JUNE 1986/$2

AIR FORCE

PUBLISHED BY THE AIR FORCE ASSOCIATION

MAGAZINE

Mastering the Transatmosphere

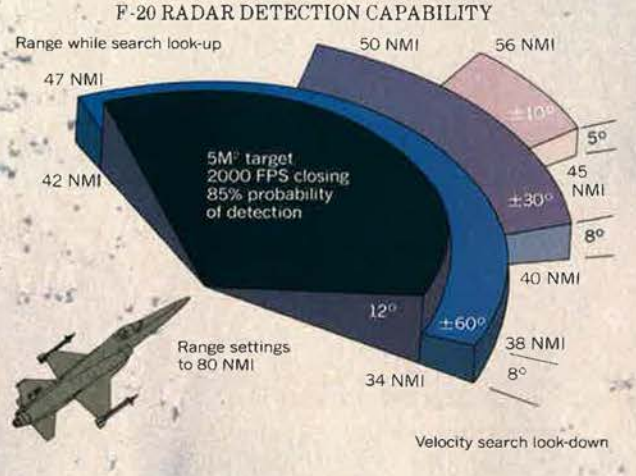
Bringing on the B-1B

Airpower in Iberia

The F-20 detects, acquires and prioritizes up to ten targets. Displays the eight most critical. Positive target identification. Day, night or adverse weather. Launches on targets beyond visual range.

Carries AIM-7. AIM-9. AIM-120 AMRAAM. With AIM-120, can simultaneously engage multiple targets.

All required switches and controls on the stick and throttle.



F-20 Tigershark

America's Newest Tactical Fighter

Northrop Corporation
1840 Century Park East
Los Angeles, CA 90067-2199 USA

THESE BIRDS FLY WITH GARRETT ELECTRONICS

Garrett Electronic Systems are found on nearly every aircraft flying.

Military fighters and transports rely on Garrett air data computers to provide accurate flight information.

Over 90% of the free world's aircraft depend on Garrett controls for cabin pressure.

Garrett fuel control and flight management systems contribute to more efficient aircraft operations.

For customers worldwide, we also design engine accessories, thrust management systems and engine health monitoring.

Whatever your next project, Garrett Electronics will make it fly.

Garrett AiResearch Electronics Systems Division, 2701 E. Elvira Road, Tucson, Arizona 85706. (602) 573-6612.

GARRETT

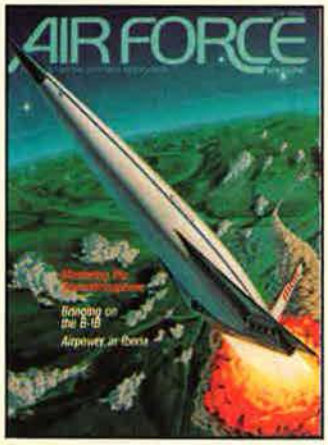
JUNE 1986
VOLUME 69, NUMBER 6

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Page 74

Page 94



About the cover: The airbrush rendering of the National Aerospace Plane (NASP) is by artist John Porter, whose work was last seen on our February issue cover, illustrating "The Military Balance." For more on NASP, see p. 48.

Special Section: Space/Strategic Forces

Features

Departments

AIR FORCE Magazine (ISSN 0730-6784) June 1986 (Vol. 69, No. 6) is published monthly by the Air Force Association, 1501 Lee Highway, Arlington, Va. 22209-1198. **Phone** (703) 247-5800. Second-class postage paid at Arlington, Va., and additional mailing offices. **Membership Rate:** $18 per year; $42 for three-year membership. **Life Membership:** $250. **Subscription rate:** $18 per year; $25 per year additional for postage to foreign addresses (except Canada and Mexico, which are $8 per year additional). Regular issues $2 each. Special issues (Soviet Aerospace Almanac, USAF Almanac issue, Anniversary Issue, and "Military Balance" issue) $5 each. **Change of address** requires four weeks' notice. Please include mailing label. **POSTMASTER:** Send change of address to Air Force Association, 1501 Lee Highway, Arlington, Va. 22209-1198. Publisher assumes no responsibility for unsolicited material.

AN EDITORIAL

Learning, Teaching, and Learning

By Russell E. Dougherty, PUBLISHER

I RETIRE as Executive Director of AFA June 1, turning over my responsibilities to a worthy successor, David L. Gray. This is my final editorial as Publisher of AIR FORCE Magazine. Thus it is time for a bit of traditional "end-of-tour" reflection about what has been achieved in the 1980s—and about the job yet to be done.

Significant among these reflections is the change Congress agreed to make in our charter in 1982—deleting the adjective "war" from our "war-veteran" member requirement. This seemingly minor change expanded significantly the composition and the future course of our Association and added substance to our classic mission.

Prior to enactment of this legislation, at least seventy-five percent of AFA's members had to have served during active conflict. The change made it possible for thousands of young veterans without war service to affiliate with AFA and share its objective of preventing future wars through prudent strength and constant readiness. It underscored the importance of the peacetime military mission of deterring wars and preserving the peace. And it accentuated our responsibility to perpetuate the vital body of knowledge about national security and the employment of military force through a never-ending process of learning and teaching and learning and teaching.

A basic constitutional mandate of our Association is "to educate ourselves and the public at large in the development of adequate aerospace power" for our nation's security and for the benefit of all mankind.

This tenet of our Association flows from the legacy of our founder, General of the Air Force Henry A. "Hap" Arnold, through our first President, General Jimmy Doolittle, and all succeeding AFA officials. This is important, for it is aerospace power that provides or denies global access, either for good or for evil. We cannot ignore the implications of this basic fact if we would protect our freedoms and our security.

All too often, our Association as well as our fellow citizens, our government, and our educational system default in our responsibility to educate ourselves and our successor generations on the importance of this overarching aspect of our nation's strength. We ignore the lessons of history; we fail to appreciate the dynamism of research and development; we try to understand and rationalize inimical forces through reflections in our own mirror; we want to leave tough decisions to others—electing to be observers rather than participants in our vital security interests.

Accepting these "teaching-learning-sharing-doing" responsibilities of our Association and of basic citizenship is difficult. But notwithstanding the difficulty, it is a task that we must accept if we are to avoid inferiority and oblivion experienced by other effete societies that just couldn't be bothered with the responsibility of vigilance.

It is not easy to sort out the real issues of defense from the bumper-sticker slogans and parochial jingoism that surround us. It is not easy to educate ourselves and convince Congress that the best and most reliable guarantee of peace with freedom is real, relevant strength. It is extremely difficult to keep up the morale of our military forces and keep their combat capabilities honed to an edge when we know that the more successful we are, the less chance they will ever be used. It is difficult to create an understanding of the danger to our national security in advance of coercive aggression or a military attack—and then it may be too late.

The most difficult of all these tasks will be that of convincing and inspiring our fellow citizens of the necessity to take actions in advance to defend and protect our political freedoms before they are put in jeopardy. Solzhenitsyn gave us the most prescient admonition I have ever read when, in *The Gulag Archipelago,* he wrote: "Free men do not know the value of things!"

As difficult as these things are, the best chance of success in all of them lies in serious, responsible education—not just academic exercises, but practical education based on experience, common sense, and involvement in the learning-teaching-learning process. Education, however, is not the answer if it is abstract and ill-founded.

That's where we come in. Within our Association, we have an unmatched wealth of experience and wisdom in security issues, military knowledge, and international understanding. It is our responsibility to teach and learn and teach some more. It is our civic obligation to our successors to see to it that the education they receive in our schools is adequate to prepare them to lead our nation in the future.

As I terminate my tenure as your Publisher and retire as AFA's Executive Director, I urge my fellow members to accept their obligation to the education of our nation—for themselves and for our fellow men. Let's get involved and stay involved. An educated and motivated population is the first step toward avoiding national ruin and is the *sine qua non* of our survival. ■

Now delivering... Singer-Rockwell TDMA JTIDS Terminals

JTIDS, the Joint Tactical Information Distribution System, is now a reality with integration in process in U.S. Air Force F-15 aircraft and the U.S. Army PLRS-JTIDS Hybrid.

Rockwell International's Collins Government Avionics Division and Singer's Kearfott Division are delivering AN/URC-107(V) Class 2 terminals which will make it possible for Air Force and Army elements to coordinate missions with reliable, real-time information.

AWACS and fighter-attack aircraft can share common information with Army ground air defense, artillery and surface-to-air missile commands over the JTIDS network. The services will also share data on enemy positions, speed and strength and important information about friendly forces, such as identity and positions, weapons status and fuel reserves.

Here's how we've geared-up for full scale production:

- Through participation in the U.S. Air Force Tech Mod program, our facilities modernization plan promises high-quality, low-cost production.
- We're applying 40 years of Collins RF expertise—including production of 20,000 ARN-118 TACANs and more than 14,000 ARC-186 VHF transceivers.
- We've developed advanced handling, assembly and test methods for RF circuitry, lead-less chips and surface-mounted devices for efficient production of JTIDS Class 2 terminals.

Rockwell and Singer are committed to providing the lightning-fast information our services 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. Or call (319) 395-2208.

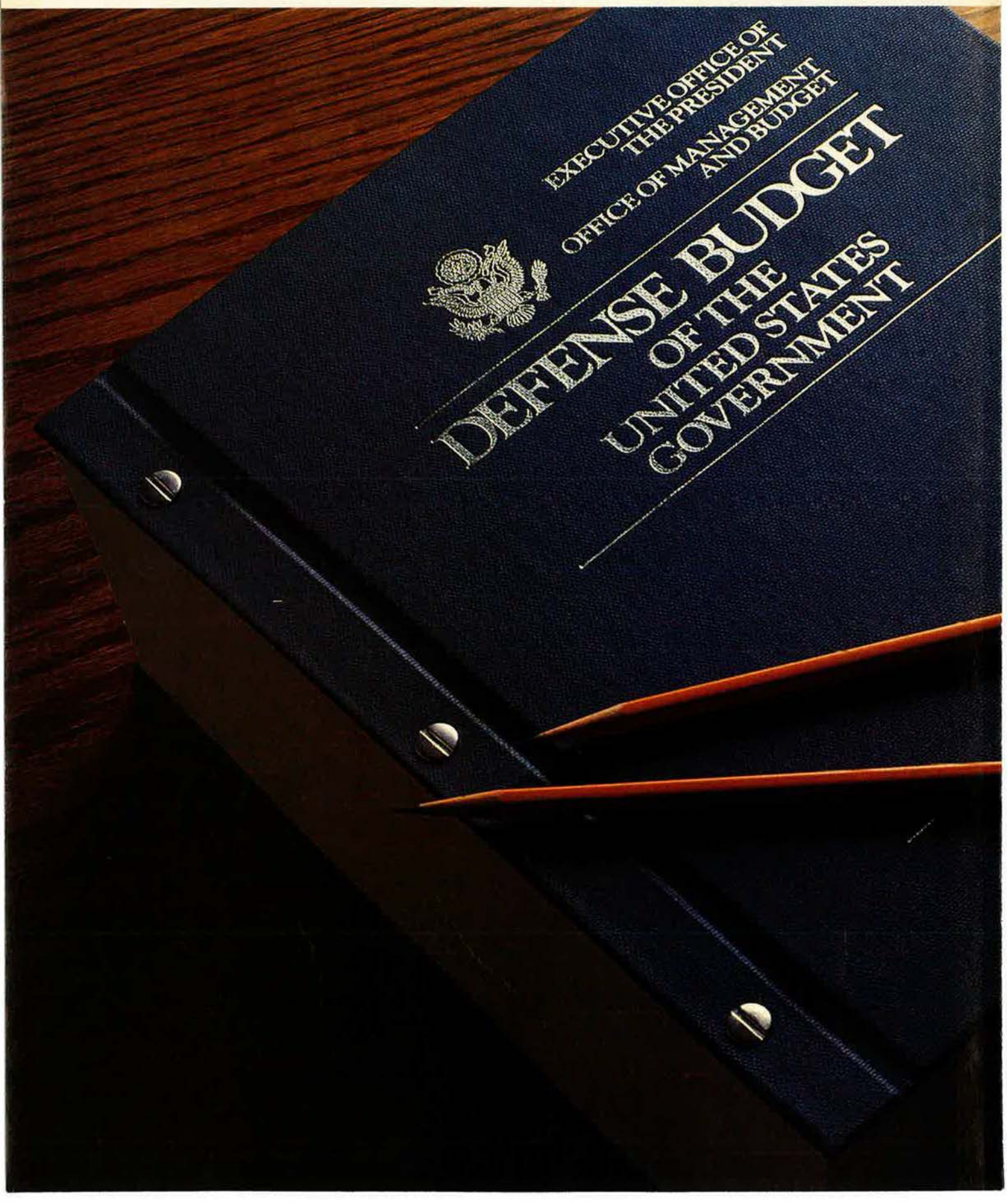
COLLINS AVIONICS

Rockwell International

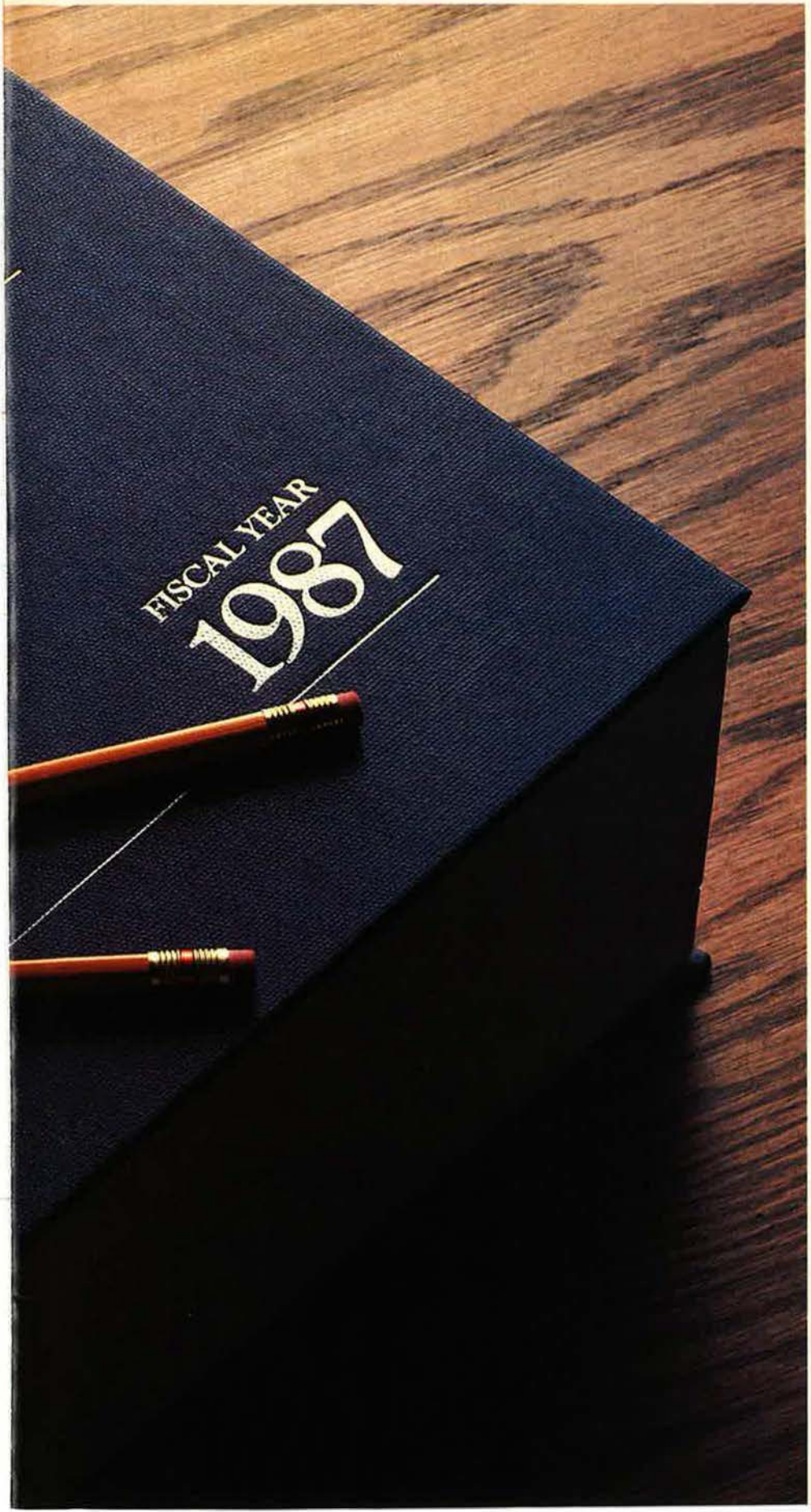
...where science gets down to business

Aerospace / Electronics / Automotive
General Industries / A-B Industrial Automation

THE BOEING ATF



FIGURES WELL IN OUR COUNTRY'S DEFENSE.



The assignment: Build the world's most advanced tactical fighter for less than $35 million per unit. At the same time, keep operating and support costs to an absolute minimum.

The solution: The Boeing ATF.

The reason: Expertise.

Boeing ATF avionics do the job better, for less. A modular design reduces the number of connections by 90%. And standardized pooled spares keep the ATF in the air with fewer maintenance manhours per flight hour. All of which will help the Boeing ATF cut avionics maintenance by 60%.

Thermoplastics developed by Boeing provide a lighter, stronger airframe at the same cost as current fighters. Thermoplastics are tougher and easier to maintain than aluminum or thermoset composites. And Boeing's innovative airframe construction requires 50% fewer fasteners and parts.

The Factory of the Future will help Boeing control costs even further. Computer-aided inventory control will eliminate waiting for parts. And an automated stockroom will be operated by robots that can handle 20 times the weight a human can.

Add it all together and it's easy to see why the Boeing ATF can be one of our country's most effective *and* affordable deterrents.

BOEING

Weapon Systems Acquisition

Excellence in Weapon Systems Engineering . . . Our Business for Over 37 Years

Vitro Corporation provides weapon systems engineering to the Department of Defense. Founded in 1948 and with nearly 6,000 employees worldwide, Vitro possesses a large experience base for engineering, system integration, and logistic support.

Time and again Vitro delivers. From system software as computer program design agent for the Ground Launched Cruise Missile to systems engineering as system integration agent for Terrier and Tartar guided missile weapons systems.

Vitro applies the rigorous methodologies that ensure reliable systems . . . systems that work.

Vitro Corporation provides a broad array of weapons technology skills, including systems analysis, acquisition support, program management assistance, and data management.

Vitro Corporation is bringing our weapon systems engineering and acquisition experience to Ft. Walton Beach to support the U.S. Air Force Systems Command, Armament Division . . . to continue a tradition of excellence.

Vitro *Turning Today's Technologies Into Tomorrow's Systems*

CORPORATION

14000 Georgia Avenue, Silver Spring, Maryland 20910
For information call our Marketing Manager, (301) 231-1300

A Unit of the Penn Central Federal Systems Company

AIRMAIL

Unchanged Values?

The attitude displayed by Editor in Chief John T. Correll in his editorial "The Drift of Values" is remarkably sophomoric *(April '86 issue, p. 4)*. Furthermore, Mr. Correll presents highly selective and misleading arguments to explain his view. I, for one, take great exception to his claim that American values have degenerated.

One should remember that this great nation watched Hitler rearm Germany, watched German armies overrun most of Europe, and watched Japanese armies conquer much of Asia before acting. In fact, it wasn't until 2,000 Americans lost their lives at Pearl Harbor that the public began to display the spirit of sacrifice and national unity required to defeat the Axis powers.

Today, has there been a "Pearl Harbor" to arouse the American people? Only if Americans fail to respond to an incident of similar magnitude can Mr. Correll claim that our values have changed.

Mr. Correll also equates more dollars given to defense with increased national security. It's not quite that simple. The output of defense spending is important (*e.g.*, force structure improvements, higher pay, better training), not spending in itself. Granted, it is difficult to measure security; however, it is not based solely on the level of spending.

Moreover, Americans today are reacting to incidents of cost overruns in military programs that approach criminal negligence. Given this, there is no reason to denigrate the values of Americans concerned about government spending.

Percentages of the GNP allocated to defense are presented to convince the reader that our values have changed. Less than seven percent is spent on defense today, whereas 8.3 percent was spent on defense in 1961. In addition, today's share for defense represents a smaller percentage of federal spending than in 1951–72.

This is misleading. The appropriate level of defense spending should be tied to the missions that the military is expected to accomplish. The level of defense spending during the post-World War II buildup (the Korean War era), spending following the Sputnik scare, and spending during the Vietnam War (all of which occurred between 1951–72) have little direct relevance to spending levels today. To suggest that we spend 8.3 percent on defense today because we did it twenty-five years ago is plain wrong.

Finally, Mr. Correll indicates that allocating a greater share of the nation's wealth to defense will let our troops know that they will not be dispatched casually to die in unpopular wars. There is simply no connection here. The experience of Vietnam should demonstrate that higher defense budgets and dirty wars that our fellow citizens don't care for are not mutually exclusive.

The tone of Mr. Correll's editorial is one of remembering how tough it was, how tough one must have been to make the attendant sacrifices. I don't feel that Americans today are that different. Mr. Correll should realize that the situation has changed, not the values of the vast majority of Americans.

James K. Rosa
Falls Church, Va.

This letter is in reference to your editorial "The Drift of Values" in the April 1986 issue.

You say American values are changing. I disagree. I believe that Americans still want a strong national defense and are as prepared as ever to sacrifice and die for their freedom.

What they are not prepared to pay for are weapons that don't work and that are overpriced, untold layers of bureaucracy at the Pentagon, where the brass claw their way to the next promotion, and congressmen who beat each other over the head to keep an outmoded military facility or the production of yet another weapon system in their district.

What they are not prepared to do is to die in small, ill-conceived wars that are merely macho muscle-flexing.

The Packard Commission's recommendations are a good first step toward demonstrating a willingness to give the taxpayer value for his money.

In other words, stop throwing money at the problems, and plan!

Judith A. Meredith
Annandale, Va.

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

Canada's Contributions

I was pleased to read the article by Contributing Editor John L. Frisbee on "Canada's Air Command" in the April 1986 issue of AIR FORCE Magazine *(p. 112)*. I think that we fail to appreciate the military forces of our allies, and this is a useful reminder of the contributions of others.

I do have one comment that I would like to make, however. The reference to the Air Reserve Group is very short, and although the size of the Group is small, it is an important element in the total force structure.

The Air Reserve Group consists of two Air Reserve Wings at Montreal and Toronto, each of which has two squadrons of Kiowa helicopters. These four squadrons would supplement 10 Tactical Air Group in support of Mobile Command. In addition, there are three other standalone squadrons with Dakota, Twin Otter, and Tracker aircraft, which supplement the transport and other responsibilities of Air Command.

While the reserve element is small, it does contribute an important part of the total force.

Edward B. Davis
Charleston, S. C.

AAF Torpedo Bombers

It was good to read John Frisbee's article "Marauders at Midway" in the April 1986 issue of AIR FORCE Maga-

AIR FORCE MAGAZINE
PUBLISHED BY THE AIR FORCE ASSOCIATION

Publisher
Russell E. Dougherty

Deputy Publisher
Andrew B. Anderson

Associate Publishers
Charles E. Cruze, Richard M. Skinner

Editor in Chief
John T. Correll

Senior Editor (Policy & Technology)
Edgar Ulsamer

Senior Editors
James W. Canan, James P. Coyne

Staff Editor
Jeffrey P. Rhodes

Military Relations Editor
James A. McDonnell, Jr.

Contributing Editors
John L. Frisbee
Brian Green
Gen. T. R. Milton, USAF (Ret.)
Maj. Randal E. Morger, USAF
John W. R. Taylor ("Jane's Supplement")
Robin L. Whittle

Managing Editor
Richard M. Skinner

Assistant Managing Editor
Hugh Winkler

Director of Production
Robert T. Shaughness

Art Director
Guy Aceto

Research Librarian
Pearlie M. Draughn

Editorial Assistants
Colleen A. Bollard, Grace Lizzio

Secretary to the Editor in Chief
Dorothy L. Swain

Advertising Director
Charles E. Cruze
1501 Lee Highway
Arlington, Va. 22209-1198
Tel: 703/247-5800

Director of Marketing Services
Patricia Teevan—703/247-5800

AREA ADVERTISING MANAGERS
East Coast and Canada
By Nicholas—203/357-7781

Midwest
William Farrell—312/446-4304

West Coast
Gary Gelt—213/641-7970

UK, Benelux, France, and Scandinavia
Richard A. Ewin
David Harrison
Overseas Publicity Ltd.
91-101 Oxford Street
London W1R 1RA, England
Tel: 1-439-9263

Italy and Switzerland
Dr. Vittorio F. Negrone, Ediconsult
Internationale S.A.S. Piazzo Fontane Marose 3
16123 Genova, Italy
Tel: (010) 543659

Germany and Austria
Fritz Thimm
645 Hanau am Main, Friedrichstrasse 15
W. Germany
Tel: (06181) 32118

BPA Circulation audited by Business Publication Audit

AIRMAIL

zine *(p. 140)*. Although primarily a well-deserved tribute to Jim Collins, I appreciated reading one of the little-known stories about an often-maligned and almost forgotten aircraft of World War II.

Following Jim Collins's experience in the Pacific at Midway, B-26s assigned to the 17th Bomb Group and committed to the North African campaign were equipped with external torpedo shackles under the fuselage and a mechanical aiming and release device remoted to the cockpit. We then received training from a Naval officer and two enlisted technicians on the care and deployment of Naval aircraft torpedoes. The suggested tactic was to initiate a torpedo run at a prescribed altitude and, for a B-26, very low airspeed.

Following the torpedo release, the run was to be continued, skip-bombing with internally carried 500-pound general-purpose bombs. B-26s making the low-altitude torpedo run would be covered by a higher B-26 group making level runs on the target ships. . . .

I did not fly any torpedo missions, and, after forty-three years, I do not recall any specific missions when torpedoes were actually dropped. However, if any such missions were flown, then I'm sure you will receive comments from the participants. . . .

Lt. Col. Seymour Liebman,
USAF (Ret.)
Northport, N. Y.

Re: The "Valor" article "Marauders at Midway" in your April 1986 issue.

With all due credit to Jim Collins and the other B-26 fly guys on that day in June, they were not the only ones to carry torpedoes into combat. The article ends with the statement, "According to Air Force historians, the AAF never again sent torpedo-armed bombers into combat."

The historians should have done more research. The B-25s of the 47th Bomb Squadron, 41st Bomb Group, Seventh Air Force, did just that.

We B-25 boys trained to use torpedoes at Eglin Field, Fla. We used these torpedoes at Sesebo harbor, Kyushu, Japan, a number of times in 1945. I should know, because I was one of those fly guys!

John Mahan
Merrimack, N. H.

European Aerospace

I was saddened to read John Cutcher's letter concerning Airbus Industrie and its products in the April 1986 "Airmail" *(p. 10)*. Financial profitability must never be the sole criterion for judging the worth of anything man-made, and, if we are honest, we must admit that commercial aviation has received subsidies of one kind or another throughout its history. Generous airmail contracts helped to establish early commercial airlines; more recently, airliner production has been underwritten sometimes by contracts for military versions of the same type. Such assistance to operators and manufacturers makes good sense.

As Editor of *Jane's All the World's Aircraft*, I am not concerned directly with aircraft prices or economics, although I deplore some of the less attractive practices in aircraft salesmanship that come to light from time to time. As an engineer, I can only view the Airbus program as the most productive commercial transport design and manufacturing venture yet undertaken on this side of the Atlantic. As such, it has been successful in keeping large sections of Europe's highly capable aviation industry alive and at work.

With the exception of a few companies such as Dassault, it is true that Europe has never been efficient at marketing its airplanes, but this does not mean that all jobs in the airliner business belong in Seattle and Long Beach, where salesmen might be more successful. Profits keep only companies alive. It takes sound engineering, as well, to keep passengers alive. In this respect, Europe has nothing of which to be ashamed.

Mr. Cutcher refers to the early success of the Viscount, when the UK pioneered turbine transportation. Today, the only supersonic airliner in the world, making a handsome operating profit in routine day-to-day service, is the Anglo-French Concorde. In the military field, the first and only Western V/STOL aircraft is the British-conceived Harrier.

Those who read my annual Aerospace Surveys in AIR FORCE Magazine *(see also "Jane's Aerospace Survey 1986," January '86 issue, p. 68)* and Forewords in *Jane's All the World's Aircraft* will know that such comments imply no European or British bias. Boeing builds the superlative 747 as the unique flagship of a family of great airliners. But if the West bought its commercial transports only from Boeing and Douglas, we should be in danger of drifting toward a policy of buying all military aircraft in St. Louis, Bethpage, Fort Worth,

CHEAP SHOT

LTV's Hypervelocity Missile: Fast, accurate and affordable.

The column of enemy tanks is still several miles away when the attacking aircraft swings onto its firing run. Its FLIR is already tracking their heat signatures. Less than three seconds later, with the aircraft still safely out of range, the missiles slam into their targets with uncanny accuracy.

Low Cost, High Firepower

One of the most awesomely effective weapons ever developed for Close Air Support/Battlefield Air Interdiction, the Hypervelocity Missile (HVM) weapon system was designed to deliver maximum firepower at a cost far below anything in our current inventory. A product of Vought Missiles and Advanced Programs Division of LTV Aerospace and Defense Company, HVM is a masterpiece of simplicity and ingenuity. It carries no warhead, relying instead on its blistering 5000-foot-per-second speed to blast a penetrator rod through heavy multi-plate armor, even at highly oblique angles at extreme range.

Its guidance system is a simple CO_2 laser, mounted on the aircraft. With only an aft-looking receiver on the missile, the amount of expensive "throwaway" hardware is held to an absolute minimum. And because HVM is a "wooden round" with no warhead, storage and handling are simpler, safer and cheaper.

Multiple Targets, Maximum Effect

The system can track and attack multiple targets simultaneously—any ground vehicle, fixed or mobile. In live fire tests an HVM was purposely aimed more than 100 feet off-target. Automatic guidance brought the missile to impact near the target center.

With no bulky on-board guidance system or warhead, the HVM is small enough to permit a large loadout—up to 24 per aircraft, at a low installed drag.

No other weapon system has ever given the CAS/BAI pilot the HVM's unique advantages in speed, accuracy and survivability—advantages matched only by its cost-efficiency and low susceptibility to countermeasures.

LTV Aerospace and Defense Company, Vought Missiles and Advanced Programs Division, P.O. Box 650003, Mail Stop MC-49, Dallas, Texas 75265-0003.

LTV Aerospace and Defense
Vought Missiles and Advanced Programs Division

L T V : L O O K I N G A H E A D

"WE BUILD THE BEST MISSILES BY STARTING FROM THE GROUND UP. QUITE LITERALLY."

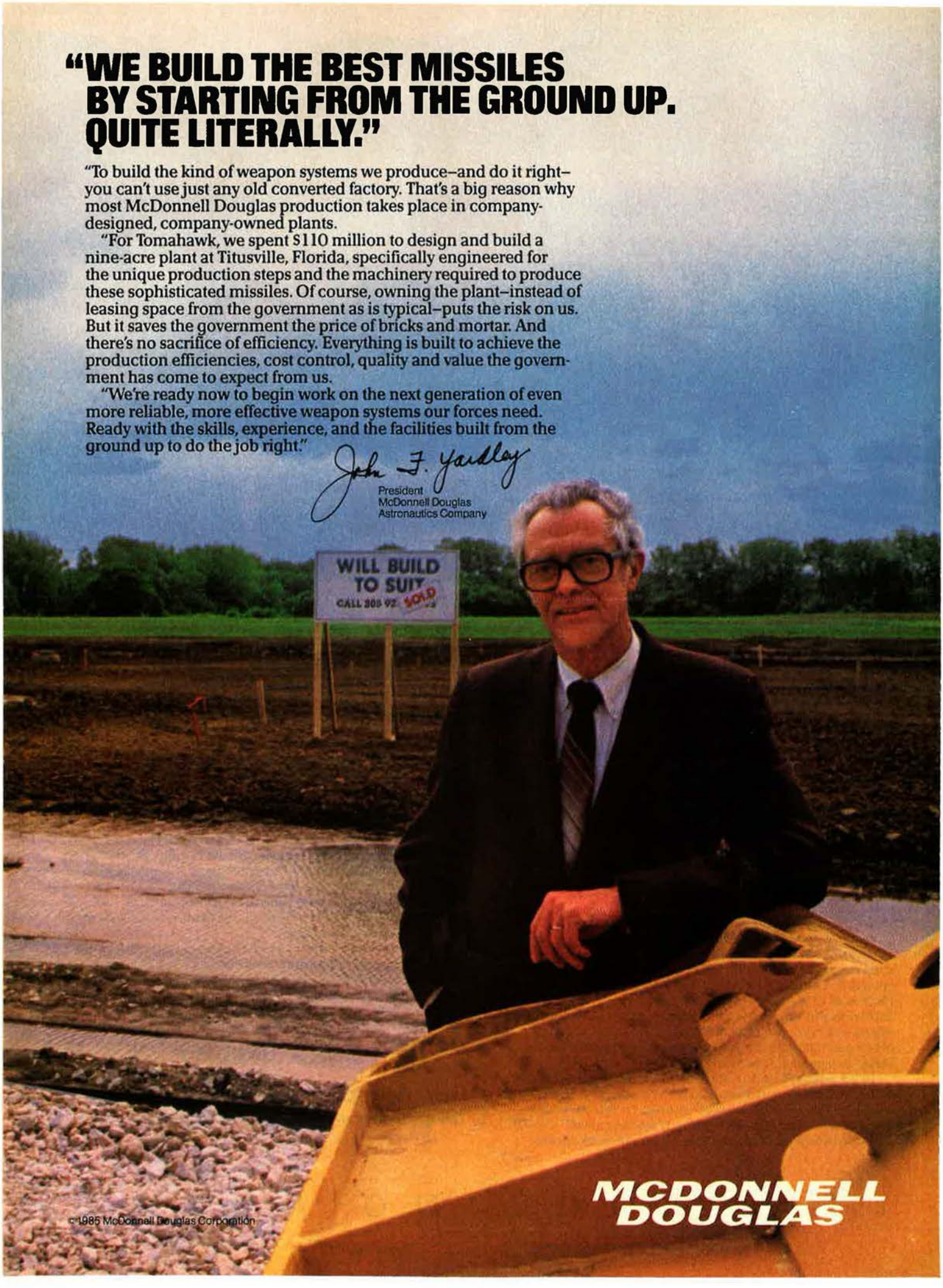
"To build the kind of weapon systems we produce–and do it right–you can't use just any old converted factory. That's a big reason why most McDonnell Douglas production takes place in company-designed, company-owned plants.

"For Tomahawk, we spent $110 million to design and build a nine-acre plant at Titusville, Florida, specifically engineered for the unique production steps and the machinery required to produce these sophisticated missiles. Of course, owning the plant–instead of leasing space from the government as is typical–puts the risk on us. But it saves the government the price of bricks and mortar. And there's no sacrifice of efficiency. Everything is built to achieve the production efficiencies, cost control, quality and value the government has come to expect from us.

"We're ready now to begin work on the next generation of even more reliable, more effective weapon systems our forces need. Ready with the skills, experience, and the facilities built from the ground up to do the job right."

John F. Yardley

President
McDonnell Douglas
Astronautics Company



MCDONNELL DOUGLAS

AIRMAIL

and California. Such a policy belongs in the East. All but the smallest airliners and all combat aircraft flown by Warsaw Pact nations are designed in the Soviet Union. The long-established and competent industries of Poland and Czechoslovakia manufacture little but trainers, gliders, small helicopters, and general aviation types.

Is this really what we want? At the moment, we have a company in Toulouse that has sold more than 500 large airliners since the early 1970s—ninety-two of them last year. They have also played a major part in keeping alive a European industry that has proved its worth in war and peace, pioneering many of the major advances throughout the history of powered aeroplane flight. Surely, with more than 890,000,000 passengers to carry on scheduled airline services each year, there is room for Airbus as well as Boeing and Douglas.

If economics had always been paramount, few pioneer aviators would ever have left the ground. Nor, throughout history, would anyone have built a great bridge or cathedral if it had been required to show a profit. Bridges, like commercial airplanes, link communities. Cathedrals provide places in which to thank God for the blessings of employment and the freedom to trade in ways that sometimes benefit nations other than our own.

The alternative is summed up cynically in the title of the James Bond film, *Live and Let Die.*

John W. R. Taylor
Surbiton, Surrey
United Kingdom

In the Bag

Re: The TAC Commander's views on better-dressed pilots *(see "Aerospace World," April '86 issue, p. 41).*

Your article reported that Gen. Robert D. Russ, TAC Commander, was searching for a better-looking uniform possibly to replace the "green bags." Such a uniform already exists. MAC aircrews belonging to the 1st Helicopter Squadron and Det. 2, 67th ARRS, along with several other non-MAC units, are wearing a blue Nomex flight suit and flight jacket that I researched, designed, tested, and procured.

The blue Nomex flight uniforms (Air Force Shade 1578, the same color as the flight caps) are similar to the green Nomex flight uniforms, but more professional in appearance. The knife pocket has been eliminated, and epaulets have been added to both the suit and jacket. This flight uniform was tested and met or exceeded the requirements of the green Nomex flight uniforms.

Provided that the Nomex material is solution-dyed, as both the green and blue uniforms are, it is my understanding that the material will not lose any of its fire-retardant qualities, no matter how often it is washed.

Capt. David C. Delisio, USAF
Andrews AFB, Md.

SAMs for Afghanistan

While the recent Administration decision to send advanced shoulder-launched SAMs to Afghanistan is a good one, depending on Stinger SAMs is not. It is not in the best interests of the US to allow our most advanced technology to fall into Soviet hands. I doubt that it will prove to be feasible for guerrillas to provide the necessary support for such a complex system.

A much better idea would be to send a mixture of different SAM systems. The goal of sending advanced SAMs should be to make it more difficult for the Soviets to provide effective countermeasures for their aircraft. The more different kinds of systems they have to defend against, the more complex that task will be.

The primary emphasis should be on the British Blowpipe. This is an all-aspect SAM designed to be operated without external support and under harsh conditions. It would force the Soviets to use ECM as well as flares to stop missiles. Active jammers can be detected with relatively primitive RDF equipment, making helicopters easier to find at longer ranges. SA-7s, Redeyes, and some Stingers would provide a diversified threat.

Scott Kitterman
Overland Park, Kan.

XLB-5 Crash

I am currently researching the crash of a US Army Air Corps bomber that occurred in Reynoldsburg, Ohio, on May 28, 1927. The aircraft involved was a Huff-Daland lighter bomber (s/n 26-208) called the XLB-5. Normally, the aircraft carried a crew of five—two pilots, two gunners, and a bombardier. Prior to the crash, four of the crew members bailed out after a propeller on the right engine broke off and subsequently did considerable damage to the lower right wing. One crew member was unable to parachute for reasons unknown and was killed on impact. . . .

This accident is of historical significance locally and is being researched for the Reynoldsburg-Truro Township Historical Society. It is also of interest on a larger scale because the aircraft commander that day, Maj. Lewis H. Brereton, later became a lieutenant general and one of the most significant figures of World War II.

While I have been able to gather a significant amount of information on the facts surrounding the crash itself, it has been harder to learn about the procurement, construction, and history of this aircraft since it was a one-of-a-kind model. Further complicating my research is the fact that the company that built it went out of business in the 1930s.

In addition to learning about the aircraft, I would like to discover what happened to the crew after the accident. The following men were on board that day: Maj. Lewis H. Brereton, 2d Lt. Bernard M. Bridget, MSgt. Clyde M. Taylor, Sgt. Fred D. Miller, and Pvt. Daniel Leroy Yeager (who perished in the crash). All were members of the 20th Bombardment Squadron at Langley Field.

I would appreciate hearing from anyone who could shed light on this incident.

Michael P. Millar
2426 Ravenel Dr.
Columbus, Ohio 43209

Weasels in Vietnam

I am researching a book about an MIA/KIA USAF officer, Capt. Michael J. Bosiljevac, who was shot down near Viet Tri, North Vietnam, on September 29, 1972. Captain Bosiljevac was an EWO aboard an F-105G Wild Weasel aircraft, of which the tactical call sign was "Condor 01." The four aircraft in the flight were F-105Ds and F-4Fs. The F-105D portion of the mission originated from Korat RTAFB, Thailand, and was assigned to the 17th Wild Weasel Squadron, 388th Tactical Fighter Wing. At the time of the downing, Lt. Col. James O'Neill was the squadron operations officer.

I understand from my research that tape recordings of the shootdown and ejections of Captain Bosiljevac and his pilot, Colonel O'Neill, were made by other aircraft in the Condor flight. Both the USAF Historical Research Center and the 388th TFW historian state that the tape recordings can no longer be found and might possibly be in the personal possession of the crew members of the other Condor aircraft.

I would appreciate hearing from

anyone who might have access to these recordings or who might have copies of the tapes. I would also appreciate hearing from any other members of the Condor flight on that fateful day or from any crew member who might have been aboard "Red Crown," which was also in voice contact with Condor 01 and which recorded the shootdown conversations.

Captain Bosiljevac's name has never appeared on any list furnished by the Vietnamese, even though his name was mentioned by an English-speaking guard named Win in the Hanoi Hilton a few days after the shootdown.

Anyone with any information on Captain Bosiljevac is asked to contact me at the address below.

Alfred A. Raneri
P. O. Box 952
Wahiawa, Hawaii 96786-0952

The Bird Dog Lives!

Your article on the O-2 in the July 1985 issue *(see "The Duck Lives," July '85 issue, p. 128)* has inspired us to call attention to a retired and almost forgotten warbird with a similar mission.

The O-1 Bird Dog (Cessna 305/L-19) served our armed forces diligently from 1951 to the early 1970s. The Air Force used the O-1 extensively in FAC roles during the Vietnam years.

Thanks to the efforts of the International Bird Dog Association (IBDA), this endangered species is back! The missions of the IBDA are to preserve the heritage of the aircraft, to keep as many of them flying as possible, and to reunite former O-1 pilots and crews.

The IBDA boasts more than 150 members. Interest in this proud little bird and the IBDA is growing rapidly. Persons interested in this endeavor should contact us at the address below.

International Bird Dog Association
3939 C-8 San Pedro, N. E.
Albuquerque, N. M. 87110

Yankee Air Force

The Yankee Air Force is seeking Air Force veterans of World War I, World War II, Korea, and Vietnam to appear as guest speakers at their meetings.

The YAF was planned and organized in 1981 to research, restore, and preserve historical and vintage aircraft for historic and educational purposes. General membership meetings are held every third Wednesday of the month at 8:00 p.m. in the Ready Room at the Essex County Airport, 125 Passaic Ave., Fairfield, N. J.

AIRMAIL

The public is welcome to attend.

If anyone is interested in being a speaker at a YAF meeting, please contact Anthony Giacobbe, YAF program chairman, at (201) 388-1962.

Yankee Air Force
Essex County Airport
125 Passaic Ave.
Fairfield, N. J. 07006

447th Bomb Group

I am the Secretary of the 447th Bomb Group Association (UK). The Association was formed in 1982 to raise funds to place a memorial to the 447th adjacent to its old airfield at Rattlesden in Suffolk. We achieved this goal two years and £2,000 later.

One of the main projects we are currently working on is the "History Project." This, we hope, will eventually serve as the basis for a written memorial of the 447th's time at Rattlesden. From contributions from local people and from 447th veterans, we hope to piece together a picture of the time and the people caught up in it. This won't be just a facts-and-figures compilation, but more of a human interest story.

We would like to hear from any readers who may be able to contribute any recollections, anecdotes, photographs, etc., to our effort. Please contact us at the address below.

Jacqueline Partridge
2, Priory Cottages
Preston St. Mary
Sudbury
Suffolk CO10 9NF
United Kingdom

708th Bomb Squadron

I am seeking information about the 708th Bomb Squadron, Eighth Air Force, which flew out of England during World War II.

Lt. Hugh C. Bowers flew a B-17 in that squadron and was coming back from a run over Berlin on August 27, 1944, when his airplane (possibly dubbed *Duback Two*) was shot down. He and the rest of the crew were lost that day.

If any reader flew in that squadron or knew that crew, I would like to hear from them. Please write me at the address below.

Christopher C. Bowers
3616 Lundie Lane
Petersburg, Va. 23805

388th TFW

The 388th Tactical Fighter Wing at Hill AFB, Utah, is trying to locate people who were members of the 388th, which dates back to 1942. This unit grew out of the 388th Bombardment Group.

The purpose of this search is to update a pictorial history and to create a narrative of the 388th TFW from 1942–86. If you have any pictures or other material that would be useful in this regard, we would like to hear from you. Please contact the address below.

SSgt. Robert J. Olson, USAF
388th TFW/HO
Hill AFB, Utah 84056-5000
Phone: (801) 777-3590/4921

17th Recon Squadron

I am conducting research on the 17th Reconnaissance Squadron, which flew in the Southwest Pacific during World War II. This unit flew B-25s and was attached to the 38th Bomb Group.

I am particularly interested in contacting W. S. Goodrich or Sumner G. Lind or any pilot or crew member who was involved in the December 26, 1944, raid on the Japanese task force headed for Biak.

Please contact me at the number or address below.

Gary Whitaker
6109 Estes Park Ct.
Haltom City, Tex. 76137
Phone: (817) 281-2843

421st TFS

I am currently in the process of gathering information on the 421st Night Fighter Squadron/Tactical Fighter Squadron for a book that will cover the history of each. I am interested in contacting any former members of the 421st who would be able to help.

I am especially interested in people who were with the 421st at George AFB (1962), McConnell AFB (1964), Kadena AB (1965), and Korat RTAFB (1965).

Please contact me at the address below.

Sgt. Jeff L. Kolln, USAF
3382 A Saratoga
Hill AFB, Utah 84056

Millville AAF

I am searching for material on the Millville Army Air Field for a project for the Millville Airport Museum. During World War II, this field was an advanced fighter training center for pilots who were transitioning to the P-47 Thunderbolt.

I hope to locate information and perhaps photographs or just to talk to

THE F-16 FIGHTING FALCON UNSURPASSED PERFORMANCE

The F-16 performs the air defense mission in ten air forces—today.

GENERAL DYNAMICS

Approved for top secret conversations.

Right at your desk.

SECTEL™: A Motorola Future Secure Voice System.

Our SecTel STU-III Secure Telephone Terminal moves operations right to your desk top. For voice and data telephone security or clear voice operation. Automated key security means minimal COMSEC custodial duty and it's unclassified when unattended. Positive caller authentication with audio quality voice recognition plus a computer compatible RS-232/RS-449 data port make use easy. Find out how easy this tamper resistant, feature phone moves voice and data communications security right to your desk. Call 602/949-3232 or write Motorola, Government Electronics Group, P.O. Box 2606, Scottsdale, AZ 85252.

Your key to future security.

MOTOROLA INC.
Government Electronics Group

AIRMAIL

the men who were stationed at the field during the war.

If you were stationed at Millville AAF, please contact me at the address below.

Michael T. Stowe
1510 West Main St.
Millville, N. J. 08332
Phone: (609) 825-4261

HU-16 Albatross

I am searching for information on the HU-16 Albatross.

I would greatly appreciate any information on squadrons, aircraft numbers, bases, etc. In addition, I would like to hear about any historical articles or books about this aircraft and any photographs of the Albatross.

Please contact me at the address below.

Ted Lang
8144 Buttonwood Way
Citrus Heights, Calif.
95621-1113

391st Bomb Group

I am interested in any and all information on aircrews, combat missions, and between-mission activities of the 391st Bomb Group.

This Martin B-26B unit, which served with the Ninth Air Force in 1944, flew out of bases located in Matching, England.

Any readers having any information about the 391st Bomb Group are requested to contact me at the address below.

Robert L. Gallo
220 Pebblestone Dr.
Benbrook, Tex. 76126

Slippery Rock Cadets

The Slippery Rock University Army ROTC Extension Center is conducting research on alumni and former students of all services who have had distinguished military careers. An area of special interest is graduates of the World War II Army Air Corps Cadet Program conducted at what was then Slippery Rock State Teachers' College, Slippery Rock, Pa.

We would like any alumni of "The Rock" to provide us with a short biography that describes accomplishments, a photo, and a patch or unit crest or other appropriate memorabilia. Please include your name, grade, unit, and any other pertinent information with your donation.

Lee F. Kichen
Slippery Rock University
Slippery Rock, Pa. 16057-9989

17th Cadet Group

If you are a Troy State University AFROTC alumnus, the 17th Cadet Group would like to hear from you. Our alumni association is currently updating its graduate files in order to reach all previous Troy cadets more effectively.

If you received a commission through the TSU AFROTC program, send us your name, rank, current mailing address, job assignment, and year of graduation. In return, we will send you a copy of our quarterly newsletter and provide you with information on the latest happenings at Troy State.

If you are from Troy State, we would like to hear from you. Please send your data to the following address.

AFROTC Det. 017
17th Cadet Gp. Alumni Ass'n
Troy State University
Troy, Ala. 36081
Phone: (205) 566-5115

Roll Call

We are trying to locate former Air Force members who served with the 504th Bomb Group flying B-29s from Tinian during World War II. A small group of these veterans got together this past summer to form the 504th Bomb Group Association. We meet occasionally to reminisce, renew old friendships, and memorialize those who gave their all in that conflict.

Any former veterans based on Tinian with the 504th Bomb Group who wish to join our association should send their name, address, squadron, and duty assignment to the address below.

B. King Martin
504th Bomb Group Ass'n
2760 Onyx St.
Eugene, Ore. 97403

I would like to correspond with anyone who knew my father, Maj. Murray L. Smith, USAF. He was killed as the result of an O-2 crash at Binh Thuy AB, Vietnam.

My father entered active duty in 1955 and served as a T-33 instructor pilot with the 3550th Pilot Training Wing at Moody AFB, Ga., from 1961–64. In Vietnam, he flew O-1Es and O-2s as a forward air controller. His crash occurred on December 12, 1967.

I would greatly appreciate any information.

A1C Gary D. Smith, USAF
1000 Pine Ave., #111
Redlands, Calif. 92373

I would like some assistance in locating a long-lost friend. His name is George Richard Ludlow. We graduated from the aviation cadet program together and went on to fly combat tours as B-24 pilots in the ETO. We corresponded for a time after the war, but I have since lost all contact with him.

Any assistance that anyone can furnish would be most appreciated.

Lt. Col. George T. Lumsden,
USAF (Ret.)
P. O. Box 27
Mauston, Wis. 53948

I'm looking for any information on the whereabouts of then-Lt. George Cunningham, who served with me in the 7503d Air Support Squadron, Third Air Force, at Brize Norton, England, during 1951 and 1952.

Anyone having any information on his current status is asked to contact me at the address below.

"Tag" Basinger
333 W. First St.
Dayton, Ohio 45402
Phone: (513) 224-7432

Collectors' Corner

I have a manufacturer's model of the Grumman F11F Tiger used by the Navy's Blue Angels aerobatic flying team. It was acquired in the early 1940s by my father, who worked for Grumman in Bethpage, N. Y.

I am interested in finding out the value of the model and might consider selling it.

Joan O. Behrle
6 Lyncliff Rd.
Hampton Bays, N. Y. 11946

We would like to request the donation of any military history books, especially any on early Air Force history.

If anyone has a library or just a collection of such works, we would be happy to send a receipt for purposes of tax deductions, but we cannot afford to purchase any books.

Please contact the address below.

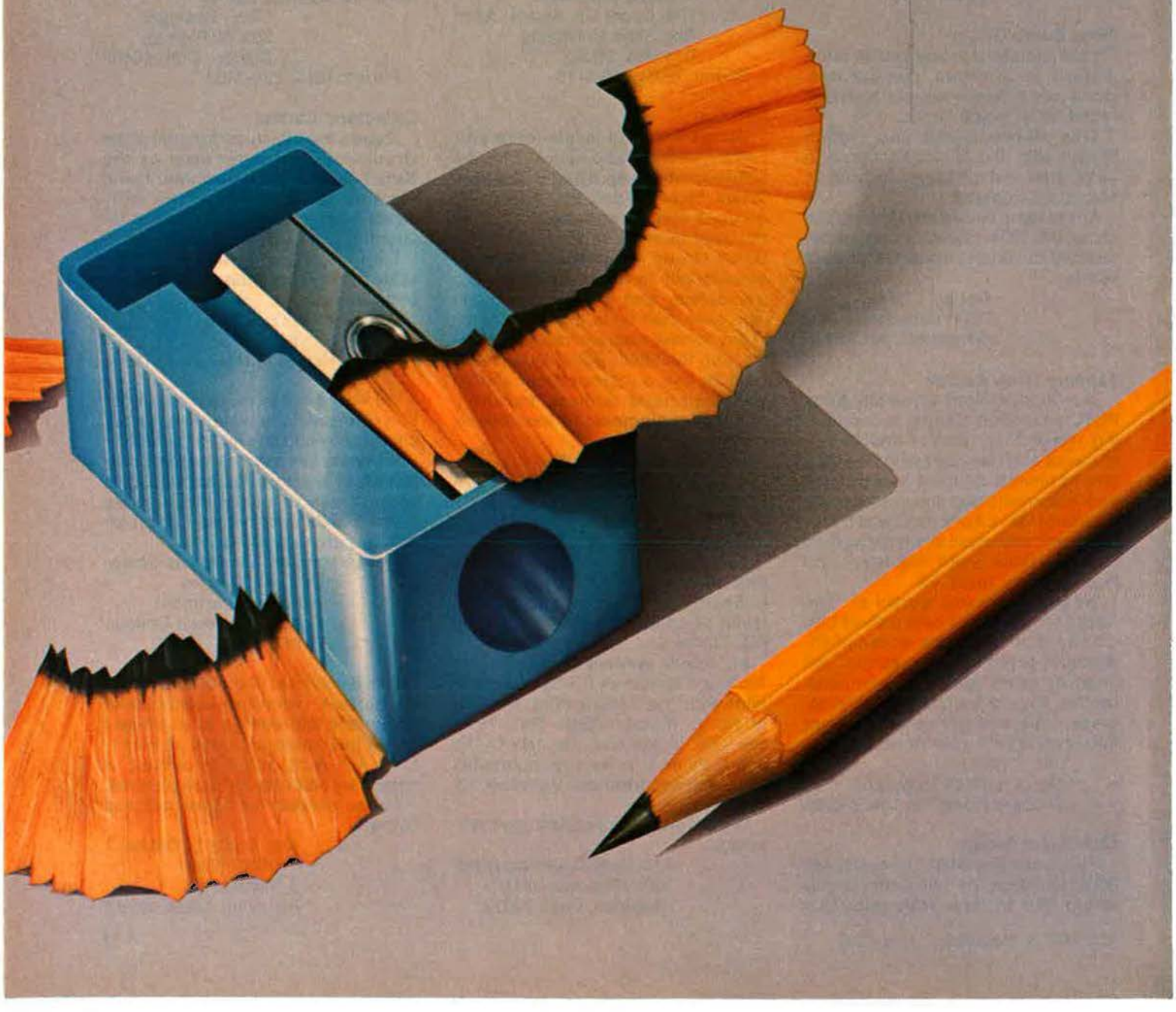
Dr. Lewis Towles
History Department
Central Wesleyan College
Central, S. C. 29630

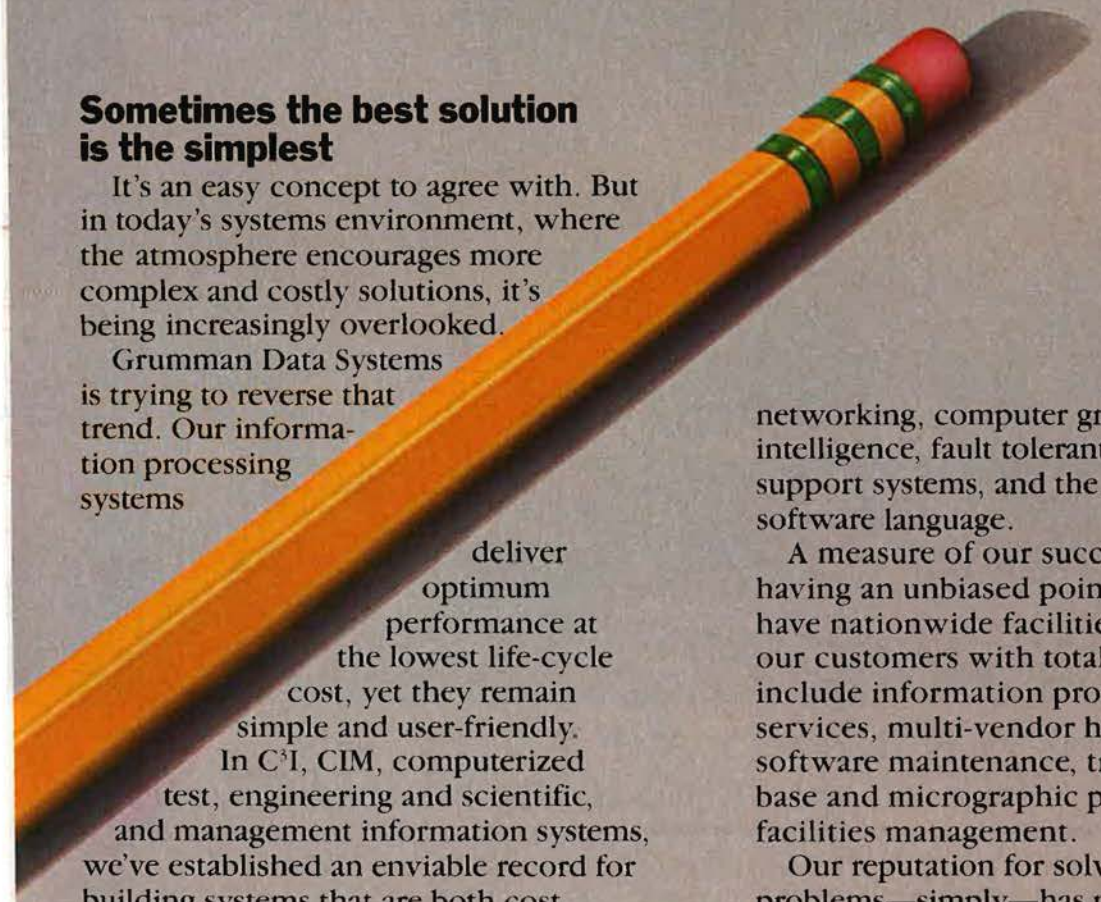
I am a collector of pictures of modern fighters. I would especially like to obtain any information as to where I could get some pictures of F-111, F-16, A-7, A-10, and F-14 aircraft. If necessary, I can pay for such pictures.

Please contact me at the address below.

Maj. Louis E. Droste,
USAF (Ret.)
8 Hillcrest Dr.
Plainville, Mass. 02762

A GREAT SOLUTION DOESN'T HAVE TO BE COMPLICATED





Sometimes the best solution is the simplest

It's an easy concept to agree with. But in today's systems environment, where the atmosphere encourages more complex and costly solutions, it's being increasingly overlooked.

Grumman Data Systems is trying to reverse that trend. Our information processing systems deliver optimum performance at the lowest life-cycle cost, yet they remain simple and user-friendly.

In C³I, CIM, computerized test, engineering and scientific, and management information systems, we've established an enviable record for building systems that are both cost effective and responsive to the user's needs.

To accomplish this, we've become leaders in advanced research and development in such areas as networking, computer graphics, machine intelligence, fault tolerant, command support systems, and the Ada software language.

A measure of our success comes from having an unbiased point of view. We have nationwide facilities that support our customers with total services that include information processing services, multi-vendor hardware and software maintenance, training, data base and micrographic publishing, and facilities management.

Our reputation for solving complex problems—simply—has made us the fastest growing division of the Grumman Corporation. For further information about any of our capabilities, contact Wesley R. Stout, Director, Technical Services at (516) 682-8500.

Grumman Data Systems

CUSTOM SOLUTIONS
for Managing Information

GRUMMAN®

® A registered trademark of Grumman Corporation

DATA GENERAL ASKS: ARE YOU PLAYING RUSSIAN ROULETTE WITH YESTERDAY'S TECHNOLOGY?

FOR ADVANCED COMPUTER SYSTEMS, TALK TO US. IT'S WHY SO MANY GOVERNMENT DEPARTMENTS HAVE CHOSEN DATA GENERAL.

Government business is too critical to be taken for granted. Too much depends on it.

No wonder nineteen of the top twenty U.S. defense contractors have bought a Data General system. As have all the Armed Services and most major departments of the federal government.

And to date, nearly thirty U.S. Senate offices and committees have chosen Data General.

TODAY'S BEST VALUE

Why such unanimity? Because Data General offers a complete range of computer solutions for government programs, with one of the best price/performance ratios in the industry.

From our powerful superminis to the DATA GENERAL/One™ portable. From unsurpassed software to our CEO® office automation system. Plus complete systems for Ada® and Multi Level Secure Operating Systems, and a strong commitment to TEMPEST.

All Data General systems have full upward compatibility. And because they adhere to international standards, our systems protect your existing equipment investment. We give you the most cost-effective compatibility with IBM outside of IBM—and the easiest to set up and use.

SOLID SUPPORT FOR THE FUTURE

We back our systems with complete service and support. As well as an investment in research and development well above the industry norm.

So instead of chancing yesterday's technology, take a closer look at the computer company that keeps you a generation ahead. Write: Data General, Federal Systems Division, C-228, 4400 Computer Drive, Westboro, MA 01580. Or call 1-800-DATAGEN.

Data General
a Generation ahead.

IN FOCUS...

The Missile Debate Goes On

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

Strategic modernization is still the top defense priority, but there is still substantial disagreement about the best size and configuration for the Midgetman ICBM.

Washington, D. C., Apr. 28

Senior Pentagon officials, including the Air Force's top leaders, leave no room to doubt that strategic force modernization must and will remain the overriding national security objective in the years ahead. In both the new POM—the program objective memorandum setting forth the Pentagon's and the services' program goals for FY '88 and beyond—and in congressional testimony on the FY '87 defense authorization request, the commitment is crystal clear to support, at all cost, such pivotal strategic programs as the deployment of a second fifty Peacekeeper ICBMs in concert with vigorous R&D on a smaller, mobile-based ICBM (the SICBM, or Midgetman), expeditiously to develop and field the Advanced Technology Bomber (ATB, or "Stealth"), and to deploy without delay the stealthy advanced cruise missile (ACM).

In joint testimony before the Senate Armed Services Committee, acting Air Force Secretary Edward C. Aldridge, Jr., and USAF Chief of Staff Gen. Charles A. Gabriel reiterated the Air Force's "strong" support for the second fifty MX missiles, pointing out that the "Peacekeeper test program has completed eleven launches successfully, underscoring the validity of this system to maintain the viability of the land-based ICBM force as a deterrent into the next century." But adding these "prompt" and highly accurate weapons to the US strategic deterrence forces is not enough, they pointed out. There is also a clear-cut need for the SICBM, which, "with its single-warhead design, supports stability objectives by decreasing individual target value and by increasing the survivability of [the ICBM] leg of the triad. The SICBM's light weight makes it compatible with a broad range of more survivable basing modes, particularly mobile options."

The Air Force, they explained under questioning, is hesitant to increase the weight of the SICBM beyond the currently proposed ceiling of about 37,000 pounds—already upped from the originally stipulated 30,000 pounds—primarily because of the resultant weight increase of the hardened mobile launcher (HML). That, in turn, could impair mobility and, hence, survivability of the weapon. As a rule of thumb, each additional pound in the weight of the missile means an increase in the HML's weight by two pounds.

According to the latest Air Force estimates, the mobility of the HML—which is hardened to resist about thirty pounds per square inch (psi) of overpressure and must be capable of operating at speeds of up to thirty miles an hour—is likely to degrade appreciably if the combined weight of the vehicle and the missile goes beyond 220,000 pounds. Senior OSD officials and influential members of Congress contest this view and argue that further research is necessary. This group holds that it might be possible to retain full mobility of the HML at a gross weight of about 250,000 pounds. This divergence of views concerning basic SICBM parameters within the defense community is of fundamental importance because it bears directly on the feasibility of MIRVing the missile with two or three warheads rather than holding the design to a single-warhead configuration.

A recently completed report of the Defense Science Board's Deutch Panel (named for its chairman, MIT scientist John Deutch) urged go-ahead for the SICBM program, with the missile's weight to be held to 37,000 pounds. Top Defense Department officials, including Defense Secretary Caspar Weinberger, rejected some of the key conclusions of that report.

In the view of some Air Force experts, retaining the presently proposed configuration would enhance "program stability." AFSC Commander Gen. Lawrence A. Skantze asserted recently, for instance, that while the Defense Department had every right to look at options beyond the single-warhead configuration, AFSC, as the developer of the SICBM, on the other hand favored the "virtue of program stability."

The Chairman of the House Armed Services Committee, Rep. Les Aspin (D-Wis.), also weighed in on the side of safeguarding the integrity of the SICBM program, especially the initial operational capability (IOC) scheduled for 1992. In a letter to the Department of the Air Force, Chairman Aspin commented that "it's time to bend metal, not float paper." Asserting that he agreed with the Air Force and the Deutch Panel on the desirability of upping the weight limit of the SICBM to 37,000 pounds—and thereby virtually assuring rescission of Congress's 1983 stricture against increasing the weight of the weapon beyond 33,000 pounds—Representative Aspin inveighed against OSD officials who seek to broaden the program's baseline to include heavier MIRVed options.

One proposal, he claimed, is to spend SICBM program funds on SDI, the Strategic Defense Initiative, "a rather curious trade-off, because SDI was conceived by the President to protect people, not our ICBMs." According to Chairman Aspin, other Pentagon elements want "to halt building missiles while OSD builds more paper studies on which missiles to build. It is hard to figure how anyone will learn more from these studies than [have] the distinguished groups that have already considered the issue in depth." He capped his letter with the contention that national security "will be best served if Congress and [the Air Force] join as partners in a unified approach" to the Midgetman program.

The worst circumstance, he warned, would be for Congress and the Air Force to agree on a 37,000-

pound weight limit and for OSD, at the program review scheduled for December 1986, to decide that it "likes an 80,000-pound MIRVed Midgetman. Then it's back to the drawing boards again for your engineers. And if some in the [Defense Department] have their way, next year the Administration will zero out Midgetman funds and boost SDI." Such an eventuality, which he termed not implausible, evokes the "basing-mode-of-the-month syndrome" and the associated technological filibusters that paralyzed the MX Peacekeeper program for years in the past decade, he claimed.

OSD termed key elements of Chairman Aspin's letter incorrect, however. The principal spokesman for the forces arrayed at the other side of the argument is Under Secretary of Defense for Research and Engineering Donald Hicks, who says that "I don't have a position, but I [do] have a responsibility." He told AIR FORCE Magazine that "we don't have the data to decide how heavy the SICBM can be without losing mobility. You can hear numbers coming out of the Air Force study that say if the HML is heavier than 230,000 pounds—which might limit [the missile] to 50,000 pounds—you would lose mobility. I don't know that number, and neither do they."

Secretary Hicks was critical of the notion that it would be impolitic to bring out facts that tend to "screw up the consensus" in Congress that, in concert with the White House's Scowcroft Commission, launched the SICBM program. "I don't buy the notion that if you disturb that consensus, you lose everything." Congress, Secretary Hicks suggested, is willing to listen to rational approaches reflecting valid trade-offs and "sound engineering decisions."

Dr. Hicks is also not cowed by the contention that a broadening of the program's baseline—and any schedule slippages that might ensue—would have unacceptable consequences: "I don't [think] we would be in any grave danger if that were to happen—say a slippage of a year or maybe two. We have lots of other ways to deter the Soviets at the present time." Because he sees no pressing need to rush the SICBM program, Dr. Hicks feels there is potential benefit in a reexamination of the program's baseline. The results might be cost savings of "at least $8 billion and a better system."

AFSC's Ballistic Missile Office recently initiated modification programs of the two mobile test vehicles (MTVs) that within two months will permit tests of dummy missiles

IN FOCUS...

weighing up to 52,000 pounds. But BMO has not been authorized as yet to seek industry proposals for a SICBM that can accommodate up to three warheads, along with penetration aids, and that would weigh significantly more than 37,000 pounds. "Growing" the missile beyond 37,000 pounds can't be achieved by "stretching" the length of the design, according to BMO. Further growth of Midgetman, therefore, necessitates configurations with diameters greater than the forty-six-inch level of the baseline design. Such a change, in turn, might require new request for proposals (RFPs) to industry.

Those who favor increasing the weight and size of Midgetman cite another reason for rejecting the argument of the *status quo* proponents that revising the RFPs would slow down the program in an intolerable manner. Congress, for a number of reasons, is already certain to reduce and stretch out the SICBM program's funding level, so delays incurred as a result of baseline changes would become meaningless.

Reiterating that he holds no preconceived notions about what constitutes the most militarily effective configuration of the SICBM, Secretary Hicks stressed that Air Force studies to date had to be confined to a single-RV missile limited initially to a weight of 30,000 pounds (plus or minus ten percent). This was then upped to the 37,000–40,000 pound range to allow for penetration aids. As a result, "They don't have data for any excursions beyond that point."

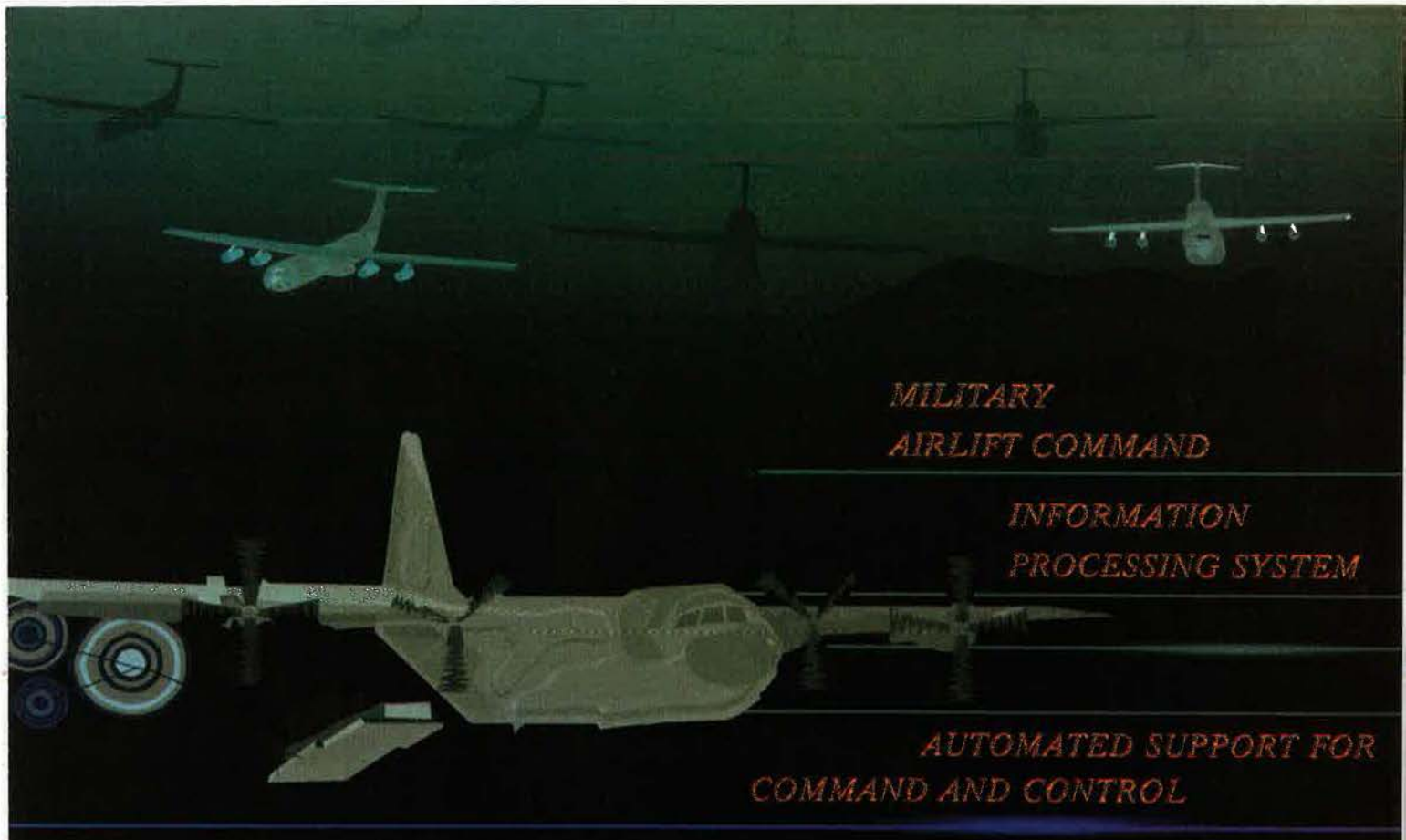
But by the time Secretary Hicks makes his recommendations to Secretary Weinberger at the DSARC in December, "I want to be certain that I can say we have looked at alternatives in the baseline and that *this* is what we found from our technical evaluation. If [the findings say] that it is a three-RV, 70,000-pound missile, so be it. If we find that it should be a 50,000-pound, two-RV plus penaids [penetration aids] missile or that we can only [accommodate a design weighing] between 37,000–40,000 pounds because of mobility considerations, that's okay too." The Defense Department's overriding concern is to accumulate incontrovertible data on cost and performance factors associated with a range of options so that congressional critics several years hence won't be able to "discover" a cheaper solution and then scuttle the program in midstream, he asserted.

Current arguments about the optimal configuration of Midgetman revolve around the Strategic Air Command's unchallenged requirement for 1,500 ICBM warheads capable of promptly destroying hardened targets. A thousand of these RVs were to be carried by 100 MIRVed MX Peacekeepers. Congress has so far authorized the deployment of only fifty MXs, with the fate of the second fifty in limbo. The remaining 500 warheads are to be carried by a survivable, probably mobile-based SICBM. The cost of 500 single-RV SICBMs is probably in the $50 billion range, compared to about $2 billion for a like number of RVs carried by the second fifty Peacekeepers, Secretary Hicks contends. He agrees, however, that the SICBM has advantages in terms of survivability: "I favor mobility, but, of course, it costs real money." He emphasized that he had "no desire to kill" the SICBM program. Secretary Hicks was equally firm in his conviction that "we simply have got to have the second fifty Peacekeepers," the widely held notion that the political deck in Congress is stacked against such an action notwithstanding.

A key argument for MIRVing the SICBM, Secretary Hicks contends, is that the Soviets would have to barrage-bomb the SICBM deployment areas, using a fixed number of warheads regardless of whether "generated" areas contained a given number of single-RV SICBMs, half that number of two-RV weapons, or only one-third that number of three-RV missiles. "The Soviets would have to put thirty psi over the entire area. It makes no difference if there are twice as many or four times as many SICBMs in there," assuming that the dash speed and mobility of the various missiles remain identical.

Claiming that this contention stands up to rigorous analysis, he said that while the price of attack in terms of expended warheads remains constant to the Soviets, the US cost of fielding a force of SICBMs carrying 500 warheads would go down considerably if that force consisted of 250 two-warhead missiles compared to 500 single-RV missiles. Under either condition, the survivability of the US SICBM force is the same, he added.

The President of the MITRE Corp., Robert R. Everett, a member of the Defense Science Board's Deutch SICBM Panel, concurred with Dr. Hicks's contention concerning fixed Soviet attack costs in his dissenting



We Deliver

Command and control for the world's largest airlift operation, the Military Airlift Command (MAC), is more than just scheduling a few flights. It's thousands of missions, scheduled and executed worldwide. The MAC Information Processing System (MAC IPS) will link command and control centers all over the world, and will provide automated support to aid airlift operators in planning, scheduling and executing MAC's airlift missions.

Building this complex system of fixed and transportable nodes is a tough job. TRW has assembled the team that has the depth and breadth of experience to solve the problem. And, we have the tools to build the system, proven expertise in workstations, local area networks, software development, algorithm design, data base management, and system integration.

Our teammates are ready as well. E-Systems has been providing communications capabilities to MAC for many years, bringing expertise in multimedia network implementation and communications processing. BETAC and RAI are old hands at airlift operations. Our team has developed simulations of mission operations and communications and built prototype workstations to give us a headstart on this evolutionary acquisition.

Now, we're ready to build the system, integrating off-the-shelf hardware and software as only TRW can, to create a system that works. We are a leader in using Ada® for complex C2 programs. Our rapid prototyping and advanced workstation concepts will aid in understanding the users' needs, and in building a system which has user acceptance. Our simulator provides insight into system operation and system sizing.

No other team can deliver full life cycle support. From evolutionary requirements definition to installation, operation and maintenance, the TRW team—E-Systems, BETAC and RAI—delivers the goods.

TRW

TRW Defense Systems Group

comments on the group's report. "Survivability comes from the area of mobility, not from the number of missiles. Changing the number of missiles does not change the probability of survival per missile." The MITRE executive argued that the "current plans for basing SICBM would probably permit a larger missile, perhaps [70,000 pounds] with three warheads, [in turn] permitting either a substantially less expensive 500-warhead program or a 1,000-warhead program at the same cost." He also pointed out that "it is unclear at the moment whether a [70,000-pound] missile would be less mobile than a [40,000]-pound missile," adding that if the full complement of 100 Peacekeepers were to be deployed, "we could take the time to do the mobile [missile] right." With a "sensible MX program . . . under way, I would undertake an orderly program for a mobile missile, not necessarily the SICBM," Mr. Everett asserted.

While, at this time, the cost figures for the SICBM remain relatively soft—and vary with various mobility options that have not yet been resolved—most experts agree that 500 single-RV missiles would have a price tag in the $50 billion range (FY '84 dollars) and that

IN FOCUS...

1,000 might cost about $80 billion. The figures for the MX Peacekeeper—in contrast—are well understood, according to Secretary Hicks. To deploy an additional fifty Peacekeepers on top of those already authorized—fifty for deployment and 123 spares—would cost about $2 billion if they were housed in upgraded Minuteman silos or about $8 billion if they were based in superhard silos.

If all 100 Peacekeepers were to be deployed in superhard silos, the overall cost increase would come to about $15 billion, according to Dr. Hicks. He defined superhard silos as those at least twenty-five times harder than the current Minuteman silos and arranged in "patterned arrays," meaning a spacing scheme that complicates the timing problems for the attacker. The combination of superhard silos and patterned arrays would ensure the survivability of MX for "a lot of years."

On the other hand, if the choice is to ensure the Peacekeeper's viability over the longest term possible, it might be advisable to resort to a "carry-hard" basing mode for MX. This would entail shifting the missile in its integral canister, which would be hardened to the 10,000 psi-plus range, within an array of low-cost shelters in a shell-game fashion. The "carry-hard" basing scheme, according to Dr. Hicks, would extend the effectiveness of MX by "a lot more years." He acknowledged that eventually—assuming an all-out sustained effort—the Soviets could overcome "carry-hard basing, but this would also be true with regard to a [mobile] SICBM."

A new concept for basing MX, initially dubbed "extra-hard," is gaining support rapidly among some Air Force, OSD, and congressional experts. The underlying notion is substantial modification of existing Minuteman silos to achieve hardness levels approaching those of superhard silos. The price of attacking extra-hard silos in terms of the Soviet force "drawdown" might approach that exacted by the superhard basing mode, according to initial Air Force and Defense Nuclear Agency calcula-

tions. The pluses that accrue to "extra-hard" compared to "superhard" are lower cost—perhaps only half that of the latter—and the ability to remain in compliance with the SALT terms that preclude a volume increase of existing silos in excess of thirty-two percent.

The Pentagon, Dr. Hicks pointed out, does not plan to "make a run" in Congress for the second fifty Peacekeepers in FY '86, but will definitely do so in FY '87. No decision has been made as yet, however, on the type of basing mode—whether regular, extra-hard, superhard, carry-hard, or some other approach—that the Air Force and the Pentagon will recommend at that time.

In the bomber field, the Air Force—with the full support of OSD and the Administration—demurring congressional offers to provide $200 million in supplemental funding this year to retain the option to buy additional quantities of B-1Bs instead of committing to the acquisition of 123 "Stealth" bombers.

SAC's Commander in Chief, Gen. Larry D. Welch, for instance, told Congress that given a choice between additional B-1Bs and ATBs, his command unhesitatingly would opt for the latter. He specifically pointed out that in conventional warfare missions involving heavily defended airspace in third countries, the elusive ATB can be counted on to get in, do the job, and get out safely under circumstances in which the risks of using either B-52s or B-1s would be unacceptably high. (According to some preliminary analyses by USAF and OSD, it appears that one ATB could have performed the task carried out by all the USAF and Navy aircraft during the recent raids against Libya.)

Dr. Hicks, in similar fashion, rejected allegations that ATB is too valuable an asset to use in conventional warfare missions: "This is categorically not true. The capability of the ATB is superb as an airplane, and in my view it will be a very important element not only of our strategic but also of our conventional capabilities." In their joint testimony, Secretary Aldridge and General Gabriel asserted that ATB "will take over as our primary penetrator in the mid-1990s, when Soviet air defenses become [even] more sophisticated." They announced that the program is "ahead of original schedule and below projected cost."

The newfound congressional largess with regard to supplemental B-1B funds, in the view of some Capitol Hill pundits, is meant in part to force Secretary Weinberger to declassify the ATB's costs. The only unclassified hint on Stealth costs that OSD has aired so far is that the ATB's production costs, expressed in constant dollars, would not exceed those of the B-1B by more than three percent.

Washington Observations

★ Defense Secretary Caspar Weinberger recently disclosed a series of significant technological advances that appears to boost the feasibility of the Strategic Defense Initiative in a major way. Specifically, "The Air Force has recently completed successful tests of booster rocket technology for nonnuclear space-based interceptor vehicles. This means that small, inexpensive boosters, needed in quantity for an effective space-based defense system, are feasible." He also announced that "a recently developed technique now makes it possible to locate accurately a target which previously might have been obscured by exhaust radiation." Lastly, "Recent free-electron laser experiments at [the Lawrence] Livermore Lab[oratory] have shown power effi-

SCIENCE/SCOPE®

A high-frequency tactical radio for military vehicles and base stations is proving extremely reliable in the field. Operating on average more than 3,000 hours between failures, the AN/GRC-213 high-frequency radio makes extensive use of large-scale integrated circuits, conservatively rated components, and proven military equipment packaging techniques. Should it need repairing or maintenance in the field, an operator can replace any of the three basic subsystems in seconds. The average repair time in the field is less than 30 minutes. In production at Hughes Aircraft Company for the U.S. Army, Navy, Marine Corps, and Air Force, the AN/GRC-213 is available for international needs.

An innovative digital receiver is being developed to alert military aircraft when they are approaching enemy radars and electronic warfare systems, thereby putting them at less risk while on a mission. The device, designed for electronic support measures (ESM), will be approximately 1/20 the weight and substantially smaller than current receivers. It will search for, intercept, record, analyze, and locate sources of radiated electromagnetic energy. The receiver can store this information. Or, if an enemy signal poses a threat, it can pass this information along to another type of electronic warfare system, such as a jamming device. Hughes is developing the receiver with independent research and development funds.

The U.S. Marine Corps has a new one-two punch for close air support with a computerized weapon delivery system and the laser-guided Maverick missile. The Angle Rate Bombing Set (ARBS), mounted in the nose of the AV-8B and A-4M aircraft, lets a pilot deliver guided and unguided weapons and direct gunfire with unprecedented accuracy. ARBS cuts the time an aircraft is exposed to enemy fire by helping the pilot hit a target on his first run and avoiding the need for other passes. Laser Maverick locks on to the reflection of a coded laser beam aimed at a target by ground troops or an aircraft crew. The air-to-surface missile can also be carried by F/A-18 Hornet Strike Fighters and A-6E aircraft. Both ARBS and Laser Maverick are in production at Hughes.

A cryogenic refrigerator designed to cool infrared sensors has passed a test equivalent to operating three years in space. The Vuilleumier cycle cooler, set in operation at twice its normal speed in order to simulate a design life of five years, has passed the year-and-a-half point of flawless operation. The device will be used with infrared sensors in space for applications such as defense and geological surveys. The sensors must be chilled to near absolute zero to maintain adequate sensitivity to low-temperature thermal radiation. The VM cooler, developed by Hughes, is believed to be the only one of its type to have performed this long at such low temperatures.

Twenty years ago on June 1, Surveyor 1 made the first soft landing on the moon, giving scientists their first close-up look of the lunar surface and blazing a trail for the manned Apollo missions three years later. The three-legged spacecraft, built by Hughes, landed one second ahead of the originally predicted time and just nine miles from the predicted target point after traveling 240,000 miles. In the following eight months, Surveyor televised 11,150 pictures, photographed the solar corona of the setting sun, made a color composite photo of the lunar surface, and measured the hardness of the lunar surface. By January 1968, four other Surveyors had made soft landings on the moon. They provided detailed scientific information about the physical and chemical character of lunar materials and added immeasurably to the understanding of the physical processes that shape the moon's surface.

For more information write to: P.O. Box 45068, Los Angeles, CA 90045-0068

HUGHES
AIRCRAFT COMPANY
Subsidiary of GM Hughes Electronics

IN FOCUS...

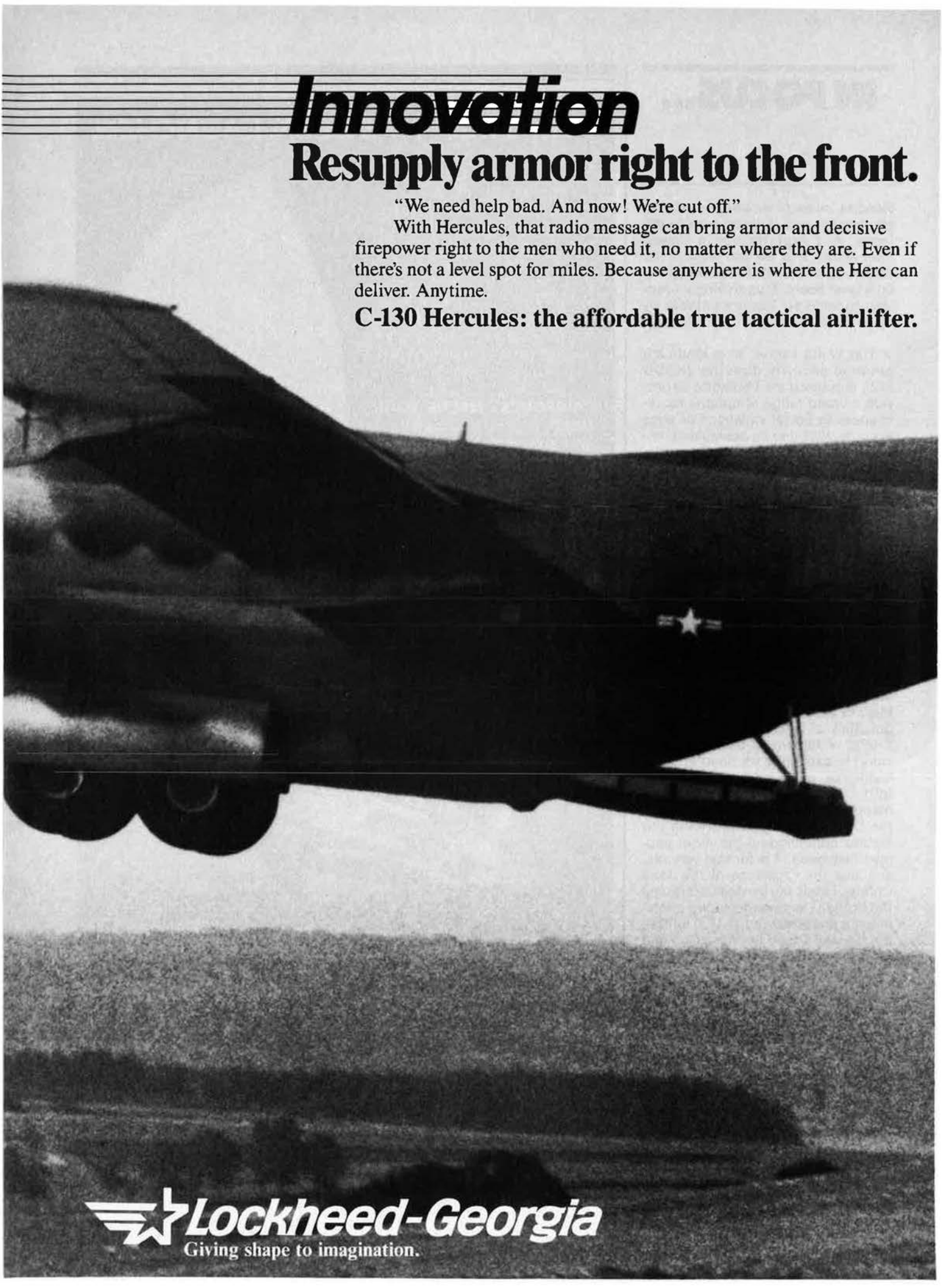
ciencies needed for effective strategic defense and ballistic missile defense. And experiments in Hawaii have shown that we can remove the distorting effects of the atmosphere on a laser beam, thus solving a problem considered insurmountable by many of SDI's critics."

★ The White House, in a landmark national security directive (NSDD 222), requested the Pentagon to provide a broad range of options for responses to Soviet violations of arms accords. Meant to be available for implementation by the end of the year—when the US butts up against major SALT ceilings—the Pentagon is to document various proposals that can serve as effective responses to Soviet treaty violations. To be included are options for a mobile Minuteman-size ICBM, upgrades of MX, adjustments in the SICBM, and the wider use of stealthy platforms for strategic nuclear purposes.

★ The Military Airlift Command's Commander in Chief, Gen. Duane H. Cassidy, came down four-square during recent congressional testimony in favor of the C-17 and against the acquisition of additional numbers of C-5Bs: "Additional C-5s will not provide the capability we need and will saddle us with costs we cannot afford." Conversely, "From cost and manpower savings to military utility, the C-17 is the key to providing our theater commanders the airlift support they need. It is for this very reason that the Chairman of the Joint Chiefs of Staff, the service Chiefs, and the Unified Commanders have unanimously endorsed the C-17," he told the Senate Armed Services Committee's Subcommittee on Seapower and Force Projection.

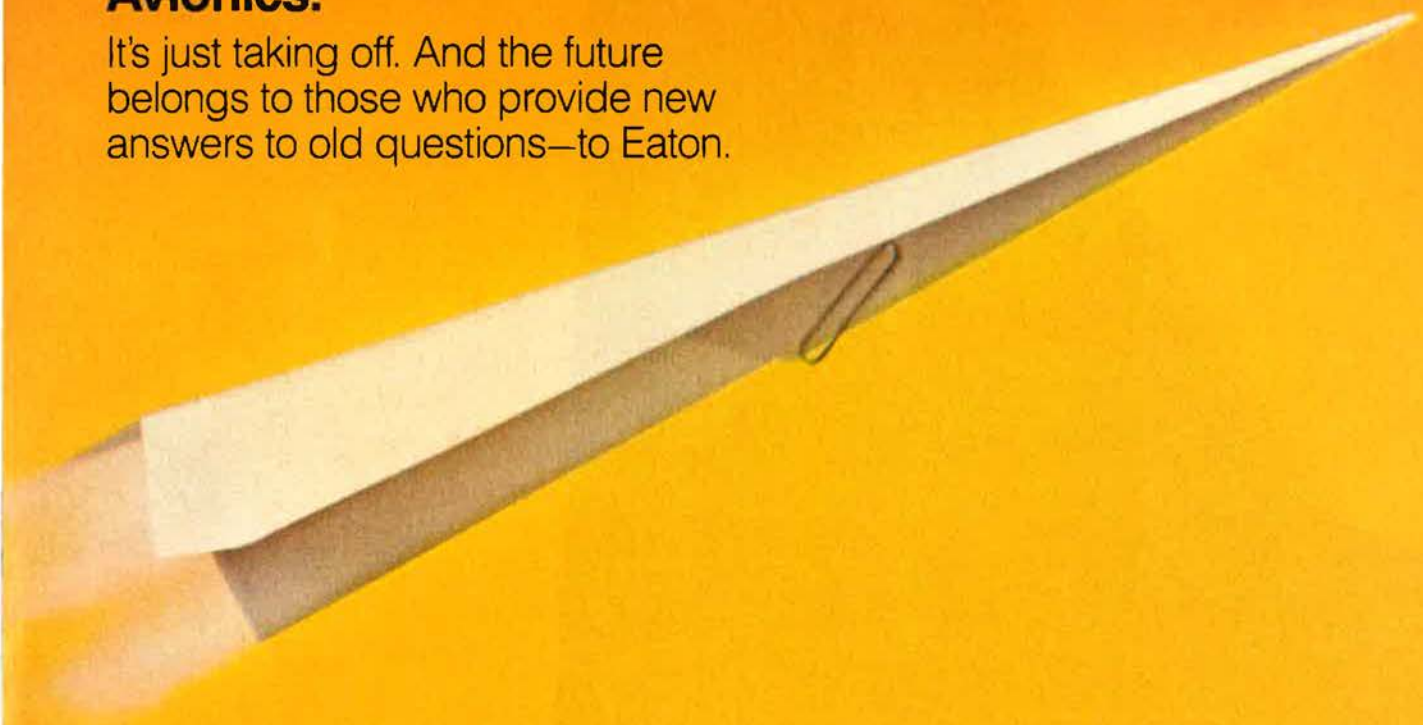
MAC, in concert with Air Force Systems Command and the Lockheed-Georgia Co., recently explored the potential for enhancing the C-5 fleet in a "series of backing and heavyweight demonstrations," he testified. The conclusions from these studies and demonstrations were that "backing cannot be planned or effectively used in an operational environment, except in extreme emergencies. The heavyweight takeoff demonstration showed that the C-5 can take off at 840,000 pounds if procedures are modified to accept the increased safety risk of a reduced three-engine climb gradient and the increased maintenance cost of an additional thrust rating," according to General Cassidy. He added, however, that "even if that were acceptable, the capability has a very limited potential application [because of] the extreme runway lengths required for takeoff."

A comprehensive analysis of airlift requirements and associated options that is known as the USAF Airlift Master Plan, General Cassidy said, showed conclusively that the life-cycle costs of a C-17 fleet would be "$16 billion cheaper and [would save] 13,000 manpower spaces over a comparable C-5 option." Further, the ability of the C-17 to bypass main operating bases and fly directly into final destination airfields allows "us to redefine the way we do business. . . . Direct delivery is not a 'nice-to-have' capability—it is an ever-increasing military must," the General said. ■


Innovation
Resupply armor right to the front.
"We need help bad. And now! We're cut off."
With Hercules, that radio message can bring armor and decisive firepower right to the men who need it, no matter where they are. Even if there's not a level spot for miles. Because anywhere is where the Herc can deliver. Anytime.
C-130 Hercules: the affordable true tactical airlifter.
Lockheed-Georgia
Giving shape to imagination.

Avionics.

It's just taking off. And the future belongs to those who provide new answers to old questions—to Eaton.



EATON

Growing into the future.

Automotive • Electronics
Defense • Capital Goods

CAPITOL HILL

By Brian Green, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Apr. 28

April 15 Budget Deadline Passes

The April 15 deadline for Senate and House passage of a budget resolution—the first major deadline imposed by the Gramm-Rudman-Hollings budget legislation—came and went with no action by either body. The Senate Budget Committee approved a measure that included $295 billion for defense (an inflation-adjusted freeze by committee calculation and $25 billion less than the Reagan Administration request). The full Senate has not yet voted on that spending package, and the House Budget Committee has yet to approve its resolution. The budget is still being held up by political maneuvering by the House, Senate, and White House.

There is no penalty for missing this deadline, and many staffers profess a lack of concern. Failure to approve an overall budget, however, has had the effect of delaying the mark-up of the defense authorization bills by the armed services committees, which have no defense spending level to use for guidance.

Secretary Aldridge Supports SICBM

Acting Secretary of the Air Force Edward C. "Pete" Aldridge, Jr., in his first appearance before the Senate Armed Services Committee (SASC) in that capacity, stated his strong support for the Small ICBM program, but saw little chance that the Defense Systems Acquisition Review Council (DSARC) would approve a substantial increase in the missile's size when the Council reviews the program in December. He argued that 37,000–40,000 pounds is the right size for the small missile and would be sufficient to permit the addition of penetration aids to defeat active Soviet missile defenses.

The SICBM is now limited by Congress to a maximum of 33,000 pounds. According to the Secretary, DSARC approval of a larger small missile "could happen," but would require "unchallengeable reasons."

Push for Acquisition Reform

The President's Blue-Ribbon Commission on Defense Management—the so-called Packard Commission—has found, in the words of William Perry, former Under Secretary of Defense for Research and Engineering under President Carter, that the defense acquisition system is "unacceptably inefficient." In his appearance before the SASC Defense Acquisition Policy Subcommittee with Commission Chairman David Packard and Jacques Gansler, a Commission consultant, he stated, "Major weapon systems cost too much, they take too long to develop, and by the time they're fielded, they incorporate obsolete technology." The Commission's findings on specific problems and its recommended solutions took place against the backdrop of a plethora of proposed legislation.

The Commission found that the current acquisition system promotes overspecification ("goldplating") by defining requirements apart from the technological and fiscal environments. Program approval occurs in what Mr. Perry described as a "huckster environment," where eager contractors are driven to understate costs. The go-ahead decision is taken in a competitive atmosphere that discourages cost realism and challenges to unrealistic requirements. Program managers, according to the Commission, thus enter full-scale development with inappropriate requirements tied to unrealistic prices, with advocates pushing add-ons and critics trying to kill the program.

Acting Air Force Secretary Edward C. Aldridge, Jr., strongly supports the Small ICBM program.

The key to turning around the problems, the Commission findings suggest, lies in centralization of policy and decentralization of execution.

The Commission found that successful programs were marked by development times of four to five years—about half the average. They all share certain key traits: short, clear lines of command; strict adherence to program performance, cost, and schedule baselines; small, high-quality staffs; limited reporting requirements; good communication with the end user; and extensive and intensive use of prototyping and operational testing.

Institutional changes recommended by the Commission include the creation of a new Under Secretary of Defense for Acquisition and a new Vice Chairman of the Joint Chiefs of Staff, with extensive acquisition experience. To shorten lines of command, a Service Acquisition Executive should be appointed by each service. They in turn would appoint a number of senior Program Executive Officers, who would manage a defined number of programs and to whom the program managers would report directly.

In the Commission's scheme of things, the Joint Requirements Management Board (JRMB), cochaired by the new Under Secretary and Vice Chairman of the Joint Chiefs, would define weapon requirements for development and would decide on cost and performance trade-offs. The JRMB would subsequently determine, based on early prototyping and testing, whether a program is affordable and whether it should enter full-scale development.

If approved for FSD, DoD should institutionalize baselining, and the Commission strongly recommended that Congress provide multiyear funding for such programs through limited production, thus providing crucial program stability. After thorough testing, the JRMB could then determine whether the program should proceed to high-rate production; if approved, the Commission again recommended multiyear funding. The Commission also recommended increased use of commercial products and competition and an improvement in quality of acquisition personnel by using flexible personnel management policies.

The Commission noted that the principal contributions of Congress in acquisition reform would be in the creation of the new Under Secretary for Acquisition, approval of multiyear funding, and simplification and recodification of federal laws governing acquisition. But it argued also that some of the congressional actions of the past have done more harm than good because of excessive attention to specific line items (micromanaging) and misguided reforms.

The SASC Defense Acquisition Subcommittee approved on April 23 an omnibus defense acquisition bill that in many respects parallels the recommendations of the Packard Commission. The bill includes a measure sponsored by Sen. Dan Quayle (R-Ind.) to give the service Secretaries authority to designate major defense acquisition programs as "enterprise programs."

Programs so designated would be run by a specially selected, long-term program manager with special authority over his staff, reporting to only one official designated by the Secretary and supported by long-term funding through the first DSARC review. The shortened lines of command, innovative personnel policies, and program stability are intended to promote greater efficiency.

Also included in the bill are provisions that provide for the creation of an Under Secretary of Defense for Acquisition (sponsored by Sen. Alan Dixon, D-Ill.); encourage the Secretary of Defense and service Secretaries to purchase off-the-shelf items "to the maximum extent practicable," rather than relying so heavily on equipment manufactured to military specification (sponsored by Sen. Carl Levin, D-Mich.); and, pertaining to the so-called "revolving-door" issue, prohibit some senior defense officials from any contact with defense contractors regarding employment opportunities for six months after the

CAPITOL HILL

end of their government service but that at the same time provide severance pay for those officials who are affected by these provisions (sponsored by Senator Quayle).

The subcommittee did not agree on legislation on an alternative personnel system. The subcommittee did agree to consult with the Packard Commission concerning personnel reform. The Commission wrote favorably about a personnel experiment at the China Lake Naval Weapons Center, in which "recruitment and retention of key civilians were correlated with pay, incentives, and advancement based on performance." Assistant Secretary of Defense for Acquisition and Logistics James Wade has also testified in support of alternative personnel policies.

The reform package must next be considered by the full SASC and other committees, such as the Government Operations Committee. In final form, it will be attached to either the FY '87 authorization bill or the Defense Reorganization Bill already approved by the SASC. The reorganization bill focuses on the organization of the Joint Chiefs of Staff, Office of the Secretary of Defense, the defense agencies, combatant commands, and military departments. Key among its provisions is the creation of the post of Vice Chief of Staff, which is one of the recommendations made by the Packard Commission.

While the full House has also approved a JCS reform bill, House legislation on acquisition reform is not so far along as in the Senate. Reps. Nick Mavroules (D-Mass.) and Dennis Hertel (D-Mich.) recently introduced a measure to create the post of Under Secretary of Defense for Acquisition and a Defense Acquisition Corps, along the same lines as in the proposed Senate bill. Representative Mavroules has also introduced a bill to require DoD to "institutionalize baselining," a la the Packard Commission.

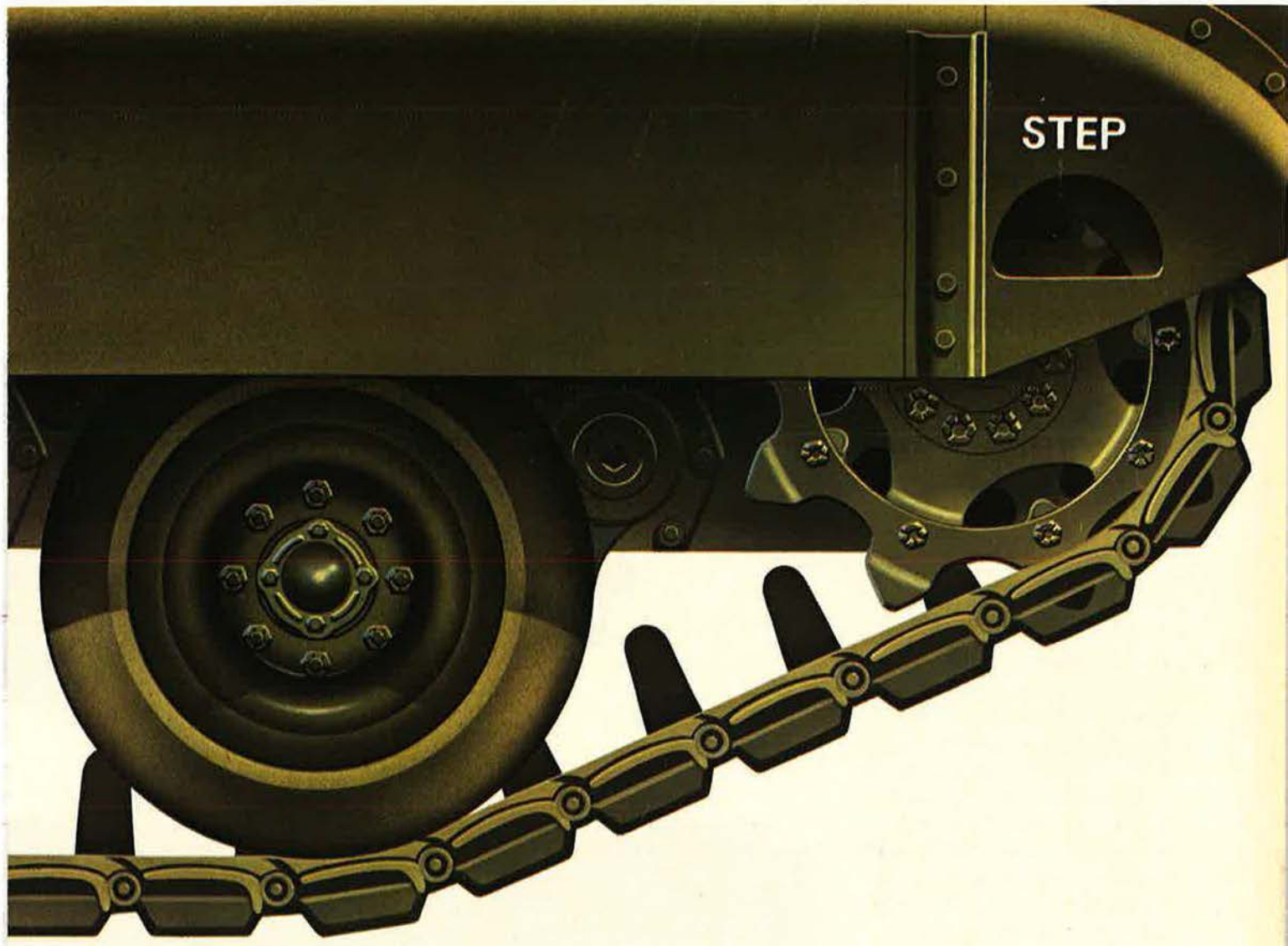
Other measures reflect the interests of individual members. They include measures to abolish the Defense Logistics Agency and the Defense Contract Audit Agency (DCAA) and to move their functions back to the services (Rep. Jim Courter [R-N. J.]); to abolish DCAA and transfer its functions to the General Accounting Office (Rep. Jim Kolbe [R-Ariz.]); and to reduce the use of unpriced contracts by DoD (Rep. Ron Wyden [D-Ore.] and others). Action on the House side has been slowed somewhat by the ill health of the Chairman of the Investigations Subcommittee (which deals with reform legislation), Rep. Bill Nichols (D-Ala.).

The reaction from the Administration and DoD has been straightforward. President Reagan signed a directive on April 1 instructing that virtually all of the Packard Commission recommendations be implemented. DoD spokesmen indicate that the Administration is moving aggressively in that direction. Defense Department witnesses at congressional hearings have stressed that great progress has already been made over the past five years in defense management, but express general approval of the thrust of the Commission's proposals. Some congressional staffers have speculated that Administration support has been predicated on a desire to head off even more radical reform proposals in Congress.

While enthusiasm is apparently widespread, some cautionary notes are also being heard. Acquisition reforms advocated by the Packard Commission could "effectively eliminate . . . Air Force Systems Command, but not the . . . need for [it]," according to Gen. Robert T. Marsh, USAF (Ret.), a former AFSC commander *(see "Packard's Partial Fix," p. 198, May '86 issue).* Assistant Secretary of the Air Force for Research, Development, and Logistics Thomas E. Cooper, in testimony on the Senate legislation, pointed out that the Air Force already benefits greatly from selective use of the enterprise program concept. He stressed the other roles Congress can play in acquisition reform:

"Stable authorization and appropriation . . . would significantly strengthen the designated programs. We believe that such congressional commitment to certain, selected programs would provide stability, foster innovation, reduce deployment times, and, at the bottom line, save taxpayers' money."

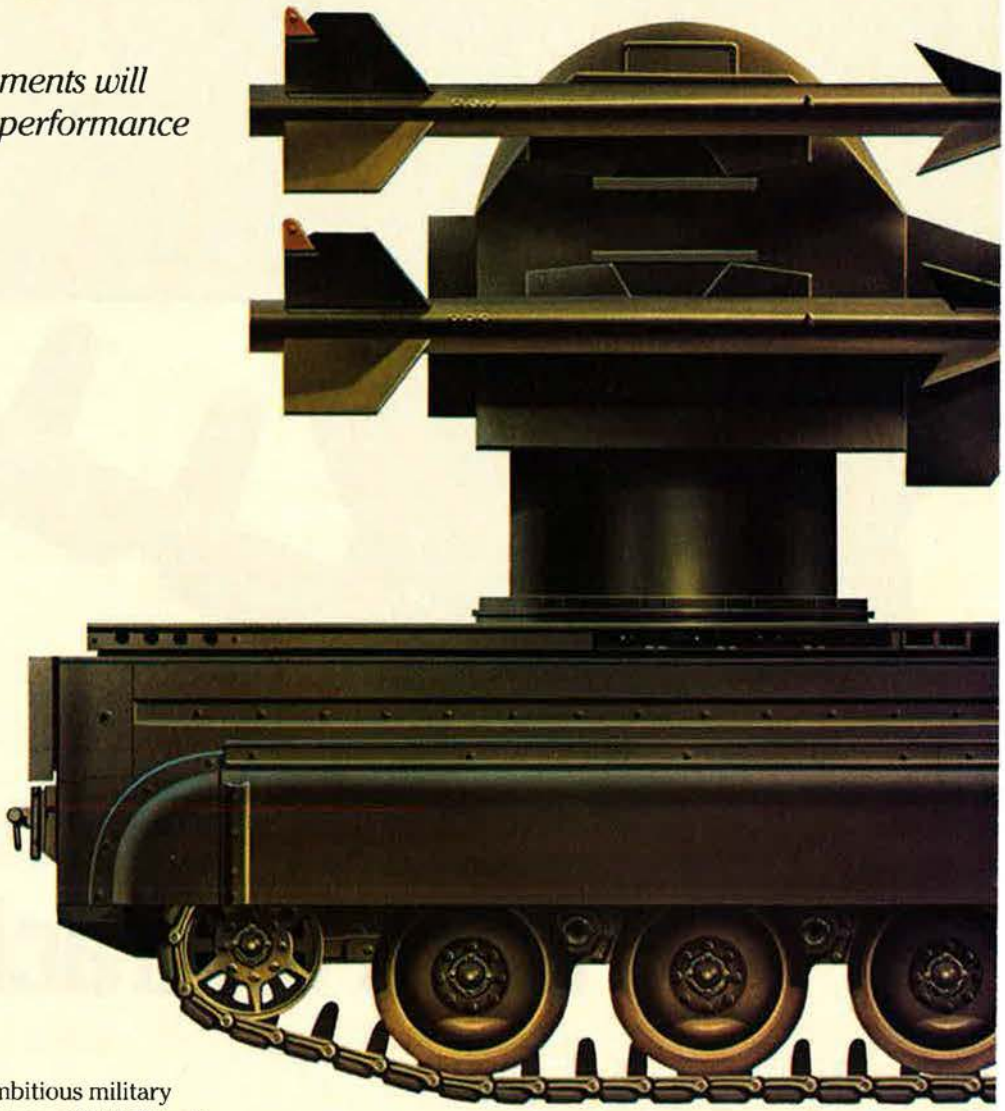
Rep. Charles Bennett (D-Fla.) warned that legislation could unnecessarily restrict other reform actions and noted that some Commission reforms were primarily "dramatic" in effect rather than substantive. Other critics of the Packard Commission reforms have suggested that many of the organizational reforms amount to little more than changing the titles of people who already perform the acquisition functions. ■



Back on track.

A new General Motors performer shoulder a

Detroit Diesel Allison improvements will increase the payload and the performance of future M113 variants.



The M730 short-range air-defense missile carrier has been improved since it was first fielded by the U.S. Army in 1969. The capability of the M730's Chaparral missile system has increased, and so has its weight–1200 pounds worth of better accuracy and electromagnetic pulse protection in the latest upgrade alone. A new General Motors power pack means the M730A2 will serve through the 1990s with greater reliability, higher efficiency, and lower support costs for the engine and transmission–without compromising vehicle performance.

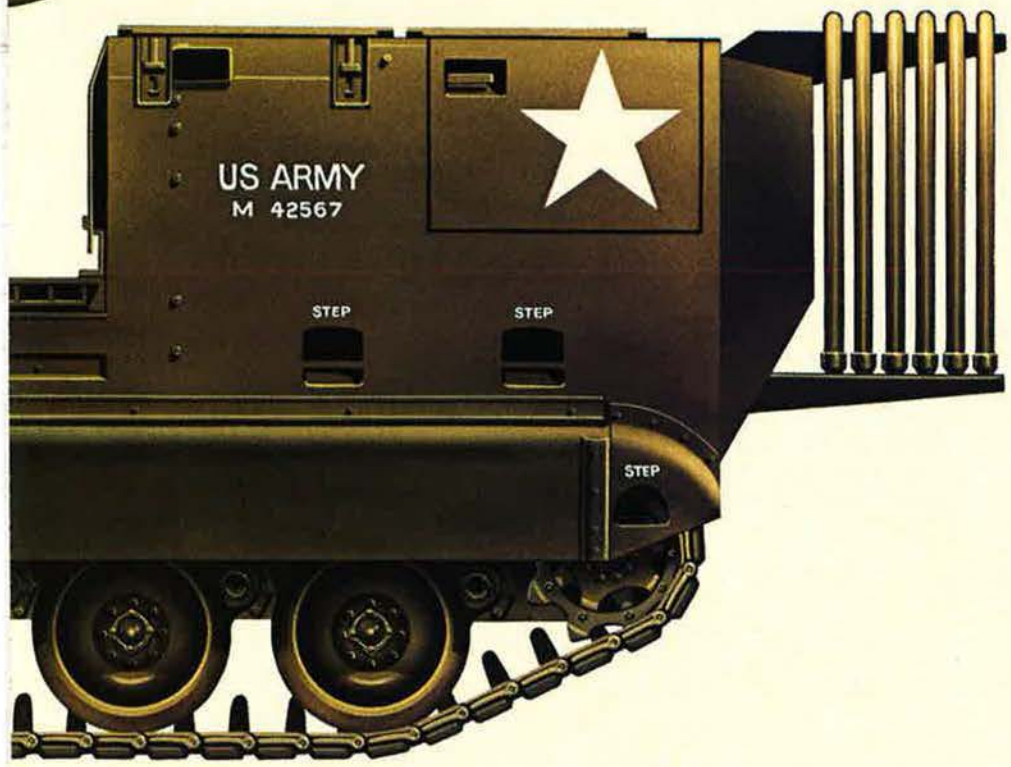
Matching engines and transmissions to ambitious military requirements is standard operating procedure at GM's Detroit Diesel Allison Division. We have been doing it for decades. For every branch of the service. For vehicles on tracks, on wheels, or on the water. For the U.S. and for its allies.

For the Marine Corps, GM builds the Light Armored Vehicle, in all its variants, around a DDA power pack. Every new truck in the U.S. Army's fleet is driven by a GM engine or transmission–or both. Detroit Diesel engines or Allison transmissions go into combat on track-laying vehicles ranging from the M113 to the Army's flagship Abrams Main Battle Tank. The Navy's Sea Fox fast patrol boats and Small Waterplane Area Twin Hull (SWATH) craft rely on Detroit Diesel engines.

One reason for our success is our wide experience with chassis and powerplant manufacturers outside GM–we worked with FMC, for example, on the M113. A measure of that success is our acceptance on vehicles manufactured outside the U.S. Detroit Diesel Allison has established an international reputation. We have proved our ability to provide our products with Integrated Logistics Support worldwide.

power pack lets a veteran greater air-defense burden.

Tomorrow's technology is the target, and Detroit Diesel Allison is hitting it with research and development. Higher power density and mobility are important to armored vehicles. The Advanced Integrated Propulsion System (AIPS) will be the state of the art. GM is developing the transmission component for AIPS: multiple speeds, full authority electronic control with diagnostic and prognostic capability; power hybrid brakes; hydrostatically controlled differential steering; throughput efficiencies in excess of 90%. Our commercial experience has already enhanced our contribution.



Mastery of electronics and new materials will maximize engine efficiency. GM is already producing engines with Detroit Diesel Electronic Controls. Simple chip changes will permit changing performance parameters. New sensors and controls will lead to prognostics and improved diagnostics. We've demonstrated a model of a Low Heat Rejection engine using ceramic components. We're at work on methanol-fuel technology, on turbocompounding, on hydraulic-assist turbocharging. We have marshalled $200 million behind plant technology to build the first diesel engine designed from the ground up with electronic controls.

Detroit Diesel Allison Division. It's just one of the many resources at GM that are committed to providing the latest in tactical and strategic technology–on time and on cost. General Motors Defense. We're your ultimate ally in the fight for dependable, affordable defense. To enlist our aid, write to our Washington, D.C. office: General Motors, 1911 North Fort Myer Drive, Suite 800, Rosslyn, Virginia 22209.

THE ULTIMATE ALLY

GENERAL MOTORS DEFENSE

AEROSPACE WORLD

Including Bulletin Board

Compiled by Jeffrey P. Rhodes, STAFF EDITOR

Washington, D. C., May 5

★ Still reeling from the destruction of Space Shuttle *Challenger,* the US space program suffered successive setbacks in early spring. On April 18, a Titan 34D booster rocket carrying a classified military payload exploded on launch at Vandenberg AFB, Calif., and on May 3, a Delta rocket with a weather satellite on board had to be destroyed because of an engine shutdown seventy-one seconds after liftoff from Cape Canaveral AFS, Fla.

The April accident marked the second straight failure of a Titan 34D. The first, on August 28, 1985, had snapped a sequence of seven successful Titan 34D launches dating back to October 30, 1982.

The second Titan 34D failure, coupled with the loss of *Challenger* and the grounding of the three remaining Shuttle orbiters, has depleted USAF's space-launching capability and assets to the extent that "this is really becoming a crisis for us," an Air Force spokesman declared.

An investigative board headed by Brig. Gen. Nathan J. Lindsay, Commander of USAF's Eastern Space and Missile Center at Patrick AFB, Fla., was looking into the accident.

A comparable panel that investigated last year's Titan 34D accident found that the booster had suffered a massive oxidizer leak, a small fuel leak, and failure of its turbopump. The fuel leak could have been overcome, but either of the other two problems was bad enough in itself to have caused the rocket to fail, the investigative board reported.

Last April's second Titan 34D failure raised questions about USAF's program to develop and procure ten larger, derivative Titan 34D-7 Complementary Expendable Launch Vehicles (CELVs) for launching big payloads that only the Shuttle orbiters *Atlantis* and *Discovery* could now accommodate.

High-priority Milstar communications satellites are in this category. The first CELV, scheduled to be launched in late 1988, is earmarked to deploy a Milstar satellite.

As a result of the *Challenger* disaster, USAF recently indicated that it will need perhaps twenty Titan 34D-7 CELVs instead of the ten that it originally contemplated.

It is possible, however, that the growing doubts about the Titan 34Ds will extend to the Titan 34D-7 development program.

The Air Force was not borrowing trouble in this regard. At this writing, it had no immediate plans to put a hold on the CELV program.

"We'll find out what went wrong with the 34D, then we'll examine the 34D-7 program with our findings in mind," an Air Force spokesman explained.

The Delta loss was especially upsetting to NASA, as the vehicle was considered one of the most reliable in the inventory. Prior to the accident, Delta had successfully launched forty-three straight times over a decade and had a total of 178 launches to its credit.

An eight-man investigating panel had been set up as this issue went to press.

With the temporary grounding of the Shuttles, the Titan 34Ds, and now the Deltas, the US space program is left with only a handful of Atlas-Centaur and Scout launch vehicles. The Atlas-Centaurs are capable of lifting relatively heavy payloads, but the rockets are in short supply. The Scouts are for lightweight payloads, and all of those remaining vehicles have already been committed to specific missions.

★ On April 16, a four-year-old European joint-venture program reached a major milestone as the Experimental Aircraft Program (EAP) technology demonstrator was rolled out at British Aerospace's (BAe) Warton Aerodrome.

The aim of the EAP is to demonstrate the application of a combination of advanced technologies, which until now have only been shown in isolation. Knowledge gained in the construction and testing of this aircraft should prove beneficial in the European Fighter Aircraft (EFA) pro-

The Experimental Aircraft Program (EAP) technology demonstrator was rolled out on April 16. The vehicle incorporates a number of advanced technologies; the knowledge gained from this program should prove beneficial in the new European Fighter Aircraft.

gram, which is still in the planning stages.

BAe and the Italian firm Aeritalia are responsible for major airframe component design and manufacture. Companies in Britain, Italy, and Germany are building the subsystems. The various contractors and the United Kingdom's Ministry of Defence are sharing the cost of the demonstrator aircraft.

The airplane features a single-seat electronic cockpit with multifunction color displays and a voice warning system, and it is configured for full hands on throttle and stick (HOTAS) capability. The plane has a variable-geometry chin intake to maximize performance at all incidence and speed conditions, and it provides for low-drag carriage of air-to-air and air-to-ground weapons.

The demonstrator also includes carbon fiber composite wings, canards, and forward fuselage, and it has new lithium/aluminum alloys for the control surfaces. The aircraft also features digital databus avionics and full-authority digital fly-by-wire controls. Two advanced-design Turbo-Union RB199 Mk. 104 engines will power the plane to speeds past Mach 2.

Flight testing of the EAP is to begin later this summer.

On the other side of the Channel, the Dassault-Breguet Rafale, France's newest fighter aircraft, has been undergoing ground and engine tests and should take to the air later this month. The Rafale "A," powered by two General Electric F404 engines, is the concept demonstrator, while the "B" model will be the production aircraft. The Rafale-B will be powered by two SNECMA M88 engines, still in development.

★ In the latest of one of his periodic reliability and maintainability (R&M) policy letters to commanders of major commands and separate operating agencies, Air Force Vice Chief of Staff Gen. John L. Piotrowski states: "The Air Force must significantly improve the reliability and maintainability of our systems to increase combat capability while living within our manpower and funding constraints. [USAF] should expect *at least* double the reliability and half the maintenance for new systems compared with their predecessors (for example, ATF compared to F-15).

"Consequently, 'Double R/Half M' will be the guide for minimum R&M objectives in requirements documents for the next-generation systems. Many defense contractors assert that 'Double R/Half M' is possible for most types of systems—*if* the Air Force demands it! The demand for significant improvements in R&M begins with the operating commands' Statements of Operational Need. The 'Double R/Half M' policy applies to all systems which are not beyond the concept exploration phase of the acquisition cycle and for which the Air Force is the principal procuring agent."

★ With more than $7.7 billion in prime contracts and roughly $1.1 billion more in contracts to its divisions and subsidiaries, McDonnell Douglas Corp. ranked number one in a recently released listing of the Department of Defense's top 100 contractors for FY '85. McDonnell Douglas, also the number-one-ranked contractor in FY '84, edged out second-place General Dynamics Corp. by $1.4 billion. General Dynamics, first in FY '83, traded places on the list with Rockwell International during 1984 and 1985. Rockwell received contracts valued at almost $6.3 billion in FY '85.

The Ten Top Defense Firms in FY '85

Firm	Contract Values (000s)	FY '84 Rank
1. McDonnell Douglas Corp.	$8,857,136	1
2. General Dynamics Corp.	7,439,914	3
3. Rockwell International Corp.	6,264,047	2
4. General Electric Co.	5,890,667	6
5. The Boeing Co.	5,458,404	5
6. Lockheed Corp.	5,082,469	4
7. United Technologies Corp.	3,905,629	8
8. Howard Hughes Medical Inst.	3,551,360	7
9. Raytheon Co.	2,998,651	9
10. Grumman Corp.	2,732,859	11

The top ten firms in FY '85, with dollar values of all contracts awarded to the parent company and its divisions and that company's FY '84 rank, are shown in the accompanying table.

In all, twenty-eight firms each contracted for more than $1 billion worth of business with DoD in FY '85. The 100th-ranked firm, Pace Industries, Inc., had contracts worth $148,230,000. Total value of contracts let to the top 100 firms totaled $105,587,453,000.

★ A new project is under way at the Sacramento Air Logistics Center at McClellan AFB, Calif., that could revolutionize the previously tedious and always messy job of stripping paint from aircraft.

Unlike one of the current methods that uses chemical solvents, the new process involves a relatively small mechanical system that features a high-intensity xenon-arc strobe light that literally vaporizes the paint off a surface.

The prototype stripping lamp is less than an inch in diameter, is nine inches long, and has a highly polished aluminum reflector. The "pen" is connected by an umbilical cord to a 220-amp power source that weighs 4,000 pounds.

The lamp emits four very high-temperature pulses per second, and the paint instantaneously decomposes. Each pulse is only a microsecond in duration, so while the paint is removed, the underlying surface remains unharmed. Because composite materials would be damaged by chemical stripping or bead blasting, there had been no way to strip these surfaces until this new lamp came along.

The lamp can strip three square feet of one-mil-thick paint in a minute. This new process also leaves no residue. "I wear a dress shirt and a tie when I demonstrate the lamp," said Manuel Morante, a chemical engineer at the Sacramento Center. "With the lamp, there is no need to wear any protective clothing, as you normally would with chemical strippers."

The lamp passed its first test on an actual aircraft earlier this spring. An airplane was brought into a hangar, and the lamp stripped parts that were undergoing nondestructive inspection (NDI).

While testing is going on, other stripping lamps are being designed to operate twice as fast as the current version. One system is on the drawing board that will fit in a suitcase and operate off house current to permit operations in the field.

★ On February 23, 1942, a two-month-old B-17E returning from the

first US raid on Rabaul crash-landed in the Agaiambo swamp on the north coast of New Guinea. Because of the tall kunai grass, the plane suffered minimal damage, and the crew, after a six-week ordeal, was able to make it back to civilization.

Now forty-four years after the bomber bellied in, The International Group for Historic Aircraft Recovery (TIGHAR)—a nonprofit Delaware-based group that organizes aircraft-recovery operations—the Royal Australian Air Force, the US Air Force, and the government of Papua New Guinea are working together to bring the B-17 back to the United States.

This particular B-17E, serial number 41-2446, is historically significant for three reasons. It was accepted by the Army Air Corps on December 6, 1941, it is the third-oldest Boeing-built B-17 in existence, and it is the only remaining example of a B-17E with a remotely operated lower turret. The wreck remained undisturbed until 1972, when the RAAF found it in remarkably well-preserved condition.

After overcoming some initial misgivings of the Papua New Guinea government earlier this spring, TIGHAR now plans to start the salvage operation this fall. In September, when the water level in the swamp is down to roughly two feet, a survey party will be sent in to clean up the site. Then, in October, TIGHAR and a group from the training school at RAAF Wagga-Wagga will begin the actual recovery.

As part of their annual deployment to New Guinea, the RAAF will fly in CH-47 Chinook helicopters that will airlift the fuselage and wings of the B-17 to Port Moresby. Once there, the B-17, after removal of the inboard engine nacelles, will be loaded into a C-5A on a scheduled training mission and will be flown back to Travis AFB, Calif. The B-17 will be restored and then put on display at the Travis Air Force Museum.

★ The Department of Defense has awarded a contract worth more than $4 million to the Michigan-based Commission on Professional and Hospital Activities to examine the quality of medical and surgical care provided in the 168 DoD hospitals.

This "civilian physician peer review" contract is scheduled to last one year. If it is deemed essential to extend the contract, the cost for the second year will rise to $5 million, and a third year would cost approximately $5.3 million.

Unlike a recent Medicare study, the DoD-sponsored review will establish a standardized process for all patient-care reviews worldwide, rather than allowing individual contractors in each state to select specific problems for examination.

The study will focus almost exclusively on the quality of medical care provided. Roughly fifteen percent of the some 1,000,000 annual DoD hospital admissions will be reviewed after the patient's discharge. The quality of care will then be measured against standard criteria developed jointly by the contractor and DoD.

★ Myth has it that Daedalus, the legendary Greek engineer, escaped from the labyrinth he had built for Minos on ancient Crete by constructing wings of feathers and wax and then flying to freedom. (His son, Icarus, however, exceeded design tolerances with his set of wings, got too near the sun, and crashed into the sea when the wax melted.)

Now, many hundreds of years later, the Smithsonian Institution's National Air and Space Museum and the Massachusetts Institute of Technology are teaming up on Project Daedalus, which will be an effort to develop a human-powered aircraft capable of crossing the shortest—at sixty-nine miles—open-water strait between Crete and the Greek mainland.

The first phase of this three-part program, a feasibility study, was recently completed. Although the flight's distance would triple the world's distance record for human-powered aircraft and no existing airframe is capable of such a trip, the journey is believed to be technically and physiologically possible. The $74,000 study was underwritten by the Air and Space Museum and MIT, with the support of the Greek government, Aanderaa Instruments, and Union Carbide.

The Daedalus team's optimism is based on the results obtained from an experimental research program conducted over the last year. The group developed an airfoil that generates thirty percent less drag than those used on previous human-powered flights, an advanced all-composite wing structure was designed and built, and, in cooperation with the Yale University School of Medicine, a flight-power, full four-hour duration ergometer test was conducted.

Phase II of the project, estimated to cost $195,000, will be the design and testing of the prototype aircraft. Support for this phase is being sought from corporate sponsors. Phase III, tentatively scheduled for 1987, will be the actual flight.

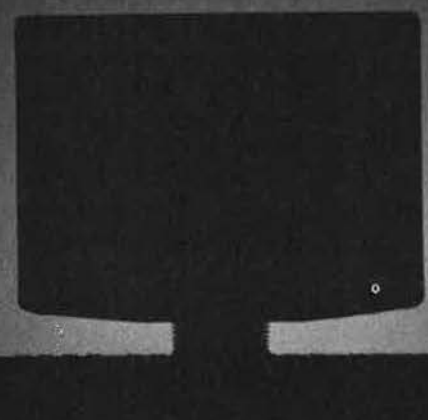
The Project Daedalus technical team is based at MIT's Department of Aeronautics and Astronautics and includes undergraduate and graduate students, faculty, and alumni.

★ The Air Force Recruiting Service reports that patriotism is a major reason prompting today's officer training school students to join the Air Force. In a separate survey, enlisted basic

AEROSPACE WORLD

Shrouded in its protective case, this Fleet Satellite Communications (FLTSATCOM) satellite was recently loaded onto a C-5A at the Los Angeles International Airport for a cross-country journey to Cape Canaveral AFS, Fla. The satellite is being loaded by employees of TRW's Space and Defense Systems Group. (USAF photo by SSgt. Mike Johnson)

WE'D LIKE TO TELL YOU HOW WANG GOT TO BE NO.1 IN THE TEMPEST MARKET, BUT IT'S A SECRET.



However, we can provide you with a few clues.

First, Wang is the only manufacturer offering a total TEMPEST solution. We provide complete systems. From PCs and multi-user PCs with fully-removable disk storage, to VS minicomputers with both data processing and office automation capabilities. And to tie it all together, FiberWay, the first fiber optic network available on the Preferred Products List (PPL).

Second, Wang has more products on the PPL than any other company.

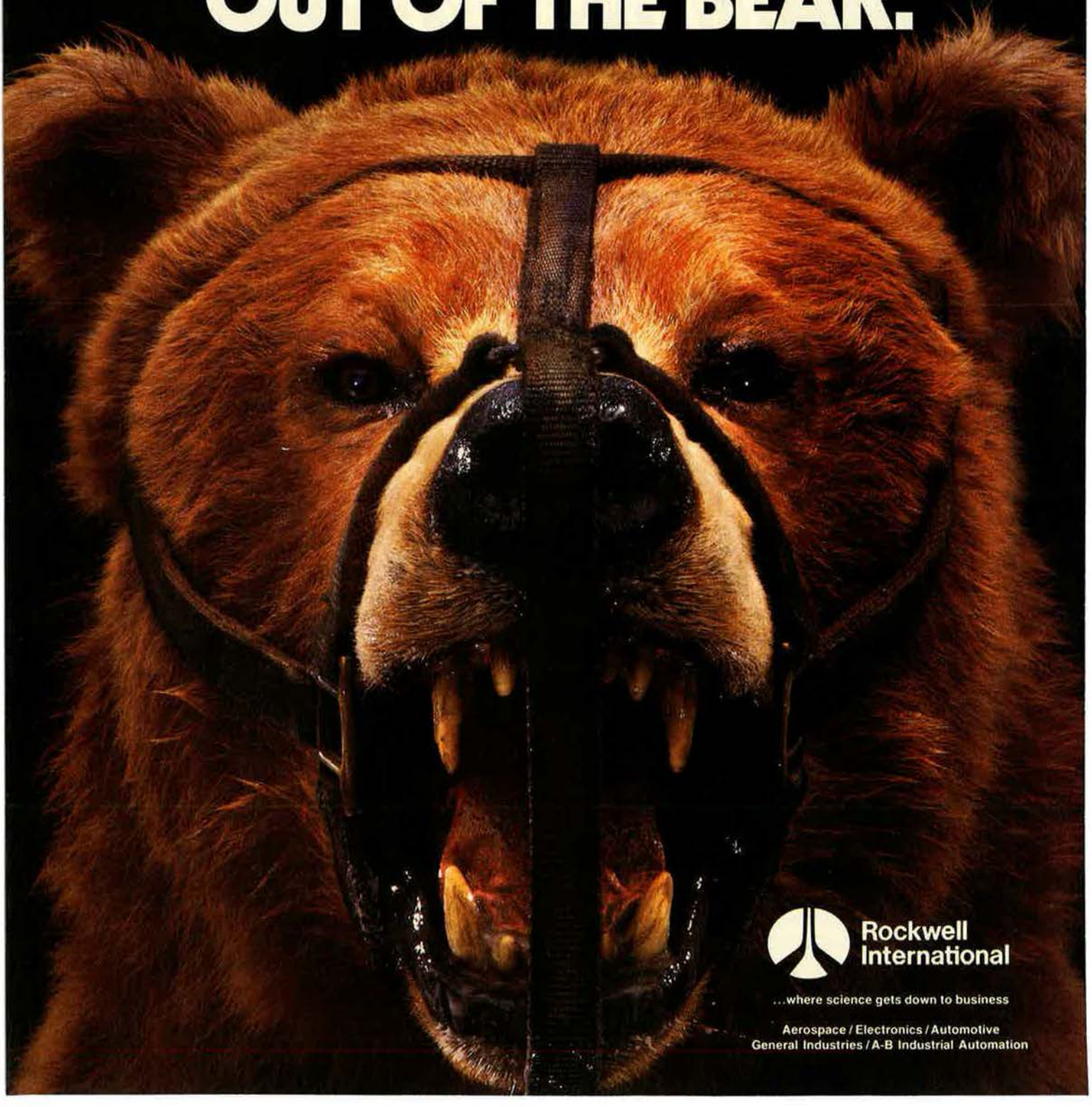
Third, Wang has more TEMPEST accredited equipment installed in the U.S. Government than any of our competitors.

That's all we can tell you in this ad. But if you'd like to learn more about Wang's TEMPEST systems, call Wang's Secure Systems Manager, Eugene Snyder, at (301) 657-5413.

WANG

The new Collins GRC-171A(V)4 is a colocatable ECCM multi-channel transceiver with space-saving frequency agile filter built right in. ■ This frequency agile UHF AM/FM Have Quick radio eliminates the need for external assets, which allows the use of multiple radios in transportable shelters, control towers, command posts and other space-limited installations. ■ Since the basic GRC-171 is already the standard air traffic control radio for the Air Force, the new GRC-171A(V)4 minimizes additional logistic support costs. This new GRC-171 is also wave form adaptable for international use. ■ For details contact: Collins Defense Communications, Rockwell International, 350 Collins Road N.E., MS 120-131, Cedar Rapids, Iowa 52498, U.S.A. (319) 395-1600, Telex 464-435. **Collins ACCD: The Electronic Combat Specialists.**

WE'VE TAKEN THE BITE OUT OF THE BEAR.



Rockwell International

...where science gets down to business

Aerospace / Electronics / Automotive
General Industries / A-B Industrial Automation

trainees also cited patriotism, along with educational opportunities, as important reasons why they enlisted.

The latest Basic Military Training Survey shows:

- Trainees still view the Air Force as the most prestigious service.
- Enlistees believe the Air Force offers better job training in skills most likely to be of benefit in later civilian life.
- Most recruits would have preferred to take their chances with a civilian job if the opportunity to join the Air Force weren't there. (This is somewhat of a change from previous surveys that revealed a preference to join any military service rather than face an uncertain job market.)
- A requirement to enlist for six years would have deterred only less than a third of the enlistees.
- Television proved to be the most persuasive advertising spur.

The OTS survey showed that sixty-seven percent of the officer candidates joined up for patriotic reasons. Management and leadership opportunities followed as considerations.

As with the basic trainees, most of the survey respondents from OTS—forty-four percent of whom were employed full-time prior to entry—said it was the Air Force specifically that they were interested in and that they would have continued in their job or in school if Air Force opportunities were not available.

AEROSPACE WORLD

★ PPG Industries' Glass Group has developed a new forward windshield and aft arch for T-38 trainers that is capable of withstanding the impact of a four-pound bird at a sea level-indicated airspeed of 400 knots.

The windshield is made of laminated polycarbonate with inboard and outboard surface materials that provide abrasion and environmental protection. To determine the most reliable windscreen cross section, forty-three bird-impact tests were performed at PPG's Huntsville, Ala., facility.

After testing several metal and composite reinforcements for the arch, the University of Dayton Research Institute designed and fabricated a composite of PPG fiberglass and du Pont Kevlar aramid fibers that met the specifications. The final configuration of windshield and arch successfully withstood twenty-two bird-impact tests.

Eight windshields are being provided for flight quality inspection, and this phase of the program should be completed in mid-1987.

Since 1961, four T-38s have been lost and three pilots killed as a result of birdstrikes on the transparencies. Using the current glazing, it is estimated that three to six aircraft would be lost as a result of windshield strikes and a further eleven to sixteen aircraft would be claimed by forward canopy strikes over the next twenty years. With the new transparency systems, the estimated loss is one aircraft.

Maj. Kevin Chilton (left) and SSgt. Bernard Keller of the 3247th Test Squadron at Eglin AFB, Fla., preflight the first Joint Tactical Information Distribution System (JTIDS)-equipped F-15A prior to its initial flight in late March. JTIDS will provide quick and secure communications in a battlefield situation.

★ The Supreme Court recently ruled that an Air Force captain, an Orthodox Jew, did not have a constitutional right to wear a yarmulke (a head cover) indoors while in uniform. This service psychiatrist has tried to wear the cap, and DoD had objected on the grounds that it was a violation of the uniform standard. This objection was upheld by the high court.

Several members of Congress have since introduced legislation that, as announced by Rep. Charles E. Schumer (D-N. Y.), would "protect anyone who desires to wear an unobtrusive religious garment like a yarmulke from punishment or discrimination under the authority of the US government."

Sen. Alfonse M. D'Amato (R-N. Y.) introduced similar legislation to permit the wearing of "neat, unobtrusive, and conservative religious apparel." Senator D'Amato said that he believed the Air Force interpreted the uniform regulations too strictly. "I question whether we can afford to preclude a certain group within our society from voluntary military service because of their centuries-old legitimate religious beliefs," he said. Senator D'Amato noted the bill would allow military personnel of any religion to wear, within reason, appropriate religious apparel.

★ While its roots trace back to World War I and Dayton's McCook Field, Air Force Systems Command's Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio, celebrated its twenty-fifth birthday on April 1.

Over the past quarter of a century, activities of the "Bicycle Shop," as ASD is affectionately known, have covered the aeronautical front from cargo planes, bombers, and fighters to tactical and cruise missiles, all the other hardware and software that the Air Force requires, and prototype and experimental vehicles that advance technology. ASD has also worked on numerous space-related programs.

ASD has grown over the years and now has more than 11,000 people and a budget of some $22 billion.

During the last twenty-five years, ASD has managed or overseen the following familiar and unfamiliar programs:

C-141—the first aircraft developed under the ASD banner; **XC-142A**—large VTOL transport aircraft; **HC-130H; C-5A/C-5B; C-131/C-135 Weightless Wonders**—aircraft used

to expose astronauts to brief periods of weightlessness by flying parabolic maneuvers; **AC-47/AC-130 Gunships; HH-53H Pave Low III**—see-in-the-dark helicopter; **YC-14/YC-15 Advanced Medium STOL Transports**—originally intended as a C-130 replacement, knowledge gained from the construction of these prototypes will now be applied to the C-17; **KC-135R Modifications; B-58**—although already flying in 1961, ASD oversaw test and operational programs; **F/FB/EF-111A; B-52 Modifications; B-1B; F/RF-4C; SR-71; F-15; A-10; F-16; F-15C MSIP; F-15E; F-16C MSIP; X-20 Dyna-Soar**—boosted glide vehicle; **XB-70; X-15; X-29; AFTI/F-16; AFTI/F-111; BOMARC**—interceptor missile later used as a target; **GAM-87 Skybolt**—air-to-ground missile; **AGM-65A and B Maverick; AGM-69A SRAM; AGM-86B ALCM;** and the **BGM-109G GLCM.**

In addition, the four laboratories that make up the Air Force Wright Aeronautical Laboratories (AFWAL)—Aero Propulsion, Avionics, Flight Dynamics, and Materials Laboratories—have pioneered the use and manufacture of composite materials, fly-by-wire controls, integrated circuits, solid-state radar, infrared systems, artificial intelligence, and high-bypass-ratio turbofan engines.

All in all, it has been a busy quarter century at the "Bicycle Shop."

★ Another important anniversary was celebrated April 20, as the North American Aerospace Defense Command (NORAD) marked twenty years of continuous operations from its underground command post in Cheyenne Mountain near Colorado Springs, Colo.

The complex is the nerve center of the system that would provide warning of aerospace attack on North America. Surveillance and tracking information on satellites, ballistic missiles, and aircraft are relayed to the command post by a system that includes satellites as well as ground-based radars, such as the Ballistic Missile Early Warning System (BMEWS), the Distant Early Warning (DEW) Line, and other sensors around Canada and the US as well as other parts of the world.

Planning for the Cheyenne Mountain complex began in 1956. Excavation began in 1961, and in order to carve out the four and one-half acres of tunnels and chambers, more than 693,000 tons of granite were removed. Eleven buildings, most of them three stories tall, were constructed. Three additional buildings, along with a new powerplant, were built in the early 1970s.

More than 1,700 members of the US and Canadian forces, civilian technicians, and contractors keep the operation working around the clock.

The command and control system is currently being upgraded to increase data-processing speed and capacity, and the reliability and maintainability of that system is also being improved.

In other news, President Ronald Reagan and Canadian Prime Minister Brian Mulroney recently extended for another five years the agreement under which the US and Canada operate NORAD. NORAD began operations in September 1958, and formal agreement on the establishment of the binational command was reached in May 1959. The initial ten-year agreement has been renewed for periods of one to five years since then.

★ The National League of Families of American Prisoners and Missing in Southeast Asia recently noted that support from veterans' and other organizations, including AFA, was deeply "appreciated and recognized" by the League.

The League recently voted to devote maximum effort to increase public awareness of the MIA issue in order to send a signal to the Vietnamese government that "America is united behind the President's strong desire to resolve the POW/MIA issue." The group continues to support "government-to-government" negotiations and opposes what it terms "irresponsible cross-border forays."

★ The Federal Republic of Germany (FRG) has become the first international customer for the AGM-88A High-speed Anti-Radiation (HARM) missile. The missiles will be used on Luftwaffe Tornado multirole combat aircraft. Texas Instruments, the missile's builder, will begin deliveries in 1987 and will continue them through 1989. The number of missiles in the

AEROSPACE WORLD

Aeronautical Systems Division (ASD) has managed numerous aircraft programs during its twenty-five-year history. In the late 1970s, the competitors for the Advanced Medium STOL Transport (AMST) program, the McDonnell Douglas YC-15 (left) and the Boeing YC-14, got together only once—May 26, 1977, on the ramp at ASD's home base of Wright-Patterson AFB, Ohio.

Air Force Association members and Avis... going places in style, with savings!

$27 a day
for a subcompact-group car.

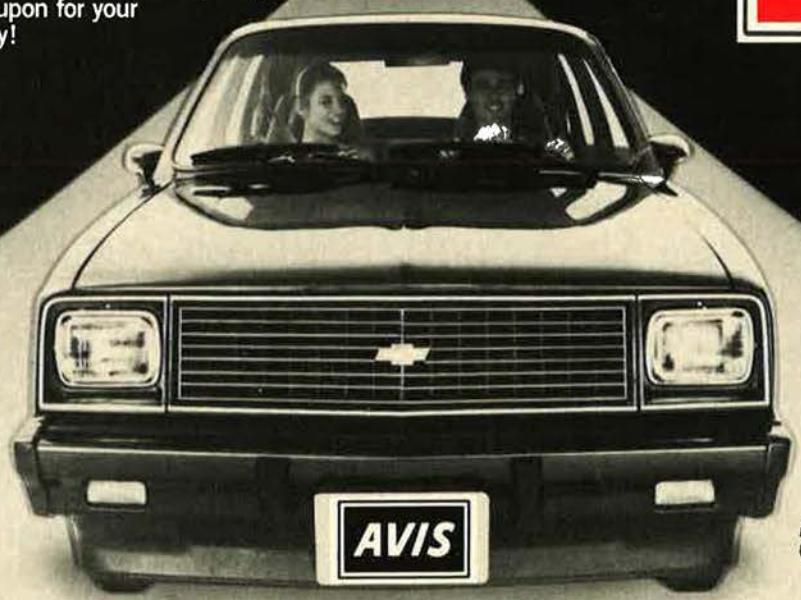
Members of the Air Force Association enjoy special low rates with unlimited mileage at Avis. You can rent a subcompact-group car, like the Chevrolet Chevette for example, for just $27 a day. Count on great savings from Avis on a wide selection of GM and other fine cars, for personal or official travel.

For all domestic and international reservations, call the Avis Government Desk, set up especially to serve you:

1-800-331-1441

To be assured of your special rates, just present an Avis or Avis-honored charge card and your Avis Worldwide Discount (AWD) card. Please clip the AWD card below for temporary use, and mail our coupon for your permanent one, today!

AVIS®



Avis features GM cars.
Chevrolet Chevette

Avis. So easy.℠

These special government rates are nondiscountable, available at all U.S. corporate and participating licensee locations and are subject to change without notice. An additional $5/day charge applies at all New York area airports and at all Manhattan locations. An additional $3/day applies at Boston and Chicago airports and at the Chicago N. Clark Street location. Rates are not available in Manhattan between 1 PM on Friday and 3 PM on Sunday and during holiday periods. (Call Avis for details.) Cars and particular car groups are subject to availability and must be returned to renting city. Refueling service charges, taxes and optional coverages not included.

Clip and carry this temporary Avis Worldwide Discount (AWD) card.
(For temporary use only.)

Air Force Association
AWD# A/A143350

AVIS®

THIS IS NOT A CREDIT CARD.

To reserve a car, call the Avis location nearest you or the Government Desk toll-free number:
1-800-331-1441

Avis. So easy.℠

For a permanent Avis Worldwide Discount card, clip and mail this coupon:

TO: Government Sales
Avis Rent A Car System, Inc.
6301 Ivy Lane
Greenbelt, MD 20770

Please send me_____Avis Worldwide Discount card(s).

Name _____

Address (or APO) _____

City/State/Zip _____

AWD# A/A143350

A-7 STRIKEFIGHTER

A new A-7, re-engineered and ready to deliver a new standard in Close Air Support/Battlefield Air Interdiction

Already a legend in its ability to deliver weapons accurately and efficiently, the celebrated A-7 Corsair is being remanufactured from the ground up. Its original builder, Vought Aero Products Division of LTV Aerospace and Defense Company, is giving it more of everything it needs to perform the CAS/BAI role well into the 21st century.

The basic airframe belongs to the rugged, performance-proven A-7 Corsair. But from there on out, it's different. It will have more power, more performance and punch, straight across the board. A new high-thrust afterburning engine with double the thrust of existing A-7's. Automatic maneuvering flaps, wing strakes, and the most advanced avionics package ever developed for navigation and weapons delivery.

More performance everywhere it counts

From takeoff to touchdown, the A-7 Strikefighter will demonstrate capabilities equal to any CAS/BAI requirements. Its takeoff roll is 45 percent shorter than the Corsair's. Its speed is 16 percent greater, topping off at Mach 1.2. It's more agile and responsive throughout its wider performance envelope.

While the Corsair can take enormous punishment, the Strikefighter can survive even more, with self-sealing fuel tanks, armor protection and redundant power control systems. And even with a full 15,000-lb. mix of bombs, rockets and 20mm "Vulcan" cannon, it can loiter on station for up to 1½ hours. And then deliver those weapons with devastating accuracy equal to anything in the air today.

Less than half the cost per copy

The Strikefighter's advantages reach from the bomb run to the balance sheet. Because the A-7 is an already-existing asset, its conversion can produce a fully capable Strikefighter at less than half the fly-away cost of a new fighter. And with trained people and equipment already deployed, its fielding and operating costs will be significantly lower. The U.S. Air Force will find the A-7 Strikefighter to be the most effective and affordable solution to its needs through the year 2010 and beyond.

LTV Aerospace and Defense
Vought Aero Products Division

L T V : L O O K I N G A H E A D

Initial order was not released, but it is known that the German Bundestag will later this year look into the purchase of more of the nearly fourteen-foot-long missiles.

★ The first of sixteen mobile aircraft arresting systems for the Air Force was delivered to Ramstein AB, West Germany, in late March. The arresting system is designed for use in combat situations where the useful length of runways or alternate landing strips has been shortened because of bomb craters and debris.

The system, built by Wickes's Advanced Development and Engineering Center, will be used with aircraft that now carry arresting hooks—A-7s, F-4s, F-15s, and F-16s. A modified B-52 brake on either side of the runway and a 1,000-foot cable on a spool strung between them constitute the major parts of the system. Much as with a carrier landing, the wire plays out after the tailhook catches the cable, and the brakes clamp down to slow the aircraft. The gear, which requires less than forty minutes to set up, can accommodate up to seventeen aircraft per hour.

The initial production lot of arresting systems will be sent to bases in Europe and in the Pacific. One set will be used for training at the Air Force Engineering and Services Center at Tyndall AFB, Fla. Current plans call for the production of 112 additional systems by the end of FY '88.

AEROSPACE WORLD

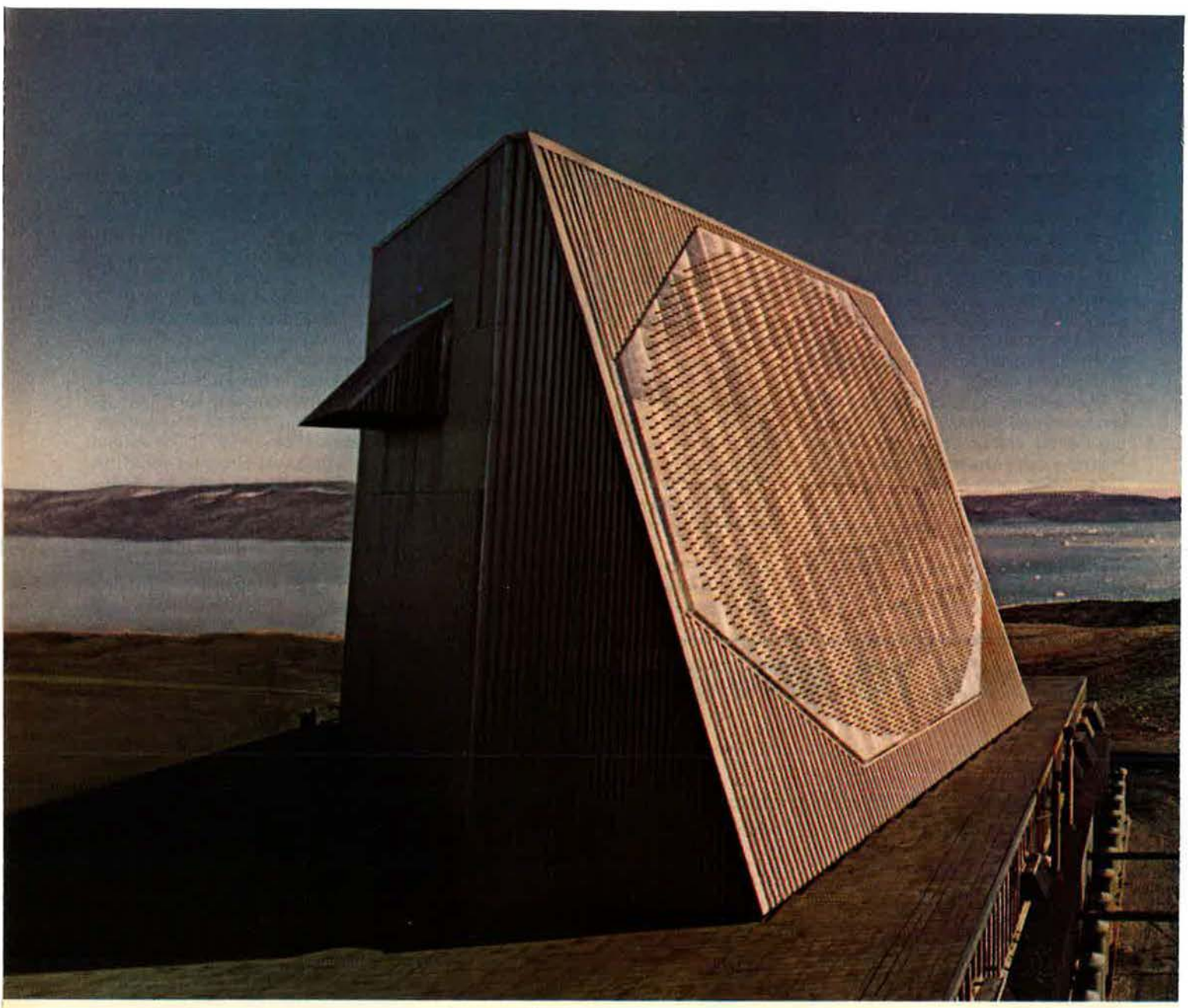
★ Marcel Dassault, pioneer French aviation designer, died April 17 at the American Hospital in Neuilly, France. He was ninety-four. M. Dassault's career began more than seventy years ago when he designed propellers for SPAD fighters in World War I. His first airplane, a collaborative effort with Henry Potez, was the SEA 4 monoplane in 1917. By 1936, M. Dassault was a millionaire, but in 1944 he was arrested by the Gestapo and deported to the Buchenwald concentration camp. He returned to France in 1945, and by 1952, the Dassault-designed Mystère II fighter was flying. The Mystère II was the first European plane to break the sound barrier in level flight. M. Dassault's company took over its last remaining French competitor, Breguet Aviation, in 1971. The Avions Marcel Dassault-Breguet Aviation company, second only to Aérospatiale in France, now produces five military jets, with the Rafale soon to come, and five civilian jets. Since World War II, M. Dassault's company has sold 6,500 airplanes in sixty-one countries. ■

INDEX TO ADVERTISERS

Senior Staff Changes

RETIREMENTS: M/G Thomas W. **Sawyer;** M/G Harold J. M. **Williams.**

CHANGES: Col. (B/G selectee) John R. Allen, Jr., from Senior Military Advisor, ACDA, Washington, D. C., to Cmdr., 45th AD, SAC, Pease AFB, N. H., replacing B/G (M/G selectee) Martin J. Ryan, Jr. . . . **B/G (M/G selectee) Marcus A. Anderson,** from Cmdt. of Cadets, Hq. USAFA, Colorado Springs, Colo., to DCS/Ops., Hq. TAC, Langley AFB, Va., replacing M/G Michael J. Dugan . . . **M/G Michael J. Dugan,** from DCS/Ops., Hq. TAC, Langley AFB, Va., to Dir. of Ops., DCS/P&O, Hq. USAF, Washington, D. C., replacing retiring M/G Harold J. M. Williams . . . **Col. (B/G selectee) Donald L. Kaufman,** from Project Dir., Joint Op. Planning and Execution System Project Group, JDA, MacDill AFB, Fla., to Command Dir., NORAD Combat Ops., NORAD/AFSPACECOM, Cheyenne Mountain Complex, Colo . . . **B/G (M/G selectee) Martin J. Ryan, Jr.,** from Cmdr., 45th AD, SAC, Pease AFB, N. H., to Dir., SPRAA, OJCS, Washington, D. C. . . . **Col. (B/G selectee) Sam W. Westbrook III,** from Cmdr., 48th TFW, USAFE, RAF Lakenheath, UK, to Cmdt. of Cadets, Hq. USAFA, Colorado Springs, Colo., replacing B/G (M/G selectee) Marcus A. Anderson . . . **B/G Larry D. Wright,** from Vice Cmdr., 22d AF, MAC, Travis AFB, Calif., to Cmdr., US Forces Azores, and Cmdr., 1605th MASW, MAC, Lajes Field, Azores, replacing B/G Donald A. Rigg.



No-fault coverage.

Electronic beams generated by this 10-story-high radar in Thule, Greenland, will soon blanket the skies over a zone extending from the North Atlantic to the European coast. When operational, this sophisticated dual-faced radar will provide the early warning and detailed impact assessment needed in the event of a mass missile raid on the United States. And it will have a reliability factor approaching 100%.

To acquire and process this amount of detailed information, the U.S. Air Force Electronic Systems Division turned to the speed and accuracy of phased array radar in updating the Ballistic Missile Early Warning System (BMEWS) at Thule. And, to meet the many challenges inherent in such a complex project, the Air Force chose Raytheon as prime contractor.

No company can match Raytheon's record of performance in building these giant radars. The Pave Paws installations on the U.S. East and West Coasts, Cobra Dane in the Aleutians, and the seaborne Cobra Judy system are prime examples. Each has multiple ballistic missile target detection and tracking capabilities and an outstanding record of operational availability.

At Raytheon, we manage the complex by first mastering the basics. In the case of BMEWS, these basics include pioneering work in the field of antenna design, an understanding of *how to apply* phased array technology, and a thorough knowledge of every facet of systems management. It's this dedication to fundamentals that enables us to successfully produce systems essential to the national defense—and to do it time, after time, after time. Because at Raytheon, quality starts with fundamentals.

Raytheon Company, Government Marketing, 141 Spring Street, Lexington, MA 02173.

Raytheon

Where quality starts with fundamentals

Apparently, the future belongs to the National Aerospace Plane—but the immediate problem is a backlog of payloads in the wake of the Shuttle disaster.

Mastering the Transatmosphere

BY JAMES W. CANAN
SENIOR EDITOR

THE United States has made its first major move toward mastering space and the transatmosphere for military and civilian pursuits in the twenty-first century.

It has gone beyond dabbling in concepts for an incredibly swift and versatile aircraft/spacecraft that would make such mastery possible and has now set up shop to design and build one. A prototype could be flying within ten years.

The National Aerospace Plane (NASP) program at Wright-Patterson AFB, Ohio, is the seat of the action.

With strong White House backing, the NASP program teams the Department of Defense and the National Aeronautics and Space Administration in what is shaping up as the most technologically and operationally tantalizing aerospace project ever undertaken.

Breaking the sound barrier, breaching lower space with rocket-powered aircraft, going to the moon, and flying and landing the Space Shuttle may come to pale alongside the multifaceted feats in prospect for the manned, X-series flying machine to which the NASP program aspires.

Given its allure, the aerospace plane is fast becoming regarded as the bright hope of the future for the US space program.

By and large, that program is well conceived and well executed. Its satellites do many marvelous things, and will do more, to enhance the prowess of US military forces and of US commercial enterprises.

The space program is increasingly costly, however, and has suffered some recent setbacks.

For one, USAF's program for developing and testing antisatellite (ASAT) rockets for high-flying F-15 fighters is in deepening political trouble in Congress. Plans to deploy an ASAT force to counter the heightening Soviet threat in space have already been scaled down. There is growing concern in Pentagon circles that such deployment may never happen.

Even more sobering, perhaps, is the dire impact that the Space Shuttle *Challenger* disaster of last January 28 has had—and will continue to have—on US space-launching capabilities and prospects. This setback has been compounded by recent failures of Titan and Delta space-launching rockets.

The aerospace plane now on the drawing board does not present itself as a near-term solution to such problems currently besetting the

Artist's concept of a hypersonic National Aerospace Plane (NASP) heading for space straight from an airfield, where three others wait on the ramp. INSET: A rocket-powered X-15 is released by a B-52 to explore manned flight at the fringe of space. The X-15 program of the late 1950s and early 1960s helped show the way to the NASP.


-15
NORTH AMERICAN AVIATION INC.

space program. It is too far off for that, even though the development of its technologies may well teach some lessons that can be applied to the space program relatively soon.

Potential Space Superstar

However, the aerospace plane's mind-boggling potential as an all-purpose superstar in space and the new national commitment to bring it into being if at all possible serve to infuse the currently bedeviled space program with optimism that would otherwise be lacking.

As planned, the experimental (X-30) aerospace plane will be capable of runway takeoff, hypersonic single-stage entry into space and/or flight in the transatmosphere, and runway landing.

NASP officials acknowledge that all this will take some doing. They express confidence, however, that now—for the first time since the idea of an aerospace plane first surfaced in the early 1960s—it can be done.

"If we didn't think so, we wouldn't be in business," declares Air Force Brig. Gen. Kenneth E. Staten, who is the director of the NASP program.

General Staten describes the aerospace plane as "revolutionary, not evolutionary." To him, the NASP program is "an adventuresome, pioneering step—the kind of thing that Americans are good at and that established America's leadership in the world."

The going will be precarious. There are great expectations but no guarantees that the extremely sophisticated and demanding technologies needed for the aerospace plane can be brought to fruition and formed into a thoroughly integrated whole.

General Staten categorizes those technologies in "three main sets—propulsion, advanced materials, and computation." The latter means computers and software.

"The computational state of the art supports our requirement," the General says. "The breakthroughs that gave us confidence to proceed were in propulsion and materials."

As a key to the ultimate success of the NASP program, the clear-cut national need for an aerospace plane may be as important as the maturation of its technologies.

The US military sector is heavily and increasingly dependent on such satellites as those for communications, navigation, warning, weather forecasting, and surveillance. The US civilian sector also sets store by space assets. Both sectors will make much greater demands on space in the years ahead.

Thus, the US will need spacecraft that will enable it to take advantage of space for military and civilian purposes much more flexibly, efficiently, and inexpensively than is possible with Shuttles and with rocket boosters in existence or under construction.

"If we're going to exploit space, we're going to have to make space cheaper and easier to exploit," asserts Gilbert H. Rye, President of COMSAT Government Systems Inc. and former director of space programs, as an Air Force colonel, on the National Security Council staff.

Wide Range of Tasks

US space planners covet the aerospace plane in this regard. They see it as a machine of many potential uses and forms.

Big aerospace planes could take heavy, bulky satellites into space or could even serve as such satellites. Platforms for lasers or rockets of the sorts being worked up in the Strategic Defense Initiative (SDI) program come to mind.

Smaller aerospace planes could be used to service and to repair satellites and could ferry people, supplies, and mail to and from the space station that NASA is planning to have assembled in space around the mid-1990s.

On the military side, varieties of aerospace planes could perform such missions as reconnaissance, global interdiction, and interception of attacking forces in space and in the air.

As General Staten puts it, "The military has a need for quickly gaining access to anywhere in the world, and this [NASP] program would give us a vehicle that could do that."

Hopes for the aerospace plane as a relatively inexpensive means of boosting payloads into space rest on the airplane-like operational mode foreseen for it.

It is not expected to require anywhere near the logistical support needed by Shuttles or by space-boosting rockets. Moreover, aerospace planes could be launched on short notice from dispersed and readily accessible runways, giving them great advantages of security and flexibility.

"It offers strategic force survivability," says Gen. Lawrence A. Skantze, Commander of Air Force

The aerospace-plane idea has been around a long time, as witness this 1965 McDonnell Douglas artist's concept of an aerospace plane that is strikingly similar to NASP configurations now being explored. The US abandoned its aerospace-plane program of the early 1960s because key technologies, now ripe for testing, were lacking back then.

Systems Command. "A fleet could sit alert like B-52s."

At an Air Force Association symposium on military space late last year, General Skantze discussed the aerospace plane in the context of USAF's Project Forecast II, a study of important new technologies and of their future impact on the Air Force. The aerospace plane gets big play in that study.

General Skantze pointed out that it "responds to a wide range of Strategic Air Command, Tactical Air Command, Military Airlift Command, and unified Space Command needs.

"We're talking about the speed of response of an ICBM and the flexibility and reliability of a bomber packaged together in a plane that can scramble, get into orbit, and *change* orbit so [that] the Soviets can't get a reading accurate enough to shoot at it," General Skantze explained.

Cheaper Way into Space

He emphasized, however, that the aerospace plane's "paramount importance" lies in its potential for "low-cost, reliable access to space—precisely what's needed to open up the space frontier to routine operations."

Getting a Shuttle off the ground is too costly and too cumbersome. It requires an elaborate and expensive launch complex. About 6,000 people are involved in the operation.

Moving the Shuttles between landing points and launching points also eats up money, as does their heavy maintenance, much of it on the protective tiles. They also depend on a single carrier aircraft, which itself needs maintaining.

These are the main reasons why it costs up to $3,000 to put just one pound of payload into space aboard a Shuttle.

The aerospace plane would dispense with most of this and would carry payloads into space at one-tenth or less of the Shuttle system's cost, officials estimate.

If this turns out to be anywhere near the mark, there will be no stopping the NASP program—providing that its technologies pan out.

"We've got to get the cost of space launches down," asserts Secretary of the Air Force Edward C. Aldridge, Jr. "If the aerospace plane can cut the cost by a factor of 100, wonderful. If it can cut it by a factor of ten, we would all be elated. But if it can't cut the cost at all, then we'll have a problem with the [NASP] program."

In any case, the aerospace plane will probably not be ready to take over from the Shuttle at the time that the Shuttle needs to be replaced as the workhorse of the US space program. That time is expected to come no later than the mid-1990s.

At this writing, the Air Force and NASA were jointly studying the requirements for a post-1995, next-generation Space Transportation System (STS) of manned or unmanned launchers, or of both. The big players in determining these requirements are the Strategic Defense Initiative Organization (SDIO) and NASA's space station planners.

The space station and SDI weapons satellites and command control communications and intelligence (C^3I) satellites are expected to need launch vehicles capable of lifting much heavier payloads into space much more cost-effectively and at much higher rates than will be possible with the Shuttles or with the Titan 34D-7 Complementary Expendable Launch Vehicles (CELVs) now under construction for USAF.

The Shuttles, the CELVs, and other, smaller expendable launch vehicles (ELVs) will suffice to boost non-SDI military payloads into space through the mid-1990s.

The US space program has been jolted by the Challenger disaster and recent failures of Titan 34D boosters. This 34D is off to a flying start.

For example, the vital Global Positioning System (GPS) navigation satellites can go into space on Shuttles or ELVs. The equally imperative Milstar communications satellites, which will be prime-choice military assets, can be launched, starting in 1988, on Shuttles or on CELVs.

However, all US military and civilian satellites have now run into a problem that has nothing to do with the one of going beyond the Shuttles, the CELVs, and the ELVs as launchers in the coming decade.

The Shortfall in Capacity

The problem is one of a severe shortfall in US space-launching capacity right now and for years to come. It was created by the loss of the Shuttle *Challenger.*

The *Challenger* disaster postdated both the NASA-DoD study of a new, post-Shuttle STS in the nearer term and the establishment of the DoD-NASA program for an aerospace plane in the farther term. It

was obviously not the motivation for either endeavor, but it served to underscore the importance of both.

It did this by dramatizing how dangerously in arrears the loss of a single Shuttle leaves the US space program—consigning to limbo the previously scheduled launchings of many military satellites—and by demonstrating that the US will have to attend to its space-launching capabilities more assiduously than it has in the past.

"We must build a space-launch posture that is stronger and more robust than that which existed before," Secretary Aldridge asserts. "Restoring the *status quo* should not be our goal. The *status quo* was too thin."

At this writing, the timetable for resuming Shuttle flights was still uncertain, even though NASA had indicated that such flights may begin again next year.

Even if they do, the problem will still remain severe. The STS will have only three Shuttle orbiters, and only two of those—*Discovery* and *Atlantis*—are capable of flying the heavier loads that DoD missions require.

Moreover, the heavy-lift Titan 34D-7 CELVs that the Air Force had the foresight to begin ordering prior to the *Challenger* disaster will not begin coming into play until late 1988.

Once the Shuttles are back in action, they will fly less frequently than scheduled prior to the *Challenger* accident. This will exacerbate a backlog of launches that is already building.

If the STS is shut down one year, ten DoD payloads will have been put off. If it is down two years, more than thirty-five Shuttle missions will have been canceled, and "DoD would have serious problems with twenty-one high-priority payloads waiting on the launchpad," Secretary Aldridge told Congress.

Moreover, he testified, "There would be a heavy impact on NASA missions, because many of the backlogged DoD missions must take priority when the flights are reinstituted."

The Air Force has encouraged Congress to approve the construction of a replacement Shuttle orbiter at an estimated cost of $2.8 billion. It also has indicated that it will need more CELVs than the ten now authorized.

Not even these moves would alleviate the problem of space-launch shortfalls in the near term, however. A new Shuttle orbiter put into construction right now would not begin flying until 1990. Adding to the number of CELVs would not hasten their advent, which is more than two years in the offing.

These days, in the wake of the *Challenger* tragedy, the appearance of undue haste is something devoutly to be avoided in the US space program.

Meanwhile, the Air Force must resort to its ELVs—such rockets as Atlas, Delta, converted Titan II, and Titan 34D. All are either too scarce or too small to handle the numbers and the masses of the payloads for which DoD requires Shuttles and CELVs.

The Manned Alternative

Some officials believe that the aerospace plane could be ready in time to succeed the Shuttle and that an interim vehicle or vehicles will not be needed.

Secretary Aldridge, for one, doubts it. "The earliest we see the aerospace plane becoming available is the very late 1990s, around the year 2000," he says, "so there would be a discrepancy of eight to ten years between the time we need a new orbiter and the time we could have the aerospace plane."

Still and all, the aerospace plane is said to figure as an outside possibility in the Air Force-NASA study of the future STS to succeed the Shuttle, and a paper associated with USAF's Project Forecast II also identifies the aerospace plane as such.

If the aerospace plane is not ready, it is possible that two varieties of stopgap spacecraft will be built to take over from the Shuttles. One would be an unmanned vehicle, parts of which would perhaps be recoverable, for lifting heavy payloads. The other would be smaller and manned and supply the space station and service satellites. The smaller one "could use derivative technology" from the NASP program, Secretary Aldridge speculates.

That program, off and running, involves the Air Force, the Navy, the Army, the Defense Advanced Research Projects Agency (DARPA), SDIO, and NASA. Each is committed to share in financing the program's two phases.

The first phase, running through mid-1989, is expected to cost $600 million. It will deal with designing the airframe, developing and testing propulsion modules, getting all technologies in hand, and testing some key components.

DARPA is the leading agency in this phase. In fact, DARPA and the White House Office of Science and Technology Policy (OSTP) are given much of the credit for the technological developments and the political influence, respectively, that gave life to the NASP program.

If all goes well in its first phase, the program will proceed into its second phase, expected to cost about $3 billion. The X-series prototype aerospace plane will be built during this phase and begin flying in the mid-1990s. USAF will have charge of this part of the endeavor.

The NASP program has a $68 million budget in the current fiscal year and is slated to receive $212 million in FY '87, which will begin next October 1.

Industry competition for the aerospace plane began in earnest last April. Airframe design contracts went to Boeing, General Dynamics, Lockheed, McDonnell Douglas, and Rockwell International. Propulsion contracts were awarded to General Electric and Pratt & Whitney.

Most of these contractors had taken part in concept studies of a Transatmospheric Vehicle (TAV) that were managed by AFSC's Aeronautical Systems Division at Wright-Patterson. That program and another at AFSC's Space Division were forerunners of the NASP program.

As conceived, the aerospace plane will be capable of flight in two modes—single stage into low-earth orbit and hypersonic (Mach 12 to Mach 25) cruising in the transatmosphere at altitudes between 100,000 feet and 350,000 feet.

The first of these modes addresses the payload-launching aspect of the US space program and is the one in which SDIO, as a prime player in the NASP program, is chiefly interested.

The NASP and SDI

SDIO's portion of the NASP program budget is $9 million in the current fiscal year and has been set at $30 million in FY '87.

Several SDI experimental projects have prospered well enough to make its goal of directed-energy weapons, kinetic-energy weapons, and C³I systems for space (if the decision is made someday to deploy them there) more tangible and nearer at hand. This lends impetus to the NASP program.

Air Force Lt. Gen. James A. Abrahamson, SDIO director, recently told Congress that the program "may be able to cut more than a decade" from its original timetable for fruition and testing of some key technologies.

The need to plan ahead for SDI space deployment figures heavily in considerations of heavy-lift launch vehicles, such as possible aerospace-plane variants.

SDI officials have recently indicated that they now emphasize the development of ground-based lasers over that of space-based lasers. They have by no means given up on the latter, however, and even the ground-based lasers would need to be teamed with beam-reflecting mirrors and with sensors, battle-management systems, and C³I systems in space to do their job of intercepting enemy missiles in post-boost and midcourse flight.

Ground-based lasers for firepower in space have been made possible by stunning SDI successes in "adaptive optics" experiments to overcome the problem of laser beams dissipating as they pass through the atmosphere into space.

To counter atmospheric distortion of the beam, a sensor in space monitors atmospheric characteristics and continuously sends down atmosphere-calibration data to a computer that is part of the laser-weapon system.

The computer keeps adjusting a "deformable mirror" in the laser system that skews its beam to compensate for the atmospheric aberrations. The result is that the deformed beam, in penetrating and interacting with the atmosphere, reacquires its original form and its intended coherency.

The SDI project also involves promising experiments in weapons that would attack enemy ICBMs from space with hypervelocity projectiles and neutral particle beams, which could also be used as sensing devices.

For ground-based systems that will intercept the reentry vehicles of such ICBMs in their "terminal" phase, Lockheed is working up the exoatmospheric reentry-vehicle interceptor subsystem (ERIS) for SDIO, and McDonnell Douglas is developing a test-bed missile for the program's High Endoatmospheric Defense Interceptor (HEDI) system. Both seem well in hand.

None of this comes cheap. However, the costs that concern SDIO officials as much as any are those of launching SDI payloads into space for testing and—if it comes to that—deployment.

Cumbersome logistics involved in preparing a Shuttle for liftoff contribute heavily to the Shuttle program's high payload-launching costs. Here, USAF works with the original Shuttle Enterprise in preparing its Vandenberg AFB, Calif., Shuttle-launching complex for eventual action.

General Abrahamson has said that the single most important cost parameter in the SDI program is that of launching such payloads.

The NASP program could be a lifesaver in this regard.

"Our initial calculations," declares the program's General Staten, "show that we will be able to go single stage to orbit with payloads at between one percent and twenty-five percent of the expense of doing it with the Shuttle."

Getting from Here to 1995

First off, however, there must *be* an aerospace plane.

Developing the propulsion system and integrating it with the airframe will be the hardest part of making the aerospace plane happen.

It is already being referred to as "a flying engine," because, says DARPA Director Dr. Robert Duncan, "the whole airframe plays a part in the propulsion system."

This means, says DARPA Deputy Director Dr. James A. Tegnelia, that "the fuselage forebody is an integral part of the engine inlets and the fuselage afterbody is an integral part of the engine nozzles."

The aerospace plane's multiple powerplants will have to operate efficiently from zero velocity at the start of the takeoff roll, which is expected to be short, to Mach 25 at the point of orbital insertion.

"We believe we have achieved some breakthroughs in propulsion that will enable us to use air-breathing technology for most of our velocity," General Staten asserts.

This means scramjets (supersonic-combustion ramjets) powered by liquid hydrogen. They will require a supersonic flow of compressed air through their combustion chambers. Regulating such a flow at hypersonic speeds to prevent shock waves and to keep the engine-ignition process stable and efficient will be extremely difficult.

The aerospace plane will have to take off from a standing start, a capability that airflow-driven scramjets cannot provide. It also will need to accelerate to, and fly at, hyper-

sonic speeds of 4,000 to 8,000 miles an hour and then drop down to subsonic speeds for approach and landing.

To manage all this, the aircraft/spacecraft could well embody hybrid powerplants that combine takeoff-power rockets with scramjets and subsonic-combustion ramjets.

The machine may also need to carry air onboard as a means of oxygenating its propulsion system to maneuver in airless space and to come back down into the atmosphere. It could restore its air supply by dipping into atmosphere.

Propulsion technologies and all others for the aerospace plane will be closely held.

"Our country has invested a quarter of a century of its money and some of its very best talents in developing these key technologies, and it would be irresponsible to compromise them until the nation has had the opportunity to capitalize on them," General Staten declares.

Even though the aerospace plane project of the early 1960s was aborted because the technologies were just not there, work on those technologies continued.

NASA, says General Staten, has been "the big champion of research in hypersonics."

The success of "Copper Canyon," a DARPA project on hydrogen-powered scramjets and ramjets, was the key to forging a virtual consensus in the US aerospace community that the aerospace-plane concept has come of age.

Some Doubt Remains

Some knowledgeable officials and observers caution against overconfidence in the NASP program's ability to master the required technologies even now, however.

One is Under Secretary of Defense for Research and Engineering Dr. Donald A. Hicks, who warns against "pretending we have something we don't have" and against "overselling" the NASP program.

"But let me not put a damper on it," Dr. Hicks continues. "I'm optimistic about the research turning out well, and I'd love to see the aerospace plane happen. It could be terribly important to us, even critical."

Another is Gen. Robert T. Marsh, USAF (Ret.), former commander of Air Force Systems Command, which itself played a major role in nurturing many aerospace-plane technologies.

General Marsh believes that the NASP program is a "sensible" one, with prudently timed and probably attainable goals.

"I'm enthusiastic about the program," he declares. "It has tremendous potential for military and civilian access to, and capability in, space. It deserves a major national push.

"But there are gaps in our understanding of hypersonics and in our experience in hypersonics. It's very complicated."

One "very challenging undertaking" that General Marsh sees in store for the NASP program is that of removing moisture from the propulsion air-liquefaction system and disposing of the water.

It would have to be done to perfection, he says, "to keep from having a flying ice cube on your hands."

In broader terms, "Propulsion is the hardest challenge of all," General Marsh continues. "It's not just engines. In hypersonics, there's a very intimate connection between propulsion and aerodynamics. What you must have is a totally integrated aerodynamic and propulsion capability, a total system that uses the externals of the vehicle to shape the airflow."

In keeping with the "high degree of streamlining" that hypersonic vehicles require, General Marsh believes that the aerospace plane's engine inlets will need "knife-edge lips. This will exacerbate the temperature problem," he asserts.

That problem is a huge one. Hypersonic flight will induce metal-melting temperatures on the airframe. The airframe will have to be built of advanced materials capable of withstanding them (Shuttle-style tiles are out of the question), and it will probably need an exotic system of fluid coolants and/or pipes to draw heat away from critical areas.

The aerospace plane's materials must also be much stronger and lighter than any ever fabricated for a flying machine—given the demands to be made on its propulsion system and on its payload-toting capability.

Breakthroughs in materials technology now make all this possible, NASP officials claim.

The supercomputers, such as NASA's Cray II, provide the computational prowess that designers need in order to figure out the aerospace plane's fluid dynamics, or the flows of air and of energy around it and into it. Such computers can simulate various airframe-engine configurations under many different airflow conditions.

Such data must be validated in flight, however, and "there's great uncertainty out there beyond Mach 6 or Mach 8," says General Marsh. "We need a lot of empirical data on hypersonic flow."

In Phase I of the NASP program, engine modules will be built and tested up to Mach 8, which is the speed limit of wind tunnels for engine tests. It will be up to the pilots of the prototype aerospace plane to find out for sure what happens beyond Mach 8—providing Phase I culminates in a decision to go forward with the prototype.

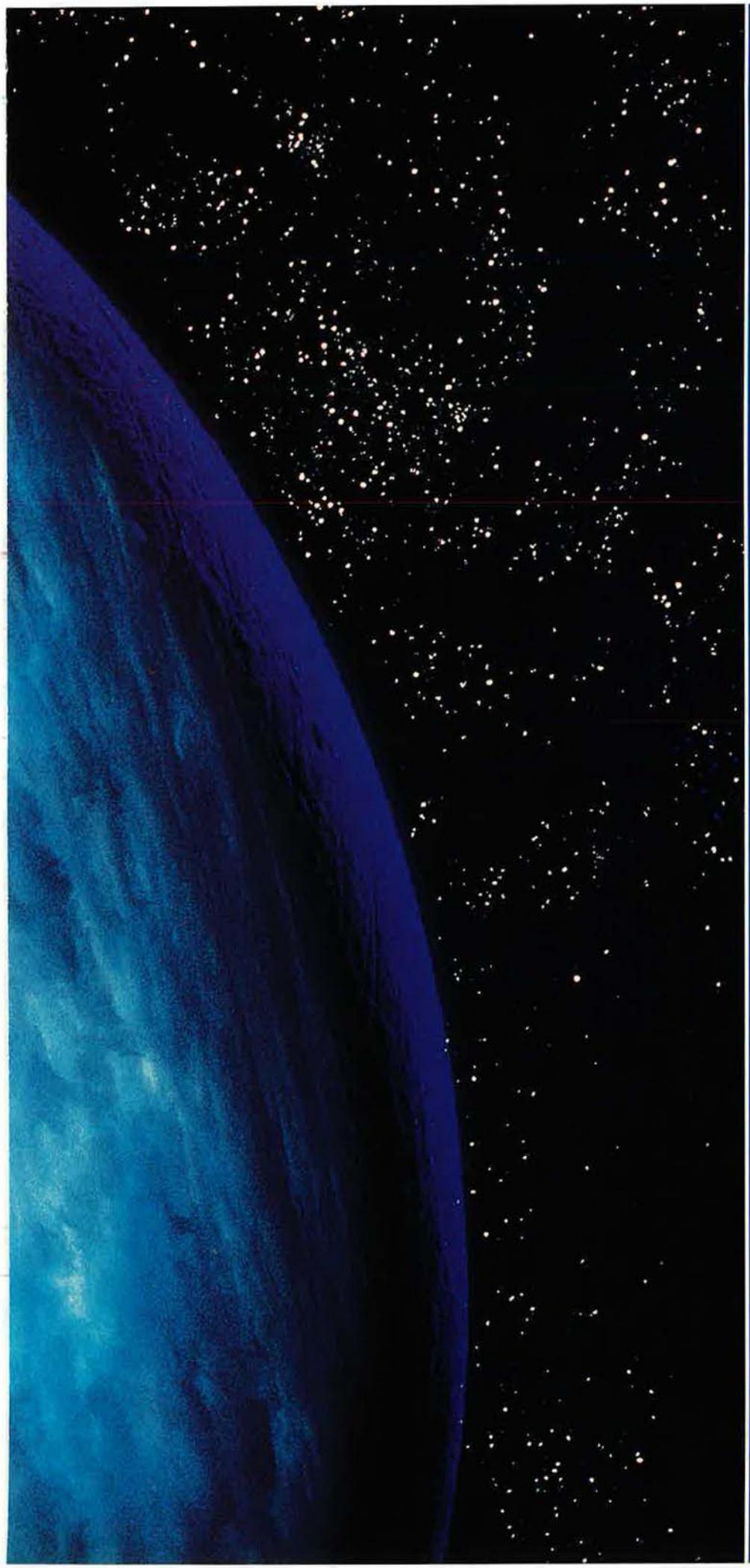
Despite its obvious risks, the aerospace plane is widely regarded in US aerospace circles as ripe for the trying. Its commercial potential may rival its military potential as the reason for this.

"I believe that it will fly and that we won't be too many years into the twenty-first century before it will be as common as Boeing 727s are today," declares an influential Administration official.

Dr. Karl G. Harr, President of the Aerospace Industries Association of America, says that the aerospace plane's "implications for future space operations, particularly the commercial development of space, are stunning."

Dr. Harr sees the aerospace plane as "dropping the cost of delivering payloads to orbit from several thousand dollars a pound to tens of dollars a pound."

Moreover, he says, its development promises to "provide a technology base that could sharply reduce the time and the cost of developing the companion commercial hypersonic transport—and that's a very big factor, because most experts have felt for years that economic feasibility has been a greater barrier than technical feasibility to faster-than-sound passenger transportation." ■



Wyle at work.

Defense systems in space protecting life on earth.

The Strategic Defense Initiative is destined to become one of the cornerstones of our national security. It's designed to insure a strong America and a peaceful world. It's one of the most important items on our national agenda.

At Wyle Laboratories, we're playing a vital part in the development of SDI. Our staff of scientists and engineers, using our highly specialized facilities, will be providing engineering and testing for some of these most important systems. Our work on SDI will be backed by over forty years experience as the nation's leading independent testing laboratory. We're also the leader in the design and construction of special purpose test facilities, simulators and test machines.

Wyle Laboratories can provide the full range of engineering and testing services for weapons systems, aircraft, missile and space vehicle components. For more information about Wyle services, call collect: Drexel Smith in Norco, CA at (714) 737-0871, Don McAvin in Huntsville, AL at (205) 837-4411, John Wood in Hampton, VA at (804) 865-0000 or Paul Turkheimer in El Segundo, CA at (213) 322-1763.

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

Huntsville, AL	Arlington, VA	Norco, CA
Lanham, MD	El Segundo, CA	Hampton, VA
Los Angeles, CA	Santa Clara, CA	Houston, TX

USAF Space Division Checklist

WHAT'S HAPPENING AT THE SPACE DIVISION OF AIR FORCE SYSTEMS COMMAND

(As of May 7, 1986)

NAME AND MISSION	STATUS	CONTRACTOR
Air Force Satellite Communications System The Air Force Satellite Communications System provides the capability of high-priority command and control communications for US strategic forces. The system is integrated with the Fleet Satellite Communications System and other DoD satellites, as it does not have its own dedicated spacecraft.	Operational	Classified
ASAT The US successfully conducted the first antisatellite test against a target in space last September 13. In preparation for other tests, two instrumented target vehicles (ITVs) were launched in December 1985. A congressional ASAT test ban will prevent further intercept testing in FY 1986. Infrared phenomenology tests will be conducted.	Development and Test	LTV Aerospace and Defense; Boeing Aerospace Co.; Avco Systems Div.; Logicon Inc.; Aerospace Corp.
Consolidated Space Operations Center When operational, the Consolidated Space Operations Center (CSOC) at Falcon AFS near Colorado Springs, Colo., will provide in one location an enduring and secure facility to command and control DoD Space Shuttle and satellite missions. The Center will complement NASA space operations and integrate such military requirements as the need for increased security. Major construction of the Center is nearing completion, and work is beginning on installation of essential interior equipment. Control of some space operations is expected to begin in 1987, with full capability planned for the early 1990s. When completed, the Center will provide a capability to accomplish interactive and highly secure space and Shuttle operations through a dedicated DoD command structure. Control of satellite remote tracking, telemetry, and command stations will be shared by operators at the Center and those at the Satellite Test Center near Sunnyvale, Calif. Air Force Space Command will operate CSOC when it is completed.	Exterior Construction: Near Completion; Shuttle Operations: Full-Scale Development (1986)	TRW Defense Systems Group; Space Communications Co.; Ford Aerospace; IBM Federal Systems Div.; Lockheed Missiles & Space Corp.; Infotec Development Inc.; Global Information Systems; Communications Manufacturing Co.; Aerospace Corp.
Defense Meteorological Satellite Program Defense Meteorological Satellite Program (DMSP) spacecraft are designed to satisfy military requirements for worldwide weather information. Using data provided by these satellites, military weather forecasters can observe developing patterns of weather and can track existing weather systems over remote areas, including oceans. The data helps identify severe weather, such as thunderstorms, and other more violent atmospheric activity, such as hurricanes and typhoons. The satellite imagery is used to form three-dimensional cloud analyses that are the basis for computer simulations of various weather conditions. While the primary mission of DMSP is to gather weather data for military uses, the information is a national resource. It is frequently made available to the civilian community through the Commerce Department's National Oceanic and Atmospheric Administration. The satellites orbit at an altitude of approximately 450 nautical miles above the earth in near-polar, sun-synchronous orbits.	Operational	RCA Government Systems Div.; Aerojet ElectroSystems Co.; Hughes Aircraft Co.
Defense Satellite Communications Program The Defense Satellite Communications System (DSCS) is a worldwide satellite network that supports the Department of Defense, US State Department, and other US government agencies throughout the world by providing secure voice and high-data-rate communications service. DSCS II satellites provide current operational capability. DSCS III satellites will replace the older satellites in a phased deployment. The newer satellites are larger, have a longer design life and increased capability, and are more survivable. The first DSCS III satellite was launched in October 1982. Primary purpose of the DSCS program is to provide high-capacity communication channels by using selective narrow-coverage antennas. The system is designed to have antijam capabilities and to provide secure command and control communications.	Operational (DSCS II); IOC Reached (DSCS III)	General Electric Co.; TRW; Hughes Electronics Dynamics Co.; Aerospace Corp.
Expendable Launch Vehicles To meet the national security requirement of assured access to space for the most critical US payloads, the Air Force is buying ten complementary expendable launch vehicles (CELVs). The contract calls for acquisition of all supplies and services necessary to procure and launch ten CELVs. Each CELV will be capable of placing a 10,000-pound payload into geosynchronous orbit. Plans call for the launch of two vehicles each year beginning in late 1988 to satisfy critical DoD satellite requirements. Selection of the upgraded Titan in March 1985 completed a source selection process begun a year earlier. It is an improved version of the Titan 34D launch vehicle, with stretched first and second stages, seven-segment solid-propellant rocket motors, and either the Centaur upper stage or Inertial Upper Stage. Space Division is also on contract to convert thirteen Titan II ICBMs to space launch vehicles to support such selected payloads as DMSP. Additional launch vehicle activity in support of Shuttle recovery efforts is anticipated.	Development and Production	CELV: Martin Marietta; Aerojet TechSystems Co. (liquid-propellant engines); United Technologies, Chemical Systems Div. (solid rocket motors); GMC, Delco Systems Operations (guidance components); General Dynamics (Centaur upper stage); McDonnell Douglas Astronautics Co. (payload fairing). Atlas E/F: General Dynamics, Convair Div. Titan II: Same as CELV core contractors.
Fleet Satellite Communications System From its geosynchronous orbit above the earth's equator, the Fleet Satellite Communications System (FLTSATCOM) provides near-global communications for high-priority requirements of the US Navy and Air Force. It also supports other Department of Defense communications needs. Each satellite has twenty-three channels in the ultrahigh and superhigh frequency bands. Ten of these channels are used by the Navy to communicate worldwide with its land, sea, and air forces. One channel on the satellite is allocated to the National Command Authorities. All four operational satellites have exceeded their original five-year design life. One has been on orbit for more than eight years. In May 1983, a contract to produce three additional satellites was signed. This follow-on buy will serve to augment the established constellation in its UHF mission. An EHF addition, to be carried on satellites seven and eight and known as the FLTSATCOM EHF Package, will provide the Defense Department an early test-bed for the new Milstar EHF terminals.	Operational	TRW Space and Technology Group (development/test); Aerospace Corp. (engineering/integration)

NAME AND MISSION	STATUS	CONTRACTOR
Inertial Upper Stage The Inertial Upper Stage (IUS) was developed to provide a highly reliable, two-stage, solid-fuel vehicle to boost selected payloads from the Shuttle's low earth orbit to a higher orbit in the 22,000-mile range. This vehicle is also designed for use with such expendable launch vehicles as the new Titan 34D-7. In addition to use with military cargoes, the IUS is used by NASA to launch its tracking and data relay satellites.	Operational	Boeing Aerospace Co.; United Technologies, Chemical Systems Div. (rocket motors); Rockwell International Corp.
Milstar The next generation of military satellite communications is being developed to serve both US strategic and tactical forces. This new system, called Milstar, will provide a worldwide, highly jam-resistant, survivable communications capability for the National Command Authorities and US military forces well into the next century. Use of extremely-high-frequency and other advanced communications techniques will enable the system to achieve a high degree of survivability under conditions of both electronic warfare and physical attack. Extremely-high-frequency satellite communications recover very quickly from propagation degradation caused by high-altitude nuclear detonations. A joint-service project, the Milstar system will be deployed in the late 1980s. The space segment of the system will include newly designed EHF and UHF satellites. An EHF package will be included in two of the US Navy's Fleet Satellite Communications System spacecraft. Milstar satellites will be compatible with launch requirements associated with the Space Transportation System.	Development	Lockheed Missiles & Space Corp.; TRW
NATO III Communications System To provide military and diplomatic satellite communications capability for its military forces, NATO purchased four US-built satellites. The system provides a network for ground, airborne, and shipborne communications that are interoperable with the DSCS.	Operational	Ford Aerospace and Communications Corp.; Aerospace Corp.
Navstar GPS A constellation of eighteen satellites is being developed to provide precise navigation information for military and civilian users throughout the free world. Seven developmental satellites are now in orbit, and the test phase for the space portion of the system is now completed. Production contracts for the satellites and for upper-stage PAM-D IIs, which place the satellites into precise orbits, have been awarded, as has the contract for development and integration of user equipment. This user-equipment contract includes options to buy equipment for DoD air, sea, and land users. The space-based navigational system is expected to be operational by the late 1980s.	Production	Rockwell International Corp., Satellite Systems Div. (space segment); IBM Federal Systems Div. (control segment); Rockwell International Corp., Collins (user equipment)
PAM-D II Upper-Stage Vehicles The PAM-D II upper stage will boost Navstar GPS satellites into 10,900-nautical-mile, twelve-hour orbits from the Space Shuttle's low earth orbit. These solid-fuel Payload Assist Modules are being purchased through a multiyear purchase agreement that saves approximately $40 million when compared with single-year contracts for twenty-eight upper stages. A spring-loaded mechanism ejects the spinning PAM-D II and Navstar GPS satellite from the Shuttle cargo bay. The spinning motion stabilizes the spacecraft from initial deployment to positioning in orbit. The delivery schedule for the PAM-D II extends from 1985 to 1990.	Production	McDonnell Douglas Astronautics Co.
Space Launch Complex-6 Construction of SLC-6 at Vandenberg AFB, Calif., is complete, and all systems required for Shuttle launch are ready. Pathfinder testing in 1985 using the Orbiter *Enterprise* demonstrated facility and handling capabilities. A spacecraft test vehicle was used successfully to demonstrate payload handling systems in each payload processing facility. Launch-site validation with Orbiter *Columbia* will be completed in late 1986. The validation "stack" will then be disassembled and followed by preparations for the first launch vehicle stacking with *Discovery*. Prior to first launch in 1987, the Air Force will conduct a standard series of launch-processing tests, including a full launch countdown for the Flight Readiness Firing.	Nearing Operational Era	Martin Marietta Corp. (design, development, installation, and checkout); Lockheed Space Operations Co. (operations and maintenance)
Space Test Program The Space Test Program (STP) sponsors spaceflights for DoD space experiments that are not authorized their own means of flight. Spaceflights are provided by exploiting the unique capabilities of the Space Shuttle and several different expendable launch vehicles. STP has cooperative programs with NASA that provide for a wide range of experiment accommodation on the Shuttle, from large free-flyer satellites and Getaway-Special canisters to hand-held, crew-operated devices. STP has been preparing six experiments on a support platform for flight aboard the first scheduled Shuttle launch from Vandenberg AFB. A Scout launch vehicle will launch the Polar Beacon Research Satellite (Polar Bear) from Vandenberg AFB this year.	Ongoing	Classified
Strategic Defense Initiative Activities As a lead agency and integrator for the President's Strategic Defense Initiative program, Space Division is deeply involved in the following research areas: natural backgrounds, advanced cryocoolers, infrared focal plane, radiation hardening, focal mirror, space boosters, threat analysis, survivability analyses, large optics, atmospheric compositions, and space logistics. Research is being conducted at various government and contract laboratories.	Research and Test	Classified

Air Force Space Technology Center

As Space Division's technology arm, the Center is supporting the President's Strategic Defense Initiative program. Through its subordinate laboratories, STC is managing the development of SDI technologies for ballistic missile defense of the US and its allies.

The Air Force Weapons Laboratory is building a weapons-class cylindrical chemical laser that would be compact enough to base in space, if the President and Congress decide on space defense. Before that point is reached, acquisition, pointing, tracking, and optics technologies must be perfected.

The Air Force Geophysics Laboratory is investigating the nature of natural and man-made heat sources so that infrared sensors based in space can be developed to perform missile surveillance and provide battle management data.

The Air Force Rocket Propulsion Laboratory, in addition to producing the rocket motors that will carry US systems among the planets, is developing propulsion for space-based rocket programs.

An instructor pilot describes the lofty feeling of flying the impressive new bomber.

Pilot Report: B-1B

BY MAJ. MICHAEL A. KENNY, USAF

THE cockpit of the B-1B gives you a lofty feeling, literally and otherwise. It sits a little more than sixteen feet above the ground. And strapped into America's latest air-breathing flying machine as part of a highly trained four-man crew, one feels special and just a bit awed. Even when it's resting quietly on the ramp, there's something exotic about this craft—a sense of tremendous power and capability about to be unleashed.

Forward, the pilot and copilot begin their checks. About eight feet behind them and slightly elevated, the offensive and defensive systems officers prepare to employ some of the world's most sophisticated electronic wizardry.

Connected to the forward fuselage are five air-conditioning hoses to cool the on-board computers, more than ten of them. Ground crews make their final checks and stand ready to see the aircraft on its way.

The B-1B comes to life when the hydraulic reservoirs activate its two auxiliary power units. Generators literally bang on-line. Cockpit noise is very low. Only the rush of air from the air-conditioning and cooling system is audible.


1ST HOME OF THE B-1B
DYESS AIR FORCE BASE
OPERATIONS

After about five minutes of power from the APUs, the four General Electric F101 dual-rotor, afterburning turbofan engines are started. In the cockpit, vertical-tape engine instruments are the only clue that the engines are running. The inertial navigation system aligns while flight control checks are being made. In a very short time, the bird is ready to roll.

The pilot's first real indication that he is in a movable object is when he moves the stick (gone is the traditional heavy bomber yoke) and the four 4,000-psi hydraulic actuators engage the split-tail hydraulic stabilators. The power in the system would rock the whole aircraft noticeably if this were not done smoothly. The combination of computerized fly-by-wire and mechanical linkage to the stabilator actuators gives fighter-like control to this mighty aircraft, which is in the 400,000-pound weight class.

Ready to taxi and take off, this former B-52 pilot realizes he has transitioned to the finest that modern technology has to offer. Everything about the B-1B is smooth and effortless. It has a blended-wing body with variable-sweep wings. Forward and side visibility through the elongated wraparound windscreen are excellent. The aircraft clips quickly along the runway and will turn on a dime.

As he lights the four afterburners, the pilot commands 120,000 pounds of thrust. It's still very quiet in the cockpit, but he can now feel the engines vibrate. The earth shakes. A ground observer can feel the vibrations peak as the aircraft becomes airborne after about 4,000 feet of takeoff roll.

Inside, it feels as if you've just "planed out" on water skis, giving you the freedom and mobility to dash in any direction. With the aircraft still accelerating rapidly, gear, flaps, and slats are retracted, and the variable-sweep wings are positioned to twenty-five degrees aft to reduce drag. The wings, like the rest of the plane's configuration devices, are manually controlled by the pilot.

The Magic Show Begins

Minutes later, the ship has reached its cruise altitude, and the "magic show" begins. The B-1B is essentially a large computer system surrounded by fuel and engines. It is mind-boggling, even to those who fly it. The "brains" of the airplane are in the back station. Four aircraft computer units control most of the major systems: navigation, bombing, fuel, regulation of center of gravity, and other functions.

Here, acronyms abound. There is the GNACU (Guidance and Navigation Avionics Control Unit), the WDACU (Weapons Delivery Avionics Control Unit), the CDACU (Controls and Displays/Defensive Avionics Control Units), and the CFACU (Critical Functions Avionics Control Unit).

What these systems don't control, the EMUX, or Electrical Multiplexer Unit, does. The EMUX system provides a means of transmitting data throughout the aircraft on redundant transmission lines as well as of managing electrical system load.

The computers control altitude, heading, and airspeed. Fuel transfer sequencing is automatic and provides center of gravity control by shifting fuel to compensate for any change in the center of lift caused by movement of the variable-sweep wings.

Another computer system, the Centrally Integrated Test System, or CITS, serves as an on-board test system for most of the aircraft functions. The CITS performs test and control functions required to verify aircraft system performance in flight.

The CITS computer notifies the pilot of everything from fuel temperature to impending failure of a critical component. It will tell the defensive systems officer of a failure long before it shows on the master caution panel of 112 lights. In the B-1B, the state-of-the-art technology is nothing if not futuristic.

Maj. Mike Kenny, B-1B instructor pilot and author of this article, stands on the flight line at Dyess AFB, Tex. A SAC veteran, Major Kenny has flown B-52s, FB-111s, and now the B-1B. (Photo by SMSgt. Jesse Grice, USAF)

Currently, the 4018th Combat Crew Training Squadron is the only operational unit flying the B-1B. The squadron is in the process of training its flight instructor crews and began training crews for the first operational bombardment squadron in April. *(See also "Bringing on the B-1B," p. 63 of this issue.)*

All training missions are based on combat scenarios. They consist of air refueling with a KC-135, pen-

etration on a low-level route, terrain masking, simulated weapons release, egress, and post-target recovery. A typical training mission also includes air work and traffic pattern operations.

Air refueling is made simple by the smoothness of the computerized flight controls. The air refueling receptacle is located on the nose of the aircraft, forward of the pilot. The B-1B has a universal aerial refueling receptacle/slipway installation (UARRSI) for in-flight refueling and a single-point refueling capability for ground refueling. It's also capable of reverse air refueling and fuel dumping. Filling body and wing tanks takes just a few minutes.

Looking not unlike a patient in intensive care, a B-1B is readied for flight. By the use of a special underground system called Hydrant/CASS, the need for most service trucks has been removed. (Photo by SMSgt. Jesse Grice, USAF)

Into the Mission

When refueling is complete, the combat crew is ready to proceed to the designated low-level route for the mission. As the aircraft descends into the run, the wings are swept full aft to 67.5 degrees. This reduces drag and allows the aircraft to accelerate easily to near-supersonic speeds for cruise at low altitude.

Capabilities are being added to the aircraft in computer software blocks as they become available. One such capability is that of terrain following. Once the system is fully operational, the terrain-following computer will be engaged at high altitude, when the aircraft's wings are swept back. The computer, receiving inputs from the offensive radar system, directs the aircraft to descend quickly and then level off just above treetop level.

Regardless of weather or hour of the day, the computers can fly the aircraft just above treetop level, maintaining precise airspeed control and pinpoint navigation to the target. In front of the pilot is a cathode-ray tube with a presentation very similar to that of a computer video game. It gives altitude to the nearest foot, a vertical image of the terrain ahead, attitude, ground speed to the nearest knot, and distance to the next destination or target to the nearest tenth of a mile.

As the aircraft approaches the strategic training range, the offensive systems officer configures the computers for bombing, while the defensive systems officer configures his computers to defend the craft electronically. Seconds away from the target, the crew begins transmitting an electronic tone to the training range site. At "Bombs away!" the tone is cut. Site personnel score our release point by this electronic tone, and from this we can determine bombing accuracy.

During the bombing run, trackers at the site test our electronic countermeasures equipment to determine its effectiveness against enemy tracking radar. The B-1B's defensive avionics system provides protection from ground and airborne threats. It carries out radio-frequency surveillance, electronic countermeasures, tail warning functions, expendable countermeasures, and defense management.

The design environment of the B-1B is low-level. The craft possesses the agility to maneuver between hills and the sophistication to ride just above all kinds of terrain in any weather. When using afterburner thrust for dashes, the crew is often pressed into their ACES II ejection seats. As the aircraft climbs out of low-level, the wings are swept forward, and the mighty bomber lunges for the sky.

With its wings in the fully extended position, a B-1B initiates a bank to the port side. This remarkable aircraft is so nimble that it can even perform lazy eights.

Most Important Part

Bombing run completed, aerial training is next. The flight characteristics of the B-1B are complicated—and critical to its safe operation. For pilot training, this is the most important part of the mission. Pilots of modern aircraft must be well acquainted with flight characteristics, as many of the old standards have changed. Speed is sometimes limited by skin temperature, and computers can see through previously restrictive clouds.

One major flight characterstic to be learned involves a wing sweep demonstration, during which wings are swept from twenty-five degrees to 67.5 degrees. The wings are swept aft to reduce drag and allow for high-speed flight. One problem a pilot may discover in this configuration is that he is flying too slowly with the wings back. The B-1B is a lifting body; it can easily fly without wings so long as the "smash" (knots indicated airspeed) is up. If flown too slowly, however, the center of lift comes too far forward of the center of gravity, and the aircraft will tend to tip over backward or run out of enough thrust to sustain a high angle of attack.

The other flight characteristics demonstrated are conventional and include approach to stall (which is defined as neutral stability; the B-1B tips over backward long before its wings stall), slow flight, and lazy eights (yes, bombers can perform lazy eights).

Following the aerial training maneuvers, it's back to the base for some pattern work. The B-1B handles extremely well in the pattern. With the wings in the forward position and flaps, slats, and gear extended, the B-1B can land as slowly as 155 knots, and landing roll is sometimes less than that of a T-38 trainer.

When the B-1B turns off the runway after completion of a training mission, the computer tells us the exact temperature of each brake and prints a record of all malfunctions that might have occurred during the flight. After shutdown, this printout and a tape from the CITS computer are available to maintenance personnel, making their job significantly faster and easier.

All in all, the mighty B-1B is a truly remarkable aircraft. It's a tribute to American technology and a genuine pleasure to fly. ■

Maj. Michael A. Kenny, USAF, is the first instructor pilot in the B-1B. Now stationed at Dyess AFB, Tex., Major Kenny is a longtime bomber pilot, with 678 combat hours among his 3,300 hours of flying time. During his sixteen years in the Air Force, he has served as an instructor pilot in both B-52Ds and FB-111As. He is a graduate of Squadron Officer School and has completed both Air Command and Staff College and the National Security Management courses.

A year after delivery of the first B-1B, Dyess AFB is throbbing with activity and preparing for IOC by October 1.

Bringing on the B-1B

BY JAMES P. COYNE
SENIOR EDITOR

A YEAR ago this month, the first active-duty B-1B was delivered to the 96th Bomb Wing at Dyess AFB, Tex., along with a three-part order from Strategic Air Command.

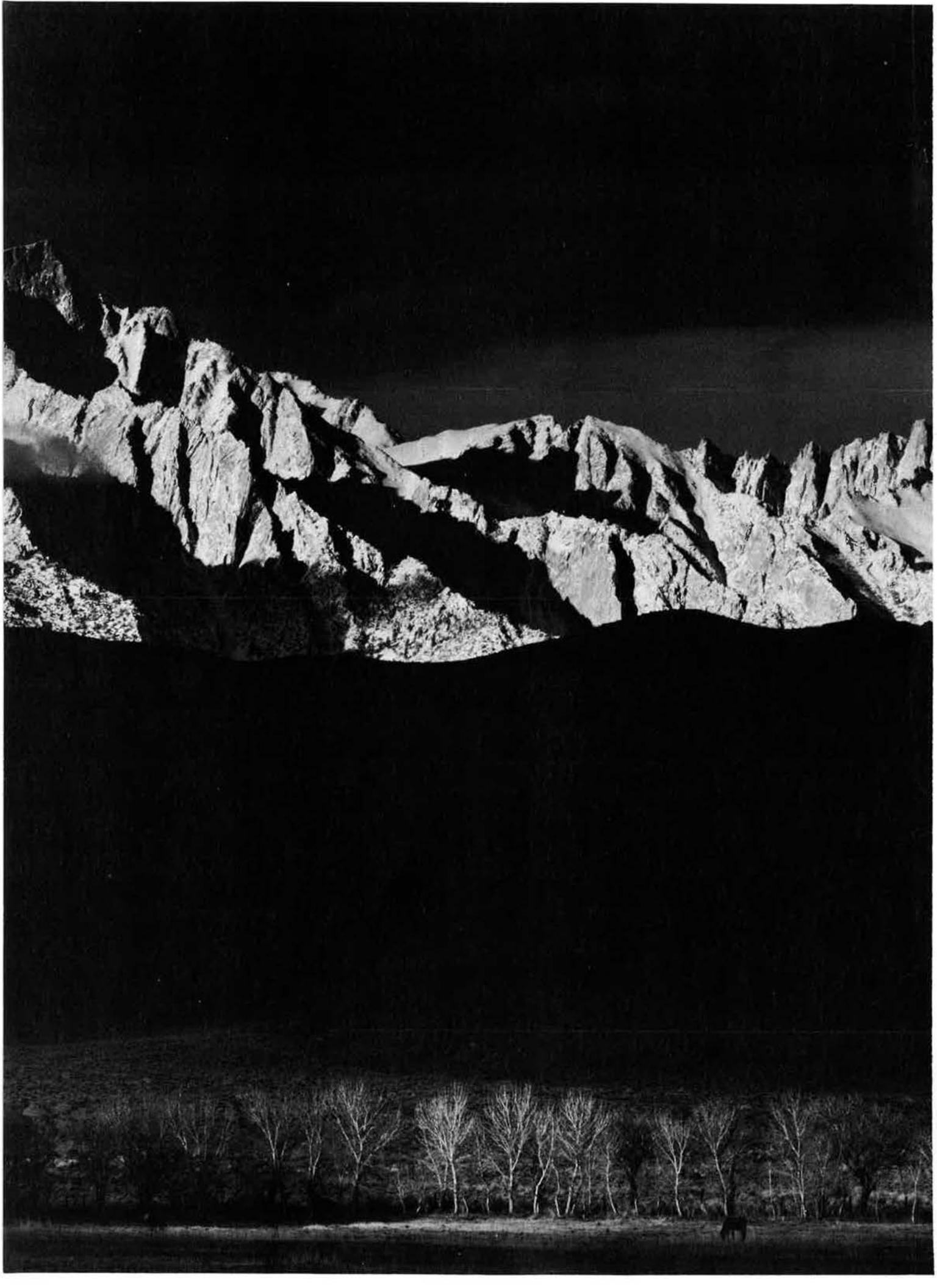
The wing was to train all of its own maintenance and operational support people. It was to start training aircrews for the fleet of 100 B-1Bs that SAC expects to have flying by 1988. And Initial Operational Capability (IOC) was to be achieved by no later than October 1, 1986, with fifteen aircraft in full service for strategic and training missions.

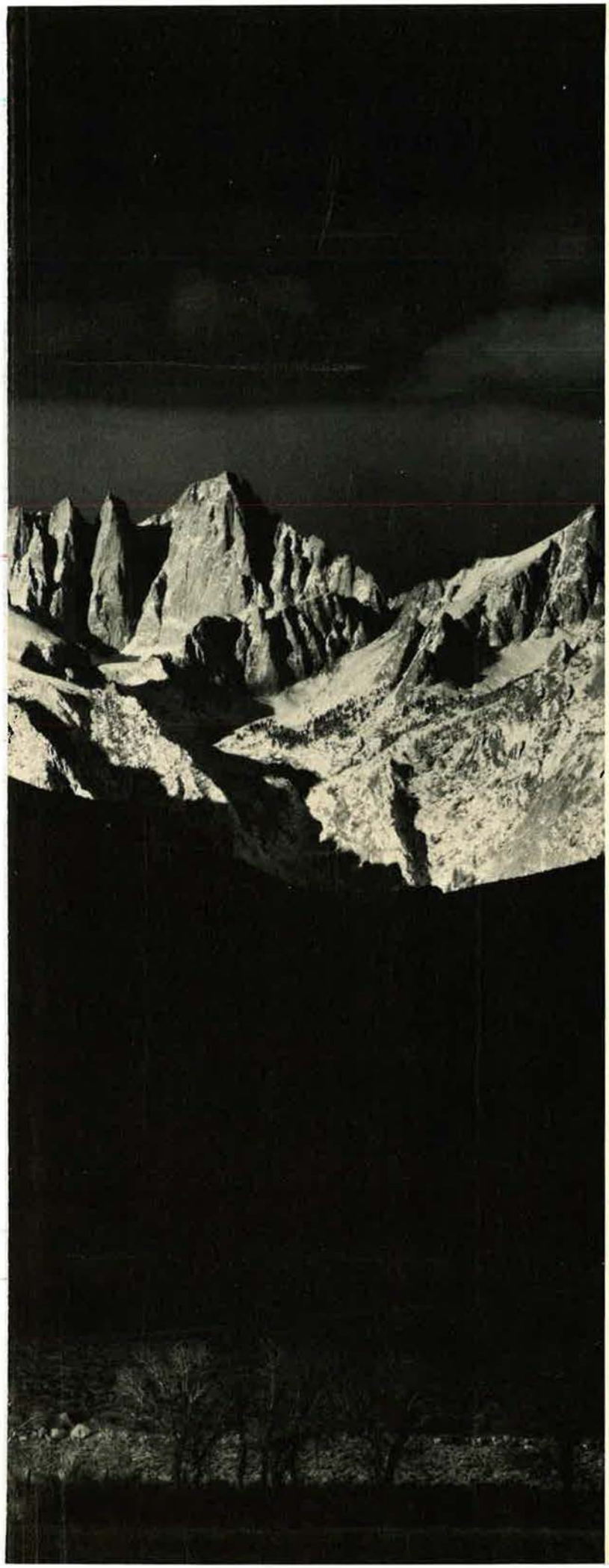
Dyess is the first and—so far—only operational base to get the superb new intercontinental bomber from Rockwell International. Next to start receiving it are Ellsworth AFB, S. D., Grand Forks AFB, N. D., and McConnell AFB, Kan.

"The B-1B isn't just a new weapon system—it's a whole new way of doing things in the bomber business," said Col. (Brig. Gen. selectee) Alan V. Rogers, the wing commander.

One example of this new way is the B-1B's early introduction into an operational unit, sooner in its development life than is traditional for new aircraft. In this case, however, the Air Force took advantage of its experience with the B-1B's forerunner, the canceled B-1A, and decided it could send the B-1B to Dyess at an earlier point than usual in the development test phase. The decision also responded to the urgent need for a new strategic bomber.

Consequently, the aircraft is becoming operational at Dyess at the same time it is still going through some developmental testing and evaluation at Edwards AFB, Calif. Dyess operators are working out some problems on the flight line that might otherwise have been solved on the test range. Many of the tools used for analysis and operations are state of the art and are being used for the first time. Time and experience are needed to "mature" them—and "maturation" is a term heard often at Dyess these days.





Winter Sunrise, The Sierra Nevada, From Lone Pine, California. Photograph by Ansel Adams. Courtesy of The Trustees of The Ansel Adams Publishing Rights Trust. All Rights Reserved.

ANOTHER AMERICAN ASSET:

B-1B. THE U.S. AIR FORCE LONG-RANGE COMBAT AIRCRAFT.

Rockwell International

...where science gets down to business

Aerospace / Electronics / Automotive
General Industries / A-B Industrial Automation

New Construction Everywhere

All around the B-1Bs parked on the ramp, sleek in their camouflage paint scheme, swirls a $100 million construction program. It is evidence that a new aircraft brings to a base more than just new hardware. Ground has been broken, and building or renovation is under way everywhere. When the new construction is finished in 1987, sixty-five facilities will have been built or modified. "More than $70 million will be spent on the flight line," said Floyd Ball, deputy base civil engineer.

One of the biggest projects is the new under-ramp fuel hydrant and Centralized Aircraft Servicing System (CASS). Hydrant/CASS will be used at each B-1B parking space to provide rapid fueling and oil and other lubricants, liquid coolant as well as cooling air, AC electrical power, ground communications, and other servicing for the aircraft. When these facilities are in full use, numerous cables, conduits, hoses, and umbilicals will link each bomber with ten covered pits beneath the ramp.

"It looks a lot like it's in intensive care," said Col. James L. Wakefield, wing deputy commander for maintenance. (He pointed out that the aircraft is completely self-contained once it has been serviced and the servicing devices are stowed in the underground pits.) Besides the convenience and speed of servicing, Hydrant/CASS eliminates the need for most of the aircraft servicing vehicles, carts, and trucks normally spotted around other USAF aircraft parking ramps.

Most prominent on the flight line is the steel framework of the huge, 89,000-square-foot heavy maintenance hangar, big enough to house three B-1Bs at the same time. It will be finished this fall. A new fuel cell—a building with special safety features that is used for working on aircraft with fuel system discrepancies—has been completed. A special addition housing new B-1B munitions-handling equipment is being built on the base's Integrated Maintenance Facility. Engine test facilities are being improved, and there is a new engine repair building. Most of these structures were sited on an existing ramp built some time ago for B-47s, Mr. Ball pointed out, saving the base several million dollars.

There are no new alert crew facilities under construction, because combat-ready B-1Bs will be parked on the alert ramp formerly used by the B-52s stationed at Dyess. The existing alert building, with facilities for round-the-clock crew living, was rated "Best in SAC" a year ago and is ready for use by B-1B crews.

Four new munitions storage "igloos," located for safety in an enclave some distance from the rest of the base, have been built. Construction crews have improved the roads and intersections of the convoy route, along which weapons loads for the bombers are transported from the storage area to the alert ramp.

Sleek but sinister in their dark camouflage paint schemes, a family of new B-1B strategic bombers awaits completion on the ramp of the Rockwell production facility at Palmdale, Calif. When finished, they will be delivered to Dyess AFB, Tex., home of the first operational B-1 wing.

Training Already Under Way

Davis Hall, a 16,000-square-foot combat crew training facility named for Gen. B. L. Davis, USAF (Ret.), SAC Commander in Chief between August 1981 and last August, was completed in December of last year. With planned building additions and expansions, the squadron complex will soon triple in size. When the building is fully equipped, it will contain two Boeing full-motion simulator/trainers in which crews can fly complete missions from scramble and takeoff through in-flight refueling, low-level penetration of enemy territory, weapons delivery, escape, and, finally, recovery back at the home base. By year's end, the facility will have six cockpit procedures trainers. For now, an interim no-motion simulator—actually an engineering research simulator—is on loan from USAF's Aerospace Medical Research Laboratory at Wright-Patterson AFB, Ohio.

When fully up to speed, more than sixty-five percent of all aircraft systems training for pilots will be taught "on computer," according to Lt. Col. Edgar A. Ott, Commander of the 4018th Combat Crew Training Squadron. About half the systems officers' course work will be on computers. "The trouble with that," he said, "is software production. It takes my people hundreds of hours of 'person time' to write a single hour of software for the computer." Getting all the software written, he estimated, "will take until well into 1988." In the meantime, his instructors are using computers and software as it becomes available and making do with traditional methods of instruction.

In the crew training classrooms, instructors are beginning to use Computer-Based Instruction (CBI) to manage and teach twenty-eight courses for B-1B pilots, defensive systems officers, and offensive systems officers. The students, in turn, work at their own pace outside the classroom, aided by Computer-Assisted Instruction (CAI). CAI consists of training devices with integral computer terminals and interactive computer screens to simulate operation of equipment in the B-1B aircrew compartments. By touching his computer screen where switches are shown, a student can cause the system to react just as a real aircraft would. Cockpit procedure trainers, of course, are vital to aircrew training and will be used all day long.

There are forty-seven instructors in the 4018th. Five aircrew classes are conducted at a time, with staggered starting dates. There are twenty-four students in each class. Training was initially directed toward turning out instructor crews. In April, however, the first operational line crew class started. "To qualify a student aircrew in the B-1B," Colonel Ott said, "takes 111 training days for pilots, 106 days for offensive systems officers, and 105 days for defensive systems officers. In calendar time, that stretches over twenty-two weeks." During the training period, pilots undergo 247 hours of academic instruction, offensive systems officers get 196 hours, and defensive systems officers receive 171 hours. Systems officers, however, spend more time in simulators than do pilots.

Flight Training Begins

Flight training starts on the sixty-fourth day of the course. There are fourteen flying training sorties totaling eighty-five flying hours. A typical sortie can last six hours. Pilots fly every sortie, but the systems officers fly less often, being replaced at times by an instructor systems officer (an instructor pilot is always in the cockpit with student pilots). As a crew, the students face a checkride on sortie thirteen and, if they pass, fly a solo crew sortie without an instructor on board for their fourteenth and final ride. Students graduate as formed crews and report as crews to their operational units.

Colonel Ott contrasted B-1B training with B-52 training, which is conducted at Castle AFB, Calif. "B-52 pilots attend ninety-two training days over nineteen weeks. During that time, they fly twelve sorties for ninety flying hours, or about one and a half hours more per sortie than our students fly in the B-1B."

B-52 crew members report to their units as individuals, not as formed crews, he noted.

By the October 1 IOC, the training squadron expects to have eighteen qualified instructor crews, including four crews to administer flight evaluations. (The 96th also expects to have four operational crews ready to stand alert.) The training schedule is coordinated to provide the right number of trained crews to man the B-1Bs as they come into the inventory.

The training schedule calls for production of 250 B-1B pilots for four SAC operational B-1B wings by 1990. By then, 300 copilots will have been trained. A larger number of copilots is needed to provide replacements for pilots who will move out of the B-1B cockpit for various reasons. In addition, 500 systems officers will have been trained.

Initially, the wing will have fifteen B-1Bs assigned for training, Colonel Ott said. In 1989, when initial SAC-wide training requirements slow down, the number of training-dedicated aircraft will drop to eleven, as four move over to the operational commitment. Ultimately, sixteen Dyess B-1Bs will be assigned to the operational 337th Bomb Squadron, ten will be assigned to the 4018th for training, and three aircraft will be spares. The 96th Bomb Wing will receive its twenty-ninth, and final, B-1B in December 1986.

Avionics and Computers Are Key

While flight crew training moves ahead, so does training of maintenance people. That goes on concurrently with normal maintenance activities on the aircraft. Because the B-1B depends so heavily on computers and electronics, much of the work deals with avionics. "When we talk of being five to ten years ahead of the Soviets, we especially mean we're ahead in the avionics field," said Lt. Col. Michael E. Frey, Commander of the 96th Avionics Maintenance Squadron. "AMS is responsible for 752 Line-Replaceable Units [LRUs], major components, and gauges on each B-1B. That's about twice as many as there are on the B-52 or FB-111." Many of these components are so new, he explained, that his people learn new things about them almost daily as they work with them. The new knowledge is used to compile operational histories on each one.

In the AMS, on the flight line, in the classrooms, and in the wing command section, you hear about "maturation." The people there talk of "maturing" the aircraft, maturing the work force, and maturing the systems. Some of those systems, unique to the B-1B, but undoubtedly soon to be supporting newer aircraft, evoke a sense of wonder. All are computer-based or computer-aided, and they do things never done before.

The Central Integrated Test System (CITS), for example, continuously diagnoses the ground and in-flight operation of all the aircraft systems by monitoring 10,000 electrical performance signals from aircraft subsystems each second. CITS records results and flags malfunctions. When a problem is detected, the flight crew can determine whether the mission should be continued. After a B-1B lands, the ground crew, by reading CITS reporting tapes, can find out what is wrong the minute they have chocked the wheels and the engines have been shut down.

"CITS can isolate a problem down to a single black box sixty-five percent of the time," Colonel Wakefield said, "and narrow the problem down to three or fewer LRUs the other thirty-five percent of the time." The crew chief can discern the problem and fix it quickly. In earlier aircraft, pilots and sensors would report the symptoms of a problem, but the aircraft would have to be "opened" up—a time-consuming process—to find the problem.

Artificial intelligence will play a big role in B-1B maintenance. With CITS Expert Parameters System (CEPS) overlaid on CITS, recurring complex problems can be diagnosed automatically. If on five consecutive occasions, for example, crew chiefs found they had to replace a certain LRU, tighten a connector, and reset a circuit breaker, on the sixth occasion CEPS would automatically spell out the corrective action for the next crew chief.

Another example is the Core Automated Management System (CAMS). CAMS eliminates the blizzard of documenting paperwork that afflicts most USAF maintenance work centers. Instead of paper forms, crew chiefs work directly on computer terminals to produce real-time data for controlling and documenting repairs and parts replacements.

The Automated Tech Order System (ATOS), when in operation, will eliminate still more paper. Tech orders provide exact instructions for aircraft systems repair and replacement. New and better ways of doing things are always evolving, so tech orders are changed frequently. The current system requires document-

View of Engineering Research Simulator at Dyess shows functionalism and simplicity of the B-1 cockpit. The Visual Situation Displays in front of the pilots are supported by tapes and round-dial backup instruments. Note the fighter-type sticks and surprisingly small throttles. (Photo by SMSgt. Jesse Grice, USAF)

ing—on paper—the thousands of changes made each year at base level, where tech orders are used. With ATOS, a B-1B crew chief will be able to obtain an instantaneous computer printout of the latest issue of any tech orders he needs. He will get them direct from the source, the Air Force Logistics Command facility at Tinker AFB, Okla. Tinker maintenance experts will update them as needed—daily, if necessary.

Heading for IOC

"When the first aircraft arrived," Colonel Wakefield said, "the wing had eighteen maintenance troops who had been trained by working alongside factory representatives and Air Force maintenance people, using the B-1As at Edwards."

By the time of AIR FORCE Magazine's visit to Dyess, which happened eight months later, the wing had more than 350 people qualified to work on the aircraft. "We did it even though we didn't have any of our maintenance trainers and only limited tech data," Colonel Wakefield said.

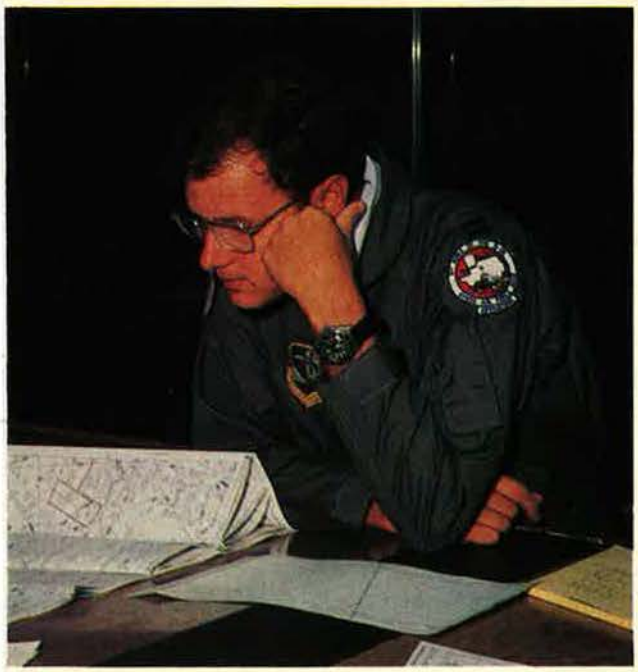
So far, maintenance experts have identified 3,000 separate repair or replacement tasks that must be performed to keep a B-1B in top flying form. For each task, tech data must be developed, tested, approved, and verified before it can be used by a crew chief at base level. "When the first aircraft arrived last summer, we had verified tech data for five tasks," Colonel Wakefield said. "We now have verified over 1,000 tasks." Even with computers, the job was formidable.

To mature the B-1B by the IOC date, Dyess must develop a stock of more than 9,400 spare parts. More than 2,400 pieces of support equipment must be brought to the flight line and shops, and people must be trained to use them properly. More than a million pages of tech data must be produced and verified. "We can do it," Colonel Wakefield said. "We've come a long way, and it is our attitude that has carried us. We have about half the things we ultimately need. So we think of our supply bins as half full, not half empty."

The wing has picked up aircraft gradually. The second B-1B was delivered to Dyess in October, followed by one each month in January, February, March, and April. Aircraft will soon be coming in at the rate of one a week. By the time the fourth aircraft arrived, the wing was averaging a flying sortie a day. "We have seen a two-sortie day and a three-sortie day," Colonel Wakefield said. "We'll soon have routine four-sortie days." When the wing is fully equipped, he said, the planned sortie rate will be 160 sorties a month, or eight per regular duty day. This rate will be maintained with a large part of the force standing alert. The specific portion of the force on alert is classified.

On the operational side, Colonel Rogers is just as positive. "We will have at least fifteen aircraft on station by the IOC date. We will have at least one alert aircraft cocked by that date, and we will be capable of generating the rest of our force for a full wartime mission.

"The B-1B has been ahead of schedule from the start. It's a winner, and the American people can be proud of the program. The B-52 is a fine aircraft, but the B-1B is giving us much, much greater capabilities that are essential for the security of our country through the 1980s and 1990s and even into the next century." ■

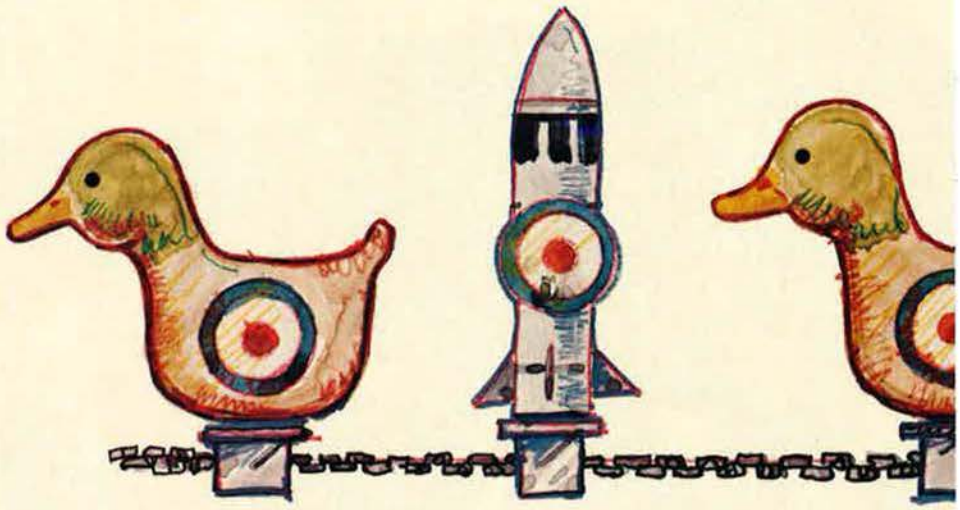


Each B-1B crew carefully plans every training or operational flight, spending an average of eight hours briefing for a typical six-hour training flight that includes takeoff, climb, cruise, in-flight refueling, fast descent, 600-mph low-level route, airwork, traffic pattern practice, and landing.

How the Ducks Line Up

Strategic planners must think about the unpleasant details of nuclear war, weapons, and targets. When you do that, the popular wisdom of the protest rally falls apart.

BY JOHN T. CORRELL
EDITOR IN CHIEF



Most people find nuclear war too frightening to think about. As a result, their opinions tend to be strongly held, but not based on any deep analysis of scary facts.

On the other hand, Gen. Russell E. Dougherty, USAF (Ret.), has been forced by duty to spend a substantial part of his life thinking about nuclear war. Like other strategic leaders responsible for credible deterrence of war, he has been denied the luxury of shying away from the unpleasant details of thermonuclear conflict.

And, as he once told a reporter, things sometimes look different to you when you study them for years instead of minutes. A strong advocate of improved US weapons that will be effective against hardened Soviet silos, for example, General Dougherty is often confronted with the standard "overkill" wisdom of the antinuclear rallies.

"Pseudoanalysts can do strange things with numbers and produce pat statements about military capabilities that may seem to make sense—until you think about them," he says. "Consider the capability of number-six shot in a twelve-gauge shell, which you would use if you were hunting ducks. Each shell contains about 300 pellets. You could conclude that's 300 times overkill for a single duck, or maybe enough to kill 300 ducks with one shell. That's the analysts' approach, but it's not the way the ducks line up. And to apply the analogy to military capabilities, that's not the way the targets line up, either."

General Dougherty is a former CINCSAC and former chief of US staff at SHAPE. More recently, he has been vice chairman of the Defense Science Board task force on ICBM modernization and, up to his retirement on June 1, Executive Di-

rector of the Air Force Association. He has just written a chapter for a new book on command and control of nuclear operations and says he plans to keep on thinking about nuclear war and ways to prevent it.

He believes, though, that—even in the nuclear age—some things are worse than war. "The easiest way for the United States to avoid war would be to disarm unilaterally and let Moscow have its way in the world," he said in a January 1984 editorial in this magazine. "To most Americans, however, a United States standing politically and economically isolated, a supplicant to the Soviet Union, would not be acceptable."

The only course, he contends, is to follow a strategy of deterrence, holding adversaries in check by possessing sufficient opposing might and defenses of one's own. "It is a grim strategy, but it works," he says.

The objective of deterrence, as General Dougherty sees it, is to deny the enemy victory or any perception of possible success from military aggression. "Once committed to conflict, winning is basic with the military," he says, "but 'winning' a major nuclear war against a comparably equipped enemy is probably best described as denying him any decisive advantage while avoiding self-destruction.

"I don't think the American body politic is interested in doing what's required to ensure victory in full-scale nuclear war," General Dougherty says. "It's interested in not having a nuclear war. The thoughtful part of it is also interested in not being denied the exercise of their sovereignty." But he regards strategies for nuclear victory as ill-founded.

"The people won't pay for it, they won't espouse it, they won't believe it, and they won't do it," he says. "That would leave us with a hollow statement of purpose without the forces to make it feasible."

The most sobering aspect of deterrence is that it cannot be a bluff. The nation must be willing to use nuclear force if all other actions fail. That, in turn, obliges strategic planners to think long and hard about nuclear warfare, no matter how frightening the subject may be.

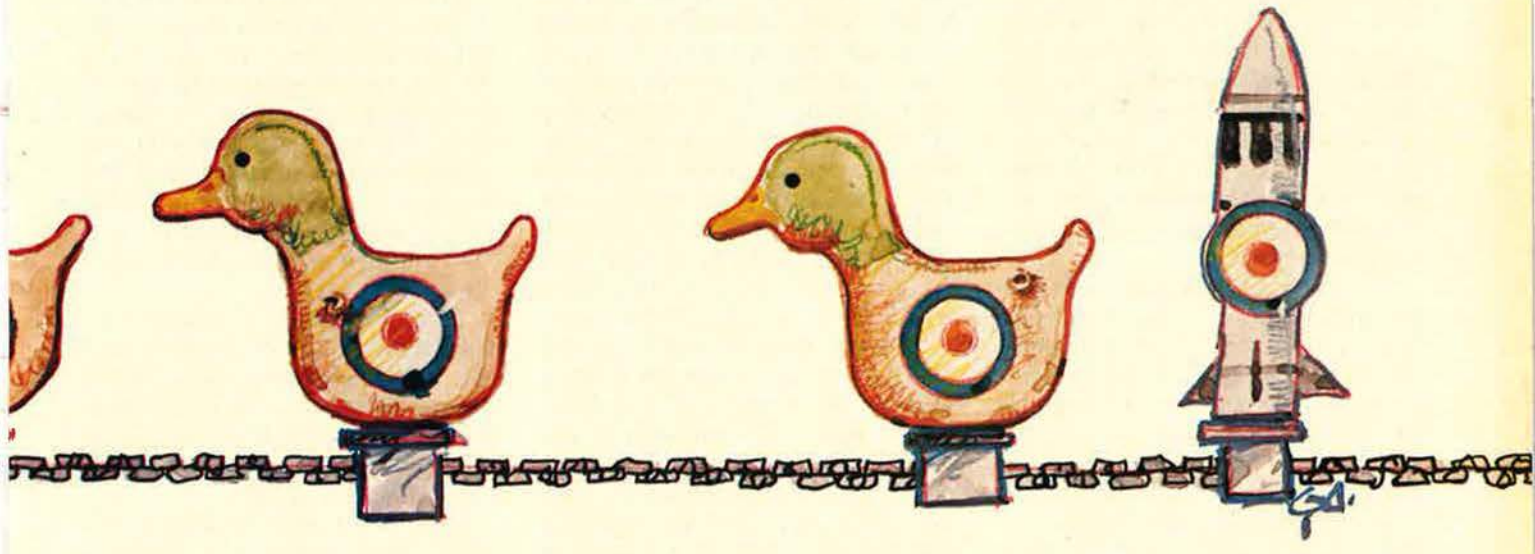
On the whole, those planners see more uncertainty about nuclear conflict than do either the Doomsday alarmists or the bold advocates of victory. The range of events that might happen is wide, and the responsible planner must take into account all of the possibilities.

"I've played a lot of war games, and one of the hardest things to do is get the war started," General Dougherty says. "A lot of the time, 'Control' has to declare the war started [because the players keep searching for and finding moves to avoid conflict]. Starting a war with nuclear weapons is a god-awful thing.

"The least likely scenario is a total nuclear assault from out of the blue with a full range of weapons timed to arrive on target simultaneously or in a continuing pattern. It's psychologically the least likely and also the most difficult from the nuclear planner's point of view because of all the difficulties in making it come off right.

"But having said it's the least likely, that it's insane, you can't rule it out. You must prepare for it. Only people without responsibility can ignore unlikely possibilities. You have to plan for all circumstances."

Another scenario the planner can neither assume nor dismiss is "inevitable escalation." That scenario, perversely, is set up by decades of economizing on military preparedness. Nuclear forces cost far less than conventional forces and, in strict terms of military utility, can be a substitute for them in many instances—if one is willing to accept the inescapable corollary:



the lowering of the nuclear threshold in conflict.

"The worst situation we can get into," says General Dougherty, "is to become so reliant on nuclear weapons and so ill-prepared with conventional forces that we're forced very early in conventional conflict to use nuclear weapons. We have total uncertainty with respect to the effect of their first use.

"A lot of people think that first use is going to be automatically escalatory and that weapons will go immediately to the highest order and greatest quantity of use. I don't know. It's wrong, I think, to say they won't immediately escalate, but it's equally wrong to say that they will automatically. And it's sinfully wrong for the nuclear planner not to plan on trying to keep nuclear use at the lowest possible level. If the planner falls into the trap of automatic escalation, then he'll have only one plan. It'll be the cheapest plan, but it will be Armageddon and a self-fulfilling prophecy."

It is impossible to say absolutely how much military force and what kind is sufficient to ensure deterrence. That depends on the capability and mind-set of the adversary to be deterred as well as on the robustness of targets and enemy defenses. All of these factors change over time and are major elements in the decision matrix used by the Joint Strategic Target Planning Staff to arrive at the most effective "laydown" of forces. In that context, popular overkill theories based on the attacking force in aggregate become irrelevant.

"You can't take the kill potential of a weapon and spread it evenly to avoid overkill at the point of impact," General Dougherty says. "You can't apply the excess power to targets 100 miles or 1,000 miles away. Nor can you scale a weapon and a target so precisely that you can avoid overkill at point zero. Too often, these calculations you hear advanced turn on amassing kill potential rather than on applying it to where the ducks are."

Weapons and Targets

Even at impact point, the adequacy of a weapon to achieve the desired effect is calculated as a *probability.* Other considerations are that some weapons will not reach targets—perhaps having been lost in an initial counterforce attack—and that not every weapon is effective against every target.

"We've got a lot of weapons in our arsenal that were capable against the softer targets of another day—targets that were above ground and easily subject to attack," General Dougherty says. "These weapons, even if they have tremendous kill potential, may be ineffective against some of the most important targets of today because those targets have been hardened and hardened and hardened."

The need to counter Soviet ICBMs in superhardened silos is a prime reason why many defense leaders, General Dougherty among them, still press for deployment of a full complement of Peacekeeper (MX) missiles. In so doing, they often hear the "empty silo" argument. In that scenario, the Soviet Union begins the war by a massive attack with its ICBMs. What possible purpose could be served by a counterattack on the silos from which those Soviet ICBMs came?

"If you can tell me which silos are empty, you bet I wouldn't put a weapon on them," General Dougherty says. "The problem is you don't know. The Soviets have three or four times the potential of an initial strike. You can't be confident that the remaining three-fourths of their arsenal is in this or that or the other silo. Also, they have reload capability. Their 'cold launch' method doesn't destroy the silo."

As the percentage of Soviet missiles in superhard sanctuaries increases, so the military applications for older US weapons diminish. With these, General Dougherty says, "all you can hope to do is disrupt the above-ground environment of a site or a weapon or a command and control center. You might be able to render it temporarily unusable. That's not without some utility, but you can't destroy the target."

There may be some benefit in exploring new concepts for employment of soft-target weapons. "There are a lot of soft targets that we've got to learn how to apply weapons to," General Dougherty says. "The classic one is the Red Army. That's a problem of location. You've got to know where and how to hit. And over the years, we've usually done our targeting against precisely located targets."

General Dougherty emphasizes that we must always design and scale forces to be able to put at risk the military forces of a potential enemy. This countermilitary capability, he says, "is the legitimate role for the employment of our forces, and we must resist pressures that misdirect our force design and employment strategies away from basic counterforce tasks."

A different concern about the US ICBM force is its vulnerability to advanced, highly accurate Soviet missiles.

"That vulnerability need not be," General Dougherty says. "It's strictly within our power to correct. All you have to do to challenge today's ICBM is make the target move. Without a special kind of vectoring warhead, you can't hit it. The Soviets are making their ICBMs move, and we're finding it very, very difficult to bring them under attack."

Technology poses no insurmountable barrier to ICBM mobility. Cost is a significant factor, since mobile basing is far more expensive than fixed sites. But the real constraint is the kind of deployment the American public will accept.

"We've established some artificial circumstances," General Dougherty says. "We've said that we don't want to see them on Interstate highways. They're certainly transportable on Interstates and probably approach invulnerability there. They're not inherently dangerous. They can be protected in many ways. Look at the industrial parks and interstate exchanges all over this country—thousands of acres under roof, providing static deployment sites for a mobile missile that can move out."

Recognizing the reluctance of the public to become involved in its own security and an unwillingness to be seriously inconvenienced for defense, General Dougherty concludes that "our nation probably won't put up with much in the way of mobility—until it feels the impulse of fear."

Missiles and Bombers

Land-based missiles, he says have a special deterrent effect.

They do not tempt an enemy to think he might destroy them without dire consequences. "They have a very strong credibility about them by being based in the sovereign territory of the nation, so that an attempt to attack them is almost certain to provoke an instantaneous and consequential response. Equally capable ICBMs on airborne aircraft or ships at sea do not have quite the same degree of reflected credibility."

General Dougherty sees the Strategic Defense Initiative (SDI) as a valuable complement to traditional deterrent forces, but warns that SDI offers "only a partial, albeit useful, defense against the most threatening of today's weapons, the ICBM and maybe the midrange ballistic missile. The idea that we're going to be able to develop a defense that makes us invulnerable to nuclear war or the ravages of war is a pipe dream."

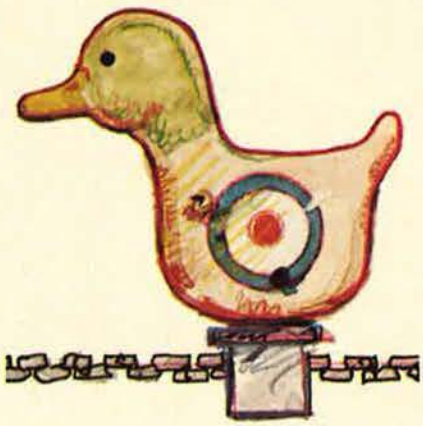
As for the manned bomber, some theoreticians pronounced it dead twenty years ago, but it's still flying in a variety of nuclear and nonnuclear missions. General Dougherty (who was once accused of advocating a strategic fleet so versatile that it could "deliver hay to the yaks in Katmandu") remains a firm proponent of long-range combat aircraft. "We're often reminded that three-fourths of the earth's surface is covered by water," he says, "but let's not forget that a hundred percent of it is covered by air."

That global access of aircraft, along with qualities of reusability and versatility, makes the bomber an asset of continuing importance across the spectrum of conflict.

"The bomber can be used in areas where the missile can't," General Dougherty says. "It's not a direct competitor to the missile. That, I think, was the mistake that President Carter made in 1977 when he evaluated the cruise missile and the bomber in the same scenario at the same point in the spectrum of warfare and came to the conclusion that they were competitive. The bomber is a carrier of things. It's not a weapon itself."

The manned bomber takes hours to reach its targets, and in a rapid war of all-out exchange, everything could be over by the time it got there. "If your construct of the war is that it's going to be one gasp and that's all, then maybe the bomber will be irrelevant in that particular scenario," General Dougherty says. "On the other hand, if it follows the historic pattern of war, the bomber may be the most usable weapon."

Nor can the bomber be counted out of all scenarios in the high spectrum of conflict. "It will come as a surprise to the editorial writers, but even in the aftermath of a large-scale nuclear attack, there's going to be a lot of the enemy still left and a lot of things that have to be done," he says.



Deterrence as a Defensive Strategy

Deterrence, according to General Dougherty, is an ancient concept. "It was the way that imperial nations controlled their remote colonies, but their deterrent threat was not a defensive one to forestall attack," he says. "It was a threat to enforce an action. *You will pay this tax. You will divide up these fields. You will grow this. You will do that. If you don't, I'll knock your city off!* And they did. After they knocked a few cities off, the word got around, and they were able to control without knocking cities off. It was a coercive, offensive strategy."

The modern innovation by the United States has been to make deterrence a defensive strategy, aimed at preventing attack rather than at extracting tribute or obedience, he says. For the past forty years, the strategy has worked, just as offensive deterrence worked for the empires of the past.

General Dougherty believes that the principle of deterrence is best stated in a formula he first heard from Col. "Abe" Lincoln of West Point. "As he used to put it, capability *times* will equals deterrence," General Dougherty says. "He emphasized that this is a proposition in multiplication, not in addition, for if either of the essential factors is zero, then the product—deterrence—is also zero."

For the capability part of the equation, General Dougherty says the deterrent force must be strong enough and relevant enough to be credible, even under conditions of stress. Sufficiency of deterrent power cannot be computed precisely, and it is dangerous to underestimate the requirement or attempt to be too clever and precise.

In a 1983 interview with *Sea Power* Magazine, General Dougherty explained: "Deterrence has to work when the other person is mad and provoked—not insane, but provoked and bent on your destruction. Not on a given Tuesday when the sun is shining, and everyone is talking reductions and limitations, and they're playing golf together in Geneva, when cultural exchanges are going on and people are buying wheat. Deterrence has got to work for us at a time when tensions are up and nerves are frayed to the ragged edge. A lot of people think deterrence is something you can measure, and then they order the minimum serving."

Capability alone is not enough, though. To illustrate the importance of will, General Dougherty recalls the fall of France in 1940.

"We think of Nazi Germany as a military colossus that took over Europe," he says. "But France did not fall to Germany in battle. France and its armed forces were equal to the Germans in almost every measure except will. Germany gave a brutal demonstration of its willingness to use force, and the French surrendered.

"That can happen to a modern nation in modern times. It can happen to us." ■

More and more military operations depend on aerial refueling, and USAF is a long way from having enough tankers to satisfy all of the needs.

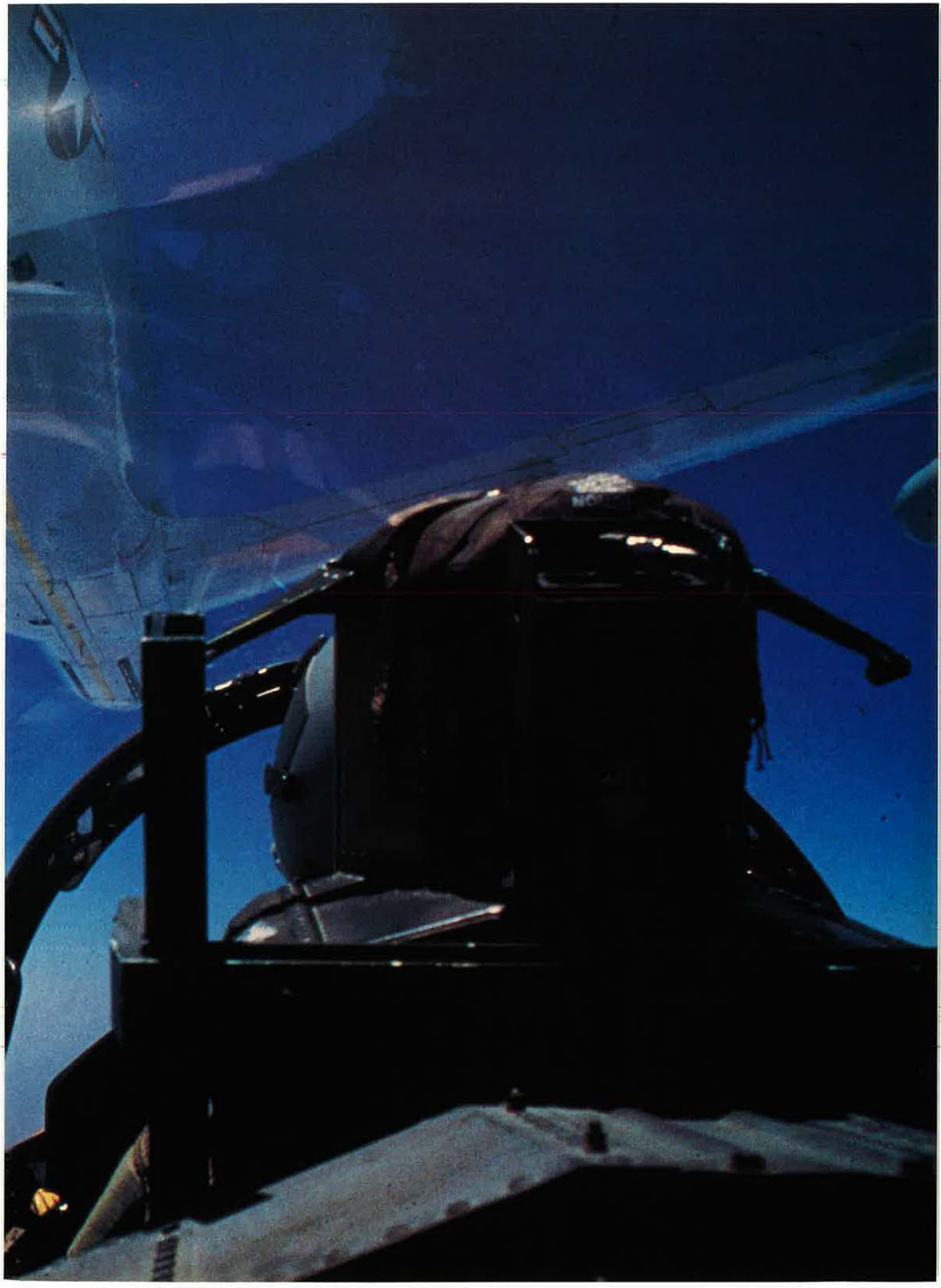
Tankers for a Thirsty Fleet

BY MAJ. RANDAL E. MORGER, USAF
CONTRIBUTING EDITOR

PICTURE this. The year is 2025, and a flight of four aging but still capable Advanced Tactical Fighters is mixing it up in a dogfight practice just off the US Atlantic coast. The tactics lesson completed, the fighters throttle back to subsonic speed and head for a tanker circling nearby. The waiting boom they ease up to protrudes from a KC-135 Stratotanker—an airplane old enough to collect Social Security.

Farfetched? Hardly. The Air Force is now in the midst of several modernization programs that will extend the life span of its KC-135 fleet well into the next century. And while some future "Son of ATF" may have neither the need nor the ability to refuel in flight, it's a safe bet that the majority of USAF combat aircraft will still be using aerial tankers, principally KC-135s, as much as forty years from now.

"You hear the word 'lifeblood'



used about a lot of things," said Lt. Gen. Harley A. Hughes, Air Force Deputy Chief of Staff for Plans and Operations, "but the tankers really are the lifeblood of our fighting force." He and other senior officers refer to the tanker fleet as "a national asset . . . irreplaceable."

With little fanfare, the role of strategic aerial tankers has evolved so greatly over the past three decades that today it's virtually impossible to conceive of any significant US military operation abroad without their support.

Even some relatively limited actions could be hamstrung. In the April 14 US reprisal against Libya, the eighteen F-111s and three EF-111s committed to the mission from the United Kingdom were forced by political reasons to fly a circuitous route through the Strait of Gibraltar to get to their targets in and around Tripoli. Tanker support for the fourteen-hour round trip included a total of twenty-eight KC-10s and KC-135s staging from RAF Mildenhall and RAF Fairford.

USAF's long-range tanker fleet of 615 KC-135s (plus a few dozen spares) and a still-building inventory of KC-10 Extenders provide force-projection capabilities that dwarf those of any other nation. However, in only a handful of crisis scenarios does US tanker capacity match foreseeable air refueling requirements.

The Air Force measures capacity in terms of "KC-135A equivalents." The A model is the most numerous, oldest, and least capable of the strategic tankers. A KC-10, when used exclusively for air refueling, is the equivalent of up to three KC-135As. Based on that measure, USAF estimates that today's tanker fleet, including the KC-10s, works out to about 775 "KC-135A equivalents."

Though exact requirements are classified, the Air Force estimates that air refueling needs and customers have increased sevenfold over the past twenty years. In a 1984 letter to the General Accounting Office (GAO), DoD's then-Principal Deputy to the Under Secretary of Research and Engineering, Dr. James P. Wade, set a minimum tanker capacity of "at least 1,000 [KC-135A] equivalents." He added, "Depending upon events and future weapon system needs, significantly more may be required."

General Hughes hinted at an even higher baseline during an AIR FORCE Magazine interview last January. "The requirement is well in excess of 1,000 KC-135[A] equivalents," he said, "and our program doesn't get there for a long, long time."

Burgeoning Tanker Missions

The problem was much simpler back in the mid-1950s. Those were the days, as one retired Air Force general put it, "when Strategic Air Command got what it wanted." The Boeing Airplane Co. risked a sum greater than its own net worth to develop a prototype jet tanker that could keep up with the new B-52s. The result was the KC-135 Stratotanker, and SAC had the wherewithal to order more than 730 of them. At the peak of the eight-year production run, Boeing was churning out twenty KC-135s a month. The slower KC-97s and KB-50s lumbered off to the reserves or into retirement. Support for the strategic bombers was—and is largely still—the *raison d'être* for the tanker fleet.

But over time, other missions demanded tanker attention, too. The KC-135s demonstrated their combat worth to the tactical air forces during the Vietnam War. At the peak of the air war over Southeast Asia, more than 100 KC-135s were providing up to 450 air refuelings daily, greatly increasing fighter flexibility, range, responsiveness, staying power, and punch. The tankers were also credited with numerous aircraft saves. Wrote one Air Force author of that era, "A tanker pilot who tries to buy a drink at a fighter base can't. He drinks for free."

Tankers are now a fundamental part of such combat exercises as TAC's Red Flag. Few long-range fighter deployments take place without tanker assistance. Fighter pilots are required to stay current in air refueling techniques—an operation they first practice in the final

USAF'S LONG-RANGE TANKER AIRCRAFT

(As of March 1, 1986)

	KC-135A	KC-135E	KC-135R	KC-10
Number in service (PAA only):	453	120	42	44
Prime Contractor:	Boeing	Boeing	Boeing/CFM International	McDonnell Douglas
Program Scope:	Procurement. Buy completed in 1965.	Modification/ reengining continuing.	Modification/ reengining continuing.	Procurement. USAF to buy total of 60.
Average cost per aircraft/modification (constant FY '86 dollars, in millions):	$19.0	$4.1	$16.5	$74.1
Performance				
Maximum gross weight (lbs):	297,000	299,000	322,500	590,000
Maximum fuel load (lbs):	189,700	189,700	202,800	355,000
Thrust per engine (lbs):	13,750	18,000	22,000	52,500
Takeoff distance (in feet, at max gross weight and 90 degrees Fahrenheit):	11,200	9,600	8,100	8,800
Fuel offload capability at 2,500 miles (lbs):	63,000	75,600	94,500	162,000
Fuel efficiency improvement compared to KC-135A:	–	14%	27%	n/a
Meets 1985 federal noise and emission standards:	no	no	yes	yes

weeks of fighter transition training.

The importance of tankers to US strategic airlift was a lesson almost learned the hard way. Following the outbreak of Mideast fighting in 1973, European nations refused landing rights to US cargo planes bearing emergency supplies to Israel. None of Military Airlift Command's C-141 transports at that time was air refuelable. Fortunately, Portugal relented and allowed the use of the Azores as a refueling stop. MAC subsequently moved 421 StarLifter cargo loads into Israel, but US vulnerability to foreign political decisions was not forgotten. As the Congressional Budget Office (CBO) later stated, "Future airlift operations in politically sensitive situations might require substantial numbers of tankers to provide airborne refueling."

Adding air refueling receptacles to the C-141s—a four-year program begun in 1979—went a long way toward fulfilling the objective expressed in 1976 by then-Air Force Chief of Staff Gen. David C. Jones "of being able to operate almost any place in the world with little if any reliance on en route bases and to project our forces quickly over great distances."

This emerging rapid deployment concept thrust the tankers fully into the "jointness" arena. Moving just one mechanized Army division from the US to Southwest Asia, for example, would entail about 500 C-5 and 1,100 C-141 missions. Conventional operations in the Pacific or Europe might differ in scope or circumstances, General Hughes said, but fighting in any of those theaters would "require a large number of tankers." How all the refueling priorities would be sorted out during a major contingency would depend largely on the situation at the time, he added, "and the scenarios are legion."

Nor have the conventional mission requirements stopped growing. Twenty years ago, about one-fifth of USAF's first-line fighters were air refuelable. Today, all of them are. So are all of MAC's strategic airlifters. Of the 42,570 KC-135 or KC-10 refueling missions flown last year, 21,120 were for tactical or airlift hookups. More than 700 missions were flown for the Navy and Marine Corps, whose requirements have been increasing for the last five years.

Meanwhile, the need for tanker support for the bomber fleet will also continue to grow—at least through the early 1990s and perhaps beyond. Among the driving factors:

- After a long decline from a peak of 620 B-52s in 1962, the total number of strategic bombers is again on the rise. The Air Force doesn't plan to retire any more of its 264 remaining B-52s until after most of the new B-1Bs and at least some Advanced Technology Bombers are operational.
- About two-thirds of the nuclear weapon-carrying B-52s are assigned to "shoot and penetrate" missions. Along with weapons stored in their bomb bays, these bombers carry twelve externally mounted—hence drag-inducing—cruise missiles. After firing the ALCMs from peripheral vantage points, they would continue on to other targets by flying through the fuel-eating lower atmosphere to avoid Soviet air defenses.
- The Soviet target structure is changing. The Air Force's FY '87 Report to the Ninety-ninth Congress notes that the bombers' "real-time potential for locating and destroying relocatable systems is vital to the maintenance of the viable [nuclear] triad." Tanker requirements are projected to increase in order to support far-ranging bomber search-and-destroy missions against mobile ballistic missile sites.

There is *some* flexibility in the number of tankers that supports the bomber leg of the triad. On any given day, however, about one-third of the KC-135s are on "ramp alert." These airframes cannot normally be used for any other purpose, unless directed by the Joint Chiefs of Staff (JCS). Should military tensions go up, SAC might bring more bombers to increased alert or even go to airborne alerts, such as it did during the 1960s. The KC-135s would have to respond accordingly, leaving even less support for the general-purpose forces, maritime missions, and allies.

The boom operator's compartment on board a KC-10 Extender offers fly-by-wire controls, superb visibility, and environmental amenities not found on older KC-135s. The operator can also control a permanently mounted drogue system to refuel Navy and allied aircraft. The "boomer" doubles as loadmaster for the dual-role KC-10. (USAF photo by SSgt. Lee Schading)

JCS-directed operational activities also reduce available tanker resources. Both active and reserve tanker crews now rotate to locations in Europe, the Pacific, and Alaska to provide theater refueling support. Temporary "Tanker Task Forces" are set up for training exercises and short-term deployments. The Air National Guard, for example, tasks its tanker units to refuel the Guard fighters in Panama carrying out the ongoing Coronet Cove defense of the Canal Zone. Since 1980, tankers operating out of Riyadh, Saudi Arabia, have kept E-3 AWACS aircraft airborne around the clock in support of Saudi air defense.

The Dilemma of Lagging Capacity

Insufficient tanker capability lessens the military's ability to conduct either conventional or nuclear operations with confidence. In a report issued in September 1985 that summarized tanker alternatives, the Congressional Budget Office stated that, with a tanker capacity of fewer than 1,000 KC-135A equivalents, "the risk would be highest of having to divert tanker resources dedicated to the strategic mission to meet conventional demand." Because of the near-term shortfall, General Hughes acknowledged, "the balance between conventional [tanker support] and SIOP [tanker support to bombers striking targets identified in the Single Integrated Operational Plan] is one that will be struck at the time of the crisis."

Air refueling capability is going up, albeit more slowly than requirements. Air Force tanker capacity increased twenty-three percent between 1980 and 1985. Much of the rise is attributable to the new McDonnell Douglas KC-10, but KC-135 modernization programs have also had an impact. Additionally, some inroads are being made by reducing wartime tanker requirements and managing the tanker fleet more efficiently.

Buying new aircraft, such as the KC-10, is the quickest way to boost refueling capacity. But it's still an expensive proposition, even though the Air Force got a good buy on the plane, saving more than $600 million by using multiyear procurement contracts. If Congress approves the eight KC-10s requested by the Air Force in FY '87, "that's probably where we'll stop," General Hughes said, "strictly because of budget considerations." USAF is programming for a total of sixty Extenders.

Since the KC-10s were purchased to support general-purpose forces, they are not linked to the SIOP. Their large fuel capacity and ability to haul cargo and people at the same time make them ideal for long-range conventional deployments. In one scenario, already practiced a number of times, a force of six to eight air-superiority F-15s launches from their Stateside base on short notice, fully loaded with missiles and ammunition. Maintenance personnel and spare pilots, along with initial spares and equipment, travel in an accompanying KC-10. Arriving just ahead of the fighters at the deployed locations, the crews are ready to "turn" the Eagles and send them on their first combat sorties almost immediately.

Although a KC-10 can haul a lot more gas than a KC-135, it still can refuel only one aircraft at a time. That limits its ability to refuel many aircraft quickly, as might be necessary in combat involving large numbers of fighters.

Keeping down the boom-to-receiver ratio is a key reason why the Air Force put the bulk of its tanker upgrade effort into KC-135 modifications. Chief among these is a program to replace the old Pratt & Whitney J57 engines with larger, more powerful CFM56-2 high-bypass-ratio turbofan engines. Under separate contracts with CFM International, a company owned jointly by SNECMA of France and the US's General Electric Co., and the Boeing Military Aircraft Co. of Wichita, Kan., the Air Force is making more than two dozen major upgrades to each KC-135 airframe. Besides the new engines, improvements include strengthened landing gear, new avionics, and structural modifications. The result is the KC-135R. Combined with still another program to reskin the aircraft's wings, these modifications

If B-1 bombers now entering the Air Force inventory are still flying in the year 2025, the odds are good that they'll be refueled by sixty-five-year-old KC-135 Stratotankers. The tankers' service life is being extended by major modifications and wing reskinning. Here, a B-1A takes a drink of JP-4.

will give the KC-135R a projected service life of at least another twenty years—probably far longer.

Because of the increased efficiency and power of the CFM56 engines, the KC-135R will have about fifty percent more capability than a comparable A model. Their thrust also allows the R models to operate from shorter runways, opening up for use about 130 more alternate strips in the US alone. Greater engine reliability will cut maintenance costs as well.

Pace of the modernization has been slow, partly because arcane funding procedures don't allow advance procurement money to be spent for modification programs. About two and a half years pass between the time Congress approves funds and when the funded KC-135R reaches the flight line.

The Air Force plans to modernize 395 KC-135As with the R kits by the end of FY '91, with fifty kits requested for FY '87. Updating the entire fleet of 641 aircraft is the long-range objective, but that probably won't be completed until the mid-1990s at the earliest. Total cost of the program could reach $9 billion, while adding 280 KC-135A equivalents.

A much less comprehensive modernization for KC-135s operated by the reserve forces has already been fully funded and should be completed this year. In 1981, Congress directed the Air Force to proceed with a program to salvage and refurbish Pratt & Whitney JT3D engines from retiring commercial Boeing 707 aircraft and refit them to KC-135s. At the outset, the Air Force balked, claiming the modification would not add significantly to the A model's service life. When Congress added money specifically for a JT3D retrofit in 1982, USAF targeted the 128 reserve tankers and a few special-duty KC-135s to be upgraded to the E configuration.

In the Air Force's view, this is an "interim fix," and it still plans to modify the E models to KC-135Rs at the tail end of that program. Nevertheless, reserve units are happy with the KC-135Es. Not only do the Air Guard and Reserve operate the oldest tankers in the fleet, with an average age of twenty-seven years, but many of them also fly out of airfields near heavily populated areas. The noise and smoke that previously announced a KC-135 takeoff are not gone entirely, but were greatly mitigated by the change of engines.

The KC-135E yields about a twenty percent increase in capability over the A at relatively low cost. It can also operate from slightly shorter runways because of increased engine thrust. Since readily available used parts are involved, each KC-135E modification takes about six months.

CBO's Unpalatable Options

These two modification programs, plus the KC-10 buy, are at the heart of the 1985 CBO study that asserted that tanker demand will peak in the early 1990s and that presented options for reaching the "1,000 KC-135 equivalents" ahead of the Air Force's current program. One alternative is to buy 225 more E kits over the next five years while capping the total number of R model conversions at 289 aircraft. That, says the CBO report, would give the Air Force 1,000 tanker equivalents in 1991, a year earlier than now planned, at initial savings of $1.2 billion.

Both the Air Force and DoD find fault with this and similar analyses performed in the past by the CBO and GAO. They point to a number of statistical and accounting differences between their analyses and those of CBO and GAO, but chiefly rebut the studies on two main points: Demand for tanker support is not likely to taper off after 1990, as the CBO asserts, and near-term capacity is not so important as long-term modernization.

"If our Ouija board said that we were going to have a conflict [that required] tremendous tanker support in another three years," the Air Force would reevaluate its KC-135 modernization program, General Hughes said. He noted that increased reliance on the KC-135E would cause the Air Force to lose long-term capability unless R-type modifications were eventually made to those airframes anyway.

The CBO report also detailed some options for reducing tanker demand, while pointing out that its alternatives could mean "military or political risks—or, indeed, added costs—that DoD apparently believes do not outweigh the benefits." Suggestions included eliminating the B-52 "shoot and penetrate" missions in favor of standoff missions only, retiring some B-52s sooner, and reverting to ground refueling of selected tactical aircraft moving to combat theaters.

The business end of the KC-135 can pass 900 gallons of jet fuel a minute to a receiver aircraft. USAF's Aeronautical Systems Division is looking at improving the boom system with higher flow fuel pumps, a new nozzle, and a load-indication system. (USAF photo by "O. C." Carlisle)

It's extremely doubtful that DoD would agree to reduce strategic target coverage of the Soviet Union in the absence of a secure arms-control agreement. But other ways to reduce tanker demand are showing results. Fuel efficiency of tactical aircraft is getting better, for example. Each gas-thirsty F-4 requires the equivalent of one KC-135A fuel load to get across the Atlantic. That same amount of fuel can get two or

three F-16s to Europe. F-15s outfitted with conformal fuel tanks can reach the Azores from the US east coast without in-flight refueling.

Tactical Air Command, faced with moving as many as sixty fighter squadrons overseas in the first ten days of a NATO-Warsaw Pact conflict, is also keeping open an "island-hopping" option. TAC officials say they've practiced the technique three times in the past two years, sending F-111s to the Pacific via Elmendorf and Shemya AFBs, Alaska, and Misawa AB, Japan. Separate flights of A-10s and F-16s have gone to Europe via Loring AFB, Me., Goose Bay, Labrador, and Keflavik NAS, Iceland.

Finally, in an effort to manage existing tanker assets more efficiently and effectively, SAC for the past eight years has chaired the Aerial Refueling Systems Advisory Group (ARSAG). Twice annually, representatives from every organization that supports or uses tankers meet to review requirements, resolve technical problems, and refine air refueling policy. It was group consensus, for example, that led all general-use tankers produced after 1981 to be fitted with both probe-and-drogue and boom-receptacle refueling features. US Navy, Marine, and allied tactical aircraft use probe-and-drogue refueling almost exclusively.

Proving the Tankers' Worth

Nearly six decades have passed since five men of the US Army Air Corps—including Ira Eaker, Elwood "Pete" Quesada, and Carl "Tooey" Spaatz—crewed a trimotor Fokker monoplane named *Question Mark* to a record-setting 150 hours and forty minutes of continuous flight. Two Douglas C-1 transports, equipped with thirty-foot steam hoses and extra fuel tanks, delivered 5,000 gallons of gas in forty-two hookups to the *Question Mark* as it cruised the California skies between January 1 and January 7, 1929. A KC-10 today could deliver the same amount of fuel in about three minutes.

Yet only a handful of the world's air forces today boasts even a rudimentary aerial refueling capability. The Israelis used their modified Boeing 707 tankers to support fighter aircraft in a surprise raid on the Palestine Liberation Organization's headquarters in Tunisia last October. Great Britain remembers the value of its limited fleet of Victor tankers, which enabled Vulcan bombers to damage an airstrip held by the Argentineans during the Falklands War. The British have since taken steps to enlarge and modernize their tanker force.

The Soviet Union is on the verge of beefing up its aerial refueling capability as well. Faced with then-formidable North American air defense forces, the Soviets eschewed the use of a large bomber force in the 1950s and '60s and concentrated instead on land-based ICBMs for the bulk of its nuclear delivery cabability. Now, the direction appears to be changing. The Soviets "are going to have a potent [nuclear] triad by the year 2000," General Hughes said. The new Blackjack bomber, now being flight-tested, "is a hell of a big airplane. . . . They're also going to have a [much more potent] tanker force," he added. "In the next eighteen months or so, we'll see a lot more evidence of that."

The General was even more concerned that the Soviets might possibly enlarge their tanker fleet for conventional force projection. In that case, he concluded, "We are almost certain to see the long arm of the Soviet Union reach past Afghanistan, for example, with credibility." ■

The Improved Aerial Refueling System

The KC-135E and KC-135R modifications are by no means the only improvements for the tanker force. Dexter Kalt, a specialist for the Fuels and Hazards Branch at Aeronautical Systems Division, Wright-Patterson AFB, Ohio, and technical chairman for the Aerial Refueling Systems Advisory Group, outlined the primary elements of a program called the Improved Aerial Refueling System (IARS). Among them:

- Continuing research aimed at adding multiple refueling points to each tanker so that more than one receiver can gas up simultaneously. Tests conducted by the Boeing Co. and ASD in the early 1970s demonstrated that multiple-point refueling was feasible, but the cost of adding new stations, particularly the boom type found now on all Air Force strategic tankers, has so far been too high.

The ability to refuel more than one aircraft at a time would be most advantageous in a European-style conflict, during which large numbers of fighters would have to refuel often and quickly. A program to reskin and strengthen KC-135 wings, now more than half complete, could help that project—at least to the extent of allowing hose-and-drogue wing pods to be mounted. Boeing has sold more than two dozen similarly equipped 707s to foreign nations.

Mr. Kalt believes that the optimum configuration for a tanker—"given the money"—would be three boom stations and three hose-and-drogue stations mounted at the tanker's wingtips and on the aircraft's centerline. Such an arrangement would overcome the problem of a limited refueling capability in combat and would provide equal flexibility to all receivers.

KC-10s are manufactured with both drogue- and boom-refueling stations, but they cannot be used simultaneously. A Stratotanker can be altered to the drogue configuration by adding a nine-foot hose to the business end of its boom. However, that requires a ground conversion and prevents the tanker from refueling boom-compatible receivers.

- Possible equipping of KC-135s with high-flow fuel pumps that increase the rate of fuel offload by about twenty-five percent. Increasing the fuel flow through the boom to 1,200 gallons a minute, roughly comparable to the capability of a KC-10, would be most beneficial when refueling such large aircraft as the E-4, C-5, and C-17.
- A new boom nozzle and a load indication system for KC-135s, featuring improved independent disconnect features. The KC-10 already has such a system, which automatically prevents excessive loads from building up between the boom and receiver. ASD is now developing a statement of work for a less expensive system to help KC-135 boomers identify and correct overloads before they damage the receiver or even break off the boom from the tanker.
- Retrofitting the KC-135 fleet with tail-mounted floodlights to aid in night refueling. About half the Stratotankers now sport these lights, and the modification is ongoing. Boom operators report that it is much easier to link up with camouflaged aircraft at night when using the floodlights.

One area not under serious consideration at this time is equipping tankers with either passive or active defenses against enemy attack. Theater commanders are responsible for protection of the tankers. As high-value targets, the tankers would receive the support of fighter escorts when operating in dangerous areas.

—R.E.M.

AIR FORCE

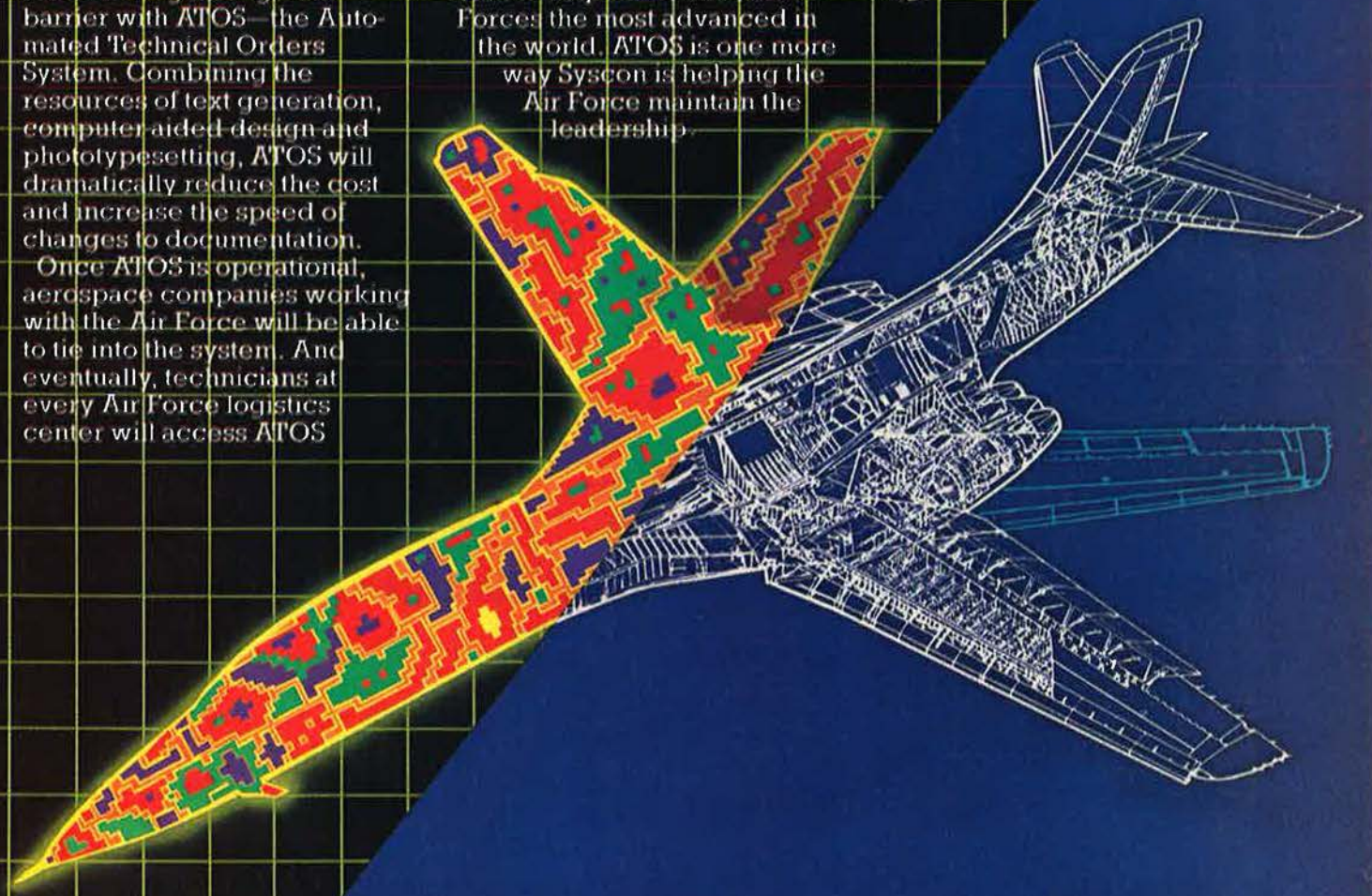
Today, standing in the way of every Air Force advance in technology, is a paperwork barrier.

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

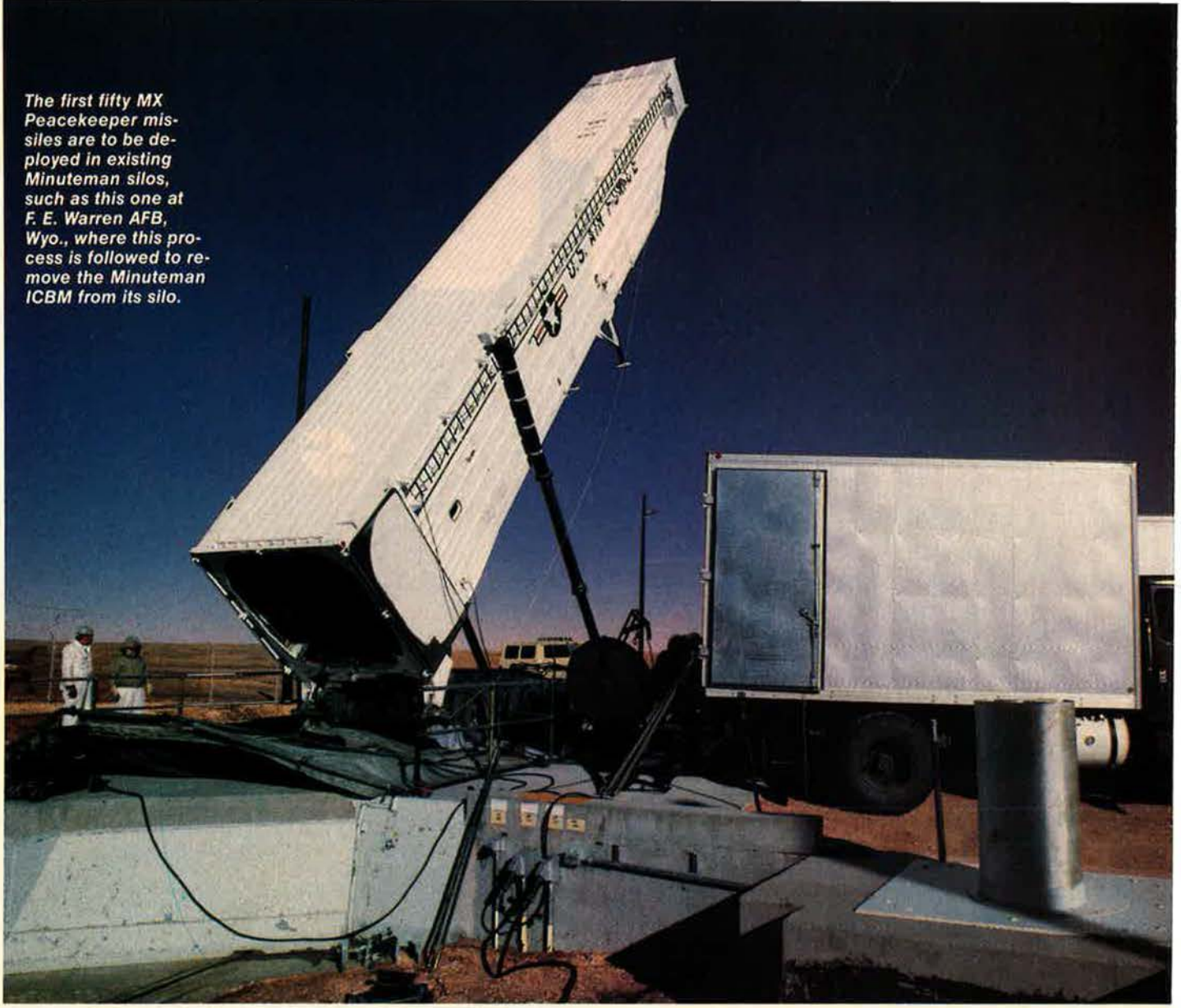
Once ATOS is operational, aerospace companies working with the Air Force will be able to tie into the system. And eventually, technicians at every Air Force logistics center will access ATOS through terminals for instant information on systems operation and maintenance.

Since 1966, Syscon and the U.S. Military have worked as a team to help make our Armed Forces the most advanced in the world. ATOS is one more way Syscon is helping the Air Force maintain the leadership.

SYSCON
CORPORATION
1000 Thomas Jefferson Street, N.W.
Washington, D.C. 20007



& SYSCON



The first fifty MX Peacekeeper missiles are to be deployed in existing Minuteman silos, such as this one at F. E. Warren AFB, Wyo., where this process is followed to remove the Minuteman ICBM from its silo.

ONE OF the most controversial weapon systems in history has been the LGM-118A Peacekeeper intercontinental ballistic missile. The Peacekeeper, or MX as it was originally called, has had to overcome more hurdles—ranging from environmentalists and antinuclear proponents to, in large part, Congress—than almost any other weapon has faced.

In its 1983 report, the President's Commission on Strategic Forces (also known as the Scowcroft Commission) recommended deployment of 100 of the ten-warhead ICBMs along with the fielding of the single-warhead Small ICBM, or Midgetman, as part of the effort to modernize US strategic forces.

After long and sometimes acrimonious debate in Congress, however, deployment of the Peacekeeper has been limited to fifty missiles to be housed in existing Minuteman missile silos. Congress will decide the fate of the second fifty missiles after the Air Force determines a more survivable means of basing the weapons.

While the political controversy still swirls around the whole concept of "the MX missile," the personnel of Air Force Systems Command's Ballistic Missile Office (BMO) at Norton AFB, Calif., Strategic Air Command (SAC) Headquarters at Offutt AFB, Neb., and especially the 90th Strategic Missile Wing at Francis E. Warren AFB, near Cheyenne, Wyo., have been working diligently for the last three years to get facilities and crews ready for operations with fifty actual, seventy-one-foot-long LGM-118 missiles.

Program Up and Running

An organization called the Site Activation Task Force (SATAF), set

The Site Activation Task Force at F. E. Warren AFB begins beddown of the new missile.

THE FIRST PEACEKEEPER

BY JEFFREY P. RHODES
STAFF EDITOR

up by the BMO, is responsible for construction of facilities and management of the deployment of the weapon system at F. E. Warren. "There was a tremendous amount of planning that went into the Peacekeeper program before we started work, and there has been a tremendous amount of activity since then," said Col. Warren H. Hickman, the SATAF Commander. "We have built fifteen new facilities and have modified ten more facilities to get ready for these missiles."

The fifteen contracts for new construction at F. E. Warren totaled $52 million spread among eleven contractors, seven of which were Wyoming-based firms. The construction included facilities for processing and storing the various parts of the missiles, a training silo and other training facilities, SATAF support buildings, and a large complex for special-purpose vehicles.

"Construction is ninety-five percent complete, we have taken possession of most of the buildings, and they are now in use," said Colonel Hickman, who has been involved with the Peacekeeper program since engineering on the missile began.

In addition to money for the facilities on base, $60 million in funds is earmarked for construction activities in the missile fields. Unlike the three-stage Minuteman, which is trucked out to the silo completely assembled, the four-stage Peacekeeper will be assembled in the silo. The Federal Highway Administration oversees the upgrades of the roads to the sites, and the Army Corps of Engineers has been supervising work on the surface modifications (including the maneuvering area for the emplacer vehicle and larger tie-down pads) at the silos.

After removal of the Minuteman missile, SAC turned over the first silo for modification to the Boeing Aerospace Co. in January. Boeing will perform all of the below-ground modifications to the silos as part of a $150 million contract. Since that time, five more missile sites and two launch control centers have been turned over.

While the actual mortar and brick will not be changed, several internal modifications have to be made to the silos before the sites can accept their new occupants.

Because the LGM-118A is larger than the Minuteman, a canister is required to house the missile. A "cold-launch" technique is used to eject the missile from the silo (that is, the missile does not fire its rocket motor until it is forced from the silo approximately 100 feet out of its internal canister by a chemical reaction between a solid fuel packet and water, similar to the way the Navy's

Poseidon and Trident missiles are launched from submarines). Consequently, a launch eject gas generator (LEGG) has to be installed below the missile in the canister. Also, the nineteen-foot-long upper launch tube liner used for the Minuteman missiles has to be replaced by a liner that is six feet shorter and that provides both shock isolation and access for assembly of the missile.

As with the Minuteman force, ten Peacekeepers will be controlled by each underground launch control center. Modifications to the centers include the installation of video display units (VDUs), which display communications to the missile combat crew as part of the new computer-aided message processing (CAMP) system that will be installed to aid in the command and control of Peacekeepers.

"We were directed to make maximum use of the existing Minuteman hardware," said Colonel Hickman. "Some things were changed and others upgraded, but we've done a good job of meeting the requirement."

The first of the Peacekeeper missiles was scheduled to arrive at F. E. Warren in May and was expected to be installed and assembled in the near future.

Peacekeeper Associate Contractors

CONTRACTOR	PURPOSE	LOCATION
Aerojet General	Stage II	Sacramento, Calif.
AVCO	Reentry System Integration	Wilmington, Mass.
Boeing	Basing Operational Support Equipment; Assembly and Checkout	Seattle, Wash.
General Electric	Mk 21 Reentry Vehicles; Arming and Fuzing	Philadelphia, Pa.
GTE	Launch Control System	Westborough, Mass.
Hercules	Stage III	Magna, Utah
Honeywell	Specific Force Integrating Receiver; Third-Generation Gyroscope	Clearwater, Fla.
Lockheed	Ordnance Production	Sunnyvale, Calif.
Logicon	SAC/Peacekeeper Software Analysis; Operational Targeting Program	San Pedro, Calif.
Martin Marietta	Assembly, Test, and Support; Production Support Equipment	Denver, Colo.
Morton Thiokol	Stage I	Brigham City, Utah
Northrop	Third-Generation Gyro	Norwood, Mass.
Northrop	Inertial Measurement Unit	Hawthorne, Calif.
Rockwell International Autonetics	Guidance and Control Program; ICBM Code Processing System	Anaheim, Calif.
Rockwell International Rocketdyne	Stage IV	Canoga Park, Calif.
TRW	Systems Engineering and Technical Assistance for Peacekeeper	Redondo Beach, Calif.
Westinghouse	Launch Canister; Launch Ejection Generator	Sunnyvale, Calif.

Development and acquisition of Air Force Intercontinental Ballistic Missile Systems (ICBM) are accomplished by the Ballistic Missile Office (BMO) at Norton AFB, Calif. The BMO, an Air Force Systems Command unit, uses an "associate contractor" philosophy for missile systems acquisition. Under this method, BMO integrates the activities of several major contractors who develop and build portions of the missile system. This approach differs from the "prime contractor" method of system acquisition, where a single civilian firm has overall engineering responsibility for a system. The above major firms have contracts with BMO for the Peacekeeper program.

Operating with Two Missiles

While the SATAF has been working to get the base ready for the missiles, Lt. Col. John L. Sipos, the Assistant for Plans, Programs, and Special Projects for the 90th SMW and the chairman of the base's Peacekeeper Working Group, has been involved in the process of integrating the new weapon into operations at F. E. Warren.

"I work as the facilitator for the wing commander, and I also assist in the wing's coordination with the SATAF," said Colonel Sipos. "I also have helped establish guidelines for O&M [operability and maintainability] training in the new facilities and with other training, such as for the assembly of the missiles."

The 400th Strategic Missile Squadron, one of four squadrons in the 90th SMW, will operate the Peacekeepers. While no crews or maintenance people will work both on the Minuteman and the Peacekeeper, there will be only minimal organizational changes.

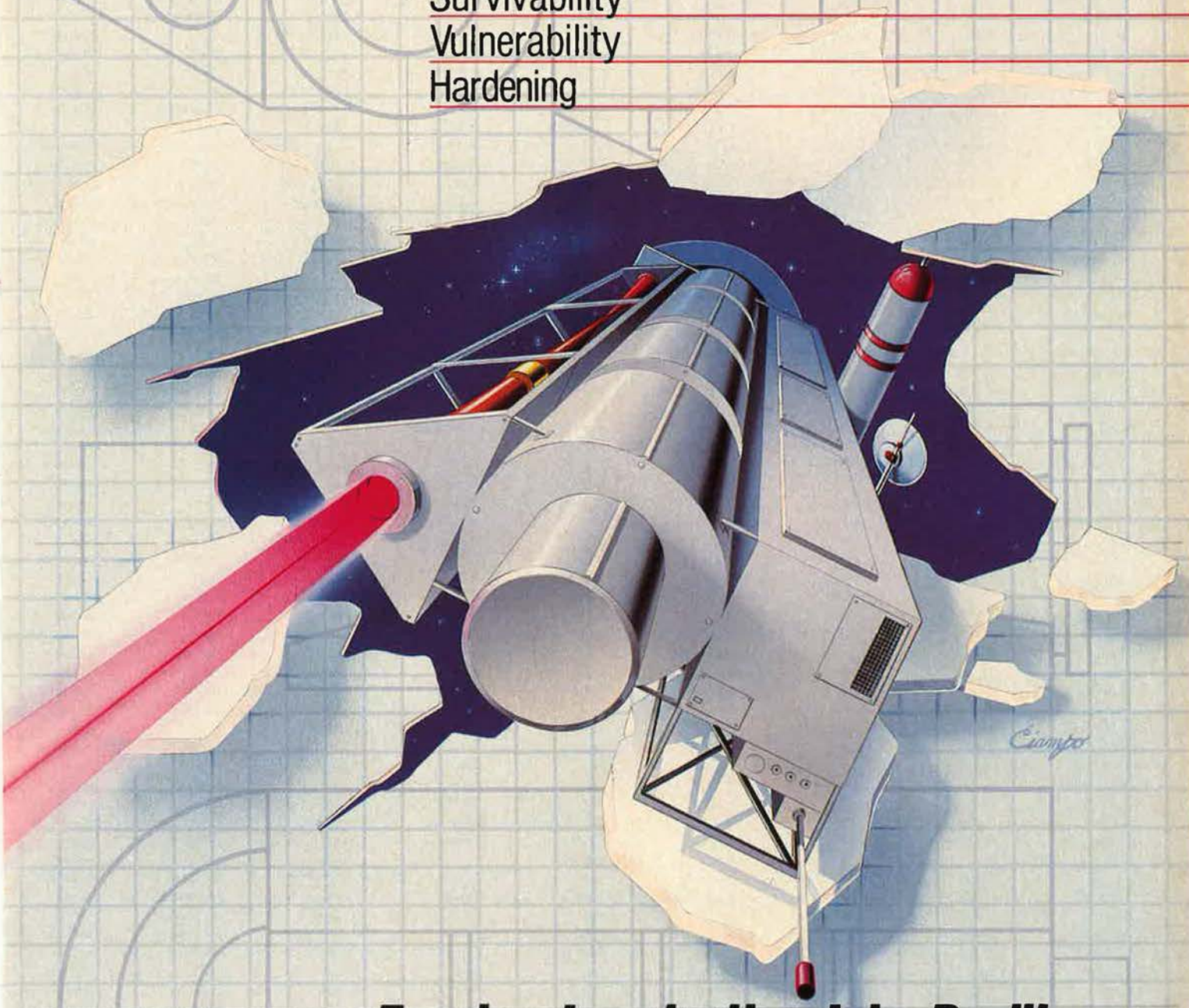
"There will be one wing commander, and there will be one control operation for missile and munition maintenance, although there will be segregation of tasks at the lower levels," noted Colonel Sipos. "Our people have been working long and hard, and they will see the fruition of their efforts in a few months."

Initial Operational Capability (IOC) is set at ten missiles and should be reached by December of this year. Deployment is scheduled to be completed by 1988. All fifty Peacekeepers will be based in the Wyoming portion of F. E. Warren's 12,600-square-mile missile range, and none of the missiles will be located any closer together than five nautical miles.

"All of the programs associated with this missile are on schedule and under budget," said Colonel Hickman. "We are all very proud of the effort on this entire program." ■

PROJECT: STRATEGIC DEFENSE

Survivability
Vulnerability
Hardening



Turning Imagination Into Reality

ACUREX
Aerotherm

Headquarters
520 Clyde Avenue, P.O. Box 7040
Mountain View, CA 94039
(415) 961-6100

Dayton Operations
Suite 120
5100 Springfield Pike
Dayton, OH 45431
(513) 253-0112

Huntsville Operations
7248 Governors Drive
Huntsville, AL 35806
(205) 830-1230

Come See Us At The Dayton International Airshow July 24-27, 1986. **East Hangar Booth #19**

bread
break
breaking
breaks
breath
breathe
breathes
breathless
bred
breeches
breed
breeding
breeds
brewers
bridegroom
bridges
brief
briefly
briefness
brim
bring
bringing
Britain
British
broils
broke
broken
brothel
brothels
brother
brother's
brothers
brought
brow
brown
brows
bruise
brutish
build
building
buoy
buoy'd
Burgundy
burn
burn'd
burning
burst
bursts
bury
bush
business
businesses
bussing
busy
but
butter'd
butterflies
button
buy
buzz
by
cackling
cadent
cage
cagion
caitiff
Caius
call
call'd
calls
call'st
came
Camelot
can
candle
canker
cannot
canst
cap
capable.
capital
captain
captives
carbonado
carbuncle
care

division
divisions
divorce
dizzy
do
doctor
does
dog
dog's
dogs
doing
dolors
dolphin
domestic
dominions
done
door
doors
dost
do't
dotage
dote
doth
double
doubt
doubted
doubtful
Dover
dower
dowerless
dowers
down
dow'r
dow'r'd
dow'rless
dow'rs
dowry
dragon
Dragon's
draw
drawn
draws
dread
dreadful
dream
drench'd
drew
dried
drink
drinks
drive
dropp'd
drops
drown'd
drum
drunkards
dry
Duchess
duchess
ducking
due
dues
Duke
Duke's
Dukes
dukes
dull
dullard
dumbness
dung
dunghill
during
durst
dust
duteous
duties
duty
dwells

each
ear
Earl
earnest
earnestly
ears
earth
ease

fully
fum
fur
furnishings
furr'd
furrow
further
fury
fut
future

gad
gain
'gainst
gait
gale
gall
gallow
gap
garb
garden
garments
garters
gasted
gate
gates
gather
gathers
gauntlet
gave
gav'st
gazing
geese
General
general
generation
generous
gentle
gentleman
gentlemen
gentleness
gentlewoman
germains
Germany
get
gets
ghost
giant
gift
gilded
girdle
give
given
gives
glad
gladly
glance
glares
glass
glib
globe
Gloucester
Gloucester's
gloves
gnawn
go
goatish
goddess
God's
gods
godson
goes
goest
going
gold
golden
gone
Goneril
good
goodliest
goodman
goodness
goose
gor'd
gorg'd
gorge
gorgeous

Highness
Highness'
hill
him
himself
hire
his
history
hit
hither
hitherward
hizzing
ho
Hobbididence
hog
hold
holding
holds
holla
hollow
hollowness
holp
holy
home
honest
honesty
honor
honorable
honor'd
honor's
honors
hope
hoping
Hoppedance
horn
horns
horrible
horrid
horror
horse
horse's
horses
hospitable
host
hot
hotly
hound
hour
hourly
hours
house
houseless
hovel
how
howe'er
however
howl
howl'd
how's
huge
hum
humanity
humbled
humh
hundred
hunt
hunting
hurricanoes
hurt
hurtless
hurts
husband
husband's
husbands
hush
hysterica

I
i'
Ice
I'd
idle
if
ignobly
ignorance
ignorant
I'ld

keeps
kennel
Kent
Kent's
kept
key
kibes
kick'd
kill
kill'd
kin
kind
kinder
kindle
kindly
kindness
King
king
kingdom
kiss
kite
knapp'd
knave
knaves
knee
kneel
kneeling
knees
knife
knight
knighthood
knights
knives
knots
know
knowest
knowing
knowledge
known
knows
know'st
know't

La
la
labor
laboring
labors
lack
lacks
lad
ladies
Lady
lady
lady's
lag
laid
lake
lameness
lamentable
lance
lances
land
landed
lands
large
largest
lark
lash
last
latch'd
late
lately
laugh
laughs
laughter
law
lawful
laws
lawyer
lay
laying
lead
leading
leads
leak
leap

like
likely
likeness
likes
liking
lily
line
lion
lip
lips
Lipsbury
list
lists
litter
little
live
liver'd
lives
lives'
living
loath
loath'd
loathed
loathly
lock'd
lodge
lodging
loins
long
longer
loo
look
look'd
looking
looks
loop'd
loose
loosen
Lord
lord
lord's
lords
lordship
lose
loses
losest
loss
losses
lost
loud
louder
louse
lov'd
love
love's
loves
loving
lov'st
low
lowest
lowness
loyal
loyalty
lubber's
lugg'd
lunatic
lurk
lust
lustre
lusts
lusty
luxury
lying
lym

machination
machinations
mad
madam
madam's
madded
made
madman
madman's
madmen
madness
mad'st

old
oldest
oldness
on
once
one
one's
ones
only
on's
on't
ope
open
operation
operative
opinion
opportunities
oppos'd
oppose
opposeless
opposite
opposites
oppress'd
oppressed
oppression
opulent
or
orbs
order
ordinance
ordinary
organs
origin
Oswald
other
others
o'thing
ought
ounce
our
ours
ourself
ourselves
out
outface
outjest
outlaw'd
outrage
outscorn
outside
outward
over
overlusty
overrul'd
overtake
overture
owe
owes
owest
owl
own
ow'st
oyster

pack
packings
packs
pah
pain
pains
painter
palace
palaces
pandar
pant
panting
pantingly
paper
papers
paramour'd
par'd
pardon
'parel
parent
parents
parings
parricides

qualified
quality
quarrel
quarrel's
quarrels
que
queasy
Queen
queen
quench'd
quest
question
questrists
quick
quicken
quickly
quit
quite

rabble
rack
radiance
radiant
rage
rages
rageth
raggedness
rags
rail
rail'd
rails
raiment
rain
raineth
rais'd
raise
rake
rank
ranks
ransom
rare
rarest
rarity
rascal
rash
rashness
rat
rather
rats
ratsbane
ravish
raz'd
read
reading
ready
realm
reason
reason'd
reasons
rebel
receiv'd
receive
received
reciprocal
reconciles
recounting
recreant
red
redeem
redeems
redress
redresses
reeking
regan
regard
regards
region
rein
relievd
relieve
relish
remain
remainders
remediate
remedies
remedy
remember

rustling
's
sa
sacred
sacrifices
sad
saddle
safe
safer
safety
said
sake
sallets
salt
salutations
same
sampire
sands
sap
sapient
Sarum
sat
satisfaction
saucily
saucy
savage
sav'd
save
'save
save
savor
saw
say
sayest
says
say'st
scald
scalding
scant
scanted
scape
scarce
scarcely
scar'd
scattered
scene
school
schoolmaster
schoolmasters
scope
score
scornful
scourg'd
scurvy
Scythian
sea
seal
search
season
seasons
second
seconds
secret
secrets
sectary
sects
secure
see
seeing
seek
seeking
seeks
seem
seem'd
seeming
seems
seen
sees
seest
see't
seize
self
semblance
send
sense
senses

troops
trot
troth
trotting
trouble
trowest
true
truly
trumpet
trumpet's
trumpets
trundle
trunk
trust
trusts
trusty
truth
truth's
try
tune
t'unsettle
Turk
Turlygod
turn
turn'd
turns
tutors
twain
'twas
'tween
twelve
twenty
twice
'twill
twinkled
'twixt
two
'twould
tyrannous
tyranny
tyrant's
ugly
unable
unaccommodated
unbolted
unbonneted
unburthen'd
unbutton
uncaught
unchaste
unconstant
uncover'd
under
understand
understanding
undertake
undivulged
undo
undone
unfed
unfee'd
unfitness
unfold
unfortunate
unfriended
ungovern'd
ungracious
unhappily
unhappy
unkind
unkindness
unknown
unless
unloose
unmannerly
unmerciful
unnatural
unnaturalness
unnecessary
unnumb'red
unpossessing
unpriz'd
unprovided
unpublish'd
unquietly
unremovable

war
ward
warlike
warm
warmth
warp'd
warrant
warring
wars
was
wash'd
wast
waste
watch
watch'd
watches
water
waters
wat'rish
waved
wawl
wax
way
ways
waywardness
We
we
weak
weakens
weal
wealth
weapon
weapons
wear
wears
wear'st
weary
weather
weaves
web
wed
weeds
weep
weeping
weigh'd
weight
welcome
welk'd
well
we'll
wenches'
went
were
were't
wert
wet
what
what's
wheat
wheel
when
whence
where
wherefore
wherein
whereof
where's
wheresoe'er
whereto
whereupon
whether
which
while
whiles
whilst
whining
whip
whip'st
whipt
whirlpool
whirlwinds
whisper'd
whistle
whistling
white
whites

wind
window'd
winds
wine
wing
winged
wins
winter
winter's
wipe
wisdom
wise
wish
wishes
wit
witch
with
withal
withdraw
wither
within
without
witness
wits
woe
woeful
woes
wolf
wolves
wolvish
woman
woman's
womb
womb'd
women
women's
wonder
wont
wooden
wool
word
word's
words
wore
work
working
world
world's
worm
worse
worser
worships
worst
worsted
worth
worthied
worthier
worthy
would
wouldest
wouldst
woundings
wrap
wrath
wrathful
wreath
wren
wrench'd
wretch
wretched
wretchedness
wretches
wrinkles
writ
write
writes
wrong
wrong'd
wrongs
wrote
wrought
y'
yard
ye
yea
year

young
younger
youngest
your
yours
yourself
yourselves
youth
zed
zir
zo
zwagger'd

Comparable to USAF's F-15 Eagle, the Sukhoi Su-27 Flanker, shown here in an artist's concept, has begun to enter the Soviet inventory. The Flanker is expected to be produced in quantity as one of the main types driving the modernization of Soviet tactical air forces.

RECENT authoritative assessments of Soviet global strategies, in particular the Defense Department's new 1986 edition of *Soviet Military Power* and Director of Central Intelligence William J. Casey's "Worldwide Intelligence Briefing" to Congress, conclude that Mikhail Gorbachev—wishful thinking to the contrary—is not likely to throttle back on either Soviet arms spending or expansionism.

Rather, the US intelligence community agrees that, under the new Soviet boss, the "backdrop of growing Soviet military power, the Soviet network of assets and facilities abroad, and Soviet promotion of disorder in the Third World are together creating an increasingly interrelated threat of growing proportions." Moreover, these conditions are being made more acute by growing Soviet force projection capabilities, a proliferating number of political as well as military bridgeheads abroad, and shifting geographic circumstances that bring Soviet and surrogate forces ever closer to strategic areas and chokepoints vital to the US and its allies.

Broad changes in the USSR's political and military leadership during the past year have had no discernible impact on the course and objectives of Soviet policy and have failed to alter the growth and expansion of that country's nuclear and conventional forces, according to the just-released edition of *Soviet Military Power.* This Pentagon document predicts that Gorbachev will continue to pursue the USSR's global ambitions, because to "alter this course would portend the collapse of Communist ideology and the failure of international socialism."

Economic and Military Modernization

There is no inconsistency between Gorbachev's drive to shore up the sluggish Soviet economy and increase productivity and the Soviet leader's commitment to continue the military buildup and policy of expansionism, the Pentagon argues: "The Soviet military has a strong, long-term interest in the success of initiatives designed to stimulate the economy. The military stands to benefit if the Soviet industrial base can be modernized and if economic performance can be improved over the long term." Current economic growth rates are not high enough to improve both military capabilities and living standards while simultaneously ensuring future economic growth. The initial indications are that Gorbachev, therefore, is returning to an intensive-growth strategy anchored in improved productivity and new technology. The military apparently supports this course unstintingly, according to the DoD analysis.

The CIA assessment points out that the Soviet leader's new Five-Year Plan boosts investments in machine building by some eighty percent while setting "ambitious goals" for high-tech support industries. These include microelectronics and computers essential to the

Despite wishful thinking about Gorbachev's approach, the facts point to continued and relentless expansion of Soviet power.

THE SOVIET JUGGERNAUT ROLLS ON

BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

development of the more complex weapon systems that the Soviets are planning for the next decade. The US intelligence community further believes that "the current high level of military spending will continue to grow [over the life of the new master plan] at the rate that has prevailed for the past ten years."

As Mr. Casey pointed out in his report to Congress, "Even at a time of economic difficulty and a reordering of domestic priorities, Soviet defense programs have been protected. . . . During the next five years, we expect ICBM production to increase substantially over the 1981–85 plan, submarine production to be up about twenty to twenty-five percent, and tank production to jump well over fifty percent." He called special attention to submarine production as the area in which the Soviets are making the greatest strides: "In the last three years, they have introduced three new types of nuclear attack submarines that are quieter, faster, and able to dive deeper than ours."

The US intelligence chief also estimated that, over the next five years, the Soviets will field some 4,000 fighters and helicopters and "a few hundred new strategic bombers." Overall, he predicted, "The prospect is for continuation of the steady twenty-year expansion and force modernization of Soviet strategic and conventional forces. The cumulative effect of this buildup is so great that the US has only begun to catch up."

The Soviet Union's adherence to the *status quo* also holds true with regard to basic military doctrine and strategy. There is no evidence in sight that the new leaders are abandoning or altering the "combined-arms concept," which is oriented toward "winning" global wars by either nuclear or conventional means—or both. At the fulcrum of this concept is the commitment to the "primacy of the offensive," including the option to use nuclear weapons "down to division level," if circumstances so dictate. In the event that war escalates to the nuclear level, nuclear strikes would involve the coordinated use of ground, Strategic Rocket Forces, naval, and aviation systems. Nuclear strikes would then be capitalized on by the "Frontal Forces."

The Strategic Balance

The USSR's strategic forces, according to the Director of Central Intelligence, have "at least caught up [with] and probably surpassed ours." The Pentagon's *Soviet Military Power* publication asserts that the Soviet Union is deploying the SS-25, the world's first operational road-mobile ICBM, while development continues apace on the SS-X-24, "which could be deployed in a rail-mobile version this year."

In terms of maritime strategic forces, the Soviet ballistic missile submarine (SSBN) fleet is—and for the foreseeable future will remain—the largest in the world.

Aircraft Production

USSR and NATO*

Aircraft Type	USSR			NATO		
	1983	1984	1985	1983	1984	1985
Bombers	35	50	50	0	0	2
Fighters/Fighter-Bombers	950	800	650	650	550	550
Transports	250	250	250	290	250	300
ASW	5	5	5	15	10	5
Helicopters	550	600	600	725	720	525
Utility/Trainers	10	10	0	425	305	300

Missile Production

USSR and NATO*

Missile Type	USSR			NATO		
	1983	1984	1985	1983	1984	1985
ICBMs	150	75	100	0	0	0
LRINFs	125	125	125	110	80	175
SRBMs	500	500	450	50	25	50
SLCMs	650	700	700	1,300	1,100	800
SLBMs	100	50	100	75	70	75

Revised to reflect current total production information. Includes United States; excludes France and Spain.

Four new Typhoon-class SSBNs are under construction, and more appear to be planned. The ten-MIRV, 8,300-kilometer-range SS-NX-23 SLBM is about to achieve operational status. SSBNs of the Delta III and IV classes are earmarked to carry this advanced-technology missile. Both the Typhoons and Deltas are apparently slated to operate from bases exploiting deep-rock tunnels for protection and survivability. A total of at least 944 SLBMs is operationally deployed at this time on sixty-two modern SSBNs.

Four of the SSBNs are Typhoons, the world's largest submarine, with a displacement one-third greater than that of the new US Trident (*Ohio*-class) SSBNs. The Typhoons are capable of operating under the Arctic Ocean ice cap in a concealed, protected fashion.

There are indications that the Soviets are working toward modified versions of existing SLBMs that could have a hard-target kill capability. *Soviet Military Power* reports as well that the Soviet Navy can be expected to deploy an extremely-low-frequency (ELF) communications system in order to permit reliable contact with the SSBNs under most operating conditions.

Somewhat a stepchild in the 1970s, Soviet strategic aviation is now in the throes of a strong renaissance, with three manned "intercontinental-capable" bombers in development and production—the Bear H, the Backfire, and the Blackjack. Since 1980, the number of Soviet intercontinental-capable bombers has increased by about 170 aircraft, while the US inventory declined by some sixty aircraft over the same period. The Soviets now have about 460 bombers in their inventory capable of performing intercontinental nuclear missions, compared to 313 for the US, according to the Pentagon report.

Some forty new Bear H bombers—each carrying AS-15 long-range cruise missiles—have been brought into the operational inventory since 1984. Backfire bombers continue to be produced at a rate of about thirty per year. Lastly, a new long-range bomber, larger and faster than the B-1 but with about the same combat radius, the Blackjack, is in flight test and could be operational within two years.

Backing up this armada of new Soviet strategic bombers is a new aerial refueling tanker version of the Il-76 transport. The pending operational deployment of this tanker, known as Midas, will extend the reach of Soviet strategic aviation significantly. In one noteworthy development, the Soviets have begun to send Bear H bombers on training flights that simulate attacks against the North American continent.

New Cruise Missiles

In phase with the buildup and modernization of their strategic bomber fleet, the Soviets are developing mod-

ern, highly capable air-launched cruise missiles. The first of this crop of cruise missiles, the 3,000-kilometer-range AS-15, became operational two years ago. Similar in design to the US Navy's Tomahawk, the AS-15 equips Bear Hs and will be carried by the Blackjack when that aircraft reaches operational status around 1988.

Sea- and ground-launched versions of this cruise missile are under development. The Pentagon identified the sea-launched variant as the SS-NX-21 and reported that this cruise missile can be fired from standard torpedo tubes and, thus, by almost all Soviet attack submarines. The ground-launched variant, the SSC-X-4, is likely to achieve operational status this year and will be deployed in the Eurasian theater in mobile fashion, similar to that of the SS-20 intermediate-range ballistic missile.

A completely new large cruise missile, the SS-NX-24, is likely to become operational next year. All of the new Soviet cruise missiles will probably be equipped with nuclear warheads when first deployed and will be able to attack hardened targets. But as the latest US threat analyses point out, these weapons are probably accurate enough to use conventional warheads, "depending on munitions developments and the type of guidance systems incorporated into their designs." Under those circumstances, these weapons would pose a significant nonnuclear threat to US and Eurasian airfields and nuclear weapons.

Over the next ten years, Secretary of Defense Caspar W. Weinberger predicted in the preface of *Soviet Military Power,* the Soviets are likely to "deploy 2,000 to 3,000 . . . nuclear-armed cruise missiles, thereby achieving an entirely new dimension of multidirectional offensive strategic nuclear capability."

The latest US intelligence assessments indicate that the Soviets believe that nuclear war might be protracted and that nuclear forces and weapon systems, therefore, must be survivable and sustainable. To support this doctrine, according to *Soviet Military Power,* the Soviets are stocking extra missiles, propellants, and warheads throughout the USSR: "Some ICBM launchers could be reloaded, and provisions have been made for the decontamination of those launchers. Plans for the survival of necessary equipment and personnel have been developed and practiced. Resupply systems are available to reload SSBNs in protected waters." Assuming continuation of present trends, almost a third of the Soviet ICBM force will be mobile and highly survivable by the mid-1990s.

The Soviet Strategic Defense Program

In the field of strategic defense, the US intelligence community expects the Soviets, by 1987, to complete improvements to their operational ABM defenses around Moscow. These improvements, in turn, give the Soviets all the components necessary for a much larger, nationwide ABM system, which would include transportable engagement radars, above-ground launchers, and a new high-acceleration short-range interceptor.

In addition, Mr. Casey told Congress that "the distinction between missions for surface-to-air missiles [SAMs] and ABMs is becoming increasingly blurred as a result of technology improvements to SAMs, such as the SA-X-12. That system's capabilities against tactical ballistic missiles give it the potential to function in a missile defense role" in the strategic sector. Other elements of the Soviet Strategic Defense Program (SSDP) include:

- Construction of a ballistic missile detection and tracking radar that, in the US view, violates the 1972 ABM Treaty.
- Extensive research into advanced technologies for defense against ballistic missiles. These technologies include laser weapons, particle-beam weapons, and kinetic-energy weapons, and in some cases, they are approaching hardware levels. Ground-based prototypes of ABM laser weapons might surface by the late 1980s, and component testing for the large-scale deployment of such a system might get under way in the early 1990s. But the Pentagon does not expect the Soviets to deploy operational space-based antisatellite lasers before the mid-1990s and full-up space-based ABM systems before the year 2000. On the other hand, high-energy air defense laser weapons are likely to show up in ground-based form in the early 1990s. Naval deployments of such weapons might follow shortly thereafter.
- Continued modernization of Soviet strategic air defense forces.
- Across-the-board improvements of passive defenses by maintaining deep bunkers and blast shelters for key personnel and enhancing the survivability of some offensive systems by mobility and hardening.

Expanding Space Efforts

The first flight of the Soviet Union's "Space Shuttle" is expected late in 1986 or in 1987, according to US intelligence estimates. While there is no hard evidence to gauge the degree to which this space system as well as the Soviet "Space Plane" will be used for military as opposed to civilian purposes, there is reason to believe that most Soviet civilian "scientific" space work is skewed toward military applications.

In the area of military space support systems, the Soviets lead this country in the crucial area of space-based radars. The nuclear-powered Radar Ocean Reconnaissance Satellite (RORSAT) and Electronic Intelligence Ocean Reconnaissance Satellite (EORSAT) are fully operational and are being used to locate and, in a training sense, target naval forces. In what is becoming standard operating routine, the Soviets, for instance, launched two RORSATs last August in time to support lengthy Soviet naval exercises, the new *Soviet Military Power* edition disclosed.

Other Soviet space support activities include the development of two new launch systems. One of these is a heavy-lift system capable of orbiting payloads of about 100,000 kilograms. This system will enable the Soviets to assemble very large modular space stations in orbit and could give them the ability to orbit such heavy payloads as directed-energy ASAT and ballistic missile defense weapons, according to US intelligence.

The other new Soviet space-launch system is a medium-lift booster that is likely to be used for the new Soviet space plane. The latter is described as a small, manned craft that "could be used for real-time reconnaissance missions, satellite repair and maintenance, crew transport, space station defense, and enemy satellite inspection or destruction," according to the new Pentagon document.

With these new launch systems, the Soviets will have ten different types of expendable launch vehicles and two reusable manned space vehicles. US experts believe that these systems will give the Soviets a versatile and redundant capability to conduct and augment military operations in space. As a corollary, the Soviets would have a distinct advantage during times of crises or hostilities because of the launch surge capability provided by this massive and versatile launch capability.

In this context, US experts are concerned about Soviet efforts to develop new, advanced space stations that could be outfitted as reconnaissance platforms, nuclear power substations, or laboratories. Designed in the form of modular components, these Soviet space stations can be assembled in various configurations and are capable of autonomous operation. Once deployed, the Pentagon suggests, these space stations will "provide the Soviets with a manned space-based military capability for such missions as reconnaissance, command and control, ASAT, and ballistic missile defense support operations."

The new intelligence assessment emphasizes that the Soviets realize that "men in space can significantly contribute to military operations. Soviet cosmonauts aboard a space station can observe large areas of the earth's surface and transmit real-time information to military forces below." With the help of advanced optical devices, military cosmonauts could monitor and report on the status of airfields, port facilities, major transportation routes, and the location and course of ships at sea.

Reorganization of Theater Forces

Under Soviet doctrine, control of theater operations rests with the Soviet Supreme High Command (VGK) and involves, in a flexible manner, major elements of all five of the USSR's military branches—that is, ground, naval, air, air defense, and Strategic Rocket Forces. Operational responsibility within a given theater devolves to a "High Command of Forces," which would be in charge of several "Fronts," strategic air defenses, any strategic air army and airborne elements allocated by the VGK, and, if applicable, a naval fleet. The "Front," in turn, is the basic combined-arms component of theater forces responsible for land operations.

At the theater level, which is known by the Russian acronym TVD, a significant restructuring occurred recently, according to the new Pentagon report: "In 1985, the Soviets began activating peacetime High Commands within the TVDs, with high-ranking officers appointed as permanent commanders in chief (CINCs). This increased the readiness of Soviet forces by moving the peacetime command structure much closer to the wartime mode. Marshal N. V. Ogarkov, the former Chief of the Soviet General Staff, is believed to have been appointed head of the crucial Western TVD oriented against NATO's Central Region."

There is evidence also of increased Soviet concern with the optimized use of airpower. Under nonnuclear conditions, the Soviets intend to rely on the mass employment of aviation forces in place of an initial nuclear strike. Such an operation would be performed simultaneously within the sectors of several fronts in order to gain air superiority and to destroy or weaken the enemy's air and nuclear resources. Air operations of this type are being treated as a crucial component of theater strategic operations and seem to be increasing in prominence in Soviet military literature.

New US intelligence assessments suggest that aviation assets, nuclear weapons, air defenses, and command and control facilities would be the principal targets of Soviet theater air operations. The Soviets apparently plan on an initial round of air operations lasting three or more days and involving from three to seven mass strikes over the period. Two or three mass strikes would occur on the first day, with the objective of destroying the enemy's tactical nuclear capabilities, disrupting any coordinated defense, and assuring air superiority. One or two mass strikes would—as needed—follow on subsequent days.

After completion of these massive strikes, Soviet tactical ground attack airpower would probably break up into small and large "strike packages." The former would typically be made up of between two and four aircraft flying close support missions for ground troops, defense suppression, and, possibly, reconnaissance missions. Large strike packages—on the order of fifty to 100 aircraft—would conduct major strike missions against nuclear storage depots, airfields, C^3 facilities, ports, rear area logistics, and support bases. All Soviet air operations would occur as part of combined-arms operations that would be tightly planned and closely coordinated.

Soviet Military Transport Aviation, or VTA, would be an integral element of theater combined-arms operations. VTA's primary missions appear to be paradrops and the landing of combat troops as well as logistics resupply of all forces in the theater, as needed. Among other specific VTA missions are rapid reinforcement and resupply, nuclear weapons resupply, and medical evacuation. Geography probably facilitates the mission of VTA and the mobilized elements of Aeroflot, the Soviet state airline, since they can count on massive backup from the Soviet rail and highway transportation networks. All Eurasian TVDs are within reach of these ground-based transportation networks, and VTA, combined with Aeroflot, controls sufficient aircraft to meet air-dependent surge and resupply missions.

Chemical Warfare

In addition to broad reliance on theater nuclear forces and their employment in a massed, coordinated fashion if victory by conventional means is in jeopardy, Soviet military dogma appears to allow for the rapid use of chemical weapons by combat commanders, once general approval for their employment has been granted by senior authorities. The Soviet military's emphasis on chemical warfare, according to the Pentagon's latest estimate, can be traced to the mid-1920s, when they opened the Shikhany Chemical Warfare Proving Ground. This facility, vastly expanded and modernized, remains the USSR's premier chemical warfare establishment.

There is also evidence that Soviet chemical warfare know-how profited from German CW stockpiles and production facilities captured toward the end of World War II. Nazi plants producing such nerve agents as tabun, sarin, and soman were dismantled and moved to

the Soviet Union, where they became the catalyst for today's proliferation of Soviet chemical weaponry.

According to *Soviet Military Power,* Moscow's chemical warfare arsenal includes nerve agents, blister agents, blood agents, choking agents, and an agent that US intelligence has not yet been able to identify fully, other than to establish that it can cause unconsciousness for an hour or more. This weapon is being tested in Afghanistan. In a step beyond chemical weaponry, the Soviets reportedly are working on radio-frequency weapons, which can also put combat troops out of commission on a temporary basis.

According to the latest Pentagon assessment, almost all Soviet conventional weapon systems, from mortars to long-range tactical missiles, are mated to compatible chemical ammunition or warheads that are available to land, air, and naval forces. Further, the Soviets have also developed the firing data required for employing chemical weapons under various battlefield scenarios. This data base includes information on the types and numbers of weapons required to attack different targets under various weather and combat conditions.

The Soviets are reportedly testing new CW systems with improved dissemination characteristics, larger payloads, increased range, and better accuracy, all leading to greater target flexibility. Two types of chemical warheads have just entered the inventory for use by tactical missiles—bulk agents and small bomblets optimized for area coverage.

All chemical warfare activities in the Soviet armed forces are carried out by specially trained troops directed by the Headquarters of Chemical Troops in the Ministry of Defense. This organization is headed by a three-star general officer and—in terms of ground forces alone—comprises more than 45,000 troops. During wartime, the size of this cadre of CW specialists is expected to double.

Chemical warfare is an integral part of Soviet combined-arms operations. Pictured is an Mi-24 Hind fitted for CW.

Soviet Support of Terrorism

The new *Soviet Military Power* charges that—public disavowals by the Kremlin of involvement in terrorist movements notwithstanding—the Soviet leadership "is not averse to creating and exploiting opportunities for covert support to terrorists and insurgents."

Soviet subversive activities are orchestrated by the Communist Party Central Committee's International Department. The Pentagon document reported that Soviet support to terrorism involves the intelligence and security services—specifically, Department 8, Directorate S, of the KGB's First Chief Directorate and the GRU's "Special Branch" and "Special Center." Additional aid to terrorists comes from other elements of the Soviet state apparatus, such as diplomatic, economic, and cultural missions abroad.

Terrorist training activities are carried out by the International Department in conjunction with the KGB and GRU, according to the Pentagon intelligence report: "Complementing this apparatus are similar organizations in East European states and Cuba. Other countries and groups with regional objectives that have mutual interests with the Soviets in destabilizing Western-oriented regimes also receive Soviet support." Singling out Libya and South Yemen from among the latter category, the US intelligence assessment finds that these surrogates "harbor, train, and equip selected terrorist groups, sometimes in cooperation with the Soviets, but often for their own purposes."

Soviet support of terrorism doesn't come cheap: "The Soviets spend large amounts of money" training potential terrorists. "Instruction in guerrilla warfare, sabotage, assassination, terror, and espionage occurs at special Soviet training facilities and camps near Moscow and along the southern Soviet border." Moscow's support "for terrorist training camps in South Yemen, Libya, Iraq, and Lebanon has been the clearest evidence of substantial Soviet investment in terrorism in the Middle East," according to the new edition of *Soviet Military Power.* The document predicts that "Soviet support for revolutionary violence and international terrorism [will] continue and perhaps escalate as a means of challenging the West."

Mr. Casey concluded in his congressional briefing that "the USSR and its Eastern European allies support a host of Near East and other Third World terrorist groups." He added that "the Eastern European hand is the more pronounced, [while] the Soviet hand is more disguised." This Soviet propensity for directly or indirectly fostering terrorism, combined with the growing Soviet global reach and expanding military infrastructure, "confronts the US with rising challenges for the future," he reported. ■

Portugal has come through a dangerous time. And now that Spain has decided to stay in NATO, the Iberian peninsula should take on greater importance in Alliance plans.

Airpower in Iberia

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

Spain has ordered seventy-five McDonnell Douglas EF-18A Hornets to upgrade its Air Force. This is the first EF-18 being put through its paces near the McDonnell Douglas plant in St. Louis, Mo.

THIS past January, Spain formally recognized the existence of Israel, possibly a sign of the waning power of OPEC. More likely, this establishment of diplomatic relations was just one more indication of Spain's emergence into Europe's mainstream. *The Economist* headlined the diplomatic breakthrough with "Shalom, Amigo," but the event itself was played at a decidedly low key, for Spanish ties with the Arab world remain strong. During his long hold on Spain, General Francisco Franco cultivated Arab friendships and made a particular point of ignoring Israel on the diplomatic front. At that time, Spanish emissaries invariably bypassed the Jewish nation on their junkets to the Mideast. At any rate, the recognition is now there, putting both ends of the Mediterranean in official touch.

A more important indication of Spain's entry into the European world has been its tentative NATO membership. For the thirty-six years of Franco's rule, Spain was an anathema to the northern European allies—except, that is, at vacation time, when hordes of Scandinavians, Dutch, and British set aside their disapproval in exchange for a bit of Franco's sun. The question of Spanish membership in NATO was raised by the US in the NATO Military Committee from time to time, only to be met with an embarrassed silence. It was left to the United States to exploit Spain's strategic location.

The US bases at Zaragoza, Torrejon, and Morón de la Frontera were built in the 1950s as forward locations for the Strategic Air Command's short-legged bomber of that era, the B-47. Those were the days of the bigger bang for a buck and, hence, SAC's unquestioned primacy in the budget. Accordingly, the Spanish bases were built to a high and comfortable standard. The naval and air base at Rota, near Gibraltar, with Polaris submarines in mind, shared in the prosperity.

In time, the B-47 was phased out, and SAC no longer needed the Spanish bases. The way things turned out, it was just as well. In January 1966, above the town of Palomares about 200 miles south of Madrid, there was a midair collision between a B-52 and a KC-135. Four thermonuclear bombs spilled onto the coastal area. Three were recovered, but the fourth was not found.

The search for the missing bomb involved a thousand Spanish and US troops, units from the Sixth Fleet, and a bathysphere piloted by Charles Lindbergh's son, Jon, all carried out under the fascinated gaze of the world's press. In April, when the bomb was at last discovered deep in the sea off the Spanish coast, fear of nuclear contamination was great. Although there was little sign of radiation, the United States undertook a massive cleanup in an attempt at reassurance. Using that mishap as justification, Spain has since forbidden nuclear overflights and nuclear storage in general. The Navy's Poseidon submarines were the last of the US atomic presence, and they have long since left Rota for Scotland.

With SAC's departure, Zaragoza and Morón lapsed into caretaker status. Torrejon, on Madrid's outskirts, became a hub for military airlift activities in the Mediterranean. In the late 1960s, a combination of domestic upheaval, NATO obligations, and available space at Torrejon led to the deployment of a fighter wing to that base. Gen. Gabriel P. Disosway, Commander of Tactical Air Command, reasoned that frequent deployment of fighter pilots to Italy and Turkey would seem less onerous to the families involved if the pilots were based in Spain. And so TAC gave up a fighter wing to US Air Forces in Europe for purely altruistic reasons. Strategic justification for the move would come along later.

When Col. Muammar Qaddafi, with his erratic, anti-American government, arrived on the scene, we lost the base in Libya, Wheelus, which had been the principal fighter weapons training facility for USAF in Europe. Zaragoza, in northern Spain, seemed a logical substitute, and it has filled that role ever since. Morón, in the south, serves a US communications role.

One way or another, then, the Spanish bases have continued to be very useful, if for different purposes than originally intended. They have also served the Spanish well. Morón and Torrejon have Spanish Air Force fighter wings, and Zaragoza will shortly receive two squadrons of EF-18s, the Spanish designation for the McDonnell Douglas F/A-18.

Well Up to NATO Standards

By any measure, the Spanish Air Force is fast becoming a thoroughly modern and progressive outfit. The EF-18A buy has been reduced for the usual budgetary reasons from the original figure to seventy-five, but seventy-five EF-18As will still be a respectable force, one that NATO covets. For that matter, the remainder of the SAF is well up to NATO standards in both equipment and training. Even the accepted practice, during Franco's time, of moonlighting by officers to make ends meet has been stopped. Pay is now considered sufficient to justify a day's work.

Like their colleagues in the Navy (also a progressive organization), Spanish Air Force officers seem unreservedly in favor of NATO membership. The Army, traditionally inclined to see Spain's threat on the next street corner rather than in another land, is evidently not so keen. Even there, however, with retirements making room for younger men, attitudes are changing.

When Felipe Gonzalez Marquez became a challenger for the job of prime minister in 1982, he probably did not expect to win. Accordingly, in the traditional manner of long shots, he made some extravagant promises. He said that, if elected, he would create 800,000 jobs and carry out a Socialist program for the economy. Gonzalez also made a politically shrewd, if irresponsible, appeal to Spain's deep-rooted xenophobia by declaring that he would hold a popular referendum on the question of NATO membership. On the basis of this platform, or perhaps because of his charisma, Gonzalez won.

The newly installed prime minister immediately began to backtrack on his electioneering promises. Once in office, the Socialist politician became the responsible and conservative leader. He particularly wanted the electorate to forget his anti-NATO stand and the promise of a referendum. Spain, however, has a Communist Party, so there wasn't a chance of that. Communists oppose NATO as an article of faith, and they helped keep the referendum issue alive. In passing, it is interesting to recall Khrushchev's malevolent warning in 1957 that should Spain join NATO, it would lay itself open to nuclear attack. Echoes of that threat had something to do with the passionate demonstrations in February calling for Spain's withdrawal from the Alliance.

Public opinion seemed to be running against NATO right up to the day of the referendum, but in the end, the vote was positive and decisive. The problem now facing Spain and NATO is the promise made by Señor Gonzalez while campaigning in the interests of his pro-NATO stand. If the vote was favorable, he said, Spain would stick to its nonintegrated position. In other words, Spain will be, like France, a NATO ally on a selective basis, a la carte.

Many Spanish military officers, particularly in the air force and navy, were outraged at this referendum caveat. Whether they meant it or not, some even went so far as to say that withdrawal from NATO was preferable to this nonintegrated status.

Much of the difficulty caused by the integration question stems from public ignorance of what it means in the NATO context. The Gonzalez government spent millions of dollars on its campaign to save Spain's NATO membership, but the matter of military integration was never clearly explained. Instead, the government simply promised that Spain would remain detached from NATO's military apparatus.

Half-Membership Is Awkward

The penalties for this sort of half-membership are onerous, if not severe. No NATO infrastructure funds, for instance, will be available for Spanish facilities. Spanish forces will not formally engage in NATO exercises, although the air force and navy will doubtless continue to work with US and other allied services. So long as Spain remains outside the NATO military structure, no allied command or staff positions will be open to Spanish officers. In other words, they will be denied much of the NATO camaraderie and broadening experience. However, one step at a time is sufficient. Spain stayed in NATO against all odds. There will be time enough later to improve its status.

The Alliance will have to wait some months, and maybe years, before it is confident of Spain's affections. Certainly, its present bystander status is an inconvenience, just as it is in the case of France, but it is better than nothing at all. In time, Spain will probably come in all the way if the Spanish people are finally convinced of the real advantages of full NATO membership.

Aside from those diehards who still see the enemy within, the Spanish military considers North Africa the potential threat. Spain has retained its two enclaves—Ceuta and Melilla—on the Moroccan coast. Most Spanish professional military men seem to have served in those places or even to have been born there. For whatever reason, the attachment to Ceuta and Melilla is strong, and Morocco has a roving eye in that direction.

In all probability, shooting will not break out so long as Hassan is King of Morocco, but the Spanish don't intend to be caught unprepared; the garrison at these outposts numbers 19,000. Besides, North Africa is a volatile region these days. Islam is on the rise, and there has been more than one attempt to end Hassan's life. In a conflict involving Spain on the African continent, NATO would surely look the other way, even though Ceuta and Melilla are considered, by Spain at least, to be integral parts of the country itself. Otherwise, Spanish emphasis on a threat from the south should meet with NATO approval—providing, of course, that the threat comes to NATO, not the other way around. If Spain one day joins the military structure, NATO strategy will have to take into account the Canary Islands. This, in turn, should create an attractive post for some future Spanish admiral.

Now that the NATO question has finally been resolved, the Spanish-US relationship should continue on a solid footing. Even the agitation about the American bases seems to be mainly for effect, although, having gone this far with the propaganda, the government may insist on some reductions in base population. According to people who should know but understandably don't wish to be quoted, Spain wants a continued US presence on those bases. In the best of all worlds, it would like to see the F-16 wing at Torrejon—the 401st TFW—move to Morón, where the US could then invest in some new facilities. Military airlift operations would remain at Torrejon, where they are a great convenience to the Spanish themselves.

Failing that solution, US willingness to foot the bill for improvements in Combat Grande, the air defense system, might quiet talk of base evacuations. The bill for this *quid pro quo* could run about $400 million.

Unquestionably, the Spanish do feel we owe them a generous gesture in return for their EF-18A purchase and our long and close association. They were disappointed when USAF rejected the Aviocar intratheater transport in favor of the British entry, the C-23A Sherpa. Construcciones Aeronautícas SA (CASA), the company that designed and builds the Aviocar, is proud of its airplane. The competition, however, was an honest one, according to all reports, and the final choice, contrary to some Spanish opinion, had nothing to do with the affectionate relationship between British Prime Minister Thatcher and President Reagan.

Notwithstanding that small setback, CASA does substantial US component work and has a coproduction agreement on the EF-18A, thanks to its minority stockholders, Northrop and McDonnell Douglas. Beyond that, CASA overhauls F-4s for the SAF and USAFE. Spain has, in CASA, a sophisticated engineering and production capability. The new consortium formed to produce the next-generation European fighter includes Spain, along with Italy, the Federal Republic of Germany, and the United Kingdom—one more reason for Spain to stay in NATO, for it is unlikely that the consortium would include a non-ally.

Divisions and Dissent

The political evolution of these past eleven years has taken place under the disapproving gaze of the Franco old guard. In 1981, this disapproval took the form of an attempted active revolt. Lieutenant Colonel Antonio Tejero, an officer of the Guardia Civil, held the Cortes—the legislature—at bay with machine guns. It was supposed to be the start of a military coup designed to put a halt to the increasingly liberal trend, as certain generals saw it, of Spain's government. King Juan Carlos, a constitutional monarch, had, and still has, enormous prestige. He placed that prestige on the line by opposing the rebellious generals, and the revolt collapsed. It was a turning point in Spain's post-Franco history.

Felipe Gonzalez, the Socialist premier with conservative instincts, has trimmed the power of the army's

Business is thriving for CASA, Spain's domestic aircraft manufacturer, as the company is involved with EF-18 coproduction and is marketing its C-212 Aviocar transport. This CASA C-101 two-seat trainer is coming in for a landing at the 1985 Paris Air Show.

provincial governors. They are now simply regional military commanders, a status that has distanced the army from politics. Gonzalez, although somewhat distrusted by the older military men, is admired, if grudgingly, by most of the officer corps. Not only has he procured modern equipment, particularly for the air force and navy, but he has made great improvements in the military pay structure. Gonzalez's latter-day enthusiasm for NATO may come in part from a desire to turn his generals' thoughts away from internal matters, but he is nonetheless a supporter of a new and more interesting role for the Spanish forces.

For all its seemingly ethnic homogeneity, Spain has its divisions. The north is industrial and relatively well off, while the south is arid and poor. Then there is the continuing problem with the Basque separatist movement ETA, a terrorist organization involved in the periodic murder of government officials. Catalonia has clung to its language, as have the Basques, in spite of Franco's attempts to make Castilian the universal language of Spain. The Basques, Catalans, and Galicians have been given autonomy, a status that seems to satisfy all except those diehard Basques who still insist on an independent state and who will presumably continue their terrorist actions.

The long rows of concrete barracks along the Costa del Sol are signs of a tourism developed without thought to the outcome. One unhappy result has been a growing reputation for hooliganism and violent crime on the part of the natives, who perhaps resent this mass intrusion of indolent and affluent foreigners. From various vantage points along that coast, another resented symbol of foreign intrusion, Gibraltar, is visible in the distance, no longer forbidden territory for travelers from Spain. The gate on the Spanish side was locked by General Franco in 1969 in protest against its status as a British colony. Felipe Gonzalez unlocked the gate last year, once more allowing free access to the Rock.

Nevertheless, Gibraltar remains an affront to Spanish nationalists, one that has existed since the British took charge in 1704. Full Spanish membership in NATO might ease the way for some sort of Spanish presence on Gibraltar, but that now seems a long way off. In the meantime, there are too many other pressing matters to be dealt with for Gibraltar to become the sort of fixation for the Spanish that led the Argentineans to undertake their ill-advised Falklands crusade. Twenty percent unemployment is a serious worry, and there are indications, such as the newly installed value-added tax, that membership in the European Community may not be without some pain.

As for anti-Americanism, it doubtless exists, but so it does everywhere. Whether this sentiment is very deep probably depends on where one looks. Certainly, it is not evident among those with whom our military people associate or in the everyday encounters with the populace at large.

Nevertheless, there is unquestionably a certain amount of resentment over the long-term US military presence. Felipe Gonzalez Marquez promised a reduction in that presence in return for a favorable referendum. It now remains to be seen how severe a reduction he has in mind and where it will fall.

Recovering from Bad Luck

Although Portugal is one of the most attractive coun-

tries in Europe, it is also among the poorest, a paradox explainable in part by luck. In Portugal's case, the luck these past fifty years has been mostly bad.

From the early 1930s until 1974, the country endured the Mussolini-like rule of Dr. Antonio de Oliveira Salazar and his successor, Marcelo Caetano. Following World War II, Salazar resisted the trend against colonialism. As a result, Angola and Mozambique—then Portuguese colonies—were plunged into civil war, occupying the full attention of Portugal's armed forces. From a military standpoint, the Portuguese were never in danger of losing, but they were bucking the tide of world opinion. During that period, Portugal's role in NATO was principally that of an observer, for there was nothing left over for European defense.

On April 25, 1974, an almost bloodless revolution—three bystanders were accidentally killed—resulted in the ouster of the Caetano government and the end of the African struggle. The revolutionaries were young military officers who promptly set the country on a Marxist course, nationalizing industries and banks. The already shaky economy began to come apart, including even the tourist industry, with its sunny golf resorts in the southern Algarve.

In the spring of 1976, when the Communist takeover was halted by a popular election, Portugal was on the ropes. Almost a million refugees from the former African colonies had arrived to complicate an already serious unemployment situation, one that had sent another million native Portuguese to northern Europe in search of work, any kind of work.

The Spanish navy has also upgraded its air arm over the last decade and now flies close to a dozen AV-8A Matadors. Another twelve advanced AV-8Bs are on order.

Those were desperate times for the only country ever to remove a Communist government from power by peaceful and democratic means. The Portuguese Communist Party had spent years plotting for the revolution and had heavily infiltrated the armed forces. It was bitterly disappointed by the setback. Like Communists everywhere, those in Portugal did not lose gracefully, and they have not given up yet.

The runoff in February for the presidential election was proof of that. Mario Soares, a Socialist and former premier, was opposed by a conservative candidate, Freitas do Amaral. The first time around, Freitas missed a clear majority by five percentage points, while Soares scarcely managed thirty-six percent of the vote. The Communists detest Soares because of his previous strong stand against them, but they detest Freitas do Amaral even more. Accordingly, the leadership of the PCP urged the faithful to turn out for Mario Soares, which they obviously did, for Soares edged out Freitas do Amaral to become president.

While the United States and the allies would have preferred a conservative victory, this election should not have any great significance. Communists can expect nothing in the way of gratitude from President Soares, and the presidency itself is not, inherently, a powerful post. The election was notable mostly for its considerable production of graffiti and the high-decibel loudspeaker vehicles that cruised every available street. Nothing much will change in Portugal's immediate future.

The drama of the revolution and of the counterrevolution has left Portugal a surprisingly tranquil land. As is true in all countries these days, there are occasional mindless acts of terrorism, but not on the scale one finds in Spain. African refugees, many of whom had never before seen Portugal, have settled into the scene with only a few wistful glances toward the good old days in Angola. The once great Portuguese empire has now been reduced to the Azores, the islands of Madeira, and, at Chinese sufferance, Macao.

Terceira, one of the volcanic islands in the Azores group, is probably Portugal's most important strategic asset. Ever since World War II, the Lajes base on Terceira has been useful to the United States—at times, even essential to our military activities. Before jets turned the Atlantic Ocean into a pond, Lajes was a routine refueling stop for military transports. Today, it serves as an almost irreplaceable base for antisubmarine patrol and an ideally situated location for tankers supporting various operations.

Searching for a Mission

Back on the mainland, the Portuguese armed forces are much smaller in size than they were during the colonial wars. In addition, they are somewhat in want of a mission.

When the Communists were turned out of office, Portugal's NATO allies gave a huge sigh of relief. On the face of it, a Communist NATO ally is unthinkable. And while NATO never reached the point of discussing Portugal's expulsion, steps were taken to exclude its envoys from certain classified matters. Thus, when reliable men returned to power in Lisbon, the joy in Brussels was great. In the euphoria of the moment, promises of help were

The backbone of the Portuguese Air Force's combat fleet is the A-7P Corsair. While the PAF is very good, it lacks a meaningful mission.

made so that Portugal might play a more important role in European defense.

Ten years have passed, and not much has happened. A Portuguese rear admiral commands IBERLANT, the NATO headquarters for minor naval activity in Iberian Atlantic waters, and a Portuguese Army brigade is earmarked for duty in Italy, if NATO ever mobilizes. A shortage of airlift inhibits that mission. There is also a need for more modern equipment, something the grateful allies of 1976 have been a little slow in providing.

The Portuguese Air Force came through the revolutionary period with a reputation as the best disciplined and best led of the country's forces. For a small and impoverished nation, the PAF is remarkable. The depot and maintenance operation at Alverca, about an hour's drive from Lisbon, is first class by anyone's standards. Supply is patterned after the USAF system, with computers and automated stock chasing. Across the runway—which can take a C-5—the maintenance and overhaul facility can do sophisticated work, including the manufacture of small aircraft. A modern jet engine facility allows for the overhaul and testing of both turboprop and turbojet engines. In short, the Portuguese Air Force has brains, leadership, and skills. What is lacking is a meaningful mission.

Some years ago, the PAF Chief of Staff, General Llemos Ferreira, managed to pry forty-eight A-7s out of the US Military Assistance Program. These were early model US Navy birds and hence do not have the performance of the later models of the A-7, but they do give the PAF a fairly modern airplane with an accurate weapon system. The trouble is that a more logical mission for the PAF would be offshore air defense, to include routine interception and identification. A-7s are not suited to that job, and so a true NATO role remains obscure.

Portugal has come through a dangerous time. Now that Spain has voted for staying in NATO, the Iberian peninsula should begin to play an important part in NATO plans. If that happens, perhaps ways will be found to make better use of Portugal's military potential. Passing on hand-me-down weapons simply because they are available is a questionable solution.

General Llemos Ferreira, a perceptive and hardworking man, is now Portugal's senior military officer. He says, a trifle wistfully, that the United States sometimes takes Portugal for granted. He is probably thinking of our long, almost proprietary use of the Lajes base in the Azores. But it may be that he is thinking of the well-trained and disciplined Portuguese Air Force he worked so hard to maintain during the unsettled years of the revolution. A useful mission for that air force, even perhaps something in the training line, such as manning an aggressor force, would prove mutually rewarding. The Portuguese clearly want an active part in European security, not just the provision of real estate. ■

Gen. T. R. Milton, USAF (Ret.), is a longtime Contributing Editor to this magazine. His forty-year military career included combat service with Eighth Air Force in World War II, participation in the Berlin Airlift, command of Thirteenth Air Force in the Philippines, service as Air Force Inspector General and USAF Comptroller, and duty as the US Representative to the NATO Military Committee. He retired from active duty in 1974 and makes his home in Colorado Springs, Colo. His latest feature contribution to AIR FORCE *Magazine was "Israel's First Line of Defense," which appeared in the May '86 issue.*

The annual ball honors General Gabriel and heads for higher levels in charity fund raising.

Iron Gate's Second

THE Air Force Chief of Staff, Gen. Charles A. Gabriel, who will retire this month, received the highest honor bestowed by AFA's New York City Iron Gate Chapter when the Chapter played host in early April to the twenty-third annual national Air Force Salute.

General Gabriel accepted the Chapter's Maxwell A. Kriendler Memorial Award from Chapter President Denis R. Brown during a ceremony that honored General Gabriel's "dedicated and devoted service to our nation and to the men and women of the United States Air Force." The award citation saluted General Gabriel's "combat skills and expertise" and his "staunch ad-

—Photo by Sid Birns

USAF Chief of Staff Gen. Charles A. Gabriel received the Iron Gate Chapter's Maxwell A. Kriendler Memorial Award from Chapter President Denis R. Brown, left. Assisting President Brown in making the award is the late Mr. Kriendler's nephew, Sheldon Tannen, right.

Million

vocacy of the Total Force concept and his support of joint and international military activities."

The Salute, one of the premier fund raisers for Air Force-related charities, is well into raising its second million dollars. The money raised is distributed among the Air Force Assistance Fund, the Falcon Foundation, the Air Force Historical Foundation, the Air Force Museum, the National Aviation Hall of Fame, and AFA's own Aerospace Education Foundation (AEF). Proceeds are also earmarked for Chapter awards and scholarships for the Air Force Academy and the Civil Air Patrol.

The Chapter also continued its tradition of sponsoring AEF Jimmy Doolittle and Ira Eaker Fellowships. With 109 Fellowships to its credit, the Chapter is the leading sponsor of Jimmy Doolittle Fellows. Sen. Barry Goldwater (R-Ariz.), AEF Chairman of the Board and also an Iron Gate Chapter member, presented a Jimmy Doolittle Fellowship to Thomas J. McKee, who has served as Chairman of the last three annual Iron Gate Salutes.

Salute guests receiving Ira C. Eaker Fellowships included Brig. Gen. Robinson Risner, USAF (Ret.), a Korean War jet ace and former POW in both Korea and Vietnam; Maj. Gen. Gerald L. Prather, Commander of Air Force Communications Command; and then-Under Secretary of the Air Force Edward C. "Pete" Aldridge, Jr.

The record crowd of more than 1,100 was entertained by an act celebrating its sixtieth year in show business—John and Donald Mills of the Mills Brothers. Their rendition of "Paper Doll," a song that sold millions of records during the 1940s, was a highlight of an evening of good fellowship and AFA charitable spirit.

Next year's Air Force Salute will take place in New York City on the evening of Saturday, April 4.

—BY JAMES A. MCDONNELL, JR.
MILITARY RELATIONS EDITOR

—Photo by Sid Birns

A variety of Air Force-related charities benefits from the proceeds of the Salute. Among those attending the twenty-third National Salute were, from left, then-Air Force Secretary Russell A. Rourke, Air Force Chief of Staff Gen. Charles A. Gabriel, Salute Coordinator Dorothy Welker, AEF Board Chairman and Iron Gate member Sen. Barry Goldwater, Salute Chairman Tom McKee, and Salute Foundation Chairman Fred Glass.

VIEWPOINT

Remembering 'Hap' Arnold

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

This year marks the centennial of the birth of the man who transformed the insignificant Army Air Corps of the 1930s into World War II's mighty AAF and today's USAF. A lesser man than Gen. H. H. "Hap" Arnold could never have done it.

The last time I saw General Arnold, we were still very much at war. He came to our base at Bassingbourn in the English Midlands shortly after D-Day, in the glittering company of Generals Marshall and Doolittle. We gathered around the great men, awestruck by the sight of so many stars. Suddenly, with that remarkable facility he had for faces and names, Arnold spotted me, called me by a childhood diminutive, and gave me an order. "Take the Chief down to the ramp," he said, "and show him an airplane." The Chief was General of the Army George C. Marshall, and I was, I'm afraid, only barely coherent.

That little episode had its roots in Fort Riley, Kan., many years before. When the dust had settled after the court-martial of Billy Mitchell, Arnold continued to be an outspoken and unregenerate Mitchell disciple. His posting to Fort Riley as Commander of the 16th Observation Squadron was viewed widely as exile and probable professional oblivion for the ambitious airman.

Fort Riley in 1927 was, arguably, the best place in the world for an eleven-year-old boy. There were endless miles of virgin land to explore on horseback, rivers full of catfish, and an infinite number of ways to get into interesting mischief. During those twilight years of the horse cavalry, Riley remained the cavalryman's mecca, the place where he could earn a graduate degree in horsemanship and other allied arts.

The Regular Army in those days was a small, neglected, and poorly paid force on the territorial model, but the cavalry had a fierce pride, coupled with a tolerant condescension toward the dismounted branches. As for the Air Corps, most cavalrymen were scarcely aware of it—beyond the certainty that it was not to be taken seriously.

The Arnold family moved into quarters along Forsythe Avenue, a leafy little street lined with old limestone duplexes and just a short walk from the commanding general's house. The occupant of that house was Brig. Gen. Ewing Booth—a poor omen, for Booth had been a member of Mitchell's court-martial. However, the cavalry general made it clear that Arnold was welcome.

Maj. Jonathan Wainwright lived another few houses away, and Capt. Lucian Truscott just up the street—famous names later on, but at that time simply the Master of Foxhounds and a good polo player. There were also a few Army brats, like George Brown and Bruce Palmer, who would be heard of in the years to come.

Anyhow, Hap Arnold decided that Fort Riley was no exile—it was, instead, a challenge. He set up an air observer course for the Cavalry School, and the horse soldiers, including my father, took to it with enthusiasm. For the first time, they began to see the world through an aviator's eyes and realized, however grudgingly, that the airplane might have a variety of military uses. Although Arnold's planes were antiquated open-cockpit DH-4s left over from World War I, he began to get his message across.

As the years went on, Arnold rose to become Chief of the Air Corps. When I graduated from West Point and chose a try at his branch of the Army, I was summoned to report, one Sunday afternoon, to General Arnold's house. He wanted to know, at the grass-roots level, why the Air Corps had declined in popularity among Academy cadets. My answer was a simple one, and it infuriated him. The Air Corps had given us a boring and unpleasant time of it during our week of indoctrination at Mitchel Field. Letting out his breath with that slight hissing sound he made when angry, Arnold said that was the last time that would happen.

The legends have it that Hap Arnold was often angry and that he could also be unreasonable. Maybe so. Only an angry and an occasionally unreasonable man could have pulled off the miracle that transformed the insignificant Army Air Corps of the 1930s into the US Army Air Forces of World War II and thus, into the United States Air Force of today. A more compliant man, one without Arnold's streak of rebelliousness, could never have pulled it off.

He had, as have all great military men, a precise sense of when to be disobedient. Admiral Nelson had it, and Stonewall Jackson had it. General Paulus, by obeying a lunatic order to stay in Stalingrad, demonstrated that he did not. Arnold's battles may have been fought in the bureaucratic arena, but they were fierce battles nonetheless.

If he had lived, Hap Arnold would be 100 years old this month. He never came close, of course. The struggle to build his Air Force took its toll on his heart long before that.

I remember, shortly before the visit he made to Bassingbourn, being summoned along with a lot of others to a meeting with General Spaatz. Arnold's old friend looked us over and then told us of the impending arrival of the boss. General Arnold, he said, would want to know what was wrong and what we needed. The purpose of the meeting was to let us know that nothing was wrong and that nothing was needed. The old man, Spaatz said, had ruined his heart in getting us everything we had. Now we should pay him back by making him happy. And so we did.

There is one final memory of Hap Arnold that somehow seems closer than the rest. We are back at Fort Riley again; two twelve-year-old boys stand by Major Arnold and look longingly at an airplane about to taxi. One of the boys voices a wish, and without further formality, the two are hoisted aboard. Like many things Hap Arnold did, this one was both impetuous and against the rules. But if he had in mind making an early convert, he succeeded. ■

LEADING BY EXAMPLE.

In the race to develop the Advanced Tactical Fighter, Grumman is already flying.

Our X-29 is presently demonstrating eight technologies integrated to reduce ATF risk.

The X-29 is more than mere theory. It's an operable approach to developing a fighter that's reliable. Maintainable. Producible. Supportable.

And affordable.

Grumman Aircraft Systems,
Bethpage, Long Island, NY 11714.

Only GRUMMAN

GRUMMAN®

® A registered trademark of Grumman Corporation

SINGER/KEARFOTT

OPENING NEW DIMENSIONS.

JTIDS IS FLYING IN F-15s.

The Singer Company, with its team member Rockwell-Collins, has delivered over 40 Class 2 terminals to the U.S. Air Force, Army, and the U.K. MOD. DT/OT testing is in progress at Eglin Air Force Base.

MAKING AIR DEFENSE ARTILLERY MORE EFFECTIVE.

With its capability of identifying friendly and hostile ground and air forces, JTIDS gives fire units like the Chaparral launcher and the Stinger greater efficiency. Once again, Singer/Kearfott opens new dimensions in C^3I.

ONE HAND KNOWS WHAT THE OTHERS ARE DOING.

JTIDS provides secure, high capacity, jam-resistant data and voice communications, including relative navigation for tactical command and control. JTIDS achieves interoperability and commonality of equipment among the U.S. and NATO surface and air forces.

The Singer Company/Kearfott Division, 1150 McBride Ave., Little Falls, NJ 07424

SINGER

JANE'S

ALL THE WORLD'S AIRCRAFT SUPPLEMENT

JUNE 1986

MiG-31 'Foxhound', judged by DoD to be the most capable Soviet air defence interceptor *(Royal Norwegian Air Force)*

MiG

MIKOYAN DESIGN BUREAU: USSR

Confirmation that the Mikoyan design team was developing an improved interceptor based on the general configuration of the MiG-25 (NATO 'Foxbat') came first from Lt Viktor Belenko, the Soviet pilot who defected to Japan in a 'Foxbat-A' in September 1976. He said that the airframe of the new fighter was strengthened to permit supersonic flight at low altitude; more powerful engines were fitted, each giving 137.3 kN (30,865 lb st) with afterburning; the avionics were improved; and fuselage mountings had been added to enable the aircraft to carry six air-to-air missiles.

In mid-1982 it became known that NATO had allocated the reporting name 'Foxhound' to what the technical press referred to as 'Super Foxbat'. A three-view drawing was displayed publicly for the first time in September of the following year, during briefings at the annual AFA Convention in Washington D. C., enabling 'Foxhound' to be illustrated in the Addenda to the 1983–84 *Jane's*. The drawing showed significant new features, including tandem seating for a two-man crew, much enlarged engine air intakes, rearward extension of the jet nozzles, and wingroot leading-edge extensions on wings that were little changed from those of the MiG-25.

Two more years were to pass before the general accuracy of the 1983 drawings could be accepted. One day in the Autumn of 1985, an F-16 of the Royal Norwegian Air Force took off to investigate an unidentified radar sighting off the coast of eastern Finnmark in northern Norway. Its pilot was probably surprised to discover that his quarry was a 'Foxhound', and that the Soviet aircrew seemed quite content to fly straight and level while the F-16 pilot photographed the MiG from all convenient angles. Some of the results accompany this entry.

MIKOYAN MiG-31

NATO reporting name: Foxhound

Addressing a national military electronics symposium of the AFA in 1985, Donald C. Latham, US Assistant Secretary of Defense for Command Con-

trol Communications and Intelligence (C^3I), said that the MiG-31, with a take-off weight exceeding that of a B-17 Flying Fortress strategic bomber of World War II, is superior to any existing US fighter. In particular, he asserted that it "has better avionics, a better C^3 system to work into, a better air-to-air missile, is faster, has greater combat range, and [the Soviets] are producing it like gangbusters".

The radar is said to embody key elements of technology found in the advanced Hughes AN/APG-65 digital radar fitted in the US Navy's F/A-18 Hornet, providing true lookdown/shootdown and multiple target engagement capability for the first time in a Soviet interceptor. The AA-9 long-range air-to-air missiles were described by Asst Secretary Latham as being "even better than AMRAAM", still under development for USAF and the US Navy. Equipment includes active countermeasures dispensers, and an infra-red sensor as pioneered on US fighters such as the F-106 but not specified for initial versions of current US interceptors.

Deployment of MiG-31s with Voyska PVO air defence regiments had begun by early 1983, and more than 100 were known to be operational by the Spring of 1986, deployed from the Arkhangelsk area near the USSR's western borders to Dolinsk on Sakhalin Island, north of Japan. Production is centred at the Gorkiy airframe plant.

The detailed description which follows must be regarded as provisional at this time. It is not possible, for example, to confirm that the arc-welded nickel steel structure of the MiG-25 has been retained on what has to be seen as a new design. The better heat resistant characteristics of steel are not essential at the reduced maximum speed of the MiG-31; but a switch to light alloy construction would have required extensive redesign of such well proven features as the basic wing structure, as well as major manufacturing changes. It is doubtful if these would have been considered worthwhile.

TYPE: Two-seat all-weather interceptor.

WINGS: Cantilever high-wing monoplane. Anhedral 4° from roots. Sweepback on leading-edge approx 40°, at quarter-chord 32°, with small sharply-swept wingroot extensions. Upper surface fence in line with each inboard weapon pylon. Aileron and flap on each wing, of greater span than those of MiG-25. No wingtip fairings or mountings.

FUSELAGE: Basic fuselage is slim, but is blended into wide rectangular air intake trunks, which have wedge inlets. Inner wall of each inlet is curved and does not run parallel with outer wall. Hinged panel forms lower lip of each inlet, with a large door towards the forward part of each top surface.

TAIL UNIT: Twin outward canted fins, with inset rudders, and all-moving one-piece horizontal surfaces. All surfaces sharply sweptback, without tabs. Two outward canted ventral fins. Large areas of each main and ventral fin form flush antennae. Aerodynamic fairings between base of each fin and engine duct, extending well forward of leading-edge.

LANDING GEAR: Retractable tricycle type. Single wheel on each main unit, retracting forward into air intake trunk. Twin nosewheels.

POWER PLANT: Two Tumansky turbojet engines, each reportedly rated at 137.3 kN (30,865 lb st) with afterburning. Fuel tankage probably similar to that of MiG-25, which has two structural tanks in fuselage, between cockpit and engine bay, saddle tanks around intake ducts, and integral tank in each wing, filling almost the entire volume inboard of outer stores pylon, with total capacity of approx 17,410 litres (3,830 Imp gallons; 4,600 US gallons). Provision for two large external fuel tanks on outer underwing pylons.

ACCOMMODATION: Pilot and weapon systems operator in tandem. Canopy has only limited side glazing for rear cockpit, and blends into shallow dorsal spine fairing which extends to forward edge of jet nozzles.

AVIONICS AND EQUIPMENT: Main fire control radar of pulse-Doppler lookdown/shootdown type in nose. Infra-red sensor in bottom of front fuselage. Radar warning receivers, active IR and electronic countermeasures.

ARMAMENT: Aircraft illustrated has four AA-9 semi-active radar homing long-range air-to-air missiles in pairs under fuselage, and multiple mounts for smaller stores such as AA-8 (NATO 'Aphid') air-to-air missiles on one large pylon under each wing. These pylons, and outer underwing pylons (not fitted when photographs were taken), can probably increase the number of AA-9s carried by MiG-31 to a total of eight.

DIMENSIONS, EXTERNAL (estimated):

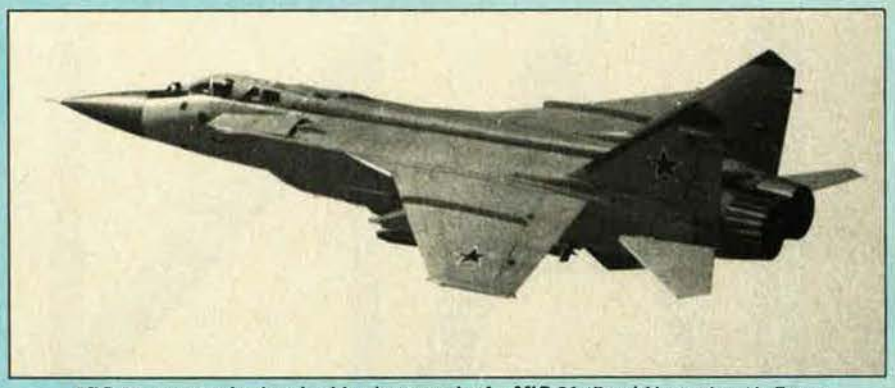
Wing span	14.00 m (45 ft 11¼ in)
Length overall, incl noseprobe	23.5 m (77 ft 1¼ in)

WEIGHTS (estimated):

Weight empty	21,825 kg (48,115 lb)
Max T-O weight	41,150 kg (90,725 lb)

PERFORMANCE (estimated):

Max level speed at height	Mach 2.4
	(1,375 knots; 2,550 km/h; 1,585 mph)
Max combat radius	1,135 nm (2,100 km; 1,305 miles)



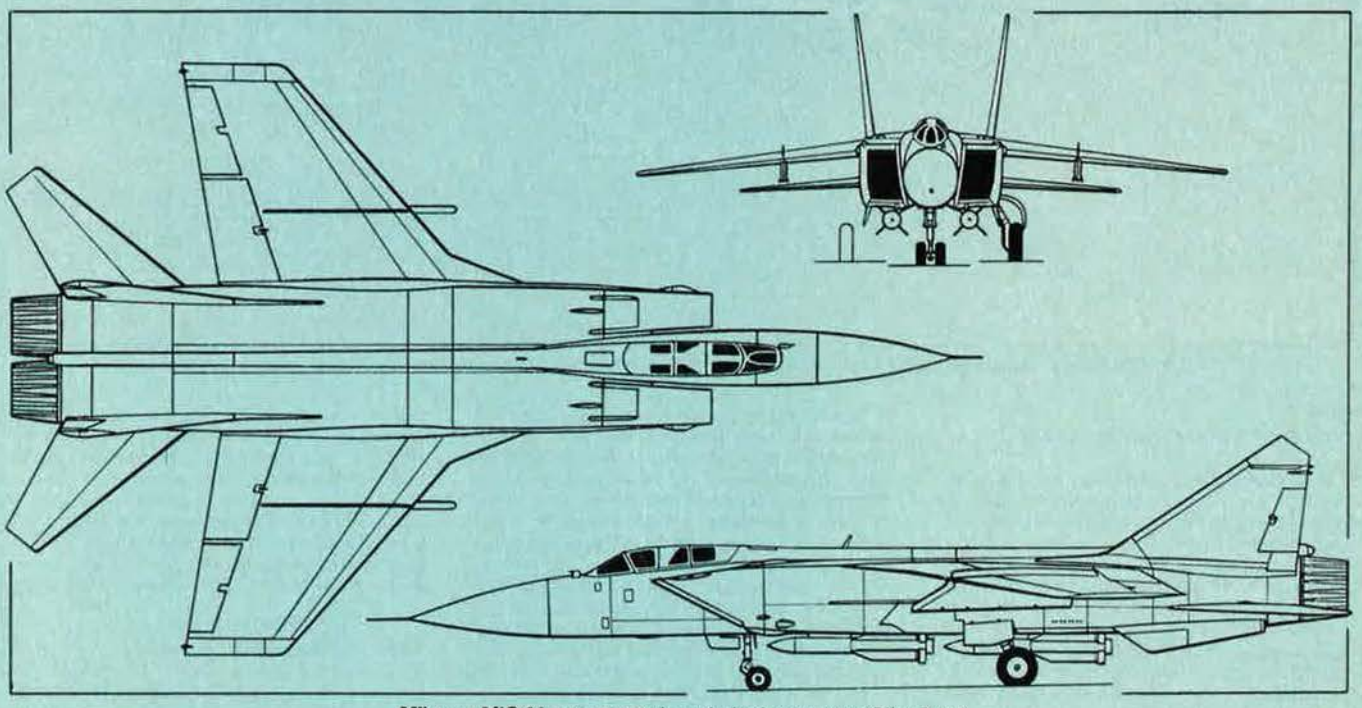
MiG-25 ancestry is clear in this photograph of a MiG-31 *(Royal Norwegian Air Force)*

SHORTS

SHORT BROTHERS PLC, PO Box 241, Airport Road, Belfast BT3 9DZ, Northern Ireland

SHORTS S312 TUCANO

Under the terms of a co-operation agreement between Shorts and EMBRAER of Brazil, an-



Mikoyan MiG-31 two-seat twin-turbojet interceptor *(Pilot Press)*

The prototype Shorts Tucano, adapted from a standard EMB-312

nounced in May 1984, Shorts undertook to develop from the basic EMB-312 Tucano a new version of the turboprop trainer that would meet or exceed all requirements of the UK Ministry of Defence Air Staff Target 412 for a Jet Provost replacement.

The UK government announced on 21 March 1985 that the Shorts Tucano had been selected for this role. The decision ended a competition which had lasted two years. The decisive consideration, according to the UK Secretary of State for Defence, was the "cost factor", the Shorts offer being the least expensive "by a clear margin". A total of 130 Tucanos will be built for the Royal Air Force. Deliveries are scheduled to begin in early 1987, and twelve aircraft will be in service by the end of that year.

To meet Air Staff Target 412, the Shorts Tucano embodies significant modifications compared with the basic EMB-312. These include a changed power plant to improve speed, particularly at low altitude, and provide an increased rate of climb; a ventral airbrake to control speed during descent; structural strengthening for increased manoeuvre loads and fatigue life; a new cockpit layout to meet RAF requirements; wide use of UK equipment; and an optional armament and strike capability. The Shorts Tucano has a design fatigue life of 12,000 hours. The first flight of a Tucano with the new Garrett engine took place in Brazil on 14 February 1986.

The following description applies to the basic Royal Air Force production Tucano T. Mk 1:

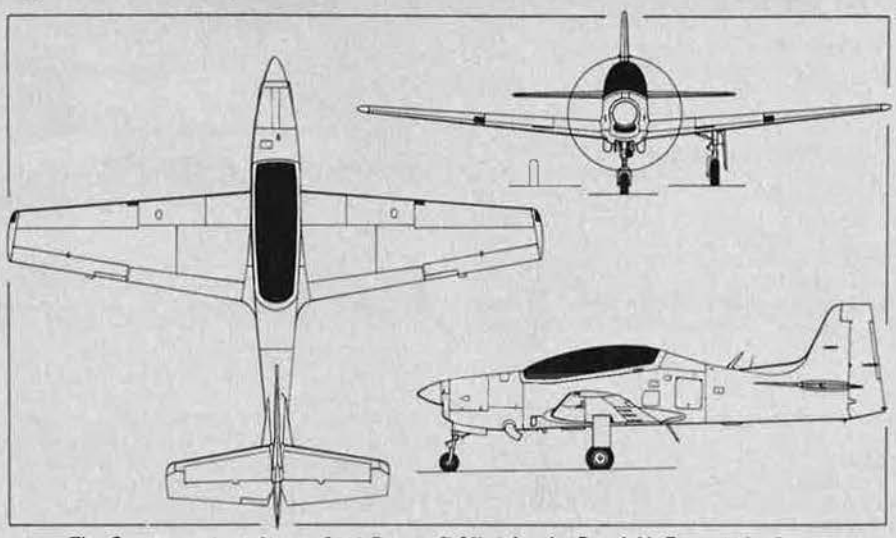
TYPE: Tandem two-seat basic trainer.

WINGS: Cantilever low-wing monoplane. Wing section NACA 63_2A-415 at root, NACA 63A-212 at tip. Dihedral 5° 30′ at 30% chord, constant from roots. Incidence 1° 13′. Sweepback 0° 43′ 26″ at quarter-chord. Aluminium alloy two-spar torsion box structure of 7075-T73 extrusions, and 7075-T76 and 2024-T3511 sheet. Single-slotted electrically actuated trailing-edge flaps of 2024-T3 aluminium alloy, supported on 4130 steel tracks. Constant chord balanced ailerons. Electrically actuated trim tab and small ground adjustable tab on each aileron.

FUSELAGE: Conventional semi-monocoque structure of 2024-T3 aluminium alloy. Hydraulically actuated ventral airbrake.

TAIL UNIT: Unswept cantilever all-metal structure, of similar construction to wings. Fin, with dorsal fin, and horn balanced rudder. Fixed incidence tailplane and horn balanced elevators. Small fillet forward of tailplane root on each side. Electromechanically actuated trim tabs in rudder and port elevator.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel and oleo-pneumatic shock absorber on each unit. Rearward retracting steerable nose unit; main units retract inward into wings. Accumulator for emergency extension after hydraulic system failure. Dunlop wheels and tyres, size 6.50-10 on mainwheels, 5.00-5 on nosewheel. Shimmy damper on nose unit. Dunlop hydraulic single-disc brakes on mainwheels.



The Garrett-engined Shorts S312 Tucano T. Mk 1 for the Royal Air Force *(Pilot Press)*

POWER PLANT: One 820 kW (1,100 shp) Garrett TPE331-12B turboprop engine, driving a Hartzell constant-speed fully-feathering reversible-pitch propeller with spinner. Two integral fuel tanks in wings, total capacity 694 litres (153 Imp gallons; 183 US gallons). Gravity refuelling point in each wing upper surface. Oil capacity 4.25 litres (0.94 Imp gallons; 1.13 US gallons).

ACCOMMODATION: Instructor and pupil in tandem, on Martin-Baker Mk BR8LC lightweight ejection seats, in air-conditioned cockpit. One-piece fully transparent vacuum formed canopy, opening sideways to starboard, with internal and external jettison provisions. Rear seat elevated. Dual controls standard. Baggage compartment in rear fuselage, with door on port side. Cockpit heating and canopy demisting by engine bleed air.

SYSTEMS: Cockpit air-conditioning by engine bleed air plus recirculated cockpit air through a regenerative turbofan system. Single hydraulic system, pressure 207 bars (3,000 lb/sq in), for landing gear extension and retraction, mainwheel brakes, and airbrake. Accumulator to lower landing gear in emergency. No pneumatic system. DC electrical power provided by a 28V 200A starter/generator and two 24Ah alkaline batteries. Static inverter for 115V and 26V AC power at 400Hz. Oxygen system supplied from a single bottle, capacity 2,250 litres (80 cu ft). Emergency oxygen bottle, capacity 70 litres (2.5 cu ft), mounted on each ejection seat. Engine air intake de-iced by engine bleed air; propeller, pitot head, static vents, and stall warning system de-iced electrically.

AVIONICS AND EQUIPMENT: Standard avionics include VHF/UHF/audio by Marconi and Plessey; gyromagnetic compass, VOR/ILS/marker beacon receiver, GEC Avionics AD2780 Tacan, and transponder.

DIMENSIONS, EXTERNAL:

Wing span	11.28 m (37 ft 0 in)
Wing chord: at root	2.30 m (7 ft 6½ in)
at tip	1.07 m (3 ft 6¼ in)
Wing aspect ratio	6.4
Length overall	9.86 m (32 ft 4¼ in)
Fuselage: Max width	1.00 m (3 ft 3½ in)
Max depth	1.55 m (5 ft 1 in)
Height overall	3.40 m (11 ft 1¾ in)
Tailplane span	4.66 m (15 ft 3½ in)
Wheel track	3.76 m (12 ft 4 in)
Wheelbase	3.16 m (10 ft 4½ in)
Propeller diameter	2.39 m (7 ft 10 in)
Propeller ground clearance	0.33 m (1 ft 1 in)
Baggage compartment door:	
Height	0.60 m (1 ft 11½ in)

Width	0.54 m (1 ft 9¼ in)
Height to sill	1.25 m (4 ft 1¼ in)
DIMENSIONS, INTERNAL:	
Cockpits:	
Combined length	2.90 m (9 ft 6¼ in)
Max height	1.55 m (5 ft 1 in)
Max width	0.85 m (2 ft 9½ in)
Baggage compartment volume	0.17 m³ (6.0 cu ft)
AREAS:	
Wings, gross	19.33 m² (208.08 sq ft)
Ailerons (total)	1.97 m² (21.20 sq ft)
Trailing-edge flaps (total)	2.58 m² (27.77 sq ft)
Fin, excl dorsal fin	2.08 m² (22.40 sq ft)
Rudder, incl tab	1.46 m² (15.70 sq ft)
Tailplane, incl fillets	4.57 m² (49.20 sq ft)
Elevators, incl tab	2.00 m² (21.53 sq ft)
WEIGHTS AND LOADINGS:	
Basic weight empty	2,017 kg (4,447 lb)
Max internal fuel	555 kg (1,223 lb)
Max T-O weight	2,650 kg (5,842 lb)
Max wing loading	137.1 kg/m² (28.07 lb/sq ft)
Max power loading	3.23 kg/kW (5.31 lb/shp)

PERFORMANCE (estimated at max T-O weight):

Never-exceed speed 280 knots (518 km/h; 322 mph) EAS

Max level and cruising speed at 3,050–4,575 m (10,000–15,000 ft) 274 knots (507 km/h; 315 mph)

Econ cruising speed at 6,100 m (20,000 ft) 220 knots (407 km/h; 253 mph)

Stalling speed, power off:

flaps and landing gear down 69 knots (128 km/h; 80 mph) EAS

flaps and landing gear up 75 knots (139 km/h; 87 mph) EAS

Max rate of climb at S/L	1,070 m (3,510 ft)/min
Service ceiling	10,365 m (34,000 ft)
T-O run	290 m (950 ft)
T-O to 15 m (50 ft)	503 m (1,650 ft)
Landing from 15 m (50 ft)	500 m (1,640 ft)
Landing run	275 m (900 ft)

Range at 7,620 m (25,000 ft) with max fuel, 30 min reserves 900 nm (1,665 km; 1,035 miles)

Endurance at econ cruising speed at 7,620 m (25,000 ft), 30 min reserves 5 h 12 min

---

LET

LET NÁRODNÍ PODNIK (LET NATIONAL CORPORATION), Uherské Hradiste-Kunovice, Czechoslovakia

Brief details of the twin-turboprop L-610 were given in the December 1985 "Jane's Supplement". The Let Corporation has since provided a much more detailed description of this new Czech transport aircraft.

LET L-610

Intended for certification in 1990 under Soviet ENLG-S civil airworthiness requirements, the L-610 is designed for short-haul operations over stage lengths of 216–324 nm (400–600 km; 248–373 miles). It is scheduled to fly for the first time in late 1987 or early 1988.

TYPE: Twin-turboprop transport aircraft.

WINGS: Cantilever high-wing monoplane. Wing sections MS(1)-0318D at root, MS(1)-0312 at tip, with respective thickness/chord ratios of 18.29% and 12%. Dihedral 2°. Incidence 3° 8′ 38.4″ at root, 0° at tip. Sweepback 1° at quarter-chord. All-metal fail-safe stressed skin structure, built of high grade aluminium alloys and high strength steel and incorporating sandwich panels. All-metal horn balanced ailerons and single-slotted trailing-edge flaps. Spoiler, of sandwich construction, forward of each outer flap segment. Electro-mechanically actuated trim tab in port aileron. Pneumatic de-icing of leading-edges.

FUSELAGE: Pressurised all-metal semi-monocoque structure, incorporating fail-safe principles. Central portion has a constant circular cross-section.

TAIL UNIT: All metal structure, with sweptback fin and rudder and long dorsal fin. Non-swept tailplane and elevators mounted near top of fin. Trim tab and balance tab in rudder and each elevator. Pneumatic de-icing of leading-edges.

LANDING GEAR: Retractable tricycle type, with single wheel on each unit. Hydraulic actuation, mainwheels retracting inward to lie flat in fairing each side of fuselage, nosewheel retracting forward. Oleo-pneumatic shock absorber in each unit. Mainwheels are type XK 34-3000.00, with 1,050 × 390 × 408 mm tyres; type XR 25-1000.00 nosewheel has a 720 × 310 × 254 mm tyre. Hydraulic disc brakes and electronically controlled anti-skid units.

POWER PLANT: Two 1,358 kW (1,822 shp) Motorlet M 602 turboprop engines, each driving an Avia V-518 five-blade fully-feathering metal propeller with reversible pitch. Fuel in two integral wing tanks, combined capacity 3,500 litres (770 Imp gallons). Pressure refuelling point in fuselage, gravity points in wings. Oil capacity 30 litres (6.6 Imp gallons).

ACCOMMODATION: Crew of two on flight deck, plus one cabin attendant. Standard accommodation for 40 passengers, four-abreast at seat pitch of 75 cm (29.5 in). Galley, two wardrobes, toilet, freight and baggage compartment, all located at rear of cabin. Passenger door at rear of fuselage, freight door at front, both opening outward on port side. Outward opening service door on starboard side, opposite passenger door, serving also as emergency exit; outward opening emergency exit beneath wing on each side. Entire accommodation pressurised and air-conditioned.

Mockup of the Let L-610 twin-turboprop 40-passenger transport

SYSTEMS: Bootstrap type air-conditioning system. Max operating cabin pressure differential 0.3 bars (4.35 lb/sq in). Duplicated hydraulic systems, operating at pressure of 210 bars (3,045 lb/sq in). APU for engine starting and auxiliary on-ground and in-flight power. Electrical system powered by two 115/200V 25kVA variable frequency AC generators, plus a third 8kVA 115/200V three-phase AC generator driven by APU. System also includes two 115V 400Hz inverters (each 1.5kVA), two 27V DC transformer-rectifiers (each 4.5kW), and a 25Ah nickel-cadmium battery for APU starting and auxiliary power supply. Portable oxygen equipment for crew and 10 per cent of passengers. Pneumatic de-icing of wing and tail unit leading-edges, engine inlets, and oil cooler; electric de-icing of propeller blades, windscreen, pitot static system, and horn balances.

AVIONICS AND EQUIPMENT: Equipped as standard with dual 760-channel VHF com, single HF com, intercom, cabin address system, weather radar, blind-flying instrumentation, dual ILS with two LOC/glideslope receivers and two marker beacon receivers, dual ADF, Doppler velocity sensor, navigation computer, dual compasses, radio altimeter, transponder, GPWS, AFCS, voice recorder, flight recorder, and Category II approach aids.

DIMENSIONS, EXTERNAL:	
Wing span	25.60 m (84 ft 0 in)
Wing chord: at root	2.917 m (9 ft 6⅞ in)
at tip	1.458 m (4 ft 9½ in)
Wing aspect ratio	11.703
Length overall	21.419 m (70 ft 3¼ in)
Fuselage: Length	20.533 m (67 ft 4⅜ in)
Max diameter	2.70 m (8 ft 10¼ in)
Distance between propeller centres	7.00 m (22 ft 11½ in)
Height overall	7.608 m (24 ft 11½ in)
Tailplane span	7.908 m (25 ft 11⅓ in)
Wheel track	4.59 m (15 ft 0¾ in)
Wheelbase	6.596 m (21 ft 7¾ in)
Propeller diameter	3.50 m (11 ft 5¾ in)
Propeller ground clearance	1.59 m (5 ft 2½ in)
Passenger door: Height	1.625 m (5 ft 4 in)
Width	0.76 m (2 ft 6 in)
Height to sill	1.448 m (4 ft 9 in)
Freight door: Height	1.30 m (4 ft 3¼ in)
Width	1.25 m (4 ft 1¼ in)
Height to sill	1.448 m (4 ft 9 in)
Service door: Height	1.286 m (4 ft 2⅓ in)
Width	0.61 m (2 ft 0 in)
Emergency exits (underwing, each):	
Height	0.915 m (3 ft 0 in)
Width	0.515 m (1 ft 8¼ in)
DIMENSIONS, INTERNAL:	
Cabin: Length	11.10 m (36 ft 5 in)
Max width	2.54 m (8 ft 4 in)
Width at floor	2.02 m (6 ft 7½ in)
Max height	1.825 m (5 ft 11⅞ in)
Floor area	22.4 m² (241.1 sq ft)
Volume	44.1 m³ (1,557.4 cu ft)
Wardrobe volume (total)	1.0 m³ (35.3 cu ft)
Baggage/freight hold volume (total)	4.3 m³ (151.8 cu ft)
AREAS:	
Wings, gross	56.0 m² (602.8 sq ft)
Ailerons (total)	3.27 m² (35.20 sq ft)
Trailing-edge flaps (total)	11.29 m² (121.52 sq ft)
Spoilers (total)	3.54 m² (38.10 sq ft)
Fin	8.30 m² (89.34 sq ft)
Rudder, incl tabs	5.54 m² (59.63 sq ft)
Tailplane	7.68 m² (82.67 sq ft)
Elevators (total, incl tabs)	5.82 m² (62.65 sq ft)
WEIGHTS AND LOADINGS:	
Operating weight empty	9,000 kg (19,841 lb)
Max fuel	2,650 kg (5,842 lb)
Max payload	3,800 kg (8,377 lb)
Max T-O weight	14,000 kg (30,865 lb)
Max ramp weight	14,040 kg (30,953 lb)
Max landing weight	13,500 kg (29,762 lb)
Max zero-fuel weight	12,800 kg (28,219 lb)
Max wing loading	250 kg/m² (51.2 lb/sq ft)
Max power loading	5.147 kg/kW (8.47 lb/shp)

PERFORMANCE (estimated at max T-O weight):

Never-exceed speed 216 knots (400 km/h; 248 mph) EAS

Max level and max cruising speed at 7,200 m (23,620 ft) 264 knots (490 km/h; 304 mph)

Long range cruising speed at 7,200 m (23,620 ft) 220 knots (408 km/h; 253 mph)

Stalling speed: flaps up 93 knots (172 km/h; 107 mph) EAS

flaps down 75 knots (139 km/h; 87 mph) EAS

Max rate of climb at S/L 570 m (1,870 ft)/min
Rate of climb at S/L, one engine out 150 m (492 ft)/min
Service ceiling:
theoretical 10,750 m (35,270 ft)
practical 10,250 m (33,630 ft)
Service ceiling, one engine out (30.5 m; 100 ft/min rate of climb):
theoretical 4,750 m (15,585 ft)
practical 3,980 m (13,060 ft)
Min ground turning radius 18.33 m (60 ft 1¾ in)
T-O run 370 m (1,214 ft)
T-O to 10.7 m (35 ft) 613 m (2,011 ft)
Balanced T-O distance 752 m (2,467 ft)
Balanced T-O field length 873 m (2,864 ft)
Landing from 9 m (30 ft) 545 m (1,788 ft)
Landing run 340 m (1,115 ft)
Range, reserves for 45 min hold:
with max payload 410 nm (760 km; 472 miles)
with max fuel 1,160 nm (2,150 km; 1,336 miles)

AERODYNE

AERODYNE SYSTEMS ENGINEERING LIMITED, 1140 19th Street NW, Suite 600, Washington, DC 20036, USA

AERODYNE M79 HORNET

In early 1985 Aerodyne Systems acquired the assets of the former Texas Helicopter company, and has since developed that company's two-seat version of its Wasp conversion of the Bell 47 helicopter. Originally known as the M79T Jet Wasp II, the prototype (N1001X) first flew in piston engined form on 6 January 1979. Redesignated M79 Hornet, and powered by an Allison 250-C20B turbine engine, the aircraft received FAA certification on 25 April 1985 and was subsequently exhibited at the Paris Air Show in June, at which time it had accumulated some 125 hours' flying.

The Hornet is intended as a low-cost training helicopter for the crews of modern combat helicopters such as the McDonnell Douglas AH-64A Apache. Airframe differences from the standard single-seat ML74 Wasp include a redesigned front fuselage and cabin area, with repositioned engine, variable incidence tailplane, and provision for armament on outriggers above the landing gear skids.

TYPE: Turbine powered light helicopter.

ROTOR SYSTEM: Two-blade semi-rigid main rotors with interchangeable blades of metal construction. Two-blade metal tail rotor with external guard ring.

ROTOR DRIVE: Centrifugal clutch with two-stage planetary transmission. Steel shaft drive to tail rotor, with 90° gearbox at aft end of tailboom. Main rotor/engine rpm ratio 1:16.66.

FUSELAGE: Centre section of welded 4130 steel tube, carrying engine and cockpit structure. Rear portion also of 4130 tube, of triangular section open framework construction, and serving as a support for the tail rotor driveshaft.

TAIL UNIT: Small triangular ventral fin constructed of light alloy honeycomb sandwich, mounted ahead of tail rotor guard. Variable incidence tailplane with small endplate fins.

LANDING GEAR: Tubular fixed skid type. Shock absorption by flexing of cross tubes. Small ground handling wheels standard.

POWER PLANT: One 313 kW (420 shp) Allison 250-C20B turboshaft engine, derated to 194 kW (260 shp) with 600 series transmission, or to 201 kW (270 shp) with 900 series transmission. Fuel contained in two stub wing fuel tanks, one above each side of the fuselage at the base of the rotor mast. Total capacity 284 litres (75 US gallons). Refuelling point at top of each tank.

ACCOMMODATION: Two seats, in tandem, in enclosed bubble cockpit. Two doors on starboard side. Dual controls and dual instrumentation standard. Contoured seat cushions, and nylon safety belts and shoulder restraints standard.

DIMENSIONS, EXTERNAL:
Main rotor diameter 11.31 m (37 ft 1¼ in)
Main rotor blade chord 0.28 m (11 in)
Tail rotor diameter 1.73 m (5 ft 8¼ in)
Length overall, excl main rotor 10.97 m (36 ft 0 in)
Height to top of rotor head 2.84 m (9 ft 3¼ in)
Skid track 2.29 m (7 ft 6 in)

DIMENSIONS, INTERNAL:
Cabin: Length 2.74 m (9 ft 0 in)
Width 0.84 m (2 ft 9 in)
Height 1.35 m (4 ft 5 in)

AREAS:
Main rotor blades (each) 1.73 m² (18.63 sq ft)
Tail rotor blades (each) 0.11 m² (1.2 sq ft)
Main rotor disc 100.69 m² (1,083.87 sq ft)
Tail rotor disc 2.35 m² (25.31 sq ft)
Ventral fin 0.36 m² (3.86 sq ft)
Tailplane 0.42 m² (4.5 sq ft)

WEIGHTS AND LOADINGS:
Weight empty 780 kg (1,720 lb)
Max T-O weight:
600 series transmission 1,338 kg (2,950 lb)
900 series transmission 1,451 kg (3,200 lb)
Max disc loading (270 shp) 14.41 kg/m² (2.95 lb/sq ft)
Max power loading (270 shp) 7.22 kg/kW (11.85 lb/shp)

Aerodyne M79 Hornet turbine powered combat training helicopter *(Brian M. Service)*

Mazlat/AAI Pioneer RPV can utilise catapult launcher in restricted areas or from shipboard

PERFORMANCE (at max T-O weight of 1,338 kg; 2,950 lb):
Never-exceed speed 92 knots (170 km/h; 106 mph)
Max level speed 92 knots (170 km/h; 106 mph)
Max cruising speed 85 knots (157 km/h; 98 mph)
Econ cruising speed 69 knots (128 km/h; 79 mph)
Max rate of climb 381 m (1,250 ft)/min
Max vertical rate of climb 296 m (970 ft)/min
Range, max fuel, no reserves 260 nm (482 km; 299 miles)

MAZLAT/AAI

MAZLAT LTD (Mini-RPV Systems), Kiryat Weizmann Science Park, Nes Ziona 70400, Israel; and AAI CORPORATION (Missiles and Robotics Division), PO Box 6767, Baltimore, Maryland 21204, USA

Israel Aircraft Industries and Tadiran Ltd announced in early 1984 a joint venture for developing and manufacturing their existing Scout and Mastiff RPVs, and for designing and developing a new-generation mini-RPV system. Mazlat Ltd is the company formed for this purpose, both to respond to Israeli Defence Forces requirements and to market Israeli RPV systems throughout the world. Its new RPV is the Pioneer, the first contract for which has been placed by the US Navy.

MAZLAT/AAI PIONEER

It was announced on 7 January 1986 that US Naval Air Systems Command had awarded a $25.8 million contract for procurement of three Pioneer short range RPV systems for US Navy (shipboard) and Marine Corps use, with deliveries to begin in May 1986 and continue until the Autumn of 1991. The contract calls for 21 drones (five to eight per system), ground control stations, portable control stations, remote data receiving stations, and launch and recovery equipment.

Pioneer is the next generation of mini-RPV systems developed by Mazlat to satisfy future military and civilian requirements. It incorporates the accumulated battlefield and technical experience of the IAI Scout and Tadiran Mastiff systems, which be-

tween them have logged more than 4,000 flight hours in about 1,000 sorties, most of them over hostile territory. Mazlat's partner in the US Navy programme is AAI Corporation. The Pioneer will be used by the USN and USMC on reconnaissance and surveillance missions, flying for extended periods of time while observing and transmitting video of surface activity by day or night.

The complete Pioneer system consists of a few basic elements, plus additional subsystems that may be used to upgrade the basic system to the specific requirements of the user. The basic system includes the air vehicles; MKD-200 stabilised TV payload; Elta GCS-2000 ground control station (GCS); portable control station (PCS); MRU-2000 mobile receiving unit (MRU); a pneumatic launcher or rocket booster; and recovery system(s). An integrated logistics support system provides all necessary logistics to allow independent storage, operation, and maintenance of the system by users in the field, and includes training (maintenance and operation), complete set of manuals, spare parts allocation, special test equipment, and maintenance shelters.

TYPE: Recoverable reconnaissance/surveillance mini-RPV.

AIRFRAME: Cantilever shoulder-wing monoplane with constant chord wings, of similar general configuration to IAI Scout. Central fuselage nacelle of mainly rectangular cross-section, tapered at each end. Slender tailboom extending from each wing, outboard of fuselage, supporting twin inward-canted fins and rudders connected by a central tailplane with elevator. Wings, booms, and tail unit detachable to simplify dismantling and assembly in the field and facilitate prompt despatch of several vehicles at one time. Airframe built mainly of composite materials to minimise radar signature. Non-retractable tricycle landing gear, plus arrester hook.

POWER PLANT: One 19.4 kW (26 hp) two-cylinder two-stroke engine, driving a two-blade pusher propeller. Fuel capacity 42 litres (9.2 Imp gallons; 11.1 US gallons).

LAUNCH AND RECOVERY: Conventional wheeled take-off from short, improvised strips; or catapult launch from pneumatically operated twin-rail launcher, compressed air tank for which is charged by truck's or ship's air compressors. Recovery by wheel landing, using short distance landing system (SDLS) of arrester cable, secured by two energy absorbers, to engage ventral hook; or by retrieval in vertically strung net attached to an energy absorbing system. Retrieval can be carried out from within GCS.

GUIDANCE AND CONTROL: Autopilot control in all mission phases, from take-off to landing, ensures platform stability and ease of control. Programmed emergency manoeuvres allow for extreme flight situations. Elta GCS-2000 ground control station operates and controls the aircraft and its payloads, and receives, computes, and displays real-time data from the aircraft, including TV pictures of the target area, via an automatic tracking antenna and secure two-way data link. Target co-ordinates are computed for display on the TV screen; alpha-numeric and graphic displays allow artillery fire adjustment and improve the commander's control of the battlefield situation. The GCS-2000 is compact enough to be housed in small shelters such as the S-250, or in an armoured personnel carrier, giving it mobility under the most severe environmental conditions. It requires only a two-person crew (aircraft operator and observer), and operation and maintenance are simplified by intensive use of microprocessors and software.

MISSION EQUIPMENT: Main payload compartment in centre-fuselage, with volume of 0.1 m^3 (3.6 cu ft). Up to 500W of electrical power available for mission payloads which can include day (TV) or night (FLIR) sensors, EW, ECM, decoy, communications relay, and laser target designator and/or rangefinder.

DIMENSIONS, EXTERNAL:

Wing span	5.12 m (16 ft 9½ in)
Length overall	4.96 m (16 ft 3¼ in)
Height overall	1.00 m (3 ft 3¼ in)

WEIGHTS:

Mission payload	up to 45 kg (100 lb)
Max T-O weight	195 kg (430 lb)

PERFORMANCE:

Max level speed (typical)	100 knots (185 km/h; 115 mph)
Cruising speed (typical)	48–70 knots (90–130 km/h; 56–81 mph)
Max rate of climb at S/L	244 m (800 ft)/min
Ceiling	4,575 m (15,000 ft)
Landing distance with SDLS	within 70 m (230 ft)
Range	100 nm (185 km; 115 miles)
Endurance (typical)	6–9 h

British avionics and the latest Chinese air-to-air missiles are features of the Xian F-7M Airguard export fighter

XIAN

XIAN STATE AIRCRAFT FACTORY, Shaanxi Province, People's Republic of China

XIAN F-7M AIRGUARD

Based originally on the early MiG-21F (NATO 'Fishbed-C'), the Chinese J-7/F-7 has undergone a number of modification programmes since the mid-1960s, mainly to improve engine performance, firepower, avionics, and payload/range capability. An account of the latest export version, the F-7M, appeared in the August 1985 "Jane's Supplement". Additional information has been released since that description was written.

Now given the name Airguard, the F-7M is being promoted for export, as an air superiority and tactical fighter, by Aircraft Technology Limited, a new Hong Kong based company formed by the Chinese import/export organisation CATIC and the British firm Lucas Aerospace Ltd. In early 1986 the F-7M was reportedly under consideration by the Pakistan Air Force as a replacement for its F-6s (Chinese MiG-19s), of which about 150 are in service.

The following details amend or expand those given in the August 1985 "Supplement":

POWER PLANT: No change to engine details. Total internal fuel capacity of 2,385 litres (524.5 Imp gallons; 630 US gallons), contained in six flexible tanks in fuselage and two integral tanks in each wing. Provision for carrying a 500 or 800 litre (110 or 176 Imp gallon; 132 or 211 US gallon) centreline drop tank, and/or a 500 litre drop tank on each outboard underwing pylon. Max possible internal/external fuel capacity 4,185 litres (920.5 Imp gallons; 1,105 US gallons).

ACCOMMODATION: Zero-height/low-speed ejection seat is manufactured by Chengdu Aircraft Corporation, and is operable between 70 and 459 knots (130–850 km/h; 81–528 mph) IAS.

AVIONICS: GEC Avionics suite includes Type 956 HUDWAC, AD 3400 two-band UHF/VHF multifunction com system, Type 226 ranging radar, and an air data computer. Other avionics include Type 602 IFF transponder, Type 0101 HR A/2 radar altimeter, WL-7 radio compass, and XS-6A marker beacon receiver. The HUDWAC (head-up display and weapon aiming computer) provides the pilot with displays for instrument flying, with air-to-air and air-to-ground weapon delivery superimposed on the same area of vision as the target. It can store 32 weapon parameter functions, allowing both current and future weapon variants to be accommodated. In air-to-air combat its four modes (missiles, conventional gunnery, snapshoot gunnery, or dogfight status) allow for all eventualities. There are also two navigation functions: approach mode, and a standby aiming reticle provided by the HUD.

ARMAMENT: Two 30 mm Type 30-1 belt-fed cannon, with 60 rds/gun, in fairings under front fuselage just forward of wing-root leading-edges. Contrary to previous description, weapons carriage remains the function of the *inboard* underwing pylons; it is the outboard ones which are 'wet' for the carriage of drop tanks. The centreline pylon is used for a drop tank only. Each inboard pylon is capable of carrying a Chinese air-to-air missile (see separate entry following F-7M description) or, at customer's option, a Matra R550 Magic; one pod of eighteen Type 57-2 (57 mm) air-to-air and air-to-ground rockets; one pod of seven Type

Pioneer RPV, derived from Israeli battle-proven drones, is now in production for the US Navy

90-1 (90 mm) air-to-ground rockets; or a 50, 150, 250, or 500 kg bomb. Each outboard pylon can carry one of the above rocket pods, a 50 or 150 kg bomb, or a 500 litre drop tank.

DIMENSIONS, EXTERNAL:
- Wing span: 7.154 m (23 ft 5⅝ in)
- Wing aspect ratio: 2.225
- Length overall:
  - excl nose probe: 13.945 m (45 ft 9 in)
  - incl nose probe: 14.885 m (48 ft 10 in)
- Height overall: 4.103 m (13 ft 5½ in)
- Tailplane span: 3.74 m (12 ft 3¼ in)
- Wheel track: 2.692 m (8 ft 10 in)
- Wheelbase: 4.807 m (15 ft 9¼ in)

AREA:
- Wings, gross: 23.00 m² (247.6 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: F-7: 5,145 kg (11,343 lb)
- F-7M: 5,275 kg (11,629 lb)
- Normal max T-O weight with two PL-2 or PL-7 air-to-air missiles:
  - F-7: 7,372 kg (16,252 lb)
  - F-7M: 7,531 kg (16,603 lb)
- Wing loading at normal max T-O weight:
  - F-7: 320.52 kg/m² (65.68 lb/sq ft)
  - F-7M: 327.43 kg/m² (67.10 lb/sq ft)
- Power loading at normal max T-O weight:
  - F-7: 123.3 kg/kN (1.21 lb/lb st)
  - F-7M: 125.5 kg/kN (1.23 lb/lb st)

PERFORMANCE (at normal max T-O weight with two PL-2 or PL-7 air-to-air missiles, except where indicated):
- Max level speed between 12,500 and 18,500 m (41,010–60,700 ft):
  - F-7, F-7M: Mach 2.05 (1,175 knots; 2,175 km/h; 1,350 mph)
- Unstick speed: F-7, F-7M: 167–178 knots (310–330 km/h; 193–205 mph)
- Touchdown speed: F-7, F-7M: 162–173 knots (300–320 km/h; 186–199 mph)
- Max rate of climb at S/L:
  - F-7: 9,000 m (29,527 ft)/min
  - F-7M: 10,800 m (35,435 ft)/min
- Acceleration from Mach 0.9 to 1.2 at 5,000 m (16,400 ft):
  - F-7M: 35 s
- Max sustained turn rate:
  - F-7M (Mach 0.7 at S/L): 14.7°/s
  - F-7M (Mach 0.8 at 5,000 m; 16,400 ft): 9.5°/s
- Service ceiling: F-7: 18,800 m (61,680 ft)
- F-7M: 18,200 m (59,710 ft)
- Absolute ceiling: F-7: 19,200 m (62,990 ft)
- F-7M: 18,700 m (61,350 ft)
- T-O run: F-7: 800–1,000 m (2,625–3,280 ft)
- F-7M: 700–950 m (2,297–3,117 ft)
- Landing run with brake-chute:
  - F-7: 800–1,000 m (2,625–3,280 ft)
  - F-7M: 600–900 m (1,969–2,953 ft)
- Typical mission profiles (F-7M):
  - Combat air patrol at 11,000 m (36,000 ft) with two air-to-air missiles and three 500 litre drop tanks, incl 5 min combat: 45 min
  - Long range interception at 11,000 m (36,000 ft) at 351 nm (650 km; 404 miles) from base, incl Mach 1.5 dash and 5 min combat, stores as above
  - Hi-lo-hi interdiction radius, out and back at 11,000 m (36,000 ft), with three 500 litre drop tanks and two 150 kg bombs: 324 nm (600 km; 373 miles)
  - Lo-lo-lo close air support radius with four rocket pods, no external tanks: 200 nm (370 km; 230 miles)
- Range:
  - F-7, two PL-2 missiles only: 647 nm (1,200 km; 745 miles)
  - F-7, two PL-2s and one 800 litre drop tank: 804 nm (1,490 km; 926 miles)
  - F-7M, two PL-7 missiles and three 500 litre drop tanks: 939 nm (1,740 km; 1,081 miles)
  - F-7M, self-ferry with one 800 litre and two 500 litre drop tanks, no missiles: 1,203 nm (2,230 km; 1,385 miles)
- *g* limits: F-7: +7
- F-7M: +8

CHINESE AIR-TO-AIR MISSILES

The following Chinese air-to-air missiles are available for the F-7M Airguard:

PL-2. Infra-red homing missile, with 11.3 kg (25 lb) warhead. Acquisition angle 90°. Max range for lock-on 5,000–7,800 m (16,400–26,000 ft); minimum launch range 1,300 m (4,265 ft).

PL-2A. Development of PL-2 with improved seeker. Max range for lock-on increased to 8,000–10,000 m (26,250–32,800 ft); other details as for PL-2.

PL-7. Advanced development of PL-2/2A with delta shaped fins, second set of fins immediately behind front set, and less sweptback tail-fins. Warhead weight increased to 12 kg (26.5 lb) and acquisition angle to 180°. Max range for lock-on 14,400 m (47,250 ft); min launch range 500 m (1,640 ft).

GULFSTREAM

GULFSTREAM AEROSPACE CORPORATION (Subsidiary of Chrysler Corporation), PO Box 2206, Savannah, Georgia 31402, USA

GULFSTREAM AEROSPACE GULFSTREAM IV

Gulfstream Aerospace has developed an improved version of the Gulfstream III business jet which is designated G1159C Gulfstream IV. Design was initiated in March 1983, and construction of three flying prototypes and one static test airframe began in 1985. Rollout of the first aircraft (N404GA) occurred on 11 September 1985, with a first flight following on 19 September. The aircraft made its first public appearance at the National Business Aircraft Association convention at New Orleans on 24 September.

The second prototype was expected to fly in March 1986, at which time the company held orders for 88 aircraft worth $1.4 billion, and was negotiating sales of a further 20. Certification is planned for 1 September 1986, with three completed customer aircraft scheduled for delivery in the year and a further 17 in 1987, not including those airframes which will be fitted out by specialist outfitting companies from 'green' airframes supplied by Gulfstream Aerospace. Peak production is planned at four aircraft per month, increasing to six per month if demand warrants.

Generally similar to the Gulfstream III, production of which will cease in December 1986, the Gulfstream IV differs primarily in having a structurally redesigned wing incorporating thirty per cent fewer parts, and offering a weight saving of 395 kg (870 lb) with 453 kg (1,000 lb) more internal fuel capacity; a fuselage lengthened by 1.37 m (4 ft 6 in); a sixth window on each side of the cabin; rudder, ailerons, spoilers, and other components made of carbon-fibre; new Rolls-Royce RB183-03 Tay Mk 610-8 turbofan engines; and an advanced 'all glass' flight deck incorporating CRT displays and digital avionics.

In March 1985 Gulfstream Aerospace announced details of a proposed airliner version of the Gulfstream IV designated **Gulfstream IV-B.** This aircraft, the configuration of which was prompted by enquiries from two US airline operators, would have a fuselage 5.64 m (18 ft 6 in) longer than that of the Gulfstream IV, achieved by the insertion of plugs forward and aft of the wing centre-section, but would retain its engines, wings, tail surfaces, and systems. The Gulfstream IV-B would offer accommodation for 24 passengers in first class seating, plus a crew of four. The aircraft would have an empty weight of 16,465 kg (36,300 lb), max T-O weight of 35,516 kg (78,300 lb), max fuel weight of 13,290 kg (29,300 lb), cabin volume of 58.3 m³ (2,060 cu ft), baggage compartment volume of 4.81 m³ (170 cu ft), and a maximum range with IFR reserves of 3,800 nm (7,042 km; 4,376 miles). A corporate airliner version, and an all-cargo **Gulfstream Cargoliner** variant with a 6,804 kg (15,000 lb) payload capacity, 63.1 m³ (2,230 cu ft) of cargo space, and a maximum range of 3,000 nm (5,560 km; 3,454 miles), have also been proposed. A decision on development of the Gulfstream IV-B is expected to be taken in the last quarter of 1986.

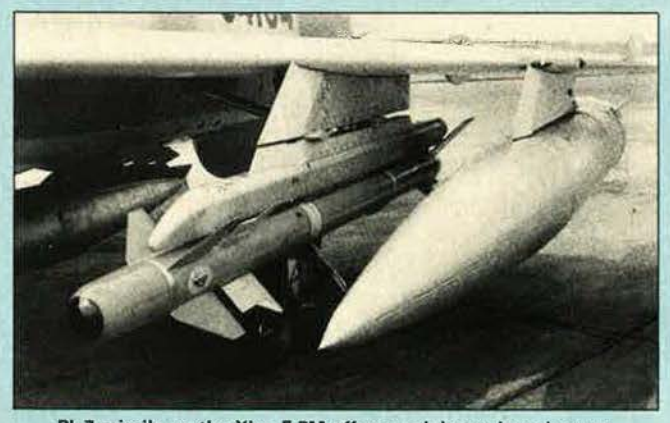
The following data apply to the basic Gulfstream IV:

TYPE: Twin-turbofan executive transport.

WINGS: Cantilever low-wing monoplane of light alloy construction with carbonfibre ailerons and spoilers. Advanced sonic rooftop wing section. Thickness/chord ratio of 10% at wing station 50 and 8.6% at wing station 414. Dihedral 3°. Incidence 3° 30′ at root, −2° at tip. Sweepback at quarter-chord 27° 40′. NASA (Whitcomb) wingtip winglets. Plain ailerons, hydraulically powered with manual reversion. Single-slotted Fowler trailing-edge flaps. Three spoilers on upper surface of each wing at 12% chord, immediately forward of trailing-edge flaps, can be operated differentially to complement ailerons for roll control, and collectively to serve as airbrakes. Trim tab in port aileron. Anti-icing of leading-edges by engine bleed air.

FUSELAGE: Conventional semi-monocoque fail-safe pressurised structure of light alloy, with carbonfibre in cabin floor and flight deck areas.

TAIL UNIT: Cantilever T tail of light alloy, except for



PL-7 missile on the Xian F-7M offers a minimum launch range of only 500 m (1,640 ft)

Modernised cockpit of the F-7M Airguard includes a HUDWAC (head-up display and weapon aiming computer)

rudder and part of tailplane of carbonfibre. Swept horizontal and vertical surfaces. Trim tab in rudder and each elevator. Hydraulically powered controls with manual reversion.

LANDING GEAR: Retractable tricycle type with twin wheels on each unit. Main units retract inward, steerable nosewheel unit forward. Mainwheel tyres size 34 × 9.25-16, pressure 12.07 bars (175 lb/sq in). Nosewheel tyres size 21 × 7.25-10, pressure 7.9 bars (115 lb/sq in). Goodyear aircooled carbon brakes, with Goodyear fully-modulated anti-skid units. Goodyear digital elecronic brake-by-wire system. Dowty electronic steer-by-wire system.

POWER PLANT: Two Rolls-Royce RB183-03 Tay Mk 610-8 turbofan engines, each flat rated at 55.24 kN (12,420 lb st) to ISA + 20°C. Target type thrust reversers. Fuel in two integral wing tanks, with total capacity of 16,428 litres (4,340 US gallons). Single pressure refuelling point in leading-edge of starboard wing.

ACCOMMODATION: Crew of two or three. Standard seating for 14 to 19 passengers in pressurised and air-conditioned cabin. Galley, toilet, and large baggage compartment, capacity 907 kg (2,000 lb), at rear of cabin. Integral airstair door at front of cabin on port side. Electrically heated wrap-around windscreen. Six cabin windows on each side.

SYSTEMS: Cabin pressurisation system max differential 0.65 bars (9.45 lb/sq in). Air-conditioning system. Two independent hydraulic systems, each 207 bars (3,000 lb/sq in). Maximum flow rate 83.3 litres (22 US gallons)/min. Two bootstrap type hydraulic reservoirs, pressurised to 4.14 bars (60 lb/sq in). Garrett GTCP 36-100 APU in tail compartment, flight-rated to 10,670 m (35,000 ft). Electrical system includes two 36kVA alternators with two solid state 30kVA converters to provide 23kVA 115/200V 400Hz AC power and 250A of regulated 28V DC power; two 24V 40Ah nickel-cadmium storage batteries and external power socket.

AVIONICS AND EQUIPMENT: Standard items include a Sperry fully integrated digital flight management system with six 20.3 cm × 20.3 cm (8 in × 8 in) colour CRT displays, two each for primary flight instruments, navigation, and engine instrument and crew alerting systems (EICAS); dual fail-operational flight guidance systems including autothrottles; dual air data systems; dual flight management systems with vertical and lateral navigation and performance management, and digital colour radar. System integration is accomplished through a Sperry avionics standard communications bus (ASCB). Other factory-installed avionics include dual VHF/HF com; dual VOR/LOC/GS and markers; dual DME; dual ADF; dual transponders; dual cockpit audio; dual flight guidance and performance computers; dual laser INS, dual ILS receivers with CAT III capability; attitude/heading reference system; dual radio altimeters; and cockpit voice recorder. The system is designed to provide growth potential for interface with MLS, GPS, and VLF Omega in future developments.

Even with a test noseprobe installed, the elegant lines of the Gulfstream IV are evident

DIMENSIONS, EXTERNAL:

Wing span	23.72 m (77 ft 10 in)
Wing chord: at root	5.94 m (19 ft 6 in)
at tip	1.85 m (6 ft 0¾ in)
Wing aspect ratio	5.92
Length overall	26.70 m (87 ft 7 in)
Fuselage length	24.03 m (78 ft 10 in)
Fuselage: Max diameter	2.39 m (7 ft 10 in)
Height overall	7.42 m (24 ft 4 in)
Tailplane span	8.23 m (27 ft 0 in)
Wheel track	4.17 m (13 ft 8 in)
Wheelbase	11.61 m (38 ft 1¼ in)
Passenger door (fwd, port):	
Height	1.57 m (5 ft 2 in)
Width	0.91 m (3 ft 0 in)
Baggage door (rear):	
Height	0.72 m (2 ft 4½ in)
Width	0.91 m (2 ft 11¾ in)

DIMENSIONS, INTERNAL:

Cabin:	
Length, incl galley, toilet, and baggage compartment	13.74 m (45 ft 1 in)
Length, passenger cabin	8.00 m (26 ft 3 in)
Max width	2.24 m (7 ft 4 in)
Max height	1.85 m (6 ft 1 in)
Floor area	21.8 m² (235 sq ft)
Total volume	47.77 m³ (1,687 cu ft)
Cabin volume	42.96 m³ (1,517 cu ft)
Passenger area volume	30.55 m³ (1,079 cu ft)
Flight deck volume	3.51 m³ (124 cu ft)
Rear baggage compartment volume	4.81 m³ (170 cu ft)

AREAS:

Wings, gross	88.29 m² (950.39 sq ft)
Ailerons, incl tabs (total)	2.68 m² (28.86 sq ft)
Trailing-edge flaps (total)	11.97 m² (128.84 sq ft)
Flight spoilers (total)	2.87 m² (30.88 sq ft)
Ground spoilers (total)	4.59 m² (49.39 sq ft)
Winglets (total)	2.38 m² (25.60 sq ft)
Fin	10.92 m² (117.53 sq ft)
Rudder	4.16 m² (44.75 sq ft)
Horizontal tail surfaces (total)	12.70 m² (136.69 sq ft)
Elevators (total)	5.22 m² (56.22 sq ft)

WEIGHTS AND LOADINGS:

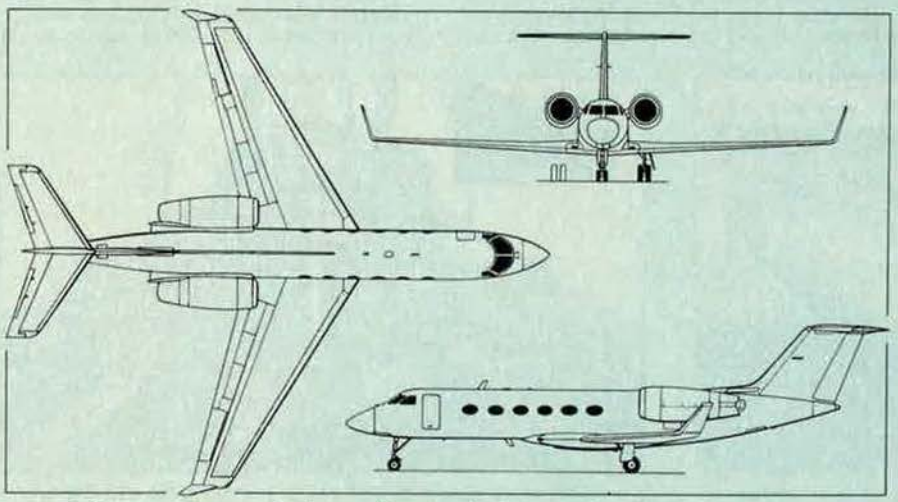
Manufacturer's weight empty	15,150 kg (33,400 lb)
Typical operating weight empty	17,826 kg (39,300 lb)
Max payload	2,132 kg (4,700 lb)
Max fuel weight	13,290 kg (29,300 lb)
Max T-O weight	31,615 kg (69,700 lb)
Max ramp weight	31,842 kg (70,200 lb)
Max zero-fuel weight	19,958 kg (44,000 lb)
Max landing weight	26,535 kg (58,500 lb)
Max wing loading	358.1 kg/m² (73.34 lb/sq ft)
Max power loading	286.0 kg/kN (2.8 lb/lb st)

PERFORMANCE (at max T-O weight, ISA, except where indicated):

Max operating speed	340 knots (629 km/h; 391 mph) CAS *or* Mach 0.85
Max cruising speed at 10,670 m (35,000 ft)	501 knots (928 km/h; 577 mph)
Econ cruising speed at 13,715 m (45,000 ft)	Mach 0.80 (459 knots; 850 km/h; 528 mph)
Stalling speed at max landing weight, 'clean'	120 knots (222 km/h; 138 mph) CAS
Stalling speed at max landing weight, landing gear and flaps down	105 knots (195 km/h; 121 mph) CAS
Approach speed at max landing weight	136 knots (252 km/h; 157 mph) CAS
Max rate of climb at S/L	1,325 m (4,350 ft)/min
Rate of climb at S/L, one engine out	396 m (1,300 ft)/min
Max operating altitude	13,715 m (45,000 ft)
Runway LCN	33
FAA balanced T-O field length at S/L	1,554 m (5,100 ft)
FAA landing distance at S/L at max landing weight	975 m (3,200 ft)
Range with max fuel, eight passengers, at Mach 0.80 and with NBAA IFR reserves	4,300 nm (7,969 km; 4,952 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36):

T-O	77.7 EPNdB
Approach	90.7 EPNdB
Sideline	92.0 EPNdB



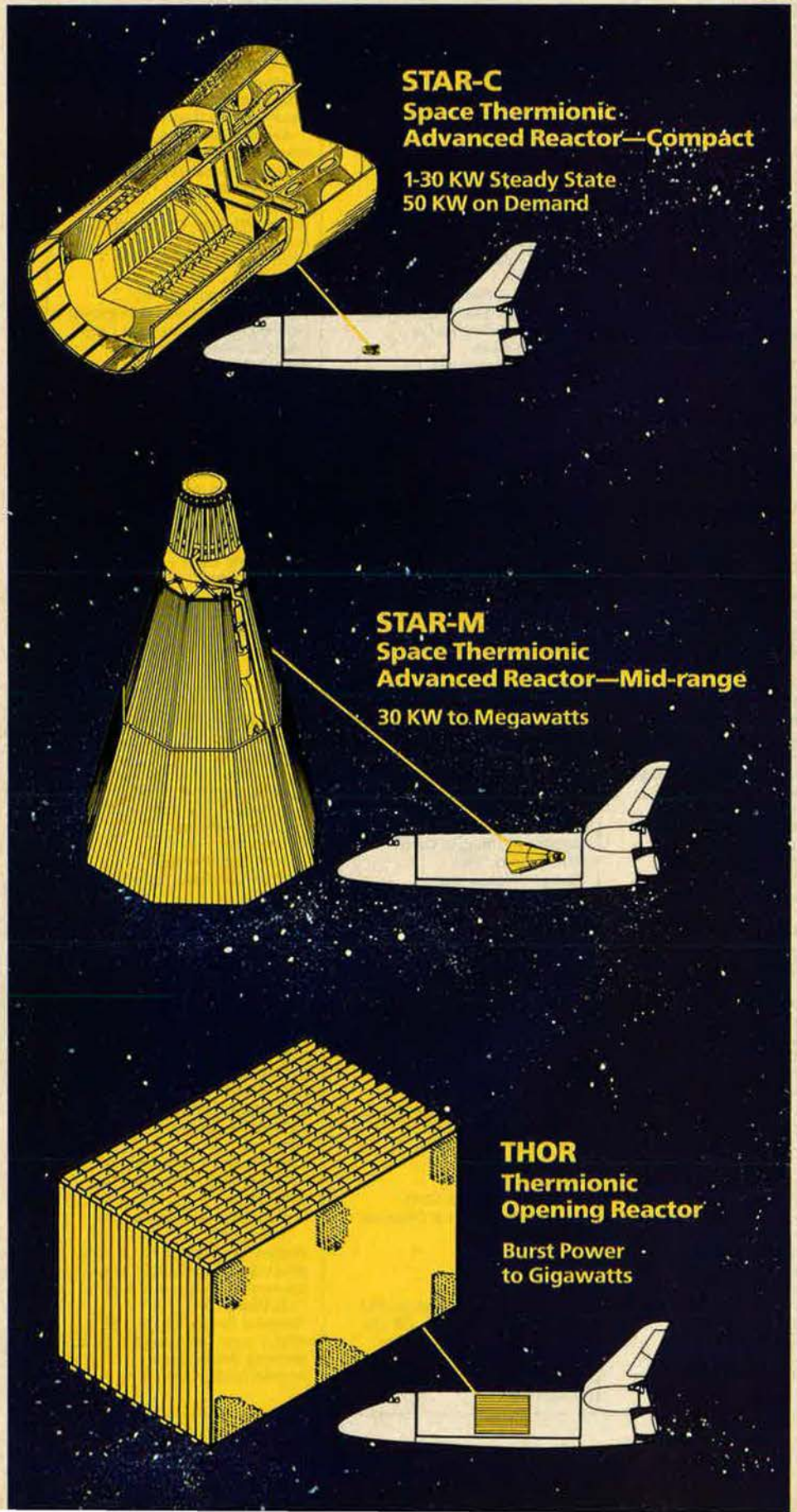
Gulfstream Aerospace Gulfstream IV twin-turbofan executive transport *(Pilot Press)*

INDUSTRIAL ASSOCIATES OF THE AIR FORCE ASSOCIATION

Listed below are the Industrial Associates of the Air Force Association. Through this affiliation, these companies support the objectives of AFA as they relate to the responsible use of aerospace technology for the betterment of society and the maintenance of adequate aerospace power as a requisite of national security and international amity.

AAR Brooks & Perkins
Acurex Corp.
Aerojet ElectroSystems Co.
Aerojet Ordnance Co.
Aerojet Strategic Propulsion Co.
Aerojet TechSystems Co.
Aerospace Corp.
Aérospatiale, Inc.
Allied Corp., Bendix Aerospace
American Airlines Training Corp.
American Cyanamid Co.
American Electronic Laboratories, Inc.
Amex Systems, Inc.
Ampex Corp., Data Systems Div.
Amtec Systems Corp.
Analytic Services Inc. (ANSER)
Anheuser-Busch, Inc.
Army Times Publishing Co.
Aster Engineering Corp.
Astronautics Corp. of America
AT&T Technologies
AT&T Technologies, Federal Systems Div.
Avco Systems Textron
Battelle Memorial Institute
BDM Corp., The
Beech Aircraft Corp.
BEI Defense Systems Co., Inc.
Bell Aerospace Textron
Bell Helicopter Textron
Boeing Aerospace Co.
Boeing Co., The
Boeing Military Airplane Co.
Bristol Aerospace Ltd.
British Aerospace, Inc.
Brunswick Corp., Defense Div.
Burdeshaw Associates, Ltd.
Burnside-Ott Div. of Military Aviation
Calspan Corp., Advanced Technology Center
Canadair
Canadian Marconi Co.
Cessna Aircraft Co.
Chamberlain Manufacturing Corp.
Clearprint Paper Co., Inc.
Clifton Precision, Instruments & Life Support Div.
Colt Industries, Inc.
Computer Sciences Corp.
Comtech Microwave Corp.
Contel Federal Systems
Contraves Goerz Corp.
Control Data Corp.
Cryomec, Inc.
Cubic Corp.
Cypress International, Inc.
Data General Corp.
Datatape Incorporated
Douglas Aircraft Co., McDonnell Douglas Corp.
Dowty
Dynalectron Corp.
Eastman Kodak Co.
Eaton Associates, Inc.
Eaton Corp., AIL Div.
EDO Corp., Government Systems Div.
Educational Computer Corp.
E. I. du Pont de Nemours & Co.
Elbit/Inframetrics
Electronic Data Systems Corp.
Emerson Electric Co.
E-Systems, Inc.
Euromissile
Evans & Sutherland
Ex-Cell-O Corp., Aerospace Div.
Executive Management Group, The
Fairchild Communications & Electronics Co.
Fairchild Control Systems Co.
Fairchild Republic Co.
Fairchild Weston Systems, Inc.
Falcon Jet Corp.
Ferranti plc
Figgie International Inc.
Fluids Control Div. of LFE Corp.
Ford Aerospace & Communications Corp.
GA Technologies, Inc.
Garrett Corp., The
Gates Learjet Corp.
GEC Avionics, Inc.
General Defense Corp., Ordnance Div.
General Dynamics Corp.
General Dynamics, Electronics Div.
General Dynamics, Fort Worth Div.
General Electric Co.
General Electric Co., AEBG
Genisco Memory Products
GMC, Allison Gas Turbine Div.
GMC, Delco Systems Operations
Goodyear Aerospace Corp.
Gould Inc., Computer Systems Div.
Grumman Corp.
Grumman Data Systems Corp.
GTE Government Systems Corp.
GTE Government Systems Corp., Communications Systems Div.
GTE Government Systems Corp., Strategic Systems Div.
Gulfstream Aerospace Corp.
Harris Government Communications Group
Harris Government Support Systems Div.
Harris Government Systems Sector
Hayes International Corp.
Hazeltine Corp.
H. B. Maynard & Co.
Hercules Aerospace Div.
Honeycomb Co. of America, Inc.
Honeywell, Inc., Aerospace & Defense Group
Howell Instruments, Inc.
HR Textron, Inc.
Hughes Aircraft Co.
IBM Corp., Federal Systems Div.
IBM Corp., National Accounts Div.
Information Systems & Networks Corp.
Ingersoll-Rand Co.
Intermetrics, Inc.
Interstate Electronics Corp.
ISC Group, Inc.
Israel Aircraft Industries Int'l, Inc.
Itek Optical Systems, A Division of Litton Industries
ITT Defense Communications Div.
ITT Defense-Space Group
ITT Federal Electric Corp.
Jane's
John Deere Technologies Int'l, Inc.
Kaiser Electronics
Kelsey-Hayes Co.
King Radio Corp.
Kollsman Instrument Co.
Lear Siegler, Inc.
Lear Siegler, Inc., Avionic Systems Div.
Lewis Engineering Co., Inc.
Litton-Amecom
Litton Applied Technology
Litton Data Systems
Litton Guidance & Control Systems
Litton Industries
Lockheed Aircraft Service Co.
Lockheed-California Co.
Lockheed Corp.
Lockheed Electronics Co.
Lockheed Engineering & Management Services Co., Inc.
Lockheed-Georgia Co.
Lockheed Missiles & Space Co.
Lockheed Space Operations Co.
Logicon, Inc.
Loral Corp.
LTV Aerospace & Defense Co.
LTV Aerospace & Defense Co., Sierra Research Div.
Lucas Industries Inc.
MacDonald Dettwiler and Associates
Magnavox Advanced Products & Systems Co.
M.A.N. Truck & Bus Corp.
Marotta Scientific Controls, Inc.
Marquardt Co., The
Martin Marietta Aerospace
Martin Marietta Denver Aerospace
Martin Marietta Orlando Aerospace
MBB
McDonnell Aircraft Co.
McDonnell Douglas Astronautics Co.
McDonnell Douglas Corp.
MITRE Corp., The
Morton Thiokol, Inc.
Motorola Government Electronics
NORDAM
Northrop Corp.
Northrop Corp., Aircraft Div.
Northrop Corp., Electronics Div.
Odetics, Inc.
OEA, Inc.
Olympus Corp., Industrial Fiberoptics Dept.
O. Miller Associates
ORI, Inc.
Oshkosh Truck Corp.
Pan Am World Services, Inc., Aerospace Services Div.
PCF Defense Industries, A Division of PACCAR
Perkin-Elmer Corp.
Planning Research Corp.
Products Research & Chemical Corp.
Rand Corp.
Raytheon Co.
RBI, Inc.
RCA, Government Systems Div.
RECON/OPTICAL, Inc., CAI Div.
Rediffusion Simulation, Inc.
Republic Electronics, Inc.
Rockwell Int'l Collins Government Avionics Div.
Rockwell Int'l Corp.
Rockwell Int'l Defense Electronics Operations
Rockwell Int'l North American Aircraft Operations
Rockwell Int'l North American Space Operations
Rohr Industries, Inc.
Rolls-Royce, Inc.
ROLM Mil-Spec Computers Div.
Rosemount Inc.
Royal Ordnance, Inc.
Sabreliner Corp.
Sanders Associates, Inc.
Schneider Services International
Science Applications Int'l Corp.
Short Brothers USA, Inc.
Singer Co., The
Singer Co., The, Link Flight Simulation Div.
Smiths Industries, Aerospace & Defence Systems Co.
SofTech
Space Applications Corp.
Space Communications Co.
Space Ordnance Systems
Sperry Corp.
Standard Manufacturing Co., Inc.
Sundstrand Corp.
Sverdrup Corp.
Syscon Co.
System Development Corp., A Burroughs Co.
Systems and Applied Sciences Corp.
Systron Donner, Safety Systems Div.
Talley Defense Systems
Teledyne CAE
Teledyne, Inc.
Teledyne Ryan Aeronautical
Texas Instruments, Defense Systems & Electronics Group
Thomson-CSF, Inc.
Tracor, Inc.
Trident Data Systems
TRW Electronics & Defense Sector
TRW Space & Technology Group
Turbomach Div. of Sundstrand Corp.
United Airlines Aircrew Training, Inc.
United Technologies Corp.
UTC, Chemical Systems
UTC, Hamilton Standard
UTC, Norden Systems, Inc.
UTC, Pratt & Whitney
UTC, Research Center
UTC, Sikorsky Aircraft
VAC-HYD/Interturbine Companies
Varo, Inc.
Vega Precision Laboratories
V. Garber Int'l Associates, Inc.
Vitro Corp.
Walter Kidde Aerospace Operations
Western Gear Corp.
Westinghouse Electric Corp.
Westinghouse Electric Corp., Baltimore Div.
Westland Technologies, Ltd.
Wild & Leitz Technologies Corp.
Williams International
Wyman-Gordon Co.

THERMIONIC



Space Power

from Kilowatts to Gigawatts... compact, reliable, survivable

Thermionic space power systems scale smoothly from a few kilowatts to gigawatts, and reflect an extensive technology data base developed over the last 20 years. These simple, reliable systems have no moving parts. By converting heat to electricity within the reactor, they eliminate the need for high temperature heat transfer systems. Heat rejection at high temperature results in a low on-orbit mass and volume, making even the THOR multimegawatt system shuttle-compatible. Thermionic systems are inactive and inherently safe during launch, and are highly survivable because of their small sizes, high temperature radiators, and invulnerable power conversion systems.

For more information, call
Al Moorman, Director,
Advanced Programs
(619) 455-3702.
GA Technologies Inc.,
P.O. Box 85608,
San Diego, California 92138.

GA Technologies

The Lady Was a Tiger

Lt. Regina Aune's act of valor typified the heroism that abounded following the tragic crash of a C-5 at Saigon.

BY JOHN L. FRISBEE
CONTRIBUTING EDITOR

THE spring of 1975 was a time of terror and uncertainty in South Vietnam. Its army, denied further American support by the US Congress, was disintegrating before North Vietnamese attacks in the Central Highlands. By the dawn of April, the Saigon government teetered on the brink of collapse. All President Gerald Ford could do to salvage a vestige of American honor was to rescue some of the South Vietnamese who were most likely to suffer under a Communist regime. On April 3, he directed the Air Force to begin by flying 2,000 orphans, many under the care of an American-operated hospital in Saigon, to a refuge in the United States.

Operation Babylift got under way the following day. At Clark Air Base in the Philippines, a Saigon-bound C-5 picked up a medical team headed by flight nurse Lt. Regina Aune. The giant cargo hauler was not equipped for medical evacuation, its cockpit crew had never flown such a mission, and none of the medical team had been in a C-5 before. On the way to Saigon, Lieutenant Aune and her team were briefed on the plane's facilities and systems. The Lieutenant planned to put her small patients, some of them ill and some only a few months old, on the upper deck, which had seats and emergency oxygen masks.

". . . waded again and again through the mud to hovering choppers."

When aircraft commander Capt. Dennis Traynor landed at Tan Son Nhut, Lieutenant Aune discovered that she would have about 250 orphans and several sick adults to care for on the flight back to Clark. Many of them would have to ride in makeshift accommodations on the lower cargo deck. A five-person medical team from a C-141 volunteered to help care for the unexpectedly large number of children on the flight. When all were aboard, Lieutenant Aune stationed herself, flight nurse Mary Klinker, and two medical technicians on the lower deck, where work would be most difficult.

A few minutes out of Saigon, Regina Aune climbed the ladder to the upper deck to get medicine for a patient. As she started back, an explosion blew off the plane's pressure door, center cargo door, and a large section of the loading ramp aft of the cargo compartment. Instantaneous decompression filled the fuselage with fog, dust, and blowing objects. Captain Traynor immediately turned back toward Saigon and began a rapid descent from 23,000 feet. Two hydraulic systems were out, and most of the control cables had been cut when the cargo door blew off, leaving him only engine power to regulate the plane's pitch.

He and copilot Capt. Tilford Harp, in what MAC Commander in Chief Gen. Paul Carlton called "one of the greatest displays of airmanship I have ever heard related," nursed the C-5 back to within two miles of Tan Son Nhut, where they first touched down in a rice paddy at 270 knots. The huge plane finally came to rest a half mile beyond touchdown, broken into four sections.

Lieutenant Aune, who was in the aisle at the time of impact, was hurled the length of the upper compartment. In the shock and confusion of the crash, she realized that her right foot was broken, and she was bleeding heavily from cuts in her left arm and leg. Dragging herself off the deck, she checked the condition of the passengers, opened an emergency exit, and began helping the crew and surviving medics remove children from the shattered fuselage. The wreckage lay in waist-deep mud and water, saturated with fuel. Nearby were burning parts of the plane. One spark could turn the area into an inferno.

Within five minutes, rescue helicopters from Saigon arrived and—unable to land on the sodden ground—hovered close to the wreckage. Regina Aune, together with crew members, waded again and again through the mud to hovering choppers, their arms full of terrified children. How long Lieutenant Aune struggled before losing consciousness she doesn't remember. At a Saigon hospital, it was discovered that, in addition to deep lacerations and her injured foot, she had a fractured leg and a broken bone in her back. But mastering pain and shock, she had helped carry 149 children to safety.

One October day the following year, Capt. Regina Aune stood in the office of Air Force Chief of Staff Gen. David Jones to receive the Cheney Award for 1975, recognizing an act of valor "in a humanitarian interest performed in connection with aircraft." She was the first woman, and to this time the only one, to earn that honor.

Regina Aune felt that in accepting the award, she represented the entire crew aboard the C-5, including the eleven who perished in the crash. In a sense, that was true, but none of the eighteen surviving crew members, all of whom were decorated for heroism, deserved to be honored more than she. ■

AIRMAN'S BOOKSHELF

From A to Vietnam

Vietnam War Almanac, by Col. Harry G. Summers, Jr., USA (Ret.). Facts On File, Inc., New York, N. Y., 1985. 416 pages with photographs, maps, bibliography, and index. $24.95.

Vietnam War Almanac is not just another book about Vietnam. What distinguishes this book from others is that it presents a wide range of information on virtually every aspect of the conflict in an objective and easy-to-understand manner.

Author Col. Harry G. Summers, Jr., looks closely at every element of the war from a number of different vantage points—military, political, social, diplomatic, strategic, and tactical. His unique perspective as a combat infantry veteran of Korea and Vietnam adds a dimension of credibility to this sourcebook. Colonel Summers is Senior Military Correspondent for *U.S. News & World Report* and is the author of the highly praised *On Strategy: A Critical Analysis of the Vietnam War.*

Written and organized for easy access, the one volume takes into account all perspectives on the conflict and gives the reader the facts necessary to form his or her own conclusions about the war. For example, the reader will find excellent descriptions of such controversial topics as the civil rights movement, antiwar protests, diplomatic and military strategy, and pacification. This book reveals clearly the complexity and diversity of America's quarter-century involvement in Vietnam.

From the arrival of the first American military mission to the Associated States of Indochina on September 17, 1950, until the last American military forces were helicoptered from the roof of the US embassy in Saigon on April 30, 1975, almost 3,500,000 American soldiers, airmen, sailors, Marines, and Coast Guardsmen served in Southeast Asia. Colonel Summers stresses that the war had a profound effect on the way that *all* Americans think of themselves and their nation, regardless of whether or not they actually ever served in Vietnam.

The *Almanac* consists of three sections. In Part I, readers are introduced to Vietnamese history from ancient times until 1959 and find a description of the physical setting of the country. This section also analyzes the significance of Vietnam's historical and physical realities in shaping American policy in the area. Special emphasis is placed on the French Indochina War of the 1950s and on identifying American misperceptions about the country and its people.

Colonel Summers stresses that it was not until 1958, well after the US became involved in Southeast Asia, that the first English-language history of Vietnam, Joseph Buttinger's *The Smaller Dragon,* was published in the US. As a result, says Colonel Summers, there was an almost complete lack of knowledge—not only among the American people but in academia and government as well—about the geography, history, and culture of Vietnam.

Part II is a detailed chronology of military and political events—both in Vietnam and America—from 1959 to the fall of Saigon in 1975.

The heart of the book is Part III. This section contains 500 articles, arranged alphabetically, on the people, battles, terms, weapons, controversial issues, and key concepts of the conflict. Many of these articles include cross-references and suggestions for further reading.

From a definition of "ace"—downing five enemy aircraft—to a short biography of Adm. Elmo R. Zumwalt, Jr., former commander of US Navy Forces Vietnam, the reader will find scores of little-known facts delivered in a straightforward style. More than 200 US military and enemy units are listed, and portraits of such individuals as Henry Kissinger, Martin Luther King, Jr., Dr. Benjamin M. Spock, and former Texas senator John G. Tower are featured. The reader will also find details on such significant military operations as Bolo, Rolling Thunder, Linebacker, and others. War-related happenings on the home front—the Pentagon Papers, the trial of the Chicago Seven, and the Kent State shootings—are explained as well.

The text is supported by more than twenty maps, such as those illustrating population distribution and the location of ethnic groups, and more than 120 photographs. The notorious "shoot-down" series of postage stamps issued by Hanoi as part of its air defense campaign is pictured in this extensive collection. Also, a variety of tables provides additional information, such as that on the number of US military casualties by service, with general data on those wounded and missing as a result of hostile action.

Colonel Summers has written a book for the serious student of the Vietnam War. It will appeal to military personnel, veterans, and anyone who wants to learn about America's longest war. It is the best book on Vietnam that I have yet read.

—Reviewed by Maj. Michael B. Perini, USAF. Major Perini is Deputy Chief, Operational Forces Branch, Media Relations Division, Secretary of the Air Force Office of Public Affairs.

Lessons of the Pacific War

Eagle Against the Sun: The American War With Japan, by Ronald H. Spector. The Free Press, New York, N. Y., 1985. 589 pages with maps, photographs, bibliographic notes, and index. $24.95.

Ronald Spector's *Eagle Against the Sun* is first-rate military history, the best single-volume history on America's World War II victory in the Pacific and fully deserving of a prominent place on any airman's bookshelf. Spector's research is solid, his judgments are sound, his treatment of controversy is objective, his coverage of all aspects of the fighting—air, sea, and land—is balanced, his discussion of the human dimension of the war is sensitive, and his writing is graceful. I have never read a military history that better amalgamates strategy, opera-

tions, and social issues. Most importantly for the professional airman, the author draws lessons for the military of today and tomorrow.

Spector's most telling criticisms concern the lack of cooperation among each side's armed forces. Because Congress and the press have recently focused on "jointness," Spector's emphasis on this area is particularly apropos.

He writes, "Both Japanese and Americans paid a price for the tradition of separateness and rivalry among their respective armed services. . . . [F]or the United States . . . the story [is] not . . . how the services forgot their differences, but rather one of the ingenuity displayed by service leaders in devising courses of action which allowed them to get on with the war without having to settle their differences." Elsewhere, Spector complains that the "two-pronged advance across the Pacific by Nimitz and MacArthur . . . was due less to strategic wisdom than to the Army's and Navy's reluctance to entrust their forces to the command of an officer of the rival service."

Yet American inability to fight jointly was as nothing compared to the Japanese problem, which saw sulfurous relations between the Imperial army and navy both before and during the war. Before December 1941, the Japanese navy, out of budgetary concerns, hid from the army its strategic shortcomings and utter pessimism regarding a war against the United States. When the tide seemed to flow toward a war with the US, the navy saw no alternative but to vote for war because of positions it had taken over the previous decade. The admirals had no confidence in victory—in fact, the reverse—but the Japanese army was ignorant of both Imperial navy capabilities and the navy's extreme despair.

Desperate rivalry continued throughout the war, and many Japanese died because of this failure of leadership. In fact, of all the causes of Japan's defeat—and there were many—the vast gulf between the army and navy looms largest.

Nearly as significant as uncoordinated armed forces in contributing to the Japanese defeat was Japan's relative industrial weakness. "In the end, it was superior American industrial power" that overwhelmed Japan, Spector writes. "The Pacific war was in many respects a war of attrition." By mid-1944, Japan had been effectively defeated, because her "supply lines had been severed by American submarines, her airpower had been dissipated in costly air battles," and "her cruiser and destroyer forces had been worn down in countless night clashes. . . . The war of attrition—and even more deadly attrition by submarines and heavy bombing in 1944–45—finally spelled Japan's defeat."

Japan entered the war with a weak manufacturing base and an even weaker resource base. The United States mobilized all of its resources to a much higher degree and crushed Japan, even though the US placed the weight of her effort on the European theater.

The nagging question in 1986, of course, is whether or not the United States today could repeat its logistical triumph of the 1940s. Logistical considerations are even more disconcerting in light of the present-day asymmetry between the US and Soviet submarine fleets.

During the Pacific war, US Navy submarines were the major killers of Japanese shipping. America began the war with the best submarines and crews, but the worst torpedoes. Operational research improved the torpedoes, and the submariners set about destroying Japanese maritime forces.

By the end of 1944, 2,700,000 tons of shipping had been sunk, amounting to half of the merchant fleet and two-thirds of the tankers, including replacements. This devastation was wreaked by a force comprising fewer than two percent of US Navy personnel—that is, several thousand submariners accounted for more than fifty-five percent of Japan's losses at sea. They sank more than 1,300 Japanese ships, including a battleship, eight aircraft carriers, and eleven cruisers.

Finally, Spector reminds us that the Pacific war "dehumanized both victor and vanquished." During the war, "Americans came to abandon some of the principles which they had long upheld. A nation which had entered the First World War in large part out of opposition to unrestricted submarine warfare deliberately chose to wage such warfare from the opening day of World War II. Similarly, American opposition to the Japanese conquest of China rested largely on revulsion against Japanese use of airpower on civilian targets. Yet the United States itself initiated an unprecedented campaign of aerial bombardment against Japan."

There is much food for thought in *Eagle Against the Sun.* It is a book worth reading because it reminds us to focus consistently on defense, forces us to pay attention to our submarine fleet and the logistical substructure that is necessary to fight a major war, and compels us to recognize the dire costs of not fighting jointly.

—Reviewed by Col. Alan L. Gropman, USAF. Colonel Gropman is Deputy Director of Air Force Plans for Planning Integration and a frequent reviewer for AIR FORCE *Magazine.*

New Books in Brief

The Evolution of the Cruise Missile, by Kenneth P. Werrell. The concept of the cruise missile, which Billy Mitchell once described as "a weapon of tremendous value and terrific force to airpower," is venerable by the relatively brief historic standards of powered flight. Throughout the extensive history of the cruise missile, however, deficiencies in guidance and propulsion retarded its full exploitation as an effective military weapon. Recent strides in technology have mitigated these problems, and the cruise missile is now a major weapon in the modern armories of the world's military forces. Author Werrell here traces the development of the cruise from the early "flying bombs" to the sophisticated, electronics-laden models now coming off the drawing boards. With photos, notes, appendices, and index. Published by the Center for Aerospace Doctrine, Research, and Education; available from the Superintendent of Documents, US GPO, Washington, D. C. 20402, 1985. 289 pages. $7.

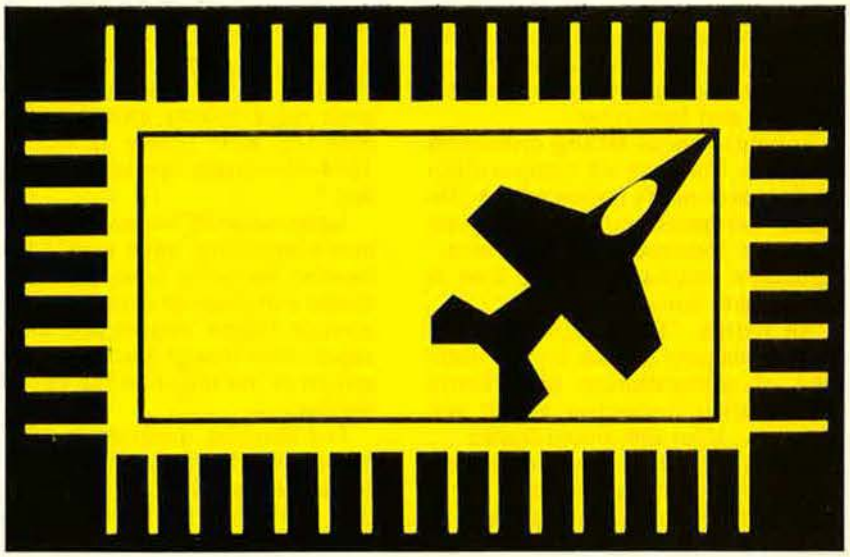
Vought A-7 Corsair II, by Robert F. Dorr. Author Dorr here steps into a breach in aviation literature with this detailed exposition on the hardy attack aircraft known affectionately by its pilots as "SLUF" (discretion enjoins a spelling out of this acronym). Development, combat history, variants, and technical specifications are covered in depth, with 160 black-and-white photographs and a special eight-page color photo section complementing the text. Also featured are appendices on manufacturing history, units flying the Corsair, and conversion aircraft. This entry in the Osprey Air Combat series is unquestionably timely in light of Vought's proposal to upgrade the Corsair to a "Strikefighter" configuration *(see also "Aerospace World," p. 34, April '86 issue).* Motorbooks International, P. O. Box 2-Rev, 729 Prospect Ave., Osceola, Wis. 54020, 1985. 200 pages with glossary and index. $14.95.

—Reviewed by Hugh Winkler, Assistant Managing Editor.

Announcing an AFA National Symposium...

Electronics and the Air Force

(C^3I and EW)



WHO: National AFA, in conjunction with Air Force Systems Command and its Electronic Systems Division.

WHAT: An in-depth look at major electronics requirements and at developments and capabilities in electronics, C^3, and electronic warfare.

WHEN: June 26, 1986.

WHERE: Boston area—near Hanscom AFB. Marriott Boston Newton Hotel, 2345 Commonwealth Ave., Newton, Mass. 02166 (Route 128/Interstate 95 and intersection of the Mass Turnpike/Interstate 90).

Since 1982, our National Electronics Symposia in the Boston area have established a proud tradition of excellence. Both government and industry leaders have told us of their utility. Thus, we have scheduled another symposium for June 1986—with a brand-new, one-day format for the busy executive.

Gen. Lawrence A. Skantze, Commander, Air Force Systems Command, will keynote this symposium. The featured dinner speaker will be the Hon. Donald C. Latham, Assistant Secretary of Defense for C^3I. Other symposium speakers include Lt. Gen. Melvin F. Chubb, Commander, Electronic Systems Division; Lt. Gen. James A. Abrahamson, Director, Strategic Defense Initiative; Maj. Gen. Gerald L. Prather, Commander, Air Force Communications Command; Maj. Gen. Thomas S. Swalm, Commander, Tactical Air Warfare Center, TAC; and Dr. Elizabeth Berman, Assistant Secretary of the Navy for C^3IS. Additional high-level speakers have been invited. The symposium will also feature presentations on Project Forecast II and the Defense Nuclear Agency.

Make your plans now to attend! For more information, call Jim McDonnell or Dottie Flanagan at (703) 247-5800.

REGISTRATION FORM

A 1986 Air Force Association National Symposium "Electronics and the Air Force"

Boston Marriott Hotel Newton
Newton, Massachusetts
June 26, 1986

Registration closes Monday, June 16, 1986. No refunds can be made for cancellations after that date.

Mail this form to: Air Force Association
Attn: Miss Flanagan
1501 Lee Highway
Arlington, VA 22209-1198
(703) 247-5805

NAME (Print) _____

TITLE _____

AFFILIATION _____

ADDRESS _____

CITY, STATE, ZIP _____

TELEPHONE: (Code) _____ (No.) _____

I am enclosing my check for $250.00, payable to the Air Force Association, to cover the Symposium fee for an AFA individual or Industrial Associate member. This fee includes one (1) dinner and one (1) luncheon ticket. (Note: Fee for non-member is $275.00)

_____ Mark here if an extra guest dinner ticket is desired. Enclose $70.00 for the additional ticket.

_____ Mark here if an extra guest lunch ticket is desired. Enclose $40.00 for the additional ticket.

AFA INTERCOM

By Robin L. Whittle, AFA DIRECTOR OF COMMUNICATIONS

On the Scene

All too often, one experiences half-hearted work done by those too easily satisfied with "the way we've always done it," says **Bill Ryon,** National Vice President, Central East Region. But that's not the case with the Thomas W. Anthony Chapter's news magazine, *Allegiance*. The Anthony Chapter, located near Andrews AFB, Md., and in Mr. Ryon's region, began publishing *Allegiance* a short time ago as a newsletter. Under the direction and nurturing of Editor **T. J. duCellier** and her editorial board, *Allegiance* has matured into a news magazine that has become self-sustaining through advertising. "A Commitment to Serve" is the theme of the Winter '86 issue, which includes articles on the Civil Air Patrol and the local Air National Guard.

The publication is an impressive vehicle for communicating important issues to Chapter members in a way that enhances the Anthony Chapter image. Congratulations to Editor duCellier, Editorial Review Board Chairman **Sam O'Dennis,** Ad Director **Dana Spencer,** Chapter President **Spann Watson,** and to all of the others who make this publication effective.

AFA's Lance Sijan/Colorado Springs Chapter was recently briefed on how Soviet military goals affect ordinary Soviet life. Navy **Capt. Richard Life,** an intelligence officer with NORAD who served as the assistant Naval attaché to Moscow from 1974 to 1976, explained that while the Soviets spend thirteen to fifteen percent of their gross national product on the military each year and have 5,000,000 people in uniform, fifty-five percent of the Soviet people live without indoor plumbing and twenty percent of those in urban areas share bathrooms and kitchens with two or more other families. Average family income totals only 200 rubles (about $250) a month, he said.

Captain Life told the AFA crowd that the Soviet government goes to great lengths to convince its people that national security is worth the price. Soviet officials respect the US for our "strong national economy and raw military power," he noted.

"They want to avoid war with the West. They will honor treaties to the letter. And I say to the letter because the spirit of an agreement is not something that comes to the mind of a Soviet. They do not understand Greek and Roman law, upon which our own laws are based." Captain Life said the Soviets respect US vital interests, so while they might try to "take advantage of unrest in the Philippines, they would probably back off if the US challenged Soviet efforts there."

AFA's Southern Indiana Chapter celebrated its sixth anniversary at a dinner at Jeremiah Sweeney's restaurant on March 25. Chapter President **Marcus Oliphant** said that the event featured a presentation by **Lt. James Morris** on the Civil Air Patrol and a film on Air Force operations in Southeast Asia. The film was shown by a contingent from AFROTC at Indiana University. During the evening, Cadets **Cathy Chinn** and **George Kelley** were honored for their support of the Chapter.

Active Texas AFA leader **Maj. Gen. P. D. Straw,** TexANG (Ret.), was recently inducted into the Texas Guard Hall of Honor along with four other distinguished Texans. General Straw is Texas AFA Treasurer and Vice President of AFA's active Alamo Chapter. Prior to his retirement in 1977, he served as Chief of Staff of the Texas ANG. **Brig. Gen. Belisario Flores,** Assistant Adjutant General of Texas for Air, assisted in the induction cere-

What are these folks talking about? AFA's Gathering of Eagles, that's what. More than 5,000 people attended the five days of symposia, reunions, and other events and activities that took place in Las Vegas, Nev., April 27 to May 1. These dignitaries, part of a group of nineteen foreign air chiefs or their representatives and fifty-one air attachés or deputy attachés who were present at the Gathering, are watching the USAF Tactical Capabilities Exercise at nearby Indian Springs Auxiliary Field. A complete report will appear in our July issue. (Photo by Scott Harke)

monies . . . Retired MAC Commander in Chief **Gen. Robert E. Huyser** was expected to draw a large crowd to the General Robert F. Travis Chapter's tenth awards banquet on April 18.

AFA's Mid-Ohio Chapter held its tenth annual awards banquet on April 4. **Sergei V. Jackson, Jr.,** Newark, Ohio, City Engineer, was honored with the Robert L. Staats Award for Excellence in Engineering, while **Steven Plumber,** Dow Chemical, received the Joseph R. Sinsabaugh Community Service Award. **William A. Jones,** a maintenance specialist at Newark AFS, was named Outstanding Employee, and **Maj. Steven M. Hoar,** Assistant to the Newark AFS Commander, picked up honors as the Outstanding Active-Duty Military Person of the Year. Other award recipients included **Fay M. Hoskins,** Office of the Director of Maintenance, who was honored as Outstanding Manager of the Year, and **SMSgt. Larry R. Altman,** from the Aerospace Guidance and Metrology Center at Newark AFS, who was named the Outstanding Air Reservist of the Year. Mid-Ohio Chapter President **Cecil Hopper** says some seventy guests turned out to thank Chapter Secretary **Charles Skidmore,** Vice President **Ted Crosier,** Banquet Director **Rocky Morris,** and all the others involved for their efforts

INTERCOM

AFA REGIONAL REPORT

North Central Region—Land of Infinite Variety

The North Central Region is one of AFA's smaller regions, but our region—comprising the states of Minnesota, North Dakota, and South Dakota—could be dubbed the "land of infinite variety," where millions of acres of ranch and farm lands surround budding high-tech industrial growth.

South Dakota is famous for Mount Rushmore, part of the Black Hills where gold was discovered in 1874, and the Homestake Mine, which is still the greatest gold producer in the Western Hemisphere. South Dakota is mainly an agricultural state. Farms and ranches cover about nine-tenths of the land area.

In North Dakota, where soil is the most precious resource, farming comes first. There are also enormous mineral resources, including one of the nation's largest oil reserves and the nation's largest coal reserve, boasting more than 350,000,000,000 tons of lignite coal. Oil wasn't discovered in North Dakota until 1951, but it quickly became one of the state's most valuable resources as well.

These two states are home to the second largest strategic nuclear force in the world. In fact, close to 80,000 square miles of territory in the entire North Central Region are devoted to America's national defense. Ranchers have Minuteman missile silos and launch control centers right on their land, and many take great pride in aiding in the nation's defense. Volunteers are always ready to help military personnel in keeping roads passable during adverse weather conditions. AFA National Director Jan Laitos, who hails from South Dakota, says AFA has worked hard to encourage military-civilian cooperation. Farmers and ranchers who are AFA members are extremely loyal to AFA and travel great distances to attend chapter meetings.

Minnesota, once known as the bread-and-butter state because of its farms, grain mills, and dairy industry, makes more butter than any other state and is the leading producer of milk and cheese. Iron mining and taconite mining are two of the principal industries of Minnesota. Duluth, in the northern part of the state, is a major seaport, with oceangoing vessels arriving nearly every day. The twin cities of St. Paul and Minneapolis are best known for their high-tech industries. The 3M Co., Sperry Division of Univac, and Northwest Airlines are based in St. Paul, along with dozens of smaller industries. Minneapolis is home to Honeywell, Control Data, General Mills, Pillsbury, and many other smaller industries. The world-famous Mayo Clinic is in Rochester, Minn.

Paul G. Markgraf is the AFA National Vice President for the North Central Region.

The small size of this diverse region allows for a close rapport between AFA and local, state, and national government officials. All of the region's congressmen, for instance, belong to an AFA chapter.

The North Central Region continues to grow in size and effectiveness. North Dakota AFA was honored in 1983 with AFA's prestigious Storz Award for membership, and, in 1984, the General David C. Jones Chapter in Minot, N. D., was named AFA's outstanding chapter for its size category (401–900 members).

During the past year, the region sponsored many outstanding events. In one such program, the General E. W. Rawlings Chapter hosted then-Chairman of the Joint Chiefs of Staff Gen. Jack Vessey at a chapter function.

—Paul G. Markgraf, National Vice President for the North Central Region.

Minnesota

Minnesota AFA became active again in March 1984. The state, led by Earl M. Rogers, Jr., has two chapters—the General E. W. Rawlings Chapter in the St. Paul area and the Richard I. Bong Chapter in Duluth. Doyle E. Larson, former Commander of Electronic Security Command, leads the Rawlings Chapter, and John R. Hed is President of the Richard I. Bong Chapter.

The Rawlings Chapter sponsored an "Enlisted Emphasis Day" in October, hosting Chief Master Sergeant of the Air Force Sam E. Parish as the evening's banquet speaker. On Veterans Day, Chapter officials sponsored "Jack Vessey Day"—a day proclaimed by the Governor of Minneso-

in organizing the awards banquet.

The next day, Chapter officials served as judges at a high school science fair held at Denison University and awarded savings bonds worth $225 to the three top winners. The next big Chapter event, the Robert L. Mesmore Memorial Golf Tournament, will be held June 6 at the Raccoon Valley Golf Course in Granville. More than 100 local golfers are expected to participate.

George W. Baldwin, Jr., President of AFA's Arc Light Chapter on Guam, reports that more than 200 people turned out for the Chapter's awards banquet held in early March at the Andersen AFB Officers Club. The evening's guest speaker, **Maj. Gen. E. G. Shuler, Jr.,** Commander of 3d Air Division, discussed events surrounding the arrival of former Philippine President Ferdinand Marcos in Guam following the turnover in governments in the Philippines. During the banquet, **Lt. Charles A. Petty** was honored as Company Grade Officer of the Year, **Sgt. David R. Kontny** was named Airman of the Year, and **SMSgt. Ronald S. Diatoku** picked up honors as the Senior NCO of the Year.

C. Cliff Ball, AFA National Vice President for the South Central Region, recently presented the Force Employment-National Security Affairs Award for Class 86-B to **SMSgt. Allen L. Hooper,** 1723 CCS/CS, Hurlburt Field, Fla. . . . In other news, AFA's H. H. Arnold Chapter honored **Lt. Gen. William E. Thurman,** AFSC Vice Commander, as "Man of the Year," says Chapter President **Morton Gross-**

ta—to honor then-Chairman of the Joint Chiefs of Staff Gen. John W. Vessey. During the day, General Vessey was heard on WCCO radio, toured the Veterans' Home and Veterans' Hospital, and attended a luncheon at the local press club. That evening, General Vessey received awards and was surprised with a congratulatory message from President Reagan.

Other Rawlings Chapter events included a Civic Leaders Tour of NORAD and the Air Force Academy for forty community leaders from the Twin Cities and a luncheon meeting that focused on the defense industry in the state. The Chapter has also planned a banquet to honor all ROTC cadets attending local colleges and universities.

AFA's Richard I. Bong Chapter, formerly known as the Head of the Lakes Chapter but recently renamed in honor of the leading Army Air Forces ace of World War II, is led by John R. Hed. Chapter officials sponsored a joint civic club meeting with the Duluth Rotary Club in conjunction with the 49th Fighter Group annual reunion. During the meeting, some 400 people commemorated the dedication of the Richard I. Bong Memorial Bridge connecting Superior, Wis., and Duluth. The event included a presentation by Maj. Gen. Donald Hutchinson, USAF (Ret.), who discussed the valor exhibited by such young WW II airmen as Bong. Minnesota AFA President Earl M. Rogers showed a videotape on Major Bong's WW II aerial exploits, which included forty victories in the P-38 Lightning. Another meeting, held with the local Rotary Club, featured Air University's National Security Briefing Team.

At another Chapter event, Maj. Jim McGuffey, USAF Liaison Officer to the Minnesota Civil Air Patrol Wing, discussed the CAP mission and local activities. Also at the meeting were Maj. Jim Johnson, Commander, CAP Group I, who was recently promoted to Deputy Wing Commander, and CAP Capt. Llynn Hegrenes, Duluth Squadron Commander, who also discussed CAP missions.

North Dakota

North Dakota AFA is led by Mike Langlie and has four chapters. In August, AFA's General David C. Jones Chapter hosted the state convention at the Minot Holiday Inn. Convention speakers included Kim Fundingsland, who appeared as Gen. George Armstrong Custer, and Col. Christopher Branch, Commander, 91st Strategic Missile Wing at Minot AFB, among others.

AFA's Concrete Mixers Chapter is led by Thomas V. Charbonneau and is located in the Langdon area. Michael J. Haugen leads AFA's Happy Hooligan Chapter in Fargo. AFA's General David C. Jones Chapter, which hosted the 1985 state convention in Minot, also sponsored a dinner for USAF's "Tops in Blue," which had performed at Minot State College in September. The Chapter is led by Carroll W. Erickson.

The Red River Valley Chapter, located in Grand Forks, is led by Mike Phillips and, during 1985, was led by President Ralph Kerr. Some 500 people turned out for the Chapter's recent "Fish Fry," which featured Gen. Larry D. Welch, CINCSAC, as the guest speaker. The Chapter presented awards to the 319th Organizational Maintenance Squadron, the Family Practice Clinic, the 321st Transportation Squadron, the 321st Organizational Missile Maintenance Squadron, and the Grand Forks AFB public affairs office. The Chapter's annual Military Ball and Awards Banquet was held in February 1985, with Rep. Byron Dorgan (D-N. D.) as speaker. More than 450 guests turned out for the evening's festivities.

In April 1985, then-AFA Executive Director Russ Dougherty was the guest of honor and speaker for another "Fish Fry" that kicked off the Chapter's membership drive. The event attracted more than 450 people. Each year, Chapter officials donate funds to "Operation White Christmas," which provides food items to needy Air Force families during the holiday season. In 1985, donations served 135 Air Force families, thanks to the contributions from the Red River Valley Chapter and other leading civic groups that participate in this program. The program is sponsored by the Grand Forks AFB Chapter of the NCO Academy Graduates Association. The Chapter also contributes to the Grand Forks AFB museum.

During the past year, the Chapter was recognized with a certificate of appreciation from base Professional Military Education Program officials at the final graduation ceremony for 1985. The Chapter will host the 1986 state convention.

South Dakota

John E. Kittelson is President of South Dakota AFA, which includes two chapters. During the past year, President Kittelson spoke on Soviet military policy and the Soviet military buildup before the Minnehaha County Republican Women's Club and the South Dakota Arnold Air Society Dining-In. The state has also worked actively to enumerate the dangers of a nuclear freeze and "nuclear-free zones" and has labored to educate local citizens on the importance of a strong, credible national defense posture. These efforts have concentrated on several community groups, including religious organizations.

AFA's Dakota Chapter in the Sioux Falls area is led by Dean C. Hofstad. The Chapter meets with local community and military organizations to sponsor joint activities and meetings. In September, a meeting was held with the local Rotary Club, with more than 250 key community leaders attending. Brig. Gen. Ervin J. Rokke from the Air Force Academy appeared as guest speaker at the meeting. In November, President Hofstad addressed the Cosmopolitan Club on "AFA's Importance to the Local Community."

R. G. McCracken leads AFA's Rushmore Chapter in Rapid City. The Chapter supports the South Dakota Air/Space Museum at Ellsworth AFB, and several Chapter members serve on the museum board. Several members also serve on the Military Affairs Committee of the local Chamber of Commerce. In other activities, Chapter officials helped to sponsor an Ellsworth AFB crew for the SAC-wide Weapons Loading Competition and supported the joint NASA and National Geographic Society Fiftieth Anniversary Balloon Launch in the Black Hills.

INTERCOM

man. General Thurman was also invested as a Jimmy Doolittle Fellow of AFA's Aerospace Education Foundation. **Walt Ruina** received the Chapter's Past President's Award and accepted an Ira Eaker Fellowship in memory of **Francis X. Battersby,** former chairman of the Chapter Executive Council and former Chapter president. **Capt. Riley Repko,** USAFR, served as banquet chairman.

Some 175,000 people turned out for the annual "Aerospace and Arizona Day" at Davis-Monthan AFB. The event featured the Thunderbirds and the Army's Golden Knights Parachute Team, and, prior to the festivities, AFA's Tucson Chapter sponsored the A&A Day's Appreciation Luncheon for 450 guests, says **Frank L. Smith,** active Tucson Chapter leader and former chairman of the Military Affairs Committee of the local Chamber of Commerce. Mr. Smith also serves on the Board of the Pima Air Museum. As part of A&A Day activities, Tucson Chapter officials sponsored a booth at Davis-Monthan at which visitors could be photographed in an A-10.

Cincinnati Chapter officials served as judges of the aerospace exhibits at the Cincinnati Engineering and Science Fair and awarded two plaques for outstanding work at the junior and senior high levels, reports **Ed Katz,** Chapter Secretary, who participated the presentations . . . Maryland AFA President **Francis O'Clair** presented the "Company Grade Officer of the Year" award to **Capt. Arthur G. Nelson** at a recent awards banquet. Captain Nelson is the Commander/Chief of Security Police, 6570th Security Police Squadron, at Brooks AFB, Tex.

Bob Cripes, general manager of Sherwood Metal Products, a Cleveland-based subsidiary of TRW, Inc., recently addressed AFA's Cleveland Chapter, reports Chapter leader **Jim Larkins.** At a meeting on March 27, Mr. Cripes discussed the company's work in manufacturing high-temperature, high-stress turbine blades that are critical to high-performance jet fighters.

At a Carl Vinson Chapter luncheon meeting in Warner Robins, Ga., some 250 people turned out to hear **Irv Burrows,** vice president and general manager of McDonnell Douglas Corp.'s F-15 program, discuss the air-superiority fighter and the new dual-role F-15E. The F-15E, a ground attack aircraft that retains air-superiority characteristics, is expected to roll out in December.

New Jersey AFA Membership Chairman **Amos Chalif** is raffling an all-expense-paid weekend at the Golden Eagle in Cape May in order to help bolster AFA membership and chapter treasuries. New Jersey chapters will earn a rebate based on total sales of the $1 ticket. As an incentive in promoting the raffle, members who sign up three new civilian members can put their names in the hat for free.

Richard E. Carver, Assistant Secretary of the Air Force for Financial Management, addressed AFA's Illini Chapter at a dinner meeting in early March, reports **Glen W. Wensch,** Illinois AFA Secretary. Secretary Carver delivered an outstanding address on key Air Force concerns and the effects of the Gramm-Rudman legislation. According to Mr. Wensch, Secretary Carver is scheduled to attend the Greater Peoria Chapter meeting when the Chapter is renamed in his honor. In related news, Mr. Wensch was recently honored by the University of Illinois College of Engineering for distinguished service in engineering. The award is given annually to five engineering alumni who have demonstrated outstanding leadership in planning and directing engineering work, fostering professional development of young engineers, and contributing to knowledge in the field of engineering.

Under Secretary of Defense for Policy **Fred Iklé** recently addressed AFA's Central Florida Chapter. In an interview with the Orlando *Sentinel,* Secretary Iklé warned that Nicaragua is merely the latest chapter "in the long-term expansion of the Soviet empire." In both the interview and his prepared remarks, Secretary Iklé spoke of imminent disaster "if the Marxists are allowed to consolidate their power" in Managua and predicted that the Sandinistas will expand into neighboring countries once they are certain of their base.

"I've just returned from a speaking engagement at the Charles A. Lindbergh Chapter of AFA in Westport, Conn., and I must pass along to you my highest praise for the most well organized, highly productive group of yours I've seen. From the first contact to the final goodbye, the attitude and enthusiasm exhibited by these folks was 'top-shelf,' " wrote **Lt. Gen. Bernard P. Randolph,** DCS for Research, Development, and Acquisition, in a

recent letter to AFA headquarters. In other Lindbergh Chapter news, President **John Henry Griffin** forwarded $500 to the Aerospace Education Foundation's Christa McAuliffe Memorial Fund in order to demonstrate "our commitment to the pioneering spirit of teachers everywhere."

AFA's Air Force Mothers' Chapter in Pennsylvania has been deactivated, but a new AFA chapter has been chartered in Montana. Named the Bozeman Chapter, it is led by **Ronald R. Glock.** In other chapter news, Washington AFA's Spokane Chapter has been renamed the Inland Empire Chapter.

Capt. John Painter, Colorado Air National Guardsman, was honored for his airmanship by AFA's Front Range Chapter at a meeting at Lowry AFB in March. Captain Painter landed an A-7 safely after a serious in-flight emergency, reports **Doug Stanley,** Front Range Communications Director. Captain Painter also received Tactical Air Command's Aircrew Distinction Award for his action.

Chuck Knox, head coach of the Seattle Seahawks pro football team, was the guest speaker at the Tacoma Chapter's Spring Social. McChord AFB military personnel, local AFJROTC cadets, and the Civil Air Patrol were honored at the event . . . **Col. Jimmy Cash,** former Commander of the 56th Tactical Training Wing at MacDill AFB, Fla., received an autographed painting of an F-4 by famed aviation artist **Keith Ferris** just after Change of Command Ceremonies at MacDill AFB. Florida Highlands Chapter President **Roy Whitton** made the presentation. Colonel Cash is the new Director of Operations, Ninth Air Force, at Shaw AFB, S. C., and flew F-4s in Vietnam.

AFA's newly active Paul Revere Chapter in the Boston area recently donated four VCRs to the enlisted dormitories at Hanscom AFB. The donation was made at the request of **Col. A. A. Zaleski,** Base Commander. The Chapter Council voted unanimously to contribute the videotape players, reports Paul Revere Chapter President **Bill Lewis** . . . **Gilbert W. Keyes,** NASA's deputy manager of Space Station/external affairs, recently addressed AFA's Greater Seattle Chapter.

Former Wild Weasel pilot **George E. Kennedy** addressed a joint meeting of AFA's Chicagoland-O'Hare Chapter, the local Association of Old Crows, and the Armed Forces Communications and Electronics Association. Kennedy, who flew more than 100 missions in Vietnam, explained how Wild Weasels were deployed to destroy radars directing SAM sites in Vietnam. Before the Wild Weasels were employed, Kennedy said that pilots had to fire at SAM sites after establishing visual contact, which proved ineffective due to the numerous "dummy SAM sites" constructed by the Vietnamese. By using sophisticated electronics operated by electronics warfare officers, Weasels were able to distinguish and pinpoint for destruction the operational SAM sites and their radars.

AFA's Goddard Chapter Community Partner effort appears to be picking up steam, reports Communications Director **Bob Griffin** in the February state newsletter. More than seventy small businesses and aerospace firms in the Santa Maria, Calif., area received invitations to hear about AFA and the Community Partner Program. Committee members gave a complimentary copy of AIR FORCE Magazine and a sample Community Partner plaque to their prospects.

The El Paso Aviation Council, in concert with AFA's Paso del Norte Chapter and leading local civic, military, business, and aviation organizations, recently sponsored a dinner that featured astronaut **Col. Joe Engle,** USAF, as the speaker and honored guest. ■

UNIT REUNIONS

AACS Alumni Ass'n
Airways and Air Communications Service alumni will hold their tenth reunion on September 18–21, 1986, in St. Louis, Mo. **Contact:** Claire Lofchie, 617 Shady Meadows, Ballwin, Mo. 63011. Phone: (314) 394-2952.

AAC Enlisted Pilots Ass'n
The Army Air Corps Enlisted Pilots Association will hold a reunion for former Army Air Corps/Army Air Forces enlisted pilots on October 1–5, 1986, in Sacramento, Calif. **Contact:** Donald E. Sturdevant, 3805 Arborlawn Dr., Fort Worth, Tex. 78109.

Dyersburg Army Air Base
A reunion will be held on July 4–6, 1986, at Dyersburg, Tenn., for any personnel who were stationed or who trained at Dyersburg AAB, Tenn., 1942–46. **Contact:** Tim Bivens, Rte. 5, Box 271, Dyersburg, Tenn. 38024.

Grim Reapers Ass'n
Members of the 13th Bomb Squadron "Grim Reapers" will hold a reunion on September 11–13, 1986, at the Golden Gate Holiday Inn in San Francisco, Calif. **Contact:** Griffis DeNeen, P. O. Box 735, Sevierville, Tenn. 37862. Phone: (615) 453-3467.

Pampa Army Airfield
Anyone who served at Pampa Army Airfield, Pampa, Tex., is invited to a reunion to be held on August 13–15, 1986. **Contact:** PAAF Reunion Association, P. O. Box 2015, Pampa, Tex. 79065.

Roswell/Walker Veterans
The Roswell AAF/Walker AFB Veterans Association will hold a reunion on September 26–28, 1986, at the Roswell Inn in Roswell, N. M. **Contact:** RAAF Veterans Association, P. O. Box 8092 (Linda Vista Station), Roswell, N. M. 88201.

1st Observation Squadron
The 1st Observation Squadron will hold its second reunion on September 9–12, 1986, in Junction City, Fort Riley, Kan. **Contact:** Col. Nester E. Cole, USAF (Ret.), 2732 Warwick Dr., Bloomfield Hills, Mich. 48013.

2d Air Division Ass'n
Members of the 2d Air Division Association, along with personnel from the 492d Bomb Group, will hold a reunion on July 11–13, 1986, at the Pheasant Run Resort in St. Charles, Ill. **Contact:** Elmer W. Clarey, 2015 Victoria Ct., Los Altos, Calif. 94022. Phone: (415) 961-0231.

2d Troop Carrier Squadron
The 2d Troop Carrier Squadron will hold a reunion in conjunction with the Hump Pilots Association on September 24–28, 1986, in Little Rock, Ark. **Contact:** John E. Scott, Jr., 1409 Parkway Dr., Griffin, Ga. 30223. Phone: (404) 229-4538. Hump Pilots Association, 808 Lester St., Poplar Bluff, Mo. 63901.

3d Strategic Support Squadron
Members of the 3d Strategic Support Squadron will hold a reunion on September 18–21, 1986, in Reno, Nev. **Contact:** Chuck Wynn, 119 Foothill Dr., Vacaville, Calif. 95688. Phone: (707) 448-8361.

4th Combat Cargo Squadron
The 4th Combat Cargo Squadron, 1st Combat Cargo Group, will hold a reunion on September 24–28, 1986, in Little Rock, Ark. **Contact:** Walt Glover, 711 18th St., Manhattan Beach, Calif. 90226. Phone: (213) 545-1058.

4th Fighter Squadron
Members of the 4th Fighter Squadron will hold a reunion on September 11–13, 1986, in San Diego, Calif. All members of the 2d and 5th Fighter Squadrons are also welcome. **Contact:** Leonard Kurka, 9421 Fermi Ave., San Diego, Calif. 92123. Phone: (619) 571-6150.

7th Photo Group Ass'n
The 7th Photo Group will hold a reunion on July 3–6, 1986, in Colorado Springs, Colo. **Contact:** Sam Quindt, 2318 Patrician Way, Colorado Springs, Colo. 80909. Phone: (303) 632-1045.

INTERCOM

8th Photo Recon Squadron Ass'n
The 8th Photo Reconnaissance Squadron will hold a reunion on September 25–29, 1986, at the Viscount Hotel in Orlando, Fla. **Contact:** Andrew J. Kappel, 6406 Walnut St., Kansas City, Mo. 64113. Phone: (816) 363-0261. Glen B. Bowers, 10631 E. Lynrose St., Temple City, Calif. 91780.

17th Bomb Group Ass'n
Members of the 17th Bomb Group will hold their reunion on September 24–27, 1986, in Albuquerque, N. M. **Contact:** 17th Bomb Group Reunion Association, 6776 E. Northwest Hwy., Dallas, Tex. 75231.

19th Bombardment Ass'n
The 19th Bombardment Association will hold a reunion on September 1–7, 1986, at the Westin Inn in Denver, Colo. **Contact:** James O'Day, 6132 Cherrywood Circle, Littleton, Colo. 80121. Phone: (303) 794-4805.

Coming Events

June 6–7, **Alaska State Convention,** Fairbanks . . . June 6–7, **Tennessee State Convention,** Tullahoma . . . June 13–14, **Idaho State Convention,** Boise . . . June 13–14, **New Hampshire State Convention,** Pease AFB . . . June 20–22, **Florida State Convention,** Cocoa Beach . . . June 20–22, **Ohio State Convention,** Cincinnati . . . June 21, **Louisiana State Convention,** Barksdale AFB . . . June 26–27, **Massachusetts State Convention,** Boston . . . June 26–27, **New Jersey State Convention,** Cape May . . . June 27–28, **Mississippi State Convention,** Columbus . . . June 28–29, **Georgia State Convention,** Atlanta . . . July 18–20, **Pennsylvania State Convention,** Wilkes-Barre . . . July 25–26, **Indiana State Convention,** Fort Wayne . . . July 25–26, **Texas State Convention,** Wichita Falls . . . August 1–2, **Colorado State Convention,** Colorado Springs . . . August 1–3, **New York State Convention,** Rome . . . August 8–9, **North Carolina State Convention,** Seymour Johnson AFB . . . August 9–10, **Arkansas State Convention,** Fort Smith . . . August 21–23, **California State Convention,** Riverside . . . September 15–18, **AFA National Convention and Aerospace Development Briefings & Displays,** Washington, D. C. . . . September 19–20, **Washington State Convention,** Tacoma.

22d Bomb Group Ass'n
The 22d Bomb Group will hold a reunion on August 28–September 1, 1986, in San Francisco, Calif. **Contact:** John E. Clark, P. O. Box 4734, Patrick AFB, Fla. 32925. Phone: (305) 636-5004.

38th Bomb Group
Veterans of the 38th Bomb Group will hold a reunion on October 2–4, 1986, at the Emerald Hotel in Anaheim, Calif. **Contact:** Harry E. Terrell, 20475 Upper Bay Dr., Santa Ana Heights, Calif. 92707. Phone: (714) 852-8015.

Class 41-F
Pilot Class 41-F (Brooks Field) will hold a forty-fifth anniversary get-together on August 14–16, 1986, in French Lick, Ind. **Contact:** M. G. Treat, 2601 Fairmont Ave., Dayton, Ohio 45419.

Class 42-A
Class 42-A (Brooks Field) will hold a reunion on September 26–28, 1986, at the Embassy Suites in Colorado Springs, Colo. **Contact:** John M. Winkler, 2212 Oakridge Lane, Colorado Springs, Colo. 80915.

44th Bomb Wing
The 44th Bomb Wing will hold its reunion on August 27–31, 1986, in Colorado Springs, Colo. **Contact:** William H. Topping, 1426 Vadera Ct., Fenton, Mo. 63026. Phone: (314) 225-7030.

57th Bomb Wing
The 57th Bomb Wing will hold its annual reunion on August 6–10, 1986, at the Red Lion Inn in Sacramento, Calif. **Contact:** Robert E. Evans, 1950 Cunningham Dr., Speedway, Ind. 46224. Phone: (317) 247-7507.

70th Fighter Squadron
The 70th Fighter Squadron will hold a reunion on September 11–14, 1986, at the Raintree Inn in Colorado Springs, Colo. **Contact:** Elbert Major, Rte. 4, Box 573, Lindale, Tex. 75771. Phone: (214) 882-5864.

75th Bomb Squadron
Members of the 75th Bomb Squadron will hold a reunion this year in Las Vegas, Nev. **Contact:** Paul T. Smith, 5409 Del Rey Ave., Las Vegas, Nev. 89109.

80th Fighter Group
Veterans of the 80th Fighter Group "Burma Banshees" will hold a reunion on September 18–20, 1986, at the Bahia Hotel in San Diego, Calif. **Contact:** George Schlagel, P. O. Box 3667, Seal Beach, Calif. 90740. Phone: (714) 854-1170.

81st Troop Carrier Squadron
The 81st Troop Carrier Squadron will hold a reunion on September 11–13, 1986, in Tucson, Ariz. **Contact:** T. W. Bonecutter, 620 Randolph St., Wilmington, Ohio 45177. Phone: (513) 382-4351.

93d Troop Carrier Squadron
The 93d Troop Carrier Squadron will hold a reunion on September 28–October 1, 1986, at the 49er Hotel in Jackson Hole, Wyo. **Contact:** Lt. Col. Thomas L. Morris,

USAF (Ret.), 456 St. George's Ct., Satellite Beach, Fla. 32937. Phone: (305) 773-6960.

313th Headquarters Squadron
Members of the 313th Headquarters Squadron and the 6th Bomb Group of Twentieth Air Force will hold a reunion on August 28–September 1, 1986, in Omaha, Neb. **Contact:** Joseph H. Cohen, 1171 Willimas Dr. S., St. Petersburg, Fla. 33705. Phone: (813) 866-8131.

315th Bomb Wing Ass'n
Members of the 315th Bomb Wing will hold their annual reunion on September 4–6, 1986, at the Marina Beach Hotel in Marina del Rey, Calif. **Contact:** George E. Harrington, 4600 Ocean Beach Blvd., Apt. 505, Cocoa Beach, Fla. 32931. Phone: (305) 784-0342.

315th Troop Carrier Group
Members of the 315th Troop Carrier Group will hold a reunion on September 25–28, 1986, in Seattle, Wash. **Contact:** William C. Conine, 16850 N. E. 6th, Bellevue, Wash. 98008. Phone: (206) 747-1456.

319th Bomb Group/Wing
Members of the 319th Bomb Group/Wing will hold their reunion on September 11–15, 1986, at the Marriott Hotel in Columbia, S. C. **Contact:** Neal A. Baker, Jr., 1831 S. Park Lane, Denison, Tex. 75020. Phone: (1-214) 465-0513.

325th Fighter Group
The 325th Fighter Group "Checkertail Clan" will hold a reunion on September 11–14, 1986, in Tucson, Ariz. **Contact:** Dan F. Penrod, 69 Keswick Ave., Pittsburgh, Pa. 15202. Phone: (412) 766-6190.

339th Fighter Group
The 339th Fighter Group will hold a reunion and a memorial dedication in England on September 19–26, 1986. **Contact:** Chet Malarz, 2405 Kings Point Dr., Atlanta, Ga. 30338.

352d Fighter Group
The 352d Fighter Group will hold a reunion on September 4–7, 1986, at the Ramada Inn-South, Dayton, Ohio. **Contact:** Richard J. DeBruin, 234 N. 74th St., Milwaukee, Wis. 53213. Phone: (414) 771-0744.

446th Bomb Group
The 446th Bomb Group (Bungay, England) will hold a reunion and memorial dedication on July 7–8, 1986, in Dayton, Ohio. **Contact:** W. F. Davenport, 13762 Loretta Dr., Santa Ana, Calif. 92705.

451st Bomb Squadron
Members of the 451st Bomb Squadron, 322d Bomb Group, will hold a reunion on September 5–7, 1986, in Minneapolis, Minn. **Contact:** James J. Crumbliss, 2014 Shady Grove Dr., Bossier City, La. 71112. Phone: (318) 742-1225.

452d Bomb Wing
The 452d Bomb Wing will hold a reunion on June 24–26, 1986, in Washington, D. C. **Contact:** Edwin E. Hatton, 419 W. Ewing, South Bend, Ind. 46613. Phone: (219) 233-8800.

453d Bomb Group
The 453d Bomb Group will hold a reunion on July 10–13, 1986, at the Pheasant Run Resort in St. Charles, Ill. **Contact:** Milton R. Stokes, P. O. Box 64, Westtown, Pa. 19395.

453d Bomb Squadron
Members of the 453d Bomb Squadron, 322d Bomb Group, will hold a reunion on September 12–14, 1986, at the Harley Hotel in Pittsburgh, Pa. **Contact:** C. V. Sochocki, 1314 N. Brookfield St., South Bend, Ind. 46628. Phone: (219) 233-6044.

459th Bomb Group
Members of the 459th Bomb Group will hold their reunion on September 25–28, 1986, at the Imperial House North in Dayton, Ohio. **Contact:** Dr. Byron E. Wentz, P. O. Box 618, Morehead, Ky. 40351. Phone: (606) 784-5355. John Devney, 90 Kimbark Rd., Rochester, N. Y. 14610. Phone: (716) 381-6174.

483d Bomb Group
The 483d Bomb Group and attached squadrons will hold a reunion on September 10–14, 1986, at the Radisson Hotel in St. Paul, Minn. **Contact:** Ray Rozycki, 5332 10th Ave. S., Minneapolis, Minn. 55417. Phone: (612) 778-4284.

527th Aggressor Squadron
The 527th Aggressor Squadron stationed at RAF Alconbury, UK, is hosting a tenth reunion and conference on July 2–6, 1986, for USAFE Aggressor personnel. **Contact:** Capt. Walt Burns, USAF, or Capt. Dave Brackett, USAF, 527th Aggressor Squadron, APO New York 09238-5000. Phone: AUTOVON 223-3483 or 223-2305.

731st Bomb Squadron
Members of the 731st Bomb Squadron (1950–51) will hold a reunion on September 13, 1986, at the Griswold Center in Claremont, Calif. **Contact:** Col. William L. Schlosser, USAF (Ret.), P. O. Box 1807, Rancho Santa Fe, Calif. 92067.

1370th Photo Mapping Wing
Members of the 1370th Photo Mapping Wing will hold a reunion on October 1–3, 1986, in San Antonio, Tex. **Contact:** Lt. Col. John Egert III, USAF (Ret.), Rte. 5, Box 5254, Boerne, Tex. 78006. Phone: (512) 336-2141.

1503d MATS
The 1503d Military Air Transport Squadron, which was stationed at Haneda AB, Japan (1950–54), will hold a reunion on August 15–17, 1986, in Lafayette, Ind. **Contact:** Lloyd G. Lucus, 3128 Stoney Dr., Lafayette, Ind. 47905. Phone: (317) 474-4194.

1045th Op/Eval Squadron
Are any former members of the 1045th Operations/Evaluation Squadron (Eglin AFB), later known as the 1115th MASS, interested in a reunion?
Please contact the address below.
Charles Monka
7010 E. Calle Bellatrix
Tucson, Ariz. 85710

AFA CHAMPLUS® .... Strong Protection

When a Single Accident or Illness Could Cost *You* Thousands of Dollars, You Need AFA CHAMPLUS®. . . for *Strong* Protection against Costs CHAMPUS Doesn't Cover!

For military retirees and their dependents . . . and dependents of active-duty personnel . . . more and more medical care is being provided through the government CHAMPUS program.

And, of course CHAMPUS pays 75% of allowable charges.

But today's soaring hospital costs—nearly $550 a day in some major metropolitan medical centers—can run up a $20,000 bill for even a moderately serious accident or illness.

Your 25% of $20,000 is no joke!

AFA CHAMPLUS® protects you against that kind of financial catastrophe *and* covers most of your share of routine medical expenses as well.

HOW AFA CHAMPLUS® WORKS FOR YOU!

WHO IS ELIGIBLE?

1) All AFA members under 65 years of age who are currently receiving military retired pay and are eligible for benefits under Public Law 89-614 (CHAMPUS), their spouses under age 65 and their unmarried dependent children under age 21, or age 23 if in college. (There are some exceptions for older age children. See "Exceptions and Limitations".)
2) All eligible dependents of AFA members on active duty. Eligible dependents are spouses under age 65 and unmarried dependent children under age 21, or age 23 if in college. (There are some exceptions for older age children. See "Exceptions and Limitations".)

EXCEPTIONAL BENEFIT PLAN

(See chart at right)

FOUR YEAR BASIC BENEFIT. Benefits for most injuries or illnesses may be paid for up to a four-year period.

PLUS THESE SPECIAL BENEFITS . . .

1) Up to 45 consecutive days of in-hospital care for mental, nervous, or emotional disorders. Outpatient care may include up to 20 visits of a physician or $500 per insured person each year.
2) Up to 30 days care per insured per year in a Skilled Nursing Facility.
3) Up to 30 days care per insured per year and up to 60 days lifetime in a CHAMPUS-approved Residential Treatment Center.
4) Up to 30 days care per insured per year and up to 60 days lifetime in a CHAMPUS-approved Special Treatment Facility.
5) Up to 5 visits per insured per year to Marriage and Family Counselors under conditions defined by CHAMPUS.

YOUR INSURANCE IS NON-CANCELLABLE

As long as you are a member of the Air Force Association, pay your premiums on time, and the master contract remains in force, your insurance cannot be cancelled.

ADMINISTERED BY YOUR ASSOCIATION . . . UNDERWRITTEN BY MUTUAL OF OMAHA

AFA CHAMPLUS® insurance is administered by trained insurance professionals on your Association staff. You get prompt, reliable, courteous service from people who know your needs and know every detail of your coverage. Your insurance is underwritten by Mutual of Omaha, the largest individual and family health insurance company in the world.

AFA OFFERS YOU HOSPITAL BENEFITS AFTER AGE 65

Once you reach Age 65 and are covered under Medicare, AFA offers you protection against hospital expenses not covered by Medicare through the *Senior Age Benefit Plan* of AFA Hospital Indemnity Insurance. Members enrolled in AFA CHAMPLUS® will automatically receive full information about AFA's Medicare supplement program upon attainment of Age 65 so there will be no lapse in coverage. However, no Medicare supplement benefits can be issued to residents of the state of Georgia.

AFA CHAMPLUS® BENEFIT SCHEDULE

Care	*CHAMPUS Pays*	*AFA CHAMPLUS® Pays*
	For Military Retirees Under Age 65 and Their Dependents	
Inpatient civilian hospital care	CHAMPUS pays 75% of allowable charges.	CHAMPLUS® pays the 25% of allowable charges not covered by CHAMPUS.
Inpatient military hospital care	The only charge normally made is a $7.30 per day subsistence fee, not covered by CHAMPUS.	CHAMPLUS® pays the $7.30 per day subsistence fee.
Outpatient care	CHAMPUS COVERS 75% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS® pays the 25% of allowable charges not covered by CHAMPUS after the deductible has been satisfied.
	For Dependents of Active-Duty Military Personnel	
Inpatient civilian hospital care	CHAMPUS pays all covered services and supplies furnished by a hospital, less $25 or $7.30 per day, whichever is greater.	CHAMPLUS® pays the greater of $7.30 per day or $25 of the reasonable hospital charges not covered by CHAMPUS.
Inpatient military hospital care	The only charge normally made is a $7.30 per day subsistence fee, not covered by CHAMPUS.	CHAMPLUS® pays the $7.30 per day subsistence fee.
Outpatient care	CHAMPUS covers 80% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS® pays the 20% of allowable charges not covered by CHAMPUS after the deductible has been satisfied.

NOTE: Outpatient benefits cover emergency room treatment, doctor bills, pharmaceuticals, and other professional services.

There are some reasonable limitations and exclusions for both inpatient and outpatient coverage. Please note these elsewhere in the plan description.

Against Costs CHAMPUS Doesn't Cover

APPLY TODAY!
JUST FOLLOW THESE STEPS

Choose either AFA CHAMPLUS® Inpatient coverage or combined Inpatient and Outpatient coverage for yourself. Determine the coverage you want for dependent members of your family. Complete the enclosed application form in full. Total the premium for the coverage you select from the premium tables on this page. Mail the application with your check or money order for your initial premium payment, payable to AFA.

AFA's CHAMPLUS®

EXCEPTIONS & LIMITATIONS

Coverage will not be provided for conditions for which treatment has been received during the 12-month period prior to the effective date of insurance until the expiration of 12 consecutive months of insurance coverage without further treatment. *After coverage has been in force for 24 consecutive months, pre-existing* conditions will be covered regardless of prior treatment. Children over age 21 (age 23 if in college) will continue to be eligible if they have been declared incapacitated and if they were insured under CHAMPLUS® on the date so declared. Coverage for these older age children will be provided at slightly higher rates upon notification to AFA.

EXCLUSIONS

This plan does not cover and no payment shall be made for:

a) routine physical examinations or immunizations

b) domiciliary or custodial care

c) dental care (except as required as a necessary adjunct to medical or surgical treatment)

d) routine care of the newborn or well-baby care

e) injuries or sickness resulting from declared or undeclared war or any act thereof

f) injuries or sickness due to acts of intentional self-destruction or attempted suicide, while sane or insane

g) treatment for prevention or cure of alcoholism or drug addiction

h) eye refraction examinations

i) Prosthetic devices (other than artificial limbs and artificial eyes), hearing aids, orthopedic footwear, eyeglasses and contact lenses

j) expenses for which benefits are or may be payable under Public Law 89-614 (CHAMPUS)

PREMIUM SCHEDULE

Plan 1—For military retirees and dependents (Quarterly Premiums)

Inpatient Benefits

Member's Attained Age	Member	Spouse	Each Child
Under 50	$21.88	$27.35	$14.85
50–54	$32.70	$40.88	$14.85
55–59	$39.78	$49.73	$14.85
60–64	$45.80	$57.25	$14.85

Inpatient and Outpatient Benefits

Under 50	$30.82	$36.98	$37.13
50–54	$42.35	$50.82	$37.13
55–59	$56.01	$67.21	$37.13
60–64	$64.48	$77.38	$37.13

Plan 2—For dependents of active-duty personnel (Annual Premiums)

Inpatient Only	None	$ 9.68	$ 5.94
Inpatient and Outpatient	None	$38.72	$29.70

APPLICATION FOR AFA CHAMPLUS®

Group Policy GMG-FC70
Mutual of Omaha Insurance Company
Home Office: Omaha, Nebraska

Full name of Member _____
Rank Last First Middle

Address _____
Number and Street City State ZIP Code

Date of Birth _____ Current Age ____ Height ____ Weight ____ Soc. Sec. No. _____
Month/Day/Year

This insurance coverage may only be issued to AFA members. Please check the appropriate box below:

☐ I am currently an AFA Member.

☐ I enclose $18 for annual AFA membership dues (includes subscription ($14) to AIR FORCE Magazine).

PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (Check One)
☐ AFA CHAMPLUS® PLAN I (for military retirees & dependents)
☐ AFA CHAMPLUS® PLAN II (for dependents of active-duty personnel)

Coverage Requested (Check One)
☐ Inpatient Benefits Only
☐ Inpatient and Outpatient Benefits

Person(s) to be insured (Check One)
☐ Member Only
☐ Spouse Only
☐ Member & Spouse
☐ Member & Children
☐ Spouse & Children
☐ Member, Spouse & Children

PREMIUM CALCULATION

All premiums are based on the attained age of the AFA member applying for this coverage. Plan I premium payments are normally paid on a quarterly basis but, if desired, they may be made on either a semi-annual (multiply by 2), or annual (multiply by 4) basis.

Quarterly (annual) premium for member (age ____) $_____

Quarterly (annual) premium for spouse (based on member's age) $_____

Quarterly (annual) premium for ____ children @ $ $_____

Total premium enclosed $_____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Dependents to be Insured	Relationship to Member	Date of Birth (Month/Day/Year)

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such pre-existing conditions will be covered after this insurance has been in effect for 24 consecutive months.

Date _____, 19 ____ _____
Member's Signature

Form 6173GH App.

Application must be accompanied by a check or money order. Send remittance to: Air Force Association, Insurance Division, 1501 Lee Highway, Arlington, VA 22209-1198

6-86

Bob Stevens'

"There I was..."

THEY WERE CALLED "NIPPER," "PIDDLER," "LIGHTNING," "BARNEY," and, MORE OFTEN THAN NOT, "SAD SACK". THESE ARE THE NAMES GIVEN TO MASCOTS BY AIRMEN IN VIRTUALLY EVERY UNIT SINCE THE FIRST AERO SQ. WAS FORMED IN 1913. MASCOT POPULATION REACHED ITS ZENITH DURING WWII.

THE MAJORITY OF CANINES ADOPTED BY FLYING UNITS HAD THEIR OWN GEAR-

(IT HAPPENED TO A LOT OF TROOPS, PAL)

342ND FTR SQ REUNION
FT. WORTH 2-5 OCT 1986

MOST EM's DOGS HATED OFFICERS.

IF MEMORY SERVES ME RIGHT, THERE WAS A '17 OUTFIT THAT HAD A SMALL DONKEY AS ITS MASCOT-

(IT WENT O'SEAS WITH 'EM!)

GREATEST MASCOT STORY: THE C-47 THAT BELLIED DEEP IN EAST GERMANY AFTER THE CREW HAD BAILED OUT LEAVING JUST THE MASCOT ABOARD*

Bob Stevens

* see AIR FORCE DEC 1985 P.98

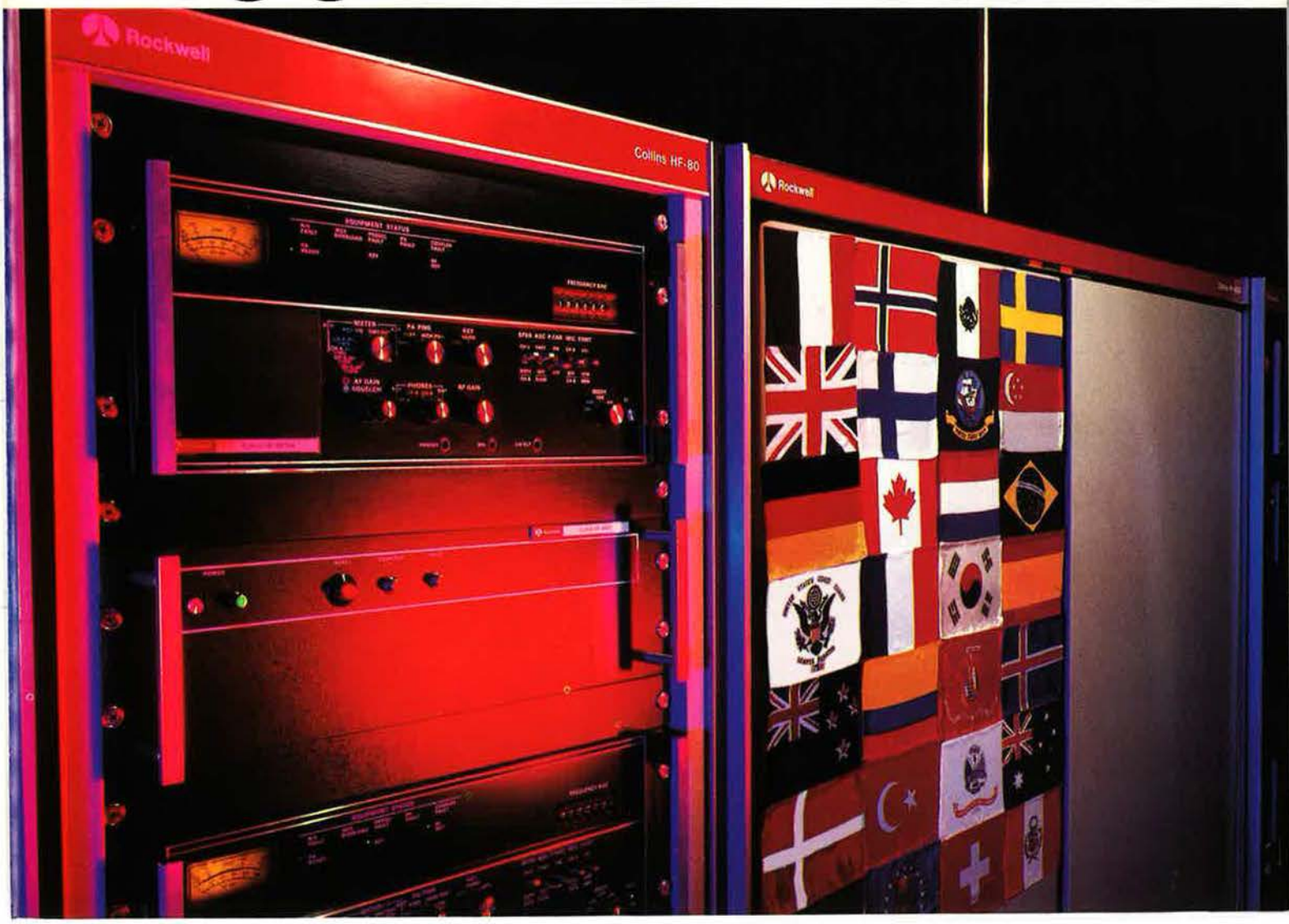
COLLINS HF: More than fifty countries are using the famous HF-80 family to provide reliable HF communication around the world. The HF-80 family's building block concept allows adding only the components necessary to build a communications system perfectly suited to your needs. ■ With transmit power levels of 1, 3, or 10 kW, the flexibility of the Collins HF-80 family offers the widest range of applications. From simple operator attended receivers and transmitters to fully automated and remote controlled fixed stations. ■ The high degree of commonality, and solid state design help reduce user costs and make field service quick and easy. Equipment is field proven and mil-qualified by the USAF and the U.S. Army. ■ The HF-80 family includes receivers, transmitters, transceivers, microprocessor remote control units and the Collins SELSCAN™ processor that automatically scans and selects the best HF channels at the touch of a button. For special purposes, optional configurations include four-channel multiplex, SIMOP and ECCM. ■ Over 50 years of technological expertise has made the Collins HF-80 family one of the most versatile, cost effective HF product lines in the world today. ■ For information contact: Collins Defense Communications, Rockwell International, Cedar Rapids, Iowa 52498, U.S.A. (319) 395-2690, Telex 464-435. ■ **COLLINS HF says it all.**

Rockwell International

...where science gets down to business

Aerospace / Electronics / Automotive
General Industries / A-B Industrial Automation

THE HF RADIO HEARD 'ROUND THE WORLD.



THE F-15: KEY PLAYER ON THE USAF TEAM.

THE SITUATION: THE AIR FORCE NEEDS A FIGHTER THAT CAN TAKE OFF AND LAND ON SHORT OR DAMAGED RUNWAYS.

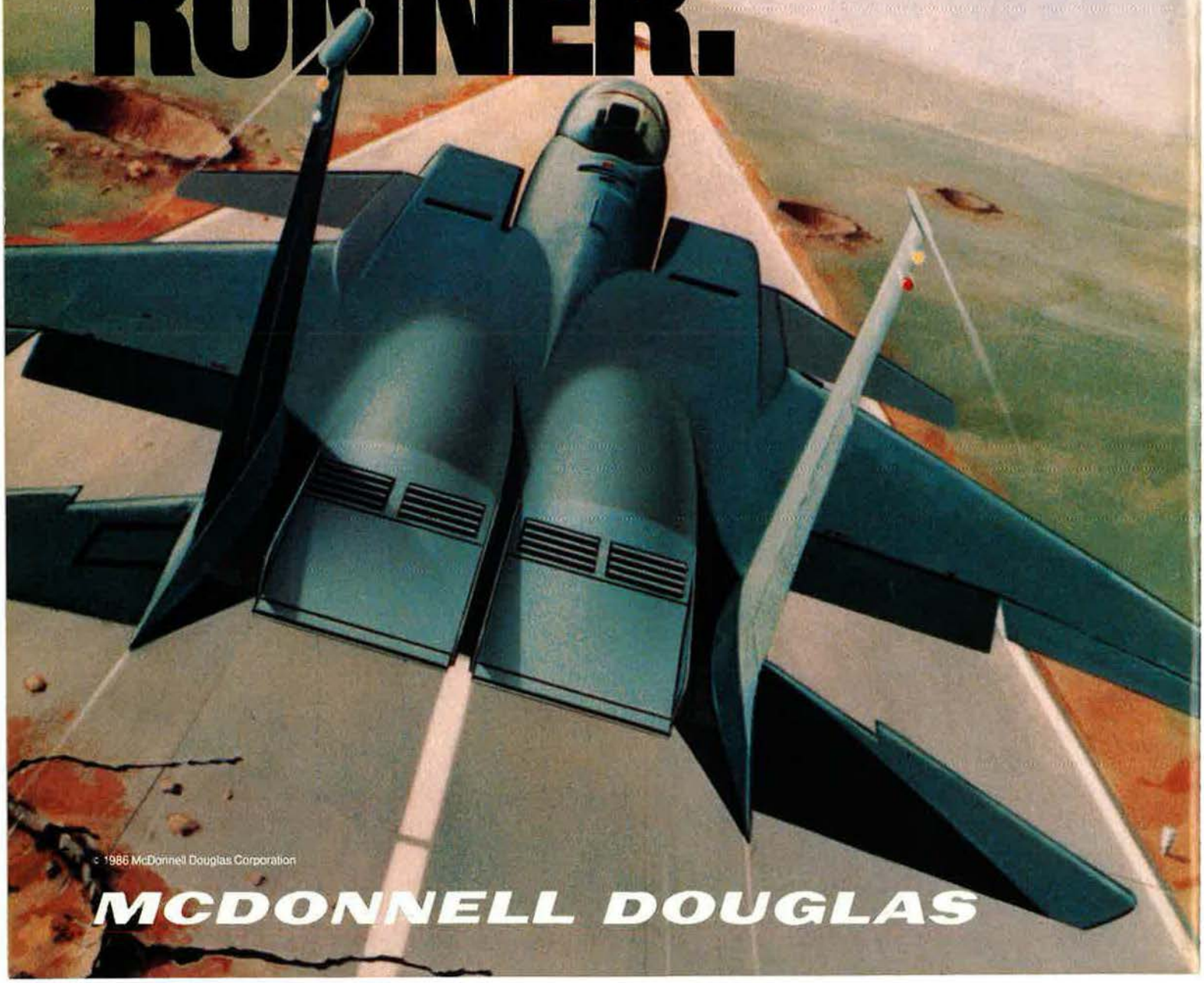
Air Force fighters could be forced to operate from makeshift runways shortened by enemy attack. In these situations, a STOL (Short Takeoff and Landing) fighter would be invaluable.

Equipped with controllable canards and thrust-vectoring engine nozzles, a STOL fighter could take off or land in 1,250 feet or less, using bomb-damaged runways, in any weather—even when icy.

To convert this need to reality, the Air Force has selected the F-15 Eagle, reasoning that STOL capabilities should be proven on today's foremost air superiority fighter. Low speed wind tunnel testing of a specially built Eagle has been completed, high speed testing is under way, and the first test flight is set for 1988.

For a strong defense, America counts on the Air Force. And the Air Force is counting on the F-15 Eagle.

BROKEN-FIELD RUNNER.



MCDONNELL DOUGLAS