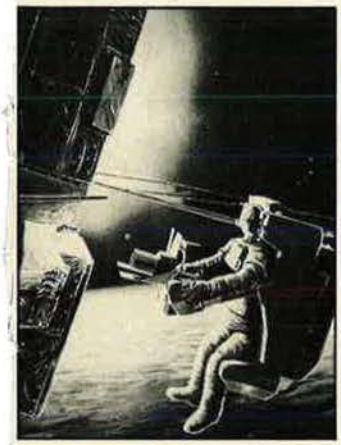
The F-16 Falcon. This outstanding air-to-air fighter is equally formidable as a tactical bomber. No other aircraft comes close to matching its proven multimission capabilities.

GENERAL DYNAMICS

AUGUST 1983
VOLUME 66, NUMBER 8

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION



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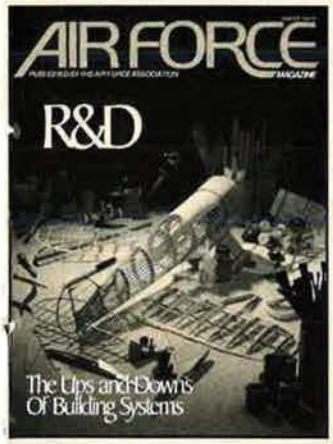


About the cover: A model in progress of a Wedell-Williams Racer, circa 1933. The model builder is Col. Hurst G. Bowers, USAF (Ret.). (Photo by Thomas W. Radcliffe)

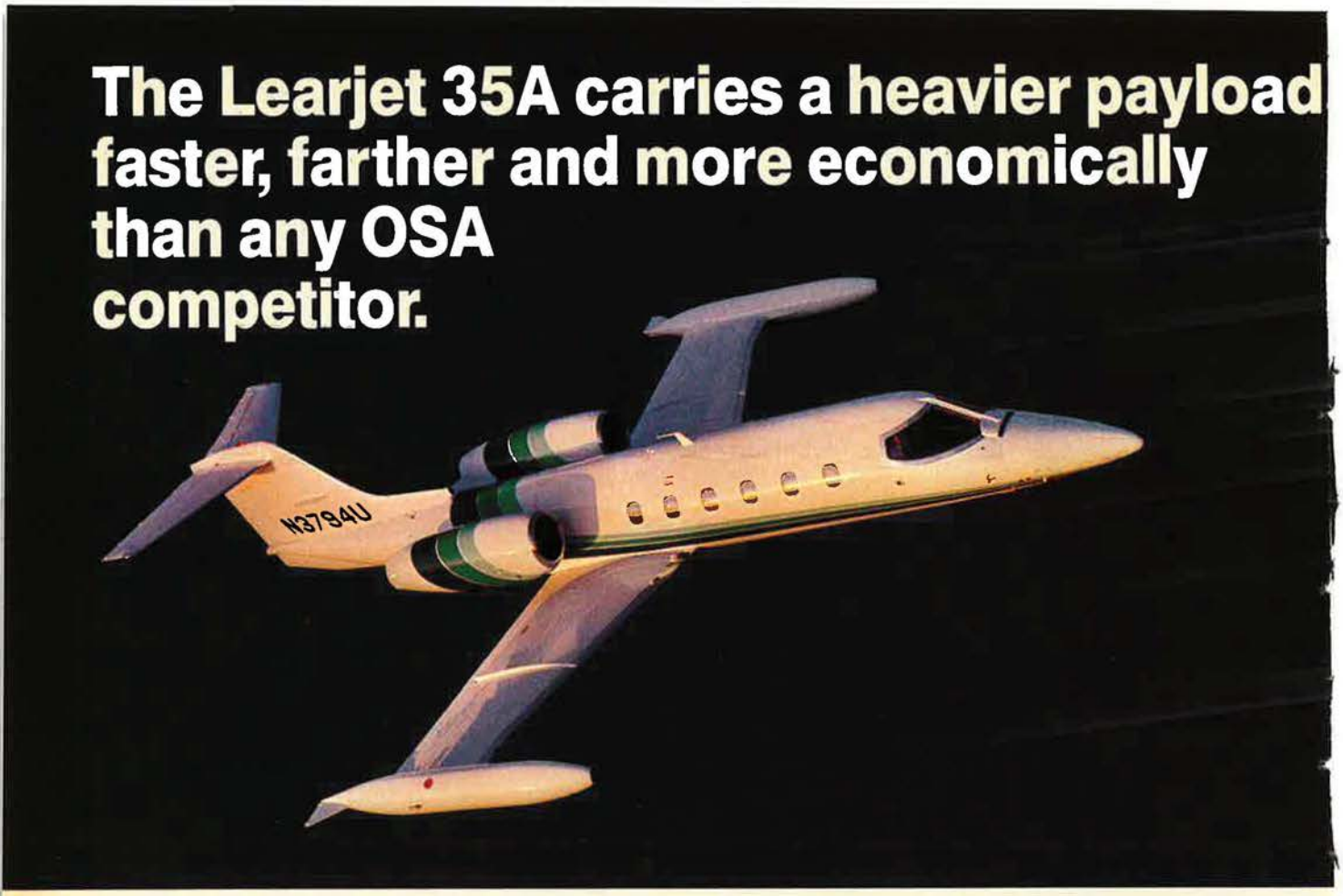
Special Section: Research and Development

Features

Departments

AIR FORCE Magazine (ISSN 0730-6784) is published monthly by the Air Force Association, Suite 400, 1750 Pennsylvania Ave., N.W., Washington, D.C. 20006. **Phone:** (202) 637-3300. Second-class postage paid at Washington, D.C., and additional mailing offices. **Membership Rate:** $15 per year; $36 for three-year membership (includes $24 for subscription). **Life Membership:** $200. **Subscription rate:** $15 per year; $25 per year additional for postage to foreign addresses (except Canada and Mexico, which are $8 per year additional). Regular issues $1 each. Special issues (Soviet Aerospace Almanac, USAF Almanac issue, Anniversary issue, and "Military Balance" issue) $3 each. **Change of address** requires four weeks' notice. Please include mailing label. Publisher assumes no responsibility for unsolicited material.

The Learjet 35A carries a heavier payload faster, farther and more economically than any OSA competitor.



The Learjet 35A is ready to join the U.S. Air Force as its Military Airlift Command Operational Support Aircraft. And it's the only aircraft in its category which offers true cost and performance improvements over the CT-39.

This is no green recruit.

The Learjet 35A has proven its performance, efficiency, and reliability through a decade of operation. The 30 series Learjet has logged over a million hours in the air. It's flown daily by more corporations than any other jet model in the world. And it's been selected by 17 different nations for special military roles — including aerial ambulance duty, cargo hauling, electronic surveillance, and photo reconnaissance.

Higher performance, bigger payloads

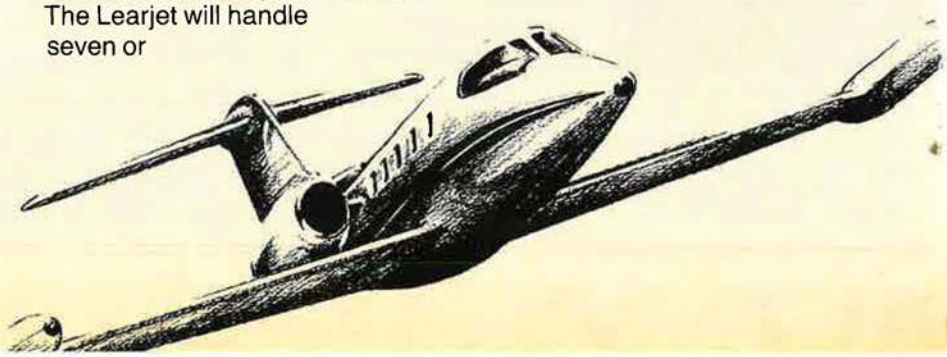
With more than 1,300 jets delivered worldwide, the Learjet is renowned as the number one business jet. But its roots are solidly in the military. The original Learjet was designed from a Swiss Air Force fighter/bomber — and that military heritage is still evident in today's 35A. Its low overall weight and high thrust give it the same durability and tactical-like qualities that made the T-39 such a versatile resource in its day. But the Learjet goes a step beyond — with performance reserve for safe single-engine operation, even on hot days, and for rapid climb to cruise altitudes above the tropopause, where weather and commercial traffic aren't a problem.

But more important for MAC's mission, that high thrust-to-weight ratio gives the Garrett TFE 731-powered Learjet an excellent payload capacity. There's no worrying about allowable cabin load limits, even at ranges well beyond those available with the CT-39 or OSA competitor aircraft. The Learjet will handle seven or eight passengers and their baggage, and still take a full load of fuel. That means passengers and cargo can go where they need to go — directly — efficiently.

Improved capability, better pilot seasoning

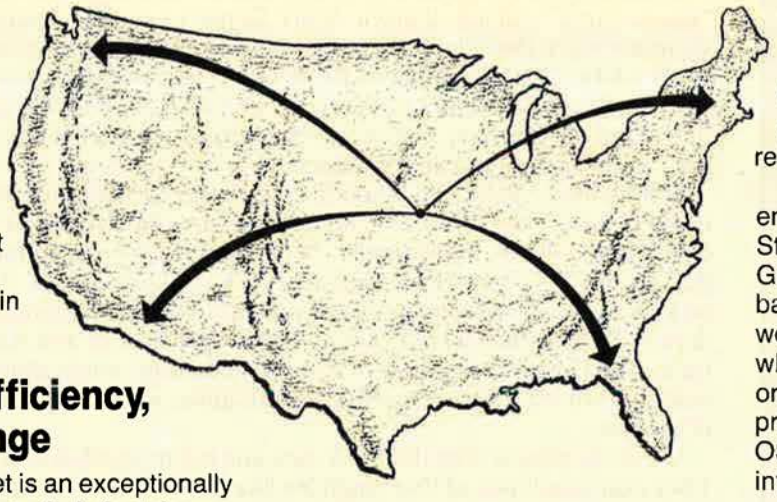
The Learjet 35A is a high-performance jet in the truest sense. Cruising at 540 mph, it can easily cover in a single day routes that are hundreds of miles longer than the CT-39 can fly. And that performance is vital for high-level government officials, ambulance patients and time-sensitive wartime payloads.

The Learjet 35A is also the perfect aircraft for seasoning pilots. It allows the Air Force to enhance



And it's ready to wear Air Force blue.

pilot proficiency in a high-performance environment. In an aircraft which enjoys one of the most outstanding safety records in the industry.



Greater efficiency, longer range

The Learjet is an exceptionally fuel-efficient aircraft. *In fact, for a fixed number of flight hours per year, no other OSA turbofan competitor can deliver more passenger miles per tax dollar, or miles per pound of fuel.*

From Scott AFB, only the Learjet can carry a full passenger load to any point in the Continental U.S., against 85% winds, in less than four hours...non-stop. Multiple sorties or en route fuel stops are eliminated...and use of available crew flight time is maximized.

Advanced technology, fully backed by Learjet and Garrett

Learjet's established record of reliability will mean maximum readiness for the OSA fleet. And that operational availability is even further assured by the Learjet's Garrett TFE 731 turbofan engines.

With more than 4,200 TFE 731 engines in daily service, Garrett has established an enviable record for producing the most reliable engine in its class.

The Learjet 35A and its Garrett engines are built right here in the States. The combined Learjet/ Garrett support network that's based here stretches around the world, and offers immediate service when needed. This entire organization stands ready to provide full support to the Learjet OSA fleet — right now, and years into the future.

Step up to Learjet. It's ready to go to work for the Air Force right now.

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AN EDITORIAL

Hang in There

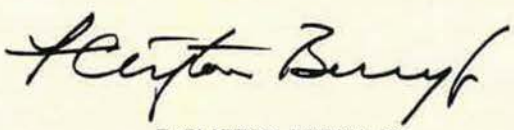
THIS summer the nation continues to enjoy peace. At least it's as close to peace as the leading world power can probably be in these troubled times. US Marines are at risk in Beirut, of course. Navy flyers patrolling the Gulf of Sidra catapult from Sixth Fleet carriers knowing they may have to shoot down more Libyan MiGs if the Colonel sends them up. Air Force crews flying the Berlin corridor are always reminded of the many times that Russian fighters have tried to bump their predecessors out of the sky. Every time they put on their flak jackets, Army soldiers along the Korean DMZ expect to fight North Koreans. In Central America, US military trainers of all services are imperiled around the clock, whether in the cities or the field. In launch control centers and alert complexes, weapons controllers and aircrews of SAC, TAC, MAC, and the rest of the Air Force—active and reserve—are ready to fight when their country needs them.

In fact, the US armed forces are in better shape today to respond to the nation's call than at any time in the past two decades. This notwithstanding severe shortages of spares, munitions, and certain special skills. But does the nation recognize that the tremendous asset its armed forces represent is largely responsible for the peace it enjoys? Not so well, if one has scanned the media recently.

In upstate New York over the July Fourth weekend, some women set up a "peace camp" outside Seneca Army Depot to protest against the nuclear weapons work they claim is going on inside. When a nearby citizen offered them a large American flag to fly at their campsite, the women refused it. They said on television that the flag "reminded them of the military." What tunnel vision they have, and a narrow, warped concept of what that glorious red, white, and blue banner represents.

Meanwhile, back in the capital, a citizens' commission headed by Mr. Peter Grace released its conclusions on how the Department of Defense could save billions immediately. Secretary of Defense Weinberger treated the report with his customary courtesy, promising to review it carefully. But he also made an appropriate judgment on some of its personnel recommendations, saying they would "create havoc with morale and readiness." He's right. The Grace Commission's recommendations, while plausible to a businessman whose sales and profits are slumping, would drive good people out of service.

It's in the people area that well-meaning but misguided citizens go wrong. They don't understand that tangibles like a decent retirement system, along with symbols like the American flag, motivate good men and women to be prepared to die for their country. The crazies of all stripes can express their nuttiness freely, thanks to the good people in uniform. Thank God for their service, and for hanging in there!



F. CLIFTON BERRY, JR.
EDITOR IN CHIEF

Lightning-Fast Information: Collins JTIDS Class 2 Terminals

JTIDS, the Joint Tactical Information Distribution System, will soon be a reality as the Collins Government Avionics Division of Rockwell International and Singer's Kearfott Division complete full-scale development and begin production of Class 2 terminals.

The JTIDS terminals will make it possible for Air Force and Army elements to coordinate missions with reliable, real-time information. AWACS aircraft and F-15 aircraft will share common information with ground air defense, artillery and surface-to-air missile commands over the JTIDS network. The services will share data on enemy forces' position, speed and strength, and important information about friendly forces, such as identity, weapons status, fuel reserves and position.

The U.S. Air Force and Army have selected Singer and Rockwell to supply prototype Class 2 terminals based on the wealth of avionics experience we are contributing to the JTIDS program, including:

- 40 years of Collins experience in RF systems and 20 years of tactical data link experience, including Link 4 and Link 11.
- Frequency-hop and anti-jam experience as demonstrated in the Collins SINCGARS V program.
- Proven production technology and capacity to manufacture JTIDS terminals at a reasonable cost.
- Design-to-Cost and reliability goal achievements with the Collins AN/ARN-118 (V) TACAN and AN/ARC-186 VHF Comm.

Singer and Rockwell are committed to providing the Air Force and Army the lightning-fast information they need. To find out more about the JTIDS program and Rockwell's role in it, contact:

Collins Government Avionics Division
Rockwell International, Cedar Rapids, Iowa 52498
(319) 395-2208.

Rockwell International

...where science gets down to business

AIRMAIL

Traffic Jam

Your June '83 editorial, "Potholes in the Two-Way Street" *(p. 4),* was right on the money. It seems incredible that special interests could railroad the battle-proven Martin-Baker ejection seat out of the Hawk trainer.

Not every protest from our European allies has merit, but their reaction to the current "Buy American" restrictions needs our immediate attention.

The specialty metals case is such a blatant violation of the two-way street concept that it will surely not survive the light of publicity.

Dr. Robert W. Clawson
Kent State University
Kent, Ohio

The System Problem?

Gen. T. R. Milton defends the MX by repeating the slogan that "preparedness never caused a war" *("Viewpoint," June '83 issue, p. 128).* I take no position here on the MX, but its defenders should search for a more persuasive logic.

Presumably, anyone who begins a war by launching an attack has "prepared"for the encounter. Indeed, to do otherwise would be folly. It follows, then, that General Milton is expressing the familiar American view that this country never begins a war, but only responds to aggression by others.

Leaving aside the question of whether that view is historically accurate, it falls a bit short in the nuclear age, and General Milton so testifies. He dismisses our use of atom bombs against Japan as "too one-sided to count" as a real nuclear war. The important point escapes him; under the stress of conflict, the US was unable to resist the temptation to become the "first user" of nuclear weapons.

Americans prefer to believe that if they had a monopoly of nuclear force the world would be "safe" from war, but, on the record, other countries have no reason to share that belief. To the Soviets, an American "first-strike" strategy always has seemed possible, and there has been no shortage of evidence—ranging from Herman Kahn in the 1960s to a resurrected civil defense concept based implicitly on first-strike thinking.

The world is not easily divided into categories of "good" and "evil." We are all locked into a system that has many times led to disaster. The system is the problem, not the separate actors.

Col. Frederick C. Thayer,
USAF (Ret.)
Pittsburgh, Pa.

Author!

I certainly concur with the laudatory comments of Sen. Barry Goldwater regarding *A Few Great Captains* and *Forged in Fire:* " . . . the greatest books I've read on the story of the Air Force and airpower." However, the author of these books was inadvertently not identified—DeWitt S. Copp.

Mr. Copp, an award-winning book and film writer of both fiction and nonfiction, was an Army Air Forces pilot during World War II. He has written numerous books and films on military and civilian aviation.

Thanks for bringing this to the attention of AIR FORCE Magazine's vast, air-minded readership.

Col. Joe Friedmann,
USAF (Ret.)
Alexandria, Va.

The AN/ARN-101

The AN/AVQ-26 Pave Tack pod discussed in the June 1983 issue *("Night Into Day With Pave Tack," p. 104)* is certainly an impressive addition to the sensor complement on F-4Es, RF-4Cs, and F-111s, and provides added capability to the aircraft weapon systems. However, clarification should be made concerning the interface integration responsibility in the F-4Es and RF-4Cs.

The Pave Tack pod supplies the target IR image, laser target range, and target illumination. The aircraft steering, navigation, and weapon delivery functions are accomplished by the Lear Siegler AN/ARN-101 Digital Modular Avionics System. The ARN-101 determines where the target is, relative to present aircraft position, sends signals to the AVQ-26 computer to point the turret at the target if required, processes the AVQ-26 laser range data to improve the quality of the range signal, and computes the necessary steering and weapon release data to strike the target.

Navigation and weapon delivery computations are an autonomous responsibility of the ARN-101 system. For conventional weapons, AVQ-26 operation is not required after the target has been identified and the system trimmed to update target coordinates.

The Lear Siegler ARN-101 provides complete navigation, as well as automatic steering, weapon delivery, and reconnaissance capability in F-4Es and RF-4Cs with or without the Pave Tack pod. The AVQ-26 adds another sophisticated eye, and a more accurate determination of range to target.

F. E. Pickel
AN/ARN-101 Program Manager
Lear Siegler, Inc.
Grand Rapids, Mich.

"Just Another Day"

In your article "Electronic Combat in Operation" *(June '83 issue, p. 52),* I was pleased to note the incorporation of the cartoon "Just Another Day at the Office."

This was inspired by a rather passionate one-on-one lecture to me on the pervasiveness of the threat by Maj. Art Ritter of the Tactical Air Warfare Center some years ago. But it took the artistry of Bobby Patterson of our company to really capture the flavor

Submissions to "Airmail" should be sent to the attention of the "Airmail" Editor, 1750 Pennsylvania Ave., N. W., Suite 400, Washington, D. C. 20006. Letters should not exceed 500 words, and preferably be typed. We reserve the right to condense letters as necessary. Names will be withheld on request, but unsigned letters are not acceptable. Because of the volume of letters received, it is not possible to print all submissions. Please allow lead time of *at least* two months for time-sensitive announcements.

of our tactical air forces aircrews with the "right stuff."

Morton T. Eldridge
Director of Marketing
Teledyne Brown Engineering
Huntsville, Ala.

Ninth Air Force

I read with interest the plea from Lt. Col. Robert L. Hall, USAF (Ret.), on page 8 of the June 1983 issue for some publicity to be given to the Ninth Air Force.

May I, as an RAF wing leader of a Spitfire wing based in the southeast corner of England in 1943, be permitted to express a few words of sincere praise for the magnificent flying and bombing carried out by the Ninth's B-26 Marauder aircrews against numerous targets in northwest France between July and November 1943?

It may be of interest to readers to know that on our first escort mission against Abbeville airfield, the eighteen Marauders staggered along at 180 mph. Such a speed was far too slow to be flying over France. General Andrews, Commanding General of the Ninth Air Force, called an urgent conference at his headquarters at Earls Colne. It was immediately ruled that the Marauders must be lightened in weight and, therefore, all unnecessary equipment was removed, *e.g.*, reduction in ammunition and oxygen load, etc. (even the kitchen sink was thrown out!).

This action transformed the B-26's performance, and it thereafter became a pleasure to escort the closely packed formations over to France. The formation's strength grew quickly from eighteen aircraft, to thirty-six, then to seventy-two in a matter of weeks. It was with pride that the RAF fighter pilots watched the amazing accuracy of the bombing of German targets in France.

Between the dates mentioned my Spitfire wing carried out more than fifty close escort missions for the Marauders of the Ninth Air Force. I remember the great respect and the admiration that we in the RAF held for all of the personnel of the Ninth Air Force.

H. Bird-Wilson
Farnham, Surrey
England

More Space for Space

Your May 1983 Air Force Almanac and June 1983 Electronic Air Force issues are always highlight copies of the year, and this year's May and June issues were no exceptions.

The only things needed to make them complete were photographs of USAF space assets (even representative examples of spacecraft!) and data on US space achievements (historic launches, astronauts, current spacecraft utilization, etc.). One wonders if the fact that the Space Shuttle system and IUS entries were separated from the remainder of the "Gallery of USAF Weapons" in the May issue by a full-page advertisement (the only systems so distinguished) was an attempt to convey a message.

Perhaps these subtleties indicate that Space Command is encountering the same institutional resistance that the US Army Air Corps encountered and that there is really a need for a US *Space* Force. Prove me wrong.

Maj. Gordon R. Middleton,
USAF
Mahé, Seychelles

***Not* Compass Call!**

Having been a member of AFA for many years, I always look forward to each issue of your fine magazine. You perform an especially outstanding job each year with your issue on the Air National Guard and Air Force Reserve.

Your June 1983 issue on the Electronic Air Force featured an article, "Electronic Combat in Operation" *(p. 52),* with a particular focus on Compass Call. On pages 54–55 was displayed a picture of a C-130 aircraft so captioned.

The aircraft portrayed is, in fact, an E series C-130, rebuilt and retrofitted for the Coronet Solo II mission. The aircraft is maintained and flown by the men and women of the 193d Electronic Combat Group, Pennsylvania Air National Guard. Though considered "part-timers," the unit is very actively tasked around the world in support of unified and specified commanders' requirements to such an extent that Maj. Gen. John B. Conaway, Director of the ANG, has called the 193d ECG "the most deployed unit in the Air Guard."

It is also important to stress that the Compass Call and Coronet Solo missions differ as night and day. Compass Call works as an electronic combat platform, while Coronet Solo's primary mission involves special operations. Coronet Solo does indeed have electronic combat capability, but strictly as an adjunct to its prime mission. Your misidentification is understandable; an unmentioned major command and its subordinate numbered air forces have had the same corporate misconception for several years.

Many folks have worked hard in recent years to gain support and increased visibility for this most important national asset. Your mis-caption will gain the system the "advertising" it deserves at the lowest dollar cost.

Lt. Col. Joe Cunningham,
ANGUS
National Guard Bureau
Washington, D. C.

I have greatly enjoyed your magazine for a number of years. In the June '83 issue, I rejoiced to see one of the aircraft from the 193d Electronic Combat Group displayed on pages 54 and 55. However, with horror, I read the caption stating that it was an EC-130H Compass Call aircraft. I would like to set the record straight.

The aircraft displayed on pages 54 and 55 is an EC-130E Coronet Solo II, flown by the 193d ECG, Pennsylvania Air National Guard. The picture shows the state capital of Harrisburg in the background. The EC-130 replaced the EC-121E Coronet Solo I in 1978 and 1979.

We at the 193d and in the PaANG are proud of the job we do for the Air Force, and are sure that the error was unintentional.

TSgt. Craig E. Friedline,
PaANG
Camp Hill, Pa.

• *The error was indeed unintentional. We apologize to the people of the 193d Electronic Combat Group and all our readers (many of whom wrote to take us to task) for the mistake. (For more on the EC-130, Coronet Solo II, and Compass Call, see the "Jane's All the World's Aircraft Supplement" on p. 83 of this issue.)*—THE EDITORS.

Colonel Irwin

In the June 1983 issue of AIR FORCE Magazine, there is a picture of Apollo astronaut Jim Irwin *(p. 145).* Under the picture, the caption lists Colonel Irwin as Lt. Col. James B. Irwin, USAF (Ret.).

He *was* a lieutenant colonel when he made the flight, but when they landed, the whole crew was promoted one rank.

Capt. Sumner H. Wyman,
USAF (Ret.)
Bloomington, Minn.

Houses or Hovels?

I was reading through your April '83 issue when I noticed that, on page 56, somebody goofed. You show three pictures of housing in Incirlik, Turkey, which is all well and good, but one of the pictures is wrong. I refer to the lower picture, which your caption states is the housing families began living in in September.

Well, I live in that new housing, and it doesn't look anything like what you show. What you show is the "model

home," and that home is in the even newer housing area you picture in the top photo.

The housing the families moved into in September are called "Fast Track," mainly because they were put up so fast. What you didn't mention in any of your captions, or in the article itself, was that the "Fast Track" housing is having many problems—cracking walls (no real problem, it's just the outside retaining wall on to the carport), hot water pipes that freeze in the winter (a design deficiency actually, not the fault of the contractor), heat-pump vents that leak when it rains (which it does here frequently), cupboard doors that fall off on a moment's notice, and washers and dryers that were supposed to be new, but, it turns out, are actually rebuilt models. I could go on, as the list gets longer *every day,* but I'd run out of space.

I realize that these are actually minor complaints, especially when you compare them with what a lot of people are putting up with on the economy. In your upper left picture, if you look closely, you'll see some older houses behind the tall apartment buildings (which are Turkish Air Force quarters). These are in an area called "Incirlik Village," and it houses a lot of unaccompanied people, mainly because there is such a shortage of on-base quarters for these people. Your magazine didn't show the dormitory construction going on, but that was probably with good reason—you couldn't show a brand-new dorm (under construction for almost three years) that is already sinking on one end due to the fact that nobody bothered to add fill dirt to shore up the foundation.

Oh, yes—before I close this letter, I do want to mention one thing. I am grateful to the Air Force for trying to give me a house that looks nice and functions well, but don't you think that somebody somewhere along the line could have built Incirlik's new housing to the earthquake standards needed for this area? We in Fast Track have been told not to be in our houses if there is an earthquake. We'd stand a better chance of surviving if we stood outside while we watched our houses fall down around us! . . .

Name Withheld by Request

Battle Damage Repair

The April '83 issue of AIR FORCE Magazine contained a good article about USAFE's role in NATO *("USAFE in the Dangerous Decade," p. 40).* However, the "Sortie Generation" section on pages 43 and 44 contained some information that is not entirely correct.

AIRMAIL

Although USAFE is well into developing an organic Aircraft Battle Damage Repair (ABDR) capability, it is not the only command working toward that goal. In December 1981, the Air Force officially directed the implementation of a program designed to establish an Air Force ABDR capability. To date, all commands participating in the program (USAFE, PACAF, TAC, SAC, MAC, AAC, ANG, AFRES, and AFLC) have made progress toward accomplishing the ABDR program objective.

The objective of the ABDR program is to maximize wartime aircraft availability and sortie rates. The Air Force has already established ABDR technician and general assessor training courses that are not peculiar to any particular weapon system. Their purpose is to introduce aircraft maintenance personnel to an assessment and repair philosophy that is different from the traditional, quality-conscious maintenance performed during peacetime operations. Weapon-system-specific assessor courses will also be available in the future. In addition to training courses, ABDR Technical Orders for the aircraft in the program are presently being developed, and ABDR tool and matériel kits are being established in every command.

Air Force Logistics Command was designated program-implementing command. This decision was based on AFLC's ABDR experience during the Southeast Asia conflict and the ABDR capability already achieved in the AFLC/AFRES Combat Logistics Support Squadrons. In addition to AFLC, Air Force Systems Command was assigned responsibility for all ABDR-related research and development.

The ABDR program is going to make it possible for the Air Force to count on having additional airframes available for combat operations. USAFE is on the right track and has made a wise decision in placing a high priority on the ABDR program. We in the ABDR Program Office are confident all operating commands will soon have an equally viable and effective ABDR capability similar to that of USAFE.

Lt. Col. D. T. McVey, USAF
USAF ABDR Program Manager
McClellan AFB, Calif.

Men's Rights

Is an ex-spouse *entitled* to half your retainer check? We don't think so.

The Men's Alliance for Legal Equity (MALE) is a nonprofit research and education organization concerned with men's rights in divorce, pension law, tax law, and many other areas. We have targeted the Schroeder [Rep. Pat Schroeder, D-Colo.] "Former Spouses Protection Act" for intensive study and possible litigation. We believe the law is a breach of contract with this nation's servicemen, that it raises serious questions of due process and states' rights, and that it is just plain bad public policy.

Please help us fight for your rights! We are interested in case histories of men who have suffered under this law and information on any litigation now pending, particularly appeals on constitutional grounds.

Membership in the Men's Alliance and subscriptions to our newsletter are available for a $25 annual contribution. All contributions are tax-deductible. Let us hear from you. Whether in Congress or the courts, we must organize to win this battle.

Dan Soliday
National Director
Men's Alliance for Legal Equity
13941 Mathews Dr.
Woodbridge, Va. 22191

8th Air Force Historical Society

As you may know, the 8th Air Force Historical Society, started in May 1975, has signed up more than 11,500 members since its inception. We are adding 1,500 to 1,800 new members every year.

We started with the idea of creating an organization that would be of value to all 8th AFers, but had to limit it to wartime members to get our nonprofit status with the IRS.

With the tax law changes in the fall of 1982, we have been able to return to our original goal. Now we are open to all 8th AFers, past and present.

Our Board of Directors has recently approved an Ira C. Eaker Airmanship Award. It will be given to a crew or individual selected each year by the 8th Air Force. This should keep us close to the current members of the 8th AF.

On the other hand, the 8th Air Force Memorial Museum Foundation (a nonprofit organization formed by the 8th AFHS to concentrate on keeping 8th AF history alive) is in discussions with the Air Force Historical Foundation with regard to joint sponsorship of the biography of Gen. Carl A. Spaatz, the first commander of the 8th AF.

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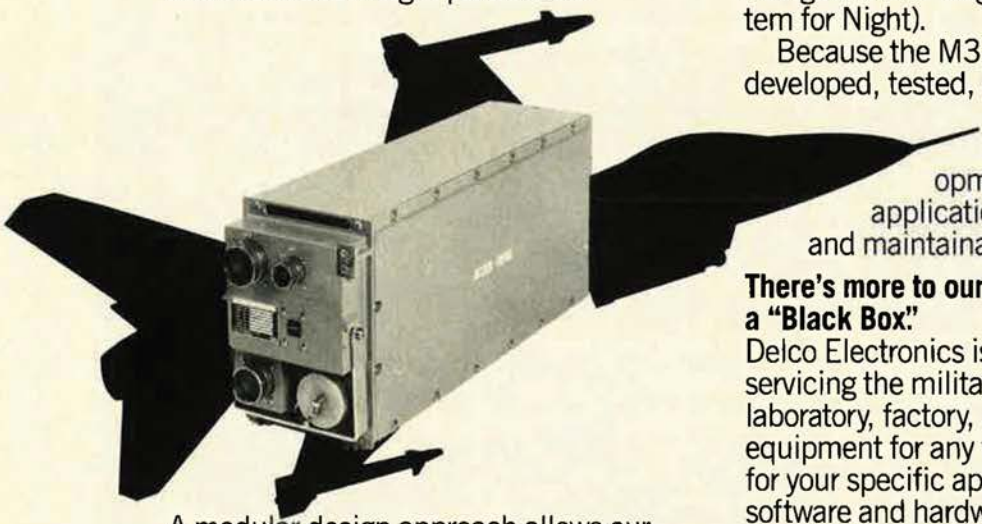

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If you have questions on military computer technology and potential applications, Delco Electronics has the answers. For further information, contact Delco Electronics Division, General Motors Corporation, 6767 Hollister Ave., Goleta, CA 93117. Or call (805) 961-5903. TWX 910-334-1174.

Delco Electronics

Division of General Motors
Santa Barbara Operations

AIRMAIL

It is well to consider the fact that 1,000,000 Americans have served in the Mighty Eighth since it was activated on January 28, 1942.

All 8th AFers are now able to help perpetuate the history of the 8th Air Force through the 8th Air Force Historical Society. Dues are $8 per year. Applications for membership should include the unit and locations and dates of service in the 8th AF.

Lt. Col. John H. Woolnough, USAF (Ret.)
8th Air Force Historical Society
P. O. Box 3556
Hollywood, Fla. 33083
Phone: (305) 961-1410

Iceland Security Police

The Air Forces Iceland Security Police Division is developing a Heritage Room to promote a sense of history and belonging among our members.

We are looking for any memorabilia and/or photos from anyone who may wish to donate them and who were assigned to Iceland since the Keflavik base opened, particularly from those assigned as MPs, APs, or SPs. Photos, if requested, will be copied and returned. Patches, photographs, uniform items, anecdotes, *White Falcon* newspapers, and any other memorabilia would be appreciated.

Please forward these items to the address listed below.

Capt. Walter G. Lucas, Jr., USAF
Chief, Security Police
Air Forces Iceland
FPO New York 09571

Civilian Flight Instructors

I am seeking contact with pilots who served as civilian flight instructors at either an AAF civilian contract primary flying school or in a CAA war training service program in World War II. I am interested in hearing from only those instructors who did not otherwise attain commission status in a branch of the US armed forces.

The purpose of this is to organize an effort to promote congressional action on legislation recognizing the service of the civilian flight instructors as active military duty, since such credit has been given WASPs and other groups but denied the instructors under Public Law 95-202.

E. D. Ballard
235 Pepper Dr.
Lexington, Ky. 40505

Boys Home

Boys Home of the South came into existence in 1957 as the result of a real need for a home of this type in our area and for the country. We have made a lot of progress because of God's help and the help of many fine people. We receive no federal, state, county, or city aid.

We have recently completed our library, of which we are very proud; however, we have a lot of space but not many books.

We would like to ask readers if they could send us books. We are especially interested in books about World War II heroes—flyers, tankers, infantrymen.

Please send any donations to the address below.

Charles W. Aiken
P. O. Box 8818
226 Pendleton St.
Greenville, S. C. 29604

Iranian Air Force

I would appreciate any help in finding photographs, patches, and any historical material on the Imperial Iranian Air Force for a forthcoming book. The time period involved covers the 1950s to the fall of the Shah.

Any assistance would be deeply appreciated. Please contact the address below.

Walter Glenn Weich
P. O. Box 56
Pemberton, N. J. 08068

Cessna O-2A

I am a model airplane enthusiast, and I plan to build a radio-controlled model of the Cessna O-2A observation plane. I cannot locate any drawings, good photos, or three-view drawings of this plane, even though I've written to just about every source available.

I would appreciate it very much if readers could furnish any information they might have on this plane (especially three-view drawings).

D. A. Sagolla
141 N. Eagle Rd.
Havertown, Pa. 19083

Tall Tales Time

I am a Second World War enthusiast deeply interested in the airplanes of that time period. To further my interest, I'm writing a book called *Air Force Memories: 1939–45,* containing favorite stories of Air Force veterans.

Would any readers be so kind as to relate a story or two, or what they remember most about the war? Comments on the aircraft you flew would also be of interest to me.

Bernie Wyatt
5306 Cindy Lane
Burlington, Ontario
Canada L7L 3Y2

Amelia Earhart

I am a researcher seeking information, stories, and tidbits about the famed aviatrix of the Thirties. I have a book being published next year listing new information about the disappearance and fate of Amelia Earhart.

Please contact me at the address below.

Hardon McDonald Wade
P. O. Box 1111
Marietta, Ga. 30061
Phone: (404) 422-7369

Rescue in the Adriatic

On April 2, 1945, a PBY aircraft based near Foggia, Italy, rescued four aircrew from a B-24 that had crashed into the Adriatic Sea. Despite a sea state not suitable for landing, this PBY crew, at some risk to themselves, made a skillful rescue. Without their timely arrival, the downed survivors would have perished.

As one of the grateful survivors, can anyone identify for me the designation of this rescue unit and, possibly, any of the resolute PBY aircrew?

Lt. Col. Howard C. Horton, USAF (Ret.)
2 Bonnievale Dr.
Bedford, Mass. 01730

Liaison Pilots

I am writing a book about the personal experiences of World War II liaison pilots and crews. I would appreciate making any contact with any WW II Air Corps liaison squadrons.

Please contact me at the address below.

Ed Arbogast
518 East Garfield
Cadillac, Mich. 49601

20th Special Ops Sqdn.

I am presently an Air Force scholarship cadet in the 835th ROTC detachment at North Texas State University. In November 1982, my mother and I traveled to Washington, D. C., in order to see the dedication of the Vietnam Veterans Memorial. My father's name, TSgt. James W. Greenwood, was inscribed on the great monument. He was with the 20th Special Operations Squadron based somewhere near Darlac Province in South Vietnam.

I have now tried several different sources in an attempt to learn of the mission of the 20th Special Operations Squadron and what it was comprised of. All that I have been able to

obtain was that the squadron used UH-1P helicopters in psychological warfare near the Cambodian border.

There is a great void in my knowledge of my father's seventeen-and-one-half-year career in USAF. I would be eternally grateful for any information that I might receive from readers regarding the "Green Hornets" of the 20th Special Operations Squadron.

Craig R. Greenwood
440 Franklin Ave.
Pottsboro, Tex. 75076

514th Bomb Squadron

I've been invited to submit a story to the American Aviation Historical Society's quarterly almanac regarding my combat experiences as a tail gunner with the 514th Bomb Squadron, 376th Bomb Group, Ninth Air Force, in the Middle East during 1942–43.

I would like to communicate with Charles S. Anderson, Norman C. Appold, Donn Odell, John Hogan, or any other former members of the 376th BG in order to refresh my memory and obtain facts and figures long since forgotten.

Harold O. Christensen
2329 Lincoln Way
San Francisco, Calif. 94122
Phone: (415) 661-9177

American Maid

I am trying to contact crew members who flew missions over Japan during World War II in a B-29 named *American Maid*. I would like to plan a surprise reunion for my husband, who piloted the B-29, Maj. George W. Ramey.

From what I can gather, the crew served with the 405th Bomb Squadron, 214th Bomb Group.

For information about a surprise reunion in late summer or early fall, please contact the address below.

Martha Ramey
881 S. W. 56th Ave.
Plantation, Fla. 33317
Phone: (305) 587-9209

Looking for . . .

I would appreciate help in contacting my dear friends, Michael and Jeannette (née Dillon) Littrell. Mike Littrell was last stationed at RAF Lakenheath, England.

My husband, George, passed away in January 1982 after a long illness, and I would like to let my friends know.

Gloria Conner
2801 Melvin Ave.
Rochester, Mich. 48063
Phone: (313) 852-0669

Anyone having information concerning the whereabouts of James Robert Wooliver, an Air Force recruiter stationed in Ohio and Tennessee in 1958–59, please contact me at the address below.

Lt. Col. Ernest N. Willard,
USAF (Ret.)
930 Pine St., #206
San Francisco, Calif. 94108

AIRMAIL

Any crew members who flew with pilot Dock O. Waller in World War II in India and Tinian, please contact me at the address below.

Don Carter
1271 Whitewater Rd.
Memphis, Tenn. 38117
Phone: (901) 685-6874

I would like to ask any family or friends of Lt. Col. Ray W. Schroeder, who died on December 9, 1979, in Uplands, Calif., to contact me on behalf of the Aeronautical System Division's Heritage Committee.

The Committee is considering his grandfather, Maj. Rudolph Schroeder, a test pilot and true aviation pioneer, as a candidate for memorialization. We need to correspond with next of kin. Contact the address below.

Aeronautical Systems Division
ASD/PAM (Mike Wallace)
Wright-Patterson AFB, Ohio
45433

We are trying to locate the following former crew members of the B-29 *Three Feathers* for a future reunion: Jack D. Alford, Richard D. Metcalf, Walter D. Landaker, Houston H. Powers, William C. Taylor, Agne V. Pearson, and Harry W. Pennel.

I would appreciate any information readers may have on the present location of these men. Please contact me at the address below.

MSgt. Ralph J. Darrow,
USAF (Ret.)
1984 Herman St.
Atwater, Calif. 95301

A disabled friend of mine in London, England, does carving as therapy. He has a keen interest in the USAF of WW II. I have tried to obtain the shoulder patches of our WW II Air Forces without too much success. Do any readers have posters or advertisements depicting the shoulder patches of WW II? I have my own 13th Air Force patch and was able to find a Ninth Air Force one, and have sent both to my friend, Bill Adams. I would appreciate it if readers could help.

Michael M. Michlo
360 Chicago Ave.
Valparaiso, Fla. 32580

I would like to hear from anyone knowing the whereabouts of Lt. Nick Fedak, a World War II ETO B-17 pilot.

Anyone having any information should contact me at the address below.

Lt. Col. Thomas F. Corrigan,
USAF (Ret.)
3815 Somerset Dr.
Colorado Springs, Colo. 80907

Collectors' Corner

I am a collector looking for the early type of World War II Eighth Air Force patch. This particular variety was worn by our troops in England during the early years of the war. This design was different in that it was embroidered on felt and had small pointed wings extending from the lower part of the figure eight. The later and more familiar design had the large circular wings.

I also need a bullion-embroidered Eighth Air Force patch. If you have one or both of the above items that you would like to sell, please send me a note with your asking price.

David Edkins
190 Beverly Rd.
Hempstead, N. Y. 11550

I was associated with the Eastern Flying Training Command in the southeast US from 1941 through 1946, at one time serving as Director of Aircraft Maintenance and headquartered at Maxwell Field from 1941–45.

Somehow, I lost the metal epaulet insignia designating that command, and I would like to borrow one to have a blazer patch made.

Please contact the address below if you can help me.

Benjamin W. Heath
P. O. Box 8194
Newport Beach, Calif. 92660

I am currently a junior in high school and am looking forward to a career as a fighter pilot. I would like some inside information on the USAF Academy's academic and extracurricular activities, etc. Opinions from ex-graduates would be greatly appreciated.

Also, since I collect patches, I am looking for F-15 or F-16 squadron patches, Stateside or overseas. I am willing to pay for the patches, including postage.

Darrin Landry
71 Diamente
Irvine, Calif. 92714

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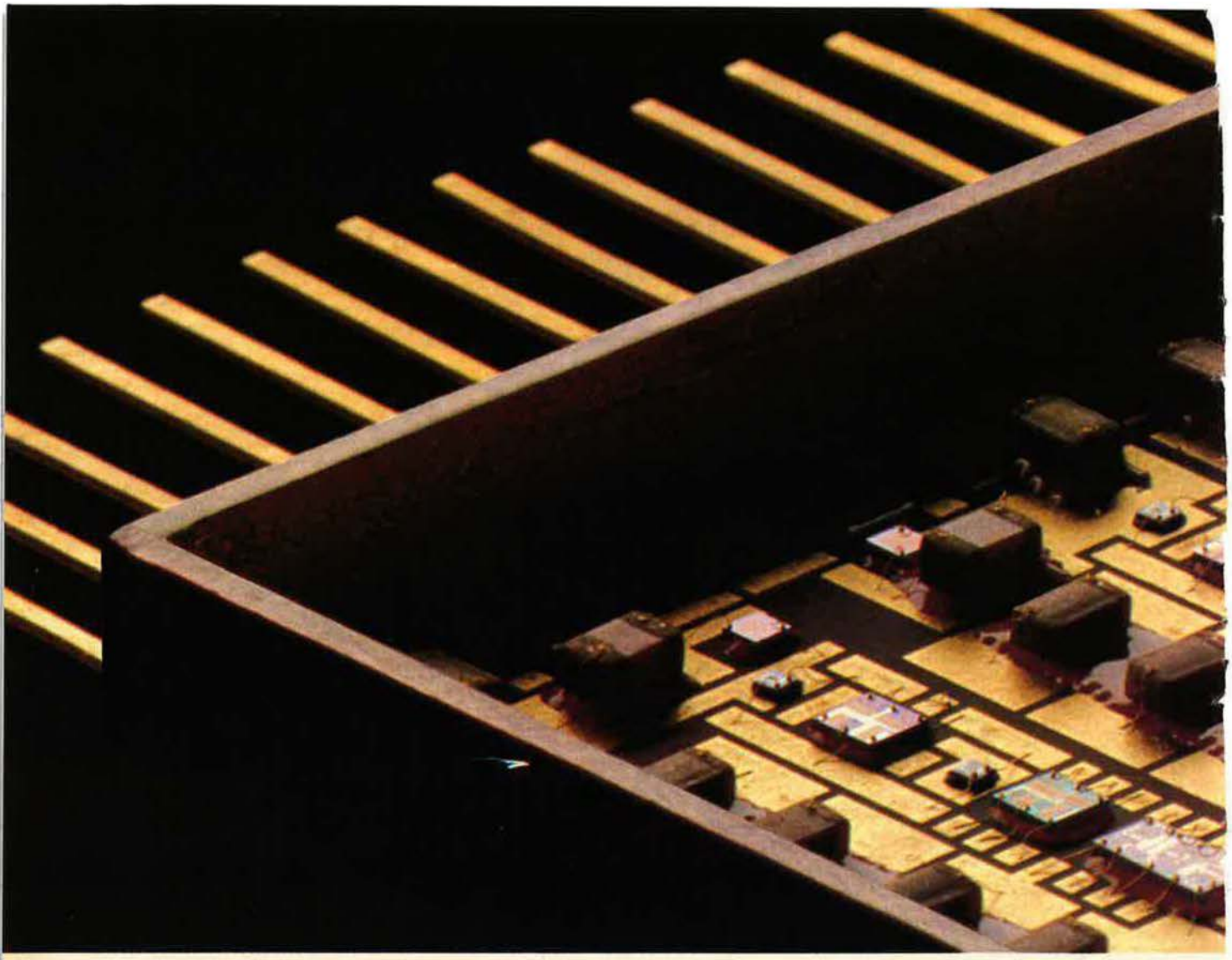

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At Aerojet, we're advancing the frontiers of electronic circuitry by taking a close look at surfaces.

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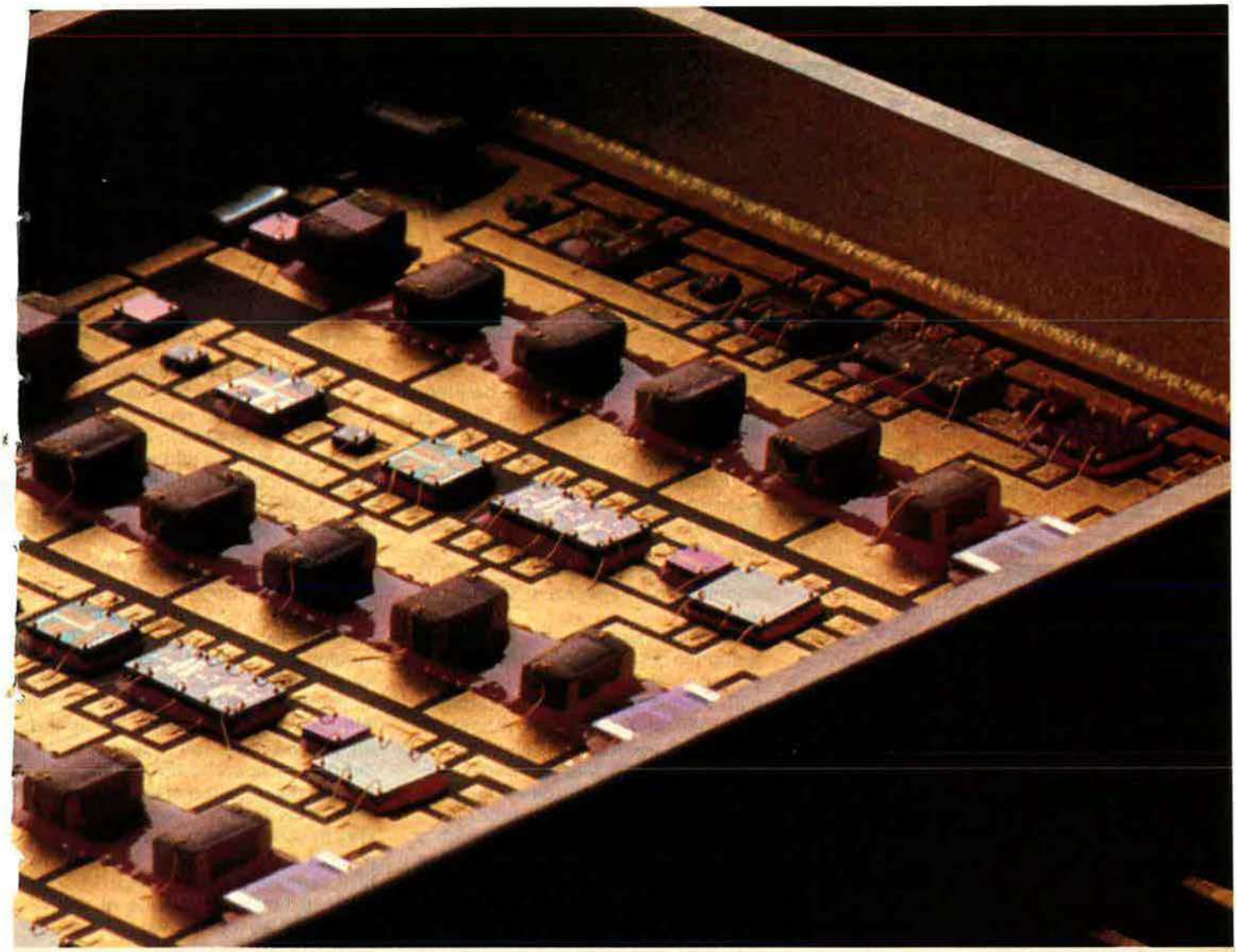

spectrographic and electron micrographic techniques are used to analyze and evaluate a variety of surface conditions and effects. And it's paying off with sharpened eyes for space sensors and improved performance and reliability for many other electronic devices.

A lot of other ideas surface at Aerojet, too. Like decoys that play siren songs for torpedoes. Advanced CAD/CAM technology that lets us build exciting devices from perfectly predictable parts. And we're researching low-signature rockets.

At Aerojet we believe that putting resources into technology today is our best investment in tomorrow. Case in point: We've tripled R&D outlays over the past three years.

No wonder so many ideas surface at Aerojet. If you have one you'd like to get off the ground, bring it to us. We'll make it fly.

Aerojet General Corp., 10300 North Torrey Pines Road, La Jolla, CA 92037/(619) 455-8500.

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IN FOCUS...

SAC Backs Small ICBM

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

The unglamorous requirements of fixing up old hardware to keep deterrence credible.

Washington, D. C., July 6

The strategic force modernization package drawn up by the Scowcroft Commission and presented to Congress by President Reagan in May is being jeopardized by allegations on Capitol Hill and in the news media that the Air Force is opposed to and is undermining development of a small, single-warhead ICBM. In addition to being false, these insinuations, in part at least, appear to be designed to derail the MX program and other efforts to modernize the land-based ICBMs.

These innuendos are also apt to impede current arms-control efforts. Because the Commission's recommendations produced, and are dependent on, a carefully constructed political consensus based on accommodating disparate congressional interests—from ardent arms-control supporters to committed hawks—removing any one element of the package would unravel this coalition of strange bedfellows and probably doom the strategic force modernization program in its entirety.

As Gen. Bennie Davis, Commander in Chief of the Strategic Air Command, told this writer, the Air Force supports "wholeheartedly all the recommendations of the Scowcroft Commission, including development of a small single-RV ICBM. That is why we established a systems program office at [AFSC's] Ballistic Missile Office and charged it with going ahead with the development" of the SICBM (small ICBM).

Whether the planned new small ICBM will eventually be deployed in a mobile mode or based in silos, perhaps even of a superhardened type, or "in a mixture of these," he said, "you will need a reasonable development cycle" to get a system that has the combination of accuracy and yield required for hard-target kill and is compatible with different flexible basing modes, General Davis stressed. Reasonable in this context, the head of the Strategic Air Command suggested, probably means somewhere between six and ten years.

A pivotal element of the SICBM is a guidance system that can deliver the weapon's single warhead—probably with a yield of about 470 kilotons—over full intercontinental ranges regardless of how the missile might be based with sufficient accuracy to assure hard-target kill capability. Expressing confidence that over time it will be possible to produce such a guidance system—based on either existing prototypes or proposed new designs—General Davis cautioned, however, that "we can't do all this by day after tomorrow." The Scowcroft report defined the SICBM as weighing "about fifteen tons" and suggested that, barring major technological hitches, its full-scale development could be initiated in 1987. Initial operational capability (IOC) ought to be achieved by about 1993, the Presidential Commission estimated.

Contrary to the contention of the "whisper campaign" on Capitol Hill that such a small, single-RV missile could be built with existing hardware, quite a number of technological and engineering hurdles need to be cleared before the SICBM could become a military reality. Preliminary studies suggest that the throw-weight of such a missile will have to be about 1,300 pounds in order to accommodate warheads large enough and guidance good enough to assure a reliable hard-target kill capability. On first blush, this means that the SICBM might have to be slightly heavier than 30,000 pounds, perhaps as high as 39,000 pounds.

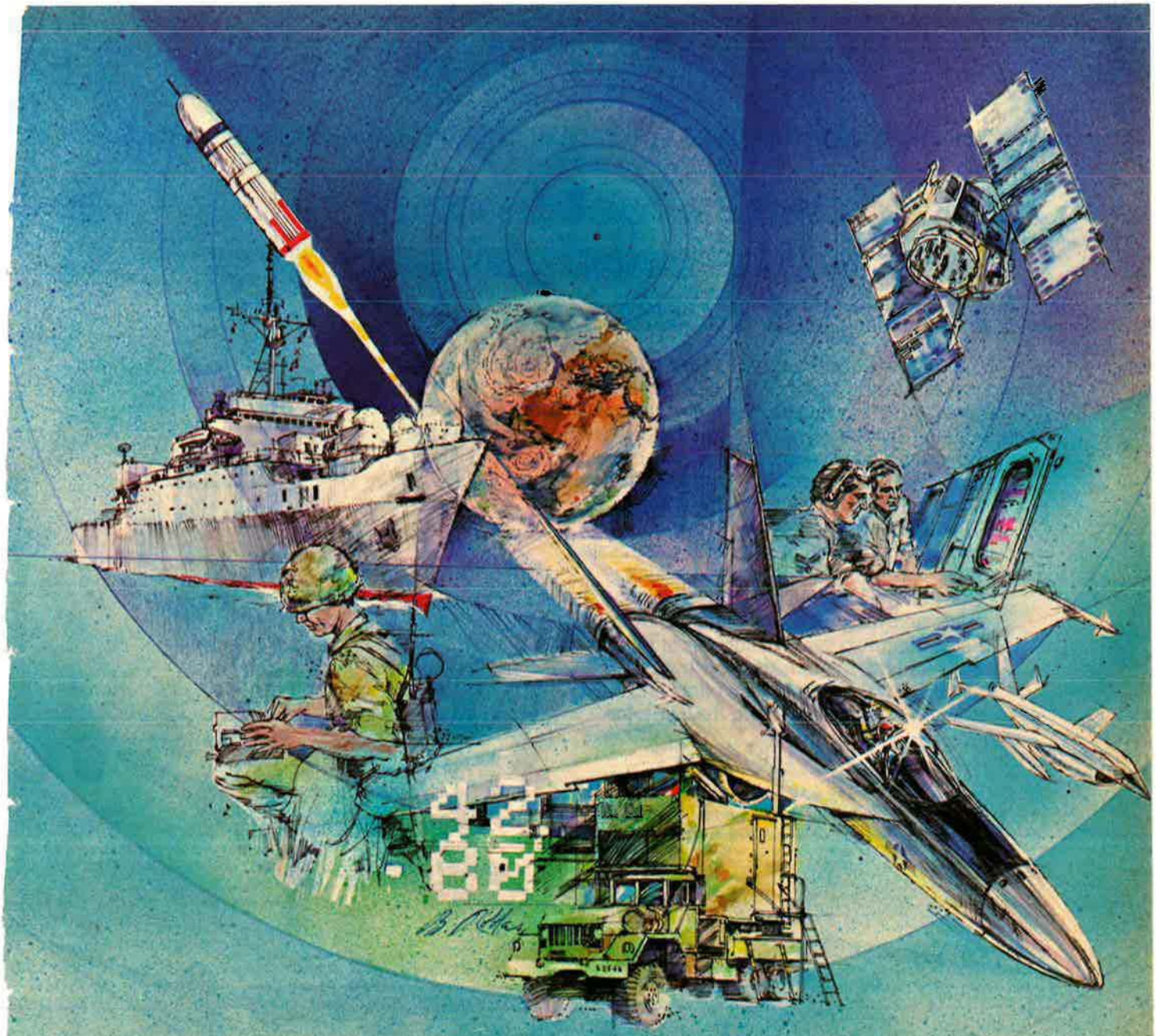
When news of these preliminary estimates, based on prudent and conservative engineering principles, reached Congress, there were charges of one-upsmanship on the part of the Air Force coupled with threats of political reprisals. Among the latter was proposed legislation to curtail the deployment of MX unless the Air Force commits itself to holding the weight of the SICBM to 30,000 pounds and launches the program at once.

General Davis stressed that the 1,300-pound throw-weight requirement—and hence the weight of the missile—was a function of range, accuracy, and warhead yield and not yet fully resolved. Two other issues associated with the Midgetman SICBM will also require further work by the Air Force before the system can be defined in specific terms. For one, there is the question of terminal guidance. This feature may prove necessary to achieve the weapon's lethality against superhard Soviet targets. In turn, terminal guidance might be confined to inertial guidance of an RV equipped to maneuver while descending on the target.

Another approach, yielding probably yet greater accuracy, would involve terminal guidance systems using external sensors, comparable to those used by the US Army's Pershing II theater ballistic missile. General Davis explained that SAC prefers guidance systems that don't depend on external elements that are subject to enemy countermeasures and susceptible to nuclear radiation effects: "In a doctrinaire sense we would like everything self-contained so that we won't depend on an external system for that last fine tuning."

If, on the other hand, the ICBM's required accuracy levels can only be attained by means of external sensors and the associated technology provides a "high degree of assurance that the external source indeed has a very high level of survivability, then I wouldn't object," he pointed out.

Obviously, the nature and traits of the proposed new missile's guidance system are determined largely by how the weapon will be based. So will be the required hardness of the weapon. If the SICBM is to be deployed in a fully mobile mode, it will require hard-



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For over a quarter-century, Interstate has been building sophisticated instrumentation for defense applications. If you have a requirement for a high-performance target tracking system, talk to the experts in GPS tracking technology. For details, contact: Director of Business Development, Range Systems, Interstate Electronics Corporation, P.O. Box 3117, Anaheim, CA 92803, Telephone (714) 635-7210, (800) 854-6979, in California (800) 422-4580, TWX 910-591-1197, Telex: 655443. In the U.K. Telex: 82431.

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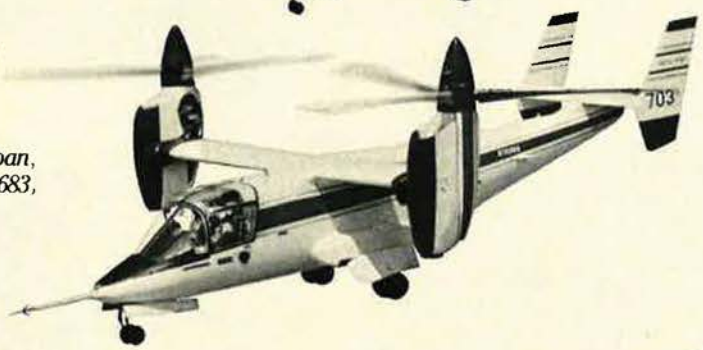

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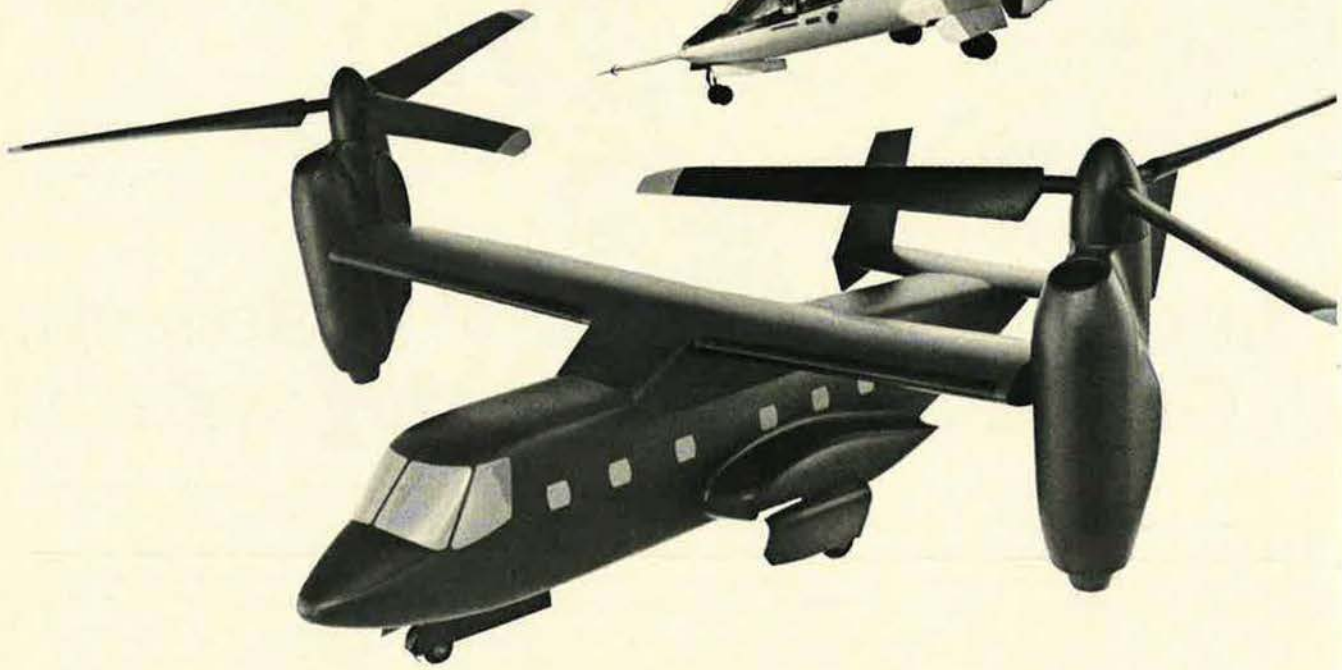
THE TILTROTOR TEAM

For more information, write to W. C. Sloan, Bell-Boeing Joint Program Office, Dept. 683, Box 482, Ft. Worth, Texas 76101 USA.



ening levels different from a weapon that is protected by a superhard silo, General Davis said. Mobile deployment would also increase the weapon's operational costs in a major way, he added: "Certainly the cost factor goes up exponentially when we allow for the number of people required to operate and guard a mobile system."

Another as-yet-open question revolves around the cost-effectiveness of developing and buying Midgetman on the basis of full competition. SAC, the Air Force, and the Pentagon "of course would like full competition," the head of the Strategic Air Command pointed out. Militating against this approach are concerns that this might not be practical because of a relatively tight schedule.

The result is a dilemma, General Davis suggested, because "if we insist on total competition with two or more complete systems, we probably would stretch out the development cycle." On the other side of the ledger there is the risk of major technical setbacks that result from confining the competition to the critical component level—such as the guidance system—in order to compress the development process, he warned.

The tradeoffs will have to be weighed carefully for both technological and political reasons, General Davis pointed out, because the traditional defense critics who supported MX as an undesirable yet unavoidable precondition for development of the SICBM "will be watching very closely. If they get the impression that we are dragging our feet, that would create a major political problem."

Two years ago SAC recommended deployment of MX in Minuteman silos as the "quickest way of enhancing our deterrence. We recognize the importance of survivability, of course, but between survivability and deterrence, I rate deterrence more important." For the time being, General Davis suggested, only MX can be furnished with the combination of accuracy and yield required to hold at risk the new superhard silos housing Soviet ICBMs that "are the centerpiece" of their offensive strategic forces.

These new silos, he explained, are "significantly harder" than the best US silos. The most effective existing US weapon system, Minuteman III equipped with the Mk 12A RV, lacks the accuracy and yield to handle such superhard targets with a credible probability of kill (P_k), and while the C-4 SLBMs are getting better, they, too, lack the lethality to dig out superhard targets, the head of SAC said.

Deployment of 100 MX ICBMs, as recommended by the Scowcroft

IN FOCUS...

Commission, on the other hand, will boost US deterrence considerably by assuring a level of destruction sufficient to curb Soviet strategic nuclear adventurism, according to General Davis. The proposed MX force does not represent a first strike force, however, because it lacks the numbers required for such an attack, General Davis said, adding that the combined force of MX and Minuteman ICBMs "doesn't give us the capability to take out [the Soviet ICBM force and associated command and control] in a first strike, but it can deter" a Soviet nuclear attack on the US.

Although firmly committed to moving strategic force modernization into high gear after a hiatus of more than a decade, the Strategic Air Command recognizes also the importance of maintaining the effectiveness and credibility of the existing strategic nuclear deterrence forces. Until the country is able to develop and deploy a new generation of strategic weapons, SAC's top priority is to keep the B-52s, FB-111s, Minuteman IIs and IIIs, Titans, and tankers at levels of maximum efficiency, General Davis said.

"There is a far larger constituency for modernization than there is for fixing up old hardware. This just isn't as glamorous," he pointed out. Nevertheless, Congress agreed to support the B-52 avionics upgrade, and "we hope to get approval to fix the avionics of the FB-111s. Soon we will start with reengining the KC-135s with the CFM56 engines. Also, of course, we are integrating ALCM into [the B-52's avionics suite] and, all importantly in the ICBM area, we are keeping Titan safe through several safety modifications until we phase all of them out by 1987," according to General Davis.

Other important fixes involve the repouring of stage two and remanufacturing of stage three of the Minuteman II and III ICBMs, along with instituting new procedures whereby periodic maintenance is actually carried out at the silos. Claims to the contrary notwithstanding, General Davis averred, "Minuteman II is in good shape." When these solid-propellant systems first went on line, the engineering community estimated that the propellant might start breaking down chemically and the liners might get sticky and deteriorate within about ten years.

"Well, they were about right. So we have started to rejuvenate them by repouring the second stages and remanufacturing the third stages. I have full confidence that with the repairs we are making they will last us and will remain reliable. Minuteman II certainly isn't a wooden round even though a lot of people thought it was," he pointed out.

SAC's Commander in Chief was equally fervent in defending the B-52s against claims that these aircraft have become obsolete and hazardous to operate. Referring to an accident early this year at Mather AFB, Calif., that resulted in a ruptured wing—that in turn triggered considerable adverse publicity—General Davis explained that the B-52G and H models incorporate fuel tanks as integral structural members of their wings. The accident at Mather was caused by a plugged fuel tank vent—in turn, the result of faulty maintenance—he said, adding that the subsequent failure of the wing "had nothing whatsoever to do with the age and structural integrity" of the airplane.

Since the B-52 entered the inventory, the aircraft has undergone three structural modifications that guarantee its "structural integrity well beyond the year 2000," General Davis stressed. It isn't the notion that the B-52s are falling apart from old age that requires adjustments in its mission from penetration to standoff cruise missile launch once the B-1 enters the inventory, he pointed out: "Rather, the Soviet defenses are getting better and better. By the late 1980s or early 1990s the B-52's large radar cross section will leave no alternative but to [operate the aircraft only] in a standoff mode."

Even though the Air Force is shifting from the present generation of cruise missiles, the ALCM-B, to a new design—the advanced cruise missile (ACM), which incorporates Stealth technology and a sizable range increase—SAC "has every confidence that the ALCM-B will continue to have a very high level of survivability," General Davis believes. While ALCM-B lacks the low observable traits of the planned new cruise missile, its small size, the low altitude at which it flies, and the fact that "we will route it around the high-threat areas," promise to provide the system with a high level of survivability well into the 1990s, in General Davis's view.

The pending shift to the "stealthy" cruise missile with a range of 2,000 miles—compared to the 1,500-mile-range ALCM-B—is largely a matter of

taking advantage of new technologies to ensure long-term survivability, according to General Davis. Just as the Stealth, or advanced technology bomber (ATB) is meant to backstop the B-1, so will the advanced cruise missile augment the initial version of these weapons, he stressed.

General Davis said SAC does not see an immediate requirement for an intercontinental "stealthy" cruise missile. DARPA, the Defense Advanced Research Projects Agency, is investigating the feasibility of such missiles. While a role for such a weapon may crop up eventually, he said, there are more pressing requirements in the strategic nuclear sector. One of these is development of a follow-on short-range attack missile (SRAM) with about three times the range and greater flexibility and capability than the existing system. The first-generation SRAMs, he warned, are getting old and the number of replacement motors is dwindling for these supersonic, semiballistic missiles with a maximum range of about 100 miles.

From SAC's point of view the timing of the development and acquisition of the B-1 and the ATB is sound. The acquisition of 100 B-1Bs, General Davis pointed out, will provide a significant boost in the nation's nuclear deterrent capabilities beginning in 1986. Work on the advanced technology bomber, a program that involves both "known and unknown" technologies, is being carried out at "just the right pace, and I expect that it will come into inventory in the 1990s."

He added that because Stealth bombers are radically different from existing aircraft, it will take some time for SAC to learn how to operate and maintain them with maximum effectiveness. Although ATB is expected to be a highly elusive target for SAMs and interceptors using radar for target detection, acquisition, and tracking, the aircraft is "optically" visible in daylight. As a result, finding ways of operating at low altitude that help the aircraft avoid Soviet air defense systems is of paramount importance.

Stressing that both the B-1 and the ATB utilize advanced low-observable technology—the latter to a greater extent than the former—the head of the Strategic Air Command explained that the efficacy of strategic bombers of this type can be compounded through the use of decoys and other external countermeasures that capitalize on Stealth technology.

For SAC's nuclear strategic forces to provide credible deterrence, it is imperative that a potential aggressor understand clearly that he can't decapitate the command and control system that launches and targets these weapons. There is concern, therefore, about possible attacks by Soviet bombers and cruise missiles on the US C³I system, including the National Command Authorities, as a precursor to a full-fledged strategic raid.

Modernization of the nation's strategic command and control system now under way—and to be funded to the tune of more than $14 billion over the next five years—will probably create a C³ system with enough nodes "to make a precursor attack virtually impossible," he suggested. Even though there is "no unanimity" within the scientific community about the effects of EMP (electromagnetic pulse) and other by-products of large nuclear bursts in the atmosphere on C³ systems, General Davis said SAC would be able to execute its strategic forces because of high redundancy in celestial and terrestrial communications links, including land-lines.

IN FOCUS...

Washington Observations

★ US Army Chief of Staff Gen. E. C. Meyer, just prior to his recent retirement, told this writer that he has "no problem whatsoever" with the Air Force, over time, assuming full responsibility for all strategic defensive operations. Once there is a "coherent addressal" of strategic defense—consonant with President Reagan's recent recommendation—there "ought to be a command made up of Army and Air Force [elements] and I would be willing to give the responsibility for it to the Air Force. I believe such a command has to be centralized."

Explaining that it would be extremely difficult to "develop the defense in the absence of the offense," he suggested that effective defense against ballistic missiles is "so important to the future that you should assign it to somebody who is looking at it in its totality." With the Air Force likely to get the "largest share of the dollars" for this mission, he deemed it logical that the Army eventually would be taken out of the ballistic missile defense (BMD) business.

Concerning an unrelated issue affecting the two services, development of the C-17 for the intratheater airlift mission, General Meyer declared himself a "strong advocate of the C-17." He termed development of such an aircraft "absolutely essential" for the kind of military involvement the United States is likely to get into in the future.

Although relatively optimistic about the C-17's prospects, he said there "will have to be continued pressure by the Army as the spokesman for what's needed in this area. The obstacles are as much political as they are military."

★ Congressman Les Aspin (D-Wis.), chairman of the Military Personnel and Compensation Subcommittee of the House Armed Services Committee, told this writer that he soon will hold hearings on the military retirement system, emphasizing especially comparisons with private pensions systems, other government retirement plans, and military retirement systems of foreign countries. Acknowledging that the proposed actions by his subcommittee will amount to little more "than stirring the pot," he predicted Congress this year is not likely to institute any major reforms of military retirement unless the Defense Department makes such a recommendation.

"What we are trying to do in these hearings is to get the Pentagon to [undertake] a serious and comprehensive reform. If that doesn't work, I don't think Congress really can pass a comprehensive reform." Suggesting that the Defense Department is not likely to do so, he said his strategy would center on "piecemeal" actions such as making military personnel on active duty "contribute" toward their retired pay in the manner of the Civil Service.

In the nuclear strategic sector—where Congressman Aspin surprisingly emerged as somewhat of a guardian angel among liberal House Democrats of the strategic force modernization package drawn up by the Scowcroft Commission and endorsed by the White House—he expressed himself in favor "of some kind of throw-weight limitation" in the Strategic Arms Reductions Talks (START) to protect mobile single-warhead ICBMs from the threat of barrage bombings.

Without such a limit on Soviet throw-weight, "you could wind up with a barrage attack that would take out the small, single-warhead missiles even though they are scattered all over the military reservations," he warned. ■

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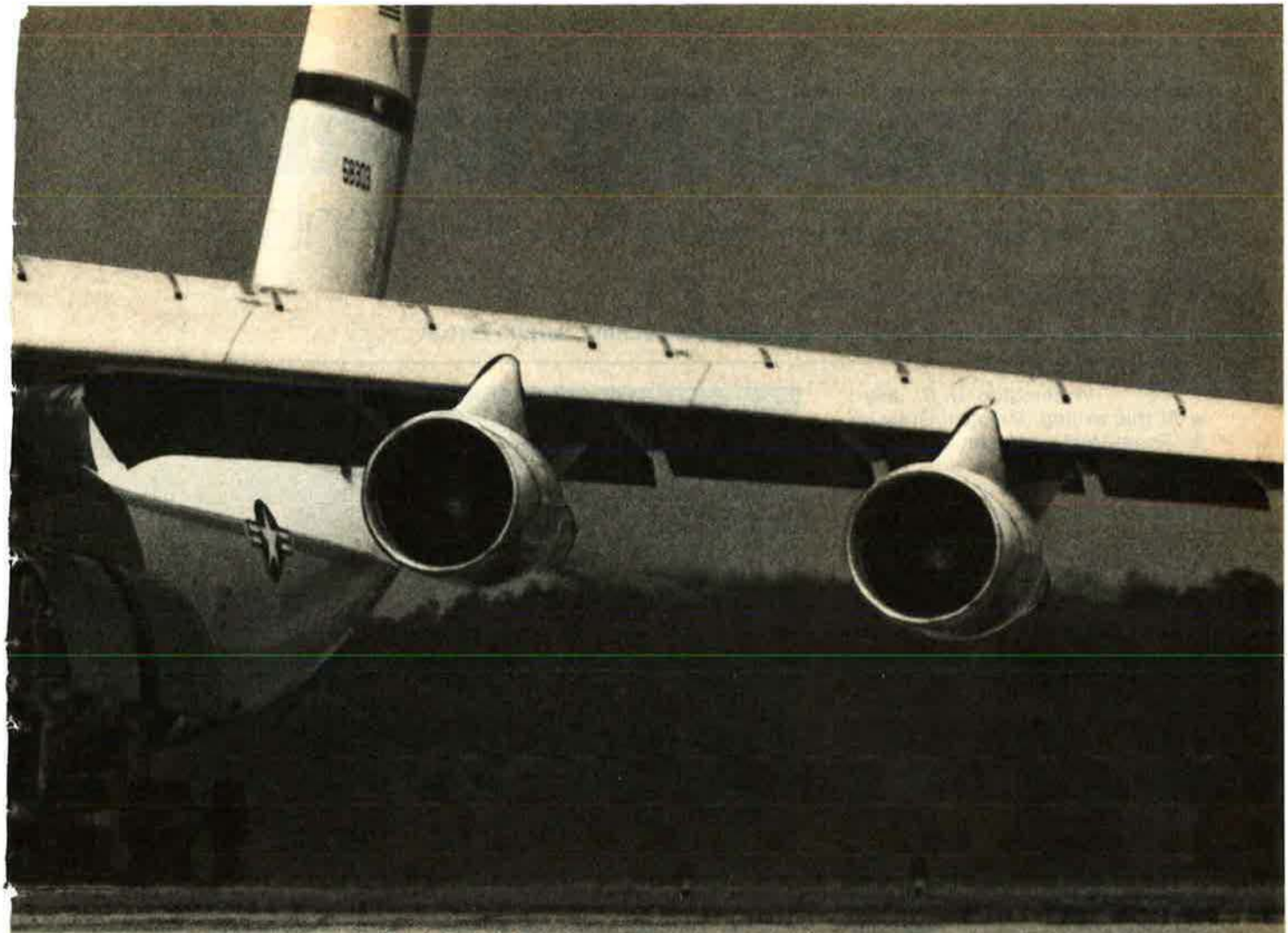
Moreover, it can carry loads impossible for any other aircraft. For example, it can reach the Middle East from this country nonstop—without in-flight refueling—with six AH-64 attack helicopters, fully assembled with only the rotors folded. It can handle self-propelled artillery and bridge launchers. All without compromising unit integrity, because crews for the equipment can travel in the C-5's passenger compartment.

A number of big ideas in the original design of the C-5 make such loads possible. First, there's the giant cargo compartment, 145 feet long. Then there are the two huge openings fore and aft. Each is 13½ feet high and 19 feet wide so it can take huge pieces of cargo. And for unloading



service for 'copters, and other big packages.

quickly, the C-5 can kneel to lower the cargo deck within five feet of the runway, making shallow ramp angles for easy, rapid roll-off of equipment.

The C-5B: Already ahead of schedule.

Now going into production, the C-5B is off to a fast start. It will include a number of improved systems which also will be installed on the C-5A fleet to assure maximum commonality. Those systems include a simplified automatic flight control system, a lighter and more reliable color weather radar, and a digital air data computer.

The C-5B also will have new production engines that incorporate all of the improvements in the engines now being retrofitted on the C-5A. The airframe will gain additional structural strength and corrosion resistance from new aluminum alloys developed since the C-5A was built. And, under terms of its fixed price contract, the C-5B will have other changes that contribute to ease of maintenance and flight readiness.

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AEROSPACE WORLD
News, Views & Comments

By William P. Schlitz, SENIOR EDITOR

Washington, D. C., July 1

★ At this writing, Malcolm Grow US Air Force Medical Center at Andrews AFB, Md., was to join with Walter Reed Army Medical Center, the Naval Medical Command for the National Capital Region, the VA Medical Center, and about forty-four civilian hospitals in a Civilian Military Contingency Hospital System exercise in July.

The Civilian Military Contingency Hospital System is a cooperative arrangement that provides medical care for returning combat casualties in civilian medical facilities. Support from the civilian medical community is necessary because the reserve capacity of the military health-care system may not be sufficient to cope with the large numbers of casualties generated by a military conflict.

The CMCHS exercise will begin at a simulated battle area at Fort A. P. Hill, Va., where about 450 "casualties" will be placed in various locations. They will receive first aid, and ground forces will summon helicopters to move patients to an air-transportable hospital in the battle area.

Patients will be stabilized and transferred to a twenty-five-bed mobile aeromedical staging facility on the flight line, where they will receive simulated medical treatment.

A C-130 Hercules, capable of transporting more than fifty litter patients, will fly the casualties to a simulated major Air Force hospital in Europe. The hospital at Dover AFB, Del., will be used in this role. The aeromedical staging units at Dover and at Malcolm Grow will be expanded for the exercise.

The scenario calls for the casualties to exceed the capabilities of DoD's medical centers, in order to activate the CMCHS.

Patients will receive additional medical treatment at Dover and be processed for medical air evacuation to Andrews on a C-141 StarLifter. At Andrews, the 10th Aeromedical Staging Flight and a Tri-Service Joint Operations Center will triage the patients and transfer them to an appropriate CMCHS hospital.

Civilian hospitals and other CMCHS agencies participate in periodic exercises conducted by the military to test the system and to ensure that it can be implemented on short notice.

The CMCHS concept has been endorsed by the AMA, the American Hospital Association, and the Joint Commission for Accreditation of Hospitals, exercise officials said.

The latest version of the Lockheed Hercules, the HC-130H-7, is one of five ordered by the US Coast Guard for long-range patrol duties.

★ Another milestone in mankind's list of exploratory achievements occurred in June when the spacecraft Pioneer-10 crossed beyond the orbits of the planets to become the first man-made object to leave our solar system.

Herbert A. Lassen was a young naval engineering officer in the 1940s when he had a vision of landing men on the moon and launching rockets on interplanetary voyages.

Twenty years later, after earning a Ph.D. in mechanical engineering, Herb Lassen delivered a technical paper entitled "Deep Space Probes: Sensors and Systems" to an American Astronautical Society symposium on unmanned exploration of the solar system. Eventually, this led to NASA contracts to Dr. Lassen's employer—TRW Inc.—to develop Pioneer-10 and its twin, Pioneer-11.

Dr. Lassen recalls that in the days of Sputnik the Soviets coined several phrases having to do with "cosmic velocities." The first cosmic velocity was that necessary for an object to enter earth orbit, the second to escape into space, and the third to leave the solar system. Dr. Lassen set his sights on the third cosmic velocity.

But the first objective was to design Pioneer-10 to travel to the planet Jupiter and to return data about it to earth, in itself a technological miracle that Dr. Lassen and his colleagues accomplished brilliantly. This has established the foundation for the future on-site exploration of other celestial bodies.

With Pioneer-10 outward bound on its eternal journey, Dr. Lassen advises young scientists "to get excited about the pioneering opportunities. . . . There is still plenty of room for individual contributions."

Pioneer-10 will continue its transmissions on the speed, density, and direction of the solar wind for about another decade. This data will be used to define the sun's extended atmosphere. Its boundary—known as the heliopause—is believed to be some five billion miles from earth. "That's the one milestone left," noted Dr. Lassen.

★ A new Air Force staff organization to integrate data automation and telecommunications into a single, more manageable activity has been set up at the Pentagon and became operational June 1.

The Office of the Assistant Chief of Staff for Information Systems (AF/SI) is now serving as the single focal point for information systems throughout USAF. Maj. Gen. Gerald L. Prather, previously Director of Command, Control and Telecommunications, heads up AF/SI.

"We began to look at the difficulties caused by the fragmented management of information systems by the separate staff agencies, particularly data information and communications," explained General Prather. "We needed a better way to satisfy the requirements of our operational commanders, especially their information needs. The growth of technology in data processing and communications was leading to an integration of disciplines and the Air Force felt it was logical to take advantage of these merging technologies," he added.

Besides the improvement in the management of Air Force data systems, AF/SI is to ensure that combat information needs are identified and met. The new organization is also responsible for developing policies and procedures to make the best use of small-computer technology and to join with DoD to simplify, integrate, and modernize data systems policy.

AF/SI will oversee systems that have no inherent manager, such as those that serve a variety of functional areas and train people to develop and manage the more complex data systems of the future.

The AF/SI staff has been drawn from General Prather's previous command, in addition to other specialists in computers, administration, analysis, and information technology. *(See also July '83 issue, p. 68.)*

★ Piper Aircraft Corp., Lock Haven, Pa., is test-flying its new Enforcer prototype close air support aircraft in preparation for an Air Force evaluation later this year.

"Initial controllability, stability, and handling checks have been completed satisfactorily," noted John McCollom, company vice president for special military projects.

Earlier in the year, the first prototype had already flown to 20,000 feet and at a speed of 300 knots, he added. The Enforcer is designed for maximum speed of 350 knots and an altitude of 25,000 feet.

In 1981, the Air Force awarded Piper a contract to design, develop, and test two lightweight, propjet-powered, close air support aircraft. The second was to begin flying in June.

Armament for the aircraft is to include two 30-mm gun pods, 2.75-inch rockets, and cluster and Rockeye bombs. Weapons configurations can be adjusted to meet mission requirements, the company official said.

"In October, we will fly to Eglin AFB in Florida for two months to deter-

World War II Ace Receives Air Force Cross

The first Allied pilot to shoot down one of the most feared German aircraft in World War II, the Me-262, has received the Air Force Cross for extraordinary heroism. The plane is considered by many experts to have been one of the most influential fighters of all time. Its appearance ushered in the jet age.

Urban L. Drew, World War II fighter ace, received the second highest Air Force decoration from Secretary of the Air Force Verne Orr in a special ceremony in May.

First Lieutenant Drew arrived in Europe in May 1944 as a flight leader in the 375th Fighter Squadron, flying bomber cover missions above Germany. He engaged two of the German jets—the world's first operational, mass-produced jet aircraft—on October 7, 1944, while flying a propeller-driven P-51 Mustang. Drew was on a bomber escort mission when he observed a dogfight which his flight investigated with negative results.

"I couldn't locate our bombers so I joined up with some red-tailed B-17s that were short on escorting fighters," he recalled.

Drew stayed with the bombers until he spotted two Me-262s about to take off from the airfield at Achmer, near Hamm, Germany.

He waited until both were airborne, then rolled over from 15,000 feet and, with his flight following, headed for the attack.

The tactic was called "rat catching"—attacking the German "wonder" jet, as it was initially called, during its vulnerable takeoffs and landings.

"I caught up with the second Me-262 when it was about 1,000 feet off the ground," he said. Drew opened fire at 400 yards and thirty degree deflection to score hits on the wings and fuselage. As the Mustang passed it, the Messerschmitt flamed.

"The other jet aircraft was about 500 yards ahead of me and had started a fast climbing turn to the left," he said. Drew also began a fast climb.

"I was still indicating about 400 mph, and I had to haul back on the stick to stay with him."

He opened fire from 300 yards and shells began hitting the Me-262's tail section. "I kept horsing back on the stick and my bullets crept up the fuselage to the cockpit," he said.

The canopy broke away, and the Me-262 rolled over and went into a flat spin until it hit the ground and exploded.

By the end of Drew's seventy-five-mission tour, he had six aerial victories, including several Me-109s, and a long list of damaged or destroyed trains, boats, and trucks to his credit.

Drew also helped sink Germany's only six-engine flying boat, the plane Hitler wanted to use to bomb Washington and New York.

Although Drew was originally considered for the Distinguished Service Cross, the equivalent of what is now the Air Force Cross, the recommendation never reached higher headquarters. A 1983 review by the Air Force Board for the Correction of Military Records determined that Drew should receive the Air Force Cross.

Upon separation from the Air Force, Drew returned to his home state of Michigan where he helped establish the first Air National Guard unit. He later served as the state's first Air Adjutant General. —M. B. P.

In the photo above, Urban L. Drew is presented the Air Force Cross by Secretary of the Air Force Verne Orr. Drew was a P-51 Mustang pilot during World War II.

mine weapons delivery capabilities," he said. "Then we go to Edwards AFB, Calif., at the end of November for the operational evaluation, during which we will fly against typical combat targets."

USAF's evaluation should be completed by May 1984, with a report to Congress submitted by year's end.

★ Those intent on a medical education have an alternative to the astronomical cost of schooling.

The Uniformed Services University of Health Sciences in Bethesda, Md., offers a tuition-free medical education in return for a commitment of seven years with one of the military medical departments. Students entering the program are commissioned as second lieutenants or ensigns and receive the pay and allowances of rank during medical training.

A fully accredited, four-year medical institution, the USUHS School of Medicine also offers training in military medicine, applied military physiology, and tropical medicine to prepare students for the type of practice they'll encounter on active duty.

Requirements for admission include:

- That a prospective student be a US citizen between eighteen and twenty-eight years old by June 30 of the year of enrollment.
- Having a bachelor's degree that includes some specialized work in chemistry, math, physics, biology, and English.
- Having taken the New Medical College Admissions Test.
- Having applied for admission via the standard American Medical College Application Service.
- Having received approval through the chain of command if on active duty.

For additional details write the Public Affairs Office, Rm. A-1045 (Attn: PJS), Uniformed Services University of Health Sciences, 4301 Jones Bridge Rd., Bethesda, Md. 20814.

AEROSPACE WORLD

★ The fad of 3-D movies is making a comeback—and then some.

Technicians at NASA's Lewis Research Center in Cleveland, Ohio, are using 3-D movies to observe the hidden workings of jet-engine compressors and other vital propulsion system parts.

The underlying principal is holography: three-dimensional imaging of test objects and processes.

By watching these images in motion that show shock occurrences between fan blades in operation, engine designers expect to learn how to improve engine performance.

Arthur J. Decker, an optical physicist at Lewis, has been studying and experimenting with holography for a decade, progressing from an early method of permitting one image per minute to be recorded to the new motion picture system that records twenty double-pulse holograms per second in precise synchronization with blade motions. The new twist is the use of a laser to film high-speed holograms.

Britain's Rotortech Ltd. has developed this helicopter-borne spraying system that uses concentrated dispersants to fight oil spills. It can be assembled, loaded, and on its way in less than ten minutes, according to officials.

"The holographic technique has been around for a while, but holographic movies are done routinely only at Lewis," Mr. Decker noted. "Holograms were invented in 1948 by Dennis Gabor who won a Nobel Prize for his work."

The key factor in the work at Lewis is the third dimension. "Since the flow of air and shock waves around

Two Enforcer prototypes, built by Piper for the close-air-support role, are undergoing a series of flight tests that will culminate in an Air Force evaluation later this year (see item).

compressor blades is three-dimensional, there is the need to see the three-dimensional structure of the shock waves," the scientist noted. "We also would like to increase the normal speed of twenty to thirty shots per second to a really high speed of thousands of shots per second."

In the special filming process, the film negative bears no visible image on its surface. Only when laser light is projected on the film is the object's light-wave signature recreated and the image reconstructed optically in midair—for the eyes of the viewer.

★ The Air Force has given the green light for full-scale engineering development of an airfield demolition bomb as an element of the Joint Navy/Air Force Cruise Missiles Project (JCMP).

Under a $17.2 million contract, Avco Systems Division, Wilmington, Mass., will develop the BLU-106/B submunition for the Medium Range Air-to-Surface Missile (MRASM).

The program is being administered by the JCMP with technical support provided by the Air Force Armaments Division, Eglin AFB, Fla.

The BLU-106/B, originally known as the Boosted Kinetic Energy Penetrator (BKEP), uses a rocket motor to accelerate its warhead to the high velocity necessary to penetrate the runway surface. The warhead then explodes "with robust cratering and heaving, thereby closing the runway for a considerable period of time," officials said.

MRASM packages twenty-eight BLU-106/B submunitions in two bays. Submunition ground impact patterns are controlled accurately by varying the dispenser eject velocity and parachute opening times of individual submunitions, "thus maximizing the probability of airfield closure," officials stressed.

According to Avco, growth potential for the weapon will allow it to be designed to penetrate earth-overburdened concrete shelters to destroy the aircraft within.

Avco's Tactical Systems Group is developing other submunitions, including the Sensor Fuzed Weapon, for direct attack of tanks and tactical vehicles; the Extended Range Antiarmor Munition (ERAM), a "smart" mine to destroy armor; and an airfield attack variant of the ERAM for destroying taxiing aircraft. According to officials, Avco is also the exclusive US licensee for the German-developed STABO runway-cratering submunition.

★ The US aerospace industry is gearing up to produce the nation's first commercially funded upper stage to orbit satellites.

Dubbed Transfer Orbit Stage (TOS), the vehicle will propel satellites and other large spacecraft from the cargo bay of the Space Shuttle to higher orbits. First flight is expected in 1986.

Martin Marietta is to develop, assemble, and test the solid-fuel TOS at its space center near Denver, Colo., under funding provided by Orbital Systems Corp., headquartered near Washington, D. C.

Orbital Systems was established to provide economical space transportation services to commercial and governmental users. It will have exclusive rights to market TOS use.

"In cost and capability, the TOS should strengthen the competitiveness of flight-proven US space launch systems against new foreign vehicles such as Europe's Ariane rocket," commented Peter B. Teets, vice president and general manager of Martin Marietta's Space Launch Systems division.

TOS is also being developed to fill a gap between the smaller Payload Assist Module boosters and such larger and more expensive upper stages as

Smaller aircraft in the news. TOP: Three years of engineering, design, and construction have resulted in the maiden flight of de Havilland Canada's latest entry into the commuter/corporate market, the Dash 8 (see also p. 77). ABOVE: The RAF plans to use its new BAe 146C Mk 1 as a light transport throughout Britain, northwest Europe, and the Mediterranean.

Centaur and Inertial Upper Stage, officials said.

★ The Air Force recently tested an aircraft windscreen designed to protect aircrews from thermal radiation released by a nuclear detonation.

First Lt. Galvin E. Mayes of England AFB, La., poses with a milestone, the one thousandth Hughes Aircraft Co. Maverick air-to-ground missile to be launched in operational training.

Made of glass, photochromic materials, and an infrared filter, the experimental screen is visualized as an alternative to the thermal curtains that currently afford such protection aboard SAC aircraft.

Thermal radiation penetrating conventional aircraft windscreens would burn and blind aircrews, and the thermal curtains are delicate, damage easily, and obscure aircrew field of vision, officials said.

The new screen would be permanently bonded to the conventional aircraft windscreen and is designed to function as do modern sunglasses that turn darker in stronger sunlight.

Under normal conditions almost transparent, the new windscreen would become opaque during the first several seconds of a nuclear detonation and then return to normal as the fireball and intense radiation faded.

The objective of the field tests at Mather AFB, Calif., was to determine how well crew members see through the slightly tinted screen during normal flight operations. The material's sensitivity to radiation has already been laboratory tested.

Officials noted that the special material would protect aircrews from burns and blindness—but not from loss of sight resulting from the flash of a nuclear fireball. Crews will still have to don the flash-protection goggles or helmets currently in use.

★ The Air Force is planning to equip an ANG unit with three wide-body commercial aircraft.

The New York ANG's 105th Tactical Air Support Group would also retire its Cessna O-2 aircraft and switch operations from Westchester County Airport near White Plains, N. Y., to Stewart Reserve Training Center near Newburgh, N. Y., in FY '84. The unit's mission, of course, would also change—from forward air control to heavy airlift.

The type of wide-body aircraft to be acquired is under review and personnel changes have not been decided, officials noted.

A final decision on the action is to be made after the mandatory environmental impact analysis.

★ This year's quartet of aerospace pioneers has been inducted into the National Aviation Hall of Fame in Dayton, Ohio.

• A. Scott Crossfield, currently a consultant to the House Committee on Science and Technology, was recognized as the first pilot to exceed Mach 2 in the Douglas Skyrocket and Mach 3 in the X-15; for his role in the development of equipment that later proved essential in the manned space program; for his contribution to the development of advanced airline navigation systems; and for his work with Congress, government, and airlines in promoting safer commercial flying.

• David S. Ingalls, currently an attorney in Cleveland, Ohio, was honored as the Navy's only ace and the nation's youngest in any service during World War I; for his promotion of carrier-borne airpower; for his contribution to the development of air supply and naval airlift during World War II; and for his postwar support of safer commercial aviation.

• Theodore von Kármán, who died in 1963 and who was known as "the father of supersonic flight," was recognized for his lifelong career in aviation as a scientist and his contributions to US airpower. One of AFA's highest annual awards, that for science and engineering, is named for him.

What's Your Favorite Aviation Book?

What is your favorite aviation book? What aviation book made the most lasting impression on you? Ian Ballantine of Peacock Press would like to know. So would we.

Six classic books on flying will be available in bookstores nationwide beginning in November. Peacock Press, a division of Bantam Books, is publishing the six volumes as a beginning of a series called "The Aviator's Bookshelf."

According to Peacock Press and Bantam, the sale of more than a million copies of the Bantam paperback edition of Tom Wolfe's *The Right Stuff* is a clear signal of the wide public interest in flying. (The motion picture made from Tom Wolfe's book is scheduled for release in October.)

The six volumes in "The Aviator's Bookshelf" were selected by Peacock and Bantam editors. They would like to hear from AIR FORCE Magazine readers about their own favorites, which could suggest the demand for future titles in the series.

The six volumes in "The Aviator's Bookshelf" are: *The Wright Brothers,* the authorized biography, by Fred C. Kelly—$2.95, about the two men who were the first to master powered flight; *The Flying North,* by Jean Potter—$2.95, about Alaskan bush pilots who flew in impossible weather; *The Sky Beyond,* by Sir Gordon Taylor—$2.95, transoceanic flight before navigational aids; *The World Aloft,* by Guy Murchie—$2.95, which describes the sky as an ocean filled with currents and wildlife of its own; *Carrying the Fire, An Astronaut's Odyssey,* by Michael Collins—$3.50, "The best-written book yet by any of the astronauts," says *Time* Magazine; *The Lonely Sky,* by William Bridgeman with Jacqueline Hazard—$3.50, the renowned test pilot's own story.

All volumes were previously published originally in hard covers, and some have been in paperbound reprint editions that are no longer available.

Please write AIR FORCE Magazine with your own selections of aviation classics that you would like to see published. The address is:

AIR FORCE Magazine, Attn: Thor Bennett, 1750 Pennsylvania Ave., N. W., Washington, D. C. 20006.

We will publish the findings in a future issue, and also pass them on to Peacock Press.

—THE EDITORS

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SCIENCE/SCOPE

More than 20 nations throughout the free world guard their skies against enemy attack with automated air defense systems developed by Hughes Aircraft Company. Since pioneering the electronically scanned 3-D radar more than 20 years ago, Hughes has produced or managed systems for Japan, Switzerland, NATO countries, Spain, Canada, and the U.S. Air Defense Ground Environment (ADGE) systems are comprised of air defense radars, computers, displays, and other electronic subsystems. Data links relay detections to data processing centers where computers identify, automatically track, and report the aircraft's speed, altitude, and course. ADGE also can command and control defensive aircraft and missiles.

The new AMRAAM missile will be good at evading enemy detection through a clever improvement to its radar system. The improvement, now patent pending, is done simply and with only a little extra hardware. It greatly reduces inaccuracies caused when the missile jumps from one radar frequency to another en route to its target. Frequency hopping makes it extremely difficult for enemy radar-detection equipment to get a fix on the missile. Hughes designed and developed the Advanced Medium-Range Air-to-Air Missile for the U.S. Air Force and Navy.

The Maverick air-to-ground missile is proving itself to be a versatile performer. The original Maverick uses a TV seeker to let a pilot locate a target and lock the seeker's cross hairs over the target image. The new imaging infrared version, besides spotting targets at longer ranges than TV Maverick, can see at night and through battlefield smoke. A new laser-guided Maverick locks on the reflection of an invisible laser beam directed at the target by either a ground or airborne designator. It carries a heavy blast penetration warhead. The three missiles share many of the same components. Hughes produces Mavericks for the U.S. Air Force, Navy, and Marine Corps, as well as several nations.

A modified radar for the proposed dual-role F-15 Eagle can cue an infrared sensor or infrared-guided missile to lock on a ground target from maximum standoff distance. The radar produces high-resolution ground maps and pinpoints targets far beyond the range of an infrared sensor. The pilot instructs his computer to point the infrared sensor toward the target. The sensor locks on as the target nears, saving the pilot the time and trouble of searching through the sensor's narrow field of view. The U.S. Air Force is evaluating the Advanced Fighter Capability Demonstrator F-15 co-sponsored by Hughes, supplier of the AN/APG-63 radar, and McDonnell Douglas, builder of the F-15. The program is showing that the F-15, with high-resolution mapping enhancements, is versatile enough to strike ground targets at night or in bad weather with the accuracy of a daytime attack aircraft, yet keep all its capabilities as an air superiority fighter.

In what may be the world's biggest aerospace cost reduction program, Hughes and its customers, including the U.S. government, have saved $1.8 billion during the past 25 years through the ideas and ingenuity of company employees. The savings were documented by the Hughes Cost Improvement Program, in which employees are encouraged to submit cost-reduction or cost-avoidance ideas on prepared forms. Last year 6,931 employees submitted ideas that saved over $250 million.

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• Thornton A. "T" Wilson, chairman of the Boeing Co., was honored for his lifelong career as an aeronautical engineer spanning the development of the B-17 to the Minuteman ICBM; for his executive and managerial capabilities; and for his participation in the introduction of the new-technology 757 and 767 jetliners.

The crew of the *Double Eagle II*—the first balloonists to succeed in a transatlantic crossing—was presented the Hall of Fame's Spirit of Flight award.

★ USAFE's Capt. (Dr.) James G. Mathis has been named Air Force flight surgeon of the year and been presented the Malcolm C. Grow Award.

Captain Mathis is assigned to the 91st Tactical Fighter Squadron, 81st Tactical Fighter Wing, RAF Bentwaters/Woodbridge, UK.

A Mathis accomplishment was the establishment of a "mini-clinic" at the squadron where he sees members and dependents beginning at 6:30 p.m. He also serves at the base clinic and supports the 67th Aerospace Rescue and Recovery Squadron at RAF Woodbridge.

Captain Mathis trains with his squadron's pilots, including winter water-survival exercises in the North Sea.

The award is named for the first Surgeon General of the Air Force.

AEROSPACE WORLD

★ **NEWS NOTES**—Computer maintenance technicians are needed **as full-time crew members aboard AWACS aircraft.** Applicants with specialty code 305X4 and at a five level would have to pass a Class III flying physical. Selectees will then undertake **sixteen weeks of training** at Tinker AFB, Okla., and serve with the 552d AWAC Wing there. Following training would be a thirty-six-month active-duty commitment. For details, contact MSgt. Jim Moriatis at AFMPC, Randolph AFB, Tex., AUTOVON 487-4378.

Officials at Fort Belvoir, Va., are **seeking enlisted specialists for defense attaché duty abroad.** Immediate openings exist for specialty codes 70270 and 70299 for duty in Argentina, Brazil, USSR, and Zaire (E-5 through E-7); Bulgaria (E-7); and Honduras (E-8). Additionally, a flight mechanic (43172 grade E-5 through E-7) is needed for duty in Venezuela. For more information call AUTOVON 354-6036.

Died: Tallmadge "Tom" Boyd, following heart surgery in Manhasset, N. Y., in May. He was seventy-six. A pilot who devoted his life to aviation, Tom Boyd was a member of the Wings Club and, as a long-time member of AFA, served as Treasurer of New York's Iron Gate Chapter until his death. A recipient of many AFA local and national awards, he was designated a Doolittle Fellow of the Aerospace Education Foundation in 1978.

Died: Gen. Alfred M. Gruenther, USA (Ret.), of pneumonia in Washington, D. C., in June. He was eighty-four. Considered one of the most brilliant staff officers in the history of the Army, General Gruenther planned the invasions of North Africa, Sicily, and Salerno in World War II. A 1918 graduate of the US Military Academy, in the postwar years the soldier-diplomat held many key posts, including Supreme Commander of NATO from 1953 to 1956. Following retirement in 1956, General Gruenther served as president of the American Red Cross and on industrial boards and Presidential commissions.

Died: Col. Patrick Montoya, USAF (Ret.), one of the best known and loved SAC senior combat-crew navigator/bombardiers from the days of World War II through the B-52H, of cancer in June in Omaha, Neb. The long-time AFA member was sixty-one. Prior to his retirement in 1970, Colonel Montoya's legendary exploits and experiences as crew member, staff officer, operational planner, and impromptu entertainer enriched the worldwide lore of SAC combat crews.

Died: George L. Washington, a seventeen-year member of the Aerospace Education Foundation board of trustees, of a heart ailment in June in Washington, D. C. The Tuskegee Airmen member and former Tuskegee Institute official who helped establish a military flying training program there in World War II was eighty. ■

INDEX TO ADVERTISERS

CAPITOL HILL

By Kathleen G. McAuliffe, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., June 29

Focus on Midgetman

An amendment to the FY '84 Defense Authorization tying MX deployment to specific milestones in the small, single-warhead missile program is arousing congressional interest. Some in Congress support the proposal because they perceive a lack of enthusiasm in some USAF circles for the small ICBM—sometimes called Midgetman.

Rep. Les Aspin (D-Wis.), a key force in securing House passage of the MX resolution, plans to offer a comprehensive amendment including the MX-Midgetman linkage as well as limiting the size of the small missile to ensure that it not become a silo-based, MX-like system. Specifically, the measure may limit MX deployment to ten missiles until a Midgetman prototype is developed and certain engineering and design milestones are met. Further deployment may be limited to thirty-five missiles until the small ICBM is flight-tested—probably in 1986 or early 1987.

The Aspin amendment will probably limit the small missile weight to some 30,000 pounds, but allow for a ten to fifteen percent growth creep. USAF wants the authority to go as high as 39,000 pounds in developing Midgetman. The guidance system and hardening against nuclear effects will add significantly to the system's weight if it is to have the accuracy and hard-target kill capability of the MX. The Air Force wants Congress to allow for needed flexibility in program development.

Congressional proponents of the small missile think that limiting the weight will ensure mobility and restrict the system to only one warhead—two factors deemed important to advancing arms control and nuclear stability.

The White House is not putting up any roadblocks to the measure for fear of dissolving the fragile coalition on MX.

Weinberger Holds Firm

Secretary of Defense Caspar Weinberger refused to advise Congress how to meet the reduced defense budget of $268.6 billion in FY '84. Responding to a request from Senate Armed Services Committee Chairman Sen. John Tower (R-Tex.) for suggestions of areas to cut in the defense authorization, Secretary Weinberger urged instead that the committee stick with the President's budget. He said that further cuts would reduce force structure, readiness and sustainability, and modernization. The Secretary suggested that the authorizing and appropriating committees need not be bound by the five percent growth level in the budget resolution since it is only a target, not a fixed limit.

The Pentagon chief assured the Senate committee he would "work diligently to persuade Congress that the President's budget . . . is essential to our national security and that any significant compromise thereto will jeopardize the President's ability to guarantee the security of the American people."

Congress is not apt to heed his warning.

B-1B MYP

The Senate Armed Services Committee provided full multiyear procurement (MYP) funding for the B-1B despite a recommendation by its Subcommittee on Strategic and Theater Nuclear Forces that it be deleted to achieve required savings to meet budget resolution targets. In a bipartisan vote, the full committee reinstated some $880 million for MYP after the Office of Management and Budget (OMB) identified $2.1 billion in unanticipated savings from changed inflation assumptions.

Chairman Sen. John Tower denied a charge by fellow committee member and B-1B opponent Sen. Edward Kennedy (D-Mass.) of "budget trickery" by the Administration. Senator Tower said the committee had hints of the inflation savings in early May. Many committee members were uncomfortable with the subcommittee recommendation on MYP, according to the chairman, and the full committee probably would have overturned that recommendation without the OMB inflation submission. This would have required offsets in other defense programs, Senator Tower said.

The committee decision, which probably will be sustained by the full Senate, means that the $20.5 billion total program cost should be met.

Arms Control

The Administration is prepared to give up MX if the Soviets relinquish all their heavy and medium ICBMs, according to Arms Control and Disarmament Agency chief Kenneth Adelman. This would require an end to about 650 Soviet SS-18s and SS-19s—the mainstay of their strategic nuclear force—and result in a complete change in their strategic nuclear force.

Some members of the Senate Foreign Relations Committee felt that the Adelman offer was an impractical negotiating proposal. Critics construe the proposal as evidence of Administration intransigence on arms control. This could cause problems for the Administration in securing MX production funds in July. However, the President told members of the House and Senate that the scale of MX deployment would be influenced by Soviet strategic programs and by any arms-reduction agreements.

The Foreign Relations Committee is conducting extensive hearings on US-Soviet relations, expected to culminate in the recommendation of specific arms-control legislation. Committee sources predict the final outcome may well see the nuclear freeze as the big loser and the nuclear builddown approach, sponsored by Sens. William Cohen (R-Me.) and Sam Nunn (D-Ga.), as the Senate favorite. It is currently endorsed by forty-five Senators—ranging from proponents of a freeze to stalwart supporters of modernization. Senator Cohen told the committee that he fears some Administration officials are not pursuing the builddown with enthusiasm. The President has endorsed a flexible builddown for inclusion in START negotiations. ■

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R&D Works Up the Options

BY JOHN T. CORRELL
SENIOR EDITOR

From the local avionics shop to stations in space, technological implications for the future.

THE Air Force's technology needs are as immediate and everyday as being able to tell, surely and quickly, what's wrong when a warning light says there's an avionics problem in the south end of an airplane.

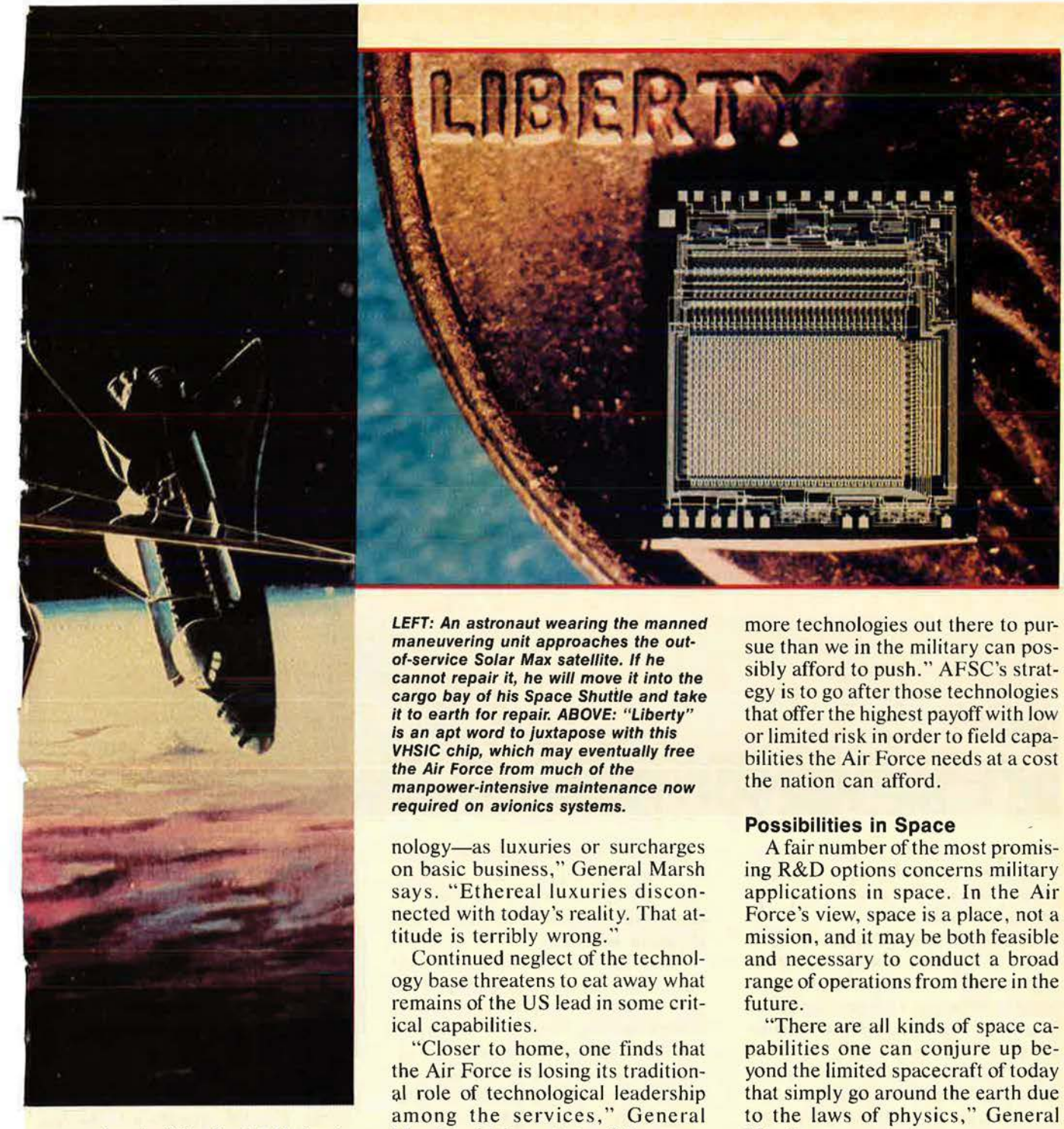
Other needs are as distant and undefined as preparing man to function in space, perhaps performing on-orbit repair and modification of satellites.

Still another set of requirements suggests the concept of the "autonomous airplane," in which a pilot might go to war with integrated systems aboard his aircraft feeding him almost any kind of data he can use, helping him make decisions, and freeing him of dependence on links to the ground or to other aircraft.

Even as Air Force Systems Command grapples with its priority objective of cost control *(see p. 45)*, it dares not slacken the pace on R&D. In some cases, technological advances may make systems more affordable. In other cases, they won't.

"One thing for sure," says Gen. Robert T. Marsh, AFSC Commander, "if we do not pursue the technology *now*, we won't have to worry about the cost/capability tradeoff questions later."

And the technology must be pursued, because the potential opposition is getting better. A decade ago, the United States was ten to twelve



LEFT: An astronaut wearing the manned maneuvering unit approaches the out-of-service Solar Max satellite. If he cannot repair it, he will move it into the cargo bay of his Space Shuttle and take it to earth for repair. ABOVE: "Liberty" is an apt word to juxtapose with this VHSIC chip, which may eventually free the Air Force from much of the manpower-intensive maintenance now required on avionics systems.

years ahead of the Soviet Union in microelectronics and computers. That lead is only three to five years now. No longer does the United States have a monopoly on such capabilities as lookdown/shootdown radar.

The Shelf Gets Bare

A problem here is that the United States has shorted itself on scientific research for many years, and the technology base has eroded badly. "Our society tends to treat technology base issues—developing scientific knowledge and technology—as luxuries or surcharges on basic business," General Marsh says. "Ethereal luxuries disconnected with today's reality. That attitude is terribly wrong."

Continued neglect of the technology base threatens to eat away what remains of the US lead in some critical capabilities.

"Closer to home, one finds that the Air Force is losing its traditional role of technological leadership among the services," General Marsh said in a state of the command assessment earlier this year. "In recent years the Air Force has lagged behind all the services and DARPA [Defense Advanced Research Projects Agency] in spending for basic and applied research." Among the reasons why this is disturbing, he says, is that "the most technically advanced service cannot afford to mortgage its future through inadequate attention to the maintenance of a viable weapons technology base."

With the shelf thus getting bare, General Marsh says, "there are a lot more technologies out there to pursue than we in the military can possibly afford to push." AFSC's strategy is to go after those technologies that offer the highest payoff with low or limited risk in order to field capabilities the Air Force needs at a cost the nation can afford.

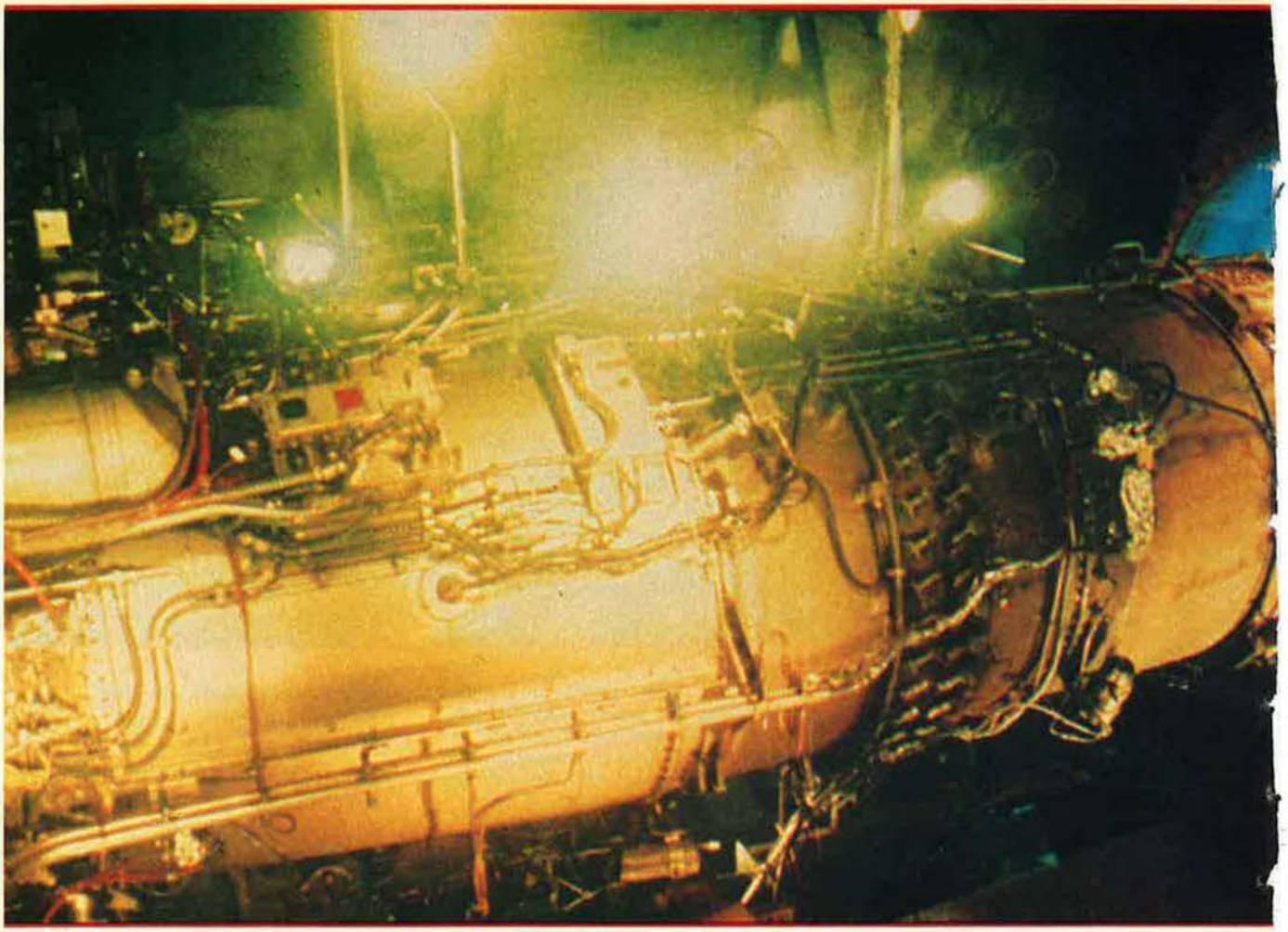
Possibilities in Space

A fair number of the most promising R&D options concerns military applications in space. In the Air Force's view, space is a place, not a mission, and it may be both feasible and necessary to conduct a broad range of operations from there in the future.

"There are all kinds of space capabilities one can conjure up beyond the limited spacecraft of today that simply go around the earth due to the laws of physics," General Marsh says.

There is substantial interest in defensive measures, techniques that might allow a satellite to jump out of the way or otherwise defend itself. This interest is driven in part by the fact that the only operational antisatellite capability in existence belongs to the Soviet Union.

"Survivability is one area that deserves critical attention," General Marsh says. "We can't continue indefinitely to expand our reliance on space-based capabilities unless we address the question of their survivability. There are a lot of techniques



that bear directly on space survivability that need to be pursued and aren't being pursued very aggressively today."

Elsewhere, the prospect of materials with greater heat resistance points to more design flexibility in reentry vehicles. Composites of the future, stronger and lighter than materials of today, could enable the construction of space stations and large platforms with increased sensor or communications capability. Developments in efficient rocket propulsion may permit the repositioning of space systems, including changes in altitude or orbital plane.

"Surely," General Marsh says, "moving one satellite to another area where it is suddenly needed must be cheaper than building and launching two satellites to achieve the same effect."

Military Man in Space

The role military man will play in space is uncertain.

"Some maintain that man is simply excess baggage in an on-orbit system," General Marsh says. "Others believe manned systems have great potential to increase our capabilities, provide flexibility, and do more with less.

"The fact is that we do not yet have the requisite technology programs under way to determine which view is correct. We simply do not know the military-related mission limitations of man in space, nor do we know enough about additional capabilities that might result from man-machine interfaces aboard space systems."

In any event, work is needed on life-support technologies. General Marsh cites, for example, the requirement for a lifeboat to rescue stranded astronauts.

Later along, such man-in-space activities as on-orbit repair, construction, reconfiguration, and modification of satellites, perhaps using plug-in modules, may turn out to be advisable for reasons of economy as well as capability.

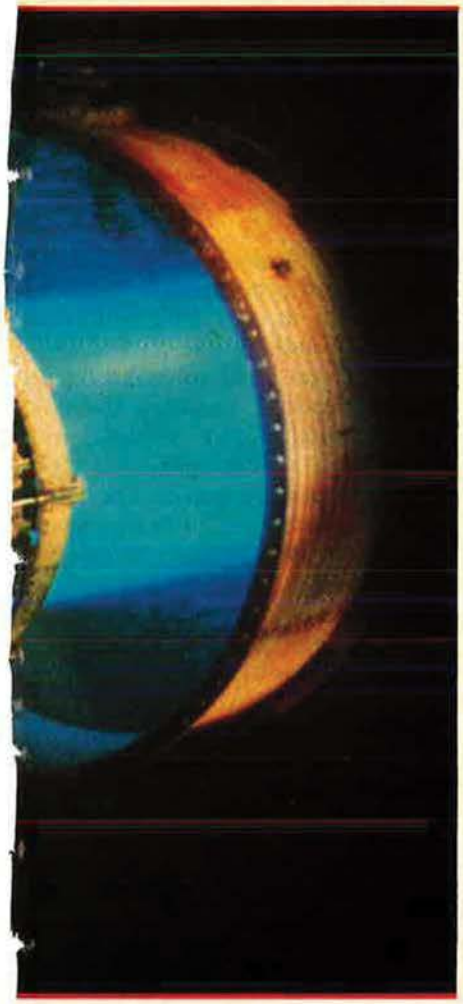
"If we look at the cold, hard facts that are available to us today, we can't conclude that there's a useful undertaking or an immediate opportunity for man—military man—in space," General Marsh says. "Even so, we need to pursue the technologies related to military man in space so we'll have the opportunity for it if that proves to be a sensible undertaking some time in the future."

Reliable and Ready

Light-years away from space in terms of public attention is the important but unglamorous R&D work of making systems more reliable and ready to go.

"Combat effectiveness and readiness are not determined solely by weapon system capability," General Marsh says. "Availability—having a weapon system ready when needed—is as important as the capability itself."

Real progress is being made. The F-15, for example, can surge to better than four sorties a day, compared with an average of one sortie every four days for World War II fighters. Subsystems are better,



New structures and alloys are evaluated in engine durability tests at Arnold Engineering Development Center. The Air Force would like to have more thrust in its next fighter engine, but, even more than that, it wants durability.

too. The latest UHF radios have a mean time between failure of about 1,000 hours. UHF radios used to fail within thirty to 100 hours.

"There was the era when we had just a great proliferation of lousy, low-reliability avionics," General Marsh says. "We generally felt we ought to develop some high-reliability avionics and standardize on them. And we've come a long way.

"You'll see the same UHF radios, ARC-164s, in all of our first-line airplanes. You'll see that good new TACAN in all of them. In all of those that need LORAN, you'll see that good LORAN-101, and so on."

For all of its benefits in reliability, logistics, and cost, standardization alone—or applied with a sledgehammer—is not the answer. The danger is freezing on obsolescence. Unrelenting standardization may block the emergence of newer and better systems.

"You've got to be somewhat careful that you don't let your standardization objective impede progress either toward higher reliability items or toward more capability per unit of cost," General Marsh says. "Also, we want to keep moving forward. That's why we're looking at ring laser gyros instead of the old mechanical type."

Modular Avionics

The way around this problem is to standardize, not on the avionics black boxes themselves, but on the receptacles they fit into on the airplane, and on the way they hook together. The shorthand for this is "modular avionics."

"That's the architecture of our new aircraft," General Marsh says. "We're going to have standard multiplex buses and standard interfaces. People can then develop avionics improvements within form, fit, and function and you plug them in and it's not a major overhaul or modification of the aircraft."

Standard interfaces for ordnance are coming, too.

"All weapons producers or developers will put the standard interface on the weapon, and we'll have the standard interface at the pylon or the rack or wherever," General Marsh says. "There'll be pins there for signal, pins for power, a fiber optics connection if the weapon needs that—and so on into the aircraft system, hopefully by way of the multiplex bus. Now then, if you develop a new weapon, we know darn well we won't have to string a bunch of new wiring out through the airplane. The weapon will fit. If you need twenty-eight volts, you go to pin J. If you need 110 volts, 400 cycle, you go to pin K."

Modular avionics will make modifications cheaper as well as easier. The Air Force tends to keep its basic airframes for a long time, but goes through several generations of avionics for them. In the future, the inevitable upgrades can be handled with less ripping and tearing. In addition, standardization will probably mean more competition from industry to make the new module. No longer will unique features of the system lead almost inevitably back to the producer of the previous module.

A Fix for CND/RTOK

This is not to say the Air Force has solved all of its avionics problems.

A particular hair shirt in the maintenance business is "CND/RTOK." It stands for "Could Not Duplicate/Retest OK," and it's what the people in the avionics shop write on the form when they can't find the problem that the warning sensor said was present when the airplane was in flight.

With the built-in test/fault isolation (BIT/FI) equipment now available, the best the shop may be able to do is narrow the problem down to one of two black boxes. CND/RTOK rates are high, and avionics maintenance expenses are steep. Even worse, the box may be put back into service with the not-improbable reasoning that the fault was in the warning sensor, not in the black box. If the box fails repeatedly, the airplane may be grounded for the costly business of tearing apart one thing after another in search of the problem.

The solution may lie in very-high-speed integrated circuits (VHSIC), which have the capability to carry built-in testing down to the chip level of every black box in the avionics suite.

"We think this will be the enabling technology to allow us to get down to two-level maintenance," says Maj. Mike Borky of AFSC's DCS/Science and Technology. "Do away with the intermediate avionics shop. The system boldly announces where it has failed. The crew chief or whoever opens up the cowling and looks for the blinking red light. He pulls that 'cigarette pack' out. Depending on how much it costs, he either throws it away or drops it in the Return to Depot bag. He plugs in a new one and closes it up."

The distinction between line-replaceable units and shop-replaceable units may disappear, and in time, manpower-intensive avionics maintenance may fade as the driving factor in aircraft support requirements.

Self-Healing Systems

Computational technology is also

leading toward the day of fault-tolerant electronics, which, in an oversimplified sort of way, might be thought of as self-healing systems.

If an avionics system fails in flight, the computer would reprogram itself, usually diverting to redundant capacity there for that express purpose. "You may not even know while you're in the heat of battle that something has failed," Major Borky says.

If failures are so extensive that they swamp the regular backup circuits, the machine would alert the pilot to the problem and flash possible work-around solutions on his head-up display. If he must continue using systems A and B, then he has to turn off either C or D because there isn't enough capacity left to support them all.

These concepts call for near-total integration of avionics, and the Air Force's existing multiplex bus standard, MIL STD 1553B, is probably not adequate for the fully integrated airplane. Preliminary analysis indicates that significantly higher data rates will be needed. The 1553B architecture may be used for subsystems that can live with the lower data rate, and higher speed mux buses may be added for those that can't.

The VHSIC Cornerstone

The cornerstone for many of these plans—and for much else the Air Force wants to do—is VHSIC. A 1981 Defense Science Board panel, looking at what it called "order of magnitude" technologies, assigned its top figure of merit (based on the ratio of high payoff to low development risk) to VHSIC.

VHSIC was originally billed as the next generation of speed in computer chips, but that doesn't say it all.

"The emphasis is on high throughput of data," says Major Borky. "The functional throughput rate is the product of speed and chip density. You can get throughput both ways. As you make transistors smaller, they switch faster. It's a fundamental law of physics, and it means that as chips get denser, they also get faster."

The first few VHSIC chips are just now rolling off the line, but dozens of studies are already identifying benefits to systems that include size, power consumption, and reliability as well as enhanced performance.

"VHSIC lends itself to doing some very special military tasks," General Marsh says. "We can't do without something like it. For example, if you want to make darn smart terminal seekers today, you're limited in a lot of munitions for volume and weight. VHSIC starts to open up putting the real smarts in terminal guidance systems that you can't really do today simply because of weight and power and space limitations."

He says that getting signal processing capabilities into smaller packages with VHSIC will be a considerable benefit. Better IFF (Identification, Friend or Foe) also looms as a possibility.

"Notionally, if you could inte-

TECHNOLOGIES FOR TOMORROW

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Remote Surgical Strike of Fixed Targets	●	○	●	●		○	●		●		○	●		●	
Space Offense and Defense Capability	●	○	●	●	○	●	○	●	●		●	●	○		●
Aerospace Warfare Management	○	○	○			●	○	●	●			●	○		●
Operations in a Chemical/ Biological/Nuclear Environment		○	●						●		●				
Ensure Adequate Sortie Generation Rate			●			●				○		●			
Penetrate Enemy Airspace	●	○	○	○		●	●		●		●	●		●	
Operations Independent of Night and Weather	●	○	○	●			●		●		●				
Mobile Target Kill	○	○	●	●	●	●	●		●		●			●	
Rapid Global Force Projection	●		○			●				●		●			

○ Essential ● Applicable

Many panels of the F-16, seen here on the General Dynamics production line at Fort Worth, are made of composite materials. Continued progress in composites will lead to stronger airframes in the future, and will allow economical manufacture of complex surfaces.

grate all of the characteristics of an enemy target, perhaps its signal or heat characteristics, even down to making a shape identification, you can characterize that target very well," General Marsh says. "Then if you have the processing capability to put all of that together, I think it will make identification possible. VHSIC will open up the processing power to facilitate enemy identification."

An even greater advantage may come in tactical data fusion. C^3I planners have long talked of ways to handle the vast amounts of information a modern battlefield generates, but the real answer has kept eluding them.

"The challenge is still to get that information back from all those sensors, chew on it fast and draw out from it the essential elements, and then provide it to a decision-maker so he can act on it quickly," General Marsh says. "VHSIC is going to give us the power to do that. And not necessarily in a big ground station that can be done away with by one little 500-pound bomb. It might be done in a C^3 airplane, or it's thinkable that it could be done in a single fighter or a bomber."

Artificial Intelligence

Even more amazing capabilities might be packed into a single airplane as computer hardware advances and as a radically new software technique—artificial intelligence—matures. Artificial intelligence is the computer simulation of thought or decision-making processes that normally require human intelligence. The computer adapts its own programming as it "learns" more about its environment.

"Previously," says Dr. Bernard Kulp, AFSC Chief Scientist, "computers manipulated numbers. They may be very clever manipulators of numbers, but, by and large, they just add and subtract. Now when one talks about artificial intelligence techniques, one doesn't store numbers in a computer or do mathematical manipulations. One stores knowledge—bits and pieces of things that basically represent knowledge—in the computer."

The computer takes statements of knowledge, compares them, and infers directly a further statement of knowledge.

"There is a knowledge train," Dr. Kulp says. "If this happens, and this and this, then *this* ought to happen. If it doesn't, try this and this and this."

Significant Air Force involvement with artificial intelligence began about three years ago. Prior to that, DARPA was the main defense participant in this line of research.

"Artificial intelligence is still a science," Dr. Kulp says. "I'm not ready to call it a technology yet. Technology to me is the state of affairs when one is ready to apply it and do something with it."

The Air Force's thrust in artificial intelligence is not the same as that of the general scientific community. "The Air Force's job now is reduction to practice, with limited objectives," Dr. Kulp says. "I think the scientific community is not interested particularly in reduction to practice, except as a hobby. Their prime interest is in advancement of the state of the art."

Among the likely candidates for applying artificial intelligence to Air Force problems are information fusion, very reliable avionics, diagnosis of system faults, and even a "software production assistant" to help humans with their computer programming. The most ambitious and fascinating application being

considered is the "autonomous airplane."

The Autonomous Airplane

It begins with the integration of all the individual sensors and pieces of avionics equipment, each of which has been becoming progressively more capable in its own right. Their synergistic capability is greater still. There is an interchange of information generated here and there all over the sensor suite. Every part of the system can take advantage of computational power available in any part of it.

"With these kinds of capabilities, we begin to think of doing a lot more things on board the aircraft, things we have traditionally done on the ground and transmitted into the aircraft," Dr. Kulp says. "One begins to think of the autonomous airplane."

The concept, he emphasizes, is not one of robotics. There will be a pilot in the cockpit with a new super-smart machine to help him. "Autonomous" refers to the extraordinary extent to which all necessary capabilities can be contained on board and the extent to which the pilot is freed from reliance on sources external to his aircraft. Artificial intelligence may be much smarter than its number-crunching ancestors, but Dr. Kulp believes it will be a long, long time before an unmanned system that will consistently defeat a man will be built.

"The important thing we need to do with this autonomous aircraft concept is work on what to automate," he says. "We know how to automate almost everything. We just don't know yet what to automate so that the man-machine combination is indeed optimized for capability in any situation."

Autonomous navigation, threat analysis, and target recognition would stand high on the list of candidates. Because of its artificial intelligence features, the machine would give the pilot information instead of raw data. Much of that information would probably come in the form of situation reporting, presentation of options, and probabilities connected with various courses of action.

"We see on-board sensors as having automatic target recognition to the extent, first, that it can tell a tank from a truck and know it's not a boulder or a puddle of water," Dr. Kulp says. "Eventually, as we move down the line twenty or thirty years, identification of a particular model number may be possible."

Autonomous navigation systems might be on the lookout for a particular bridge, knowing that the one it wants has four spans, is of open truss construction, and has railroad tracks but no highway. The machine takes it all in, keeps subtotaling and adding to what it knows. What the navigation subsystem knows, the threat assessment subsystem knows, too. If part of the bridge is blown away in battle, the artificial intelligence system sees, learns, and remembers. It might conclude that the damage has put the railroad out of commission, so the equipment it saw loaded on the train east of the bridge will be late in getting to its destination west of the bridge.

Engines and Airframes

By the time the autonomous airplane is established in the fleet, considerable strides will have been made in engines and airframes.

"We see a twelve-to-one thrust-to-weight ratio coming out in twenty years if we pay attention to our business," Dr. Kulp says. "We see aerodynamic drag coming down. We can expect to see the drag at Mach 1.5 to Mach 2 being not much higher than it is at Mach 0.9 right now. That, combined with the thrust-to-weight ratio of the engines and some improvement in specific fuel consumption, says that sustained operation at supersonic speeds will be economically achievable in military aircraft."

Continued progress in composite materials technology will improve the strength-to-weight ratio of airframes and allow the tailoring of aerodynamic surfaces in manufacturing.

"We will be able to make very complex surfaces economically, because basically, you make a mold for these things and cast them," Dr. Kulp says. "It isn't like you had to machine every square inch of it like we presently do with metal structures. It also allows us to tailor the strength in the high stress direction."

These features, however, lie beyond the turn of the century. The advanced technology fighter for the 1990s will have improvements on a more modest scale. The engine, for example, may very well have fewer parts than present engines and may be significantly more durable.

"Durability is number one on our list," General Marsh says. "We've just got to get the operation and support costs of our engines down, because they've got some very big logistics tails today. There's no question but that we want to get the thrust-to-weight ratio of our engines up, so lighter-weight materials, in conjunction with durability, are certainly an important objective. We're looking for good fuel economy, because fuel's becoming a bigger and bigger factor in the O&S costs. And I would also say good, reliable accessories of all kinds, including fuel control systems."

He says the Air Force is still looking at the need for supersonic cruise in the advanced fighter, and may want the engine to be able to support that.

"And we want thrust," he says, "but we're not looking for a big leap forward in thrust from the current fighter engine."

More R&D of Significance

Among the many other Systems Command R&D enterprises, the following stand out as particularly significant.

- Stealth, or "low observables," technology to make aircraft more difficult for the enemy to detect.
- Autonomous guided weapons. Tactical missiles that lock on after launch with no data links required. "Missiles that actually see," says General Marsh. "The great advantage here is that the launching aircraft never has to visually or electronically acquire the target."
- Voice controls and unconventional flight paths for fighter aircraft, previewed in the exploits of the AFTI/F-16 (*see "The Future Forms Up at ASD,"* AIR FORCE *Magazine, January '83).*
- Generators and accelerators for directed-energy weapons.
- A new guidance system for the small, single-warhead ICBM. It will have to be smaller and lighter than the MX guidance package, and, thanks to new technology such as ring laser gyros, perhaps more accurate as well. ■

BENDING THE TECHNOLOGY-COST CURVE

What law of nature says that costs must always rise? In some technological endeavors, they don't.

BY JOHN T. CORRELL
SENIOR EDITOR

MIDWAY through the biggest weapon system modernization effort in thirty years, the Air Force faced grimly up to the fact that its acquisition strategy wasn't working.

Through the 1970s and into the 1980s, fewer numbers of systems than intended rolled off the production lines and into service, the Air Force paid more for them than had been planned, and development time was nearly double that of predecessor systems.

To determine exactly what was happening—and why—Air Force Systems Command conducted an in-depth analysis of past acquisitions, encompassing four decades and 109 different systems. That study, the Affordable Acquisition Approach (A^3), revealed how program instability, cost overruns, and the traditional way of reacting to them have robbed the Air Force of wing after wing of new aircraft it might otherwise have had flying today. In addition, it showed how a continuation of the historical pattern might lead to a shortfall of twenty-three percent or worse in the projected weapons buy between now and FY '88. *(For a detailed report on A^3, see "The Costly Alternative to Controlling Cost," AIR FORCE Magazine, June '83.)*

"We didn't invent a new truth here by any means, but we did bring it out to where it hits you between the eyes," says Gen. Robert T. Marsh, AFSC Commander. "We can't just continue indefinitely in the same old direction or the force structure will shrink to that one airplane Calvin Coolidge talked about, with pilots taking turns flying it."

Many factors have contributed to escalating cost, but the pivotal one is program instability. From concept to initial operational capability, it now takes an average of nearly twelve years to field a weapon system. Thus, in its development, a typical system will have been through the administrations of at least two different Presidents, 2.4 full cycles of the Five-Year Defense Plan, and a dozen federal budget debates. Program directors will have come and gone, and there will have been some shifting in perceived requirements and relative priorities within the Air Force.

This situation practically invites instability. The high-value programs have suffered most. The B-1 bomber, for example, was started, stopped, and restarted. The MX missile has been subjected to a long string of agonizing reappraisals.

The Agreement That Wasn't

To make matters worse, the Air Force often assumed more internal agreement about the nature of emerging systems than actually existed. That has been demonstrated starkly by AFSC's new approach to baselining, which requires formal agreement on content of a program from the user, tester, builder, trainer, and maintainer. "The frustration level of my staff has mounted because it is so hard to get everyone to agree about a program baseline," General Marsh says. "But I think the difficulty of the task attests to the need for it. We used to assume agreement. We now know we didn't have it, and how hard it is to get."

Loose and ephemeral baselines go side by side with faulty cost estimates because, as Brig. Gen. Daniel B. Geran, AFSC Comptroller, says, "it is impossible to estimate what you can't define."

In the 1970s, defense budgets dropped, and procurement authority for force modernization fell far short of what the Air Force had expected to get. That, combined with unforeseen inflation rates, constant tinkering with baselines, and a variety of factors such as technical problems and underestimation of actual costs, left the Air Force with less buying power than it had counted on. The typical response—to cut back on quantities and stretch out acquisitions over more time—added to the problem. Inefficient production rates and additional overhead expenses drove unit costs up.

Costs and Budgets

The A^3 study indicates that the Air Force cannot carry out its intended acquisition program unless it can bring cost growth to zero—down from the prevailing average of more than five percent a year—and at the same time get the full procurement authority called for in its FY '83–88 projections. General Marsh is not among those who see such an objective as being impossible to attain.

"I've been in this business too long to lay out what I think are unachievable aims," he says. "In the past, we didn't achieve the procurement authority we had planned on.

Instead of eliminating some things, we took that reduced obligation authority and spread the hurt over all of our programs, including the well ones, and made them all sick.

"The striking lesson that came out of A³ is that we can't continue to do that. If we have to take cuts, if we don't get the program the President has asked for, then we've got to take that reduction in a smart way. Don't *shallow* the base—*narrow* the base. That's the first rule."

He says that the Air Force leadership is prepared for the possibility that this strategy may involve more than killing weak or marginal programs. Some healthy and critically needed ones may have to go, too.

"What it says is that you might have to cancel your lowest priorities," General Marsh continues. "We have proposed a program that we think to be the minimum essential. We need all of it. We feel strongly about that, and the President feels strongly about it, and we're trying to defend that program so I'm not going to stand here and tell you what programs are going to be canceled. But if it comes down to the spades and we don't get the program we're asking for, we're ready to approach that in a sensible fashion."

The Air Force, with no real control over budget authority, is concentrating its energies on eliminating cost growth. In the wake of A³, Systems Command has elevated cost reduction to the top priority in its 1984 corporate plan.

All this hits just as the Air Force is defining its long-range directions and requirements in such activities as Air Force 2000 and AFSC 1990. Continuation of business as usual, General Marsh says, will lead to "the day when we might not be able to afford both the weapons we need and the forces necessary to man them."

Technology Can Help

In Project Cost, the broad effort to address the problems identified in A³, Systems Command is emphasizing affordability, stability, management, and rigorous application of solid business procedures. Beyond that, General Marsh believes, a proper technology investment strategy can contribute not only to operational capabilities needed for the future, but also to making those capabilities more affordable than now.

"I don't think that it's a law of nature that the weapon system cost curve has to continue rising," he says. "I think that technology is the factor that can bend the curve back down, and we've got to put it to work for us.

"That cost curve has been going out of sight, but it is not typical across all technological endeavors. This wristwatch is a lot cheaper than its predecessor, and it's a lot better. And that calculator is a lot better than its predecessor and a lot cheaper. There are lots of examples where technology has produced more capability at lower costs than the predecessor capability. We've, therefore, got to bring technology to bear in our weapon systems not only to produce improved capability but, perhaps more important, to reduce the cost per unit of capability."

Computational technology, where very-high-speed integrated circuitry (VHSIC) can lead to less maintenance and lower life-cycle costs for avionics systems, is a prime example.

"Composites very definitely offer the promise of lower cost airframes," General Marsh adds. "Technology is bringing the cost of propulsion—thrust per pound—down, and it is going to continue to do so. Composite applications to turbine engines will help bring that down. In our investment strategy, we have to give equal importance to those technologies that offer promise of reducing cost as we do to those technologies that offer the promise of increased capabilities."

Affordability

The three elements in Project Cost are affordability, stability, and management.

"Affordability," General Marsh says, "is sort of a fundamental notion. First, we in this command have got to do a better job of making sure the Air Force understands the total implications of an initial decision to acquire a weapon system. We've got to do a better job of cost estimating so we can make a decision on whether a system is affordable or not."

A related issue is the propriety of the costs being estimated.

"We've got a cost-based philosophy of procurement," General Marsh says. "We generally try to satisfy ourselves that the costs are actually being incurred and that they are legitimate. We then add profit to that, and that's the price of the undertaking. If you're going to reduce the price of an item, you've got to get at the cost base.

"Now if you accept this thesis, and I contend that it's true, then industry is not fundamentally motivated to reduce the cost base. In fact, you could say that our approach is a disincentivizing one, because profit is generally a percentage of cost.

"That leads us to do everything within our power to reduce that cost base. That's why we seek out things like incentives to a contractor for productivity, because that will reduce costs. That's why we subsidize the manufacturing technology efforts of the aerospace industry, because that will reduce costs. And that's why I'm very much interested in their labor rates, in how many executives are apportioned to an effort, and in overhead of all kinds, because that comes back to us as cost." *(See box, p. 48.)*

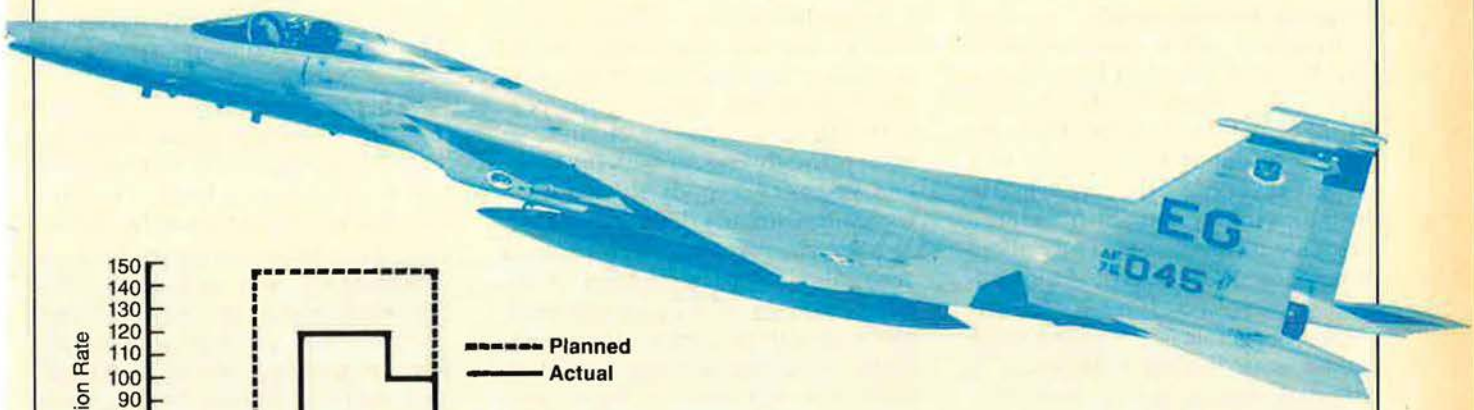
Stability

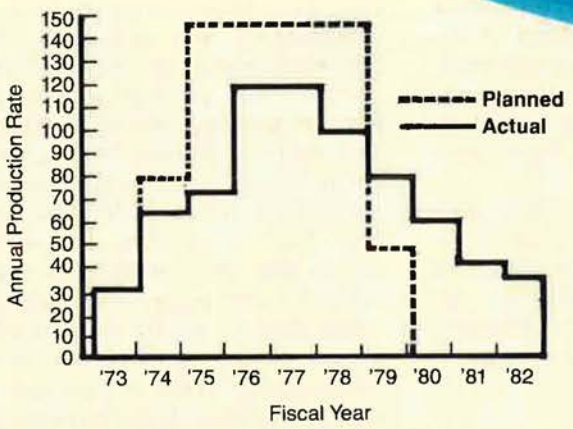
The classic "horror example," as General Marsh calls it, from A³ is what happened to procurement of the original increment of 729 F-15 fighters. To stay within budget, the Air Force departed from its original plan of acquiring F-15s at an average rate of 144 aircraft a year and stretched the program out from six years to nine. *(See chart on next page.)* That added $2 billion—the price of an additional wing of F-15s—to the program cost.

The Air Force had hoped to stabilize the F-15 program by putting it on multiyear procurement, thus eliminating the ups and downs and unpredictabilities of year-by-year acquisition. (That approach has worked well with the F-16 fighter program, where nearly a quarter of a billion dollars has been saved already as a result of multiyear procurement. The cost of procuring forty-four KC-10 aircraft was reduced by about $606 million by using multiyear procurement rather than annual contracting.)

But such is not to be—at least not yet—for the F-15 program, where

The Stretchout That Stole a Wing





Procurement of the original increment of F-15s was stretched out from six years to nine—at a cost of $2 billion, the price of an additional wing of F-15s. This year, Congress cut the F-15 buy again. If the FY '84 acquisition rate were applied to the total remaining F-15 buy, the additional cost would be equal to the price of 760 more airplanes.

the horror story is not over. In May, the House Armed Services Committee rejected the Air Force's request for F-15 multiyear procurement and cut the FY '84 buy to thirty, down from the Air Force's proposal to acquire forty-eight.

This perpetuates the pattern that A[3] warned against. True, less money is spent in the near term—$1.4 billion rather than $1.7 billion—but unit price for the smaller buy rises from $25.2 million to $30.9 million.

The telling effect is seen in projecting this schedule out over the 696 aircraft remaining in the F-15 procurement in FY '84 and beyond. The Air Force had proposed acquiring forty-eight in FY '84, seventy-two in FY '85, and then stabilizing production at ninety-six aircraft a year through 1991. That would result in a total cost of $24.2 billion and an average unit cost of $28.9 million over the life of the buy.

Horror Projection

The House ruling does not address production schedules in the outyears. If, however, the remaining F-15s *were* bought at a rate of thirty a year, the procurement would not be completed until 2007, at a total cost of $46.3 billion and a unit cost of $56.5 million. *(It would mean stretching out the procurement for an additional sixteen years and more than doubling the total cost. Figured at the original unit price, that difference in total cost could buy an additional 760 airplanes.)*

Other cost factors pale in comparison to the effects of instability. The Air Force will continue to press its analyses as emphatically as it can, and in the meantime work hard on internal measures to promote stability. General Marsh believes that increased program stability may be the best tool he has for controlling and reducing costs.

"The real illness in the business and the real cause of unconstrained cost growth that typified our programs over a period of ten to twenty years was in the stability area—in not laying out a program and adhering to it," he says. "Instead of doing that, we cut production rates as we went along, taking the management reserve out of programs, delaying and stretching out programs."

Congress willing, the Air Force does not intend to do that again.

Systems Command is about one-third of the way through establishing firm baselines for its existing programs. Baselines define a program in terms of cost, schedule, technical content, and supportability. All future programs will be baselined as they enter full-scale development. The difficulty in getting all interested parties in ongoing programs to agree and sign up to baselines has been an eye-opener. The Air Force had not previously realized there was so much divergence of opinion about programs in progress. Resolving those differences should eliminate some of the instability problems later on—especially since anyone proposing changes will have to come armed with heavy ammunition.

"One of the root causes of cost growth is that we historically haven't done a good job of defining the program in pre-FSD [full-scale development]," says Maj. Gen. Melvin F. Chubb, Jr., AFSC Deputy Chief of Staff for Systems.

Realistic baselines depend on good cost estimates. Actually, AFSC's cost estimating has gotten better since the 1950s and 1960s, but more than a third of the estimates still are hitting low of the mark. Systems Command has begun twenty-one separate actions to improve this average. Initiatives range from greater use of independent esti-

mates to "murder boards," where cost estimators present their findings and methodology to colleagues for critical evaluation.

Program Management

"Programs often run into problems because they don't get off to a good start," General Marsh says. He notes that the historical trend is that up to eighty-five percent of a system's eventual cost can be laid to decisions made before it entered full-scale development. Only about three percent of the cost is expended in that period, though, and the crucial decisions are often made by people with limited experience in program management. Seasoned managers move in when the program approaches full-scale development.

"Can we reduce costs simply by putting our most experienced people on the early phases of programs?" General Marsh asks. "We don't know for sure yet."

The answer will be coming, because AFSC has already asked its product divisions to put more experienced people—although not necessarily higher-ranking ones—on programs early.

"Further," General Marsh says, "we are looking at longer assignments for program directors to ensure that they are in the position long enough actually to be accountable for cost-control efforts."

Accountability begins early. When a new manager is assigned, he is given a reasonable time to study the history and status of his program. Before assuming control, he must formally concur with the baseline, just as everybody else involved with it has already done. After that, he's responsible for it. This chain of accountability is in contrast to bygone practice, when program managers were freer to blame their problems on the messes they inherited. They also felt freer to fiddle with baselines.

If, in the future, a program does get into trouble, the program manager will be required to submit at least one workable solution that can be implemented without diverting money from some other program.

The Bottom Line

"The bottom line of all this," General Marsh says, referring to A^3 and to the analyses since then, "has been that we in the Air Force have not been able to acquire as much capability for the dollars spent as we should have been able to acquire."

The consequences of this situation, if not corrected, could go well beyond this sort of lost capabilities. In his personal assessment that prefaces the AFSC corporate plan for 1984, General Marsh puts it this way:

"There appears to be an increasingly questioning attitude about defense spending, both in Congress and in the public at large. This attitude has been heightened by the debate over major systems such as Peacekeeper, laser weapons, and by the major issues surrounding arms control. The perception that defense is growing ever more expensive, and that defense funds are not spent wisely has also contributed.

"Defense dollars will be increasingly hard to get, and our performance will be even more carefully scrutinized to assure that each and every defense dollar is spent efficiently. Every cost overrun, every schedule slip, and every instance of less than expected performance will weaken our credibility with the public and reduce congressional confidence and support.

"A direct link between poor management and a weakened national defense is not hard to establish." ■

Alarm About Aerospace Overhead

Increased scrutiny for wage rates and other expenses that contractors pass along to the Air Force.

The Air Force struck a nerve when it began digging into the wage and salary structure of the aerospace industry last year. It found that salaries and wage increases were running ahead of American industry in general, and that, on the average, aerospace workers were making $1.92 an hour above the prevailing wage elsewhere for similar services.

The combination of basic wages and cost-of-living allowances, as of early 1982, was giving aerospace workers an increase of 26.1 percent in compensation over a three-year period. And this did not include "progression increments," which are similar to in-grade step increases for civil servants.

Up to seventy percent of the cost of a weapon system contract may be labor-related, and in most cases the contractor can pass the expense of wage increases on to the government in accordance with the Defense Acquisition Regulation (DAR).

"I think it is absolutely ludicrous to expect all elements of government and all retirees and pensioners from government to undergo strict limitation of their receipts from our federal government while at the same time, through our contracts, we pay substantially larger increases to labor forces building our weapon systems," Secretary of the Air Force Verne Orr says. He suggests that contractors take excess negotiated payments out of their profits. If the crackdown results in work stoppages on defense contracts, he says he is fully prepared to see that happen.

The Air Force does not intend to tell a contractor how much he can pay his employees, but the contractor may find it difficult to charge off unreasonable settlements to the government. One approach may be to change Economic Price Adjustment (EPA) provisions whereby defense contracts can be modified for increases in wage rates.

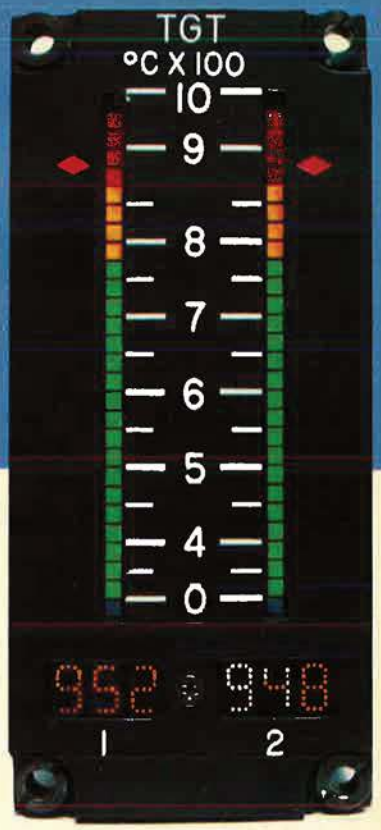
Salary scales—including executive pay—are not the only items under increased scrutiny as the Air Force attempts to trim the cost base of its acquisition contracts. Among other overhead expenses being examined: bonuses, group health plans, corporate aircraft, relocation expenses, excessive engineering and design overhead, advertising costs, and "golden parachutes"—generous settlements for executives leaving a company. Systems Command has notified major contractors that it wants to see such overhead costs as bonuses linked directly to measurable benefits to the program they are charged against.

The Air Force is also showing increased interest in the "Hidden Factory," a term describing poor practices in quality control and leading to such wasteful results as scrap, rework, and repair. AFSC has estimated that the "Hidden Factory" costs on its contracts are $570 million or more a year.

Industry is uneasy with all this poking around into its procedures and its payrolls, but the Air Force gives every indication it intends to stay the course.

Increasing use is being made of the "Should Cost" technique, which looks at what costs reasonably ought to be rather than at what they are or have been. Systems Command cites a savings of $263.8 million from using "Should Cost" techniques last year.

Opto-electronic Engine Instruments



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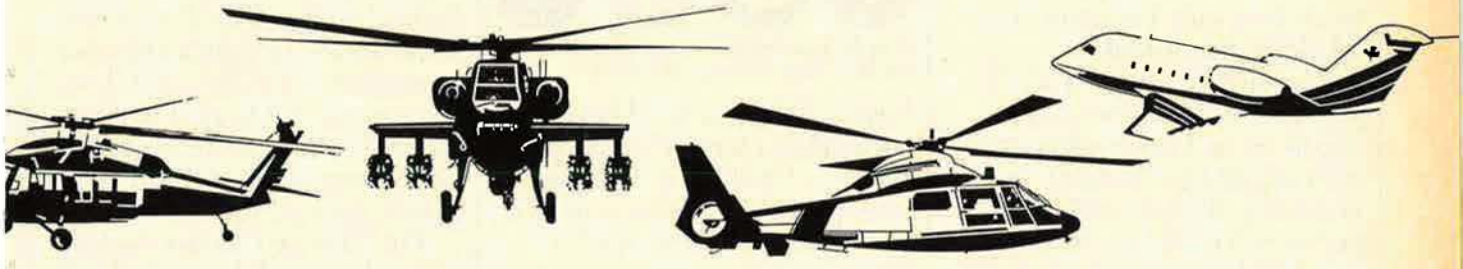

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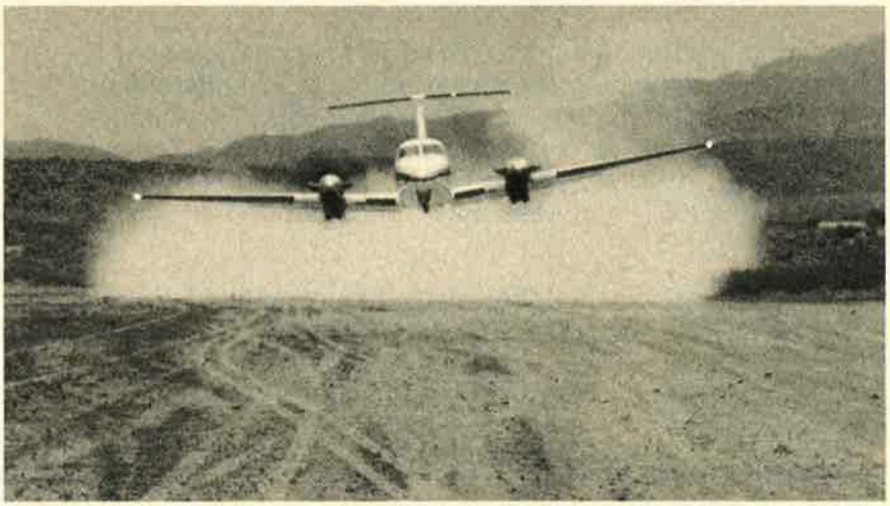

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The pressurized Beech C-12 performs medevac, personnel transport, and cargo missions with efficiency, reliability, and versatility. With short-field performance, 307 cu. ft. cabin, and 3,500 pound payload, it can undertake missions out to 1,925 nautical miles. On typical missions of 500 miles or less, its 290 kt. speed makes it virtually unbeatable.

Product endorsement: The Beech C-12 is the only aircraft that has been enlisted in all four branches of the military – Army, Navy, Air Force, and Marines.

King Air in the military – rugged duty proves reliability. King Air serves all 4 services.

Nearly 200 C-12s in all have accumulated some 480,000 flight hours. A lot of flying. Cumulative operational readiness in 1982 was better than 95%. A lot of readiness.

Keeping all these C-12s flying is contract maintenance support from BASI, Beech Aerospace Services, Inc.

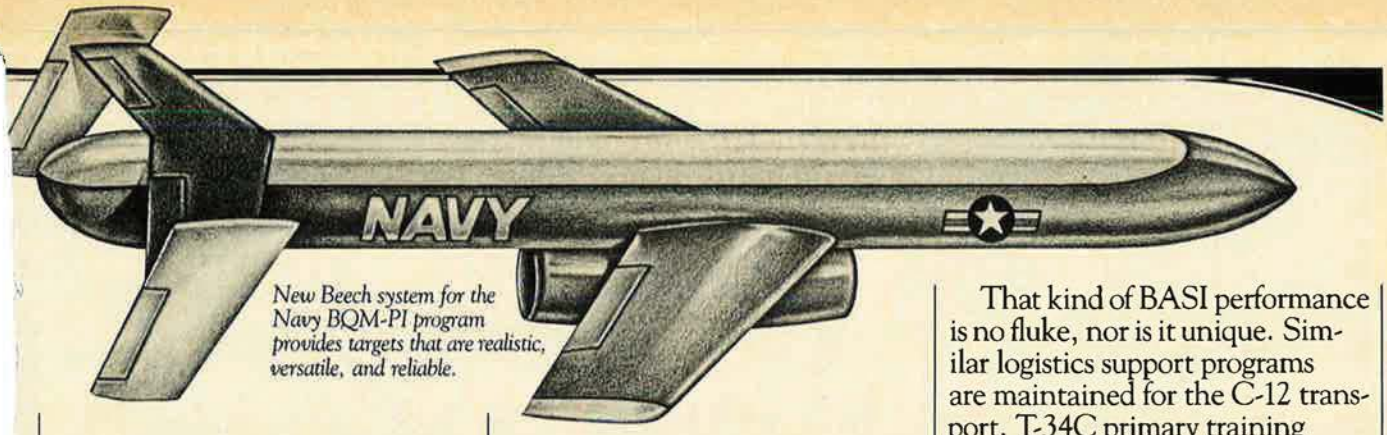
The efficiency of the C-12 fleet saves thousands of dollars worth of fuel, and makes thousands of gallons more fuel available to combat forces. A lot of efficiency.

Clay pigeons that don't forget to duck.

White Sands, New Mexico – Rocket-boosted and jet-propelled, a missile roars off its mobile launcher. Its mission – a high-speed, low-level attack run to challenge an Army ground-to-air missile battery. Downrange – the anti-aircraft missile fires; a hit is registered.

The "downed" target deploys a parachute and descends slowly to earth for recovery and refit. The Beech MQM-107 target system will fly again.

Now used by the Army, and planned for Air Force practice, the MQM-107 has earned a rep-



New Beech system for the Navy BQM-PI program provides targets that are realistic, versatile, and reliable.

utation for target realism and operational dependability with a launch reliability rate of 99.4%. Average flight life – is 20 flights. A lot of flights. A lot of training. A lot of dollars saved.

A tough airplane for rough aviators.

Corpus Christi, Texas – a Navy T-44A turboprop taxis in at Mainside and shuts down. The flight crew – one instructor, two weary student aviators – deplane and head in for debrief. One hour later, a new crew arrives to commence their preflight, as another training cycle is begun.

Navy pilots have to earn their wings and the Beech T-44A multi-engine training aircraft has earned its way in a bruising flight training environment.

Intensive training schedules test both pilots and planes. The landings are many, and many leave a lot to be desired. But the T-44As can take it. Since 1977, the fleet has amassed 201,000 flight hours, and logged over 600,000 landings in polishing the skills of thousands of Naval Aviators.

Total logistics support for the T-44As is provided by Beech Aerospace Services, Inc. (BASI). It amounts to line service, all levels of maintenance, and spares inventory management. (Some 5000 parts are maintained on-site at Navy Corpus.)

BASI T-44A maintenance has exceeded contract specifications for 74 consecutive months.

That kind of BASI performance is no fluke, nor is it unique. Similar logistics support programs are maintained for the C-12 transport, T-34C primary training aircraft, and for Beech missile target systems.

We're quite proud of our achievements in reliability and efficiency, but we must share the credit with a lot of military commanders who are demanding more for their money. At Beech, we are used to that, generals like "Mills, Motors, and Tire," can be tough customers, too.

For more information about how Beech's efficiency of quality contributes to military operational readiness, write:
Beech Aircraft Corporation
Aerospace Programs, Dept. AF8
Wichita, Kansas 67201.

Beechcraft
The efficiency of quality.

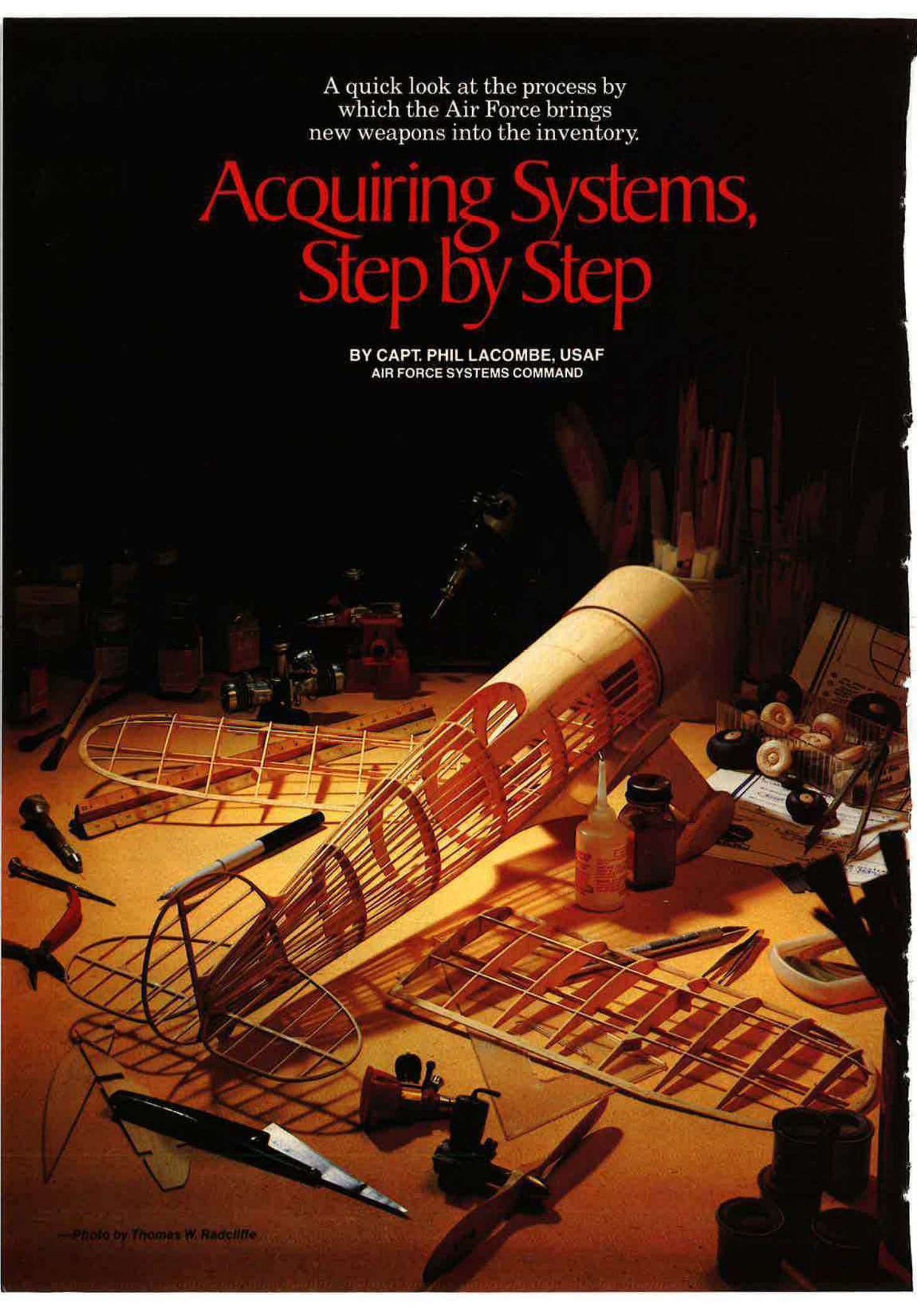
Special mission C-12 has 360-degree radar and two bubble viewing ports for electronic/visual scanning. Extended range fuel tanks give it the "time on station" for range clearing.

A Raytheon Company

A quick look at the process by which the Air Force brings new weapons into the inventory.

Acquiring Systems, Step by Step

BY CAPT. PHIL LACOMBE, USAF
AIR FORCE SYSTEMS COMMAND



—Photo by Thomas W. Radcliffe

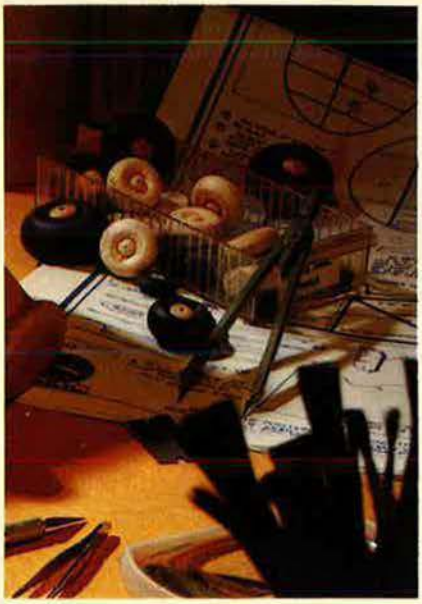
For many years now, the United States has relied on its technical and industrial strength to provide its defense forces with the highly capable weapon systems necessary to deter aggression by the numerically superior forces of our adversaries. With this in mind, it is easy to understand that the acquisition of major weapon systems is an absolutely critical job—a job that provides, in a real sense, the nation's first line of defense.

To achieve the weapon systems capabilities necessary for deterrence today and in the future, the Air Force and DoD operate an extensive, complicated, and—if history is any guide—generally effective acquisition system. Basically, systems acquisition is the process by which the Air Force identifies the need for additional capabilities, defines those capabilities and expresses them as requirements, develops a weapon system (including the basic research and application of technology efforts that go into the weapon system), and purchases the weapon system.

The process employed by the Air Force is actually an element of the Defense Department's acquisition system. Critical decisions, however, about important and costly weapon systems development and acquisition efforts are actually made by the Secretary of Defense, not by the Air Force. The role of the Air Force is to produce its requirements for weapon systems, advocate those requirements before pertinent DoD, congressional, and other decision-making bodies, and then to manage the systems acquisition program that is approved by those same decision-makers.

Systems Command's Role

Within USAF, Air Force Systems Command (AFSC) is the primary organization responsible for the research, development, and acquisition of Air Force weapon systems. AFSC is functionally organized with four product divisions and one office specializing in R&D and acquisition of specific types of systems. These product divisions have the laboratories and test facilities—staffed by scientists, engineers, various technical specialists, and managers—to perform and manage the development and acquisition of Air Force systems. These organizations are:



The requirement for coordination is so extensive that the process is sometimes called 'Management by Vugraph.'

- **Electronic Systems Division.** ESD, located at Hanscom AFB, Mass., is responsible for electronic systems, including command and control systems, communications systems, and the E-3A Airborne Warning and Control System (AWACS) aircraft.
- **Armament Division.** AD, at Eglin AFB, Fla., develops and acquires the services' conventional armaments—everything from laser-guided munitions to iron bombs.
- **Aeronautical Systems Division.** ASD, at Wright-Patterson AFB, Ohio, concentrates on aircraft systems and subsystems.
- **Space Division.** SD, at Los Angeles AFS, Calif., is AFSC's space-oriented organization, performing all preoperational activities, including launch and on-orbit test.
- **The Ballistic Missile Office.** BMO, at Norton AFB, Calif., handles all of the Air Force's ICBM requirements, including the MX Peacekeeper missile and the R&D work on a new, small, single-warhead ICBM.

The product divisions are responsible for the entire spectrum of acquisition activities, from the basic research into concepts that may have future application to weapon systems through post-production testing of the systems. Although some research, design, testing, and engineering activities are performed by Air Force men and women at the product division laboratories and other organizations, the majority of the R&D work is contracted, with the product divisions concentrating their efforts on the numerous management activities necessary to ensure, among other things, that the right weapon systems are developed, that they do what they are supposed to do, that they can actually be used by the Air Force people who will have to use them, and that they do not cost more than is absolutely necessary.

Other AFSC organizations assist the product divisions in acquisition of weapon systems. One of these is the Air Force Contract Management Division at Kirtland AFB, N. M., which provides the business expertise necessary for everything from writing and negotiating a contract to estimating costs and validating contractors' business practices. Another is the Foreign Technology Division at Wright-Patterson AFB, Ohio, AFSC's technical intelligence organization, which provides the assessments of adversaries' capabilities that are necessary to design weapon systems that can realistically counter the threat—today and in the future. In addition, the Aerospace Medical Division at Brooks AFB, Tex., puts the human element into the work of the product divisions. Finally, the Air Force Flight Test Center performs testing and evaluation of weapon systems.

System Program Offices

Within the product divisions are the System Program Offices, or SPOs. The SPOs are the front line of the acquisition effort. SPOs are formed for specific programs to manage the actual development and acquisition of a weapon system. Usually headed by a colonel or lieutenant colonel, SPOs have engineers, procurement officers, and business management people as-

signed. In addition, lawyers, manufacturing specialists, and a variety of other specialists are available to assist in managing the program.

The SPOs don't actually build the system. Rather, the SPOs concentrate on the management of the program—such activities as defining the system being developed, determining the specifications, preparing and administering the contract, and performing the thousands of other acquisition management tasks that go into meeting the cost, schedule, and performance goals of the program.

The SPO director is the Air Force's "man-on-the-spot" for the acquisition of a weapon system. The director is responsible, through higher levels of authority—the Product Division Commander, AFSC Commander, Air Force, DoD, and, in some cases, even beyond that—for every element of the development, production, and purchase of the system.

Each SPO functions as the single point of contact for the acquisition of its assigned weapon system—interfacing with the dozens of DoD and other agencies interested in the system, and with the contractor who is building the system. In this role, the SPO will interface with AFLC about the support and maintenance of the weapon system; with ATC about the training requirements for the people who will operate, maintain, and support the weapon system; with the operational commands about the actual performance of the weapon system; with the FAA about the weapon system's use of airspace; and so on.

In fact, with the extensive decision-making apparatus above the SPO's head, and the extensive briefing and coordination requirements involved, some people have described the acquisition process as "management by Vugraph."

Decision-making in the Acquisition Process

The acquisition process itself is defined by the Department of Defense and managed according to the voluminous Defense Acquisition Regulations, or DARs. Major weapon system decisions are made by the Secretary of Defense or his designee, although AFSC manages the process for Air Force weapon systems—including day-to-day decision-making and, when necessary, making appropriate recommendations to the Air Staff, the Secretary of the Air Force, and the Secretary of Defense.

There are four 'milestones' or decision points, corresponding with reviews by the DSARC or AFSARC.

There are four milestones or decision points in the life of weapon system acquisition program. At each of these points, the Secretary of Defense (on major programs), the Secretary of the Air Force, or another designated official decides whether to continue pursuing the program. The first is Milestone 0, which is the decision to initiate a program. The second is Milestone I, which is the decision to enter the demonstration and validation phase of the program. Next is Milestone II, which is the decision to send a program into full-scale development. Finally, Milestone III represents the decision actually to build and purchase a weapon system.

Corresponding with these milestones are Defense System Acquisition Review Council (DSARC) or Air Force System Acquisition Review Council (AFSARC) reviews of the program. These councils investigate the program and make a recommendation based on a validation of the need for the capabilities being sought and an assessment of the technical and financial health of the program—including whether the technology involved is mature enough to move into the next phase of development or acquisition—to the appropriate secretary about whether to continue the program.

In the past, a DSARC recommendation was required at each of the milestones in a program's life. Today, however, an official within the Office of the Secretary of Defense, known as the Defense Acquisition Executive, may recommend that the Secretary issue a decision without conducting a DSARC. The result of the Secretary's decision, whether or not a DSARC is used, is issued as a Secretary of Defense Decision Memorandum (SDDM).

How It Works

The process begins with the identification of a threat (which may even be improved capabilities of an adversary's existing weapons) or deficiency by various intelligence agencies and operational commands. Cognizant Air Force operational commands, intelligence agencies, AFSC, and other organizations define what is generally needed to counter the new threat. The Air Force then produces a Statement of Need, which establishes a requirement for these capabilities.

Establishing the requirements for the program and defining the program are critical tasks. They require the coordination and agreement of the operational commands that face the threat and establish the requirements or capabilities desired. These decisions must take into account the nature of the threat, existing technology, funding constraints, schedule considerations, and so forth. This first step toward program initiation is important. If the requirements are not properly stated, if cost estimates are wrong, or if other errors occur, there is a risk of not meeting the stated need, of meeting it with the wrong system, or of incurring cost growth later when requirements are changed or clarified.

Air Force acquisition officials continue to stress the need to define a program's requirements in terms

of capabilities, rather than in terms of improved performance, bigger payload, or other evolutionary improvements to existing systems. Too often in the past there was a tendency to define requirements in evolutionary terms, like "Give me a club just like the last one, only this time make it bigger and put a nail in the end of it!"

Requirements definitions such as that tend to eliminate chances for innovation—innovation that could provide substantial breakthroughs in terms of capability. In the above example, the requirements definition would not allow the substitution of a bow and arrow, which might do the job better and increase the operator's chances for survival, as well as cost less.

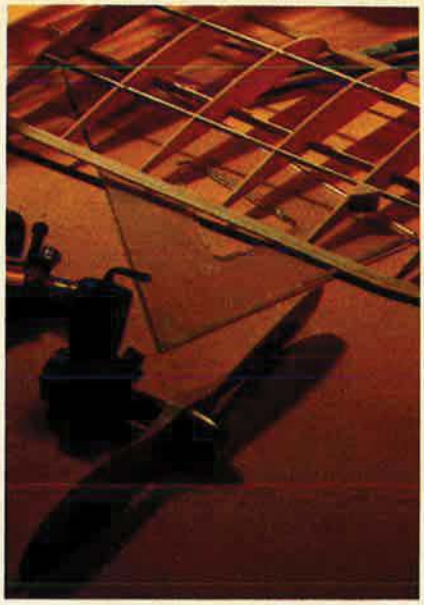
After extensive research, evaluation, and coordination, the program proposal is presented to the Secretary of Defense—this is the Milestone 0 decision. If the Secretary approves, a Mission Element Need Statement is issued, providing the authority necessary to pursue the program.

The program then proceeds through its initial phases of development. At Milestone I, the program moves into brassboarding and validation—ensuring that the technology and hardware developed does actually work. Next, at Milestone II, the program enters full-scale development—the building, testing, demonstration, and refinement of prototypes. Finally, at Milestone III, the program moves into production, and the system that was developed in the previous stages is bought.

Procurement

Procurement of the system is also a complicated process. It normally begins with the Air Force advertising its intention to solicit bids for the weapon system. The Air Force produces a Request for Proposal, or RFP, which is a detailed statement of the requirements being sought by the Air Force, including the specifications required in the system, the elements required in the contractor's bid, and the relative criteria against which bids will be evaluated. With the issuing of the RFP to industry, the Air Force formally enters Source Selection.

Once contractors receive the RFP and respond with a bid, the Air Force evaluates the contractor proposals. This is the process of deciding which contractor's proposal should be accepted.



The acquisition cycle is far from completed when the contract is signed.

Source Selection is accomplished at the AFSC product division responsible for the weapon system. It is a multistep process involving a Source Selection Evaluation Board (SSEB), which evaluates contractors' proposals to assure that the contractors can reasonably be expected to accomplish what their proposals say they can; a Source Selection Advisory Council (SSAC), which ranks the contractors' proposals by weighing the various technical, schedule, cost, and management factors that were evaluated by the SSEB; and, finally, a Source Selection Authority (SSA), who decides which contractor should actually get the job.

Following evaluation by the SSEB, the process moves into the writing of the contract. This is not as easy as it sounds. It involves a negotiation between the Air Force and the contractor on almost every statement contained in what will become a contract more easily measured in pounds than in numbers of pages.

The Air Force position, throughout the negotiation, will be that it wants to acquire the greatest capability possible at the most reasonable cost possible. Air Force negotiators will critique every element of a contractor's proposals—attempting to identify costs that can be reduced or eliminated and ensuring that the contract reflects the "best deal" possible without reducing the quality of the weapon or slipping the schedule. Such factors as the number and composition of the engineering teams assigned by a contractor and various management and overhead costs will be closely scrutinized.

Negotiations are completed with each of the contractors in the competition signing a contract. Source Selection is completed when the SSA, based on the recommendations of the SSAC, signs one of the contracts and announces the winner of the competition. This decision is subject to review by higher levels, which can substantially delay announcement or cause a decision to revert to square one of the evaluation process.

After the R&D contract is finalized, the process is still not complete. The system enters production and the big money is spent on the actual purchase of weapons. But the acquisition system—with its goal of delivering a supported weapon system to the operational commander—is still operating to handle the support requirements, maintenance and logistical requirements, training, and so forth.

In addition, the Air Force Contract Management Division actively manages the contract at the contractor's plant, ensuring that charged costs are valid, and that the contractor is building the system that was contracted.

At initial operational capability, or as soon as it is practical, Air Force Systems Command will transfer management of the program to Air Force Logistics Command. AFLC will begin managing the myriad support requirements—spares, maintenance procedures and equipment, retrofitting, and support—of the program.

But that is another story. ■

Claws by EDO

Notice: There's an entirely new derivative class of EDO's Ejector Release Units (ERUs) and EDO Government Systems Division is building them.

Tornado's light and heavy-duty Claws for the German Air Force and Navy, and the Italian Air Force have reached the full-scale production milestone. EDO ERUs are now flying in Italy and Germany.

ERU derivatives of both Tornado units have been developed for application to other high performance combat aircraft. These ERUs utilize EDO's proven advanced technology. The incorporation of many qualified basic Tornado ERU components ensures extensive benefits in new program scheduling, unit costs and rapid response to requirements.

Right now, EDO stands ready with production capability and a complete range of proven ERU designs to provide ERUs for all classes of aircraft and helicopters, operational or planned... Look to EDO for ERUs.

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EDO Corporation
Government Systems Division
College Point, New York 11356
Telephone 212 445-6000. Telex 127421

EDO CORPORATION GOVERNMENT SYSTEMS DIVISION

Where Technological Innovation Becomes Reality

Some of the US major manufacturers did not exhibit, the US Air Force did not fly, but the Space Shuttle *Enterprise* was visually dominant. Tentative conclusions from the 35th running of the premier aviation trade show include . . .

Third World Surges at Paris

BY F. CLIFTON BERRY, JR.
EDITOR IN CHIEF

The Space Shuttle* Enterprise *atop its NASA Boeing 747 carrier aircraft was dubbed the "world's largest biplane" by observers at the Paris Air Show. The aircraft dominated Le Bourget's aircraft display area, and thrilled citizens of France, Germany, and Great Britain in demonstration flights around their capital cities. After the European tour,* Enterprise *and its 747 were displayed aerially and on the ground to Baltimore and Washington-area audiences. (*Air Force *Magazine photo)

ATTENDANCE at the Paris Air Show provided answers to some of the questions noted in the advance article "Questions at the Paris Air Show" *(June '83 issue, p. 94)*. Both the British and the French governments decided to support development of an advanced fighter aircraft, and the decisions were revealed during the show.

In the British case, the mechanism is a UK government contract with British Aerospace "for the development and construction of a technology demonstrator aircraft with a potential application for fighter aircraft in the 1990s." The program is a joint undertaking by the Ministry of Defense and the UK aerospace industry. It is being implemented by British Aerospace's Warton Division "in conjunction with European industrial partners." It will use a prototype of the Agile Combat Aircraft (ACA) announced at the 1982 Farnborough Air Show. The technology demonstrator aircraft is due to fly in 1986. One of the European partners is almost certainly Germany's Messerschmitt-Bölkow-Blohm (MBB). Italian firms are probably also involved.

The French entry in the 1990s fighter sweepstakes is the ACX *(Avion de Combat Expérimental)* designed by Avions Marcel Dassault-Breguet. A full-scale mockup of the aircraft was shown in Paris, as were smaller models. The development project is being funded by the French Defense Ministry. Unanswered in the case of the ACX are the possible foreign partners. However, they would like to get as many involved as possible, including Germany and Italy.

Clearly, then, one of the projects may run into disappointments if it does not have enough foreign development, partnership, and funding. Also, both projects are seen as business opportunities by US engine and component companies.

Other International Projects

During the show several new international cooperative projects were announced. They included Grumman Aerospace's being selected by Israel Aircraft Industries as the winner of its competition for major components (wing and vertical tail sections) of IAI's Lavi fighter, now in development.

Another international project with US corporate participation (Lockheed) is the Future International Medium Airlifter (FIMA). Other participants in the FIMA project are France's Aérospatiale, British Aerospace, and Germany's MBB. The project seeks to explore and study opportunities for future military and civil transports. Examples of aircraft that could be replaced by FIMA are France's Transall C-160 and Lockheed's ubiquitous C-130.

Northrop's F-20 Flown Daily

Although no USAF aircraft were displayed at the show, Northrop demonstrated its F-20 Tigershark fighter every day. The F-20 continued to demonstrate high reliability, as shown in the early part of its test program and continuing through its demonstrations. The aircraft was flown by Northrop chief test pilot Darrell Cornell.

LEFT: Model of France's ACX fighter aircraft was displayed at the 35th Paris Air Show by Avions Marcel Dassault-Breguet Aviation, its developer. The French Ministry of Defense is supporting the development project; Dassault and the French government are seeking international partners for it. Competition for partners and customers comes from the British Aerospace ACA fighter project, in concurrent development. RIGHT: Fairchild Republic's USAF T-46 Next-Generation Trainer aircraft was shown at Paris Air Show as the FRC-225, a full-spectrum trainer offered for export customers. A General Electric gun pod can be seen on the right underwing pylon. Interest in the FRC-225 was expressed by representatives of the Royal Air Force, Luftwaffe, RCAF, Swedish Air Force, and the air forces of Singapore, Thailand, Jordan, United Arab Emirates, and Bangladesh.

Northrop's foreign sales efforts were given a boost by the May 21 agreement with USAF's Systems Command. Under the agreement, USAF will verify Tigershark's capabilities, a confidence-builder for potential buyers. The aircraft is a commercial fixed-price item with a constant unit flyaway price of $10.3 million in 1983 dollars. However, the USAF agreement means that foreign purchases can be done under US Foreign Military Sales rules.

Fairchild Industries showed its T-46 Next-Generation Trainer in mockup form under the title FRC-225 *(see photo).*

The FRC-225 was yet another example of multirole trainers. Also on hand with the concept was the Mooney TX-1, a version of its model 231. New foreign trainer/light attack aircraft at the show were a mockup of Argentina's IA-63, whose flight is planned for later this year, and Yugoslavia's Galeb-4, already flying.

No Soviet aircraft were shown. A last-minute decision by Moscow withdrew the five or six that had been expected. However, Western

ABOVE LEFT: The F-20 Tigershark impressed potential customers with its dependable daily performance during the show. LEFT: Argentina's Fábrica Militar de Aviones (FMA) displayed mockup of its IA-63 jet trainer/light attack aircraft at Paris. First flight is planned for later in 1983. Prototype is powered by Garrett TFE-731 turbofan engine. The IA-63 epitomizes increasing diversity of aircraft suppliers as traditional US-European dominance wanes. (Air Force Magazine photos)

observers were intrigued by a photo of wind-tunnel testing of a swing-wing bomber design, perhaps the Blackjack being developed by Tupolev.

As for financing, and the hot issues of "Buy American" and limits on technology transfer, no generalized answers emerged. There was much talk of creative financing as a necessity to gain foreign business, but few companies were willing to supply proprietary specifics. As for technology transfer, few US companies had difficulty getting their exhibits approved by the Department of Defense. Most industry sources questioned said that they policed their own exhibits before submitting them to DoD for review to ensure that they weren't giving away technology leads.

Third World Surge

The burgeoning capabilities of Third World countries in the aerospace business were much more in evidence at Paris this time. Examples included Indonesia's Nurtanio, looking for coproduction of aircraft as well as for service contracts, both military and civil. Greece's Hellenic Aerospace Industries (HAI) expanded its participation in the show, displaying its greater capabilities and emphasizing the range of work it can absorb. HAI seems to have excess capabilities now because its potential foreign customers are concerned about the uncertainties of doing business in Greece under the Papandreou government.

Brazil's EMBRAER continues to expand its international business, both military and civil. Its officers noted proudly that they had sold more than 200 of the Bandeirante commuter aircraft in the US market alone, filling a gap ignored somewhat by US industry.

Other countries whose aerospace industries expanded their participation included Romania, Czechoslovakia, Japan, and Finland.

The major US aerospace companies who decided not to participate in Paris this year—McDonnell Douglas, Lockheed, General Dynamics, Pratt & Whitney, and Vought—were on hand both at the show and downtown, meeting customers and doing business without the benefit of an exhibit stand or chalet.

They and other companies stressed the high cost of paticipation at Paris and Farnborough as a matter of continuing concern, one that receives attention from their executives and boards of directors. They stressed that while a company may not exhibit at Paris or Farnborough, it is essential to have people on hand to reassure customers that they still care for their business. ■

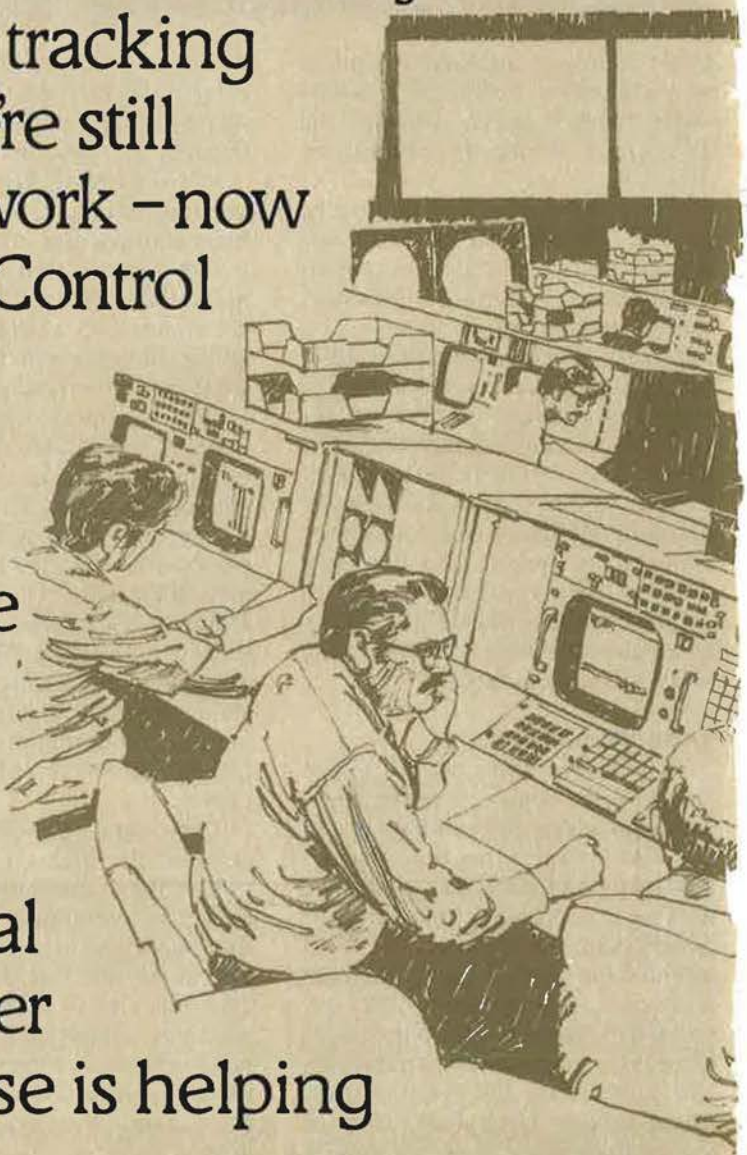
How the Department of Commerce Sees Exports and the Paris Air Show

- The aerospace industry ranks number one in US exports with 7.4 percent of total exports.
- Aerospace exports accounted for an estimated twenty-six percent of total US aerospace shipments in 1982; however, that was the lowest level since 1977.
- US aircraft exports of $7 billion in 1982 created approximately 44,100 production-worker jobs.
- The world market for military aircraft from 1983–92 is forecast to exceed 21,000 units with a value of $196 billion (estimated in 1982 dollars).
- The value of US military aircraft exports in 1982 rose to $2.4 billion—up from $1.7 billion in 1981.
- US exports of missile and space equipment rose substantially during 1982. Missile and space exports are expected to continue to increase as foreign countries seek to improve their military preparedness and space capability.
- A total of 133 US companies exhibited aerospace and avionics products at the 1983 Paris Air Show. An additional sixty US companies exhibited in other areas at the air show.
- The 1981 Paris Air Show resulted in reported floor sales of $37.6 million for US companies exhibiting in the US Pavilion. Floor sales for 1983 were estimated to be $30 million. Total sales projected for the next twelve months are $104.66 million.

In the Beginning, we

For over a quarter-century, Ford Aerospace has been the company to start things. Important things in every aspect of the Space Mission.

In 1957, we participated in the design and development of the first major U.S. military spacecraft tracking network. Today, we're still servicing that network – now the USAF Satellite Control facility, the largest of its kind.

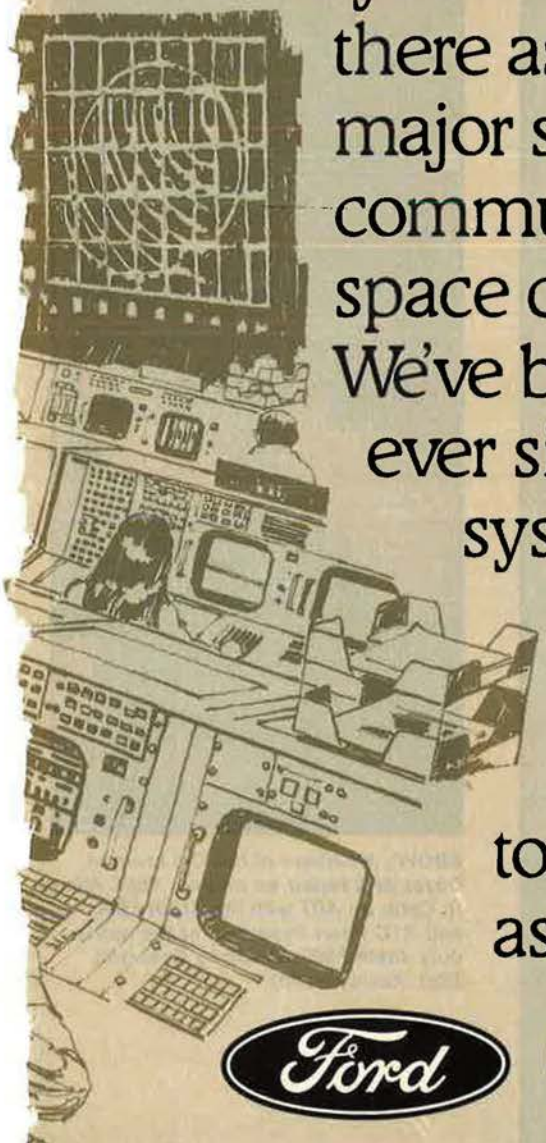


In 1963, we began building the Mission Control Center at Johnson Space Center, and we've provided total system support ever since. This expertise is helping

were there.

us today to design the Operational Control Centers for the NASA and DoD Space Shuttle and the Spacelab payloads.

In 1965, the NORAD Combat Operations Center became operational within Cheyenne Mountain and we were there as prime contractor for major segments of the communication, display, and space computational systems. We've been in the Mountain ever since providing total system support.



And what of future challenges? Ford Aerospace is prepared to meet those challenges, as it was in the beginning.

Ford

Ford Aerospace & Communications Corporation

On a bleak evening in January, a C-5A Galaxy, utilizing its capability for operations in adverse weather, climbed up through heavy overcast on takeoff from Dover AFB in Delaware.

Aboard were a crew of fifteen and forty-four passengers. Including cargo, the huge C-5 weighed in at a hefty 678,000 pounds.

At altitude of about 200 feet, the aircraft took a massive strike from a flock of snow geese undetected in the dense clouds. It was later learned that the geese had deviated from their seasonal migratory pattern.

"These were no mere 'birds,'" noted Dover safety officer Maj. Dwight Sterling, "but projectiles weighing from seven to ten pounds each. We estimated that as many as eighty may have struck the aircraft or been ingested in the engines."

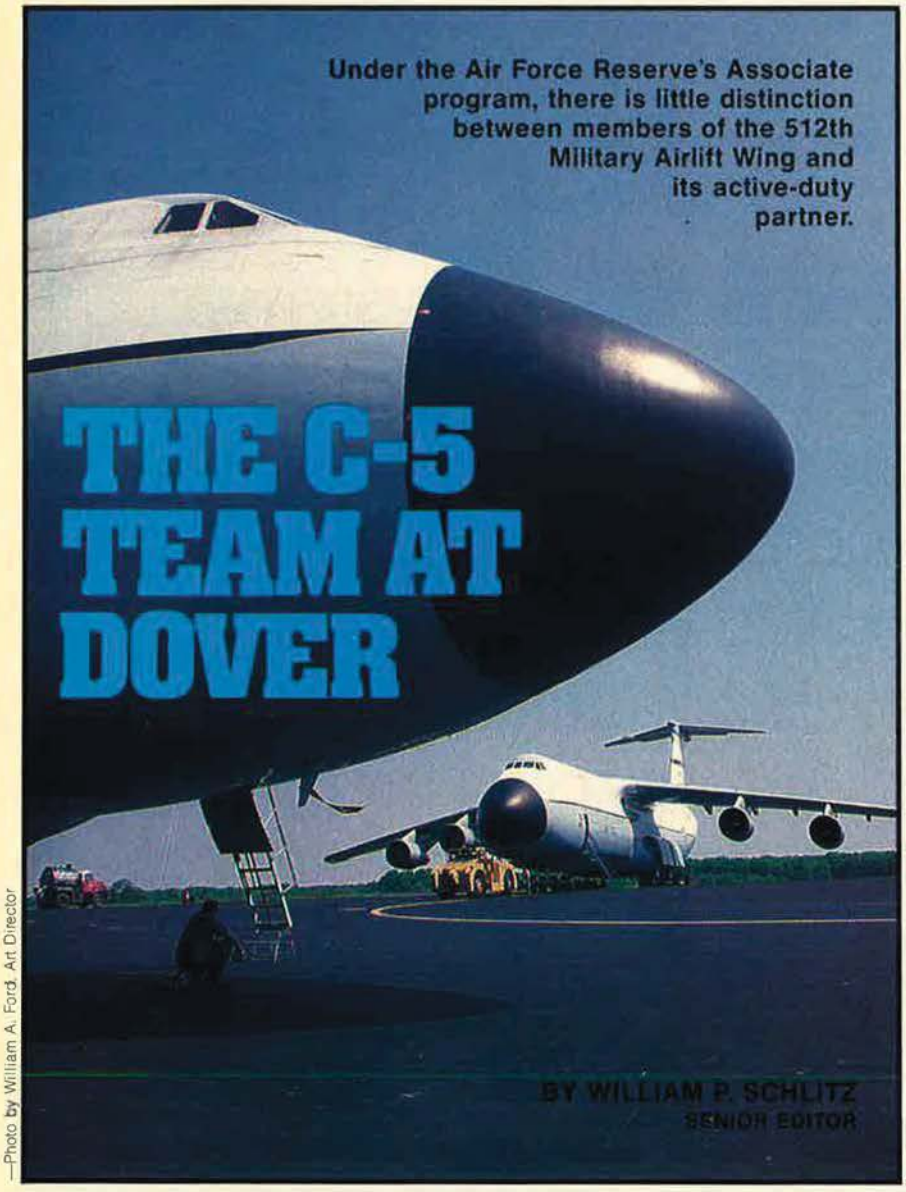
The crew's reaction was immediate and unruffled. Number two engine began heating up and was retarded to idle as the pilot declared an emergency and the crew prepared to fly a box pattern to return to base. Flames were seen in number four engine, and it was shut down.

"Number four engine held together long enough for us to gain sufficient airspeed and altitude for the return to Dover," said pilot and aircraft commander Lt. Col. Ralph H. Oates.

Fuel was then jettisoned and the aircraft landed safely. Later, all crew members were decorated in recognition of their airmanship. *(For details and a crew list, see May '83 issue, p. 33.)*

That the crew of Reservists from the 512th Military Airlift Wing at Dover acted with such professionalism came as no surprise. "Given the circumstances, any of our Associate or active-duty crews at Dover could have been expected to react similarly," noted Major Sterling. "All have been trained for such contingencies."

Under the Reserve Associate program, the 512th is a full-fledged partner with the active-duty 436th Military Airlift Wing at Dover in flying and maintaining the latter's thirty-six C-5s. The 436th is the only Air Force wing equipped exclusively with the C-5. (At Travis AFB in California the two wings fly C-141s as well as C-5s. Other Associate partners fly C-141s and C-9s. To underline the progressiveness of the Associate program, the newest addition to USAF's strategic



Under the Air Force Reserve's Associate program, there is little distinction between members of the 512th Military Airlift Wing and its active-duty partner.

THE C-5 TEAM AT DOVER

BY WILLIAM P. SCHLITZ
SENIOR EDITOR

—Photo by William A. Ford, Art Director

ABOVE: Members of the C-5 team at Dover AFB repair an engine: TSgt. Allen R. Cote, an ART with the 512th FMS, and A1C Pearl Pyzewski, of the active-duty 436th FMS. (Photo by Reservist TSgt. Kevin Heslin)

inventory, SAC's KC-10, is also flown by Reserve crews.)

Without delving too deeply into the derivation and initial objectives of AFRES's Associate program, a brief history would be helpful. It is the brainchild of Gen. Howell M. Estes, Jr., MAC Commander in the late 1960s. At that time, there was considerable Reserve airlift, but it was provided by units equipped with obsolete aircraft. At the same time, the C-141 was coming into the inventory, an aircraft with the potential to outfly its crews. But because of budgetary considerations only so many C-141s could be purchased. The solution: Instead of buying new aircraft for Reserve airlift units, use their crews to augment the active-duty crews flying the C-141s. Reserve maintenance and other support activities could also be gainfully employed in operating the aircraft.

Against opposition—even from Reservists who believed that a Reserve unit wouldn't be such without its own aircraft—the concept gathered support, and Congress approved it.

In 1973, the 512th was constituted to help fly and maintain the C-5s at Dover. Its relationship with the 436th can be considered a model of what the Associate program was designed to achieve.

The partnership of the two wings begins at the top with the full cooperation of both Commanders (who even appear together at civic functions) and continues through other joint activities. "While there is bound to be some competitive spirit between Reserve and active units because of their very nature," noted Col. Jack P. Ferguson, Commander of the 512th, "the Associate program is aimed at getting away from the idea that we are somehow in competition."

In peacetime, aircrews of the two wings—under MAC auspices—conduct a military aerial delivery service. "You name it, we deliver it," commented Col. William H. Sistrunk, Commander of the 436th Wing.

The service consists of routinely scheduled missions—known as "channel flights"—from CONUS to circuits of air bases in Europe, Africa, the Mideast, and the Far East. Cargo could consist of, for example, Army helicopters being rotated to the US for depot maintenance.

On the other side of the coin are one-of-a-kind deliveries requested of MAC that only the C-5 can ac-

LEFT ABOVE: A1C Lewis Irvin of the active-duty 436th Aerial Port Squadron uses a hand-held computer terminal to check in cargo. (USAF photo by Skip Ruiz) LEFT: In the welding shop, TSgt. Garland Dula, an ART with the 512th FMS, makes sparks fly during oxyacetylene cutting. ABOVE: Working on a C-5 tail assembly is TSgt. Ray McCloskey, an ART with the 512th Organizational Maintenance Squadron. (Photos by TSgt. Kevin Heslin)

commodate. "For example," noted Colonel Ferguson, "this summer, the active and Reserve wings will demonstrate their unique relationship—and the C-5's airlift capability—when they join forces to accomplish a highly visible special mission. A C-5 with a mixed crew will fly to Moscow to retrieve a giant electromagnet loaned to the Soviets for experimental purposes."

Makeup of the 512th

The 512th is made up of two flying squadrons, three aerial port squadrons, and three maintenance squadrons constituted exactly as their active-duty counterparts in the 436th Wing. There is also an air base squadron and several smaller assigned elements, including a specialized Security Police flight.

At 99.5 percent of authorized strength, the wing has a force composed of 2,128 Reservists, 267 Air Reserve Technicians (ARTs), and thirty civilians. Of its some 225 officers, most are aircrew members. About forty-seven percent of them have civilian jobs as airline pilots.

Besides the usual motivations for being associated with the Reserve (pay, patriotism, a link with the blue-suit community, a hedge against civilian job layoff, etc.), other benefits accrue to these Reservists. Notably, explained Colonel Ferguson, many of the pilots are second officers (flight engineer equivalents) aboard civilian jetliners. The Reserve link enables them to maintain currency at the flight controls. Also, the carriers look favorably on hours logged in Air Force multiengine jet aircraft.

To perform its airlift mission as well as to keep its aircrews current in flying skills in accordance with MAC regulations, the 512th schedules about 8,100 flying hours a year. These are roughly divided per month and made available by 436th Wing Operations working with 512th Operations for aircrew training and regular channel missions.

The flying hours translate into missions flown. In all, about a third of the C-5 missions—and a third of the total flying hours—out of Dover are by 512th crews.

While most Air Force flying is accomplished to maintain proficiency in various skills, MAC—and its Reserve crews—every day fly line missions all over the world, just as they would in war.

And while 512th Operations likes to put all-Reserve crews aboard the C-5s, it is not unusual for the 436th to contribute active-duty crew members to fill vacancies. The reverse is also true, with Reservists flying with 436th crews. "There is a lot of mixing and matching that makes the system function with a minimum of snags," noted Colonel Ferguson.

While the Operations elements of the two wings are distinct—each has its own facilities—other activities are thoroughly integrated, in some cases to the point of "fusion." This is extremely beneficial in terms of training and maintaining the C-5 fleet.

In a mobilization, the 512th would cease to exist, being absorbed into the 436th. The entities of the two gained flying squadrons would remain intact, but all Reservists would come under the command of the 436th Wing Commander. "Many of the active-duty people would move to mobility positions overseas and the Reservists would step in to run the maintenance shops and the aerial port," Colonel Sistrunk noted.

Integrated Maintenance

Nowhere is the close cooperation between the two wings better illustrated than in C-5 maintenance performed at Dover. "The 512th's three maintenance squadrons own no facilities and work with 436th equipment and in its shops," noted Col. Joseph A. Sabin, Deputy Commander for Maintenance of the active-duty wing.

"The 215 full-time 512th Air Reserve Technicians from those squadrons hold the combined maintenance operation of both wings together," Colonel Sabin added. The three squadrons are designated Organizational Maintenance, Field Maintenance, and Avionics Maintenance.

Many of the ARTs have ten or more years' experience with the C-5 and train active-duty 436th people as well as their own Reservists. "The ARTs by design are distributed throughout the various levels of the maintenance complex," commented Lt. Col. Emmett Venett, the 512th's Deputy Commander for Maintenance and Colonel Sabin's counterpart. "This way they're of optimum value rather than bunched up in remote managerial positions."

Colonel Venett pointed out that about fifty-five percent of 512th personnel—or 1,100—are in maintenance. The Reserve wing contributes about ten percent of the maintenance complex supervisors and managers and about twelve percent of the man-hours by working during weekend Unit Training Assemblies (UTAs) and yearly two-week active-duty stints. For the UTAs, the ARTs have preplanned the on-the-job training with the objective of upgrading the Reservists' skill levels.

"The active-duty Air Force is fluid," noted 512th maintenance control officer Maj. Mark Hollobaugh. "As throughout the Air Force, maintenance personnel serve a tour here and then are transferred. Whereas the Reservists and ARTs are more or less permanent until retirement. So it's natural that they train replacements—either other Reservists or active-duty members arriving as replacements," he added.

In terms of the latter, "The ARTs are the rocks over which the active-duty stream flows," said Major Hollobaugh. "This has come about in a sort of practical evolution since the establishment of the Associate program at Dover."

"Aside from the ARTs' contribution of corporate memory and continuity in day-to-day operations, training the Reservists," added Colonel Sabin, "helps to provide an essential product—flyable aircraft."

During their two-week active-duty tours each year, a number of maintenance Reservists are sent TDY as teams to serve at overseas bases. "There," said CMSgt. Martin F. Hogan, in charge of such a team at RAF Mildenhall in May, "our mixed group of maintenance specialists from the 512th supplemented the local support unit. The primary aim was to broaden our experience with aircraft other than the C-5, such as the C-141 that we might have to fix at Dover some day. A dual objective was to instruct the base's permanent party in the intricacies of the C-5," the Chief noted.

Individual 512th maintenance

people also receive broadened experience at such Stateside sites as the Lockheed plant near Marietta, Ga., and Army stations that have heavy MAC traffic, such as Fort Campbell, Ky. (where, incidentally, MAC maintains permanent liaison). "This extensive program is the best-kept maintenance secret in the Air Force," commented Chief Hogan.

Following basic training and technical school, Reservist and active-duty newcomer maintenance people receive additional instruction at Dover's field training detachment managed by Air Training Command. Those destined for duty with support units overseas also attend.

Instead of by the number of hours flown, a C-5 is scheduled for baseline maintenance in the "iso dock" (for isochronal inspection dock) every 150 days to ensure an even flow of aircraft. (Depot maintenance takes place every forty-two months during a three-month session at the San Antonio Air Logistics Center at Kelly AFB, Tex.) The aircraft remains in the iso dock for three days followed by a twenty-four-hour checkout to replace panels and the like.

If an aircraft is in the iso dock when the Reservists arrive for their UTAs, they simply pick up under the supervision of ARTs (and "pure" Reserve maintenance officers) where the active-duty people left off. "ARTs, though," noted Major Hollobaugh, "are at every level, from shop manager to worker bee."

The Three Maintenance Squadrons

Keeping a complex aircraft like the C-5 flying requires the talents of three very specialized units. For example, the Organizational Mainte-

The Enlisted Crew Members' Contribution

To the uninitiated, the sequence of events in launching a C-5 mission goes like this: The cockpit crew arrives and straps in, runs through the checklist, gets a green light from the tower, and it's up, up, and away.

Few outsiders realize the extent of the contribution of a C-5 crew's enlisted members to the successful completion of a mission.

Three types of enlisted specialists are critical: flight engineers, loadmasters, and dedicated crew chiefs. (In otherwise all-Reservist C-5 crews, the dedicated crew chief is active duty.)

These arrive at the aircraft by regulation two and a half hours before scheduled takeoff, and in most cases sooner.

Without their painstaking calculations and attention to detail, the mission simply couldn't be flown.

For example, loadmasters are experts in the scientific distribution of cargo. Because of the C-5's complex loading system, three loadmasters are required on a mission. The C-5 can load or unload from either end. And, especially important, it can "kneel," that is, the entire airplane can be lowered by retracting the landing gear to conform, say, to the height of a flatbed truck. This would be important in a combat zone where aerial port unloading systems aren't available. So the loadmaster must know the aircraft's hydraulic systems cold.

In the air, the loadmasters double as flight attendants in the aircraft's upper aft compartment to care for up to seventy-three passengers—military or civilian—and supervise their safe boarding and unloading. The loadmasters also handle customs matters.

(The C-5 can be likened to a passenger-carrying freighter of the sky. Besides the huge cargo "hold" and passenger compartment with airline-type seats and designed originally for the crews and maintenance folk of the equipment being hauled by the aircraft, the cockpit compartment affords the space of a small jetliner. It sleeps six and in a rest area seats fifteen—relief crew, couriers, and the like.)

The loadmaster, aside from his knowledge of the tie-down system and supervision of loading and unloading, must also be able to calculate the aircraft's operating weight based on the basic weight of the aircraft plus those of the fuel, cargo, and passengers. The loadmaster must also be able to determine the loaded aircraft's center of gravity.

With these in hand, the flight engineer takes over. (One chore is to compute the pitch of the C-5's unique movable T-tail, which helps to stabilize the aircraft in flight.) The flight engineer must work up the TOLD—takeoff and landing data—card for use by the pilot and copilot. The TOLD card is among the most critical elements in any C-5 flight—or that of any MAC transport.

"For example," noted TSgt. Frank G. Amey, Jr., "based on a careful equation of the aircraft, fuel, and cargo weights, we must know how much runway we need for takeoff. Into the TOLD brew are also stirred such other essential factors as weather, barometric pressure, and condition of the runway—whether it's wet or dry," he added. "These are all taken into consideration in figuring safe takeoff speed to include the loss of one engine and clearing any obstacles in the flight path."

These are no small matters in dealing with a takeoff weight of 357 tons, Sergeant Amey stressed.

The flight engineer calculates the optimum altitude the aircraft is capable of attaining on initial climb-out following takeoff. During the flight, altitude is recalculated to ensure that the aircraft is operating under the most fuel-efficient conditions possible.

"Shortly before landing, the TOLD card is recomputed to provide the pilot with the proper airspeeds for approach and landing based on aircraft gross weight, weather conditions, and field limitations," noted Sergeant Amey, a former 512th Reservist now on active duty with the 436th.

It is the first flight engineer's responsibility—working at the cockpit panel—to check out all aircraft systems prior to the flight. In this, he has the assistance of a second flight engineer—or "scanner"—who is responsible for checking various flight systems located in the cargo compartment and the aircraft's entire exterior. In this, the second engineer also checks wing panel movement, any visible leaks, landing gear damage, and the like.

Sergeant Amey noted that the engineer's preflight checklist for the C-5 takes about two hours and entails 150 steps. Some thirty-five fuel valves and pumps alone must be checked.

The first flight engineer alone—not the ground crew or second engineer—is authorized to conduct "power-on" preflight checks.

"Flight engineers regard themselves as having a position rather than a job and take pride from the prestige associated with keeping a major national resource like the C-5 in the air," noted Sergeant Amey.

The basic C-5 crew includes two flight engineers, one of whom must be a first engineer. Augmented for a twenty-four-hour-duty day, both engineers must be first engineers. "When an equipment problem arises during a flight, the pilot has to know only two words, 'Yo engineer,' " noted one flight engineer with a grin and perhaps only a slight exaggeration.

Also proud of his responsibility is the C-5's dedicated crew chief, who must know the aircraft inside and out. If anything breaks, he must be able to fix it or know how to get it fixed. The dedicated crew chief is critical because of his specific knowledge of the aircraft to which he is assigned. His main function when the aircraft lands is to correct those "mission-essential" malfunctions identified by the flight engineer to keep the aircraft operational and on schedule.

nance Squadron handles day-to-day general work on the aircraft and its equipment. This squadron is said to "own" the C-5s. Among other things, OMS refuels, performs routinely scheduled inspections, and with the assistance of its Maintenance Control section coordinates all on-going maintenance on the aircraft. A computer Ground Processing System is essential in this.

The Field Maintenance Squadron of more than 1,000 strong is the largest of the three units. It is responsible for hydraulics, fuel, and environmental systems, and for repair shops concerned with engine overhaul, welding, paint, and sheet metal work, among other types of repair. The squadron also maintains landing gear, no small task considering the beating they take.

The Avionics Maintenance Squadron is responsible for the C-5's "black boxes"—communications/navigation and automatic flight control equipment. This squadron will service a new color weather radar system that will replace older equipment in the C-5.

The Aerial Port at Dover

The Aerial Port at Dover is one of some two score in CONUS and the busiest air freight terminal in the MAC system. During their duty weekends, Reservists of the 512th's 46th Aerial Port Squadron supplement members of the active-duty wing's 436th APS. (The 46th this year won a MAC award for the best strategic Reserve aerial port squadron.) The Reservists also serve alongside their active-duty counterparts during the mandatory two-week annual tours.

The Aerial Port is staffed around the clock. The 436th active-duty and civilian contingent numbers about 560, while the 46th APS has about 136 Reservists assigned. There are no ARTs at the Aerial Port. The Reservists are also scheduled in small numbers for deployments to aerial ports in Europe where they supplement permanent party personnel during peak periods.

During a mobilization, the Reservists are prepared to take over completely at Dover, relieving their active-duty counterparts for service at essential aerial ports worldwide.

The 512th MAW, unlike the active-duty 436th, also has two other aerial port squadrons assigned. One—the 71st—is located for administration at Langley AFB, Va., but its personnel perform their cargo processing function at the Navy installation at Norfolk.

The second APS—the 92d—is stationed at Wyoming Valley, Pa. Both schedule members for hands-on training at Dover each quarter.

Even though the 436th's recent Operational Readiness Inspection (ORI) was not scheduled by the IG during a 512th UTA, Reservists flew sixteen percent of the scenario missions and even volunteered for overseas channel flights to free up active-duty crews. Furthermore, the base did not suspend operations to contend with the ORI. At the Aerial Port, it was business as usual. During the ORI, 103 sorties were flown in under forty-eight hours.

Ground Security for the C-5

The active-duty 436th Security Police Squadron at Dover has a mission similar to that of the 1776th SPS at Andrews AFB, Md. The 1776th's unique aspect is that it has a section of hand-picked Air Police who are detailed to travel with Presidential and other special air mission air-

512th Wing Restoring *Shoo Shoo Baby*

Boeing B-17G number 42-3207 began flying missions over the Continent from Bassingbourn, England, in March 1944. The ship had been named *Shoo Shoo Baby* by crew chief Hank Cordes after a popular song of the period and assigned to the 91st Bomb Group, Eighth Air Force.

Three months later, she was on her twenty-sixth mission, to Posen in Poland. Although an engine failed crossing the German border, the aircraft continued on the mission, dropped her bomb load, but lost another engine over the target. Ditching all loose equipment, the crew diverted the aircraft to a successful forced landing in neutral Sweden and was interned.

Postwar, the aircraft flew successively for the Swedes, Danes, and French in a variety of peacetime roles before being grounded permanently at an airfield in France in July 1961.

Donated to the Air Force Museum ten years later, the aircraft was dismantled by a US Air Force team and airlifted in crates to the US from Frankfurt, Germany—ironically, *Shoo Shoo Baby's* first target.

Subsequently, the aircraft was stored at Wright-Patterson AFB, Ohio, until 1978 when the 512th Military Airlift Wing at Dover offered to restore her to her original flying condition as an AFRES community service project.

Shoo Shoo Baby is the only known "G" model B-17 still in existence that actually flew combat missions during World War II. The "G" was famous for the distinctive chin turret added to defend against head-on attacks by German fighters. Of the more than 12,000 B-17s produced during the war, just a handful still exist. Only *Shoo Shoo Baby* and the famed "F" model *Memphis Belle* served in combat in Europe.

"We anticipate that the restoration will require about 60,000-plus man-hours and another two and a half years," noted project director TSgt. Ray McCloskey, a 512th Air Reserve Technician.

The restoration is an all-volunteer project with materials being donated by many individuals and corporations. "The work is being conducted evenings, on weekends, or any time the volunteers can spare a moment," noted Ray McCloskey.

"We're actually rebuilding the aircraft," commented structural expert SMSgt. Lou Lefebvre. "When the crates first arrived, we thought it would be a 'clean and reassemble' project. But those who took *Shoo Shoo* apart didn't disassemble it, they dismembered it."

The project is being conducted under the auspices of the "512th Antique Aircraft Restoration Group" established by the organizers to manage and document the restoration.

"Once returned to mint condition," commented McCloskey, "the aircraft will be on display at Dover for a year before being returned to the Air Force Museum as a permanent exhibit."

Lt. Col. Mike Sibbald, Commander of the wing's 326th Squadron and a TWA pilot in civilian life, has volunteered to journey to the Confederate Air Force in Texas for a cockpit checkout in a CAF B-17. He hopes to pilot *Shoo Shoo Baby* to Ohio when the time comes.

The restoration group offers *Shoo Shoo Baby* tee shirts, pins, and patches for sale and accepts donations to finance the rehabilitation. The 91st Bomb Group Memorial Association has also been supportive.

Volunteers at Dover conduct tours of the hangar area where display cases contain artifacts associated with the aircraft. Wing members also address schools, clubs, and other organizations on the saga of *Shoo Shoo Baby* and the contribution of the B-17 Flying Fortress during World War II. For further information, call (302) 678-6971.

craft to provide ground security during stops.

For its part, at Dover the 436th SPS's special section of Security Policemen is responsible for safeguarding C-5s deployed to airfields at home and abroad which lack adequate DoD security measures. As many as three flight-qualified Security Policemen will travel with a C-5, to stand around-the-clock shifts if necessary. They are armed with .38-caliber pistols and M-16 automatic rifles.

The primary mission of the 436th SPS is not law enforcement. The squadron has been charged by the Department of Defense with the protection of the national resource C-5s. Security Policemen perform that duty in the maintenance hangars as well as on the flight line. When shortages of manpower occur in the special section because of heavy utilization of the C-5 fleet, others from law enforcement fill in.

In another example of the "fusion" of the Reserve and active-duty wings, "We make no distinction between Security Policemen of either unit," noted Capt. Roy E. Gmitter, Commander of the 436th SPS.

Reflecting its special relationship with the C-5, the Reserve unit carries the unusual designation of 512th Weapons Systems Security Flight. Members have no law-enforcement obligation and "we routinely assign them when available to flights aboard C-5s with the active-duty members," commented Captain Gmitter.

"During their training weekends, they also supplement my flight-line Security Police. In war, the 512th WSSF would be absorbed into my active-duty squadron," he added.

According to Col. Fred R. Endrikat, 512th Deputy Commander for Resources Management, the Reserve wing also contributes medical personnel for the base clinic during UTAs. Wing chaplains hold services at the base church.

Recruiting and Retention

Dover's geographical location in the midst of Delaware farm country and far from metropolitan areas should present drawbacks in 512th recruiting and retention, especially considering the not-unsubstantial costs of automobile travel and such other expenses as tolls. But the high manning rate indicates otherwise.

One reason for this is the C-5, according to TSgt. Laurel Kuhns, a Reservist recruiter serving a four-year active tour and attached to the 512th. "Anyone in the east seeking a C-5 Reserve slot has to come to us," she noted.

The excellent relationship with the surrounding community is another key factor and one that both wings strive to maintain, according to Colonel Ferguson. "About once a year civic leaders tour several bases by C-5 and are briefed at MAC Headquarters. We believe it is important for them to understand what we do here."

"Dover people have an affinity for the military and especially for the Air Force," Sergeant Kuhns noted. "Local youngsters interested in a military career might come to us for a taste of the life before committing themselves to active duty," she added. "They'll be serving close to home with either the 512th or the active-duty wing," the recruiter noted.

One such young person is A1C Patricia J. Sutton. While the extra pay was a consideration in joining the Reserves, "I just wanted to do something different," Airman Sutton said. That something different is helping her Reserve team repair C-5 engines.

"Another recruiting advantage," noted Sergeant Kuhns, "is that trained people concluding a hitch with the 436th stand a good chance of landing a job with us.

"The active wing is tightly structured," commented the recruiter, "with little slack for cross-training. The 512th is more fluid."

Examples abound. First Lt. Edward M. Poling, for instance, of the 326th Squadron, began his military career in 1972 and by 1978 was an instructor loadmaster. He then became a navigator and in 1980 entered undergraduate pilot training. He is now a pilot with a commitment to the 512th. "This transition indicates just how steps up the ladder can be accelerated," stressed his squadron commander, Lt. Col. Mike Sibbald. "We have the flexibility to shift good people, say, from jet engine maintenance to flying status," Colonel Sibbald added. "This is a big plus in recruiting and retention. A lot of people have begun to catch on to what a good deal the Reserve program is."

One of them is the 326th's SSgt. Donna Jean Lehmann, the first qualified woman C-5 loadmaster. While holding down a job as a computer operator, she is taking computer programming in college and is planning a career in the Reserves.

There are also a number of programs that link schooling with financial aid as lures for joining the Reserves. In the education-oriented community, these are especially helpful to Sergeant Kuhns.

The recruiter has noted a two-way street between the Reserve and active-duty wing, with a trend toward former Reservists finishing up their careers on the active-duty side.

The Simulator

The two wings also share operation of the cockpit simulator at Dover. "With cockpit personnel of both units to train and receive their refresher courses," noted Lt. Col. Dan Drummond, "the simulator is in use sixteen hours a day seven days a week."

Colonel Drummond is a simulator instructor with the 436th who is also qualified to give check rides in aircraft of both Reserve and active-duty crew members.

The 512th has its own simulator instructors, but these must be interchangeable with those of the 436th because of the heavy work load. For example, by MAC regulation, each pilot and flight engineer—whether active-duty or Reservist—must undertake a five-day simulator refresher course annually and the pilots a two-day course every six months.

On a Sunday during a recent 512th Unit Training Assembly weekend, no Reservist pilot instructor was available so Colonel Drummond filled in. He was on duty with MSgt. Ralph Kellenberger, a 512th ART and flight engineer instructor, another example of the fusion of the two wings' activities.

"We make no distinction between active-duty and Reservists here," noted Colonel Drummond, "in fact, if I didn't look at the shoulder patch I wouldn't know which was which." That comment is heard often at Dover. ■

RAVENS ON THE ICE CAP

BY CAPT. MICHAEL B. PERINI, USAF, CONTRIBUTING EDITOR
Photos by the Author

THE airstrip at Sondrestrom AB is thirty-three miles north of the Arctic Circle at the end of a long fjord along the west coast of Greenland.

Poised at the end of the 9,200-foot asphalt runway, the ski-equipped C-130D shuddered as its three-blade props clawed at the crisp Arctic air.

The weather on this Sunday in May at "Sondy" was near perfect—a warm four degrees Fahrenheit with clear skies. A mild heat wave compared to the six weeks of minus-forty-degree temperatures in February and March, making for the coldest winter in the base's forty-three-year history.

Six Air National Guard crew members from the 109th Tactical Airlift Group based at Schenectady County Airport, N. Y., were on board the "skibird." I was along from AIR FORCE Magazine to observe the flight.

In the belly of the aircraft, on metal pallets, were steel beams weighing 30,000 pounds. The beams were in ten-foot sections stacked chest high and secured with steel chain. The aircraft's total takeoff weight was 124,000 pounds. This weight is only 200 pounds less than the maximum safe load for the twenty-five-year-old aircraft.

With the engine throttles pushed forward, takeoff toward the east took less than 6,000 feet under reduced power. This procedure lessens wear and tear on the engine.

The skibird took off at an airspeed of 106 knots with flaps at fifty percent. A south-southeasterly heading of 150 degrees and a climb to 11,000 feet put the crew on a straight line toward their destination—Greenland's desolate ice cap.

Airlift: The Only Way

Six-sevenths of Greenland is covered by a massive ice cap. Only the remaining one-seventh, along the coasts, is free from the year-round ice burden. Some scientists have speculated that if the entire ice cap were to melt, the resulting water would raise the earth's oceans by thirty feet. The ice is, however, flat and stable, except for a marginal zone of ice where the ice cap meets the coastal mountains. Here the ice is unstable, heavily crevassed, and dangerous.

The ice cap is, for all practical purposes, impassable by surface transport. Thus, airlift is the only way to get the steel beams (legs for a Distant Early Warning [DEW] radar site) across the ice.

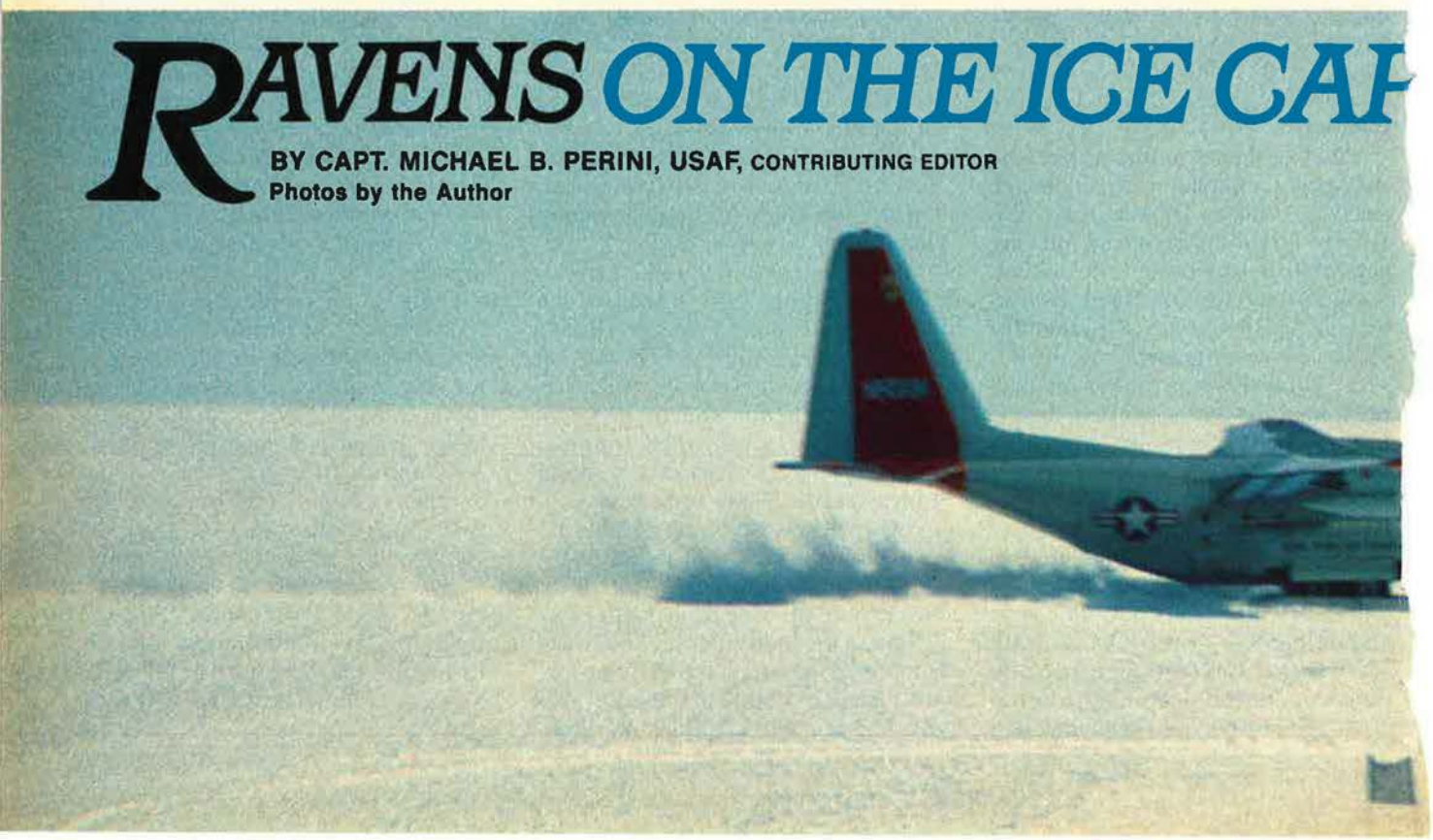
Sea Bass is the name for the site, according to the IFR approach plate, but DEW line officials refer to it as a "DYE" site, after Cape Dyer, Canada, the main station to which Greenland's four DEW line sites report. DYE-2 (Sea Bass) is approximately 100 miles from Sondrestrom, and, like the other three DYE sites in Greenland, is operated by American and Danish personnel.

The steel beams, construction equipment, and Diesel Fuel-Arctic—more commonly referred to as POL, for Petroleum, Oil, and Lubricants—had been shipped the previous summer from the US to a shallow-water port seven miles from Sondrestrom.

Sondrestrom personnel are responsible for operating the port, which serves both military and civilian ships. The longest paved road in Greenland connects the port to the base. The port sits at the end of a long fjord that is blocked by ice except during July and August.

Though equipment can be airlifted to the sites shortly after it arrives, the POL can't. The relatively warm POL, if stored at the radar sites, would melt the snow surrounding the rubber fuel bladders and steel fuel tanks and cause them to sink down into the ice cap, breaking fuel lines and making pumping impossible. So the POL is cold-soaked in storage tanks at the base during the winter.

Since early April, a year's supply of fuel (more than 500,000 US gallons) and nonperishable supplies had been flown from Sondrestrom to Greenland's DEW line sites by



the 109th TAG as part of the annual spring resupply.

This week's job for the unit, however, was different—haul oversize construction equipment, steel, and wood to raise DYE-2 above the snowline, and bring new steel fuel tanks and equipment to DYE-3 (204 miles from Sondrestrom) to replace fuel bladders.

It had been only sixteen hours since arriving at Sondrestrom after a six-and-one-quarter hour nonstop flight of 1,692 nautical miles by a C-130D from Schenectady. This flight was the Guardsmen's first ice cap mission of the week.

"Having experienced crews allows us to get out quickly to the sites," says Lt. Col. Thomas F. Noel, mission commander for the deployment. The 109th has had a turnover of only four pilots since September 1979.

The unit has adopted the nickname of the "Raven Gang," after the large, black birds that can be seen at Sondrestrom as well as along the west coast of Greenland.

The 109th stages its ice cap missions out of Sondrestrom. The six-member aircrew and some thirty-five support personnel rotate weekly. The unit keeps four of its ski-equipped aircraft in Greenland during the annual resupply. The four aircraft are also supported by the one rotation aircraft flown in from New York with spare parts and equipment as needed.

The C-130D is basically the same aircraft as the C-130A model, with some modifications to accommodate ski installation. The skis are installed so that the landing gear—which remains on the aircraft—can be lowered through the installed skis. This allows the aircraft to be used in either ski or normal runway operations. The unit also flies four C-130D-6s (skiplanes with skis removed).

Greenland's DYE Sites

The DEW line is a continuous radar fence starting at Point Lay, Alaska, and running across the top of the North American continent eastward to Kulusuk Island off the east coast of Greenland. The system of thirty-one remote radar stations, under the operational control of Tactical Air Command, is managed by Air Defense TAC's DEW Systems Office located at Peterson AFB, Colo.

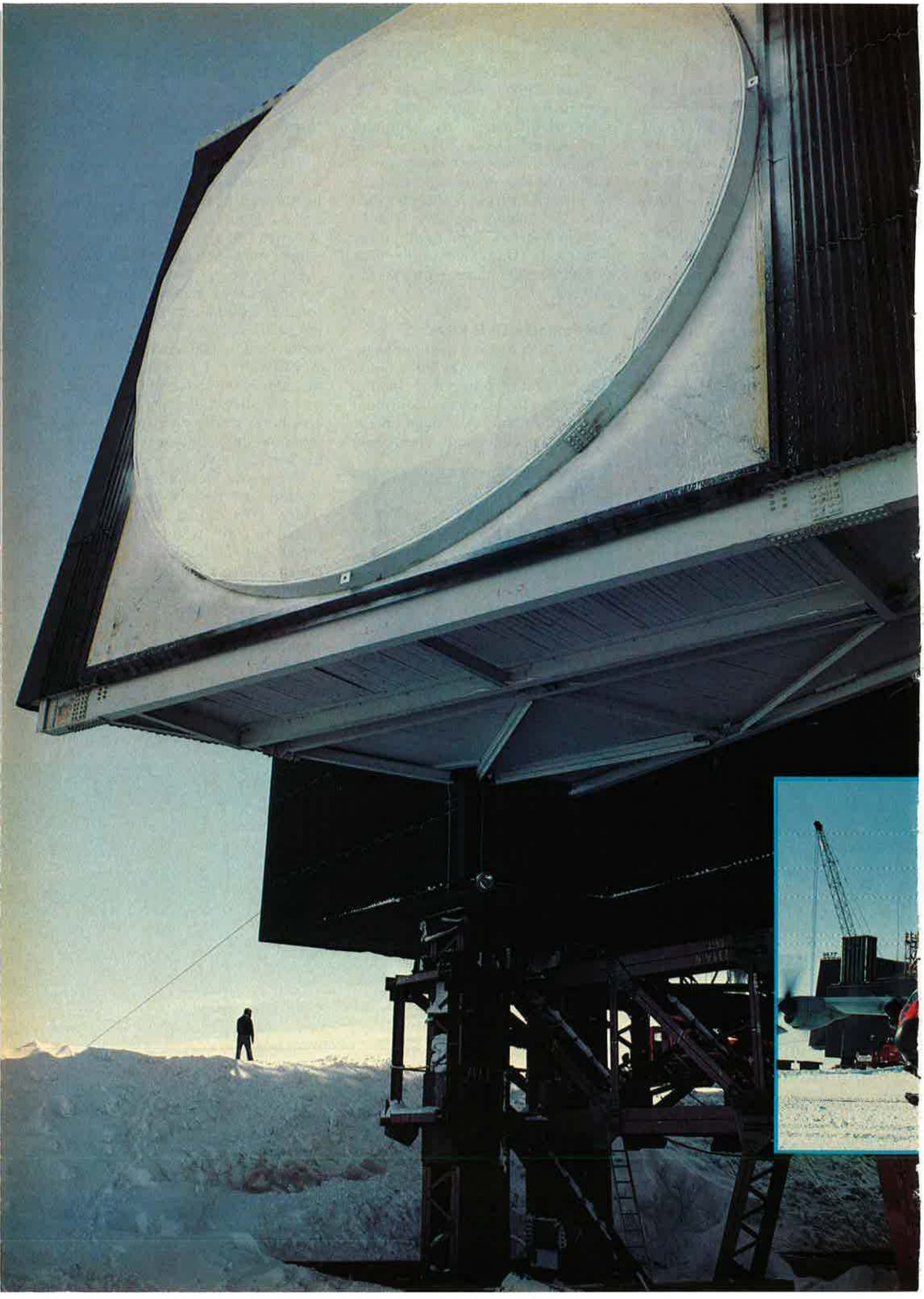
The mission of the sites is the detection and reporting of airborne vehicles over the polar region, and lateral communications. About fifteen American and Danish civilian personnel man each Greenland site.

DYE sites in Greenland stand seven stories high and weigh 3,500 tons. The buildings have usable living, working, and storage space of more than 40,000 square feet. The AN/FPS-30 radar takes up the remainder of the space and is covered by a fifty-five-foot white dome. Tropospheric scatter dish antennas are mounted on each side of the building for communications.

The useful lifetime originally expected for the sites was twenty years. DYE-2 and DYE-3, completed in 1961, were moved to extend the life of the sites. Ice pushing toward the ocean had caused tremendous pressure on the foundations of steel embedded in the ice. Steel beams had been bent and wooden support braces had been shattered.

Even though the sites were built some twenty feet above snow level and can be raised by hydraulic jacks, more steel has been added

A ski-equipped C-130D lands on the Greenland ice cap. INSET: View from the flight deck as the aircraft is marshaled by a Dane at DYE-2.



This is the fourth year that the 109th's flying season, which normally ends in June, has been extended to accommodate site construction work. The unit will continue to fly missions from Sondrestrom through November.

over the years to raise the site above the accumulation of snow. As one site official said, "The site is on an elevator that only goes up."

DYE-3 had 105 feet of steel under the snow before it was moved in 1977. Even so, plans call for it to be jacked up again next year. DYE-2 was moved laterally in 1982.

DYE-1 is located on the west coast about sixty-six miles southwest of Sondrestrom. DYE-2 and DYE-3 can both be found on Greenland's ice cap. DYE-2 sits at an altitude of 7,650 feet and 107 miles southeast of Sondrestrom, while DYE-3 is up at 8,700 feet and 204 miles southeast of the base. DYE-4 is positioned on the rocky island of Kulusuk on the east coast of Greenland—406 miles from Sondrestrom.

Sondrestrom: A Crucial Role

Sondrestrom, which transferred from operational control of Strategic Air Command to Space Command in May, acts as a logistical support center for the eastern section of the DEW line. "Supplies arrive from Denmark and the US, via sea and airlift, and are then shipped to the DYE sites," says Col. Hamilton W. Kennedy, Commander of 4684th Air Base Group at Sondrestrom. The base's annual operations budget in support of the Greenland DEW line sites is $17.5 million.

Scandinavian Airlines System, under a contract with the Air Force, flies DEW line supplies and equipment purchased in Denmark to Sondrestrom once every four weeks.

Travel to the DYE sites, however, is provided by only two flying organizations. Both units operate out of Sondrestrom. One is Greenlandair, which, under contract to the Air Force, provides yearly resupply. Greenlandair helicopters, like the Sikorsky S-61, are used to transport personnel, high-priority supplies, and equipment to DYE-1. A Greenlandair ski-equipped Twin Otter supplies both DYE-2 and DYE-3 with mail, commissary goods, spare parts, and various small equipment. DYE-4, on the other hand, is supplied by a de Havilland Dash 7.

The other unit is the Raven Gang, which provides the annual POL resupply for DYE-2 and DYE-3 as well as delivering supplies and oversize cargo to DYE sites 2 through 4. Items hauled over the years include D-6 bulldozers, structural steel, cranes, and mobile trailers used by construction personnel for living space when working out at the radar sites.

This is the fourth year that the 109th's flying season, which normally ends in June, has been extended to accommodate site construction work. The unit will continue to fly missions from Sondrestrom through November.

Flying to the DYE Sites

The 109th flies the only ski-equipped C-130s in USAF.

The "D-Model," as it is called by those who fly it, is fitted with two main twenty-foot-long skis, each weighing one ton, and a ten-foot nose ski. The skis are coated with friction-reducing Teflon. Additional hydraulic and mechanical parts allow the skis and the normal wheels to be extended or retracted independently, depending on the runway surface. Each engine drives a three-blade constant-speed prop having full feathering and reversing pitch. According to those who have flown the aircraft, the three-blade props are more efficient than the four-blade props when operating at low altitudes.

SSgt. Michael T. Cristiano, flight engineer, inspects the nose and main ski assemblies during unloading at DYE-2.

The job of flying on the ice cap requires close aircrew coordination. This is especially true during times of reduced visibility. "The horizon disappears and a white-out situation develops with no reference points," says Colonel Noel. "It becomes difficult to estimate whether visibility is half a mile, or even fifteen miles, or if one is even looking at the snow at all."

The average crew experience level is fifteen years and more than 3,000 flying hours. The aircrews are required to make three instrument approaches and ski landings every six months to maintain their currency rating.

There are no navigational aids available at the sites to help the crew find them. The aircraft is, however, equipped with ADF loop, VOR, TACAN, Omega ARN-131, APN-59 radar with display, a celestial D-16 periscopic sextant, and pressure and radio altimeters. When flying to the sites, the aircraft's TACAN system is always locked onto Sondrestrom.

"If the radar should fail en route to a site, we return to Sondy. We

LEFT: The radar station at DYE-2 stands seven stories high, dwarfing one of the men who has duty there. ABOVE: Engines remain running during unloading to avoid restart problems.

As we got to within twenty-five miles, Major Maybee was able to pick out on his radarscope the small flags that outline the "skiway"—a 6,000-foot stretch of snow plowed by a drag made from angle iron steel.

take no chances out here," Colonel Noel said.

On this Sunday morning flight in May, Maj. Brian G. Maybee, navigator, was able to observe the radar site on his radar screen eighty miles out. The crew got their first visual glimpse of the site at fifty miles. No more than a speck at that distance, DYE-2 stood out starkly against the blanket of whiteness at the crew's 11,000-foot-high vantage point.

As we got to within twenty-five miles, Major Maybee was able to pick out on his radarscope the small flags that outline the "skiway"—a 6,000-foot stretch of snow plowed by DYE site personnel using a steel drag made from angle iron steel.

Except when weather conditions are excellent for a straight-in visual approach, normal landing procedure is for the navigator to direct an Airborne Radar Approach (ARA). Even though weather conditions were excellent, since it was the first landing for the crew on this week's rotation, Maj. Lawrence A. Maciariello, aircraft commander, elected to fly a conventional box-pattern ARA. This meant overflying the skiway and tracking outbound ten nautical miles before turning crosswind and then downwind for the eventual turn to base leg and then a turn to final. The pattern was flown at 1,000 feet AGL.

"All turns in the pattern will be at twenty degrees of bank until on final approach," Major Maybee said during his ARA briefing.

Final descent instructions began at six and one-half miles out at 8,600 feet, with the DYE site on the right on landing. Major Maybee gave altitude and heading corrections each mile to Major Maciariello, who was flying on instruments.

A minimum rate of descent of 300 feet per mile is required for the approach. Furthermore, crews are not allowed to land on the ice cap when the maximum wind, including gusts, exceeds thirty-five knots. Nor can they land when the cross-

ABOVE: Pallets are pushed onto a giant sled and pulled by a snow-going tractor. CENTER: Cargo for use inside the radar site is lifted by a crane to a hole in the bottom of the steel structure. FAR RIGHT: Knud Vaegter, a Dane, wears Arctic gear including sunglasses to guard against snow blindness. The 109th has named the Dane "King of the Arctic" for his outstanding support during offloading of supplies.

wind component exceeds fifteen knots. The winds today, however, were calm—an unusual occurrence.

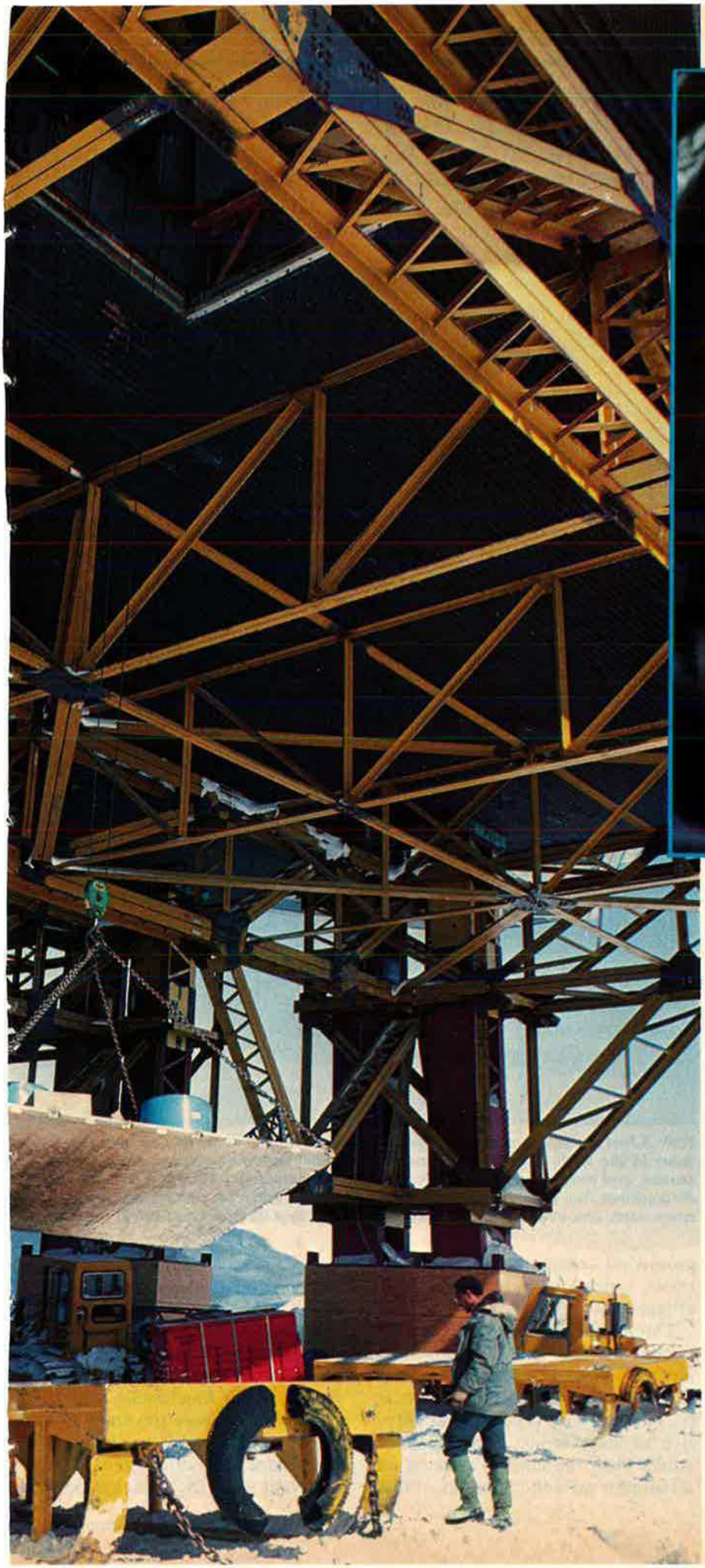
The copilot, Capt. Richard M. Saburro, began looking for a series of lead-in flags of black fabric placed in the snow several thousand feet in front of the skiway. "If we can't see the lead-in flags by one mile, we stop our descent and try again," Major Maybee said.

At three nautical miles from touchdown, the flags were spotted by Captain Saburro. Major Maciariello began his transition from the instruments to looking outside and flying visual.

"Each snow-blown landing is different from the last one," Major Maciariello said.

Rudder turns are restricted to ten degrees of heading change to prevent excessive slip/yaw angles that may lead to a fin stall condition.

There was no need to try a second landing today. The first attempt was perfect, landing within the first



1,000 feet of the skiway. The touchdown was as smooth as a commercial Boeing 727 landing on an asphalt runway.

After touchdown the aircraft slid along on its Teflon-coated skis. "The aircraft is steered not so much with the nose ski as with differential power from the engines," Major Maciariello said as he slowed the aircraft to a taxi speed of twenty knots.

Using forward or reverse thrust on individual engines allows the C-130 to be turned and stopped in the snow. There is no follow-me truck and no permanent flightline facilities on the ice cap. And as far as taxiways go, "We just make our own," the major said as he turned the C-130 toward the site and onto unplowed snow.

Unloading on the Cap

The cap depth is more than a mile thick at DYE-2. The surface is composed of layers of compressed snow, with the top sixty feet forming a dry,

crusty surface. With this much ice it acts as a giant refrigerator. This fact, plus the difference in elevation from Sondrestrom, means temperature differences can be as much as thirty to forty degrees. That day, it was minus twenty-seven degrees Fahrenheit.

Loadmasters SSgt. Casper J. Twedt and SrA. Raymond P. Morgan quickly opened the tail door and began unfastening the cargo chains that held the palleted steel to the sides of the aircraft. The pallets were then pulled onto a forty-foot sled by a snow-going tractor. Once loaded, the tractor took off with the load and headed toward the site less than two hundred yards away.

Minus twenty degree temperature makes unloading tough enough, but add a thirty-five-knot snow-whipping prop wash (extremely low temperatures play havoc on engine starts, so at least one engine is kept running at ground idle), and load crews are forced to empty the cargo in a virtual blizzard. The chill factor within the propwash at the aircraft's rear can drop to minus seventy-five degrees Fahrenheit.

During unloading, the flight engineer inspects the nose and main ski assemblies. After about one-half hour, Sergeant Twedt made last-minute checks and sealed the crew entrance door. Waiting inside were fresh Danish pastries and coffee made at the site. "Just a small way of saying thanks for keeping us alive," said Knud Vaegter, a Danish official responsible for DYE-2 unloading operations. Several years ago the 109th named the Dane "King of the Arctic" for his outstanding support during offloading of supplies.

The aircraft slid easily down the skiway in a cloud of blowing snow. Takeoffs on the skiway are not attempted after any new snow accumulation if the crosswind component exceeds ten knots, unless the skiway has been dragged.

TOP: A fuel storage tank is offloaded at DYE-3. Oversized items hauled over the years by the 109th have included bulldozers, construction equipment, steel, wood, cranes, and mobile trailers used by construction personnel. ABOVE: A Greenlandair ski-equipped Twin Otter supplies both DYE-2 and DYE-3 with mail, commissary goods, spare parts, and small equipment. DYE-4 is supplied by a de Havilland Dash 7.

A Tough Place to Fly

Major Maciariello eased the throttles forward. Occasionally, the skis freeze to the snow after the aircraft has been stopped. "When this happens, we cycle the skis while applying power. The wheels are lowered first and then the skis are raised," he said. The process is then reversed. This action is usually sufficient to loosen the skis.

For this takeoff in May, the aircraft slid easily down the skiway in a cloud of blowing snow. Takeoffs on the skiway are not attempted after any new snow accumulation if the crosswind component exceeds ten knots, unless the skiway has been dragged.

Due to the immense friction between the skis and the snow, the aircraft cannot achieve a normal takeoff speed. Instead, the plane is accelerated to a maximum of fifty-five to sixty knots, then the pilot yanks back the control yoke in an attempt to raise the nose ski. If this is done, and it can take several attempts, the plane accelerates and finally lifts off the snow. "This kind of takeoff is considered a calculated risk because it occurs below the minimum control airspeed of the aircraft," Major Maciariello said.

"In cases where the snow is too sticky or the load is too heavy, we use assisted takeoff rockets," Colonel Noel said. Eight rocket bottles

are mounted near the back of the fuselage. They provide the thrust of one additional engine for about ten seconds of burn time.

The crews are hesitant to use them, as they have failed in the past. For example, earlier this year MSgt. David C. Getty, a 109th TAG loadmaster, received New York's highest honor, the Medal of Valor, for an incident with such rockets in 1979. One of the surging rockets detached and burned into the cargo compartment.

"It broke loose and tore into the plane, exploding with about 1,000 pounds of forward thrust," Getty recalled.

One of the five crew members nearest to the explosion was hit in the legs and arms with fragments. Getty was further forward and wasn't injured by the blast, which caused a three-foot hole in the fuselage and damaged the hydraulic system, ruptured fuel lines, and cracked wing struts and the main landing gear. He grabbed an extinguisher and doused the fire.

The rockets were used once during my trip in May without incident.

Flying supply missions to a DEW radar site can have other unexpected problems as well. When the 109th flew a scientific expedition team to a research point near Jakobshavn Glacier in 1980, the skibird, after landing, rapidly began sinking into the snow. The crew kept the throttles at full power. Even with that, they could only attain a taxi speed of twenty-five knots. The crew was afraid to stop, lest they sink deeper into the ice cap, so the equipment was unloaded using the "combat offload" technique.

"This amounted to dropping everything and everybody out the back while the aircraft taxied in a circle, still at max power," Colonel Noel said.

The crew then tried to plow a skiway in the snow by traveling back and forth in a 6,000-foot straight line, but the snow was so powdery that it wouldn't compact. The only remaining choice was to attempt taxiing about 150 miles to a radar site in hopes of finding better snow along the way.

After one hour and twenty-five miles of taxiing at full power, the snow conditions had improved and the aircraft had lightened its fuel load enough to allow it to leap off the snow.

"Other problems, like ice-fog and snow blowing near the surface, can make it near impossible to see the skiways in time for landing," Colonel Noel said. This phenomenon occurred during a mission with this writer along in May. The site was visible fifty miles away, but the skiway could not be seen until two miles from landing.

The ice is always moving toward the ocean. It grows some four feet annually, thus causing problems during ground handling of cargo. The surface is unprepared and often at angles requiring crews to break out the shovels and pile the snow high enough until the cargo sled is level with the plane's cargo ramp.

The ice cap missions are tough on aircraft as well. "Though the planes have only an average of 11,000 hours on them, it translates to more like 20,000 because of the rough landing and takeoff conditions as well as the extreme cold," said TSgt. Buzz N. Squires, a mechanic and flight engineer with eight years of experience on the ice cap.

"We've had to change engines on the ice cap, replace nose skis, and rebuild the sides of aircraft before flying them back home," he said.

"The cold has caused hydraulic leaks to occur, as seals tend to harden and windows to crack and shatter," he added.

"To safeguard engine seals, oil temperatures must be at sixty degrees before we taxi the aircraft," he said.

Finally, a resupply mission by the 109th TAG has not been done at night. "Everything we do would be magnified tenfold," said Col. Stanley W. Hemstreet, Commander of the 109th TAG.

"Weather can go from visual flight rules to zero/zero in less than fifteen minutes. It's like flying inside a ping-pong ball. No references at all," he said. "If this should occur at night, it would be disastrous."

Ahead of Schedule

The 109th has been doing the mission since 1975. Prior to that, the 17th TAS of Alaskan Air Command had the unique mission. It is a MAC-directed mission called Volant Dew. During the week I flew with the unit, it completed twenty-two sorties and delivered 364,250 pounds of supplies.

Last year the Guardsmen moved 8,000,000 pounds of cargo. The unit was so far ahead of schedule that two weeks of deliveries in June and July of this year were canceled.

The unit has also been asked to fly supply missions in Canada's Northwest Territories and in Alaska. In addition, they also assist the National Science Foundation in research conducted in various places on the ice cap. "The most interesting cargo we have hauled was the first Ice Age samples of ice to be taken from Greenland," Colonel Hemstreet said.

New Skibirds on the Horizon

The 109th will receive four new ski-equipped LC-130Hs (L means ski-equipped)—straight from the assembly line—beginning in late 1984. The Navy currently flies this model in their resupply efforts in Antarctica.

Each ski-equipped aircraft will cost approximately $25 million.

The new aircraft will have larger engines, more fuel capacity, and, in what some aircrews see as the biggest improvement, an inertial navigation system.

Although the 109th's mission is one of the most dangerous of active-duty or reserve forces flying missions, this Air Guard unit has had an excellent safety record, attesting to the dedication, training, and professionalism of the Guardsmen in accomplishing this important job. The unit received the Air Force Outstanding Unit Award in 1980 and it is a nine-time recipient of the New York Governor's Air Trophy.

But is the risk worth it?

"I couldn't get people trained within the required time frame until we got this mission," said Colonel Hemstreet. Retention is up to eighty-six percent this year from a low of sixty-four percent in 1974, the year prior to the ice-cap mission.

"The ice cap is one of the planet's last frontiers," said Colonel Noel. "It offers some of the most interesting flying anywhere."

"Flying out to the cap makes you proud of being able to do something special, unique, and important to our nation's defense all at once," Sergeant Squires concluded. ■

Hybrid circuit technology on the move.

Bill Greig on advanced IC packaging

"The growing use of leading edge technologies such as LSI, VLSI, and VHSIC demands innovative packaging approaches," states Bill Greig, Hybrid Electronics Staff Engineer at Lockheed Electronics. "These approaches must maintain the high performance realized at the IC chip level through subsequent interconnections.

"Developing the hybrids or modules involves merging disciplines such as Physics, Chemistry, Metallurgy, Mechanical Engineering and Electrical Engineering. Technologies used in producing advanced packages include Thick Film, Thin Film, Photolithography, Microassembly and automatic, high-speed, computer-controlled Electrical Testing.

"The hybrid package or modules typically are a ceramic substrate that supports a conductor network that functions as an interconnection for various microelectronic components. Active and passive components range from a single chip capacitor to highly complex VLSI or VHSIC devices. The IC chips can be either pre-packaged in ceramic chip carriers or uncased for use in multi-chip hybrid packaging applications.

"To accommodate the interconnections, the conductor network may consist of several layers of conductor requiring Computer Aided Design to assist in placing components and routing of interconnections.

"To provide the advanced packaging that increasingly will be needed, LEC has built one of the most modern facilities in the country in terms of special environmental controls, sophisticated equipment—and the staff to go with it."

Engineers interested in contributing to advanced electronic systems are invited to write Employment Manager at the address at right.

Lockheed Electronics

Plainfield, New Jersey 07061

JANE'S

ALL THE WORLD'S AIRCRAFT SUPPLEMENT

AUGUST 1983

Prototype de Havilland Canada Dash 8 (two Pratt & Whitney Aircraft of Canada PW120 turboprop engines)

DE HAVILLAND CANADA

THE DE HAVILLAND AIRCRAFT OF CANADA LTD; Head Office and Works: Garratt Boulevard, Downsview, Ontario M3K 1Y5, Canada

DHC-8 DASH 8

The Dash 8 is being developed by de Havilland Canada to fill the growing demand for a quiet, fuel-efficient, short-haul transport in the 30/40-seat category. The first of four flying prototypes (C-GDNK) was rolled out on April 19, 1983, and was scheduled to make its first flight in June. The second Dash 8 is due to fly in September 1983; three major subassemblies have been completed for structural testing.

Sized to accommodate 36 to 39 passengers, the Dash 8 fits in between the company's 19-passenger Twin Otter and 50-passenger Dash 7, and is designed to meet the requirements of FAR Pt 25. Certification by the Canadian DoT, scheduled for Autumn 1984, will be to FAR Pts 25 and 36, and SFAR No. 27. Worldwide applications include scheduled airline service on routes of up to 600 nm (1,112 km; 691 miles); convertible passenger/cargo operations in developing countries overseas; or comparable corporate and military transport roles.

Initial brief details of the Dash 8 were released in April 1980, concurrently with the news that NorOntair, the air service sector of the Ontario Northland Transportation Commission, had ordered two of these aircraft. The first Dash 8 for NorOntair is due for delivery in September 1984, and to enter service later that year. By May 1983 de Havilland Canada had received 53 firm orders and 66 options for the Dash 8, from operators in ten countries. Forty-four per cent of these orders were from customers in the USA, 22% in Canada, and 34% elsewhere. Plans are to achieve an output of six aircraft per month within a year and a half of the first delivery.

Two basic versions of the Dash 8 are being offered:

Commuter. Standard local-service version, to which the detailed description mainly applies. With full IFR fuel reserves for a 100 nm (185 km; 115 mile) diversion, plus 45 min at long range cruising speed at 1,525 m (5,000 ft), this version has enough fuel to fly four 100 nm stages without refuelling, carrying a 3,102 kg (6,840 lb) payload of 36 passengers and their baggage.

Corporate. To be marketed in North America exclusively by Innotech Aviation of Montreal, outside North America by DHC, the corporate version will have an extended range capability of up to 2,000 nm (3,706 km; 2,303 miles), plus IFR reserves, with a 544 kg (1,200 lb) payload. In a more typical mission it will be able to carry 17 passengers and their baggage for up to 1,320 nm (2,446 km; 1,520 miles), with reserves, at a max cruising speed of 270 knots (500 km/h; 311 mph). An APU will be standard in this version. Alternative layouts may include a single cabin with first class accommodation for about 24 passengers; the standard commuter interior will also be available for corporate customers.

TYPE: Twin-turboprop quiet short-range transport.

WINGS: Cantilever high-wing monoplane, with constant chord centre-section and tapered outer panels. Thickness/chord ratio 18% at root, 13% at tip. Dihedral 2° 30' on outer panels. Tip to tip torsion box formed by front and rear spars, ribs, and skin. Single-slotted Fowler flaps inboard and outboard of engine nacelles. Hydraulically actuated roll control spoilers/lift dumpers forward of each outer flap segment; independent ground spoiler/lift dumper inboard and outboard of each engine nacelle. Mechanically actuated balanced ailerons, with inset tabs. Pneumatic rubber boot deicing of leading-edges. Composite materials used for construction of leading-edges, wingtip fairings, flap shrouds, flap trailing-edges, and other components.

FUSELAGE: Conventional semi-monocoque pres-

Standard interior of the Dash 8 provides seating for 36 commuter passengers

surised structure, of near-circular cross-section. Extensive use of adhesively bonded stringers. Radome, nose bay, wing/fuselage fairings, and tailcone of Kevlar and other composites.

TAIL UNIT: Cantilever T tailplane; full span balanced elevator, with tabs. Sweptback fin (integral with rear fuselage), large dorsal fin, and two-segment serially hinged hydraulically actuated rudder with yaw damper. Composites used in construction of dorsal fin, fin leading-edge, fin/tailplane fairings, tailplane leading-edges, and tips.

LANDING GEAR: Retractable tricycle type, by Dowty Equipment of Canada Ltd, with twin wheels on each unit. Steer-by-wire nose unit retracts forward, main units rearward into engine nacelles. Goodrich mainwheels and brakes. Low pressure tyres optional, pressure 4.41 bars (64 lb/sq in) on main units, 3.10 bars (45 lb/sq in) on nose unit.

POWER PLANT: Two 1,491 kW (2,000 shp) Pratt & Whitney Aircraft of Canada PW120 turboprop engines, each driving a Hamilton Standard 14SF-7 four-blade constant-speed fully-feathering propeller with reverse pitch. In the event of one engine failing, the other automatically increases power from 1,342 kW (1,800 shp) to 1,491 kW (2,000 shp). Propeller blades have a solid aluminium spar, glassfibre outer shell, nickel erosion sheath outboard, electric de-icing, and Beta control. Lower cowling panels, air intakes, and rear of nacelles are of Kevlar and other composites. Standard internal max fuel capacity 3,270 litres (719 Imp gallons; 864 US gallons); optional auxiliary tank system increases this maximum to 4,565 litres (1,004 Imp gallons; 1,206 US gallons). Extended range tanks on corporate version raise maximum capacity to 4,709 litres (1,036 Imp gallons; 1,244 US gallons). Oil capacity 19 litres (4.2 Imp gallons, 5 US gallons) per engine.

ACCOMMODATION: Crew of two on flight deck, plus one attendant in cabin. Dual controls standard, although aircraft will be certificated for single-pilot operation. Standard commuter layout in main cabin provides four-abreast seating, with central aisle, for 36 passengers at 79 cm (31 in) pitch, plus buffet, toilet, and large rear baggage compartment. Wardrobe at front of passenger cabin, in addition to overhead lockers and under-seat stowage, provides additional carry-on capacity for passengers' baggage. Alternative 38/39-passenger, mixed passenger/cargo, or corporate layouts available at customer's option. Movable bulkhead to facilitate conversion to mixed-traffic or all-cargo configuration. Port-side airstair door at front provides access for crew as well as passengers; large inward-opening port-side door aft of wing for cargo loading. Emergency exit each side, in line with wing leading-edge, and opposite passenger door on starboard side. Entire accommodation pressurised and air-conditioned.

SYSTEMS: Air cycle air-conditioning system provides heating, cooling, ventilation, and pressurisation (cabin max differential 0.38 bars; 5.5 lb/sq in). Normal hydraulic system comprises two independent systems, each having an engine driven variable displacement pump and an electrically driven standby pump; accumulator and handpump for emergency use. Electrical system DC power provided by two starter/generators, two transformer-rectifier units, and two nickel-cadmium batteries. Variable frequency AC power provided by two engine driven AC generators and three static inverters. De-icing system consists of pneumatic system plus electric heating. APU standard in corporate version.

AVIONICS AND EQUIPMENT: Standard factory-installed avionics package includes Sperry SPZ-800 dual-channel digital AFCS with integrated fail-operational flight director/autopilot system, dual digital air data system, electro-mechanical flight instruments, and Primus 800 colour weather radar; Sperry electronic flight instrumentation system (EFIS) optional on commuter, standard on corporate version. Avtech audio integrating system. Telephonics PA system. Simmonds fuel monitoring system.

DIMENSIONS, EXTERNAL:

Wing span	25.895 m (84 ft 11½ in)
Wing aspect ratio	12.34
Length overall	22.25 m (73 ft 0 in)
Fuselage: Max diameter	2.69 m (8 ft 10 in)
Height overall	7.44 m (24 ft 5 in)
Tailplane span	7.92 m (26 ft 0 in)
Wheel track (c/l of shock struts)	7.88 m (25 ft 10.4 in)
Wheelbase	7.95 m (26 ft 1 in)
Propeller diameter	3.96 m (13 ft 0 in)
Propeller ground clearance	0.94 m (3 ft 1 in)
Propeller/fuselage clearance	0.76 m (2 ft 6 in)
Passenger/crew door (fwd, port):	
Height	1.68 m (5 ft 6 in)
Width	0.76 m (2 ft 6 in)
Height to sill	1.09 m (3 ft 7 in)
Cargo door (rear, port):	
Height	1.55 m (5 ft 1 in)
Width	1.27 m (4 ft 2 in)
Height to sill	1.09 m (3 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length	9.19 m (30 ft 2 in)
Max width	2.49 m (8 ft 2 in)
Width at floor	2.03 m (6 ft 8 in)
Max height	1.88 m (6 ft 2 in)
Volume	36.8 m³ (1,300 cu ft)
Net volume available for cargo	31.1 m³ (1,100 cu ft)
Cargo compartment volume	8.5 m³ (300 cu ft)

AREAS:

Wings, gross	54.35 m² (585.0 sq ft)
Vertical tail surfaces (total)	14.12 m² (152.0 sq ft)
Horizontal tail surfaces (total)	13.94 m² (150.0 sq ft)

WEIGHTS AND LOADING:

Operating weight empty	9,151 kg (20,176 lb)
Max fuel	2,662 kg (5,870 lb)
Max payload:	
passengers	3,549 kg (7,824 lb)
cargo	3,855 kg (8,500 lb)
Max T-O weight	13,834 kg (30,500 lb)
Max landing weight	13,607 kg (30,000 lb)
Max zero-fuel weight	12,700 kg (28,000 lb)
Max wing loading	254.5 kg/m² (52.1 lb/sq ft)

PERFORMANCE (estimated at max T-O weight except where indicated):

Max cruising speed at 13,143 kg (28,975 lb) (95% of max T-O weight):	
at 4,575 m (15,000 ft)	270 knots (500 km/h; 311 mph)
at 6,100 m (20,000 ft)	269 knots (498 km/h; 309 mph)
at 7,620 m (25,000 ft)	262 knots (485 km/h; 301 mph)
Stalling speed, flaps down	72 knots (134 km/h; 83 mph)
Max rate of climb at S/L	631 m (2,070 ft)/min
Rate of climb at S/L, one engine out	162 m (530 ft)/min
FAR Pt 25 T-O field length at S/L, 15° flap, at max T-O weight:	
ISA	826 m (2,710 ft)
ISA + 15°C	887 m (2,910 ft)
FAR Pt 25 landing field length at S/L, 35° flap, at max landing weight:	
ISA and ISA + 15°C	908 m (2,980 ft)
Block times (7 min terminal allowance):	
100 nm (185 km; 115 miles)	32 min 12 s
200 nm (370 km; 230 miles)	55 min 36 s
300 nm (555 km; 345 miles)	80 min 12 s
Range with IFR reserves (max cruise rating):	
normal (full passenger load)	600 nm (1,112 km; 691 miles)
max (full fuel)	1,300 nm (2,409 km; 1,497 miles)
Range with max fuel, long range cruise, no reserves	1,810 nm (3,354 km; 2,084 miles)
Endurance with max fuel, no reserves	9 h 54 min

OPERATIONAL NOISE LEVELS (estimated, FAR Pt 36 Stage 3 and ICAO Annex 16):

T-O	80 EPNdB
Sideline	86 EPNdB
Approach	91 EPNdB

GRUMMAN

GRUMMAN AEROSPACE CORPORATION; Head Office and Works: South Oyster Bay Road, Bethpage, New York 11714, USA

GRUMMAN MODEL 712 FORWARD SWEPT WING DEMONSTRATOR

US Air Force designation: X-29A

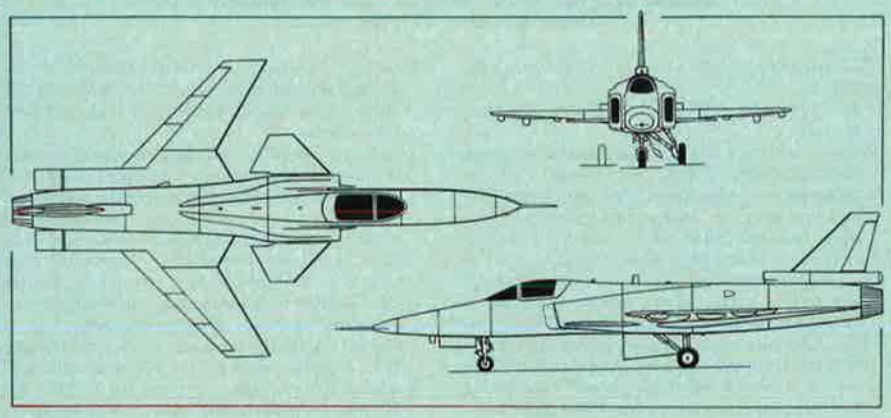
Grumman has been exploring for some time the benefits offered by a forward swept wing (FSW) design, and conducted a series of wind tunnel test programmes that was funded by the Defense Advanced Research Projects Agency. Monitored by the US Air Force, these programmes verified the aerodynamic benefits of such a design. As a result, it was announced on December 22, 1981, that Grumman had been awarded a $71.3 million contract to build two FSW demonstrator aircraft that would be designated X-29A. Basic design had started in January 1981 and, following award of the contract, construction of the first single-seat prototype began in January 1982. This aircraft is scheduled to fly for the first time in April 1984 at the company's Calverton, Long Island, flight test facility. The major portion of subsequent flight testing will be carried out at NASA's Dryden Flight Research Center at Edwards AFB, California.

Grumman's FSW design offers the promise of a new generation of tactical aircraft that will be smaller, lighter in weight, less costly, but more efficient than contemporary fighters. The concept is not new, as the aerodynamic advantages of forward wing sweep were recognised during the second

World War. They included improved manoeuvrability, with virtually spin-proof characteristics, better low-speed handling, and reduced stalling speeds. In addition, such aircraft would have the advantage of lower drag across the entire operational envelope, particularly at speeds approaching Mach 1, which will permit the use of a less powerful engine. However, the achievement of a suitable structure to reap these benefits was found to be impracticable at the state of the art prevailing in the 1940s.

With an FSW aircraft of conventional construction, when aerodynamic stresses flex the wing in flight, this increases the angle of attack (and hence the lift) of the outer wing sections. This, in turn, increases the air loads and causes further deformation of the wings; higher speeds will raise these forces until they eventually exceed the strength of the wing structure. To compensate for this divergence problem, FSWs of metal construction had to be stiffened to the point where a weight penalty was incurred, negating any aerodynamic benefit. Grumman appreciated that the advent of advanced composite materials offered a solution. Exceptionally strong and light in weight, an FSW of graphite composite material can be tailored to eliminate twisting when the wing bends.

The single-seat X-29A which is under construc-



Grumman Model 712 forward swept wing demonstrator being built for the US Air Force as the X-29A *(Pilot Press)*

tion has a thin supercritical wing of metal/composite construction, with a variable-camber trailing-edge that changes the shape of the wing to match flight conditions, and a close-coupled foreplane to reduce supersonic trim drag. A standard Northrop F-5A forward fuselage and nose landing gear, and many off-the-shelf components, such as F-16 main landing gear and control surface actuators, are being utilised to reduce costs. Flight control is by triplex-redundant fly-by-wire, and the aircraft is designed to be highly unstable longitudinally. Sufficient flexibility is being built into the programme to allow for the flight testing of other advanced concepts relating to cockpits, two-dimensional exhaust nozzles, weapons carriage, and techniques to reduce further the take-off and landing speed of FSW aircraft.

TYPE: FSW demonstrator aircraft.

WINGS: Cantilever low/mid-wing monoplane. Supercritical wing section. Thickness/chord ratio at root 6.2%, at tip 4.9%. No dihedral. Incidence −6° at WS 20 to +0.8° at WS 163.22. Forward sweep at quarter-chord 33° 44'. Safe-life construction with substructure of aluminium alloy and titanium and graphite epoxy composite skins. Full-span dual hinged camber-changing trailing-edge flaps/ailerons ('flaperons') with two National Water Lift integrated servo actuators in each wing. A wing strake extends aft from the trailing-edge at each wing root, each strake with a trailing-edge flap which has its own Moog integrated servo actuator. No wing de-icing system.

FOREPLANES: All-moving canard surfaces of conventional aluminium alloy construction, one on each side of the centre-fuselage, outboard of engine inlet ducts. Operated by National Water Lift servo actuators. No anti-icing system.

FUSELAGE: Semi-monocoque fail-safe structure of aluminium alloy, incorporating pressurised cockpit section.

TAIL UNIT: Swept vertical surfaces only, of aluminium alloy construction, comprising fin and rudder. Rudder operated by National Water Lift integrated servo actuator. No anti-icing system.

LANDING GEAR: Hydraulically retractable tricycle type, all three units retracting forward. Menasco oleo-pneumatic shock absorber in each unit. Goodrich wheels and tyres. Nosewheel tyre size 18 × 6-8, pressure 10.35 bars (150 lb/sq in); main-wheel tyres each 24 × 5.5, pressure 17.25 bars (250 lb/sq in). Goodrich hydraulic carbon disc brakes, aircooled; Goodyear anti-skid units.

POWER PLANT: One General Electric F404-GE-400 augmented turbofan in the 71.2 kN (16,000 lb st) class. Two bladder fuel cells within the fuselage and integral tanks in each wing strake, with a total capacity of 1,804 kg (3,978 lb) of JP5 fuel. No flight refuelling capability.

ACCOMMODATION: Pilot only, on Martin-Baker GRQ7A ejection seat, beneath upward opening canopy hinged at rear edge. Accommodation air-conditioned and pressurised.

SYSTEMS: AiResearch bootstrap air-cycle air-conditioning and pressurisation system, providing cockpit pressure differential of 0.34 bars (5 lb/sq in). Dual engine driven hydraulic pumps for two independent systems, each 207 bars (3,000 lb/sq in) for operation of flight control actuators, landing gear, and utility systems. Electrical system includes engine driven Westinghouse 40kVA generator and Lear Siegler 5kVA emergency generator, 500VA converter, two transformer-rectifiers, 20Ah storage battery, and external power socket. Liquid oxygen system with converter. AiResearch emergency power unit, operated by engine bleed air and/or hydrazine fuel, to drive the Lear Siegler 5kVA emergency generator and a hydraulic pump of 83 litres (22 US gallons)/min output. Engine fire extinguishing system.

AVIONICS: Will include navigational equipment, UHF com, and RT-1063B/APX-101V IFF/SIF.

DIMENSIONS, EXTERNAL:

Wing span	8.29 m (27 ft 2½ in)
Wing chord:	
at root	2.96 m (9 ft 8½ in)
at tip	1.19 m (3 ft 11 in)
Wing aspect ratio	4
Foreplane span	4.15 m (13 ft 7½ in)
Length overall, incl nose probe	16.44 m (53 ft 11¼ in)
Length of fuselage	14.66 m (48 ft 1 in)
Height overall	4.36 m (14 ft 3½ in)
Wheel track	2.30 m (7 ft 6½ in)
Wheelbase	5.48 m (17 ft 11¼ in)

AREAS (exposed):

Wings	17.54 m² (188.84 sq ft)
Foreplane	3.34 m² (35.96 sq ft)
Vertical tail surfaces	3.02 m² (32.51 sq ft)

WEIGHTS (estimated):

Weight empty	6,045 kg (13,326 lb)
Max fuel weight	1,804 kg (3,978 lb)
Max T-O weight	7,848 kg (17,303 lb)

PERFORMANCE:

No details available, but max level speed approx Mach 1.6

AERITALIA

AERITALIA—SOCIETÀ AEROSPAZIALE ITALIANA p.A. (Transport Aircraft Group): Headquarters and Naples Area Works: 80038 Pomigliano d'Arco, Naples, Italy

AERITALIA G222

Designed by Ing Giuseppe Gabrielli, the Aeritalia (originally Fiat) G222 was conceived in four separate configurations, three of which were halted at the research project stage. Two unpressurised prototypes were built of the military transport version, of which the first (MM582) made its initial flight on July 18, 1970, and the second (MM583) on July 22, 1971. The first prototype was handed over to the Italian Air Force on December 21, 1971, for operational evaluation. One airframe was completed for static and one for fatigue testing.

Several major Italian airframe companies share in the construction programme, including Aermacchi (outer wings); Piaggio (wing centre-section); SIAI-Marchetti (tail unit); CIRSEA (landing gear); and IAM (miscellaneous airframe components). Other structural components are contributed by Hellenic Aerospace Industries. Fuselages are built by Aeritalia's Transport Aircraft Group, in the Pomigliano d'Arco Works near Naples; final assembly takes place at the Capodichino Works, Naples. The following versions have been built:

G222. Standard military transport, to which the detailed description mainly applies. First delivery of a production G222 was made in November 1976 to the air force of Dubai, which ordered one. This was followed in 1977 by the first of three for the Argentine Army, and in early 1981 by two for the Somali Air Force. Two others originally ordered by Somalia were later cancelled. This version also ordered by the Venezuelan Army (two) and Air Force (six), and the Nigerian Air Force (five); deliveries to these countries were due to begin in Summer and Autumn 1983, respectively. Principal G222 customer is the Italian Air Force, which has 32 standard transports on order, of which 28 had been delivered by March 1983. The first G222 for the Italian Air Force (MM62101) flew on December 23, 1975, and deliveries began on April 21, 1978. These aircraft are in service with the 46a Aerobrigata at Pisa-San Giusta, and are operated primarily in the roles of troop, paratroop, and cargo transport, or for aeromedical duties. Six quick-change kits, produced by Aeritalia, are held by the Italian Air Force for in-the-field conversions to the aeromedical configuration. This latter version has been used in recent years in support of Red Cross relief operations in Kampuchea, Peru, and elsewhere.

G222RM. Radio/radar calibration version (Radio Misure), equipped for flights below 3,050 m (10,000 ft) to calibrate airport flight paths and radio assistance, enabling it to check VOR, ILS, DME, Tacan, PAR, decibel noise levels, marker beacon receivers, and air traffic control systems, in addition to VHF and UHF radio transmissions. Onboard equipment includes separate receivers and displays, a central computer to collect inertial navigation data (updated continually by DME), and data on the state of the radio aid(s) being calibrated. Only one equipment operator is necessary, in addition to the two-man flight crew, and ample space remains in the rear of the hold to carry a Jeep-type vehicle for ground-based operations. This version has an optional secondary capability to perform survey missions, at altitudes between 6,100 and 7,620 m (20,000 and 25,000 ft), for multiple control of flight path assistance. First flight of a G222RM took place in October 1982; the Italian Air Force has ordered four, of which one had been delivered by March 1983. Dimensions, weights, and performance are similar to those of the standard troop transport.

G222SAMA. Firefighting version (Sistema Aeronautico Modulare Antincendio), with specially designed modular dispersal system for water or re-

tardant (see 'Equipment' paragraph later), testing of which was completed in 1976. Six delivered to Italian Air Force, which used them extensively and successfully in many parts of Italy during the Summer of 1982. One aircraft was lost during these operations, but the other five remained in service with the Italian Air Force's Reparto Sperimentale Volo (Experimental Flying Establishment) at Pratica di Mare in the Spring of 1983.

G222T. Version with Rolls-Royce Tyne turboprop engines (see under 'Power Plant' for details), larger-diameter propellers, and higher operating weights; other differences noted under 'Systems' and 'Performance' in main description. Produced initially for Libyan Arab Air Force, by whom it is known as **G222L**, to overcome US embargo on export of General Electric engines to that country, and flown for the first time on May 13, 1980. Libyan order for 20 includes two in VIP transport configuration; deliveries began in February 1981 and had totalled 17, including one VIP aircraft, by March 1983.

G222VS (Version Speciale). Electronic warfare version, first flown in prototype form on March 9, 1978. Carrying a pilot, co-pilot, and up to ten systems operators, it has a modified cabin fitted with racks and consoles for detection, signal processing, and data recording equipment, and an electrical system providing up to 40kW of power for its operation. Externally distinguishable by small 'thimble' radome beneath the nose and a larger 'doughnut' radome on top of the tail-fin. Two ordered by Italian Air Force, of which one had been delivered by March 1983; in service with the 71° Gruppo at Pratica di Mare. Dimensions, weights, and performance are similar to those of the standard troop transport.

Of the total of 83 G222s ordered (all versions), 59 had been delivered by March 1983, with production continuing at the rate of 11 per year.

In addition to the foregoing, Aeritalia is actively studying three further versions of the G222. The first of these is a 'light' airborne early warning/AWACS version, with Tyne engines and a rotating 'saucer' radome mounted above the fuselage. The second is a T64-powered version for maritime patrol and possible ASW/ASV missions, and a third is a Tyne-engined launch aircraft for RPVs. This last project, known as **Quiver**, would have a dorsal radome similar to (but smaller than) that of the AWACS version, and would be able to carry up to six Meteor Mirach-100 jet-powered RPVs beneath the outer wings.

The following description applies to the standard G222 military transport version, except where indicated:

TYPE: Twin-turboprop general purpose transport aircraft.

WINGS: Cantilever high-wing monoplane, with max thickness/chord ratio of 15%. Dihedral 2° 30' on outer panels. Aluminium alloy three-spar fail-safe box structure, built in three portions. One-piece constant-chord centre-section fits into recess in top of fuselage and is secured by bolts at six main points. Outer panels tapered on leading- and trailing-edges. Upper surface skins are of 7075-T6 alloy, lower surface skins of 2024-T3 alloy. All control surfaces have bonded metal skins with metal honeycomb core. Double-slotted flaps extend over 60% of trailing-edge. Two-section hydraulically actuated spoilers ahead of each outboard flap segment, used also as lift dumpers on landing. Spoilers and flaps fully powered by tandem hydraulic actuators. Manually operated ailerons, each with inset servo tab. Pneumatically inflated de-icing boots on outer leading-edges, using engine bleed air.

Aeritalia G222 twin-turboprop general purpose transport of the Libyan Air Force, with Tyne engines

FUSELAGE: Pressurised fail-safe structure of aluminium alloy stressed-skin construction and circular cross-section. Easily removable stiffened floor panels.

TAIL UNIT: Cantilever safe-life structure of aluminium alloy, with sweptback three-spar fin and non-swept two-spar variable-incidence tailplane. Pneumatically inflated de-icing boots on fin and tailplane leading-edges, using engine bleed air. Rudder and elevators of metal honeycomb construction. Two tabs in each elevator; no rudder tabs. Rudder fully powered by tandem hydraulic actuators; elevators operated manually.

LANDING GEAR: Hydraulically retractable tricycle type, suitable for use from prepared runways, semi-prepared strips, or grass fields. Messier-Hispano-Bugatti design, built under license by CIRSEA (Nardi-Magnaghi). Steerable twin-wheel nose unit retracts forward. Main units, each consisting of two single wheels in tandem, retract into fairings on sides of fuselage. Oleo-pneumatic shock absorbers. Gear can be lowered by gravity in emergency, the nose unit being aided by aerodynamic action and the main units by the shock absorbers, which remain compressed in the retracted position. Oleo pressure in shock absorbers is adjustable to permit variation in height and attitude of cabin floor from ground. Low-pressure tubeless tyres on all units, size 37.91 × 12.35 in (Type III) on mainwheels, 27.56 × 10.51 in (Type III) on nosewheels. Tyre pressures 4.41 bars (64 lb/sq in) on main units, 3.92 bars (56.88 lb/sq in) on nose unit. Hydraulic multi-disc brakes.

POWER PLANT (except G222T): Two Fiat-built General Electric T64-GE-P4D turboprop engines, each flat rated to 2,535 kW (3,400 shp) at ISA + 25°C and driving a Hamilton Standard 63E60-27 three-blade variable- and reversible-pitch propeller with spinner. Fuel in integral tanks: two in the outer wings, combined capacity 6,800 litres (1,495 Imp gallons), and two centre-section tanks, combined capacity 5,200 litres (1,143 Imp gallons), with cross-feed provision to either engine. Total overall fuel capacity 12,000 litres (2,638 Imp gallons). Single pressure refuelling point in starboard main landing gear fairing. Overwing gravity refuelling point above each tank.

POWER PLANT (G222T): Two 3,624 kW (4,860 shp) Rolls-Royce Tyne RTy.20 Mk 801 turboprop engines, with BAeDG 4/7000/6 four-blade variable-pitch propellers. Fuel system and capacity as for standard version.

ACCOMMODATION: Normal crew of three (two pilots and radio operator/flight engineer) on flight deck. Provision for loadmaster or jumpmaster

G222RM radio/radar calibration version of the Aeritalia G222

when required. Standard troop transport version has 32 foldaway sidewall seats and 21 stowable seats for 53 fully equipped troops, and carries also two 20-man life rafts stowed in the wing/fuselage fairing and a single 9-man life raft in the cargo compartment. Paratroop transport version can carry up to 42 fully equipped paratroops, and is fitted with the 32 sidewall seats and life rafts as in the troop transport version, plus ten stowable seats, door jump platforms, and static lines. Cargo transport version can accept standard pallets of up to 2.24 m (7 ft 4 in) wide, and can carry up to 9,000 kg (19,840 lb) of freight. Provision is made for 135 cargo tiedown points, on a 51 cm (20 in) square NATO standard grid, and a 1,500 kg (3,306 lb) capacity cargo hoist. Typical Italian military equipment loads can include two CL-52 light trucks; one CL-52 with a 105 mm L4 howitzer or one-ton trailer; Fiat AR-59 Campagnola reconnaissance vehicle with 106 mm recoilless gun or 250 kg (550 lb) trailer; or five standard A-22 freight containers. In the aeromedical role the G222 can accommodate 36 stretchers, two sitting patients, and four medical attendants. A second toilet can be installed, and provision can be made to increase the water supply and to install electrical points and hooks for medical treatment bottles. In this version, the cabin oxygen system is available to all stretcher positions. Crew door is forward of cabin on port side. Passenger doors, at front and rear of main cabin on starboard side and at rear on port side, can be used also as emergency exits. Two emergency hatches in cabin roof, forward and aft of wing carry-through structure. Hydraulically operated rear loading ramp and upward opening door in underside of upswept rear fuselage, which can be opened in flight for airdrop operations. In cargo version, five loads of up to 1,000 kg (2,205 lb) each can be airdropped from rear opening, or a single load of up to 5,000 kg (11,023 lb). Paratroop jumps can be made either from this opening or from the rear side doors. Windscreens and quarter-light panels are de-iced and demisted electrically. Wipers and screen wash for both windscreens. Entire accommodation pressurised and air-conditioned.

SYSTEMS: Pressurisation system maintains a cabin differential of 0.41 bars (5.97 lb/sq in), giving a 1,200 m (3,940 ft) environment at altitudes up to 6,000 m (19,680 ft). Air-conditioning system uses engine bleed air (air supplied by centrifugal compressor in G222T) during flight; on ground, it is fed by compressor bleed air from APU to provide cabin heating to a minimum of 18°C. Garrett 113.3 kW (152 hp) APU, installed in starboard main landing gear fairing, provides power for engine starting, hydraulic pump and alternator actuation, air-conditioning on ground, and all hydraulic and electrical systems necessary for loading and unloading on ground. Two independent hydraulic systems, each of 207 bars (3,000 lb/sq in) pressure. No. 1 system actuates flaps, spoilers, rudder, wheel brakes, and (in emergency only) landing gear extension; No. 2 system actuates flaps, spoilers, rudder, wheel brakes, nosewheel steering, landing gear extension and retraction, rear ramp/door, and windscreen wipers. Auxiliary hydraulic system, fed by APU-powered pump, can take over from No. 2 system in flight, if both main systems fail, to operate essential services. In addition, a standby handpump is provided for emergency use to lower the landing gear and, on the ground, to operate the ramp/door and parking brakes. Three 45kVA (60kVA in G222T) alternators, one driven by each engine through constant-speed drive units and one by the APU, provide 115/200V three-phase AC electrical power at 400Hz. 28V DC power is supplied from the main AC buses via two transformer-rectifiers, with 24V 34Ah nickel-cadmium battery and static inverter for standby and emergency power. External AC power socket. Electrical de-icing of spinners (except on G222T) and propeller leading-edges. Engine intakes anti-iced by electrical/hot-air system. Liquid oxygen system for crew and passengers (with cabin wall outlets); this system can be replaced by a gaseous oxygen system if required. Emergency oxygen system available for all occupants in the event of a pressurisation failure.

AVIONICS AND EQUIPMENT: Standard communications equipment includes 3,500-channel UHF, two 1,360 channel VHF-AM, 920-channel VHF-FM, 28,000-channel HF/SSB, crew intercom, and PA system. Navigation equipment includes Omega system, with TAS computer, autopilot, flight director, two compasses, and two vertical gyros; and an integrated ground-based system incorporating two VOR, marker beacon receiver, two ILS, ADF, two Tacan or DME, and horizontal situation indicator. Other avionics include Meteo weather radar, with secondary terrain-mapping mode; radar altimeter; and IFF/ATC transponder including altitude reporting. Provision for head-up display. Landing light on nosewheel leg.

EQUIPMENT (G222SAMA): Modular palletised fire-fighting pack can be installed in under two hours without any modification to the basic transport aircraft. The module consists of a 6,300 litre (1,385 Imp gallon) tank and four pressurised air containers to activate the pneumatic actuators and discharge the retardant through the rear ramp/door opening via two nozzles. Length of area covered averages 300 m (985 ft).

DIMENSIONS, EXTERNAL:

Wing span	28.70 m (94 ft 2 in)
Wing chord:	
at root	3.40 m (11 ft 1¾ in)
at tip	1.685 m (5 ft 6¼ in)
Wing aspect ratio	9.15
Length overall	22.70 m (74 ft 5½ in)
Height overall	9.80 m (32 ft 1¾ in)
Fuselage: Max diameter	3.55 m (11 ft 7¾ in)
Tailplane span	12.40 m (40 ft 8¼ in)
Wheel track	3.668 m (12 ft 0½ in)
Wheelbase (to c/l of main units)	6.23 m (20 ft 5¼ in)
Propeller diameter:	
except G222T	4.42 m (14 ft 6 in)
G222T	4.88 m (16 ft 0 in)
Distance between propeller centres	9.50 m (31 ft 2 in)
Rear-loading ramp/door:	
Width	2.45 m (8 ft 0½ in)
Height	2.25 m (7 ft 4½ in)

DIMENSIONS, INTERNAL:

Main cabin:	
Length	8.58 m (28 ft 1¾ in)
Width	2.45 m (8 ft 0½ in)
Height	2.25 m (7 ft 4½ in)
Floor area:	
excl ramp	21.00 m² (226.0 sq ft)
incl ramp	25.68 m² (276.4 sq ft)
Volume	58.0 m³ (2,048 cu ft)

AREAS:

Wings, gross	82.00 m² (882.6 sq ft)
Ailerons (total)	3.65 m² (39.29 sq ft)
Trailing-edge flaps (total)	18.40 m² (198.06 sq ft)
Spoilers (total)	1.65 m² (17.76 sq ft)
Fin (incl dorsal fin)	12.19 m² (131.21 sq ft)
Rudder	7.02 m² (75.56 sq ft)
Tailplane	19.09 m² (205.48 sq ft)
Elevators (total)	4.61 m² (49.62 sq ft)

WEIGHTS AND LOADINGS (standard version except where indicated):

Weight empty	14,590 kg (32,165 lb)
Weight empty, equipped	15,400 kg (33,950 lb)
Operating weight empty:	
standard and SAMA	15,700 kg (34,610 lb)
G222T	18,000 kg (39,685 lb)
Max payload (cargo)	9,000 kg (19,840 lb)
Equipment module (SAMA)	2,200 kg (4,850 lb)
Retardant (SAMA)	6,800 kg (14,990 lb)
Max fuel load	9,400 kg (20,725 lb)
Fuel (SAMA)	3,330 kg (7,340 lb)
Max T-O weight:	
standard and SAMA	28,000 kg (61,730 lb)
G222T	29,000 kg (63,935 lb)
Max landing weight:	
standard and SAMA	26,500 kg (58,420 lb)
G222T	27,200 kg (59,965 lb)
Max zero-fuel weight	24,400 kg (53,790 lb)
Max cargo floor loading	750 kg/m² (155 lb/sq ft)
Max wing loading	341.5 kg/m² (69.9 lb/sq ft)
Max power loading	5.52 kg/kW (9.1 lb/shp)

PERFORMANCE (standard G222 transport, at max T-O weight, except where indicated):

Max level speed:
- G222 at 4,575 m (15,000 ft): 291 knots (540 km/h; 336 mph)
- G222T at 9,150 m (30,000 ft): 310 knots (574 km/h; 357 mph)

Long-range cruising speed:
- G222 at 6,000 m (19,680 ft): 237 knots (439 km/h; 273 mph)
- G222T at 9,150 m (30,000 ft): 300 knots (556 km/h; 345 mph)

Airdrop speed (paratroops or cargo): 110–140 knots (204–259 km/h; 127–161 mph) IAS

Drop speed (G222SAMA, T-O configuration): 120 knots (222 km/h; 138 mph)

Stalling speed, flaps and landing gear down: 84 knots (155 km/h; 97 mph)

Time to height:
- G222 to 4,500 m (14,760 ft): 8 min 35 s
- G222T to 4,575 m (15,000 ft): 6 min 48 s

Max rate of climb at S/L: 520 m (1,705 ft)/min

Rate of climb at S/L, one engine out:
- G222: 125 m (410 ft)/min
- G222T: 305 m (1,000 ft)/min

Service ceiling: 7,620 m (25,000 ft)

Service ceiling, one engine out:
- G222: 5,000 m (16,400 ft)
- G222T: 4,725 m (15,500 ft)

Optimum height above ground during drop (G222SAMA): 50–100 m (165–330 ft)

T-O run:
- G222: 662 m (2,172 ft)
- G222T: 649 m (2,130 ft)

T-O to 15 m (50 ft):
- G222: 1,000 m (3,280 ft)
- G222T: 1,006 m (3,300 ft)

Landing from 15 m (50 ft):
- G222: 775 m (2,543 ft)
- G222T: 655 m (2,150 ft)

Landing run at max landing weight:
- G222: 545 m (1,788 ft)
- G222T: 378 m (1,240 ft)

Accelerate/stop distance: 1,200 m (3,937 ft)

Min ground turning radius: 20.80 m (68 ft 3 in)

Range with max payload, optimum cruising speed and height:
- G222: 740 nm (1,371 km; 852 miles)
- G222T: 1,020 nm (1,890 km; 1,174 miles)

Range with 36 stretchers and 4 medical attendants:
- G222: 1,349 nm (2,500 km; 1,553 miles)

Range with max retardant load:
- G222SAMA: 540 nm (1,000 km; 621 miles)

Ferry range with max fuel:
- G222: 2,500 nm (4,633 km; 2,879 miles)
- G222T: 2,750 nm (5,096 km; 3,166 miles)

g limit: +2.5

AAC

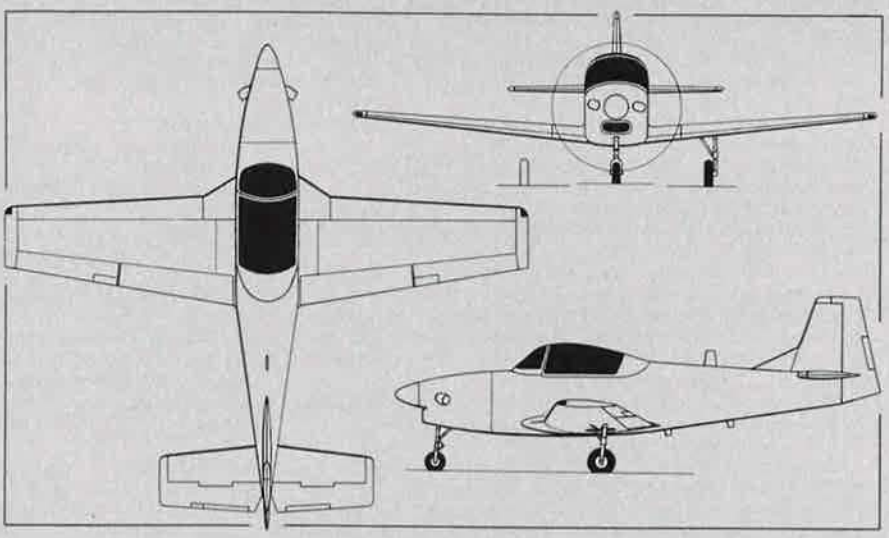
AUSTRALIAN AIRCRAFT CONSORTIUM PTY LTD; Postal Address: Private Bag No. 14, Fishermen's Bend, Port Melbourne, Victoria 3207, Australia

Australian Aircraft Consortium Pty Ltd (AAC) was formed by Commonwealth Aircraft Corporation, Government Aircraft Factories, and Hawker de Havilland Australia to design, develop, and produce a new turboprop-powered military basic training aircraft, to replace the CT4A Airtrainer in RAAF service and for export.

AAC AUSTRALIAN BASIC TRAINER

The design and development contract for the ABT was awarded to AAC by the Australian government in early 1982, and covers the manufacture of two prototypes and two structural test airframes. The subsequent production contract for the RAAF is likely to be for 69 aircraft.

As the accompanying illustration shows, the aircraft is a cantilever low-wing monoplane, with a retractable tricycle landing gear and side by side



AAC Australian Basic Trainer, under development for the RAAF *(Pilot Press)*

seating for the instructor and student pilot. The cockpit is equipped with IFR instrumentation, air-conditioning, and soundproofing. The airframe makes extensive use of corrosion-resistant materials, corrosion-proofing, and weather-proofing, and is designed for long service life with high reliability and low maintenance costs. The aircraft is powered by a Pratt & Whitney Aircraft of Canada PT6A-25D turboprop engine flat rated at approx 410 kW (550 shp). The four underwing stores points are stressed for loads of up to 250 kg (551 lb) each inboard and 150 kg (330 lb) each outboard.

Rollout of the first prototype is scheduled for late 1984, with the first delivery of a production aircraft to the Royal Australian Air Force due in 1987. Export versions of the trainer, possibly available before then, could be configured for weapons training, light close air support, reconnaissance/surveillance, and forward air control.

DIMENSIONS, EXTERNAL:

Wing span	11.00 m (36 ft 1 in)
Wing chord:	
at c/l	3.03 m (9 ft 11¼ in)
at tip	1.21 m (3 ft 11½ in)
Wing aspect ratio	6.05
Length overall	10.01 m (32 ft 10 in)
Height overall	3.70 m (12 ft 1⅗ in)
Elevator span	4.50 m (14 ft 9¼ in)
Wheel track	3.48 m (11 ft 5 in)
Wheelbase	3.50 m (11 ft 5¾ in)
Propeller diameter	2.29 m (7 ft 6 in)

AREAS:

Wings, gross reference	20.00 m² (215.3 sq ft)
Vertical tail surfaces (total)	2.90 m² (31.2 sq ft)
Horizontal tail surfaces (total)	5.40 m² (58.1 sq ft)

WEIGHTS:

Weight empty, equipped	1,394 kg (3,073 lb)
Max T-O weight:	
training	2,000 kg (4,409 lb)
alternative roles	2,600 kg (5,732 lb)

PERFORMANCE (estimated at max training T-O weight, RAAF Mean Tropical Atmosphere):

Never-exceed speed	250 knots (463 km/h; 287 mph)
Max cruising speed at S/L	180 knots (333 km/h; 207 mph)
Max speed in gusty conditions	180 knots (333 km/h; 207 mph) EAS
Approach speed	80 knots (148 km/h; 92 mph)
Stalling speed:	
flaps up	64 knots (119 km/h; 74 mph)
flaps down	57 knots (106 km/h; 66 mph)
Max rate of climb at S/L	561 m (1,840 ft)/min
Time to 3,050 m (10,000 ft)	less than 6 min
Operational ceiling	6,100 m (20,000 ft)
T-O to, and landing from, 15 m (50 ft)	less than 500 m (1,640 ft)
Design endurance, 50 min reserves	3 h
Design *g* limits	+7.0/−3.5

SHORTS

SHORT BROTHERS LTD: Head Office, Works, and Aerodrome: PO Box 241, Airport Road, Belfast BT3 9DZ, Northern Ireland

SHORTS SHERPA

The Sherpa is a freighter version of the Shorts 330-200 twin-turboprop 30-passenger transport that was designed primarily to meet the requirements of commuter and regional air service operators. It retains many features of the all-passenger version, to allow utility passenger transport operations to be undertaken. The forward freight door and wide-body hold of the 330-200 are unchanged, but the Sherpa's design incorporates a Shorts Skyvan type full-width rear cargo door, which permits through-loading.

The hydraulically-actuated rear ramp/door, which is operated from inside or outside the aircraft, can be lowered to a variety of positions to simplify loading from a wide range of ground equipment. The forward baggage compartment of the Shorts 330-200 is retained and this, being lockable, is suitable for high value cargo. Standard airline containers can be accommodated in the main cabin, up to the size of the LD3 which is used widely on intercontinental transport aircraft, making the Sherpa particularly suited for the operation of short-haul cargo feeder services. Typical loads can include two LD3 containers and nine passengers; four LD3 or seven CO8 containers; two half-ton vehicles in the class of the Land-Rover, using load spreaders; and a wide range of bulky cargo. The cabin is suitable for the installation of specialist-role equipment and, for example, lends itself readily to onboard sorting of letters and small packages. Roller conveyor systems, including pallet locks which pick up on the aircraft's standard seat rails, are available optionally.

The prototype of the Sherpa was flown for the first time on December 23, 1982, and production aircraft are now available.

TYPE: Twin-turboprop freight/utility aircraft.

WINGS: Braced high-wing monoplane, of all-metal safe-life construction, built in three sections. Wing sections NACA 63A series (modified). Thickness/chord ratio 18% at root, 14% on outer panels. Dihedral 3° on outer panels. Centre-section, integral with top of centre-fuselage, has taper on leading- and trailing-edges, and is a two-spar single-cell box structure of light alloy with conventional skin and stringers. The strut-braced outer panels, which are pin-jointed to the centre-section, are reinforced Skyvan constant-chord units, built of light alloy; each consists of a two-cell box having wing skins made up of a smooth outer skin bonded to a corrugated inner skin. All-metal single-slotted ailerons. Geared trim tabs in ailerons. All-metal single-slotted flaps, each in three sections. Primary control surfaces are rod-actuated. Optional Goodrich pneumatic-boot de-icing of leading-edges.

FUSELAGE: Light alloy structure, built in two main portions: nose (including flight deck, nosewheel bay, and forward baggage compartment); and the centre (including main wing spar attachment frames and lower transverse beams which carry the main landing gear and associated fairings) and rear portion (including the hydraulically-actuated rear-loading ramp/door and tail unit attachment frames). The nose is of conventional skin/stringer design. The remainder is composed of a smooth outer skin bonded to a corrugated inner skin and stabilised by frames.

TAIL UNIT: Cantilever all-metal two-spar structure with twin fins and rudders, basically similar to that of the Skyvan. Fixed-incidence tailplane, with reinforced leading-edge. Full-span elevator, aerodynamically balanced by set-back hinges. Rudders each have an unshielded horn aerodynamic balance. Primary control surfaces are rod-actuated. Geared trim tabs in elevator and starboard rudder (port rudder, trim only). Optional Goodrich pneumatic-boot de-icing of leading-edges.

LANDING GEAR: Menasco hydraulically-retractable tricycle type, with single wheel on each unit. Main units carried on short sponsons into which the wheels retract. Oleo-pneumatic shock absorbers. Nosewheel is steerable. Normal tyre pressures: main units 5.45 bars (79 lb/sq in), nose unit 3.79 bars (55 lb/sq in).

POWER PLANT: Two 893 kW (1,198 shp) Pratt & Whitney Aircraft of Canada PT6A-45R turboprop engines, each with a max continuous rating of 761 kW (1,020 shp) and driving a Hartzell five-blade low-speed propeller. Fuel in main tanks in wing centre-section/fuselage fairing, total usable capacity 2,182 litres (480 Imp gallons). Normal cross-feed provisions to allow for pump failure. Single point pressure refuelling. Provision to increase total fuel capacity for special requirements.

ACCOMMODATION: Crew of two on flight deck. Dual controls standard. Flight deck air-conditioned, extension to main cabin optional. Baggage compartment in nose (1.27 m³; 45 cu ft) with external access. Passenger door at rear of cabin on port side. Cargo door at front of cabin on port side. Hydraulically-actuated full-width rear-loading ramp/door. In an all-cargo configuration the cabin can accommodate up to seven CO8 or four LD3 containers. Cabin floor is flat throughout its length, and is designed to support 181 kg (400 lb) per foot run at 610.3 kg/m² (125 lb/sq ft). The locally-reinforced centre cabin area is able to carry 272 kg (600 lb) per foot run at 732.4 kg/m² (150 lb/sq ft). A further 272 kg (600 lb) total load can be stowed on the ramp/door. Seat rails can be used as cargo lashing points. Freight loading is facilitated by the low-level cabin floor.

SYSTEMS: Hamilton Standard air-conditioning system, using engine bleed air. Hydraulic system of 207 bars (3,000 lb/sq in), supplied by engine-driven pumps, operates landing gear, flaps, and, at lower pressure, nosewheel steering and brakes, and includes emergency accumulators. Main electrical system, for general services, is 28V DC and is of the split busbar type with cross-coupling for essential services. Lucas 28V 250A starter/generator for engine starting and aircraft services, with separate 1.5kW 200V AC output for windscreen anti-icing and demisting. Special AC sources of 115V and 26V available at 400Hz for certain instruments, avionics, and fuel booster pumps. The engine intake ducts and lips, propellers, and windscreen are all equipped to permit dispatch of the aircraft into known icing conditions. Pneumatic aerofoil de-icing is available as an optional extra.

AVIONICS AND EQUIPMENT: The 330 has a comprehensive avionics system to full Air Transport Category standard as required by FAR 121 operational requirements. Based mainly on Collins

Sherpa freight/utility transport version of the Shorts 330-200 passenger aircraft

New rear ramp and roller conveyors facilitate loading into the large-section hold

Pro-Line equipment, the standard fit includes dual VHF com, dual VOR/ILS/GS, dual RMI, dual compass system, ADF, DME, flight director, transponder, ELT, weather radar, and an audio system. Radar altimeter and cockpit voice and flight data recorders are optional.

DIMENSIONS, EXTERNAL:

Wing span	22.78 m (74 ft 9 in)
Wing chord (standard mean)	1.85 m (6 ft 0.7 in)
Length overall	17.69 m (58 ft 0½ in)
Height overall	4.95 m (16 ft 3 in)
Tailplane span	5.68 m (18 ft 7¼ in)
Wheel track	4.24 m (13 ft 11 in)
Wheelbase	6.15 m (20 ft 2 in)
Propeller diameter	2.82 m (9 ft 3 in)
Propeller ground clearance	1.83 m (6 ft 0 in)
Cabin floor:	
Height above ground	0.94 m (3 ft 1 in)
Passenger door (port, rear):	
Height	1.57 m (5 ft 2 in)
Width	0.69 m (2 ft 3 in)
Forward cargo door (port):	
Height	1.68 m (5 ft 6 in)
Width	1.42 m (4 ft 8 in)
Rear loading door:	
Height	1.98 m (6 ft 6 in)
Width	1.98 m (6 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin:	
Max length	9.09 m (29 ft 10 in)
Max height	1.98 m (6 ft 6 in)
Max width	1.98 m (6 ft 6 in)
Volume (all-cargo)	35.68 m³ (1,260 cu ft)
Baggage compartment (nose)	1.27 m³ (45 cu ft)

AREAS:

Wings, gross	42.1 m² (453.0 sq ft)
Ailerons (total, aft of hinges)	2.55 m² (27.5 sq ft)
Trailing-edge flaps (total, aft of hinges)	7.74 m² (83.3 sq ft)
Fins (total)	8.65 m² (93.1 sq ft)
Rudders (total, aft of hinges)	2.24 m² (24.1 sq ft)
Tailplane	7.77 m² (83.6 sq ft)
Elevator (total, aft of hinges)	2.55 m² (27.4 sq ft)

WEIGHTS AND LOADINGS:

Max payload	3,175 kg (7,000 lb)
Max fuel weight	1,742 kg (3,840 lb)
Max T-O weight	10,387 kg (22,900 lb)
Max landing weight	10,251 kg (22,600 lb)
Max wing loading	246.8 kg/m² (50.55 lb/sq ft)
Max power loading	5.81 kg/kW (9.56 lb/shp)

PERFORMANCE (at max T-O weight, ISA, except where indicated):

Max cruising speed at AUW of 9,525 kg (21,000 lb) at 3,050 m (10,000 ft)	190 knots (352 km/h; 218 mph)
Econ cruising speed at AUW of 9,525 kg (21,000 lb) at 3,050 m (10,000 ft)	157 knots (291 km/h; 181 mph)
Max rate of climb at S/L	360 m (1,180 ft)/min
Service ceiling, one engine out, AUW of 9,072 kg (20,000 lb)	3,930 m (12,900 ft)
T-O distance (FAR Pt 25 and BCAR Gp A):	
ISA	1,036 m (3,400 ft)
ISA + 15°C	1,305 m (4,280 ft)
Landing distance at max landing weight:	
BCAR:	
normal field	1,225 m (4,020 ft)
short field	960 m (3,150 ft)
FAR	1,113 m (3,650 ft)

Range with max fuel, reserves for 45 min hold and 43 nm (80 km; 50 mile) diversion:
with 3,175 kg (7,000 lb) payload
195 nm (362 km; 225 miles)
with 2,268 kg (5,000 lb) payload
669 nm (1,239 km; 770 miles)

LOCKHEED

LOCKHEED-GEORGIA COMPANY; Address: 86 South Cobb Drive, Marietta, Georgia 30063, USA

It is now known that three types of EC-130 Hercules are operated by USAF and the ANG, and that information on the EC-130E supplied officially for the *Gallery of USAF Weapons* in the May 1983 AIR FORCE Magazine was only partially complete.

LOCKHEED EC-130

Versions of the EC-130 in USAF/ANG service are as follows:

EC-130E 'Coronet Solo II'. Electronic surveillance version operated by the 193d Electronic Combat Group, ANG, from Harrisburg International Airport, Pennsylvania, as a replacement for the EC-121. Major exterior modifications include large blade antennae under each outer wing and above the dorsal fin, with a smaller horizontal blade antenna on each side of the rear fuselage. Bullet shape canisters outboard of each underwing antenna and at the extreme tail of the aircraft house trailing-wire antennae that extend several hundred feet behind the EC-130E. Air-conditioning system uprated to dissipate heat generated by the onboard electrical equipment, with heat exchanger pod under each wing, above main landing gear fairing.

EC-130E ABCCC. Airborne Battlefield Command and Control Center operated by the 7th Airborne Command and Control Squadron, 552d Airborne Warning and Control Wing, from Keesler AFB, Mississippi. Known as the C-130E-II until April 1977, this version carries the AN/USC-15 ABCCC capsule (12.19 m; 40 ft long and weighing about 9,070 kg; 20,000 lb) which fits into cargo hold. Aircraft carries a crew of four, plus 12 battle staff crew manning the windowless capsule, which has four HF transceivers, four VHF transceivers, four FM transceivers, eight UHF transceivers, two secure teletypewriters, and 14 channels of voice/data recorders. External features include a ram air scoop on each side, between the flight deck windows and wing leading-edge; HF probe antenna under each outer wing; a long wire antenna extending from the upper wing surface on each side, aft of the outer engine, to the tailplane tip and then to the rear fuselage; four UHF antennae along the top of the fuselage and eight more in pairs on the undersurface; four VHF-AM antennae under the centre-fuselage; and four VHF-FM whip antennae in pairs on each side of the rear cargo door. Duties include management of tactical air resources, direct air support of ground forces, and provision of integrated communications. Ten aircraft produced from 1965. Four since modified to have T56-A-15 engines, instead of T56-A-7, and equipment to make them air refuellable. One (62-1809) was lost in the Iranian desert during attempted rescue of US hostages on April 25, 1980, but it was not carrying capsule at the time.

EC-130H 'Compass Call'. Operated by 41st Electronic Combat Squadron of the 552d AWACW from Davis-Monthan AFB, Arizona. Works with ground mobile C³CM systems to jam enemy command control and communications systems.

Loading an ABCCC capsule into a Lockheed EC-130E. Not too many window seats!

Hillman Model 360 three-seat light helicopter (Avco Lycoming HIO-360-C1A engine)

HILLMAN

HILLMAN HELICOPTER ASSOCIATES; FLIGHT TEST CENTRE: PO Box 820, Chandler, Arizona 85224, USA

HILLMAN MODEL 360

The prototype of this lightweight, sturdy, but mechanically simple helicopter flew for the first time on October 15, 1981. Certification under FAR Pts 21 and 27 is planned for mid-1984, followed shortly afterwards by first deliveries of production Model 360s.

TYPE: Three-seat light utility helicopter.

ROTOR SYSTEM: Two-blade main rotor, with a semi-rigid underslung teetering head to reduce rotor vibration and control force feedback. Tapered-chord main rotor blades are mounted 3° above horizontal to minimise blade flexing, and have 3° of twist. Construction is of glassfibre, with stainless steel leading-edge. Two-blade teetering tail rotor, with glassfibre blades which have leading-edges of stainless steel. No rotor brake at present.

ROTOR DRIVE: Eight-grooved common-back V belt drive, with a sprag type overrunning clutch in the driven pulley. Right-angle spiral bevel gear reduction in an aluminium gearcase. Tail rotor driven via spiral bevel gears. Main rotor/engine rpm ratio 1:5.5; tail rotor/engine rpm ratio 1:1.

FUSELAGE: Welded chrome-molybdenum steel tube centre-section and tailboom. Glassfibre cabin structure, and light alloy tailboom skin. Guard to protect tail rotor in tail-down attitudes.

TAIL UNIT: Small horizontal stabiliser, with end-plate fins of sweptback V form.

LANDING GEAR: Prototype has non-retractable tricycle type. Nose unit with oleo-pneumatic shock absorption and a castoring and self-centering nosewheel. Mainwheels carried on multiple spring steel leaves. Hydraulic brakes. Steel/aluminium tubular skid landing gear will be standard for production aircraft.

POWER PLANT: One 153 kW (205 hp) Avco Lycoming HIO-360-C1A flat-four engine, mounted horizontally in the lower rear section of the fuselage pod. Exhaust is muffled, and sound-dampening foam is installed on firewall. Robertson crashworthy fuel system with single standard tank, capacity 197 litres (52 US gallons). Optional tanks of larger capacity will be available. Oil capacity 7.5 litres (2 US gallons).

ACCOMMODATION: Pilot and two passengers, side by side on contoured bench seat, with dual controls standard. Fully enclosed cabin, with overhead eyebrow window. Removable door on each side of cabin. Baggage space at rear of cabin and around engine compartment. Cabin heating optional; ventilation standard.

SYSTEM: Electrical system includes a 24V 60A engine driven alternator.

AVIONICS AND EQUIPMENT: Optional avionics include a King KY 197 com transceiver, KN 53 nav receiver, KT 76A transponder, and K2 87 ADF, or similar installation by Edo or Narco. Standard equipment includes sensitive altimeter, low rpm warning lights, and anti-collision and navigation lights. Optional equipment includes amphibious floats, a lighting package, agricultural spraying system, cargo racks, a cargo hook, and stretcher kits.

DIMENSIONS, EXTERNAL:

Main rotor diameter	9.45 m (31 ft 0 in)
Tail rotor diameter	1.37 m (4 ft 6 in)
Distance between rotor centres	5.54 m (18 ft 2 in)
Length of fuselage	8.28 m (27 ft 2 in)
Height overall	2.74 m (9 ft 0 in)
Wheelbase	2.18 m (7 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.40 m (4 ft 7 in)
Baggage hold volume	0.17 m³ (6.0 cu ft)

AREAS:

Tail rotor blades (each)	0.059 m² (0.63 sq ft)
Main rotor disc	70.12 m² (754.8 sq ft)
Tail rotor disc	1.48 m² (15.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	499 kg (1,100 lb)
Fuel weight, standard	185.5 kg (409 lb)
Max T-O and landing weight	998 kg (2,200 lb)
Max disc loading	16.75 kg/m² (3.43 lb/sq ft)
Max power loading	6.52 kg/kW (10.73 lb/hp)

PERFORMANCE (estimated at max T-O weight):

Never-exceed speed	113 knots (209 km/h; 130 mph)
Max cruising speed	100 knots (185 km/h; 115 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
Service ceiling	4,575 m (15,000 ft)
Hovering ceiling IGE	3,050 m (10,000 ft)
Hovering ceiling OGE	2,440 m (8,000 ft)
Range with max optional fuel and max payload	1,355 nm (2,511 km; 1,560 miles)

LMSC

LOCKHEED MISSILES AND SPACE COMPANY INC; Address: 1111 Lockheed Way, Sunnyvale, California 94086, USA

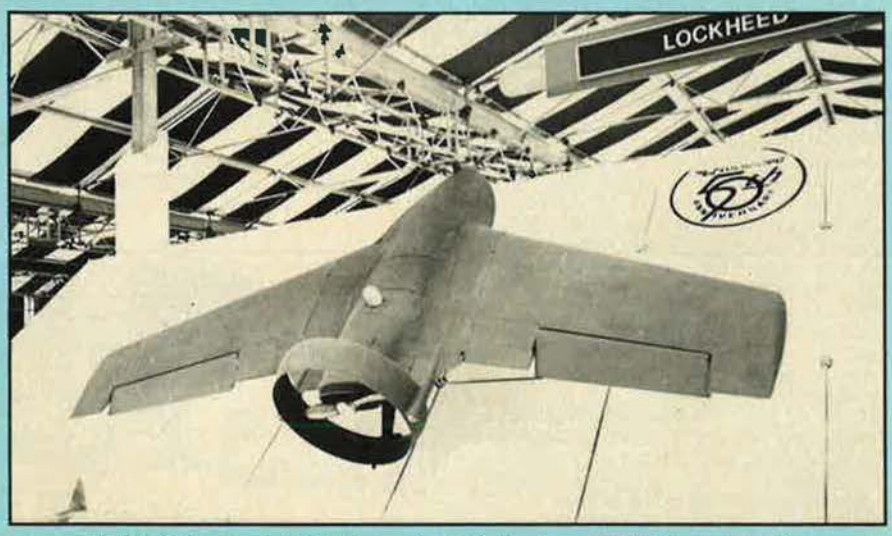
LMSC AQUILA

US Army designation: YMQM-105

The Aquila (Latin for 'eagle') is a small RPV intended to provide real-time target acquisition, first-round fire for effect, artillery adjustment, laser target designation, and aerial reconnaissance. US Army interest in such a vehicle was first expressed in 1974, and resulted in a system technology demonstration (STD) programme to quantify the necessary performance, operations, and training characteristics for such a system. Design and development of the air vehicle utilised prior efforts by Development Sciences Inc with that company's SkyEye RPV, and DSI supplied LMSC with technology demonstration airframe parts for the STD programme, under which 23 **XMQM-105** Aquila prototypes (see 1980–81 *Jane's*) were completed.

The STD programme included 219 flights (150 of them using US Army crews), totalling more than 300 hours, and was completed in 1978. It was followed by a full-scale engineering development (FSED) phase in which the Army has awarded LMSC contracts totalling $267 million in FY 1980–82 for a 70-month programme, beginning on August 31, 1979. Under these contracts LMSC is supplying a total of 28 **YMQM-105** Aquila air vehicles, together with five ground control stations (GCS), a remote ground terminal (RGT), five hydraulic catapult launchers, five Dornier net-type recovery units, 22 'payload' subassemblies, five maintenance shelters, plus training simulators and training manuals.

The current mission 'payload' consists of a stabilised TV sensor with a laser rangefinder/designator. The air vehicle and its payload are controlled from the GCS; video imagery and target location information are returned via an anti-jamming data link. The target acquisition system can be used for conventional artillery as well as for such laser homing missiles as Copperhead. Real-time TV pictures



YMQM-105 Aquila mini-RPV, displayed at 1982 Farnborough Air Show *(Anna Hogg)*

and damage assessment data can be relayed to an RGT many miles behind the battlefront.

Command and control of the tactical system entail four basic functions: (1) launch and navigation of the air vehicle over enemy territory and return for recovery; (2) control of an onboard video camera by ground operators to acquire and track targets; (3) accurate determination of target co-ordinates; and (4) processing and transmission of target data to fire direction centres, for use by artillery batteries.

An operational section equipped with the Aquila system would consist of five air vehicles, seven trucks, three trailers, plus thirteen troops with an officer in charge, and would be air transportable in a Lockheed C-5A Galaxy. Set-up and launching can be done in one hour after arrival at a tactical site; stowage and make-ready for transportation takes 30 min.

Progress in developing the Aquila system has been more protracted than expected, due chiefly to problems in fitting the main electronic subsystems—data link and mission payload—into the very small air vehicle, which was designed to stringent US Army size and weight limitations, and to fluctuations in programme funding. However, in 1981 and early 1982 YMQM-105 subsystems were air-tested in manned aircraft using an interim data link, the airborne portion of which was installed in a modified Piper Seneca II. Launch and retrieval testing of an unpowered Aquila was carried out at Sunnyvale in late 1981/early 1982. Flight testing of the YMQM-105 (17 flights) was carried out successfully at Fort Huachuca, Arizona, in the Summer and Autumn of 1982. Initial operational capability, originally set for late 1985, is now planned for 1988; an eventual Army requirement for 995 air vehicles and 74 GCS has been quoted.

Several growth options for the Aquila system have been enumerated. Principally, these are expected to include forward-looking infra-red (FLIR), multiple drone control, and extended range operations, but Aquila is potentially capable of a wide variety of prospective missions.

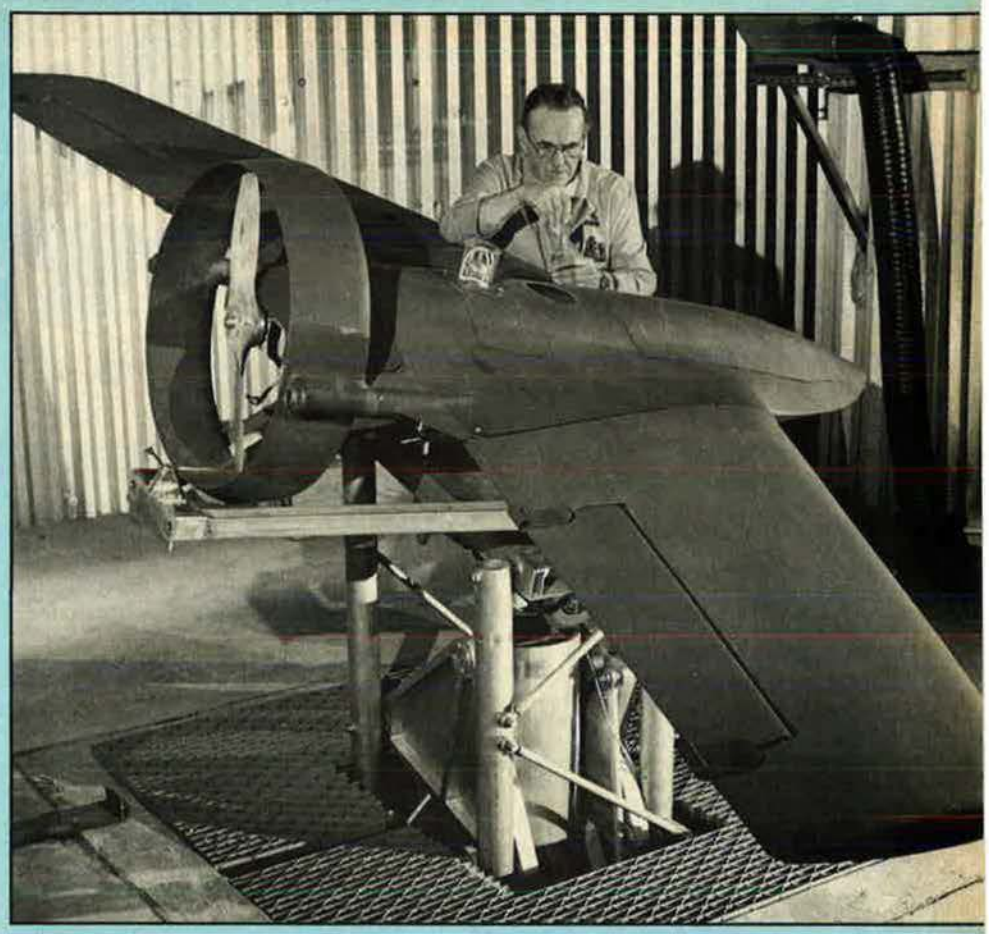
TYPE: Recoverable tactical mini-RPV.

AIRFRAME: Shoulder-mounted sweptwing tail-less monoplane, built by Lockheed-Georgia from pre-impregnated Kevlar 49 epoxy honeycomb material for low radar signature. Leading-edge sweepback 28°. Differentially operated elevons on trailing-edges; turned-down wingtips. Airframe dismantles into four major subsections (centrebody, two wings, and propeller duct), and has quick-disconnect bladder fuel system.

POWER PLANT: One Herbrandson Dyad 280B two-stroke flat-twin piston engine (19.5 kW; 26 hp at 8,000 rpm), driving a two-blade fixed-pitch wooden pusher propeller within an annular duct. Muffled exhaust is directed upward to minimise IR signature. Collapsible bladder-type fuel cell; fuel is a 20:1 (by volume) petrol/oil mixture.

LAUNCH AND RECOVERY: Launched from All American Engineering hydraulically actuated catapult mounted on a 5 ton truck. Primary recovery system uses infra-red sensors to 'capture' air vehicle, which is guided into a Dornier hydraulically deployed nylon vertical ribbon net, raised on back of M814 truck and capable of being lowered quickly after recovery in order to maintain low profile. For test and training flights, YMQM-105 has an 11.5 m (37 ft 9 in) diameter nylon parachute for emergency backup recovery, from which air vehicle is suspended inverted to protect mission equipment. Parachute may be deleted from operational version.

GUIDANCE AND CONTROL: Air vehicle is intended to be launched 5.5–8 nm (10–15 km; 6–9 miles) back on friendly side of FEBA. Flight is defined by up to 100 pre-programmed waypoints stored in Norden Systems GCS computer. At any time during mission, air vehicle operator can change waypoints or command RPV to go into any of several loiter or jinking modes. If data link transmission is interrupted, RPV continues its flight according to last set of instructions and position data received. At any time when within line-of-sight, RPV can receive a burst transmission with position update and, if desired, onboard computer can be reloaded with new instructions. Final waypoint is recovery area. Flight control subsystem includes a flight control electronic package (FCEP), Singer-Kearfott attitude reference assembly (ARA), two air data transducers, three servo-actuators, a power supply, and a near IR source landing aid. FCEP provides computation capability for navigation, guidance, and control of RPV as well as signals for controlling TV camera, air data terminal, and built-in test functions. ARA is a strapdown inertial sensor package, key components of which are a three-axis rate gyro assembly, three-axis accelerometer assembly, and a small computer to provide co-ordinate transformation calculations. System requires periodic position update by burst transmission; this allows onboard computer to calculate and compensate for gyro and accelerometer errors and calculate a new wind estimate. Computer also points the steerable data link antennae, transfers control from one GCS to another following hand-off, and initiates pre-programmed link loss and reacquisition logic following dead reckoning or inadvertent link loss. Air data transducers provide barometric altitude and airspeed information to the FCEP, where it is combined with outputs from the ARA to provide signals to the servo-actuators controlling elevons and throttle. Airborne data terminal (ADT) receives command signals from, and returns status and video signals to, the RGT.



LMSC Aquila target acquisition and surveillance RPV in its latest known configuration

The Aquila FSED programme utilises a Harris Inc modular integrated communication and navigation system (MICNS) as its jamming-resistant data link. This J-band system provides command uplink, telemetry and video downlinks, and navigation of the RPV relative to the RGT, all in a hostile jamming environment. Location of target with respect to RPV is determined from the mission payload gimbal angles while it is tracking the target; the laser measures slant range. The ARA provides heading and local vertical reference to the onboard computer, which calculates target position relative to local vertical. This vector is transmitted to the GCS and combined with RPV position and the surveyed location of the RGT to determine co-ordinates of the target. GCS is the control centre of the RPV system. Telemetry and video data from the air vehicle are processed and displayed; command data are generated and relayed to the air vehicle via the RGT.

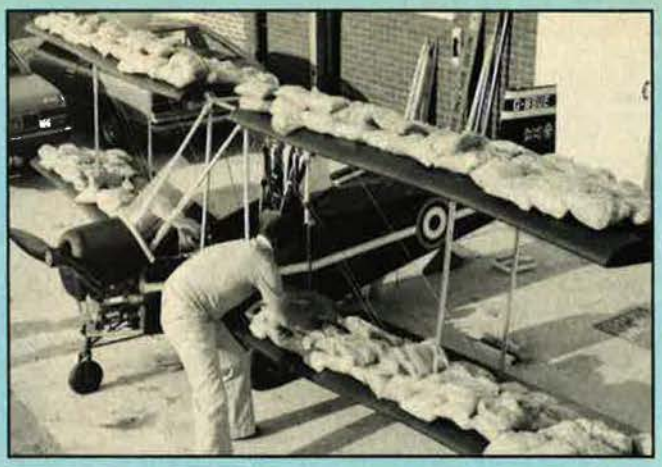
SYSTEM: Electrical power for onboard subsystems provided by a 1.5kW 28V DC engine-driven alternator via a power conditioning unit.

EQUIPMENT: Mission payload subsystem (MPS) is mounted in lower forward fuselage. Current MPS is a Westinghouse three-axis stabilised daylight TV camera, plus a laser rangefinder/designator, autotracker (controlled by a microprocessor), and three fields of view optics. Line-of-sight stabilisation and tracking is provided throughout lower hemisphere and up to 15° elevation above air vehicle's horizontal reference plane. Azimuth

APACHE CORRECTION

The article in the April 1983 'Jane's Supplement', using a source that seemed reliable at the time of writing, quoted an estimated unit cost for the AH-64A of $15.1 million. In fact, the true figure is significantly lower. According to Hughes Helicopters Inc, the correct figures in the three most commonly cited unit cost categories, in FY 1983 dollars, are as follows: flyaway cost (including recurring manufacturing costs) $7.2 million; procurement cost $9.8 million (flyaway cost plus ground support equipment, training and technical aids, etc); and programme acquisition cost $12.0 million (procurement cost plus unit portion of total R&D cost).

MBA Tiger Cub 440 single-seat microlight biplane on its towing trailer



Loads of more than one ton were supported by the MBA Tiger Cub 440's wings during static testing

rotation is continuous while observing targets. The TV camera, laser, laser receiver, and control electronics are stationary, with image stabilisation provided by a gimballed mirror system. The boresighted laser provides range to target and designation. A turret-mounted Kevlar shroud protects the gimballed portion of the MPS, and contains a multi-faceted window through which the optical line-of-sight is projected. The turret is environmentally sealed. A FLIR MPS is being developed by Texas Instruments for later incorporation, to extend RPV operations to 24-hour day/night and restricted visibility conditions.

DIMENSIONS, EXTERNAL:

Wing span	3.89 m (12 ft 9 in)
Length overall	2.08 m (6 ft 10 in)
Propeller diameter	0.66 m (2 ft 2 in)

WEIGHTS:

Fuel	approx 15 kg (33 lb)
Mission payload subsystem	24 kg (53 lb)
Max launching weight	113 kg (250 lb)

PERFORMANCE:

Max level speed	110 knots (203 km/h; 126 mph)
Min service ceiling	3,660 m (12,000 ft)
Range	more than 27 nm (50 km; 31 miles)
Endurance	more than 3 h

MBA

MICRO BIPLANE AVIATION; Address: Sopwith Works, Central Avenue, Worksop, Nottinghamshire S80 1EN, England

MBA TIGER CUB 440

MBA's single-seat biplane microlight aircraft was known originally as the Micro-Bipe. More than 100 hours of test and display flying were carried out in 1982 by the prototype, which was powered by a 24 kW (32 hp) 250 cc two-cylinder engine; this aircraft was described and illustrated in the 1982–83 *Jane's*.

It was intended to power the production version with an MBA-modified 22–26 kW (30–35 hp) 330 cc Fuji Robin engine, but MBA subsequently found it possible to fit a modified 440 cc power plant. This provides an additional 7.5–11 kW (10–15 hp) for an installation weight little more than that of the 330 cc unit, thus permitting performance to be improved or heavier loads to be carried. In this form the aircraft is now known as the Tiger Cub 440.

Production is under way in both kit and ready-to-fly form, including a 100 kg (220 lb) empty weight kit version for export, known as the **Tiger Cub E100.**

TYPE: Single-seat microlight aircraft.

AIRFRAME: Equal-span single-bay biplane. Main frame of tubular HS30 anodised aluminium alloy, with flying surfaces of pre-formed composite materials. Entire structure covered with heat-shrunk woven fabric. Stainless steel or galvanised flying and rigging wires. Wing and tail surfaces have a foam core with internal high-tensile spars and a non-stressed skin. Each half-wing is made from five pre-formed sections, bonded together with ribs and main spars; wings can be folded back alongside fuselage for transportation and storage. Three-axis control by differential ailerons (lower wings only, over almost full span), elevators, and rudder. No fixed fin or tailplane. Non-retractable four-wheel landing gear comprises two 350 × 6 × 4 mainwheels, 4 in steerable tailwheel, and castoring nosewheel. No brakes. Open cockpit, with side doors and shatterproof windscreen.

POWER PLANT: One 33.5 kW (45 hp) MBA-modified 440 cc Fuji Robin two-cylinder two-stroke air-cooled engine, with reduction belt drive to a two-blade wooden tractor propeller. Fuel is a 40:1 petrol/oil mixture; tank capacity is 22.75 litres (5 Imp gallons), tank is attached to interplane struts aft of cockpit.

DIMENSIONS:

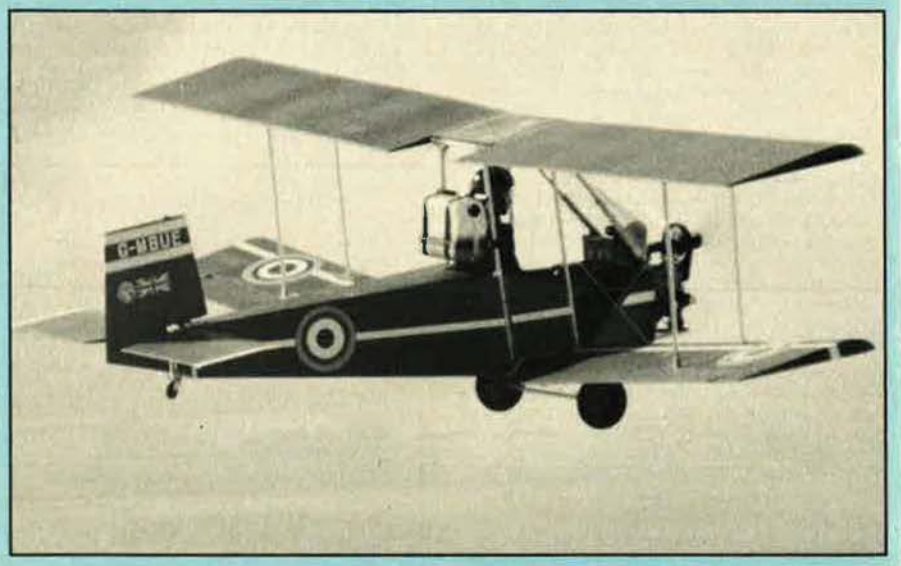
Wing span	6.71 m (22 ft 0 in)
Wing area, gross	12.08 m² (130.0 sq ft)
Wing aspect ratio	3.72
Length overall	4.11 m (13 ft 6 in)
Height overall	1.83 m (6 ft 0 in)
Width, wings folded	2.06 m (6 ft 9 in)
Propeller diameter	1.37 m (4 ft 6 in)

WEIGHTS AND LOADINGS:

Weight empty	120 kg (265 lb)
Max pilot weight	95 kg (210 lb)
Max T-O weight	226 kg (500 lb)
Wing loading:	
empty	9.76 kg/m² (2.0 lb/sq ft)
max	18.77 kg/m² (3.85 lb/sq ft)
Max power loading	6.75 kg/kW (11.1 lb/hp)

PERFORMANCE: (440 at S/L, 10°C/50°F, zero wind, with 73 kg; 160 lb pilot and 9 litres; 2 Imp gallons fuel, except where indicated):

Never-exceed speed	73 knots (136 km/h; 85 mph) IAS
Max level speed:	
440	69 knots (129 km/h; 80 mph) IAS
E100	56 knots (105 km/h; 65 mph) IAS
Max cruising speed	56 knots (105 km/h; 65 mph) IAS
Recommended cruising speed	52 knots (96 km/h; 60 mph) IAS
Econ cruising speed	48 knots (88 km/h; 55 mph) IAS
Recommended landing approach speed	39 knots (72 km/h; 45 mph) IAS
Recommended gliding speed, power off	43 knots (81 km/h; 50 mph) IAS
Mush stalling speed, power on:	
440	27 knots (49 km/h; 30 mph) IAS
E100	21 knots (39 km/h; 24 mph) IAS
Operational max wind speed (clean airflow)	22 knots (40 km/h; 25 mph)
Operational crosswind component:	
proven	16 knots (29 km/h; 18 mph)
max recommended	9 knots (16 km/h; 10 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
Time to 1,525 m (5,000 ft)	10 min
Rate of roll at 43 knots (81 km/h; 50 mph)	more than 30°/s
Service ceiling	3,660 m (12,000 ft)
T-O run, grass field	37 m (120 ft)
Landing run, grass field	55 m (180 ft)
Range with max fuel	119 nm (220 km; 137 miles)
Endurance with max fuel	2 h 30 min
g limits	+6.0/−5.0



The biplane Tiger Cub is available in kit form or off-the-shelf

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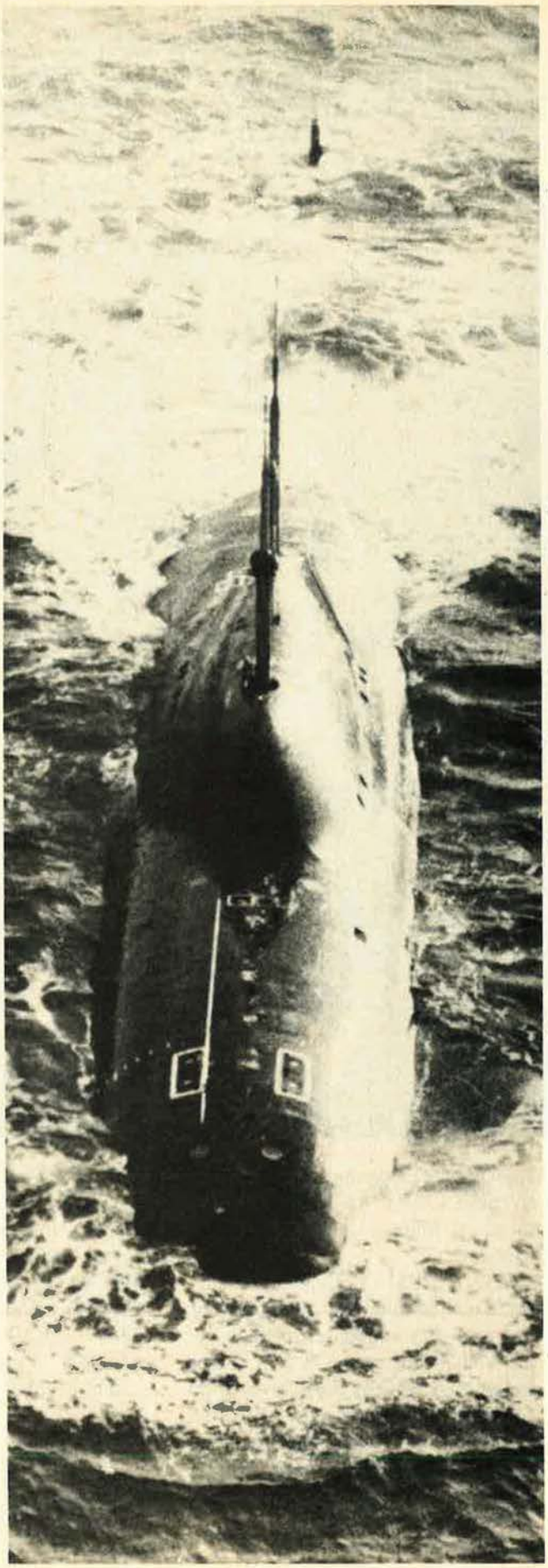
BOBBING, WEAVING, AND FIGHTING SMART

The US Navy looks to new systems and to new concepts to maintain its maritime edge.

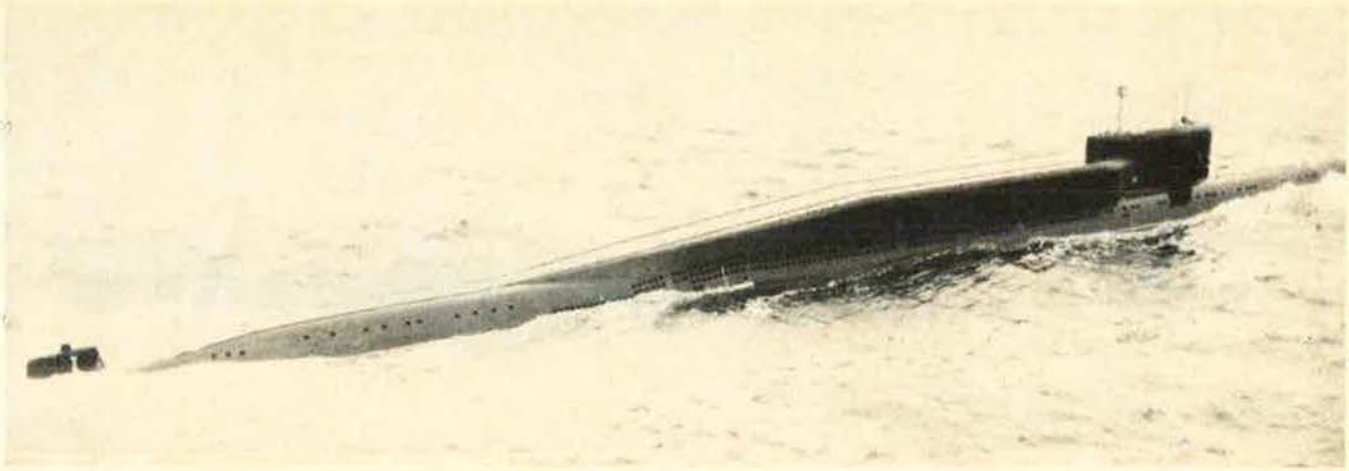
BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

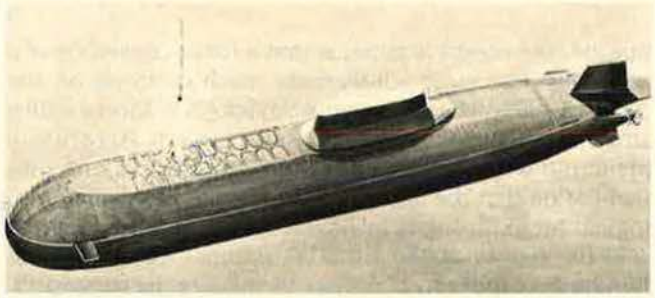


SOVIET SSBNs, the nuclear-powered ballistic missile-launching submarines, and associated SSNs, the attack submarines that ride shotgun for them, have shown over the past few years an increasing "strong interest to operate extensively in the marginal 'ice zone' of the Arctic," according to Adm. James D. Watkins, Chief of Naval Operations. This term, he explained to a group of Pentagon correspondents, means ice of a thickness of up to about three meters that submerged submarines can break through by means of their buoyancy and special hardpoints.

Because of security considerations, he declined to say whether the Soviets have as yet "demonstrated a capability" for such under-ice combat operations, but acknowledged that this "noisy, confusing, and complex environment" could provide a haven for the Soviet SSBNs to hide in. The US Navy, in contrast, has no plans to operate its SSBNs under the polar ice. US submarines, he claimed, are sufficiently quiet, and hence presumably undetectable by Soviet ASW (anti-submarine warfare) forces, to roam freely under "some 30,000,000 square miles" of open ocean areas.

The Soviet intent to stake out such a sanctuary for their SLBM-launching submarines, on the other hand,





FACING PAGE: The Soviet's nuclear-powered, deep-diving, titanium-hulled Alfa-class torpedo attack submarine is the world's fastest. ABOVE: The Delta III SSBN carries sixteen liquid-fueled MIRVed SS-N-18 SLBMs. LEFT: The first 25,000-ton Typhoon-class SSBN armed with twenty launchers for the MIRVed SS-NX-20 SLBM will be operational in 1983.

caused the Navy to step up under-ice training operations by its SSN-688 and SSN-637 attack submarines that in case of war would attempt to hunt down and kill the Soviet SSBNs before they could launch their missiles against US targets. Both the US and the Soviets, he suggested, treat their SSBNs as secure strategic reserve forces, the ultimate "ace in the hole" that neither side would use or expend early. Rather, the SSBNs can be played as the last bargaining chip for negotiating a favorable war termination by the side whose strategic submarine fleet is still intact. Admiral Watkins said "that is why [the Soviets] would keep their forces under the ice—to keep them as a viable force which after a nuclear exchange [would become] a key bargaining tool."

Even though actions of this type might trigger concerns about destabilizing the balance of nuclear deterrence, the National Command Authorities must be given the option, at the outset of nuclear conflict, to go after the Soviet submarines hiding under the ice, he said. If—"as we expect"—there are Soviet naval forces in that part of the world, "we better know how to fight in that region. It's a very new and complex concept [especially during the Arctic winter] when the ice cap gets very thick and there is little separation between the ice and the ocean bottom."

From the submariner's point of view, under-ice operations hinge on such questions as, "Where is the ice above you and the floor below you? Am I moving into the valley of death by entering a canyon that I can't get out of? Do you have too much ice above you and not enough buoyancy in the submarine to break through?" It's a tough, noisy environment because of the drifting ice floes and varying ice thicknesses.

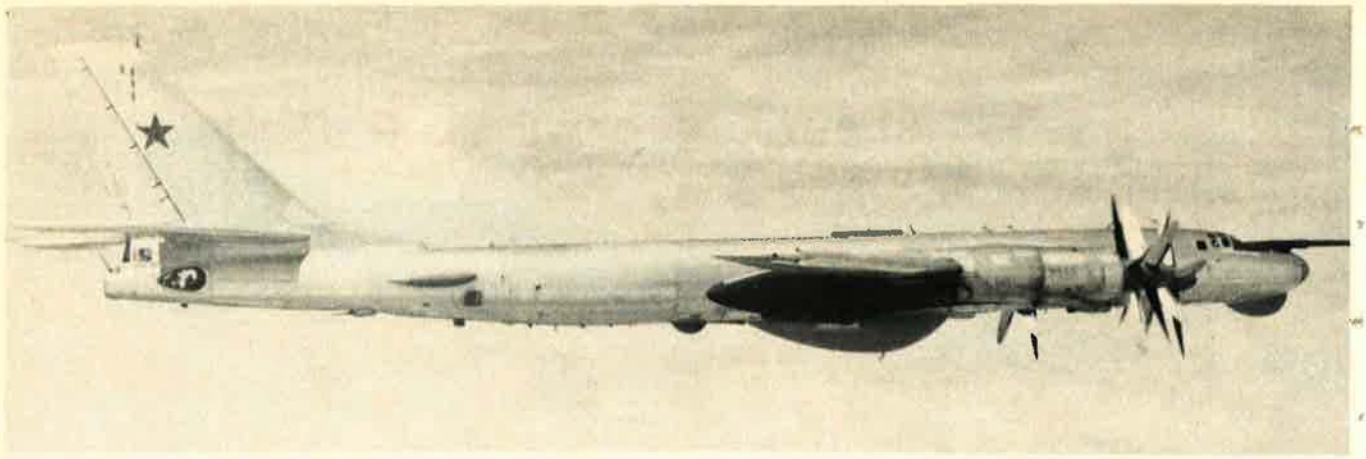
These lurking dangers notwithstanding, the US Navy is putting increased emphasis on under-ice operations, including extensive under-ice exercises by submarines from both the Pacific and Atlantic Fleets that "marry up at the North Pole," according to the Chief of Naval Operations. Although the Navy has "known how to work under the ice for years," there remain some questions about modifying the software of the computers aboard the submarines for such operations as well as to the effects of this unique environment on weapons performance, especially torpedoes, he said.

The US, over the past thirty years, has carried out extensive oceanographic research in the polar region with the result that "we really have very good information about the ice, its movement, and its characteristics. . . . We are quite confident that we can navigate up there [except for] that time of year when the ice depth comes down and squashes the distance between the bottom of the ice and the floor under" the submarine. All the SSN-688s now coming off the line are equipped with the special hardpoints—using high-strength steels—on their sailplanes needed to push through the ice cover, according to Admiral Watkins. There are also tentative plans to retrofit older SSN-688 attack submarines with hardpoints of this type.

Soviet Submarine Technology

Even though the Chief of Naval Operations was bullish about the US Navy's continuing ability to best Soviet forces in all aspects of submarine warfare—from assured survivability of US SSBNs to denial of that survivability to Soviet SSBNs—he pointed out that there are aspects of the Soviet submarine program that "we need to worry about." For one, he warned, "the new Soviet submarines are much quieter" than the previous designs, with the result that the oceans are getting to be "more opaque [because] they are learning how to hide in them much as we have learned" to do.

The US Navy, therefore, considers it imperative to begin development of a new, improved SSN attack submarine that "will take us well beyond the turn of the century and keep our lead over the Soviet Union" in submarine technology, Admiral Watkins, a former sub-



The F version of the Tu-95 Bear strategic bomber serves in an ASW role. Some of these bombers are based in Cuba and threaten US submarines stationed at King's Bay, Ga.

marine skipper, explained. The new design will be faster, dive deeper, carry about twice the amount of weapons of the SSN-688, and "take advantage of all the modern technology [especially in the sensor field] to permit us to stay inside the Soviet acoustical envelope while he can't get inside of ours," he pointed out.

While the *Los Angeles*-class attack submarines, the SSN-688s, provide these capabilities against currently operational Soviet naval systems, the scope and rate of that country's modernization program are "working against us. We are talking about a submarine that [won't enter our inventory] until 1996." If the US vacillates in developing and deploying an advanced technology killer submarine, the Chief of Naval Operations said, the country might lose this pivotal element of "sea-control superiority that we have over the Soviets."

The proposed new SSN program—which the Navy plans to start in next year's budget request—envisions a design with a submerged displacement in the 7,000- to 10,000-ton range that can launch a variety of cruise missiles from its torpedo tubes. The new SSN also will be able to launch the Harpoon antiship missile from a submerged position, as well as advanced technology torpedoes and a variety of deception devices, according to Admiral Watkins.

Follow-on to the Trident

While the Chief of Naval Operations stressed the importance of modernizing the SSBN force by expeditious deployment of the new Trident submarines, along with their C-4 and eventually D-5 SLBMs, he assigned a low priority to the development of a new small SSBN recommended by the President's Commission on Strategic Forces, the so-called Scowcroft Report.

That report, which was endorsed and presented without change to Congress by the President as his official recommendation, called for the start of a research program "now on smaller ballistic-missile carrying submarines, each carrying fewer missiles than the Trident, as a potential follow-on to the Trident submarine forces. The objective of such research should be to design a submarine and missile system that would, as much as possible, reduce the value of each platform and also present radically different problems to a Soviet attacker than does the Trident submarine force."

A primary motive for the development of such a submarine, the report argued, is that a force consisting of a relatively few large submarines, each carrying on the order of 200 warheads, tempts Soviet ASW forces with a small number of extremely lucrative targets. Agreeing in principle with the Presidential Commission's recommendation that the Navy ought to hedge against technological breakthroughs in Soviet ASW, Admiral Watkins said the reality of the situation is that "we have spent hundreds of millions of dollars to validate the survivability of our force for many years to come. There is nothing on the docket that would indicate that we have less than nearly a 100 percent survivability for the SSBN force until the turn of the century." He therefore recommended against major investments in the development of a smaller SSBN—accommodating perhaps four SLBM launch tubes compared to the Trident's twenty-four—at this time: "We don't have enough resources to do everything, and my feeling is that . . . with small amounts of R&D trickling into [such a] concept, we can be ready if that in fact is the way to break out in an ASW context."

Increasing Soviet emphasis on cruise missile-launching submarines is probably an attempt on their part to counter US deployment of SLCMs (sea-launched Tomahawk cruise missiles), according to Admiral Watkins. While the Soviets were ahead of this country for several years in the operational deployment of such weapons, the US Navy managed to leapfrog the Soviets by fielding technologically advanced SLCMs.

The Soviets, however, have fielded their first *Oscar* SSGN. With a displacement of about 14,000 tons, it is the world's largest submarine and accommodates twenty-four nuclear-armed cruise missiles. At the same time, the Soviet Union is converting some older *Yankee*-class SSBNs to SSGN cruise missile launchers. A new Soviet SLCM, the SS-NX-21 that is compatible with submarine torpedo tubes and that has a range of about 3,000 kilometers, is about to enter the operational inventory. The conversion of *Yankee*-class submarines, Admiral Watkins suggested, represents probably a quick-fix solution on the part of the Soviets because these "submarines are very noisy. I just don't believe that they will want to [put] all their eggs in one basket because they would be easy prey for us."

The Navy, he said, has put three submarines equipped with Tomahawk SLCMs into operation so far, and more

are coming on line. In addition, Tomahawk cruise missiles are also being deployed on other vessels, including the recommissioned battleship *New Jersey*. In addition, SLCMs will be used by other surface ships in armored box launchers as well as in vertical launch systems that make it possible to fire a number of cruise missiles virtually simultaneously.

Recent incidents off the Swedish coast suggesting the presence of Soviet remote-controlled deep-submergence vehicles militate for slight shifts in emphasis on the part of the US Navy's ASW operations, Admiral Watkins acknowledged. "We are reemphasizing the other assets of ASW which have declined over the past twenty years [such as] active sonar and active approaches to underwater acoustics" that are most effective in shallow waters. The "beauty" of the US ASW system, he stressed, is the synergism of a variety of forces and capabilities arrayed in a "defense-in-depth fashion."

The outer zone of the Navy's layered ASW strategy is positioned in forward areas and barriers and involves long-range, land-based P-3 patrol aircraft and attack submarines supported by undersea surveillance systems. Attack submarines operating in concert with carrier battle groups, carrier-based S-3 aircraft, and surface combatants equipped with towed-array passive sonar systems and LAMPS helicopters form a middle zone of ASW protection. Finally, an inner defensive zone is provided by hull-mounted active sonars and by carrier-based helicopters. A variety of weapons, from advanced technology torpedoes that can hunt their quarry in high-sea states, under ice, and in the presence of intensive countermeasures, to long-range antisubmarine rockets provide the actual kill mechanism for the layered ASW system.

ASW Surveillance Capabilities

ASW surveillance capabilities include fixed undersea surveillance networks. This sensor network is vulnerable, however, and as Admiral Watkins put it, "We know the Soviets have targeted it and will try to put it out of commission early" in case of conflict. For that reason, the Navy is developing a new mobile surveillance system, the TAGOS Surveillance Towed-Array Sonar System (SURTASS) that complements the fixed system and provides the necessary flexibility to respond to changes in Soviet submarine deployment patterns and to extend coverage to remote ocean areas not presently monitored by fixed systems.

The Soviets have added a new nuclear-powered cruise-missile Oscar-class attack submarine to their modern fleet in an attempt to counter US deployment of the Tomahawk sea-launched cruise missile.

Adm. James D. Watkins, Chief of Naval Operations, believes the Navy is the nation's escalatory control agent and, with the Marines, is the prime deterrent force in peacetime. Naval forces "offer a unique means to influence or even prevent conflict—especially in areas where access is precluded or restricted in peacetime . . ." he said.

Yet another new ASW surveillance system, the Rapidly Deployable Surveillance System (RDSS), is under development. RDSS will be dropped from aircraft to provide undersea surveillance as needed to augment or replace other sensors in rapid fashion.

Because the Navy takes ASW surveillance data from such a broad range of sensors and shapes them into an integrated intelligence product, "we are able to track the Soviet submarines in a far more effective fashion than they can ours," according to Admiral Watkins. As a result, he suggested, the Soviets are more concerned about their SSBN force than any of their other forces at sea. While he described the Soviet SSBN force as cautious and generally inclined to "keep out of our lair," he said that Moscow is displaying new boldness by encroaching incrementally on the US Navy in its own backyard.

Pointing out that the Soviets are now operating Tu-95Fs—an ASW version of the strategic Bear bomber—out of Cuba on a regular basis, he suggested that "we are in a new ball game with them [now stationed just] a few hundred miles from King's Bay, Ga.," a major US submarine base. The Soviets, he said, are moving in on US bases "little by little, adding submarines, adding [Tu-95Fs], adding 63,000 tons of weaponry in 1981 and 68,000 tons in 1982. So it's a new ball game and we are very concerned."

Carriers No "Sitting Ducks"?

President Reagan termed US maritime superiority a national necessity last year, explaining that "we must be able in time of emergency to venture in harm's way, controlling air, surface, and subsurface areas to assure access to all the oceans of the world. Failure to do so will leave the credibility of our conventional defense forces in doubt." This rationale underlies the Administration's commitment to "building a 600-ship fleet including fifteen carrier battle groups," he explained at the recommissioning of the USS *New Jersey*.

Achievement of this goal, according to Admiral Watkins, requires a "combined arms" approach that

depends on the contributions of other US air and land assets and allied forces. As he explained, "Air Force capabilities in warning, surveillance and targeting, command and control, electronic warfare, and in-flight refueling will contribute to our overall capacity to wage war at and from the sea. We also depend on contributions from our allies, such as their 140-plus diesel submarines which are well-versed in their local waters and best employed in executing special missions in those areas."

The US Navy, the Chief of Naval Operations said, thinks of itself as "the escalatory control agent for the country. We are the prime element of deterrence, along with the Marines, in peacetime." He defined the latter term as including various crisis buildup phases. Naval forces, according to Admiral Watkins, "offer a unique means to influence or even prevent conflict—especially in areas where access is precluded or restricted in peacetime—because of their ability to deploy rapidly with logistics support independent of extensive foreign basing or overflight rights." He argued that "carrier battle groups supported by attack submarines, land-based aviation, and surveillance assets possess the combat capability necessary to operate successfully, even in high-threat areas."

The key to prevailing against the principal adversary, the Soviet Navy, according to the CNO, is "to fight more intelligently and effectively. We must not only plan to defeat his forces, but also to defeat his strategy and his will to resist. The Naval War College is being revitalized as a crucible for strategic and tactical thinking to ensure that we will be able to 'fight smart' if war comes.

"Our efforts in this area include developing a better understanding of Soviet thought processes and inherent strengths and weaknesses in order to counter and exploit them. We are now rotating some of our most highly qualified officers to the War College immediately after they complete assignments as commanding officers of our operational ships and aircraft squadrons. Exposure of our finest, tactically proven professionals to strategic thinking at the Naval War College should prove a superb opportunity to test the tactical and strategic thinking over a wide variety of applications.

"One clear payoff will be a cadre of tactically and strategically sound thinking commanders ready to move into key assignments ashore and subsequently at sea in more senior battle force roles. Moreover, by so doing, we will force more effective coupling between National Security, Defense, Unified Commanders, Service, Inter-Service, Allied, and US Naval Commander at-sea strategies and implementing plans so that we can be confident we are optimizing the powerful potential of combined arms. All of our major future war games will be played from a combined arms point of view, avoiding the pitfalls of parochial, Navy-only wargaming, which can be misleading and unrealistic."

How Flex Ops Works

The Navy responded recently to the growing Soviet threat with a concept that is centered on the forward deployment of carrier battle groups and that is known as Flexible Operations, or Flex Ops. The new schedule maintains the carrier battle group presence at previous levels in the Mediterranean and the Pacific theaters while reducing presence in the Indian Ocean from an average of one and one-half carrier battle groups to one continuously deployed group. This adjustment provides the opportunities for worldwide battle group training involving two or more carriers and for increased operations in areas where carriers have seldom operated in the past, such as the Caribbean, the Sea of Japan, and the Northwest Pacific.

The Navy believes that the flex-ops schedule reduces the predictability of its carrier deployments and provides the flexibility to increase presence in areas of potential crises. Admiral Watkins graphically termed this strategy as one of "bobbing and weaving, so that we have a Navy that is moving around the world eight out of thirteen battle groups at a given time."

In case of war in Europe, Admiral Watkins explained that the Navy's principal task would be to maintain the sea lines of communications so "that we can support our forces and allies in Central Europe—that's our key role and our key task at sea is ASW and antiair warfare. These are big tasks and we don't have land-based air that covers everything. We work very closely, therefore, with the Air Force. For instance, in Iceland, it's AWACS aircraft, it's carrier air, and it's land-based air, all working together to assure that we hold that important strategic jewel in the Atlantic."

The global responsibilities of the US Navy require a minimum of fifteen carrier battle groups and four surface action groups centered on recommissioned battleships, according to Admiral Watkins. In turn, these forces, in combination with about 100 attack submarines, the Trident and Poseidon SSBNs, 110 escort ships, and essential sealift ships, create the need for the "600-ship Navy," the CNO stressed. The Navy's inventory at present is 512 ships and thirteen carrier battle groups, including four nuclear-powered carriers.

Need to Beef Up the Pacific Fleet

Among the areas that urgently require beefing up is the Pacific off the Western Aleutians, Admiral Watkins stressed: "We simply don't have [adequate] defenses of the Western United States in that region unless we can bring Naval forces to bear. That's why we just operated up there with three battle groups along with some thirty Air Force aircraft [including F-15s, KC-10 tankers, and AWACS] and US Coast Guard and Canadian forces to demonstrate that we are serious" about the defense of North America.

Clearly one of the most contentious issues facing the Navy is the possibility that its expensive, highly visible carriers might be turned into sitting ducks in case of global conflict. Admiral Watkins rejected the "simplicity of this argument. We know how to deal with the Soviets, how to use deception, how to use our forward-based [and] overhead intelligence. We know how to position our forces [and, therefore,] feel we won't be sitting ducks."

The National Academy of Sciences' National Research Council, he said, recently completed an exhaustive study of "The Implications of Advancing Technology for Naval Aviation" that concluded that "the carrier is viable past the turn of the century." Specifically, the Council found that "the large aircraft carrier, and particularly the nuclear-powered aircraft carrier with its air

group, will continue to be the Navy's most versatile and powerful surface warfare force element. The large aircraft carrier provides economy of scale, employs enough aircraft for sustained strike operations, and considerably enhances safety of operation for high-performance aircraft.

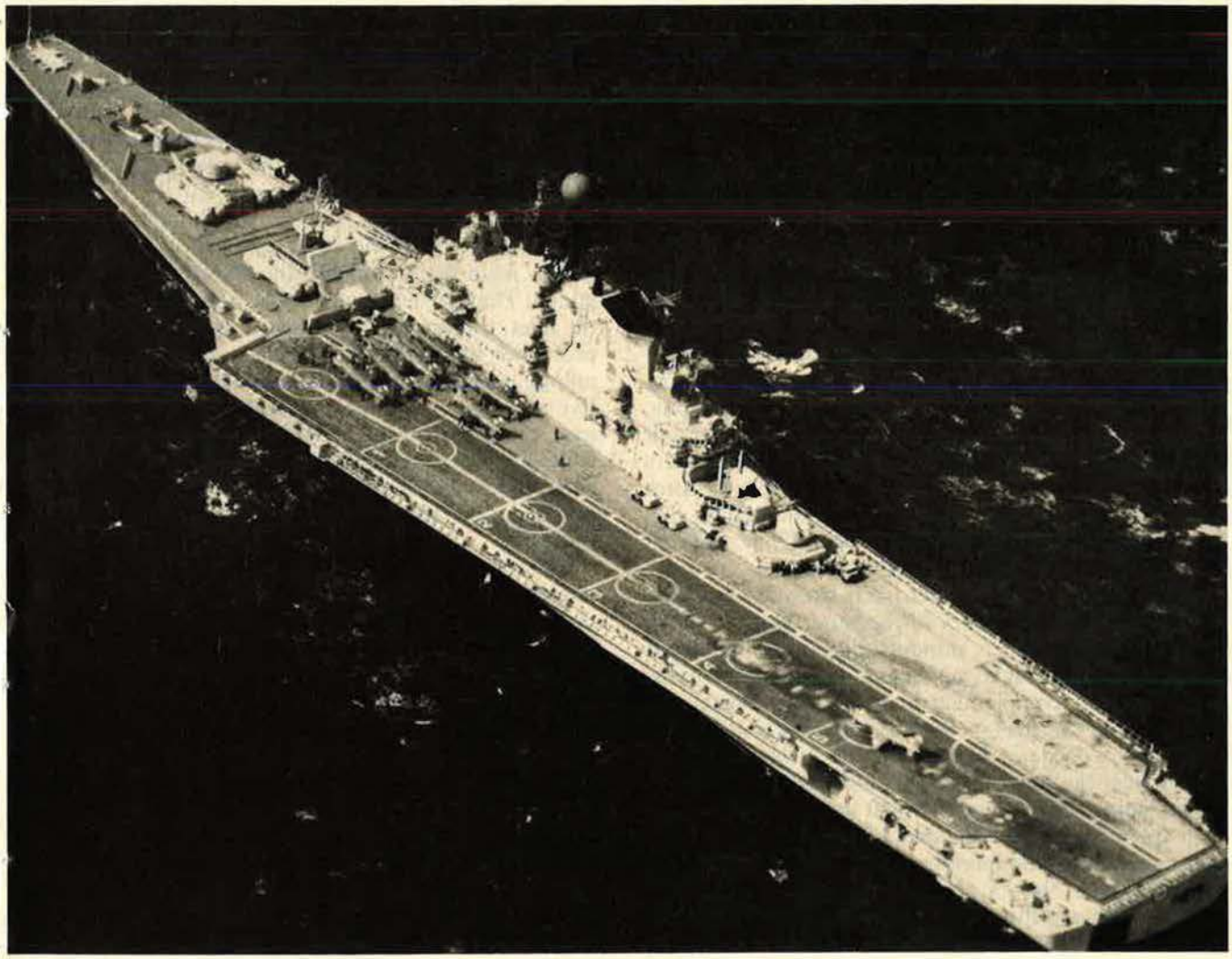
"Evolving technologies will lead to changes in embarked aircraft, weapons, distribution of functions, and particularly command control and communications (C^3) capabilities. However, it would be difficult to suggest a more apt system with refuel, refurbish, rearm, and damage control for the same number of aircraft and to achieve the same responsiveness and time on station. The battle group centered on the large carrier will have greatest leverage for conventional limited wars, including the leading edge of threat scenarios with the Soviet Union."

The Need for Change

The study did foresee some problems and the need for change, however. Out of the approximately seventy aircraft aboard the average carrier, only half, between thirty and forty, are available for offensive operations while the rest are needed for defensive missions. The offensively employed aircraft "can do little damage to the opposing target complex unless they revisit it many times, with cumulative attrition that could be fatal in the case of adequate enemy defenses. In present circumstances, the carrier is therefore at risk for periods that are too long, the attack aircraft are likely to be lost to target-area defenses before their mission is completed, and the political consequences of long war and collateral nontactical damage are likely to be severe," according to the National Research Council's Naval Studies Board.

As the Soviet threat impels major growth in both ASW and air defenses, the offensive power of the carrier's aviation assets plummets. As the study points out, "This is even more dramatic if the cost of accompanying defensive ships is included. The growth of land-based and shipboard defenses at and around targets has further diminished the capability of the offensive airpower that remains on the carrier."

The Naval Studies Board suggested two remedies for these adverse trends, "off-loading defensive 'overhead' from the carrier to increase the size of its offensive air arm, and . . . increasing the offensive power of that air arm." In the first instance, the study foresaw the potential for major relief in the form of technologically advanced combat ships. These ships, the Board predicted, "would be primarily missile carriers that can keep up



The **Kiev**, *pictured above with Forger fighter-bombers on deck, is the lead ship of the* **Kiev**-*class guided missile V/STOL aircraft carriers. A fourth* **Kiev**-*class carrier is expected to join the fleet in 1984.*

with the big decks in heavy seas—an essential requirement if the carrier battle group is to survive high-speed transit while under attack. Some of these ships could be air-capable to launch sensor-carrying aircraft for target localization and forward control of long-range missiles.

"New ship design concepts, particularly SWATH [Small Waterplane Twin Hull], can provide this capability. Similarly, ship concepts such as the improved high length-to-beam ratio SES [surface effect ship] will be able to provide fast-deployment, air-capable amphibious assault and combat air support more effectively than current conventional designs."

By basing V/STOL aircraft aboard combat ships of either the SWATH or SES type, the Navy could enhance the offensive power of large aircraft carriers by reducing the traffic demands of support aircraft on their limited deck space, according to the Naval Studies Board.

The study dealt rather gingerly with the potential long-term impact of highly accurate cruise missiles and conventionally armed ballistic missiles on the naval forces of the future, referring to them elliptically as the "main agents" of change.

The Navy and Stealth Technology

Another area of major concern for the Navy, especially so far as its aircraft carriers are concerned, is Stealth technology, in particular the prospect of a "full Stealth environment." The Navy, he explained, has elicited advice on how to deal with this new technology from a number of prominent scientists and other experts, and is on the road to meeting this challenge.

On balance, he was sanguine that the "defense-in-depth" approach of the Navy's carrier battle groups will work even in a stressed environment. The concept involves three concentric defense zones consisting of an outer zone, a surface-to-air missile (SAM) zone, and a point defense zone. The Navy's current Five-Year Plan calls for significant boosts in defense-in-depth capabilities across the board.

The outer defensive ring will be made up of carrier-based E-2C early warning aircraft, fighter interceptors of the F-4, F-14, and F-18 type, and EA-6B electronic warfare aircraft. The SAM zone is formed by the antiair warfare ships, which include the new CG-47 cruisers and DDG-51 destroyers. Finally, point defense is provided by short-range SAMs, such as the NATO Sea Sparrow, antiaircraft guns of the Vulcan Phalanx type, and electronic warfare and decoy systems.

Understandably, Navy doctrine is skewed toward intercepting enemy bombers in the outer defense zone, before they can launch standoff missiles. This means enough early warning to get a large portion of the battle group's fighter complement in position to engage the bombers. For this reason, the Navy's Integrated Tactical Surveillance System (ITSS) is to be augmented by a tactical over-the-horizon (OTH) radar capable of detecting intruding aircraft up to 1,800 nautical miles away from their base sites. Related C^3I (command control communications and intelligence) improvements are to strengthen the Navy's ability to deploy carrier-based aircraft in time to thwart the launch of standoff missiles by attacking bomber forces.

One of the most critical naval air defense weapons is the new Aegis area defense missile system, which has a range of about ninety miles. Although not designed to intercept Soviet Backfire bombers before they can launch their 200-mile standoff missiles, Aegis, used in concert with effective jamming and deception techniques, can prevent these bombers from launching standoff missiles, according to Admiral Watkins. In a recent series of fourteen Aegis test shots, the system brought down incoming missiles in thirteen instances, he said, adding that the intercepts ranged from targets traveling as fast as Mach 2.5 and as high as 75,000 feet to as slow as Mach 0.9 and as low as forty feet off the water.

While the Navy lacks targets that can simulate supersonic sea-skimming missiles, extrapolation of data from the recent Aegis test shots suggest that the system is capable of coping with such threats. Aegis, he said, "is the finest system the Navy has ever [fielded] to bring down either aircraft or missiles," including salvos of small-radar-cross-section missiles. Whether or not Aegis in its present configuration will be effective against "stealthy" missiles is not yet clear, "but we are working the problem," Admiral Watkins said.

A Carrier Battle Force Scenario

The pivot of the Navy's efforts to prevent its carriers from becoming sitting ducks in case of war with the Soviet Union is how they will be deployed.

In the CNO's view, this country's SSN attack submarines would be assigned the brunt of the offensive naval mission. The performance of that force would determine this country's ability to control the seas in a protracted war, he suggested. Key here, of course, would be the ability of the US SSNs to hunt down and kill the Soviet SSBNs under the polar ice or in any of their other bastions—the Bering Sea, the Norwegian Sea, the Sea of Japan, the Sea of Okhotsk, the White Sea, or wherever—the CNO asserted.

Two main factors qualify the SSNs for this task, he added: They are least vulnerable, among all elements of the fleet, to the land-based Soviet air forces that will be protecting the SSBNs and, because US submarine technology is ahead of that of the Soviet Union by between five and eight years, they enjoy an intrinsic advantage over their quarry, the Soviet SSBNs. As a result, the CNO said, "I expect that the SSNs would be employed early on [in case of war with the Soviet Union] to stir the pot and take the focus off other elements of naval power."

The carriers, on the other hand, would probably be moved to areas "where they can maintain air superiority, coupled with our Air Force counterparts, [in such places as] Iceland, the Azores, and the like. I would expect them to move to the Mediterranean to the extent they are needed there for sea control and to project [power] to shore because we have inadequate air support in the Southern Region of NATO." He suggested that it probably would be unwise to move as many as four carriers into the Mediterranean immediately, even though their offensive air capabilities would be needed in the region; a better way would be to keep "two carriers in the western Mediterranean until we know what we can do against the Soviet air coming out of the Crimea."

On balance, he concluded, "we are comfortable with our maritime strategy. We know it works." ■

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Miracle at U-Tapao

Logic said no one could be alive in the B-52, but something drew Capt. Brent Diefenbach to the blazing bomber.

BY JOHN L. FRISBEE

LINEBACKER II, the eleven-day bombing campaign of December 1972 that persuaded North Vietnam to sign a cease-fire, had been halted on Christmas Day. Now it was the night of December 26 and the operation was on again. The B-52 with Lt. Robert Hymel as copilot was assigned a target near Hanoi. Everyone knew the North Vietnamese had used the bombing break to restock and repair their surface-to-air missile (SAM) sites. It was going to be a rough night.

As Hymel's B-52 dropped its bombs and turned off target, the rear gunner called two SAMs coming up. Despite evasive action by the B-52, the missiles exploded just to the right of the bomber, wounding the gunner, knocking out two engines, and causing major fuel leaks and other undetermined damage. The aircraft commander headed for an emergency landing at Da Nang, then decided that, with several refuelings, they could make it back to their base at U-Tapao, in Thailand. The wounded gunner would have better medical treatment there.

Shortly after midnight, the BUFF started a straight-in approach to the Thai base. Capt. Brent Diefenbach, a B-52 aircraft commander who had just returned from a mission in the North, sat in a crew bus, waiting to cross the end of the runway as Hymel's battle-damaged bomber neared the runway lights. The approach didn't look or sound right. Suddenly, the aircraft veered to the left and the engines roared as power was added for a go-around. Diefenbach watched, horrified, as the big bomber pitched up, plunged to earth about a mile beyond the runway, and exploded in a ball of fire.

Diefenbach later remembered the compulsive thought that he had to get to the crash site. "It appeared obvious to me that no one was alive, but something kept drawing me to go." He knew he had to get there fast. Jumping off the bus, he went out an entrance gate and climbed aboard a Thai bus that was headed in the direction of the crash. When the driver refused to go farther, Diefenbach ran down the road toward the burning B-52 until he spotted a path in the tall grass that seemed to lead to the aircraft.

"For a second," Diefenbach recalled, "I thought, 'Why go on? No one is alive in that inferno.'" But again he felt impelled, almost against his will. He approached the wreckage, shouting to see if anyone was alive. To his surprise, he heard a voice inside the bomber calling for help. Rolling down the sleeves of his flight suit for protection against the heat, he entered the burning plane amidst a fusillade of exploding ammunition and pressure lines. There was no way of knowing if bombs were still aboard.

—Illustration by Jack Pardue

"For a second I thought, 'Why go on? No one is alive in that inferno.' "

Diefenbach followed the cries—the only sign of life—through a pall of smoke to find copilot Hymel, badly injured, crumpled in a position that prevented him from unbuckling his seat harness, and with one fractured leg trapped in the wreckage. Diefenbach remembers accusing Hymel of not helping and of falling asleep —"anything to keep him conscious." In desperation, Hymel told his rescuer to cut off the leg if he had to. Finally, working together for what seemed an eternity, they were able to free the injured man. "By that time, the explosions [and] the heat were nearer than I care to think about."

Diefenbach dragged Hymel out of the fuselage and carried him away from the blazing wreck just as a helicopter and fire trucks arrived. The rescue crew was unable to approach the B-52, now engulfed in flames.

Lieutenant Hymel was air-evacuated to Clark Air Base in the Philippines, then to a hospital in the States where he eventually recovered from multiple fractures and lacerations.

After Diefenbach had reported details of the rescue to the wing commander and his staff, he was taken to the base hospital "for some minor repairs and bandages." Some time later, he discovered there were "a lot of thank you's in order for the Chief Pilot in the Sky." He had extricated the copilot from an armed ejection seat. That it had not fired in the struggle to free Hymel was a miracle within a miraculous and heroic rescue, for which the Commander in Chief of Strategic Air Command, Gen. John C. Meyer, presented Capt. Brent Diefenbach the Airman's Medal. ■

AIRMAN'S BOOKSHELF

Island Power in the Caribbean

The Cuban Threat, by Carla Anne Robbins. McGraw-Hill, New York, N. Y., 1983. 351 pages with index, notes, and photographs. $17.95.

Since Fidel Castro came to power and established a Communist government in Cuba some two decades ago, the "Cuban threat" has been a major concern of US policymakers. But, according to Carla Robbins, that concern and the policy resulting from it have often been flawed by prejudice and hostility, and by the failure of Americans to understand Cuban objectives and policies.

This book attempts to explain the foreign policies of Castro's Cuba. It also seeks to identify some of the myths and assumptions that have influenced American policy toward Cuba, and to suggest policy alternatives for the future.

Robbins traces the evolution of Cuban foreign policy from Castro's attempts to export revolution to other Latin American states during the 1960s, through the resulting Cuban isolation and frustration of the 1970s, and, finally, to the far-ranging activities of thousands of Cuban troops and civilian advisors in Africa and the Caribbean in the 1980s. She shows that the Cubans have learned from both failure and success, and that their foreign policy has moved from reckless adventurism to careful pragmatism.

While Cuba remains committed to armed struggle against the existing economic and social order, Cuban policy has been moderated by US hostility, Soviet restraint, and Third World suspicion.

Hostility between Cuba and the United States came easily for both nations: Cuban nationalism resented the long history of US intervention in Cuban affairs, and the US was incensed at Cuba's drift toward communism, which was seen as a breach of the Monroe Doctrine. The Bay of Pigs invasion, the October 1962 missile crisis, and US-sponsored economic and political isolation of Cuba followed.

Robbins traces the growth of this hostility and claims that, despite hostility, a break in US-Cuban relations was not "inevitable." She argues that irrational obsession on both sides obstructed accommodation.

In contrast to the growth of US-Cuban hostility, the alliance between Cuba and the Soviet Union was a less-likely development. The Soviets were surprised by the Cuban revolution, viewed the Caribbean as a US sphere of influence, and initially suspected that Soviet support of Cuba might alienate other Latin American states and provoke US military intervention.

Robbins believes that Castro's 1961 public avowal of socialism was intended to force the Soviet Union to support the Cuban revolution openly or risk charges of ideological hypocrisy from China and the Third World.

This strategy worked, and by 1962 Moscow had committed itself fully to the defense of Cuba, and had preparations under way for the deployment of offensive Soviet missiles on the island. But relations between these two socialist states were frequently strained: The Cubans were resentful and uneasy about being excluded from the US-Soviet negotiations to resolve the missile crisis; and the Soviets felt compelled to use economic blackmail to restrain risky Cuban policies that threatened to embroil the superpowers in conflict.

Castro sought to maintain some independence from the Soviets—while continuing to enjoy their military protection—through an active role in the Nonaligned Movement. In Robbins's view, this Cuban strategy helps explain Castro's initial commitment of troops and advisors in Africa.

Carla Robbins's analysis of relationships between Cuba and its friends and enemies is an important and useful book for anyone who seeks a better understanding of US policy options in the Third World in general, or the Caribbean in particular. Her most valuable contribution is a convincing description of the myths that haunt US policy toward Cuba:

That Cuba is a Soviet pawn; that Cubans are everywhere; that Cubans are always subversive; that Cubans always win; that Cubans are international outlaws; that everyone agrees with the US view of Cuba.

While debunking these myths, Robbins remains objective. She concludes that "the real Cuban threat may be the reaction that forces the United States into untenable alliances with right-wing regimes, involves the United States in unpopular and often illegal overseas entanglements, alienates many of its citizens, and undercuts its prestige and influence abroad.

"The real Cuban threat," says Robbins, "may well come from within the United States." That thesis clearly deserves thoughtful consideration, even if it is rejected.

—Reviewed by Lt. Col. Drue L. DeBerry, USAF, currently a Senior Fellow with the Atlantic Council.

A Time to Die

The Sacred Warriors, by Dennis and Peggy Warner with Cmdr. Sadao Seno, JMSDF (Ret.). Van Nostrand Reinhold Co., New York, N. Y., 1982. 370 pages with index, maps, and photographs. $24.95.

Nearly three years after its overwhelmingly successful attack on Pearl Harbor in 1941, Japan's military fortunes had reversed and it faced imminent invasion of the home islands.

In a desperate move to stave off defeat, the Japanese organized a kamikaze Special Attack Corps—the "Divine Wind"—of aircraft on suicidal missions against Allied ships.

Through interviews with those who launched the kamikaze attacks and those who survived them, the authors explore the motivation that impelled the Japanese to take such a drastic measure and the Allied reaction to it.

The Allies had been warned that the special attack force had been created, but as US Navy Adm. William "Bull" Halsey later noted, "I think that most

of us took it as sort of a token terror, a tissue-paper dragon." That paper dragon, according to the authors, sank at least fifty-seven ships, with another eighty-five suffering either serious structural damage or heavy casualties. An additional 220 ships were afflicted with minor damage. During the aerial siege, the US lost 12,000 men killed and 36,400 wounded.

On July 29, 1945, the US destroyer *Callaghan,* which had survived twelve previous kamikaze attacks, was the last ship to be sunk. Japan had sacrificed 3,900 pilots in the attacks, some as young as seventeen years of age.

The Divine Wind—named for the typhoon that destroyed a Mongol invasion fleet that threatened Japan in the thirteenth century—while a desperate move was no mere whim of the Japanese. For centuries, Japanese youth had been instilled with the belief that death was a privileged way of serving the Emperor, who was indeed a "divine" being. Surrender in battle was a disgrace to one's self and to one's ancestors.

In militaristic Japan, up to the conclusion of the war these aspects of the samurai code applied even to the civilian population. On the island of Saipan, as one example, this—along with fear of their fate in enemy hands—resulted in the suicides of thousands of men, women, and children to forestall capture by advancing American troops.

For the Allies at sea, the prospect of kamikaze aircraft in suicidal encounters with ships shattered morale and shook the resolution of antiaircraft gunners. The Japanese pilots—there was no need for parachutes—were ordered to aim for the weakest part of the ship. Unless stopped by antiaircraft or combat air patrols, the kamikazes were certain to inflict heavy damage.

It was a savage war, and American troops were not above reproach. In one grisly passage, the authors relate how bones and other parts of Japanese bodies were sent home as souvenirs.

At the time of the kamikaze campaign, Dennis Warner was an Australian war correspondent aboard a ship that withstood two attacks. He and his wife are the coauthors of several books on Japan. Sadao Seno commanded a midget submarine in the closing months of the war and later became a war historian.

"Americans who fight to live find it hard to realize that another people will fight to die," commented Admiral Halsey—a sentiment few Americans will dispute. *The Sacred Warriors* puts the Japanese will toward self-destruction—so difficult to understand even decades after the war—into perspective.

—Reviewed by Capt. Michael B. Perini, USAF, Contributing Editor.

New Books in Brief

The Air Guard, by René J. Francillon. This information-packed history of the Air National Guard—"the world's fifth largest air force"—should prove a welcome addition to any airman's bookshelf. The text is organized in three parts. Part I covers general ANG history, Part II deals with each individual flying unit of the ANG, and Part III catalogs all the aircraft ever flown by the Air Guard. The book is copiously illustrated with drawings and hundreds of photographs. In addition, there is an extensive list of tables, providing information ranging from an accounting of pre-WW II Guard observation squadrons by date of activation to a chart giving aircraft specifications for current active ANG mission aircraft. With bibliography, footnotes, and index. Distributed by Motorbooks International; available from Aerofax, Inc., P. O. Box 5337, Austin, Tex. 78763, 1983. 180 pages. $24.95.

The Long Campaign: The History of the 15th Fighter Group in World War II, by John W. Lambert. The 15th Fighter Group—which saw action on both the first and last days of World War II—served honorably and valiantly in battles with the Japanese at Pearl Harbor, Iwo Jima, and above the Japanese home islands. When not engaged with the enemy, the group saw duty as a replacement training unit and provided air defense for the Hawaiian Islands. The author, relying on official records and interviews with veterans of the 15th Fighter Group, has produced a detailed but highly readable account of the wartime activities of the unit. With illustrations, maps, glossary, appendices, and bibliography. Available from Sunflower University Press, 1531 Yuma, Box 1009, Manhattan, Kan. 66502, 1982. 186 pages. $35.

Shooting Star, T-Bird and Starfire: A Famous Lockheed Family, by Lt. Col. Rhodes Arnold, USAF (Ret.). Colonel Arnold has leavened the discipline of the historian with the enthusiasm of the true *aficionado* in producing this general history of the US's first operational jet fighter—the F-80 Shooting Star. In addition to the more than 100 illustrations that accompany the text, the author has assembled ten appendices that provide supplementary information on Star aircraft, including a chronology of the Star family, listings of foreign and civilian models, a survey of preserved Stars, a serial number listing, and more. Also featured is a section by five Star pilots who relate personal experiences with the F-80 and who compare it with other aircraft they have flown. With bibliography and index. AZTEX Corp., P. O. Box 50046, Tucson, Ariz. 85703, 1982. 144 pages. $12.95.

UFOs: The Public Deceived, by Philip J. Klass. Despite the lack of a single shred of hard evidence to confirm the existence of UFOs, a majority of Americans say they are convinced that flying saucers are real, and many believe that the US government and USAF have confirmed the existence of UFOs but are keeping the information from the public. Author Klass, an editor for *Aviation Week & Space Technology* magazine and a recognized authority on the UFO phenomenon, has written a fascinating account of how this belief has come about because of wishful thinking, credulous "UFOlogists," and outright deceptions by so-called "experts." All those who are convinced of the reality of UFOs would do well to study this straightforward, well-documented work. With appendix and index. Prometheus Books, 700 E. Amherst St., Buffalo, N. Y. 14215, 1983. 310 pages. $17.95.

V-Force: The History of Britain's Airborne Deterrent, by Andrew Brookes. Though Britain's nuclear deterrent force now lurks deep beneath the waves of the world's oceans aboard Polaris submarines, at one time the British relied on their own nuclear "triad"—the V-Force of Valiant, Victor, and Vulcan bombers. In this detailed, scholarly work, author Brookes—a serving RAF officer who saw duty as a V-bomber commander—tells for the first time the story of the "Made in Britain" strategic strike force. (Readers may recall that Vulcan bombers were in the news last year when they were used to bomb the airfield at Port Stanley in the Falklands. Previous plans to mothball the Vulcans have been canceled, giving the venerable aircraft a new lease on life.) With illustrations, select bibliography, and index. A Jane's publication available from Science Books International, Inc., Russia Wharf, 286 Congress St., Boston, Mass. 02210, 1983. 173 pages. $19.95.

—Reviewed by Hugh Winkler, Ass't Managing Editor.

VIEWPOINT

Lessons From Our Heritage

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

USAF's founding fathers knew that winning wars calls for superior numbers—and superior technology.

Now and then it is pleasant to take a backward look. Not, as Satchel Paige put it, to see if anyone is gaining on us, but simply to have a look. Since backward looks tend to become the indulgence of old age and the consequent source of much boredom among the young, the practice should not be overdone. But now and then, as we said, it can be pleasant to look back, even instructive. Besides, almost the entire history of airpower is still within the living memory of some men I was with a short time ago.

It is almost incredible to think that Ira Eaker and Pete Quesada, for instance, were around when the Army Air Corps was just beginning to attract attention. And while they never flew the very first military airplanes, they were intimately associated with those who did. The airplanes of 1920 seem as far removed from the B-1s and F-15s of today as the ships of Admiral Decatur from nuclear carriers. Still, since airpower's history is so compressed, some of those present at the creation are still around, very much a part of the scene.

A few weeks ago the Chief of Staff, General Gabriel, took time out from the Pentagon rat race to host a group of visitors from the Air Force's recent and distant past.

Jimmy Doolittle was there, lively and interested as ever, the same Jimmy Doolittle whose aviation exploits occupy a substantial part of the Smithsonian Air and Space Museum: Doolittle, the daredevil air racer; Dr. Doolittle, the aeronautical engineer; Doolittle, the test pilot and business executive; Doolittle, Tokyo Raider, Medal of Honor recipient, and imaginative leader of the Eighth Air Force. His predecessor in the Eighth, the legendary Ira Eaker, was laid up this year but was only a phone call away.

Eaker's fellow crew member on the *Question Mark,* that historic 1929 experiment in aerial refueling, Elwood "Pete" Quesada, was there. Just seeing him raised memories of the decisive role of the Ninth Air Force in the Normandy invasion. Whatever doubts the ground generals might have harbored about the value of airpower disappeared on D-Day. The great invasion armada, one of the juiciest targets ever, wallowed across the Channel to Normandy without seeing an enemy airplane, nor did the troops ever see many thereafter. A few months before the invasion, Pete Quesada had promised a skeptical Winston Churchill there would be no Luftwaffe in the air on D-Day. It was, we should note, a promise, not a boast.

It is hard to argue against the proposition that the side outnumbered is the underdog. And while superior technology is a great force multiplier, even the best airplanes can only be one place at a time.

The campaign against the Luftwaffe was the carefully planned result of thinking that had begun long before in the Air Corps Tactical School. Back in the twenties, men like Kenney, Chennault, Hansell, Eaker, Andrews, and Spaatz were developing theories about airpower and the essentiality of air superiority. This was original thinking, and it had a great deal to do with the outcome of World War II.

We can be thankful that the Germans, for all their brilliant ground war strategy, had no comparable airpower theoreticians. Although they had superior numbers and excellent airplanes and pilots, they seemingly failed to grasp the essentiality of air superiority. As Quesada points out, if the Luftwaffe had concentrated on the RAF, the Battle of Britain could have gone the other way.

Presumably, everyone now understands the need for air superiority. Enemy air must be dealt with before other tasks, like close support, can be given priority. The only question is how best to gain that superiority. On that matter there appears to be some divergence of opinion—numbers vs. high technology.

As in most such debates, one finds a certain amount of hyperbole. The high-numbers advocates cite dogfight statistics where F-5s have prevailed against F-15s. Apostles of high technology simply point to the recent Israeli-Syrian slaughter where the score was Israel 86, Syria 0. While taking nothing away from the superb Israeli pilots, that one-sided fracas owes a great deal to technology. In particular, command and control plus intelligence—C^3I in the current jargon—gave the Israelis an overpowering edge. Training, motivation, and fine airplanes took care of the rest.

The argument approaches the point of absurdity when the debaters employ a time warp. Two F-16s, for example, could do the job at Schweinfurt, or on the other side of the argument, 500 Messerschmitt Bf 109s would give an F-15 a bad time, if, that is, the F-15 pilot were foolish enough to engage at cannon range.

A brilliant British engineer, Frederick William Lanchester, was interested in a number of things, among them military strategy. He studied various forms of conflict on a mathematical basis, and his conclusions resulted in Lanchester's Law. As a test, he applied the law to the Battle of Trafalgar with the satisfying conclusion that Nelson had intuitively followed the same logic. Briefly, and greatly oversimplified, Lanchester's Law states that the combat effectiveness of a force depends on the quality of the weapon systems multiplied by the square of the size of the force. Numbers, then, in Lanchester's calculations, count for more than technology.

He published his study on aerial warfare in 1916, and wars have become complicated beyond recognition since that time, but it is hard to argue against the proposition that the side outnumbered is the underdog. And while superior technology is a great force multiplier, even the best airplanes can only be one place at a time.

The founding fathers of the Air Force had no doubts. They saw the need for numbers, and they also knew they had to have superior equipment. The airplanes we had at the start of World War II—B-18s, P-36s, P-39s, and P-40s—would not have done the job in any numbers. To pull off air superiority with inferior airplanes, a time warp is necessary. But a handful of P-51s and B-17s—the F-15s and B-1s of their day—would not have done it either. Ira Eaker knew that better than anyone, and so he refused all pressures to use them piecemeal. When the Eighth went deep, it went in numbers. ■

WE'RE GOING SOUTH...FOR GOOD!

CSD has sold its Sunnyvale, California headquarters, and will centralize activities at its 5,200 acre complex, 30 minutes away in South San Jose. Centralization and the investment of $15 million in new construction and improvement of present facilities will make CSD the most modern, efficient and productive *PROPULSION* company in the country. CSD will still be in the Santa Clara (Silicon) Valley, in close proximity to Stanford and the University of California, Berkeley, the cultural centers of the San Francisco Bay Area and the San Francisco and San Jose Airports. We're going south—for good!

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THE BULLETIN BOARD

By James A. McDonnell, Jr., MILITARY RELATIONS EDITOR

Eighth CMSAF Takes Office

CMSgt. Sam E. Parish, who was SAC Senior Enlisted Advisor, was installed on the first of this month as the eighth Chief Master Sergeant of the Air Force. (AIR FORCE Magazine will feature an extended interview with the new CMSAF next month.)

Chief Parish succeeds retiring CMSAF Arthur L. Andrews, who told AIR FORCE Magazine, "It's been a wonderful two years—the very pinnacle of my career. I like to think I left the Air Force a little better than I found it, and I wish the very best of success to Chief Parish. The troops today are good, dedicated people, and I think he's going to find this job the best motivator he's ever had."

Chief Parish was one of three finalists for the senior enlisted post among fourteen top nominees from throughout USAF. A central board at the Air Force Manpower and Personnel Center (AFMPC) had selected Parish, CMSgt. James C. Binnicker, Assistant for Chief Master Sergeant Matters at Hq. AFMPC, Randolph AFB, Tex. (and Chairman of AFA's Enlisted Council), and CMSgt. Earl E. Dorris, Executive Officer with the Defense Communications Agency, Arlington, Va., as the final competitors.

The three contenders—and, in a departure from previous practice, their wives—traveled to Washington, D. C., in June for final evaluation and ultimate selection by Air Force Chief of Staff Gen. Charles A. Gabriel.

The new Chief Master Sergeant of the Air Force is CMSgt. Sam E. Parish.

Official Washington said good-bye to Chief Andrews last month at a sparkling dinner at Bolling AFB. AFA was on hand and presented him a special AFA plaque. Summing up the Association's respect and admiration for the accomplishments of his tenure, it read: "For more than thirty years of exceptional and dedicated service to the nation. His forthright and uncompromising leadership style has indelibly marked his outstanding service to the enlisted men and women of the Air Force as the Senior Non-Commissioned Officer of the entire United States Air Force, 1981–83."

Purple Heart Updating Urged

Sen. John Warner (R-Va.) has officially asked President Reagan to update the Executive Order covering the award of the Purple Heart. The Senator says that the changing circumstances under which today's military personnel serve make this necessary.

Speaking to his colleagues on the Senate floor during the sixty-seventh national celebration of Flag Day, Senator Warner said, "The existing guidance for the Purple Heart was formulated when there was far less terrorist threat and unconventional activity focused toward our military. Today, members of the armed forces find themselves increasingly exposed to violence and injury in foreign lands acting in the line of duty, under Presidential orders."

The award of the Purple Heart dates back to the Revolutionary War, when George Washington recognized those military men who had served with distinction. Currently, it is generally restricted to those who have been killed or wounded in combat.

Deaf Veterans Can Get Telecaption Recorders

Qualified deaf veterans are now eligible to receive telecaption decoders free from VA. When attached to a television set, the decoder enables hearing-impaired viewers to read on the screen the dialogue of programs that have been previously closed captioned.

VA defines "qualified" in this instance as a veteran whose hearing loss cannot be corrected by a hearing aid. Veterans should apply for the benefit at the nearest VA facility. Once eligibility is established, the VA will purchase the decoder for the veteran. They normally retail for just under $300. Currently, more than forty hours of TV programs each week are closed captioned. Additionally, twelve feature-length movies are available on home videocassettes.

Retirees/Separatees Get Word

A new regulation, AFR 211-46, Foreign Government Employment of Retirees, will implement a long-existing public law that requires retired Air Force members to get approval from the Secretary of the Air Force and the Secretary of State before taking a job with a foreign government. The regulation will provide specific Air Force direction to help base personnel offices better inform potential retirees about foreign employment rules.

A retiree who accepts a job with a foreign government without approval may have pay withheld equal to the amount received from the job. In addition, there may be other penalties, depending on the circumstances.

In a related move, PACAF Headquarters has tightened up its retirement and discharge procedures and reminded members that getting out at the overseas location isn't guaranteed and that not everyone will be granted the privilege.

PACAF is carefully screening each request for in-country separation in Japan, Korea, and the Republic of the Philippines. Members who have poor or questionable records are being turned down. Continued good relations with host governments are key considerations behind the policy.

About twenty to twenty-five requests for in-country separation are received by PACAF each month, and they're approving about eighty-five percent. Most members, of course, cite employment and educational pursuits as prime reasons for getting out in the overseas location. Also not unusual is that the member is married to another military person. The

spouse may still have tour time left.

Meanwhile, the Selective Service System has highlighted a little-known aspect of the law which requires military members born after January 1, 1960, to register with Selective Service when they leave active duty if they have not previously done so. This applies even if the member is going on into the National Guard or Reserve. Those who don't do this—and evidently many have not—may be subject to prosecution. Any US Post Office is the place to go for this, although the Selective Service is pressing the military to include the opportunity to sign up as part of exit processing.

Eglin Hospital First with HIS

The Eglin Regional Hospital is the first in the Air Force to come on line with a new data automation system called HIS—the Hospital Information System.

The system will allow health-care providers direct access to patient information and, in turn, patients should see more efficient scheduling of appointments and faster service from hospital departments.

Whenever a patient makes an appointment, picks up a prescription, receives treatment, is administered tests, or uses the hospital in any way, a complete record of the event will be entered in the HIS. Separate keying will ensure that pertinent, accurate, and complete data can be obtained based on the patient's name, birth date, or Social Security number. Sponsor data will be collected and stored with dependent records.

VA Home Loans Explained

With both interest in the housing market and questions about it perking up again, VA has recapped some of the pertinent points concerning VA-guaranteed home loans.

Veterans must first apply for a certificate of eligibility from the VA by submitting an application form and a copy of discharge. The certificate of eligibility is then presented to the lending institution who submits the loan application to the VA for approval. The VA stresses that it does not make the loan; it guarantees it, and it is the veteran's responsibility to find the lending institution.

The VA does set a maximum rate that the lender can charge and the rate in effect at the time the loan is closed applies to the loan. The current interest rate for a VA-guaranteed loan is twelve percent.

The big plus for the VA home loan is that the VA promises mortgage lenders that they can collect up to sixty percent (to $27,500), which may be due them if an eligible veteran defaults on the loan. This, in effect, makes the VA the veteran's cosigner and thus makes him/her more attractive to the lender as a borrower. This also generally means that the veteran will not be required to make a down payment.

There are some restrictions not found in conventional mortgages. The veteran must certify that he/she will live in the house being purchased. Also, if the loan is being sought for refinancing or improvements, the applicant must certify that he/she is, in fact, residing in the home.

VA home loans are not available for purchasing or building a home outside of the United States.

Air Force Intelligence Reserve Seeks Members

A unique Reserve unit is seeking new blood. The Air Force Intelligence Reserve program is looking for new members with prior military service.

Vacancies exist now in officer and enlisted ranks below the grade of major. A foreign language or experience in the intelligence or related fields is desirable. Training sites for new members are located throughout the US and at a number of overseas locations.

The AFIR works at developing a combat-ready Reserve for augmenting active-force intelligence operations during peacetime contingencies or wartime mobilization. It's headquartered at Fort Belvoir, Va. A number of these people were on twenty-four-hour alert for one year prior to the Vietnam War American POW repatriation, and thirty-five qualified Reserve interrogators saw prisoner-interview duty in Southeast Asia. They volunteer frequently for holiday duty at the Pentagon and major command headquarters.

Information is available from Hq. AFIS/REPM, Fort Belvoir, Va. 22060, or call toll-free (800) 336-4937.

ISEF Winners Selected

More than fifty Air Force judges, knowledgeable in a variety of disciplines, converged recently at the thirty-fourth International Science and Engineering Fair (ISEF) in Albuquerque, N. M., to select winners of Air Force awards in this high school student competition.

The Air Force judges were drawn from the active-duty, Reserve, and Guard ranks. Winners in each of the twelve categories of competition were selected. Awards were presented for the Air Force by Brig. Gen. Donald J. Stukel, Commander of the Air Force Contract Management Division, Kirtland AFB, N. M.

The ISEF is the culmination of competitions held at some 250 regional and state-level fairs this spring. Air Force participation—including active duty, Reserve forces, recruiting squadrons, AFROTC detachments, and Air Force Academy liaison officers—in judging was extensive. The Air Force is a special awards contributor to the program, which is sponsored by the Science Service, a Washington-based nonprofit group. Air Force awards at the international competition level include a one-week tour of Air Force research and development facilities hosted by AFSC, and congratulations from the Secretary of the Air Force and the Air Force Chief Scientist.

AFA also supports the effort. First-place winners receive an AFA leather briefcase and a year's subscription to AIR FORCE Magazine. In addition to general support for scientific and technological endeavors, the Air Force's interest in this project is sparked, of course, by the possibility of interesting some of these talented young people in scientific careers with the Air Force, either in a military or civilian capacity.

The first-place winners and their home towns are as follows:

Victoria Burns, Houma, La. (Behavioral and Social Sciences); Cuong Viet Do, Oklahoma City, Okla. (Biochemistry); David A. Burns, Lexington, Ky. (Botany); Arthur J. Kudla, Warren, Mich. (Environmental Sciences); Shari-Lynn Umlas, North Miami Beach, Fla. (Medicine and Health); Timothy Allen Thrailkill, Indiatlantic, Fla. (Microbiology).

Also, Hani El-Mahmoudi, Victoria, Tex. (Zoology); Steven G. Spears, Houston, Tex. (Chemistry); William Yew-Wai Ho, Gainesville, Fla. (Earth and Space Sciences); Marcus Lamar Moore, Hixson, Tenn. (Engineering); Tracey K. McGrath, Paeonian Springs, Va. (Mathematics and Computers); and Jonathan Santos, Bowie, Md. (Physics).

CHAMPUS Speech Therapy Guidelines Revised

CHAMPUS has revised its speech therapy guidelines, making it easier for CHAMPUS patients to have their claims cost-shared. Previously, such claims had to be reviewed at differing points, depending on the diagnosis. Now, all speech therapy claims will get a special review when therapy extends beyond thirty sessions in a twelve-month period.

Although CHAMPUS still covers

speech therapy only when it's part of the overall treatment of a physical defect, the new guidelines now include some additional physical problems that may be treated. For the first time, for example, CHAMPUS will help pay for such therapy when the speech problems are a result of cerebral palsy or repeated ear infections that interfere with speech development. As in the past, speech therapy is authorized for the following physical defects: stroke, significant hearing loss, congenital problems such as cleft lip or palate, speech difficulties following brain injury or surgery, or problems resulting from radiation treatment or vocal cord surgery.

CHAMPUS still can't cover speech therapy provided to any child eligible to receive the care through the public school system, the state of residence, or any federal agency. Normally, CHAMPUS will cost-share for individual speech therapy sessions lasting thirty minutes for patients five years old and under, and one hour for patients over the age of five. Group therapy sessions lasting ninety minutes are covered if the attending physician certifies them as beneficial.

THE BULLETIN BOARD

Short Bursts

The **average age of patients in VA**

SENIOR STAFF CHANGES

PROMOTIONS: To be **Lieutenant General:** Edgar A. **Chavarrie;** James E. **Light,** Jr.; Winston D. **Powers;** Richard K. **Saxer.**

RETIREMENTS: M/G Theodore D. **Broadwater;** M/G Herbert L. **Emanuel;** L/G John J. **Murphy;** B/G William A. **Orth;** B/G Donald A. **Vogt.**

CHANGES: B/G Donald O. Aldridge, from Dep. US Mil. Rep., NATO Mil. Committee, Brussels, Belgium, to JCS Rep. for Strategic Arms Reduction Talks (START), OJCS, Washington, D. C. . . . **M/G Spence M. Armstrong,** from Cmdr., AF Mil. Training Ctr., ATC, Lackland AFB, Tex., to Chief, US Mil. Training Mission, Dhahran, Saudi Arabia . . . **B/G Thomas A. Baker,** from Dep. Dir. of Ops., DCS/P&O, Hq. USAF, Washington, D. C., to Dir., Int'l Programs, DCS/P&R, Hq. USAF, Washington, D. C., replacing retired B/G Henry J. Sechler . . . **B/G Thomas C. Brandt,** from Command Dir., NORAD Combat Ops., J-31, NORAD/SPACECOM, Cheyenne Mountain Complex, Colo., to DCS/Intel., Hq. NORAD/SPACECOM, Peterson AFB, Colo.

B/G (M/G selectee) William J. Breckner, Jr., from DCS/Log., Hq. ATC, Randolph AFB, Tex., to C/S, Hq. USAFE, Ramstein AB, Germany, replacing M/G David L. Nichols . . . **B/G Elmer T. Brooks,** from Dep. Dir., Int'l Negotiations, J-5, OJCS, Washington, D. C., to Mil. Ass't to Dep. Under Sec. of Defense for Research & Engineering (Strategic & Theater Nuclear Forces), OSD, Washington, D. C., replacing retired B/G Donald A. Vogt . . . **M/G Richard A. Burpee,** from Ass't DCS/P&O, Hq. USAF, Washington, D. C., to Cmdr., Oklahoma City, ALC, AFLC, Tinker AFB, Okla., replacing M/G (L/G selectee) James E. Light, Jr. . . . **B/G James T. Callaghan,** from Dep. Dir., Regional Plans & Policy, & Dir., GLCM, DCS/P&O, Hq. USAF, Washington, D. C., to Cmdt., AFIT, AU, Wright-Patterson AFB, Ohio, replacing retired M/G Herbert L. Emanuel.

Col. (B/G selectee) James S. Cassity, Jr., from Cmdr., Engineering Installation Ctr., AFCC, Oklahoma City ALC, Tinker AFB, Okla., to Cmdr., US European Communications Div., AFCC, & DCS/Communications-Electronics & Air Traffic Control, USAFE, Kapaun AS, Germany, replacing B/G John P. Hyde . . . **M/G (L/G selectee) Edgar A. Chavarrie,** from Ass't DCS/P&R, Hq. USAF, Washington, D. C., to Dep. Ass't Sec. for Mil. Personnel & Force Mgmt., OSD, Washington, D. C. . . . **B/G Wilson C. Cooney,** from Dep. Cmdr., 5ATAF, AIRSOUTH, Vicenza, Italy, to DCS/Ops., 2ATAF, AAFCE, Mönchengladbach, Germany, replacing B/G Robert B. Plowden, Jr. . . . **B/G Alexander K. Davidson,** from Ass't DCS/Ops., Hq. MAC, Scott AFB, Ill., to Dep. Dir. of Ops., DCS/P&O, Hq. USAF, Washington, D. C., replacing B/G Thomas A. Baker.

B/G Richard F. Gillis, from Vice Cmdr., Warner Robins ALC, AFLC, Robins AFB, Ga., to DCS/Log., Hq. ATC, Randolph AFB, Tex., replacing B/G (M/G selectee) William J. Breckner, Jr. . . . **B/G Charles R. Hamm,** from Defense Attaché USSR, Helsinki, Finland, to Dep. Dir. of Plans, DCS/P&O, Hq. USAF, Washington, D. C., replacing B/G (M/G selectee) John A. Shaud . . . **Col. (B/G selectee) Richard G. Head,** from Spec. Ass't to Dir. of the Joint Staff, Joint Matters, OJCS, Washington, D. C., to Dep. Cmdr., 5ATAF, AIRSOUTH, Vicenza, Italy, replacing B/G Wilson C. Cooney . . . **B/G John P. Hyde,** from Cmdr., US European Communications Div., AFCC, & DCS/Communications-Electronics & Air Traffic Control, USAFE, Kapaun AS, Germany, to DCS/Communications-Electronics, Hq. SPACECOM, & DCS/Communications, Electronics, & Computer Resources (J-6), Hq. NORAD, Peterson AFB, Colo., replacing M/G (L/G selectee) Winston D. Powers.

B/G Buford D. Lary, from Dep. Ass't Sec. of Defense (Plans & Ops.) (Legislative Affairs), OSD, Washington, D. C., to Senior Mil. Ass't to Dep. Sec. of Defense, OSD, Washington, D. C. . . . **M/G (L/G selectee) James E. Light, Jr.,** from Cmdr., Oklahoma City ALC, AFLC, Tinker AFB, Okla., to Cmdr., 15th AF, SAC, March AFB, Calif., replacing retiring L/G John J. Murphy . . . **Col. (B/G selectee) Donald A. Logeais,** from Cmdr., 437th MAW, MAC, Charleston AFB, S. C., to Vice Cmdr., Warner Robins ALC, AFLC, Robins AFB, Ga., replacing B/G Richard F. Gillis . . . **Col. (B/G selectee) Charles C. McDonald,** from DCS/Ops., 15th AF, SAC, March AFB, Calif., to Vice Cmdr., Ogden ALC, AFLC, Hill AFB, Utah, replacing B/G Stanton R. Musser.

B/G Stanton R. Musser, from Vice Cmdr., Ogden ALC, AFLC, Hill AFB, Utah, to Chief, Office of Mil. Cooperation, Cairo, Egypt, replacing M/G Edward L. Tixier . . . **M/G David L. Nichols,** from C/S, Hq. USAFE, Ramstein AB, Germany, to Ass't DCS/P&O, Hq. USAF, Washington, D. C., replacing M/G Richard A. Burpee . . . **B/G Robert B. Plowden, Jr.,** from DCS/Ops., 2ATAF, AAFCE, Mönchengladbach, Germany, to Dep. Dir., Regional Plans & Policy, & Dir., GLCM, DCS/P&O, Hq. USAF, Washington, D. C., replacing B/G James T. Callaghan . . . **M/G (L/G selectee) Winston D. Powers,** from DCS/Communications-Electronics, Hq. SPACECOM, & DCS/Communications, Electronics, & Computer Resources (J-6), Hq. NORAD, Peterson AFB, Colo., to Dir., Defense Communications Agency, Washington, D. C.

M/G (L/G selectee) Richard K. Saxer, from Dep. Dir. (Ops. & Admin.), Defense Nuclear Agency, Washington, D. C., to Dir., Defense Nuclear Agency, Washington, D. C. . . . **B/G (M/G selectee) John A. Shaud,** from Dep. Dir. of Plans, DCS/P&O, Hq. USAF, Washington, D. C., to Dir. of Plans, DCS/P&O, Hq. USAF, Washington, D. C., replacing M/G Perry M. Smith . . . **M/G Carl R. Smith,** from Senior Mil. Ass't to Sec. of Defense, OSD, Washington, D. C., to Cmdr., AF Mil. Training Ctr., ATC, Lackland AFB, Tex., replacing M/G Spence M. Armstrong . . . **M/G Perry M. Smith,** from Dir. of Plans, DCS/P&O, Hq. USAF, Washington, D. C., to Cmdt., Nat'l War College, Ft. McNair, Washington, D. C.

M/G Edward L. Tixier, from Chief, Office of Mil. Cooperation, Cairo, Egypt, to Dep. Ass't Sec. of Defense (Near Eastern & South Asian Affairs), OSD/Int'l Security Affairs, Washington, D. C. . . . **Col. (B/G selectee) Richard J. Trzaskoma,** from Cmdr., 834th Airlift Div., MAC, Hickam AFB, Hawaii, to Ass't DCS/Ops., Hq. MAC, Scott AFB, Ill., replacing B/G Alexander K. Davidson . . . **B/G Paul D. Wagoner,** from Cmdr., 20th AD/NORAD Region, TAC, Ft. Lee AFS, Va., to Command Dir., NORAD Combat Ops., J-31, NORAD/SPACECOM, Cheyenne Mountain Complex, Colo., replacing B/G Thomas C. Brandt.

SENIOR ENLISTED ADVISOR CHANGE: CMSgt. Sam E. Parish, from SEA, Hq. SAC, Offutt AFB, Neb., to CMSAF, Hq. USAF, Washington, D. C., replacing retired CMSAF Arthur L. Andrews. ■

hospitals today has moved up to **fifty-six.** Outpatients are just slightly younger, on the average, at fifty-two.

Congressman Doug Barnard (D-Ga.) has introduced a bill to allow **retirees serving as AFJROTC instructors to count those years toward the retirement computation** when they leave the high school job. This is a long-sought goal of AFJROTC Aerospace Education Instructors and Assistants and does make sense following the argument that they wear the uniform, comply with Air Force regulations, and, of course, teach military-related topics. The Administration is not supportive of it, however, and **chances seem dim.**

The recently passed **national jobs bill** contains **$75 million for the VA.** It will use the money for hundreds of needed maintenance and repair projects, putting thousands of unemployed to work at such labor-intensive tasks as painting, paving, and roof repair. The jobs bill requires that seventy-five percent of the allocation be targeted to areas with high unemployment and urges agencies to hire those who have been unemployed at least fifteen of the last thirty-six weeks.

Base Exchange customers are voting this summer on which of three uniforms they think best for the **US team at the 1984 Olympics.** The promotion is sponsored by Levi Strauss and Co., the official team outfitter, and includes a chance to win a trip to the games in Los Angeles.

Beginning in October, money from the new Job Training Partnership Act will provide funds for state and local governments to help boost **training and job opportunities for disabled, Vietnam-era, and recently discharged vets.** The Labor Department is trying hard to get the word out this summer to employment officials.

A **new service for overseas-bound military members** allows them to call AUTOVON 487-5861, around the clock, to get answers on the reassignment that their base can't provide. Answers, either by phone or letter, are promised within forty-eight hours. AFMPC notes that master sergeants and above can call their career-field manager at the Center directly and don't really need to use the new hotline.

The Air Force captured the 1983 men's **interservice volleyball championship** for the twelfth consecutive time. Air Force women won second place.

The **Air Force Nurse Corps** is writing its **official history,** to include anecdotes and photos, and wants help. If you can contribute action stories, photos, memorabilia, uniforms, etc., please contact Col. Delores Jean Haritos, AF/SGN, Bolling AFB, D. C. 20332, or call (202) 767-5074, AUTOVON 297-5074.

CMSgt. James Fahey, the Aerospace Physiological Branch Superintendent, Mather AFB, Calif., retired last month. In his thirty years of service it's estimated that he's **trained more than 45,000 students** in the use of life-support equipment just at Mather, and who knows how many others elsewhere? If you received such training, you probably met him. He's clocked more than 600 hours in the altitude chamber.

NCO Academy Instructor of the Year is SMSgt. John W. Watts, Jr., from the SAC NCO Academy at Barksdale AFB, La. In other award news, **SAC came through again,** capturing the top major command Social Actions Award, named for the late Col. Joseph L. Brown, former Hq. USAF Director of Social Actions.

If you bought **garden hose** at the BX last year, you contributed to their record sale of some 32.5 million feet—or, as they note, enough hose to stretch from San Francisco to New York City and back again. ■

The AFA Nominees for 1983-84

BY JEANNE BUFFALINO
OFFICE OF AFA FIELD ORGANIZATIONS

AT A meeting on May 28 in Colorado Springs, Colo., the Air Force Association Nominating Committee selected a slate of candidates for four national officer positions and for the eighteen elective positions on the Board of Directors to be presented to the delegates at the National Convention in Washington, D. C., on September 12. The Nominating Committee consists of incumbent National Officers and Directors and the President (or his/her designee) of each AFA State Organization.

The four incumbent National Officers—David L. Blankenship, President; John G. Brosky, Chairman of the Board; Sherman W. Wilkins, Secretary; and George H. Chabbott, Treasurer—were nominated for another term in their respective offices.

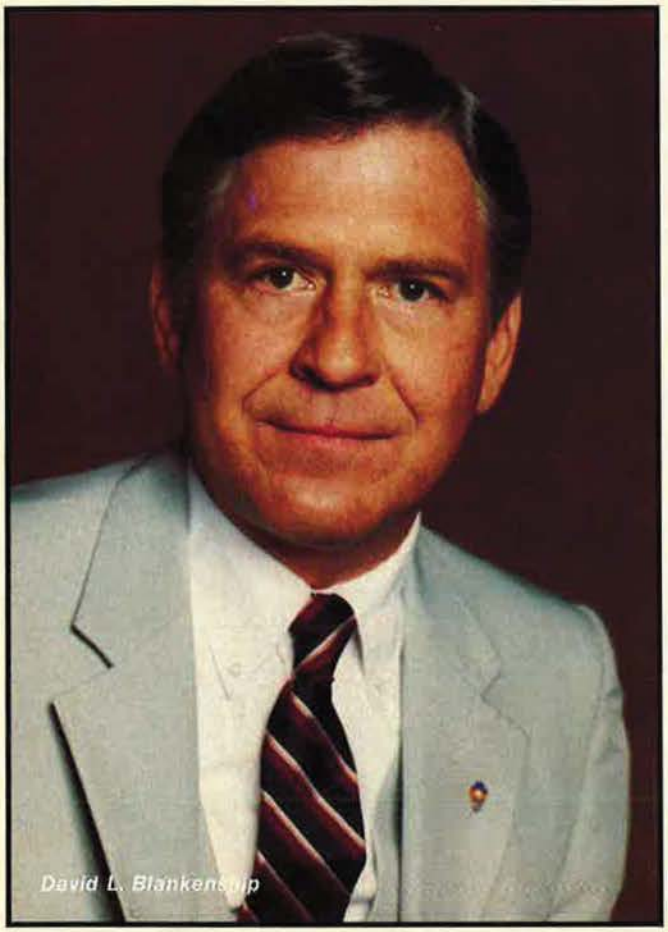
Nominated for National President is **David L. Blankenship** of Tulsa, Okla. An aerospace industry executive, he received his bachelor's degree in economics from the University of Tulsa in 1955 where he continued graduate study in industrial psychology. Following college, he was commissioned in the United States Air Force and served four years as a pilot with assignments in TAC, SAC, and ATC.

Mr. Blankenship's civic activities have included service on the Board of Directors of the Oklahoma Chamber of Commerce; Board of Directors, National Conference of Christians and Jews; Advisory Board of the Tulsa Urban League's Business Development Center; Tulsa Public Schools' Vocational Advisory Council; and the Executive Board of the Indian Nations Council of Boy Scouts of America. In 1967, he was selected as one of the Outstanding Young Men of America.

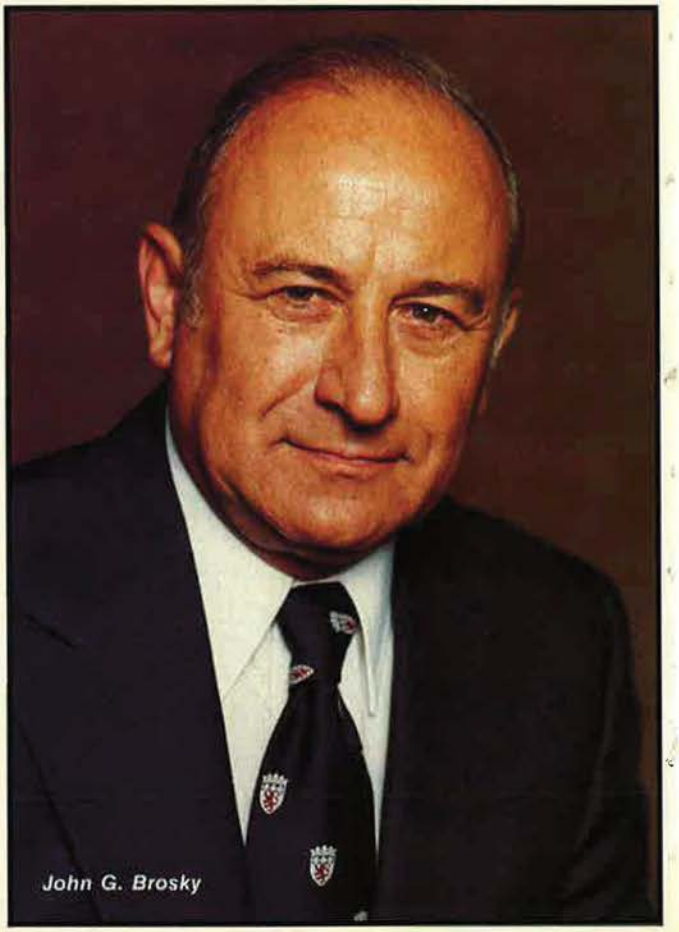
Mr. Blankenship, in addition to serving AFA as National President, is Chairman of the Association's Executive Committee and a Trustee of the Aerospace Education Foundation. He has served as a member of the Board of Directors, Chairman of the Association's Membership Committee, as a member of the Organizational Advisory Council, and as a State and Chapter President. He is an AFA Life Member.

John G. Brosky was nominated for the office of Chairman of the Board of Directors. A resident of Pittsburgh, Pa., he is a judge serving on the Superior Court of Pennsylvania. During World War II he served in the South Pacific as an artillery captain. He retired from the Air Force as a brigadier general, and is a retired major general of the Pennsylvania Air National Guard. He is a graduate of the University of Pittsburgh and its law school, and is an Outstanding Letterman of Distinction at the university.

A past president of the Pennsylvania National Guard Association, Judge Brosky has also served as President of the Pennsylvania Disabled American Veterans and as Scholarship Chairman for the National Football Hall of Fame. A



David L. Blankenship



John G. Brosky

former aviation writer, he also has been active in many other national and civic organizations.

Judge Brosky serves AFA presently as National Chairman of the Board and Vice Chairman of the Executive Committee. Besides service as National President and as a member of the Board of Directors, he has served as National Vice President (Northeast Region), State President, and President, Vice President, and Secretary at the Chapter level. He was honored as Pennsylvania State AFA Man of the Year in 1972. He is a Trustee of the Aerospace Education Foundation, a Jimmy Doolittle Fellow, and an Ira C. Eaker Fellow. He is a Life Member of AFA.

Sherman W. Wilkins, a retired aerospace executive from Bellevue, Wash., was nominated for the office of National Secretary. An alumnus of the University of Connecticut and George Washington University, he also is a graduate of the Army Command and Staff College and the Air War College. His active-duty career spanned twenty-seven and a half years, and he retired in 1968 with the rank of colonel. His decorations include the Legion of Merit, the Distinguished Flying Cross, and the Air Medal.

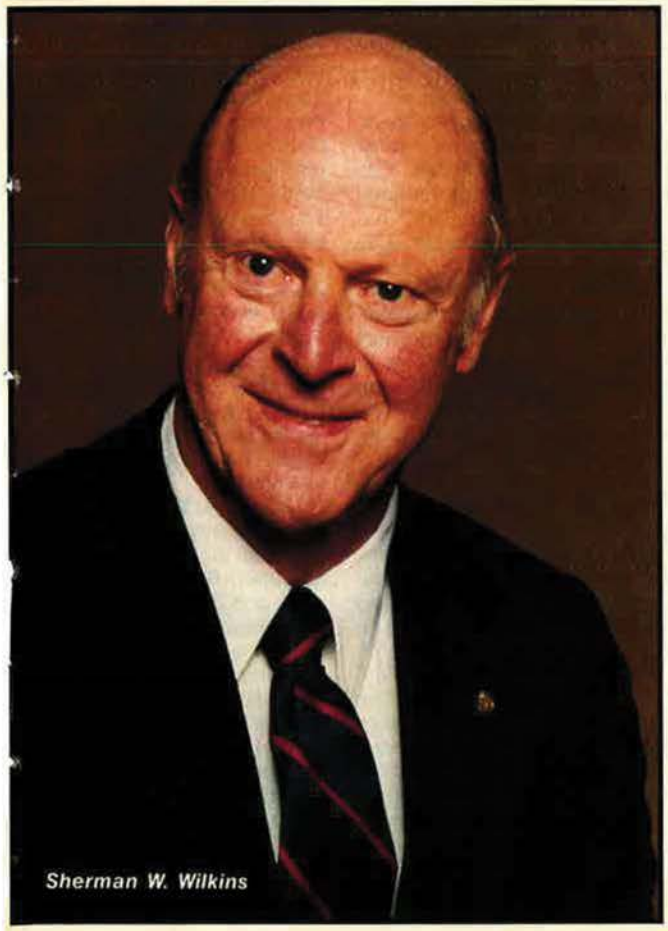
Mr. Wilkins's civic activities have included leadership roles in the PTA and the Boy Scouts of America, and in numerous military-oriented organizations. In addition to serving as National Secretary, Mr. Wilkins is currently a member of the Executive Committee and Chairman of the Resolutions Committee. He has also served AFA as a member of the Board of Directors, National Vice President (Northwest Region), and a Chapter President. He is a Trustee of the Aerospace Education Foundation, a Jimmy Doolittle Fellow, and a Life Member of AFA.

Nominated for a third term as National Treasurer was **George H. Chabbott** of Dover, Del. He is a management consultant and real estate counselor. He served in the Air Force for twenty-three years, retiring as a colonel in 1973. He participated in fifty combat missions flying B-26s in Korea, and flew 100 combat missions as a forward air controller in the Vietnam War. A graduate of Utah State University, he attended senior-level finance courses at the Columbia School of Bank Administration and Management, and has been awarded the designation of Certified Commercial Investment Member (CCIM) by the National Real Estate Marketing Institute.

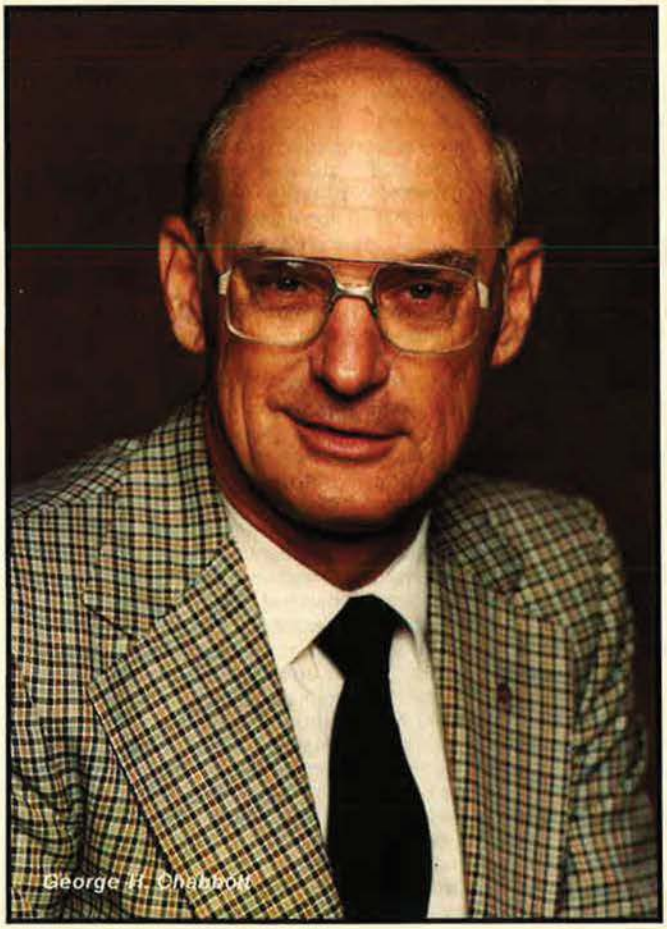
In addition to his current service as National Treasurer, Mr. Chabbott is Chairman of the Finance Committee and a member of the Executive Committee. He also has held the elective offices of National Director, National Vice President (Central East Region), and State President. Mr. Chabbott is an officer of the Aerospace Education Foundation's Finance Committee, and is an AFA Life Member.

The following are permanent members of the AFA Board of Directors under provision of Article IX of AFA's National Constitution: John R. Alison, Joseph E. Assaf, William R. Berkeley, David L. Blankenship, John G. Brosky, Daniel F. Callahan, Earl D. Clark, Jr., Edward P. Curtis, James H. Doolittle, George M. Douglas, Joe Foss, Jack B. Gross, George D. Hardy, Alexander E. Harris, Martin H. Harris, Gerald V. Hasler, John P. Henebry, Robert S. Johnson, Sam E. Keith, Jr., Arthur F. Kelly, Victor R. Kregel, Thomas G. Lanphier, Jr., Jess Larson, Curtis E. LeMay, Carl J. Long, Nathan H. Mazer, J. P. McConnell, J. B. Montgomery, Edward T. Nedder, J. Gilbert Nettleton, Jr., Martin M. Ostrow, Jack C. Price, Julian B. Rosenthal, John D. Ryan, Peter J. Schenk, Joe L. Shosid, C. R. Smith, William W. Spruance, Thos. F. Stack, James H. Straubel, Harold C. Stuart, James M. Trail, and A. A. West.

The eighteen people whose photographs appear on the following page are nominees for the eighteen elected Directorships for the coming year. Names marked with an asterisk are incumbent elected National Directors.



Sherman W. Wilkins



George H. Chabbott

Bigger

Cunningham

Dean

Donnelly

Falcone

Jones

Lugo

Mack

McBride

McCoy

Monaghan

Nottingham

Rapp

Reed

Stearn

Sterrett

Taylor

Taylor

Nominees for AFA's Board of Directors

Incumbent Elected National Directors indicated with an asterisk (*)

***Thomas O. Bigger,** Tullahoma, Tenn. Industrial engineer. Former National Vice President (South Central Region), national committee member, State President, and Chapter President and Secretary. Current National Director and national committee member. Life Member.

Gregg L. Cunningham, Denver, Colo. Attorney/cable television executive. Former member of Pennsylvania House of Representatives. Former Under-40 National Director. Current Under-40 National Director and national committee member.

***Hoadley Dean,** Rapid City, S. D. Investment company and mining executive. Former national committee member, National Vice President (North Central Region), and Chapter Secretary. Current National Director, national committee member, and Aerospace Education Foundation Board member. Life Member.

***Jon R. Donnelly,** Richmond, Va. Editor. Former Under-40 National Director, national committee member, National Vice President (South Central Region), State President, and Chapter President. Current National Director, national committee Chairman, and Aerospace Education Foundation Board member. Life Member.

***Joseph R. Falcone,** Rockville, Conn. Industry administrator. Former National Vice President (New England Region), national committee member, State President, Vice President, and Secretary, and Chapter Secretary. Current National Director and national committee member. Life Member.

***Francis L. Jones,** Wichita Falls, Tex. Property manager. Former National Vice President (Southwest Region), national committee member, State Vice President, and Chapter President and Vice President. Current National Director and national committee member. Life Member.

Frank M. Lugo, Mobile, Ala. Educator. Former national committee member, State and Chapter President. Current National Vice President (South Central Region), national committee member, and Aerospace Education Foundation Board member. Life Member.

John L. Mack, Duluth, Ga. Marketing director. Former Under-40 National Director and Chapter President and Vice President. Current Under-40 National Director and national committee member.

***William V. McBride,** San Antonio, Tex. Consultant. Former USAF Vice Chief of Staff. Former national committee member. Current National Director, national committee member, and Aerospace Education Foundation Board member. Life Member.

James M. McCoy, Bellevue, Neb. Insurance executive. Former national committee member. Current National Director, national committee Chairman, and national committee member. Life Member.

Edward J. Monaghan, Anchorage, Alaska. Flight instructor/president. Former State President and Vice President and Chapter President and Secretary. Current National Vice President (Northwest Region) and national committee member.

***Ellis T. Nottingham, Jr.,** Arlington, Va. Marketing manager. Former Under-40 National Director, national committee member, and Chapter President and Secretary. Current National Director and national committee member. Life Member.

***William C. Rapp,** Buffalo, N. Y. Telephone company executive. Former National Vice President (Northeast Region), national committee member, State President, and Chapter President. Current National Director, national committee member, and Aerospace Education Foundation Board member. Life Member.

***Margaret A. Reed,** Seattle, Wash. Industry executive. Former National Vice President (Northwest Region) and State President, Secretary, and Treasurer. Current National Director and national committee member. Life Member.

Edward A. Stearn, Redlands, Calif. Aerospace industry executive. Former National Director, national committee member, State President, and Chapter President. Current National Vice President (Far West Region), national committee member, and Aerospace Education Foundation Board member. Life Member.

***J. Deane Sterrett,** Beaver Falls, Pa. Educator. Former National Vice President (Northeast Region), State President and Vice President, and Chapter President and Vice President. Current National Director, national committee member, and Aerospace Education Foundation Board member. Life Member.

***James H. Taylor,** Farmington, Utah. Industry executive. Former National Vice President (Rocky Mountain Region), State President, and Chapter President and Vice President. Current National Director, national committee member, and Aerospace Education Foundation Board member. Life Member.

***Liston T. Taylor,** Lompoc, Calif. Industry consultant. Former National Vice President (Far West Region), national committee member, and State President and Chapter President. Current National Director and national committee member. Life Member. ■

AFA Intercom

Past and present AFA, AEF, and Air Force leaders honored at this year's Salute to Senior Statesmen included (standing, from left): AFA Executive Director Russell E. Dougherty; AFA Chairman of the Board John G. Brosky; Gen. Lauris Norstad, USAF (Ret.); AEF President Dr. Don C. Garrison; (seated, from left): AEF Chairman of the Board Sen. Barry M. Goldwater; and Lt. Gen. Jimmy Doolittle, USAF (Ret.). See item. (Photo by Ron Hall)

AEF Board Chairman Sen. Barry M. Goldwater (right) presents Jimmy Doolittle Fellowship plaque to AEF President Dr. Don C. Garrison during Senior Statesmen Salute. See item. (Photo by Ron Hall)

The Stars Shine: AFA And AEF Host Salute To Senior Statesmen

Nearly 500 individuals gathered at the Officer's Open Mess at Bolling AFB in Washington, D. C., on June 15, 1983, to pay tribute to past and present Air Force, AFA, and AEF leaders.

Among the Air Force honorees were former Chiefs of Staff Gens. Curtis E. LeMay, John D. Ryan, David C. Jones, and Lew Allen, Jr., as well as the current Chief, Gen. Charles A. Gabriel; former Chief Master Sergeants of the Air Force Donald L. Harlow, Richard D. Kisling, and James M. McCoy; and former Secretaries of the Air Force Stuart Symington, James H. Douglas, Jr., and Hans Mark, and the current Secretary, Verne Orr.

Also representing the active-duty Air Force were Vice Chief of Staff Gen. Jerome F. O'Malley, AFSC Commander Gen. Robert T. Marsh, AFLC Commander Gen. James P. Mullins, several Deputy Chiefs of Staff, and Assistant and Under Secretaries of the Air Force.

Also in attendance were forty-one retired four-star generals, and retired Lt. Gens. Jimmy Doolittle and Elwood R. Quesada. Mrs. Carl "Tooey" Spaatz, Mrs. Ira C. Eaker, and Mrs. George Brown, along with all of the other Air Force wives, were toasted in recognition of their unique contributions.

Former AFA National Presidents and Chairmen of the Board honored were John R. Alison, Daniel F. Callahan, George M. Douglas, Jack B. Gross, George D. Hardy, Gerald V. Hasler, John P. Henebry, Arthur F. Kelly, Victor R. Kregel, Thomas G. Lanphier, Jr., Jess Larson, Howard T. Markey, Peter J. Schenk, Joe L. Shosid, James M. Trail, and the current Chairman of the Board, John G. Brosky. AFA's current National President, David L. Blankenship, was in Europe on AFA business and was unable to attend.

The Aerospace Education Foundation was represented by former National President Dr. Walter J. Hesse, former Chairmen of the Board J. Gilbert Nettleton and George D. Hardy, current President Dr. Don C. Garrison, and current Chairman of the Board Sen. Barry M. Goldwater.

Members of Congress in attendance included Sens. Mack Mattingly (R-Ga.), Paul S. Trible, Jr. (R-Va.), and John W. Warner (R-Va.); and Reps. Herbert H. Bateman (R-Va.), Thomas J. Bliley, Jr. (R-Va.), Dan Daniel (D-Va.), James R. Olin (D-Va.), J. Kenneth Robinson (R-Va.), Norman Sisisky (D-Va.), and G. William Whitehurst (R-Va.).

The program for the evening included announcement by AEF President Dr. Don C. Garrison of the recipients of Jimmy Doolittle and Ira Eaker Fellowships *(see box, p. 110)*. The Fellowships were presented by General Doolittle and Senator Goldwater.

In addition, an enlarged photograph of Senator Goldwater and the 1982 Outstanding Airmen, autographed by the airmen, was presented to the Senator, and General Doolittle received a photograph of himself autographed by all those in attendance.

Finally, audiovisual presentations of the Wright "B" Flyer and the Thunderbirds were shown.

1982–83 AFJROTC Contest Winners

OVERALL WINNER

Scotch Plains-Fanwood High School, Scotch Plains, N. J.

CATEGORY WINNERS

Audiotape: Lockport Township High School, Lockport, Ill.
Essay: Bolingbrook High School, Bolingbrook, Ill.
Other (game): Florida Air Academy, Melbourne, Fla.
Sound/Slide: West Anchorage High School, Anchorage, Alaska
Videotape: Scotch Plains-Fanwood High School, Scotch Plains, N. J.

HONORABLE MENTIONS

(in alphabetical order by state)

Sunnyslope High School, Phoenix, Ariz.
Mater Dei High School, Santa Ana, Calif.
Lake Worth Community High School, Lake Worth, Fla.
Florida Air Academy, Melbourne, Fla.
Satellite High School, Satellite Beach, Fla.
Vero Beach High School, Vero Beach, Fla.
Bolingbrook High School, Bolingbrook, Ill.
Harrison County High School, Cynthiana, Ky.
Gwynn Park High School, Brandywine, Md.
Bellevue West High School, Bellevue, Neb.
Patchogue-Medford High School, Medford, N. Y.
Southern High School, Graham, N. C.
Irmo High School, Columbia, S. C.
Orangeburg-Wilkinson High School, Orangeburg, S. C.
Judson High School, Converse, Tex.
Holy Cross High School, San Antonio, Tex.
Clearfield High School, Clearfield, Utah
Hampton High School, Hampton, Va.
Patrick Henry High School, Roanoke, Va.
General H. H. Arnold High School, West Germany

Winners Selected in AFA's 1982–83 AFJROTC Contest

"How We Prepare Ourselves for Leadership in America's Future" was the topic for the 1982–83 AFJROTC contest sponsored by AFA and administered by its affiliate, the Aerospace Education Foundation. This was the eleventh year of the contest.

All Air Force Junior ROTC units are eligible to submit entries in any or all of the five following categories: videotape, sound/slide, audiotape, essay, or other (games, poems, etc.). Seventy units submitted a total of 106 entries. Winners in each category receive $500 in prize money and a plaque for display in their school. The overall winner is selected from among the five category winners and receives an additional $1,500 in prize money and a distinctive first-place plaque. *(For this year's winners, see accompanying box.)*

Entries were subjected to a series of judgings conducted by AFA and Foundation staff members. The final judging to determine the overall winner was conducted by selected representatives from the Air Force Office of Public Affairs, the Air Force Office of the Director of Personnel Plans, and the Association for Educational Communication and Technology.

All-AFA Crew of The B-29 *Eddie Allen* Reunited in Wichita

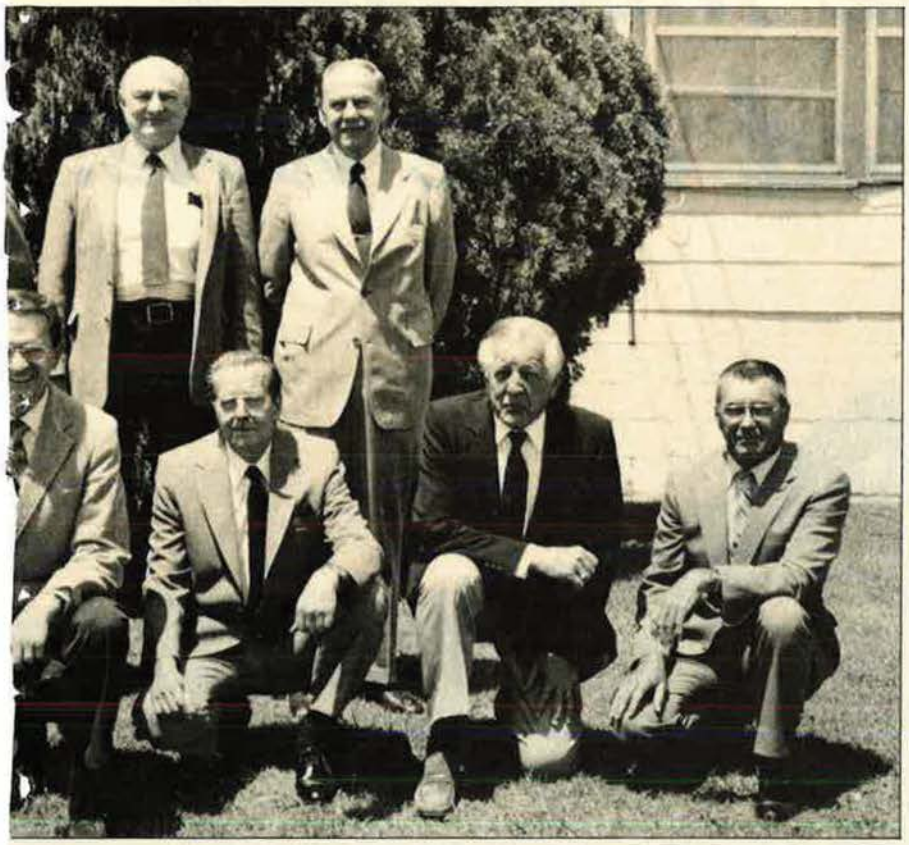
Nine of the original eleven crew members who flew the B-29 *Eddie Allen* on its last mission on May 24, 1945, were

Aerospace Education Foundation Fellowships

(Presented at June 15 Salute)

Individual Jimmy Doolittle Fellows	Sponsor
Mrs. Helen M. LeMay	Gen. Edwin W. Rawlings, USAF (Ret.)
Mr. Kenneth A. Rowe	Friends, State of Virginia
Dr. Don C. Garrison	Foundation Trustees
Rep. Herbert H. Bateman (R-Va.)	Ten Patriotic Constituents
Rep. Thomas J. Bliley, Jr. (R-Va.)	Ten Patriotic Constituents
Rep. Frederick C. Boucher (D-Va.)	Ten Patriotic Constituents
Rep. Dan Daniel (D-Va.)	Ten Patriotic Constituents
Rep. James R. Olin (D-Va.)	Ten Patriotic Constituents
Rep. J. Kenneth Robinson (R-Va.)	Ten Patriotic Constituents
Rep. Norman Sisisky (D-Va.)	Ten Patriotic Constituents
Rep. G. William Whitehurst (R-Va.)	Ten Patriotic Constituents
Sen. Paul S. Trible, Jr. (R-Va.)	Ten Patriotic Constituents
Sen. John W. Warner (R-Va.)	Ten Patriotic Constituents

Individual Ira Eaker Fellows	Sponsor
Maj. Gen. John B. Conaway, USAF	Brig. Gen. William W. Spruance, USAF (Ret.)
CMSgt. James M. McCoy, USAF (Ret.)	Gen. & Mrs. Russell E. Dougherty, USAF (Ret.)



LEFT: Thirty-eight years after the last mission of the Eddie Allen, *nine of the original eleven crew members were reunited. Recreating a photograph first taken in 1945 are (standing, from left): Louis C. Bicknese, Eino E. Jenstrom, Walter Kraus, Francis H. Moch, Jr., (kneeling, from left): Olan W. Garrett, Ralph F. Desch, Daniel F. Thorne, Victor H. Braeunig, and James E. Taliaferro. Missing from the photo are Fred E. Billingsley, deceased, and Robert W. Mautner, who could not be located. BELOW LEFT: Dwarfed by a SAC B-52 on the ramp at McConnell AFB, Kan., are, from left: Walter Kraus, Francis H. Moch, Jr., and Eino E. Jenstrom, who flew an early version of the B-52 in the late 1950s. See item.*

recently reunited in Wichita, Kan. *(For details about the* Eddie Allen, *see "The Last Mission of the* Eddie Allen," AIR FORCE *Magazine, August 1980, p. 94.)*

The all-AFA crew and their wives were treated to a tour of nearby McConnell AFB, where they heard CMSgt. Thomas Schifler of the 184th Tactical Fighter Group, KanANG, discuss the Total Force concept and tell of the close, mutually respectful relationship that exists between the active-duty units (the 381st Strategic Missile Wing and 384th Air Refueling Wing) and the ANG unit. The visitors were able to see the "new" Air Force in action—both on the ground and in the air. As one crew member said: "How things have changed! I am proud to have been part of it and to be a part of it again."

Another highlight of the reunion was a visit to the Boeing Military Airplane Co.'s Wichita plant. Crew members were afforded the opportunity to meet and thank some of the Boeing employees who had helped build the *Eddie Allen* nearly forty years ago.

All of the crew members reported that the thirty-eight-year separation had not weakened the bonds that were forged in the heat of battle aboard a special airplane.

Thank You, AFA

Dear AFA:

I am very pleased to tell you of the memorable experience enjoyed by the thirty-one women veterans during their participation in the National POW/MIA Recognition Day Program in Washington. Three days of receptions and ceremonies were culminated by a personal meeting with President Reagan at the White House.

These "Angels of Bataan and Corregidor," many of whom had not met since their liberation in 1945, join me in expressing gratitude to you and members of your organization for helping to make this occasion possible.

This response is another example of the dedication, support, and enthusiasm I have found in your organization in service to all veterans. I look forward to this continued partnership in future endeavors.

Harry N. Walters
Administrator of Veterans Affairs

President Reagan greets former POW Lt. Col. Eunice F. Young, USAF (Ret.).

Cheyenne Mountain, We're glad to be here!

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AFA Intercom

Wright "B" Flyer at AFA Convention

A major theme of this year's AFA National Convention is the seventy-fifth anniversary of military aviation. In February 1908, the Wright brothers signed the first formal contract to provide a US Army airplane. In August of that year, Orville Wright and his ground crew brought their airplane to Fort Myer, Va. In September, Orville made fourteen flights from Fort Myer, both alone and with passengers, setting and resetting endurance records. Although the September 17th flight ended tragically, with Lt. Thomas Selfridge killed and Orville injured, the Army and the Wright brothers pressed on. The rest is history. The Army bought an improved version of the 1908 machine, and an air arm was begun.

The so-called Wright "B" Flyer—several variations removed from the original Flyer—flew between 1910 and 1918. Over the past several years, a group of dedicated aviation enthusiasts from the Wright brothers' home town of Dayton, Ohio, has built a modern, airworthy look-alike of the original 1911 Wright "B" Flyer. The "new" Flyer made its maiden flight this past November. *(For more details, see "The Wright 'B' Flyer: A Pilot Report," Air Force Magazine, July '83, p. 78.)*

This September, the Wright "B" Flyer look-alike will make its first appearance outside the Dayton area at AFA's National Convention. The aircraft will be on display and flying at Andrews AFB, Md., during the convention. A commemorative flight over Fort Myer is also planned. Details about dates and flight paths will be announced in Air Force Magazine.

Wright "B" Flyer pilot John H. Warlick checks the "cockpit" of the look-alike of the original 1911 Wright "B" Flyer. See above item.

AFA National President David L. Blankenship, left, chats with PACAF Commander Lt. Gen. Arnold W. Braswell, center, and Brig. Gen. Benjamin B. Cassiday, Jr., USAF (Ret.), member of Hawaii State AFA's Board of Directors, during a recent visit to the Aloha State to survey AFA membership activities there.

AFA State Contacts

Following each state name, in parentheses, are the names of the localities 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 state contact.

ALABAMA (Auburn, Birmingham, Huntsville, Mobile, Montgomery, Selma): **Don Krekelberg,** 904 Delcris Drive, Birmingham, Ala. 35226 (phone 205-942-0784).

ALASKA (Anchorage, Fairbanks): **William M. Mack,** 610 McKay Bldg., 338 Denali St., Anchorage, Alaska 99501 (phone 907-266-1253).

ARIZONA (Phoenix, Sedona, Sun City, Tucson): **Thomas W. Henderson,** 4820 N. Camino Real, Tucson, Ariz. 85718 (phone 602-299-6467).

ARKANSAS (Blytheville, Fayetteville, Fort Smith, Little Rock): **Charles E. Hoffman,** 1041 Rockwood Trail, Fayetteville, Ark. 72701 (phone 501-521-7614).

CALIFORNIA (Apple Valley, Edwards, Fairfield, Fresno, Hermosa Beach, Los Angeles, Merced, Monterey, Novato, Orange County, Pasadena, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, San Jose, Santa Barbara, Santa Monica, Sunnyvale, Vandenberg AFB, Yuba City): **Scott Norwood,** 19561 Moray Court, Saratoga, Calif. 95070 (phone 408-867-9466).

COLORADO (Aurora, Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Littleton, Pueblo, Waterton): **William R. Morris,** 5521 S. Telluride Court, Aurora, Colo. 80015 (phone 303-693-4464).

CONNECTICUT (East Hartford, North Haven, Storrs, Stratford, Westport, Windsor Locks): **Raymond E. Choquette,** 16 Tonica Springs Trail, Manchester, Conn. 06040 (phone 203-646-4818).

DELAWARE (Dover, Wilmington): **Joseph H. Allen, Jr.,** 537 Roberta Ave., Dover, Del. 19901 (phone 302-674-3472).

DISTRICT OF COLUMBIA (Washington, D. C.): **A. B. Outlaw,** 1750 Pa. Ave., N. W., Suite 400, Washington, D. C. 20006 (phone 202-637-3346).

FLORIDA (Broward, Cape Coral, Fort Walton Beach, Gainesville, Jacksonville, Naples, New Port Richey, Orlando, Panama City, Patrick AFB, Redington Beach, Sarasota, Tallahassee, Tampa, West Palm Beach, Winter Haven): **Morgan S. Tyler, Jr.,** 1776 6th St., N. W., Apt. 606, Winter Haven, Fla. 33880 (phone 813-299-2773).

GEORGIA (Athens, Atlanta, Columbus, Rome, Savannah, St. Simons Island, Valdosta, Warner Robins): **Edward I. Wexler,** 8 E. Back St., Savannah, Ga. 31406 (phone 912-964-1941, ext. 253).

GUAM (Agana): **Joe Gyulavics,** P. O. Box 21543, Guam 96921 (phone 671-734-2369).

HAWAII (Honolulu): **Don J. Daley,** P. O. Box 3200, Honolulu, Hawaii 96847 (phone 808-525-6296).

IDAHO (Boise, Mountain Home, Twin Falls): **John W. Logan,** 3131 Malad St., Boise, Idaho 83705 (phone 208-385-5475).

ILLINOIS (Belleville, Champaign, Chicago, Decatur, Elmhurst, Peoria): **Richard H. Becker,** 7 Devonshire Drive, Oak Brook, Ill. 60521 (phone 312-654-3938).

INDIANA (Bloomfield, Fort Wayne, Indianapolis, Lafayette, Logansport, Marion, Mentone, South Bend): **John Kagel,** 1029 Riverside Drive, South Bend, Ind. 46616 (phone 219-234-8855).

IOWA (Des Moines): **Carl B. Zimmerman,** 608 Waterloo Bldg., Waterloo, Iowa 50701 (phone 319-232-2650).

KANSAS (Topeka, Wichita): **Cletus J. Pottebaum,** 6503 E. Murdock, Wichita, Kan. 67206 (phone 316-683-3963).

KENTUCKY (Louisville): **Elmo C. Burgess,** 116 S. 5th St., Louisville, Ky. 40202 (phone 502-585-5169).

LOUISIANA (Alexandria, Baton Rouge, Bossier City, Monroe, New Orleans, Shreveport): **James S. Kendall,** 4428 Parkridge Drive, Benton, La. 71006 (phone 318-965-9164).

MAINE (Bangor, Limestone, N. Berwick): **Arley McQueen, Jr.,** Route 1, Box 215, Wells, Me. 04090 (phone 207-676-9511, ext. 2354).

MARYLAND (Andrews area, Baltimore): **William L. Ryon, Jr.,** 8711 Liberty Lane, Potomac, Md. 20854 (phone 301-299-8717).

MASSACHUSETTS (Bedford, Boston, Falmouth, Florence, Hanscom AFB, Lexington, Taunton, Worcester): **Zaven Kaprielian,** 428 Mt. Auburn St., Watertown, Mass. 02172 (phone 617-924-5010).

MICHIGAN (Battle Creek, Detroit, Kalamazoo, Marquette, Mount Clemens, Oscoda, Petoskey, Southfield): **Jeryl L. Marlatt,** 740 S. Cranbrook Rd., Birmingham, Mich. 48009 (phone 313-362-0511).

MINNESOTA (Duluth, Minneapolis-St. Paul): **Edward A. Orman,** 368 Pike Lake, Duluth, Minn. 55811 (phone 218-727-8381).

MISSISSIPPI (Biloxi, Columbus, Jackson): **Clarence Ball, Jr.,** 5813 David Davis Pl., Ocean Springs, Miss. 39564 (phone 601-875-5883).

MISSOURI (Kansas City, Knob Noster, Springfield, St. Louis): **James R. Hopkins,** 316 Hillcrest Drive, Warrensburg, Mo. 64093 (phone 816-747-6087).

MONTANA (Great Falls): **Al Lovington,** P. O. Box 1569, Great Falls, Mont. 59403 (phone 406-453-1118).

NEBRASKA (Lincoln, Omaha): **Edward A. Crouchley,** 1314 Douglas On the Mall, Omaha, Neb. 68102 (phone 402-633-2125).

NEVADA (Las Vegas, Reno): **William J. Becker,** 1709 Valmora, Las Vegas, Nev. 89102 (phone 702-873-5945).

NEW HAMPSHIRE (Manchester, Pease AFB): **Charles J. Sattan,** 53 Gale Ave., Laconia, N. H. 03246 (phone 603-524-5407).

NEW JERSEY (Andover, Atlantic City, Belleville, Camden, Chatham, Cherry Hill, E. Rutherford, Forked River, Fort Monmouth, Jersey City, McGuire AFB, Middlesex County, Newark, Old Bridge, Trenton, Wallington, Whitehouse Station, West Orange): **Frank Kula,** 264 Edgewood Drive, Toms River, N. J. 08753 (phone 201-244-2491).

NEW MEXICO (Alamogordo, Albuquerque, Clovis): **Louie T. Evers,** P. O. Box 1946, Clovis, N. M. 88101 (phone 505-762-1798).

NEW YORK (Albany, Brooklyn, Buffalo, Chautauqua, Garden City, Hempstead, Hudson Valley, New York City, Niagara Falls, Plattsburgh, Queens, Rochester, Rome/Utica, Southern Tier, Staten Island, Suffolk County, Syosset, Syracuse, Westchester): **Robert E. Holland,** 750-75A Lido Blvd., Lido Beach, N. Y. 11561 (phone 516-889-1571).

NORTH CAROLINA (Asheville, Charlotte, Fayetteville, Goldsboro, Greensboro, Kitty Hawk, Raleigh): **Hal Davis,** 1034 Manchester Drive, Cary, N. C. 27511 (phone 919-467-6511).

NORTH DAKOTA (Concrete, Fargo, Grand Forks, Minot): **Maurice M. Rothkopf,** 3210 Cherry St., Grand Forks, N. D. 58201 (phone 701-746-5493).

OHIO (Akron, Cincinnati, Cleveland, Columbus, Dayton, Newark, Youngstown): **Charles B. Spencer,** 333 West 1st St., Suite 252, Dayton, Ohio 45402 (phone 513-228-1175).

OKLAHOMA (Altus, Enid, Oklahoma City, Tulsa): **Aaron C. Burleson,** P. O. Box 757, Altus, Okla. 73522 (phone 405-482-0005).

OREGON (Eugene, Portland): **William Gleaves,** 2353 Oakway Terrace, Eugene, Ore. 97401 (phone 503-687-2269).

PENNSYLVANIA (Allentown, Beaver Falls, Drexel Hill, Dormont, Erie, Harrisburg, Homestead, Lewistown, Philadelphia, Pittsburgh, Scranton, State College, Washington, Willow Grove, York): **Tillie Metzger,** 2285 Valera Ave., Pittsburgh, Pa. 15210 (phone 412-881-1991).

PUERTO RICO (San Juan): **Fred Brown,** 1991 Jose F. Diaz, Rio Piedras, P. R. 00928 (phone 809-790-5288).

RHODE ISLAND (Warwick): **King Odell,** 413 Atlantic Ave., Warwick, R. I. 02888 (phone 401-941-5472).

SOUTH CAROLINA (Charleston, Clemson, Columbia, Myrtle Beach, Sumter): **William B. Gemmill,** 11 Victoria Ave., Myrtle Beach, S. C. 29577 (phone 803-626-9628).

SOUTH DAKOTA (Rapid City, Sioux Falls): **Duane L. Corning,** Box 901 RR 4, Rapid City, S. D. 57701.

TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tri-Cities Area, Tullahoma): **Arthur MacFadden,** 4501 Amnicola Highway, Chattanooga, Tenn. 37406 (phone 615-622-6262).

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): **John Sparks,** 118 Broadway, Suite 234, San Antonio, Tex. 78205 (phone 817-723-2741).

UTAH (Brigham City, Clearfield, Ogden, Provo, Salt Lake City): **Nuel Sanders,** 370 S. 500 East, Suite 120, Clearfield, Utah 84015 (phone 801-776-2101).

VERMONT (Burlington): **John D. Navin,** 350 Spear St., Unit 64, South Burlington, Vt. 05401 (phone 802-863-1510).

VIRGINIA (Arlington, Danville, Harrisonburg, Langley AFB, Lynchburg, Norfolk, Petersburg, Richmond, Roanoke): **Ivan R. Frey,** 73 James Landing Rd., Newport News, Va. 23606 (phone 804-595-5617).

WASHINGTON (Seattle, Spokane, Tacoma): **E. A. Kees, Jr.,** 7710 Ruby Drive, S. W., Tacoma, Wash. 98498.

WEST VIRGINIA (Huntington): **David Bush,** 2317 S. Walnut Drive, St. Albans, W. Va. 25177 (phone 304-722-3583).

WISCONSIN (Madison, Milwaukee): **Kenneth Kuenn,** 3239 N. 81st St., Milwaukee, Wis. 53222 (phone 414-871-3766).

WYOMING (Cheyenne): **Al Guidotti,** P. O. Box 811, Cheyenne, Wyo. 82001 (phone 307-638-3361).

AFA Intercom

Col. Richard O. Robinson, USAF, right, Vice Commander of MAC's 76th Airlift Division, Andrews AFB, Md., presents an AFA appreciation plaque to Squadron Leader John Blackwell, leader of the Royal Air Force Red Arrows aerial demonstration team. The presentation was made at a dinner, sponsored by AFA's Andrews Chapter, honoring the Red Arrows during their visit this spring to Andrews AFB for DoD's Joint Services Open House.

Unit Reunions

CBI Hump Pilot Ass'n, Inc.
The thirty-eighth annual reunion of the China-Burma-India Hump Pilots and support personnel will be held on September 15–19, 1983, at the East Tower Complex, Town & Country Hotel, in San Diego, Calif. **Contact:** Mrs. Jan Thies, 808 Lester St., Poplar Bluff, Mo. 63901. Phone: (314) 785-2420.

National Warplane Museum
The National Warplane Museum of Geneseo will hold its fourth annual 1941 Warbird Air Show and Aviation Flea Market on September 15–18, 1983, at Geneseo Airport in Geneseo, N. Y. **Contact:** Bob Moses at (716) 243-3011 or 243-0400. Lee Ehmann at (716) 346-3689. Beverly Brisbee at (716) 658-3411.

USAF Photo-Mappers
A reunion for all personnel assigned to USAF Photo-Mapping units (1946–76), including the 311th PMW, the 55th SRW, the 91st SRW, the 1370th PMW, and ACGS, will be held on September 21–25, 1983, in Colorado Springs, Colo. **Contact:** E. B. Van Diver, 3813 Manchester St., Colorado Springs, Colo. 80907. Phone: (303) 593-9877. Max Trout, 1287 Winterhaven, Pueblo West, Colo. 81007. Phone: (303) 547-2240

USAFSS/ESC
The US Air Force Security Service/Electronic Security Command (USAFSS/ESC) and the USAFSS/ESC Alumni Association will be jointly celebrating the USAFSS/ESC thirty-fifth anniversary during their

annual reunion in San Antonio, Tex., on September 30–October 1, 1983. **Contact:** 6960 ESW/CC, Attn: USAFSS/ESC Alumni Association, San Antonio, Tex. 78243.

1st Air Division
A reunion of the 1st Air Division will be held in conjunction with the 8th AFHS on October 12–16, 1983, at the Hyatt Regency Hotel in Houston, Tex. **Contact:** Lt. Col. Henry C. Gelula, USAF (Ret.), 401 N. Douglas Ave., Margate, N. J. 08402.

8th Photo Recce Sqdn.
The 8th Photographic Reconnaissance Squadron, Fifth Air Force, will hold its sixth annual reunion on September 30–October 2, 1983, at the Hyatt Regency Hotel in Arlington, Va. **Contact:** Ernie "Barney" Ross, 9629 Yukon Ct., Broomfield, Colo. 80020. Phone: (303) 422-4242.

40th Bomb Group Ass'n
The fourth reunion of the 40th Bomb Group will be held September 23–25, 1983, in Dayton, Ohio. **Contact:** Ira V. Matthews, 1805 N. Indian Creek Dr., Mobile, Ala. 36607.

43d Bomb Group Ass'n
The 43d Bomb Group "Ken's Men," including the 63d, 64th, 65th, and 403d Squadrons, will hold its third annual reunion on September 30–October 3, 1983, on the *Queen Mary* in Long Beach, Calif. **Contact:** R. H. Butler, 511 Forest Lake Rd., Fayetteville, N. C. 28305. Phone: (1-919) 484-3013.

Class 47-C
The first USAF pilot class, known as the "Guinea Pigs," invites all former members to its annual reunion on September 28–October 1, 1983, at Cape Canaveral, Fla. **Contact:** Robert Campion, Jr., Box 88, Richardson, Tex. 75080.

Eighth Air Force Historical Society

The Eighth Air Force Historical Society, which has enlisted more than 11,800 members since its inception in 1975, will hold its ninth annual reunion on October 12–16, 1983, at the Sheraton-Houston Hotel in Houston, Tex. The Eighth Air Force Memorial Museum Foundation, Inc., an affiliate of the 8th AFHS, will hold its third Air-War Symposium during the reunion. The topic of this year's symposium is "The Characteristics and Limitations of the B-17 and the B-24 in the European Theater of Operations in WW II." For more information about the 8th AFHS, contact Lt. Col. John H. Woolnough, USAF (Ret.), P. O. Box 3556, Hollywood, Fla. 33083. Phone: (305) 961-1410.

At a recently held meeting of AFA's Greater Seattle Chapter, E. E. "Ed" Teapoorten (second from right) was presented an Aerospace Education Foundation Scott Associate Plaque in recognition of his singularly outstanding efforts at recruiting new members. Pictured above (from left) are: Dave Anderson, Washington State AFA Vice President; Al Lloyd, Greater Seattle Chapter President; Ed Teapoorten; and Michael Winslow, AFA National Director.

64th Troop Carrier Group
The 64th Troop Carrier Group reunion will be held on October 13–17, 1983, in the Washington, D. C., area. **Contact:** Roger Coleson, Box 205G, Nanjemoy, Md. 20662.

95th Bomb Group
Members of the 95th Bomb Group, a B-17 outfit in the Eighth Air Force, will hold their reunion on August 28–30, 1983, at the Imperial Palace Hotel in Las Vegas, Nev. **Contact:** M. J. Steele, 8754 Dallas St., La Mesa, Calif. 92041.

507th Fighter Group
The 507th Fighter Group will hold its thirteenth reunion on September 2–5, 1983, in Colorado Springs, Colo. **Contact:** Clyde Whaley, 3729 Wren, Fort Worth, Tex. 76133. Phone: (817) 292-0889.

613th Tactical Fighter Sqdn.
A reunion for members of the 613th Tactical Fighter Squadron assigned to England AFB, La., from 1954–63 will be held on September 9–11, 1983, in Las Vegas, Nev. **Contact:** Dale Leatham, 3870 Mayhill Ave., Las Vegas, Nev. 89121. Phone: (702) 456-7782.

671st Bomb Sqdn.
The 671st Bomb Squadron will hold an anniversary reunion in Oklahoma City, Okla., on September 15–18, 1983. **Contact:** John Maruffi, 501 Hopewell Rd., South Glastonbury, Conn. 06073. Phone: (203) 633-2281.

780th Bomb Sqdn.
The fortieth anniversary reunion for the 780th Bomb Squadron, 465th Bomb Group, Fifteenth Air Force, will be held at the Maxim Hotel in Las Vegas, Nev., on September 22–25, 1983. **Contact:** Don White, Rte. 1, Box M-11-B, Jesup, Ga. 31545. Bernard Bezinover, Box 107, Northridge, Calif. 91328. Phone: (213) 993-1280.

Coming Events

August 11–13, **California State Convention,** Sunnyvale . . . August 12–13, **Missouri State Convention,** Whiteman AFB . . . August 12–13, **North Carolina State Convention,** Pope AFB . . . August 12–14, **New York State Convention,** Rome . . . August 13–14, **North Dakota State Convention,** Minot . . . August 18–20, **Utah State Convention,** Ogden . . . August 19–20, **Wisconsin State Convention,** Milwaukee . . . August 26–28, **Oregon State Convention,** Portland . . . August 27, **Arizona State Convention,** Tucson . . . September 11–15, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C. . . . October 6–7, **AFA Symposium, "Logistics: The Long Pole in the Tent,"** Dayton, Ohio . . . October 20–22, **Aerospace Education Symposium,** Montgomery, Ala. . . . November 17–18, **AFA Symposium,** Hyatt House Airport Hotel, Los Angeles, Calif. . . . November 18, **Los Angeles Air Force Ball,** Los Angeles, Calif. . . . December 6, **Lieutenant General Jimmy Doolittle Salute Dinner,** National Air and Space Museum, Washington, D. C.

AFA's 1983 National Convention and Aerospace Development Briefings and Displays

September 11–15 • Washington, D.C.

Plan now to attend: AFA's 1983 National Convention and Aerospace Development Briefings and Displays at the new Sheraton Washington Hotel. Additional rooms available at the Shoreham Hotel across the street and the Dupont Plaza Hotel served by Metro, at substantially lower rates than the Sheraton Washington.

Hotel reservation requests: for the Sheraton Washington, send to: Sheraton Washington Hotel, 2660 Woodley Road, N. W., Washington, D.C. 20008; for the Shoreham Hotel, send to: 2500 Calvert St., N. W., Washington, D.C. 20008; and the Dupont Plaza Hotel, 1500 New Hampshire Ave., N. W., Washington, D.C. 20036. Make your reservations as soon as possible. *All three hotels have a cutoff date of August 19.* To assure acceptance of your reservation requests, please refer to the AFA National Convention. All reservation requests must be accompanied by one night's deposit or an American Express number and expiration date. Deposited reservations must be canceled by 4:00 p.m. on the date of arrival to avoid being charged for that night.

Convention activities include: Opening Ceremonies, Business Sessions, Symposia, luncheons honoring the Secretary of the Air Force and the Air Force Chief of Staff, Aerospace Education Foundation Awards Luncheon, the Annual Reception, and the black-tie 36th Air Force Anniversary Reception and Dinner Dance.

• A first this year will be an all-day symposium, Wednesday, September 14, highlighting the changes and challenges of Tactical Air Warfare. Also, on Thursday, September 15, the Aerospace Education Foundation will mount a major National Laboratory for the Advancement of Education. This one-day seminar with interested industrialists and educators will seek specific measures to stop our national drift toward scientific and technological illiteracy.

ADVANCE REGISTRATION FORM*

Air Force Association National Convention and Aerospace Development Briefings and Displays
September 11–15, 1983 • Sheraton Washington Hotel • Washington, D.C.

Type or Print

Name _____

Title _____

Affiliation _____

Address _____

City, State, ZIP _____

Note: Advance registration and/or ticket purchases must be accompanied by check made payable to AFA. Mail to AFA, 1750 Pennsylvania Ave., N.W., Suite 400, Washington, D.C. 20006.

Reserve the following for me:

___ Advance Registrations $_____
@ $115 per person (includes credentials and tickets to the following Convention functions: AF Chief of Staff Luncheon, Annual Reception, AF Secretary's Luncheon).

Tickets may also be purchased separately for the following:

___ Aerospace Ed. Foundation Luncheon @ $35 $_____
___ AF Chief of Staff Luncheon @ $35 $_____
___ Annual Reception @ $35 $_____
___ AF Secretary's Luncheon @ $35 $_____
___ AF Anniversary Reception and Dinner Dance @ $75 $_____
Total for separate tickets $_____

Total Amount Enclosed $_____

Advance Registration Fee before September 2—$115 (After September 2—$125)

*Note: Official convention delegates, national directors, vice presidents, and committee members meeting at convention should *not* use this form. Your registration information has been mailed separately to you and you are eligible to register for "Red," "White," "Blue," or "Flag" convention packages.

All members under age 65 now eligible to apply

NEW, RECORD BENEFIT

CURRENT BENEFIT TABLES

Including Substantial Benefit Increases for Policyholders Under Age 65

(effective May 31, 1982)

Member's Attained Age	STANDARD Premium: $10 per month Basic Benefit*		HIGH OPTION Premium: $15 per month Basic Benefit*		HIGH OPTION PLUS PLAN Premium: $20 per month Basic Benefit*	
	Former Coverage	New Coverage	Former Coverage	New Coverage	Former Coverage	New Coverage
20-24	$85,000	**$100,000**	$127,500	**$150,000**	$170,000	**$200,000**
25-29	85,000	**95,000**	127,500	**142,500**	170,000	**190,000**
30-34	65,000	**70,000**	97,500	**105,000**	130,000	**140,000**
35-39	50,000	**55,000**	75,000	**82,500**	100,000	**110,000**
40-44	35,000	**37,500**	52,500	**56,250**	70,000	**75,000**
45-49	20,000	**22,500**	30,000	**33,750**	40,000	**45,000**
50-54	12,500	**15,000**	18,750	**22,500**	25,000	**30,000**
55-59	10,000	**11,000**	15,000	**16,500**	20,000	**22,000**
60-64	7,500	**8,000**	11,250	**12,000**	15,000	**16,000**
65-69	4,000	**4,000**	6,000	**6,000**	8,000	**8,000**
70-74	2,500	**2,500**	3,750	**3,750**	5,000	**5,000**

AVIATION DEATH BENEFIT* (for pilots and crew members)

Non-war related: Ages 20-34—Payment of ½ the scheduled benefit. (Applies to Standard, High Option and High Option Plus Plans)
Ages 35-74—Payment of the full scheduled benefit. (Applies to Standard, High Option and High Option Plus Plans)

War related:	$15,000	$22,500	$30,000
EXTRA ACCIDENTAL DEATH BENEFIT**	$12,500	$15,000	$17,500

***AVIATION DEATH BENEFIT:** The coverage provided under the Aviation Death Benefit is paid for death which is caused by an aviation accident in which the insured is serving as pilot or crew member of the aircraft involved. Under this condition, the Aviation Death Benefit is paid in lieu of all other benefits of this coverage. Furthermore, the non-war related benefit will be paid in all cases where the death does not result from war or act of war, whether declared or undeclared.

****EXTRA ACCIDENTAL DEATH BENEFIT:** In the event of an accidental death occurring within 13 weeks of the accident, these AFA plans pay an additional lump sum benefit as shown in the tables, except as noted under AVIATION DEATH BENEFIT above.

OTHER IMPORTANT BENEFITS

COVERAGE YOU CAN KEEP. Provided you apply for coverage under age 65 (See "ELIGIBILITY") your insurance may be retained at the same low group rates to age 75.

FULL TIME, WORLD WIDE PROTECTION. The policy contains no war clause, hazardous duty restriction, combat zone waiting period or geographical limitation.

DISABILITY WAIVER OF PREMIUM. If you become totally disabled at any time prior to age 60 for at least a 9-month period, your coverage will be continued in force without further payment of premiums as long as you remain disabled.

FULL CHOICE OF SETTLEMENT OPTIONS. All standard forms of settlement options, as well as special options agreed to by the insured and United of Omaha, are available to insured members.

CONVENIENT PAYMENT PLANS. Premium payments may be made by monthly government allotment (payable to Air Force Association), or direct to AFA in quarterly, annual or semi-annual installments.

DIVIDEND POLICY. AFA's primary policy is to provide maximum coverage at the lowest possible cost. Consistent with this policy, AFA has provided year-end dividends in all but three years (during the Vietnam War) since the program was initiated in 1961, and basic coverage has been increased on seven separate occasions.

ADDITIONAL INFORMATION

Effective Date of Your Coverage. All certificates are dated and take effect on the last day of the month in which your application for coverage is approved, and coverage runs concurrently with AFA membership. AFA Group Life Insurance is written in conformity with the insurance regulations of the State of Minnesota. The insurance will be provided under the group insurance policy issued by United of Omaha to the First National Bank of Minnesota as trustees of the Air Force Association Group Insurance Trust.

EXCEPTIONS: There are a few logical exceptions to this coverage. They are:

Group Life Insurance: Benefits for suicide or death from injuries intentionally self-inflicted while sane or insane will not be effective until your coverage has been in force for 12 months.

The Accidental Death Benefit and Aviation Death Benefit shall not be effective if death results: (1) From injuries intentionally self-inflicted while sane or insane, or (2) From injuries sustained while committing a felony, or (3) Either directly or indirectly from bodily or mental infirmity, poisoning or asphyxiation from carbon monoxide, or (4) During any period a member's coverage is being continued under the waiver of premium provision, or (5) From an aviation accident, either military or civilian, in which the insured was acting as pilot or crew member of the aircraft involved, except as provided under AVIATION DEATH BENEFIT.

ELIGIBILITY

All members of the Air Force Association are eligible to apply for this coverage provided they are under age 65 at the time application for coverage is made.

*Because of certain restrictions on the issuance of group insurance coverage, applications for coverage under the group program cannot be accepted from non-active duty personnel residing in New York.

OPTIONAL FAMILY COVERAGE

PREMIUM: $2.50 per month

Member's Attained Age	Life Insurance Coverage for Spouse	Life Insurance Coverage for each child*
20-39	$20,000.00	$4,000.00
40-44	15,000.00	4,000.00
45-49	10,000.00	4,000.00
50-54	7,000.00	4,000.00
55-59	5,000.00	4,000.00
60-64	3,000.00	4,000.00
65-69	2,000.00	4,000.00
70-75	1,000.00	4,000.00

*Children under six months are provided with $250 coverage once they are 15 days old and discharged from the hospital.
Upon attaining age 21, and upon submission of satisfactory evidence of insurability, insured dependent children may replace this $4,000 group coverage (in most states) with a $10,000 permanent individual life insurance policy with guaranteed purchase options.

Please Retain This Medical Bureau Prenotification For Your Records

Information regarding your insurability will be treated as confidential. United of Oma Life Insurance Company may, however, make a brief report thereon to the Medi Information Bureau, a nonprofit membership organization of life insurance compani which operates an information exchange on behalf of its members. If you apply another bureau member company for life or health insurance coverage, or a claim benefits is submitted to such a company, the Bureau, upon request, will supply su company with the information in its file.

Upon receipt of a request from you, the Bureau will arrange disclosure of a information it may have in your file. (Medical information will be disclosed only to yo attending physician.) If you question the accuracy of information in the Bureau's fi you may contact the Bureau and seek a correction in accordance with the procedures s forth in the federal Fair Credit Reporting Act. The address of the Bureau's informat office is P.O. Box 105, Essex Station, Boston, Mass. 02112. Phone (617) 426-3660.

United of Omaha Life Insurance Company may also release information in its file other life insurance companies to whom you may apply for life or health insurance, or whom a claim for benefits may be submitted.

OW AVAILABLE (30% Dividend—1981)

APPLICATION FOR
AFA GROUP LIFE INSURANCE

United of Omaha

Group Policy GLG-2625
United of Omaha Life Insurance Company
Home Office Omaha Nebraska

Full name of member _____
Rank Last First Middle

Address _____
Number and Street City State ZIP Code

Date of birth	Height	Weight	Social Security Number
Mo. Day Yr.			

This insurance is available only to AFA members

☐ I enclose $15 for annual AFA membership dues (includes subscription ($9) 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:

Mode of Payment	Plan of Insurance: Standard Plan		High Option Plan		High Option PLUS Plan	
	Member Only	Member And Dependents	Member Only	Member And Dependents	Member Only	Member And Dependents
Monthly government allotment (only for military personnel). I enclose 2 month's 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 medical or 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

FORM 3767GL App REV. 10-79

Application must be accompanied by a check or money order. Send remittance to:
Insurance Division, AFA, 1750 Pennsylvania Avenue, NW, Washington, D.C. 20006

8/83

Bob Stevens'

"There I was..."

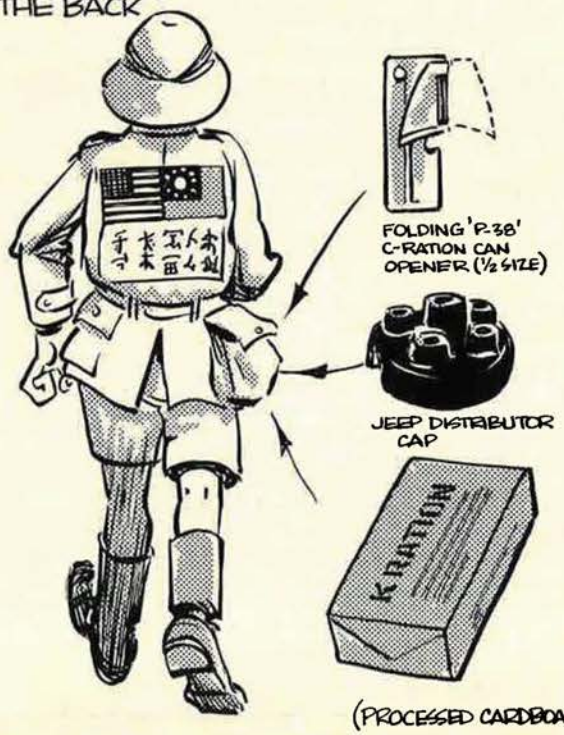
RECENTLY THIS MAGAZINE RAN A STORY WHICH FEATURED A COLUMN CALLED, "YOU KNOW YOU'RE OVERSEAS WHEN..." THIS PROMPTED THE FOLLOWING FROM THE *EX-CBI (CHINA BURMA INDIA) ROUNDUP* FROM WW II –

"YOU KNOW YOU'RE A ***REAL*** CBIer WHEN YOU OPEN YOUR BEER CAN WITH A BAYONET..."

TROPICAL VERSION OF GI BROGANS

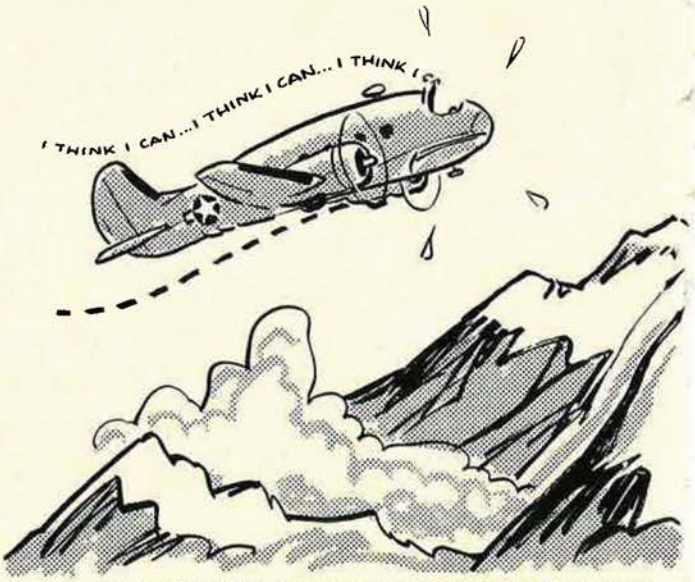
"REAL CBIers DON'T CALCULATE THE LOAD OF AN AIRPLANE. THEY EYEBALL THE CARGO *and* TAKE OFF WHEN THE PLANE LOOKS FULL"

"REAL CBIers WEAR JACKETS WITH STRANGE FLAGS *and* CRAZY WRITING ON THE BACK"



(PROCESSED CARDBOARD)

"REAL CBIers TRAVEL ANYWHERE IN THE WORLD FOR ANY LENGTH OF TIME WITH ONE BEAT-UP FLIGHT BAG"*



* WITH SPACE, OF COURSE, FOR CAMEL CIGARETTES, HERSHEY BARS & LADIES' SILK STOCKINGS!

Bob Stevens

ELECTRONIC WARFARE SYSTEMS ARE NOW MORE TACTICAL AND PRACTICAL...

BECAUSE SPERRY KNOWS HOW TO LISTEN.

Helping to maintain our operational edge with systems for defensive countermeasures, signal intelligence, and EW simulation and training, Sperry is keeping a technological step ahead.

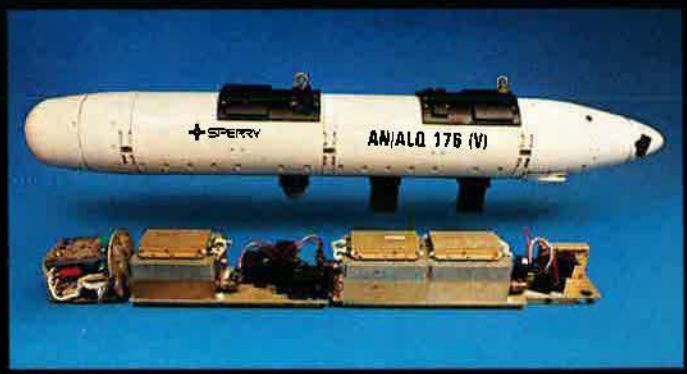
Our AN/ALQ-176(V) pod jammer mounts on standard aircraft stores/munitions stations, and provides generic, multimission capabilities in ECM support, standoff jamming, combat evaluation and training capabilities for a wide range of aircraft. Operating on either aircraft power or its own ram-air, turbine generator, this slim pod can accommodate up to five transmitters in variable ECM configurations—depending upon the threat and the mission. And our unique technology, design and packaging within the pod allow the AN/ALQ-176(V) to be modified quickly in response to new threats.

Successfully tested and evaluated by both the United States Air Force and the Royal Norwegian Air Force, this versatile system provides multi-band frequency ECM capabilities for fighter attack, transport and training aircraft.

For NATO's TRACS VANS Program, Sperry is developing a transportable radar, ECM, and communications simulator for realistic, at-sea combat training. Capable of simulating dense threat environments under high-speed computer control, TRACS VANS will help to evaluate and improve the NATO force readiness capability.

For more information on what we're up to in electronic warfare, just ask us...we understand how important it is to listen.

Write to Sperry Corporation, Electronic Systems, Great Neck, NY 11020. Attention: Marketing Department.



SPERRY

New Vital Simulation Systems:

Texture you can "feel" with your eyes. Texture no other system can match for the money.

Now, with Vital, terrain has substance and depth. Water has waves. Clouds take on natural shapes. Sand and snow sweep across tire-marked runways.

The illusion of reality, only suggested in still photos, comes vividly alive in Vital. You have to see Vital at work to appreciate how texture heightens realism and accentuates training cues. Pilots making Vital simulated approaches become keenly aware of descent rate and ground proximity. Distance and speed can be judged with remarkable accuracy and assurance.

New Vital systems—Vital V with an expanded color-beam penetration display and Vital VI with a full color shadow-mask display—are structured around totally new, flexible and expandable multiprocessor architecture.

These new Vital systems are joining more than 200 Vital installations operating an average of 20 hours a day, seven days a week—at 98% availability—in customer facilities around the world. No other visual simulation system matches Vital for capability, reliability and ease of support.

They are designed to meet all present and future FAA requirements for total simulation training, and the military's need for full mission training. They provide this capability at a cost lower than any competing system.

For more details, or to arrange a demonstration, contact: Vital Marketing, McDonnell Douglas Electronics Company, Box 426, St. Charles, MO 63301. Phone (314) 925-4467. Telex 447369.

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