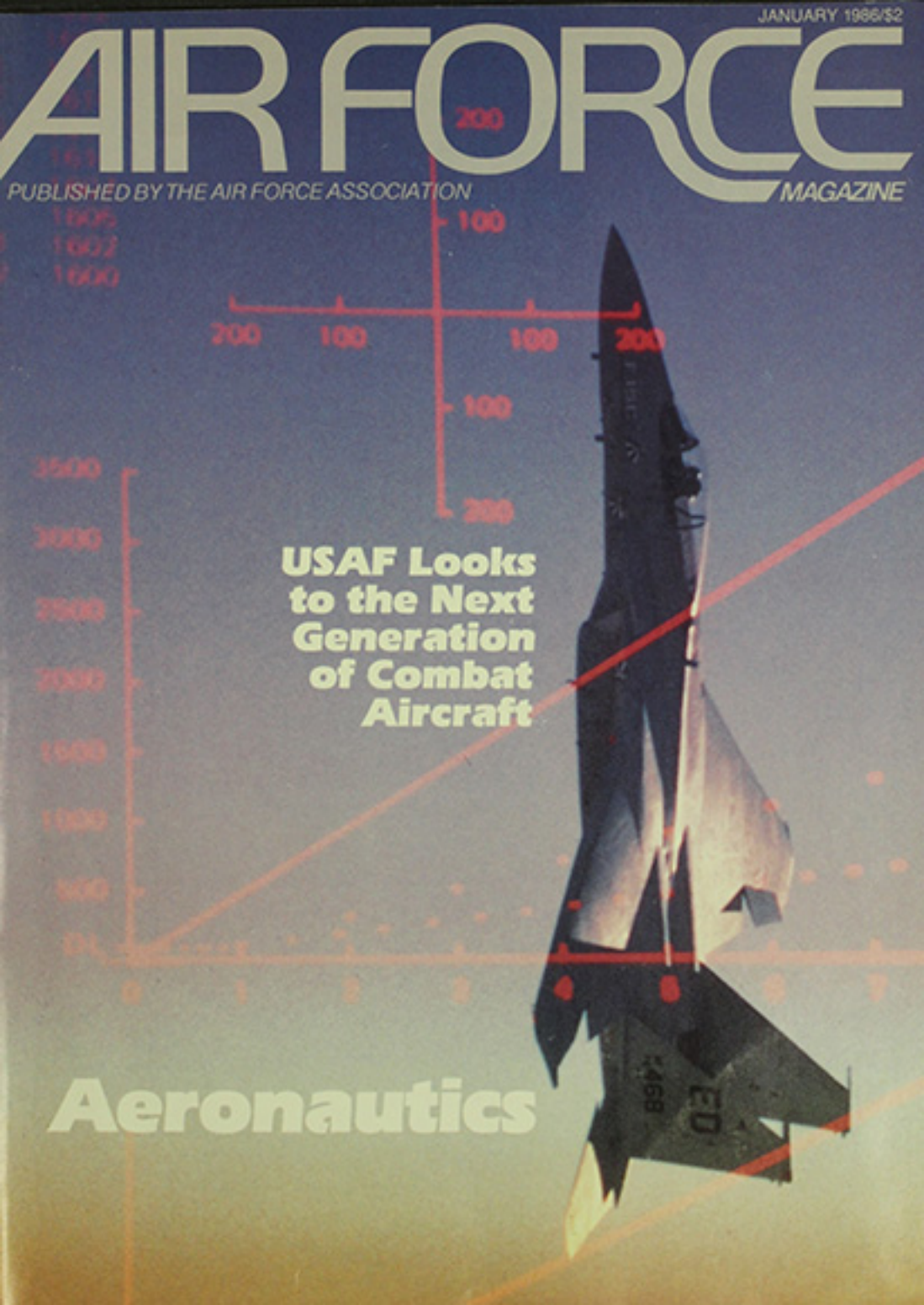
JANUARY 1966/$2

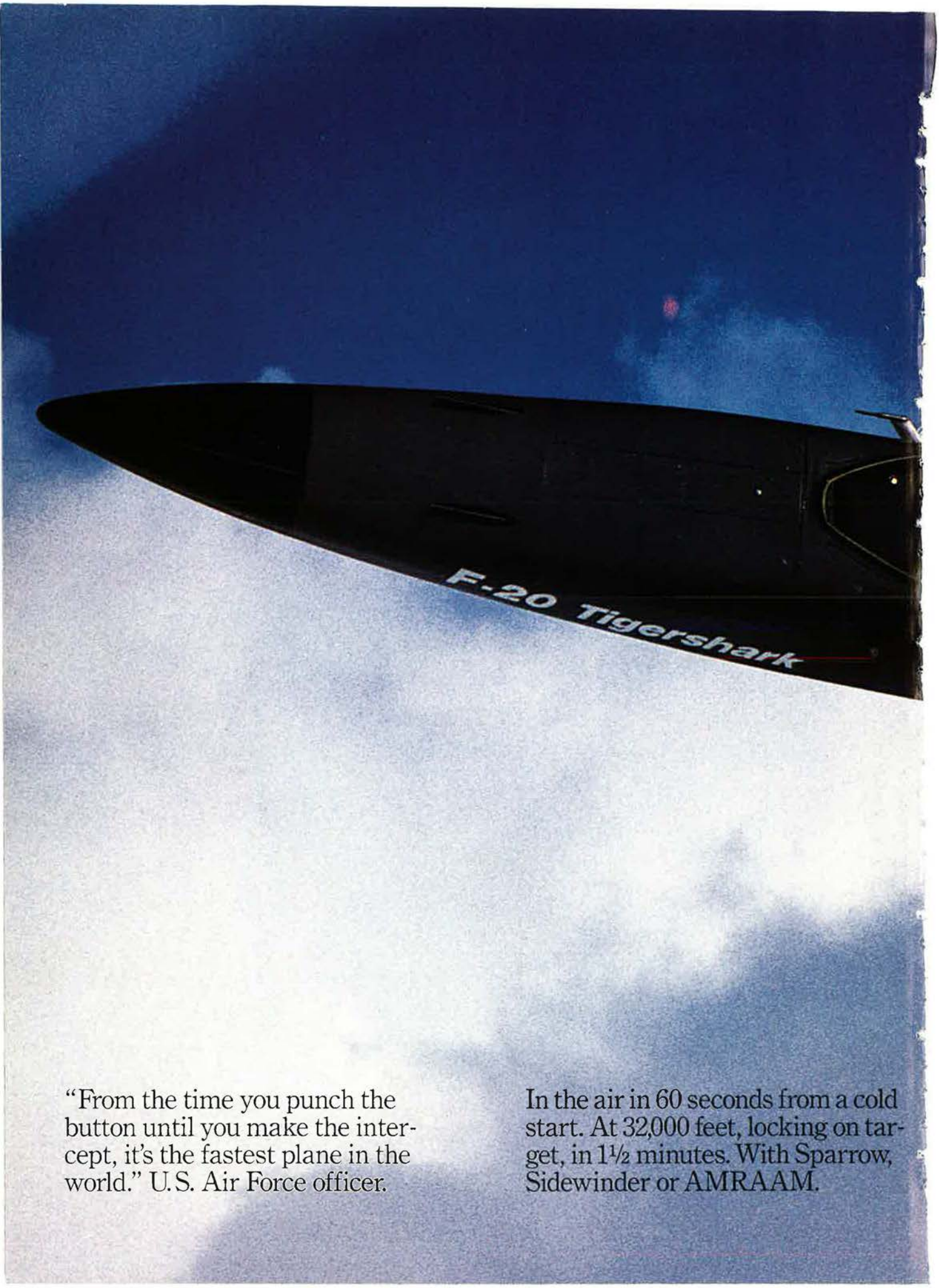
AIR FORCE

PUBLISHED BY THE AIR FORCE ASSOCIATION MAGAZINE



USAF Looks to the Next Generation of Combat Aircraft

Aeronautics



"From the time you punch the button until you make the intercept, it's the fastest plane in the world." U.S. Air Force officer.

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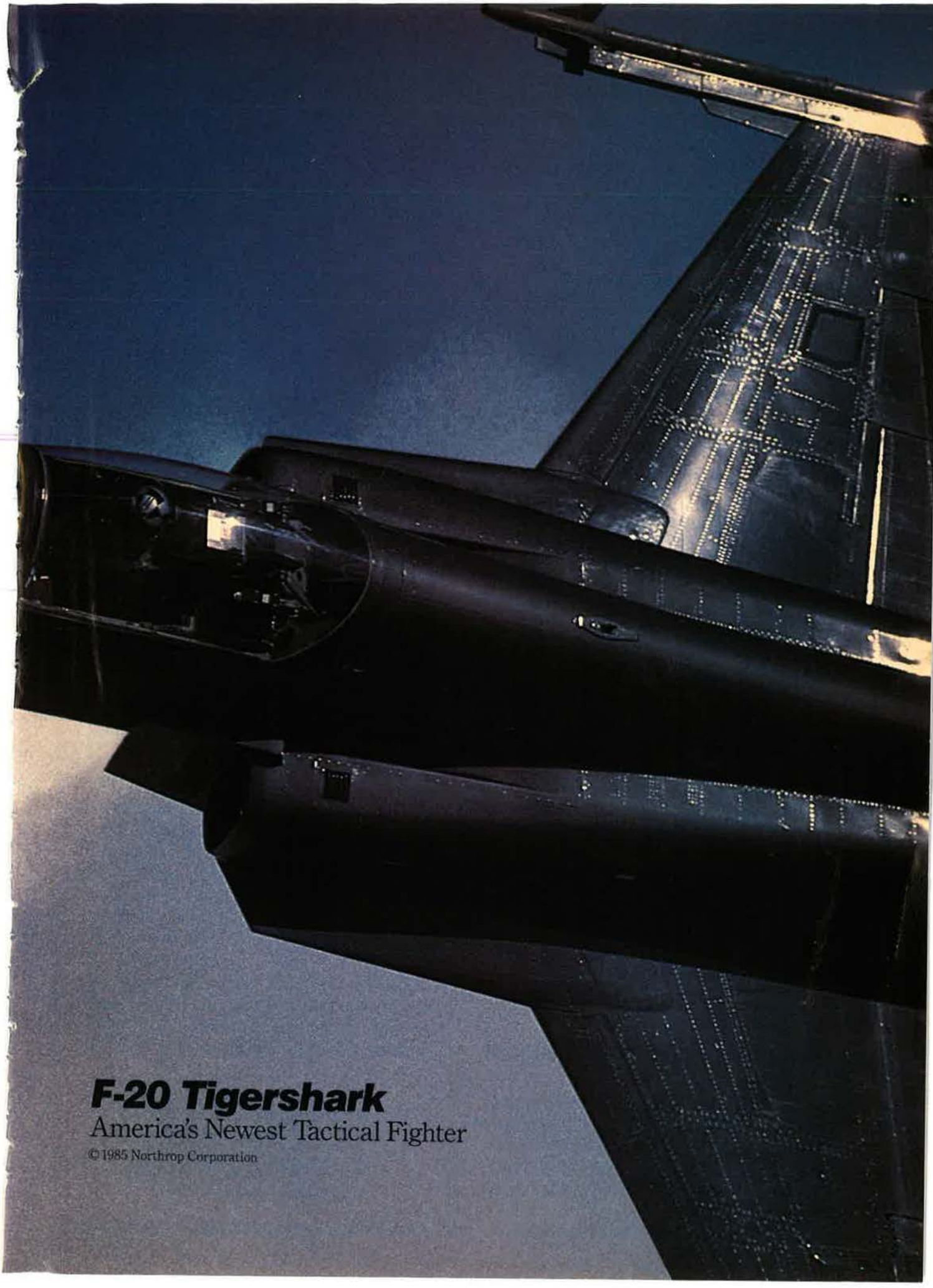

F-20 Tigershark

America's Newest Tactical Fighter

Interstate chosen as GPS prime for Tri-Service Test and Training Ranges.

Small receiver wins big contract.

Interstate Electronics has been chosen to produce a family of Global Positioning System (GPS) receivers for DOD test and training ranges.

The $164 million contract awarded by the U.S. Air Force Armament Division is for the initial phase of a multiphase program for the development and test of GPS range tracking equipment for DOD ranges.

Presenting our winning team!

Delivering total GPS solutions takes a company-wide effort from a large, experienced and responsive team. Since Interstate is the only organization that both develops and uses GPS equipment, we know its every aspect.

This new contract serves to reinforce the fact that we have the product and the expertise to integrate GPS into platforms of all types.

And with these capabilities comes Interstate's commitment to quality, reliability and customer satisfaction through teamwork.

Putting the high dynamic platform in its place.

Interstate stays on top of the fastest moving GPS applications. We proved our capabilities on Trident I, then came back with an advanced missile tracking system for Trident II and are currently applying our GPS technology to high dynamic aircraft.

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Find out more about our award-winning GPS capabilities. For details, contact: Director of Business Development, Navigation and Range Systems, Interstate Electronics Corporation, P.O. Box 3117, Anaheim, CA 92803. Telephone (714) 758-0500.

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JANUARY 1986
VOLUME 69, NUMBER 1

AIR FORCE MAGAZINE

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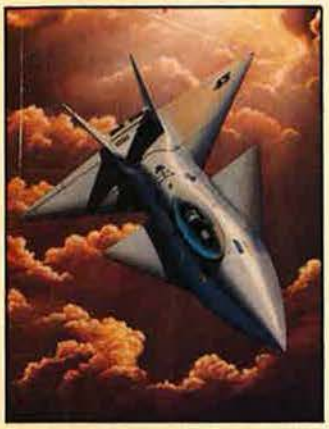

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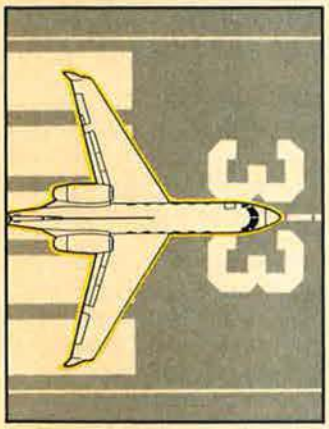

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About the cover: This F-15C from the Flight Test Center at Edwards AFB, Calif., and the computer-generated plotted data points show aeronautics from its theoretical and practical standpoints. A special section on "Aeronautics" begins on p. 38. (Photo by Erik Simonsen)

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AN EDITORIAL

Zero Growth—Or Worse

By Russell E. Dougherty, PUBLISHER

In October, Gen. Charles A. Gabriel, Air Force Chief of Staff, told an Air Force Association symposium audience in Los Angeles that "over the past five years, we have rebuilt our defenses because enough dollars have been made available. But budget reductions are starting to take a toll. Cuts in the Defense Department five-year plan since January [1985] total almost $300 billion. The Air Force share is about $75 billion. Reductions like this can't be made without cutting into the muscle—we've had to terminate forty programs and have had to stretch and delay many others."

"Zero-Three-Three" is a current Washington buzz term that has become accepted legerdemain for what is politically possible in defense budgeting: no growth in the FY '86 defense budget and three percent growth in each of the next two fiscal years. At best, we enter FY '86 with a "zero growth" expectation. More likely, however, the Air Force's budget will encounter "negative growth" before the year is out because of optimistic repricing assumptions and a congressional decision to regard unspent funds from previous years as new money.

Any defense official who justified his force or personnel recommendations only by saying something like "I'm achieving zero growth" should be—and possibly would be—relieved on the spot as irresponsible. But our Congress, with the constitutional power and duty to raise and support our nation's armed forces and to provide what is required for our common defense and general welfare, seems to be on the threshold of doing something just as absurd.

Given our leadership role in the free world, the United States does not have the luxury of static force requirements. As a result, we cannot buy our national security capability as a fixed-price package. Our military requirements are developed through a series of judgments in line with changes in the threat and in our national objectives. The ultimate purpose is to determine what best serves our common defense interests and what will keep us from becoming inferior to any potential enemy. It is not a perfect system, of course, but it is one designed to maintain a *relevance to these threats* by thoughtful selections and sizings. This important relevance and balance cannot be maintained with fiscal slogans and experimental accounting theories. We will never be able to find a responsible, definitive, and unchanging answer to the question "How much is enough?" simply because we do not control the extent or character of the threat—nor can we do so by some sort of fiscal fiat.

Congressman Les Aspin (D-Wis.), Chairman of the House Armed Services Committee, wrote an "open letter" (Washington *Post*, October 27) to Secretary of Defense Caspar Weinberger saying that the budget deficit reduction plan being advanced by Sens. Phil Gramm (R-Tex.), Warren Rudman (R-N. H.), and Ernest Hollings (D-S. C.) was "the dumbest piece of legislation that I have seen in fifteen years on Capitol Hill" and that, if it became law, the Secretary was "going to preside over the largest peacetime cutback in history." Congressman Philip Crane (R-Ill.) countered in an "open letter" riposte (Washington *Post*, November 26), pointing out Congressman Aspin's inconsistency in criticizing the massive defense reductions inherent in the Gramm-Rudman-Hollings formula while, in the same breath, supporting a House Democratic deficit-reduction plan that mandates *far greater* cuts in future defense budgets than those in the Senate plan he had condemned.

In both letters, and in the general mindset evident on Capitol Hill, it is apparent that all of the popular deficit-reduction plans would give short shrift to the logic and substance behind our future defense requirements. It seems that congressional actions will curtail current defense budgets through arbitrary, across-the-board percentage reductions as well as by specifically targeted cuts, culminating in "zero growth"—or less.

Unfortunately, in none of these deficit-reduction plans does it appear that budget levels, authorizations, or appropriations for future defense requirements will result from serious consideration of the imperative to keep our technology and our force levels *relevant* to the threats we will face. ■

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The ARN-139(V) flies on Air Force KC-10s, U.S. Marine C-130Ts and a variety of international tankers. It can also be used in tactical, ground and remote field operations.

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Raytheon has just made the military bette

Better communications was what U.S. military commanders needed and that's what they are now getting. Critical multichannel communications are becoming more secure and efficient as Raytheon-developed AN/TRC-170 troposcatter radio systems reach the field.

Deliveries of the system, complete with spares and logistic support equipment, are now being made. That makes the TRC-170 one of the first elements in the Tri-Service Tactical Communications Program (TRI-TAC) to go into service.

Developed under contract for the U.S. Air Force's Electronic Systems Division, the all-digital, highly mobile TRC-170 uses a Raytheon-patented tropo modem to achieve a nominal operational range of up to 150 miles. This modem utilizes the dispersion of the tropo channel to provide more effective transmissions than are possible with older equipment.

The new system has other advantages. For example, its very low bit error rate ensures that messages will be received as sent. And those messages will be secure because the TRC-170 permits digital encryption of all channels.

With a maximum capacity of 120 channels, the TRC-170 makes available up to five times as many channels as older analog equipment. Its small size and simplicity also reduce transportation, power, fuel, and manpower requirements.

The TRC-170 is another example of how Raytheon applies its

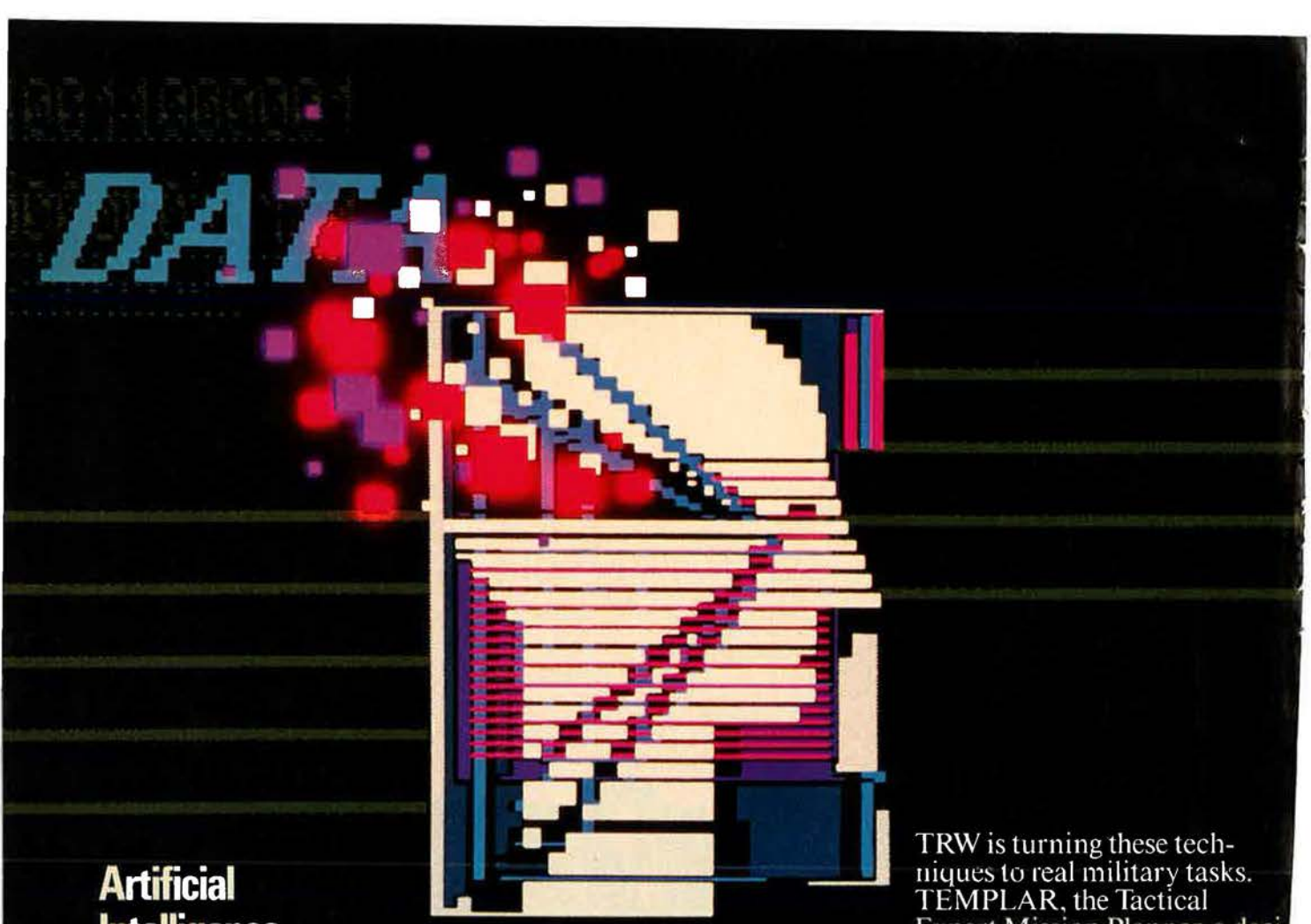
alkers. AN/TRC-170 is on the air.

in-depth knowledge of electronic fundamentals and systems integration to military communications requirements. At Raytheon, quality starts with fundamentals.

For more information, write: Raytheon Company, Government Marketing, 141 Spring Street, Lexington, Massachusetts 02173.

Raytheon-produced Digital Group Multiplexers are an integral part of the AN/TRC-170 system.

Raytheon



Artificial Intelligence

Problem: Help military decision-makers decipher an overpowering on-rush of data.

Solution: TRW Artificial Intelligence

Computer-automated intelligence workstations are powerful tools to better understand the battlefield. But, too much data came pouring through the first intelligence fusion devices; analysts couldn't keep up. Humans, it seemed, might be the weak link.

TRW determined the problem: operator cognitive overload. There was simply not enough time to form good hypotheses, a key step in understanding the complicated displays. TRW's approach was to apply artificial intelligence and build a hypothesis generator, an aid to analysts navigating the swollen data stream.

With TRW-developed techniques of knowledge engineering, we extracted the rules expert analysts use in formulating hypotheses. These rules were programmed into a workstation. Analysts could alter the rule-base to determine how conclusions are reached. Now we're creating an intelligent man-machine interface which can sense the operator's mission and automatically tailor the screen to specifically support it.

TRW is turning these techniques to real military tasks. TEMPLAR, the Tactical Expert Mission Planner, a decision-aid for the operational user is one of the largest AI contracts. The machine will aid in the allocation of Air Force resources for tactical strike mission planning. We are working to apply these same AI techniques to the Army's air-land battle management problem. Our expert systems techniques have application in integrated diagnostics, strategic mission planning, and a whole host of other expert decision-making systems as well.

TRW is at work where the minds of men and machines must ultimately meet.

TRW

TRW Defense Systems Group

AIRMAIL

Quality People

Your policy statement "Quality People—Quality Force" in the November '85 issue *(p. 108)* was outstanding. I am glad to see that someone actually had the nerve to put in writing why experienced, educated, and quality career people are leaving the Air Force. I notice this happening in my career field, and it seems to be happening at an alarming rate. And I am not talking about first-termers. I am speaking of people on their third and fourth enlistments.

What Air Force Chief of Staff Gen. Charles Gabriel has to say about the caliber of today's Air Force people is true. It is really a shame that, after all of the sacrifices that Air Force members and their families go through, they can't be better provided for in return. Air Force members must endure long duty hours, poor pay, frequent PCS moves, frequent school changes for their children, inadequate affordable housing, insufficient reimbursement of PCS costs, no dental care for dependents, a poor promotion system—and the list goes on. These are some of the reasons why tech and staff sergeants whom I have spoken with are separating. These people generally have outstanding military records.

I myself have made the decision to separate, as have many others, for the reasons cited above. I have an excellent fourteen-year military record. I am one of the quality people the Air Force needs to hold on to. It's just that my wife and I are tired of how tough life is in the military. . . .

There are some fine young men and women in the Air Force who need to be treated a lot better. . . .

Bruce G. Pelkowski
Altus, Okla.

I read with great interest your article in the November '85 issue entitled "Quality People—Quality Force." It was a pleasure to note that there is a growing awareness of the many changes that are occurring in the way Air Force members and their families are living their lives.

As a wife who has worked during most of the twenty-two years of her husband's career, it is comforting to see that this form of contribution is finally being recognized along with the other contributions that spouses and families have made through the years. I can assure you that the working spouse is more concerned about the impact that Air Force life has upon his or her career than about whether or not the commissary or BX system continues to operate. . . .

Please continue your fine work in helping to shape the responses to the many concerns that affect Air Force families.

Betty O'Lear
Satellite Beach, Fla.

Under the Gun

There was a former governor of a southern state who, when accused of having sticky fingers while in office, allegedly responded, "I only stole a little, but I could have stolen a lot."

I am reminded of that comment by the general tone of the article "Industry Under the Gun" in the November '85 issue of AIR FORCE Magazine *(p. 68)*.

The apologists for both industry and the Air Force express the sentiment that the quality of the weapon systems provided mitigates the demonstrated lack of ethics and downright fraud in some elements of the defense industry.

Blaming the media for reporting bad news but not good news shows a lack of appreciation of the old adage—when a dog bites a man, it is not news, but when a man bites a dog, it is.

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.

The logical extension of that adage is that the public expects, and has a right to expect, USAF personnel to be honest, diligent, and professional. Likewise, the taxpayers have every right to expect defense contractors to provide weapon systems and components that meet contract specifications and to be meticulously honest in charging the government for those goods and services.

One must agree with Gen. Lawrence Skantze's statement that there is a "regulatory swamp" of military procurement laws. Yet I would hazard an educated guess that a large number of these laws are the result of past irregularities on the part of the Defense Department and defense contractors.

The "damage control session" reported by Editor in Chief John Correll, in my view, reflected little credit on either the participants or AIR FORCE Magazine.

Col. George R. Smith,
USAF (Ret.)
Fresno, Calif.

• *If good news is not newsworthy, where does the public get the understanding to interpret the bad news in context?*—THE EDITORS

F-4 Upgrade

In response to Mr. Jeffrey G. Canclini's call for an F-4 upgrade in the November '85 issue *(p. 14)*, I can only respond, "Are you kidding?" To be fair to the fighter community, I need to point out that I am a "heavy driver" (C-141), and I should let them fight their own battles, but I'm going to stick my nose in.

As a pilot training tool, the F-4 should be kept in the inventory so long as it can be made to fly. Consistently, graduates from the USAF Test Pilot School comment that F-4 pilots do much better in that program than any other identifiable category. The F-4 taxes the pilot to the extent that he is always concentrating on flying in order to survive. This is exactly what a training aircraft should do. It is exactly what a combat aircraft should not do.

We have all seen the accident reports ("task saturation," "loss of situation awareness") that indicate that the pilot cannot do it alone under all conditions. The Air Force is spending millions investigating the "Pilot's Associate" program to assist him. To remanufacture the F-4 would cancel any benefit that this research might contribute. Advanced avionics will not change the flying characteristics of this aircraft. If Mr. Canclini would survey former F-4 pilots, he would find that a majority of them prefers whatever it is that they have transitioned to.

The argument made against the need for maneuverability is weak. Regardless of the current capabilities of weapons, we have not reached the point where a weapon will be fired before the target has been visually identified. Also, the current trend of flying lower and faster to avoid defenses demands maneuverability. Add to this the psychological advantage of flying the best, and you see that it is not all bottom line. . . .

But the cheapest at the bottom line is not the cheapest in the long run. It's time to realize that Uncle Sam pays the whole cost. He pays for repairs. The F-4 was not designed to be easily maintained. He pays the salaries of the pilots. More aircraft instead of better aircraft includes that hidden cost. He pays for fuel. Better F-4 engines would help, but additional savings are gained by having a lighter, sleeker airframe. A realistic solution to the need for stronger airpower comes from looking at the whole system. . . .

Try as some might like, we are still moving forward in time. It has always been the trend to improve on what our fathers and mothers did. We could drive Model Ts and get by, but instead, we drive safer, faster, and better cars. We should allow our museums to teach us where we have been. But museum pieces should not be out on the flight lines in defense of our nation.

Capt. William M. Clifford, USAF
Wright-Patterson AFB, Ohio

• *For more on the proposed F-4 upgrade program, see "Aerospace World," p. 28 of this issue.*—THE EDITORS

Digital Engine Control

It will come as a great surprise to those binary bits making their appointed rounds within every Pratt & Whitney F100 electronic engine control (EEC) that they are "not now digital," as reported in "Aerospace World" *(November '85 issue, p. 34).*

Hamilton Standard designed a six-

AIRMAIL

teen-bit parallel digital computer for the EEC in 1970 that led the industry for several years as the only engine-mounted digital control in full-scale production.

New Digital Electronic Engine Controls (DEECs) for enhanced versions of the Pratt & Whitney F100 engines all contain direct architectural descendents of that early EEC digital processor and input/output circuitry. Of course, significant technological improvements have occurred in all areas. The original digital supervisory "Electronic Engine Control" has been replaced by a full-authority "Digital Electronic Engine Control." The EEC pioneered digital engine control through the use of twenty-six bipolar, 112-gate custom gate arrays. The DEEC continues this proven tradition through the use of current-technology CMOS gate arrays.

Your consideration in restoring the EEC to its well-earned position as patriarch of digital engine controls would be appreciated.

John Lovkay
President, Hamilton Standard Div., UTC
Windsor Locks, Conn.

Award for Chaplains?

In the November '85 issue of AIR FORCE Magazine, I noted on page 134 that, under the heading of "Special Citations and Other Awards," there was an award for lawyers and another for physicians.

Would you please consider my suggestion that it would be a fine gesture to have a similar award for chaplains? I need not dwell on the fact that we, too, have served with distinction.

I trust that serious thought will be given to this matter.

Lt. Col. John H. K. Miller, USAF (Ret.)
Dover, Del.

In our November 1985 issue, we published a letter purporting to be from Mr. Tom Ivie regarding the 352d Fighter Group *(p. 17).* Mr. Ivie subsequently contacted us and informed us that he did *not* write that letter. Readers are therefore advised not to contact Mr. Ivie regarding the 352d Fighter Group.—THE EDITORS

Purple Airlift

I'd like to compliment you on your recent article "The Ups and Downs of Jointness" in the October '85 issue *(p. 46).* It was a well-researched and well-written article.

However, I would like to point out one omission on your part—the Airlift Concepts and Requirements Agency (ACRA). ACRA is a joint USAF Military Airlift Command (MAC) and US Army Training and Doctrine Command (TRADOC) directorate located at Scott AFB, Ill. ACRA was established as a direct result of Initiative Thirty of the Joint Force Development Process initiatives signed by the Army and Air Force Chiefs of Staff in May 1984. ACRA's mission is to "coordinate and integrate MAC-TRADOC efforts regarding the development and promulgation of joint airlift concepts and doctrine which support Army, Air Force, and unified command requirements."

Even though ACRA is a relatively new organization, we are excited about what it's doing. The airlift support provided to our military forces must be the best possible, and ACRA promises to be of vital importance in helping us achieve that goal.

When you speak of "jointness," let me encourage you and your readers not to forget the important role that airlift plays. Airpower history is filled with airlift feats: the CBI campaign, the Berlin Airlift, and, most recently, Operation Urgent Fury (the rescue of Americans from Grenada). Airlift's many humanitarian efforts are usually well publicized, while the day-to-day operations of worldwide airlift go on unnoticed. Airlift is quietly honing its skills for immediate response and rapid force projection. It is truly the "Backbone of Deterrence."

If any readers wish to correspond with ACRA, their address is Hq. MAC/XP-ACRA, Scott AFB, Ill. 62225-5001. AUTOVON is 576-6621, and the commercial phone number is (618) 256-6621.

Maj. Gen. Anthony J. Burshnick, USAF
DCS/Plans, Hq. MAC
Scott AFB, Ill.

Above the DMZ

I received your October 1985 issue today and, as usual, set to reading it from cover to cover.

The October '85 article on "Coordinating the Air-Ground Battle" *(p. 64)* has an error of omission, which I'm sure can be attested to by former members of the 20th Tactical Air Support Squadron based at Danang in South Vietnam.

From sometime in 1967 before my

Atlas Launches Satellite from Vandenberg AFB, Calif.

Atlas/Centaur Launches Communications Satellite from Cape Canaveral, Fla.

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GENERAL DYNAMICS

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arrival until October 1, 1968, when the bombing halt in North Vietnam was called, O-1s and O-2s flew daily missions in Route Pack 1 and 2 above the Demilitarized Zone. Yes, the flak was heavy, and we even had some SAMs fired at us about 100 nautical miles north of the DMZ. Numerous aircraft received hits, but during my four-and-a-half-month tour in the "North," we only lost one aircraft north of the DMZ.

After winding up both rubber bands eighty-eight times for 367.4 hours in North Vietnam, I can assure you that the slow-movers were there.

Col. Robert C. Peck, USAF
Khartoum, Sudan

DoD Acquisition Process

While not wanting to use your fine magazine as a battleground of words, I must, however, object to the comments made by John F. Lewis in a letter in the "Airmail" section of the October '85 issue *(p. 10)*.

On behalf of the many dedicated and hardworking people I work with and have known in the past, I must protest Mr. Lewis's attack on the entire DoD acquisition process. Mr. Lewis's letter smacks of a disgruntled private contractor who, as he states in his opening paragraph, is "trying to do business with the US government." His comments about the government making "mountains out of molehills during the acquisition phase of a project" and further comments about awarding contracts to the lowest bidder makes it obvious to me that Mr. Lewis does not always get the contracts he bids on. Therefore, he has no alternative but to blame the system.

While there are bad apples in all baskets, government as well as private industry, it is not only unfair but also irresponsible to attack the entire system for the mistakes of a few. While the many legislative acts and high-level DoD policies have vastly improved the acquisition process, it would have been impossible without the hard work and commitment of government employees at the working level who carry out those laws and policies. It is this working level that Mr. Lewis slanders with his comments.

We all agree that overpricing of spare parts is outrageous and must be eliminated. Many positive things are being done throughout DoD to accomplish this end, and I wish other national media besides AIR FORCE Magazine would publish stories about the good being done at all levels of the government. Unfortunately for most publications, $916 stool caps sell better than the millions saved through acquisition reform.

One other comment: Mr. Lewis states that "private industry . . . will not tolerate such [overpricing] foolishness." If this is true, I must ask who proposed to sell the government the $916 stool caps, the $7,622 coffee makers, the $600 Allen wrenches, and the $300 hammers?

It is obvious that something needs to be done to curb the outlandish prices that keep making the headlines—as well as those that do not. However, the answer is cooperation, not conflict. Cooperation between the government and private industry works if given a chance.

I know—I've seen it work.

David Mason
San Antonio, Tex.

AIRMAIL

388th Bomb Group

I am in the process of compiling the history of the 388th Bombardment Group, to include the associated 560th, 561st, 562d, and 563d Bomb Squadrons. I am planning to trace the individual histories of these squadrons from their inception in 1942 to the present-day tactical fighter squadrons.

I am in need of personal accounts of activities that took place within these units during times of combat as well as during peacetime. Also of great value would be any photographs, combat reports, aircraft historical information, and anything else that is relevant to the history of these units.

I am quite sure that there is someone out there who was assigned to these units at one time or another and who has information that would be of great value to me in compiling the accurate story of these lesser-known squadrons.

All material and photographs will be copied and returned if the sender so desires. All contributions are welcome.

Werner W. Hartman
4793 Le Roy St.
San Bernardino, Calif. 92404
Phone: (714) 882-1681

P-61 Black Widow

I have been commissioned by Aerofax to write a history of the P-61 Black Widow as a part of their continuing Minigraph series.

I would appreciate hearing from anyone with a firsthand knowledge of this historical aircraft. Any material borrowed will be carefully treated, acknowledged in the end product, and returned.

(Readers of AIR FORCE Magazine, many of whom have supported my research efforts in the past, may be interested to know that my history of the F-82 Twin Mustang will soon be available.)

Please contact me at the address below.

David R. McLaren
2055 Sapphire Lane
Aurora, Ill. 60506

Program 437

The USAF Space Command History Office is currently researching an official study of the development and operations of Program 437, the US Air Force's first ASAT system, from 1963–75.

I would like to contact any USAF or contractor personnel who were involved with Program 437 during any phase of its existence. Responses should be directed to the address below.

Wayne R. Austerman
Space Command/HO
Peterson AFB, Colo. 80914-5001

19th Bomb Group

I am currently collecting material for a book on the 19th Bomb Group during the period from 1941 to 1954.

I would appreciate any assistance that readers could give me on this project, particularly any assistance in the way of data on specific aircraft, missions, and assignments. Any reference to previously published material would also be helpful. Of great interest would be photographs, especially those showing serial numbers or nose art. I would, of course, copy any photos sent and return the originals to the owners.

I realize I sound somewhat greedy in terms of what I'm looking for, but my writing style seems to require that I wallow in raw data and then sort out the good stuff. At this point, anything that readers might be able to furnish would be of interest and highly appreciated.

Please contact me at the address below.

Robert Mann
1971 Briscoe Terrace
Fremont, Calif. 94538
Phone: (415) 657-3481

WW II Nose Art

For a book-length study of American aircraft nose art during World War II, I would like to hear from individuals who either executed such art

AIRMAIL

or who used it on their aircraft. I am interested in how and why subjects and motifs were chosen and would like to hear any memories or stories about individual examples.

All materials will be returned to their owners after copying. Please contact me at the address below.

Randall Bond
Art Librarian
205 Bird Library
Syracuse University
Syracuse, N. Y. 13244-2010
Phone: (315) 423-2440

50th Fighter-Bomber Group

I am trying to locate pictures of aircraft that the 50th Fighter-Bomber Group flew during World War II (P-40, P-47, and P-51). I am looking particularly for photos of aircraft with nose art.

The group was in reserve status at the start of World War II, but later flew out of England. In commemoration of World War II, selected aircraft of the present-day 50th Tactical Fighter Wing can be painted with appropriate nose art from WW II.

Can any veterans out there help me?

SSgt. Beatrice A. Liu, USAF
50th TFW/HO
APO New York 09109-5000

315th Bomb Wing

I am seeking information for a history of the 315th Bomb Wing, Twentieth Air Force, during World War II.

Retired Col. George E. Harrington, Chairman and Executive Director of the 315th Bomb Wing Association, will be the sponsor for this unit history.

If anyone can help me with my research, please contact me at the address below.

Maj. Larry Swann, USAF
6713 Spivey Court
Montgomery, Ala. 36116

"Colonel Bogey March"

I would like to hear from someone who remembers the special words that were made up for the "Colonel Bogey March" (later used as the theme to the movie *The Bridge on the River Kwai*). The lyrics were highly appropriate for some of the training we received during World War II.

I need this information for a book I am writing. Anyone who may be able to help is invited to contact me at the address below.

Richard D. Terry
3903 Calle Abril
San Clemente, Calif. 92672

Fire/Crash Equipment

We are interested in obtaining any photos or information on prewar and World War II-era USAAF fire and crash apparatus. This information will be used for an article tracing the development of crash/fire/rescue protection in the Air Force.

Any information should be sent to the address below.

Frank San Severino
P. O. Box 379
Moody, Me. 04054

AFROTC Det. 205

A newsletter for alumni of AFROTC Detachment 205, Southern Illinois University at Carbondale, is being started. Any person who was or is associated with Detachment 205 and who would like a copy of the newsletter should write to the following address. (In your correspondence, please indicate your affiliation with the detachment.)

Det. 205 Alumni News
% Lt. Wilhelm Eberle
8556 McCormick Blvd.
Skokie, Ill. 60076

Collectors' Corner

As an avid collector of US wings, I recently acquired two unusual USAF wings that I'm having difficulty in identifying.

The two wings are finely detailed and appear to be hat badges/pins, since they have a screw-type back. They are brushed silver and black in color and are approximately one inch wide. At the center of the wings, in a blue enamel circle, are the letters "GOC" in silver. Surrounding the center, in a white ring, are the words "United States Air Force," also lettered in silver. At the bottom of the white ring are the titles of "Supervisor" on one set of wings and "Observer" on the other.

Any assistance in identifying these wings or any information about them would be welcomed. I believe that they may belong to some AFROTC or USAF foreign training unit.

I'd also enjoy hearing from other collectors of wings as well. I'd like to expand my collection to include pilot wings from other countries. Any collectors who are interested are invited to contact me at the address below.

SSgt. E. K. Johnson, MichANG
4108 Green Meadows Blvd.
#112
Ypsilanti, Mich. 48197

I am looking for patches from the 4080th Strategic Reconnaissance Wing and the 100th Strategic Reconnaissance Wing.

I served with the 4080th from 1962 until 1965, when it became the 100th, and stayed with that unit until 1969. The 4080th/100th was the U-2 and special-purpose aircraft unit, and I hold special pride in having been a part of it.

Anyone having any wing patches from these units is asked to contact me at the address below.

Gerald A. Berwick
406 W. Lincoln
Sulphur, La. 70663
Phone: (318) 527-0971

After almost thirty-five years of military and commercial flying while wearing my Class 51-B cadet ring, it has almost worn out.

If anyone has any information on how I might go about securing a replacement ring, I would appreciate hearing from them. Please write to me at the address below.

Charles J. Logue
848 Del Valle Dr.
Fallbrook, Calif. 92028

I have a few spare unit patches, and I'm interested in hearing from anyone who would like to trade.

Please contact me at the address below.

Charles T. Thompson
1 Winfred Dr.
Felton, Del. 19943

Roll Call

I am seeking to contact or would like to gather any information about 2d Lt. Clifford Evans, Jr., and Sgt. Theodore S. Schmidt, survivors of 2d Lt. Mark R. Dunkel's crew, 381st Bomb Group, 533d Bomb Squadron. Their aircraft was shot down over Hamburg on June 20, 1944. My uncle, 2d Lt. Kenneth Roehr, was Dunkel's copilot.

Please contact the address below.

Jim Roehr
5460 Walker Rd.
Cheyenne, Wyo. 82009
Phone: (307) 632-9768

I am trying to locate the following B-29 crew members, last known to be stationed at Guam's North Field with the 6th Bomb Squadron, 29th Bomb Group, 314th Bomb Wing.

They are Robert Vogt, Norman Ellis, and Miller Chestnut.

Anyone having any information about these men is asked to contact me at the address below.

C. F. Heddleson
9619 Carriage Rd.
Kensington, Md. 20895

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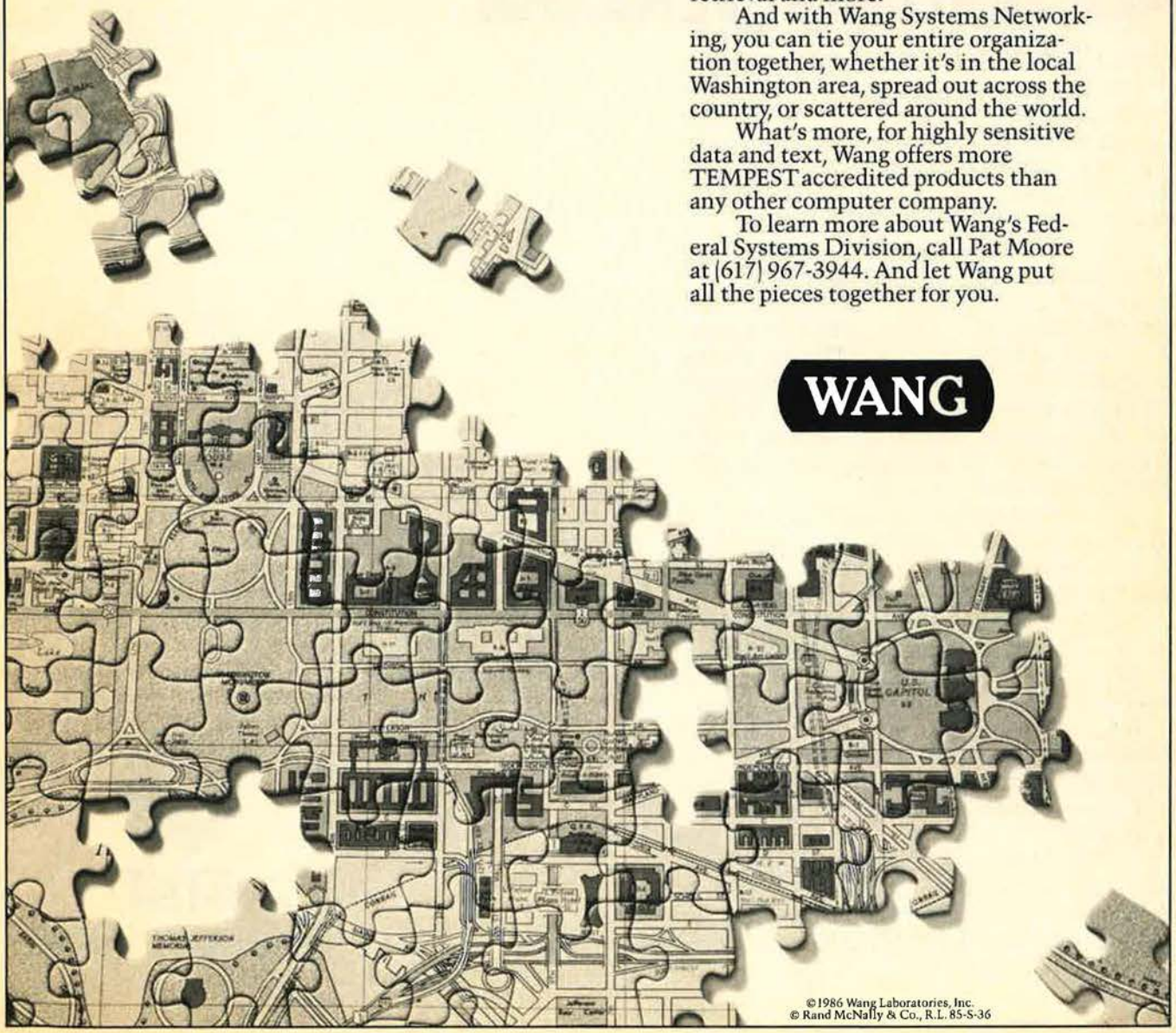

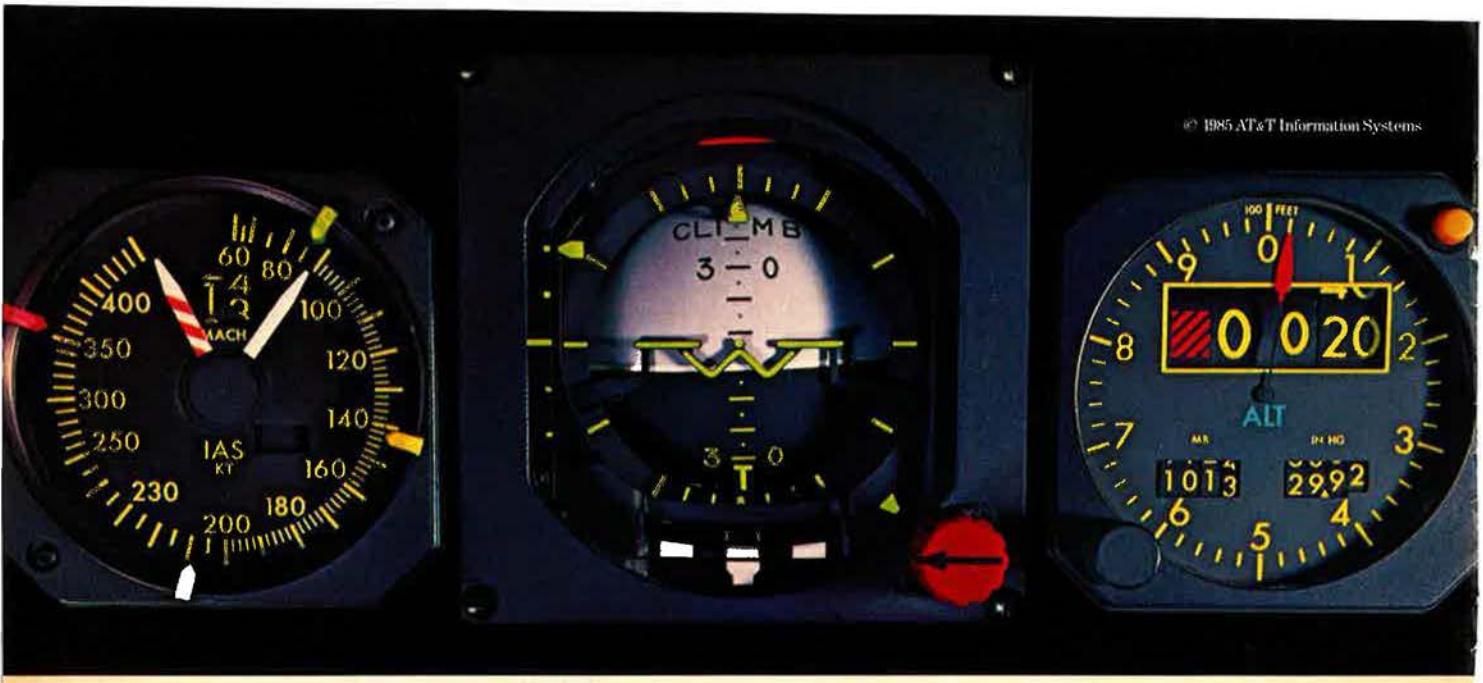

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IN FOCUS...

The Swarm Option

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

Forecast II looks again to see if large numbers of small, relatively inexpensive spacecraft might be able to generate a higher capability in the aggregate.

Washington, D. C., Dec. 2 Following in the footsteps of such pioneering technology stocktaking as the post-World War II "New Horizons" and early 1960s "Forecast I" studies, Project Forecast II, the Air Force's current search for technologies that can revolutionize future warfighting concepts, has already scored major initial payoffs. These include advanced concepts for cost-effective, survivable, space-based radar systems and hypersonic flight vehicles. As AFSC Commander Gen. Lawrence A. Skantze puts it, "The Air Force is ready for a quantum leap—via technology—into the twenty-first century. The time is right for another hard technology push, Project Forecast II."

Initiated last fall at the direction of the Secretary and the Chief of Staff of the Air Force, Forecast II is being carried out under AFSC aegis by eighteen panels of experts who were told "to avoid being hamstrung by evolutionary approaches to technology research and to plot a course that is not driven by requirements." Because of this unfettered license, the AFSC Commander predicts, "Forecast II can expose opportunities not deliberately sought—the same way Stealth technology emerged." The Air Force, he points out, "never said, 'We need invisible airplanes.' Researchers who were thinking more about technical capability than about operational need recognized the possibility of building an aircraft that could evade electronic detection." Forecast II, in similar fashion, has been told to look "for the art of the possible."

Forecast II's eighteen specialty panels are delving into such "high-leverage" technology fields as new fuels and propulsion technologies that could produce 20:1 thrust-to-weight ratios; materials that can be tailored at the molecular level; "photonics," meaning command control and communications (C^3) systems and avionics that use light rather than electronic signals and that are hence impervious to electronic warfare measures and interference; and revolutionary artificial intelligence uses.

"By tapping the best minds in the military, academia, science, and industry, we have uncovered about 1,500 ideas. The panels will [ferret] out the most promising, and by next February we will end up with a list of about twenty high-leverage technologies and system concepts options." General Skantze explains that "the senior leadership of the Air Force will [then] select the candidates to put money on."

Forecast II's timing is especially propitious, because over the twenty-some years that have elapsed since its original namesake study was completed, "the Air Force has undergone major organizational and force structure changes," including emphasis on space, in the AFSC Commander's view. The art of the technologically and economically possible is ingrained in the Forecast II process: "To discern what doors technology can open, my people have devised a structure relating technologies to the systems they [make possible] and systems to military capability. Pushing technology and breaking away from the cycle of responding to the pull of force requirements pave the way for revolutionary system concepts." Stressing that technology determines the realm of the possible, General Skantze suggests that military operational commanders may well need systems and weapons that they have not even defined or deemed feasible. In that category may well be "swarm," a system concept that "gets us away from thinking too much like earthlings about what we can do in space."

The US approach to space systems in the past revolved around small numbers of highly capable, expensive, ultrareliable, and relatively vulnerable satellites. "Swarm," the AFSC Commander points out with visible excitement, "suggests another way of using space, [to wit], putting up large numbers of small, relatively inexpensive, less vulnerable spacecraft with high capability in the aggregate. Each might have phased arrays with panels dedicated to navigation, radar, communications, and other gear. The panels could be electronically synchronized for autonomous, survivable operation. And the more small [space]craft we put up, the more capable the system. A relatively small 'swarm' could answer the defense requirement for precise identification and location of targets on earth—like [naval] cruisers and tank formations. As enemy targets show smaller and smaller radar cross sections, larger 'swarms' would be required."

The feasibility of such a space-based radar whose individual elements would be sufficiently dispersed so that attacks could only degrade but not disable the system hinges in part on economics. As General Skantze points out, "Although nothing is cheap in orbit, a 'swarm network' may offer economies of scale, and proliferation could relieve us from the cost of the last few percent of reliability that is out of sight. The 'swarm' concept is not new, but Forecast II is taking a deep look to see if it's an option now."

Swarm's implications for force structure tradeoffs form an intriguing aspect, according to the AFSC Commander: "An alternative to locking capability into one or two expensive spacecraft means we can put up what we can afford at a given [moment], deploy more for more capability [in stages], and have some flexibility when it comes to tradeoffs, say, between aircraft and elements of 'swarm.' "

For the time being, however, the Pentagon is not likely to make a decision on when to launch a full-scale development program for a space-based radar system, according to

General Skantze. The main reason for deferring go-ahead is that the relationship between costs and capabilities needs further study. In technical terms, it would not be difficult to commit to the development of a space-based radar with sufficient resolution to cope with targets whose radar cross sections are in the twenty-square-meter range. But when the cost of such a system is taken into consideration—possibly as high as $10 billion—potential users are tempted to ask for higher resolution levels to detect even low radar cross section cruise missiles. Accomplishing that adds "another dimension to the challenge," especially in terms of the density and, hence, the cost of the arrays that need to be deployed.

The Air Force, he suggested, is not yet at the point of such a decision, but within "five or six years, we probably will be."

The Advanced Aerospace Vehicle

Senior Administration officials recently told a congressional panel that the White House plans to decide in January 1986 whether or not to launch a comprehensive $500 million effort to establish the feasibility of an Advanced Aerospace Vehicle (AAV), also known as the aerospace plane. If the technical feasibility of such a vehicle is established at the end of the program's first phase, the Air Force—in concert with other Defense Department elements and NASA—would, about three years from now, start the development of a prototype flight research vehicle, the X-31, at an estimated cost of between $2 billion and $3 billion. Flight testing of the AAV might begin in the early 1990s, if the current schedule is maintained.

The initial funding approach to the AAV project, whose military portion is code-named "Copper Canyon," envisions a cost-sharing arrangement involving the Defense Department—which would pay for about eighty percent of the cost—and NASA, whose share would cover the remaining twenty percent.

General Skantze credits AAVs with meeting a host of potential future requirements by SAC, TAC, MAC, and the unified Space Command. The US Navy has also formally expressed a long-term interest in the aerospace plane program. The central traits that attract the Pentagon to AAV, according to General Skantze, are that it responds "with the speed of an ICBM and the flexibility and recallability of a bomber." In fact, the AAV is a "plane that can scramble, get into orbit, and change orbit so the Soviets can't get a

IN FOCUS...

reading accurate enough to shoot at it. It offers strategic force survivability, [because a fleet of AAVs] could sit alert like B-52s." Among the host of potential missions that such a vehicle could perform, one stands out from the military point of view, according to the AFSC Commander: "It could mean low-cost, reliable access to space—precisely what's needed to open up the space frontier for routine operations."

Forecasts about just how much AAVs might be able to lower the cost of delivering payloads to orbit vary at this time, but in general envision reductions from current levels that extend from twentyfold to about a hundredfold. According to James Tegnelia, acting director of DARPA, an air-breathing AAV could shed about 4,000,000 pounds compared to the rocket-propelled Space Shuttle's 4,500,000-pound takeoff weight and still deliver roughly the same payload to orbit. The Shuttle carries along its own oxydizer; the AAV, by contrast, burns the oxygen in the air.

The AAV project, White House Science Advisor Dr. G. A. Keyworth II told the Congressional Aviation Forum recently, could serve a range of national interests that extends on the civil side from future hypersonic transports to space transports and in the military sector from vehicles serving in tactical and strategic missions to space launchers. Recent work by NASA, DARPA—the latter involving several Air Force laboratories—and industry has led to the realization that, in the civil transportation sector, AAV technology "may allow us to . . . literally skip a generation of aircraft and spacelaunch technology."

According to DARPA's Mr. Tegnelia, AAV technology is likely to branch out into two basic areas: vehicles that come under the heading of hypersonic aircraft—nicknamed the "Orient Express," that would operate in the Mach 12 range at altitudes between 120,000 feet and 150,000 feet—and aerospace planes that reach speeds of Mach 26 and operate at altitudes of about 350,000 feet. The hypersonic transport sector might be subdivided into a lower-speed regime—below Mach 10—that uses methane as a fuel and systems that operate above that speed and that use liquid hydrogen.

Fanning the technical community's optimism with regard to AAV technology are recent advances in three generic areas. One is the advent of such advanced materials as carbon/carbon composites that get stronger as they get hotter rather than weaker. That is the bane of metals, including even titanium. The new composites, which are used in ballistic missile reentry vehicles and the Space Shuttle, can withstand temperatures well above 3,000 degrees on a sustained basis.

Secondly, new approaches to ramjet/scramjet propulsion have been tested out, with encouraging results at speeds of about Mach 10. Lastly, revolutionary advances in simulating aerodynamic flowfields in three dimensions with the help of recent dramatic advances in computer capability virtually eliminate the need to design such advanced aerodynamic shapes on a trial-and-error basis.

Congressional Interest in ATBM

The European NATO nations as well as the US are becoming increasingly concerned over the as yet modest, but growing, Soviet capabilities in the field of defense against US tactical ballistic missiles—the US Army's Pershing IIs—and against USAF's ground-launched cruise missiles (GLCMs). NATO's level of apprehension over these capabilities—residing in the main in the Soviet SA-12 weapon system—is being exacerbated by continuing, massive deployments of the Soviet Union's own theater intermediate-range nuclear forces (INFs), consisting, in addition to the MIRVed SS-20s, of SS-21, SS-22, and SS-23 medium-range ballistic missile systems.

The initial counter to the growing offensive and defensive INF capabilities of the Soviet Union might well come in the form of a response in kind, meaning modification and proliferation of the US Army's Patriot surface-to-air missile systems to cover also the role of an antitactical ballistic missile (ATBM). This is precisely what the Soviets are doing with their SA-12s. Western intelligence credits these brand-new Soviet weapons with the ability to intercept not only air-breathing systems but rates them similarly effective against the Pershing II medium-range ballistic missiles and certain types of SLBMs.

The need for US ATBM systems, especially in the context of NATO/Warsaw Pact conflict scenarios, is being questioned, however, by some Pentagon analysts who hold that advanced command and control countermeasures might be just as effective as actual ATBMs. This minority view

SCIENCE/SCOPE®

Advanced computers give North America's new air defense system more capability at a fraction of previous operating costs. The Joint Surveillance System (JSS), developed for the U.S. Air Force by Hughes Aircraft Company, watches over the entire United States and Canada from eight regional operations control centers. The system is controlled by nine Hughes 5118 ME central computers, each with 500,000 words of memory and capable of performing 1 million operations per second. These computers, in turn, direct seven Hughes HMP 1116 peripheral computers to perform subordinate tasks. The system provides its own back-up whenever faults are detected. Because the system requires less staff and maintenance than the previous system, JSS saves over $100 million a year in operating costs.

Demonstrating a key feature of its advanced capabilities, an Amraam missile scored a direct hit on a target aircraft while receiving new target data en route. The test was the fourth consecutive success in the full-scale development program. The unarmed missile was launched from an F-16 flying at supersonic speed at 25,000 feet. The target flew in a head-on approach just below supersonic speed at 20,000 feet. The missile initially flew under control of its on-board inertial reference unit, using target coordinates provided by the F-16's radar before launch. The missile then received post-launch target updates from the F-16 through the radar data link communications system. It used this information to confirm it was on course, or to modify its heading if necessary. In the latter stages of flight, the Amraam switched to its terminal mode using its own active radar. Hughes is developing the AIM-120A advanced medium-range air-to-air missile for the U.S. Air Force and Navy.

The U.S. Marine Corps has extra punch for close air support now that the first production models of the laser-guided Maverick missile are rolling off the assembly line. The air-to-ground missile, designated the AGM-65E, guides itself on a coded reflected laser beam from a target illuminated by a laser designator. This precise designation allows the Laser Maverick to be launched safely at targets located near friendly troops. The weapon can be carried by four Marine Corps aircraft: the AV-8B Harrier II, the F/A-18 Hornet Strike Fighter, the A-6E, and the A-4M. Its 300-pound warhead carries a delay fuze, which can be set while airborne prior to missile launch to detonate on impact or after penetrating a target. In operational tests, the Laser Maverick was successful 15 times in 15 launches. The missile, built by Hughes, shares the same airframe and propulsion system as the U.S. Air Force infrared-guided Maverick.

A compact laser device lets F-5 jet fighter crews pinpoint targets for laser-homing weapons. A crewman sights a target with a telescope and then fires the Laser Target Designator Set (LTDS) at the target. The laser beam hits the target and is reflected like an identifying beacon. The laser-homing weapon follows the beam's reflection to the target and destroys it. Hughes has produced over 100 laser designators for Northrop Corporation's LTDS.

Lasers will help halve the cost of inspecting metal parts for fighter aircraft radars when a new manufacturing technique goes into effect at Hughes. Advanced optics technology will be used to inspect newly fabricated radar antenna plates in three dimensions. Besides lowering costs, the process will reduce errors. The project is part of an Industrial Modernization Incentive Program (IMIP) awarded by the U.S. Navy and Air Force to help create the electronics factory of the future. IMIP is a share-the-savings concept that will reduce costs of the F-14, F-15, and F/A-18 Hornet Strike Fighter radar programs by more than $10 million, while improving the quality and reliability of the systems.

For more information write to: P.O. Box 45068, Dept. 77-3, Los Angeles, CA 90045-0068

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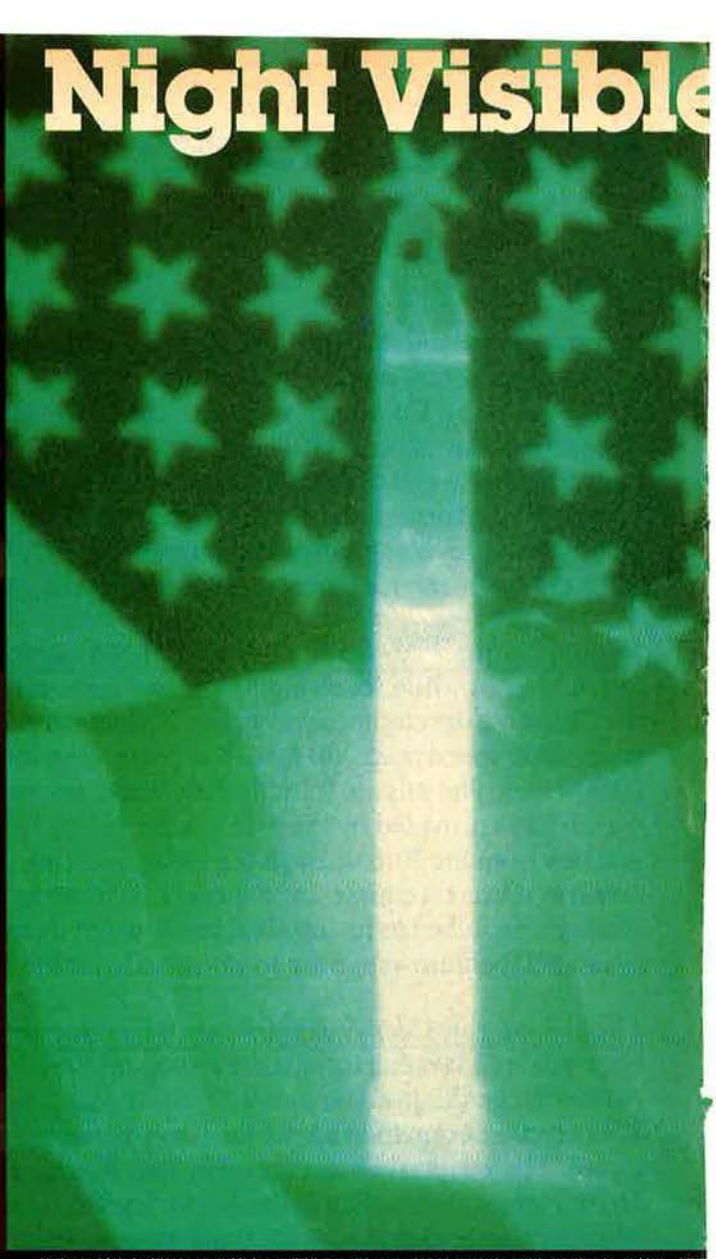

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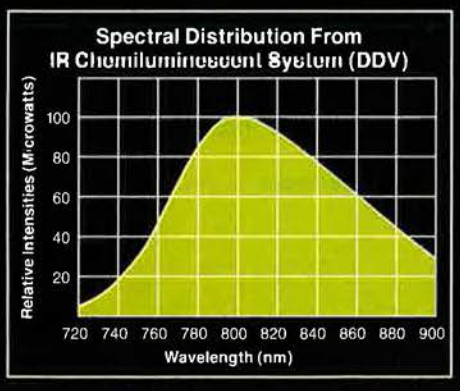

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For further information, contact Bob Cozzo, Military Sales Manager, American Cyanamid Company, Chemical Light Department, One Cyanamid Plaza, Wayne, NJ 07470, (201) 831-3179.

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stems from the notion that the command and control facilities and protocol associated with the release of Soviet INFs are vulnerable to NATO countermeasures. Exploitation of these alleged vulnerabilities through NATO countermeasures could prevent the effective employment of Soviet INFs, according to this school of thought, but sole reliance on such an unprovable abstraction would entail risks that most NATO planners on both sides of the Atlantic seem to find unacceptable. As a result, momentum for the development of US ATBMs is building.

In the political sphere, Sen. Dan Quayle (R-Ind.), a member of the Senate Armed Services Committee and of its strategic and intermediate-range nuclear forces subcommittee, is building a case for ATBM. In a discussion with this writer, he pointed out that the traditional Soviet penchant for comprehensive defensive capabilities superimposed on massive offensive forces is creating new, critical threats for NATO in the INF sector: "The threat is there, and we had better come up with a response. The logical response, in my view, is an ATBM defense."

The requirement to counter Soviet or Soviet-supplied short- and medium-range ballistic missiles is not confined to Europe, in Senator Quayle's view: "Israel faces a ballistic missile threat from Syria. It is likely that Israel therefore will become more interested in ATBM [systems developed by the US], which would give the issue additional political clout on [Capitol] Hill." Korea and Japan are other non-NATO countries that eventually might seek ATBM defenses against ballistic missile threats, he suggested.

The case for expeditious development and deployment of US ATBMs, he said, pivots on four "good reasons. For one, it meets the immediate threat of Soviet [theater] ballistic missiles; secondly, it recognizes that the Soviet Union has defensive [ATBM] capabilities in place; thirdly, it does not represent a violation of the ABM treaty [that constrains defenses against strategic nuclear weapons]; and fourth, it will show the Europeans and everybody else that [we are working on] the proper balance between offensive and defensive forces."

Development of ATBMs should be carried out as part of the Strategic Defense Initiative (SDI), Senator Quayle recommended. This would assuage European concern that SDI will erect a defensive shield over the US and, hence, cause this country to "forget Europe." By folding ATBM into SDI, this country could allay these fears in NATO Europe, "since we would provide a defensive shield for both Europe and ourselves." Stressing that ATBM development is the natural first step toward evolving a layered strategic defense, he pointed out that theater and strategic defenses share a number of common technologies. The US, he said, "should push ahead quite forcefully on ATBM. Once we can clearly see the viability of such a system, the process of deploying SDI in this country will be a lot easier."

At his initiative, the strategic and theater nuclear forces subcommittee of the Senate Armed Services Committee is about to launch hearings on the ATBM question in order to call national and international attention to the potential deterrence value of such weapons as well as to convince the Administration of their merit: "We are finding a sympathetic echo to our recommendations in the Administration, but they haven't organized yet to put ATBM on the front burner."

Support in Europe for pursuing ATBM technology as part of the SDI program is growing, with "Germany and Britain interested in and tentatively committed to some form of R&D partnership," according to the Indiana senator. His first goal is to establish ATBM as a national priority, to get it funded, and to secure overseas support for such an endeavor: "A lot of people are interested, but we need to provide a focus for such a program."

IN FOCUS...

Washington Observations

★ The new Soviet ballistic-missile-launching Typhoon submarines—three of which are operational at this time, carrying twenty SS-N-20 SLBMs each—are designed for operation under the polar ice cap to enhance their survivability. These SSBNs are sufficiently hardened to "shoulder" their way through thick ice, launch their missiles, and then "disappear" under the ice, according to the Defense Intelligence Agency's Deputy Director for External Affairs, A. Denis Clift.

The Soviets, he told an AFA symposium recently, are "closing the gap that the US enjoyed for so many years" in SSBN and SLBM technology. The new Soviet cruise-missile-carrying nuclear-powered Oscar-class submarines have no Western equivalent. These 14,000-ton submarines carry twenty-four "sea-skimming, 500-kilometer-range, supersonic cruise missiles."

Modernization of the Soviet ICBM force continues unabated, with development of a sixth generation of advanced weapons under way. Included here is a follow-on to the world's largest and most lethal ICBM, the SS-18, whose throw-weight is twice that of the not yet operational MX Peacekeeper. The SS-18 follow-on has an even greater throw-weight than the SS-18—308 of which are deployed in six complexes across the USSR and which carry a combined total of 3,080 high-yield warheads—and yet better accuracy.

Lastly, the little-noticed but intensive Soviet ICBM enhanced hardening program has resulted in some 818 "extremely hard" Soviet ICBM silos—out of a total of some 1,400—that have a "very good chance of surviving attacks by our present ICBM force," according to the DIA official.

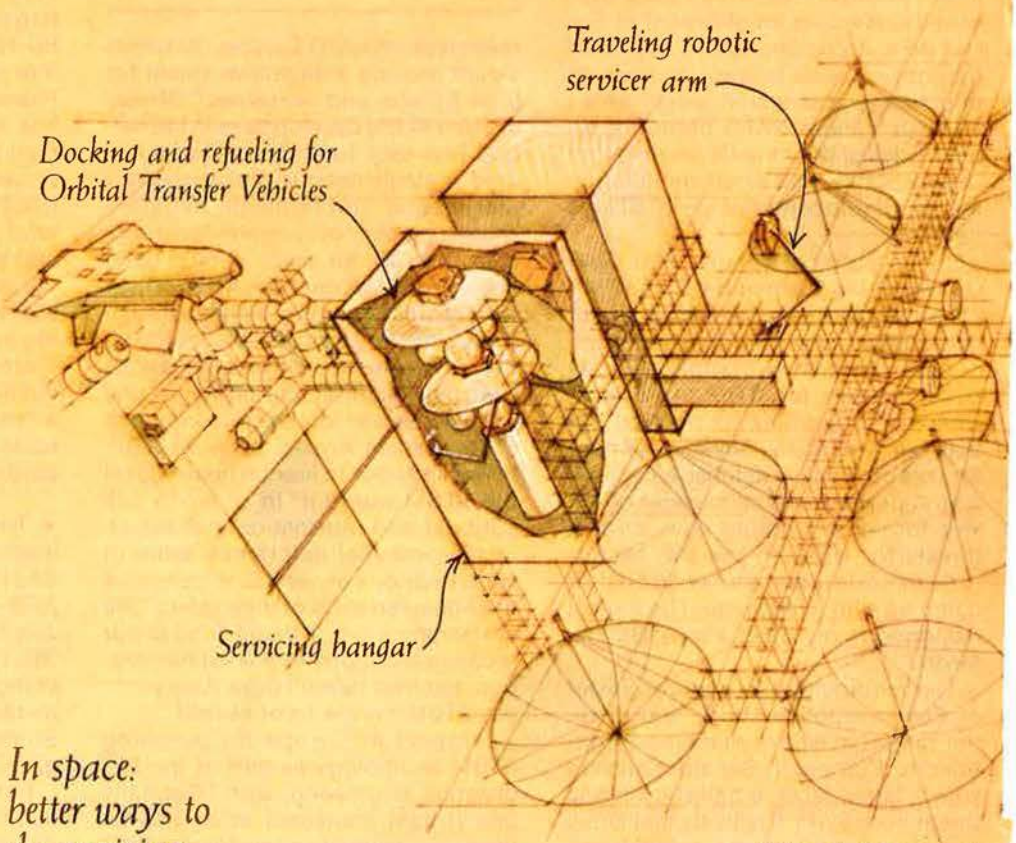
★ Two of the critically important payloads to be orbited by the first Space Shuttle flight from Vandenberg AFB—now postponed until about July 15, 1986—are Teal Ruby and CIRRIS 1A. The latter acronym stands for cryogenic infrared radiance instrumentation/Shuttle and is part of the Strategic Defense Initiative (SDI) program.

Purpose of CIRRIS 1A, according to Lt. Gen. B. P. Randolph, USAF's Deputy Chief of Staff for R&D and Acquisition, is to probe "earthlimb airglow and [its] effect on space object surveillance, infrared background changes caused by auroras, space targets of opportunity, [as well as] . . . infrared contamination around the Shuttle and how it would affect potential on-board sensor experiments."

The Teal Ruby payload has an on-orbit life span of a year and can be retrieved during subsequent Shuttle missions. Purpose of this experimental sensor is to prove the detectability of such "dim targets" as aircraft, ships, and missiles in a "bright background" from space. Teal Ruby, according to General Randolph, "will use a step-stare operation, whereby the sensor stares at a point on earth. As an object goes through the surveillance fence, the sensor steps to a new point on earth. Background scenes are 'imaged' by stepping detector zones in different spectral bands to the same point on earth. There are up to forty targets and 150 background experiments planned." Teal Ruby, he added, is about to complete final testing at a Rockwell International facility "ahead of schedule." ■

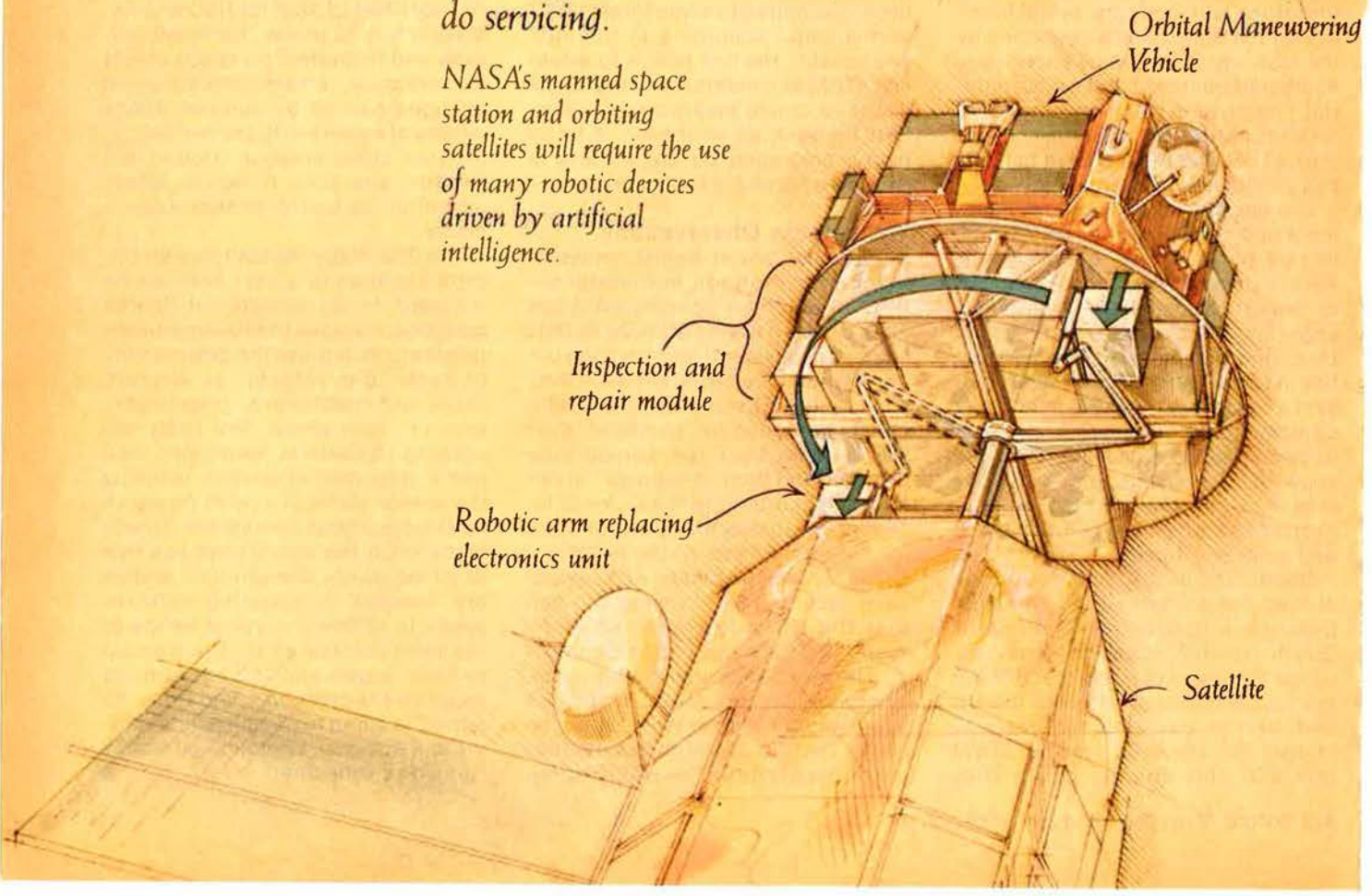
Artificial intelligence and robotics: giving machines the ability to sense, reason and act.

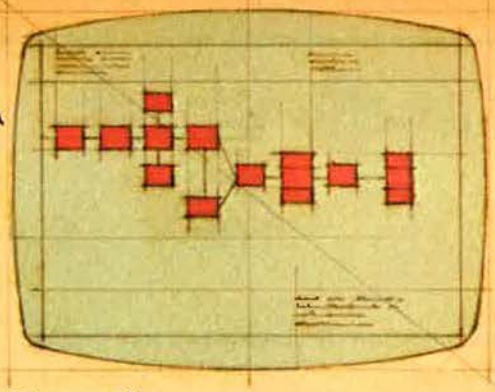
Much as it may hurt to think so, many things might be done better by independently functioning machines than by humans. Certain tasks may require superhuman precision or speed, or need to be done where humans can't go. Martin Marietta is creating systems that combine the ability to sense, reason and take action—to function autonomously and intelligently. And we are exploring ways to put them to work on a variety of tasks.

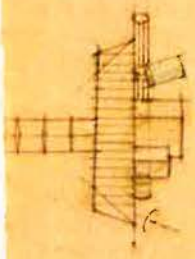


In space: better ways to do servicing.

NASA's manned space station and orbiting satellites will require the use of many robotic devices driven by artificial intelligence.

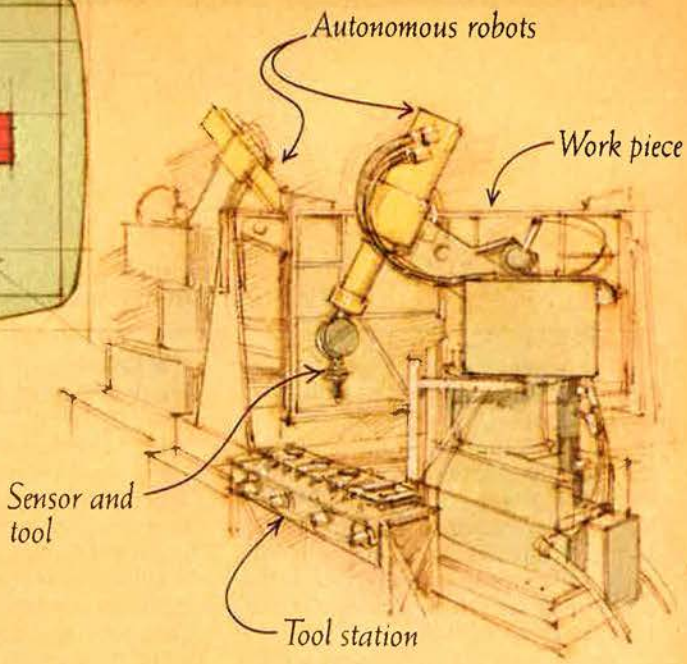


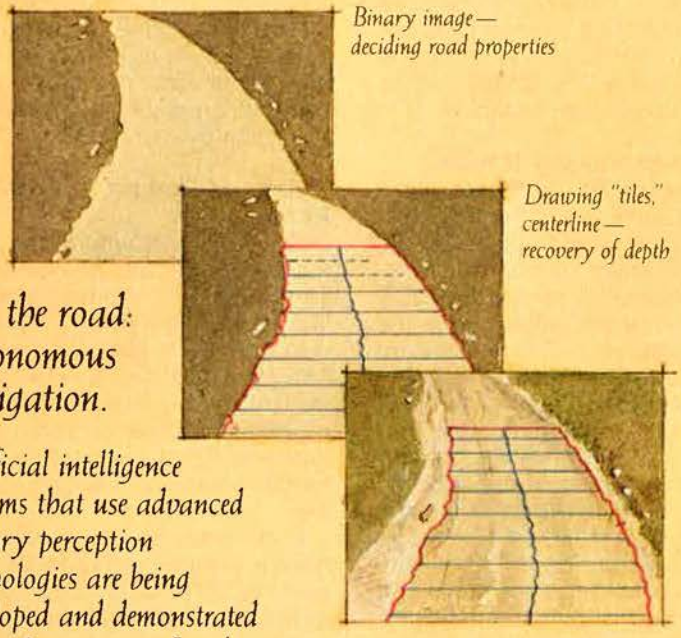




On earth: faster manufacturing and inspections.

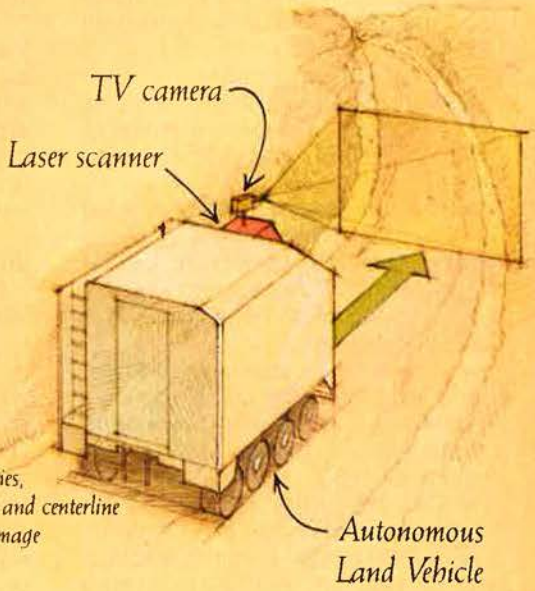
With creative intelligence stemming from software that we are developing, autonomous robots can quickly and efficiently perform batch manufacturing and precision inspections, even choose their own tools.





On the road: autonomous navigation.

Artificial intelligence systems that use advanced sensory perception technologies are being developed and demonstrated in the Autonomous Land Vehicle. Already able to follow roads, this mobile test bed will eventually be able to plan its route, avoid obstacles and even thread its way across country.



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CAPITOL HILL

By Brian Green, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Nov. 25

Senate Appropriations Action

The Senate Appropriations Committee (SAC) approved its version of the defense appropriations bill on November 5. The bill contains $282.5 billion in new obligational authority, a trim of about $3 billion (mostly in military retirement funds) from the amount approved by the SAC's Defense Subcommittee.

That funding is consistent with a total defense budget of about $299 billion, an increase that covers slightly less than the estimated cost of inflation in FY '86. The committee, however, added $5.5 billion in unspent funds from prior years, bringing the total FY '86 funding to $288.1 billion, in line with a defense budget of about $305 billion—slightly higher than the $302.5 billion authorization level.

The Senate bill includes:

- $2.96 billion for the Strategic Defense Initiative. A move to trim that to the authorization level of $2.75 billion failed.
- The full $624 million requested for the Small ICBM (SICBM, or Midgetman). The committee expressed serious reservations concerning the cost and technical risks inherent in the SICBM program.
- A deferral of multiyear procurement for F-16s until the air defense fighter competition has been completed. The competition will be established in FY '86.
- $140 million for R&D on the Advanced Tactical Fighter (ATF), a reduction of $103 million from the Administration request. While expressing support for the ATF, SAC expressed concern over potential costs and "unacceptable" technical risks in the program.
- $183 million for ASAT R&D. The $33 million earmarked for ASAT procurement was insufficient to purchase any test missiles and was thus shifted to ASAT R&D.
- $29.4 million for advance procurement of the Advanced Medium-Range Air-to-Air Missile (AMRAAM) and $150 million for other procurement activities.
- $240 million for the Joint Surveillance and Target Attack Radar System (JSTARS), $20 million below the Administration request but $180 million over the House recommendation. The JSTARS program involves development of an airborne platform and a radar that can detect and designate moving or stationary ground targets. Both the Senate and House are dissatisfied with the survivability of the C-18, the platform agreed upon by the Air Force and Army.
- $164 million for initial production of new binary chemical weapons.

The Defense Department is currently funded at FY '85 levels by a Continuing Resolution (CR) that expires December 12. While the full Senate is scheduled to take up the bill in early December, its provisions differ from those of the House on many of the contentious issues that have divided those two bodies in the past. A Senate-House conference could be difficult and time-consuming. The shortness of time raises the possibility that the bill will be folded into an omnibus continuing resolution.

JCS Reform Passes House

On November 20, the House passed the Joint Chiefs of Staff Reorganization Act by a lopsided vote of 383–27. In its current form, the bill would revise significantly the extant JCS structure. The bill would make the Chairman of the JCS the principal military advisor to the Secretary of Defense, National Security Council, and President, rather than the corporate JCS. It also creates the position of deputy chairman to conduct the duties of the Chairman in his absence, requires that dissenting opinion be submitted along with the military advice of the Chairman, and instructs the Chairman to submit program recommendations and budget proposals.

Proponents of the measure said the current JCS structure is incapable of providing timely or relevant military advice because of its rule-by-committee nature, service parochialism, and time constraints faced by the individual service chiefs. They argued that strengthening the Chairman would provide a single strong voice for the JCS, which would be less constrained by the need to compromise, while still permitting differing military opinions to reach higher authorities.

Critics of the bill maintained that civilian control of the military could be undermined by placing too much power in the hands of the Chairman, that the chain of command would not be clarified, and that the JCS would be needlessly interjected into the procurement process.

In recent years, the Senate has blocked House JCS reform measures. This October, however, the Senate Armed Services Committee (SASC) released a staff report that expressed similar objections to the current JCS structure. While not endorsed by the SASC membership, Chairman Barry Goldwater (R-Ariz.) and ranking Democrat Sam Nunn (D-Ga.) have both expressed support for some sort of JCS reform. The Senate is expected to complete a series of hearings on defense organizational reform by mid-December and have legislation ready for action by early 1986.

Balanced Budget Act Still Pending

The Gramm-Rudman amendment (named for its primary Senate sponsors, Sens. Phil Gramm [R-Tex.] and Warren Rudman, [R-N. H.]) still looms over the current budget proceedings. The House passed a version of the measure on November 1 that calls for quicker and deeper deficit reductions—and that will hit defense even harder—than that passed by the Senate.

Both measures call for deep reductions in the annual budget deficit and automatic spending cuts if deficit targets are not met. While President Reagan could submit budgets that would include previously agreed increases in defense spending, the virtually unanimous sentiment in Congress is that such increases are politically untenable if domestic spending is declining precipitously. Defense spending is thus likely to decline if such a measure passes. ■

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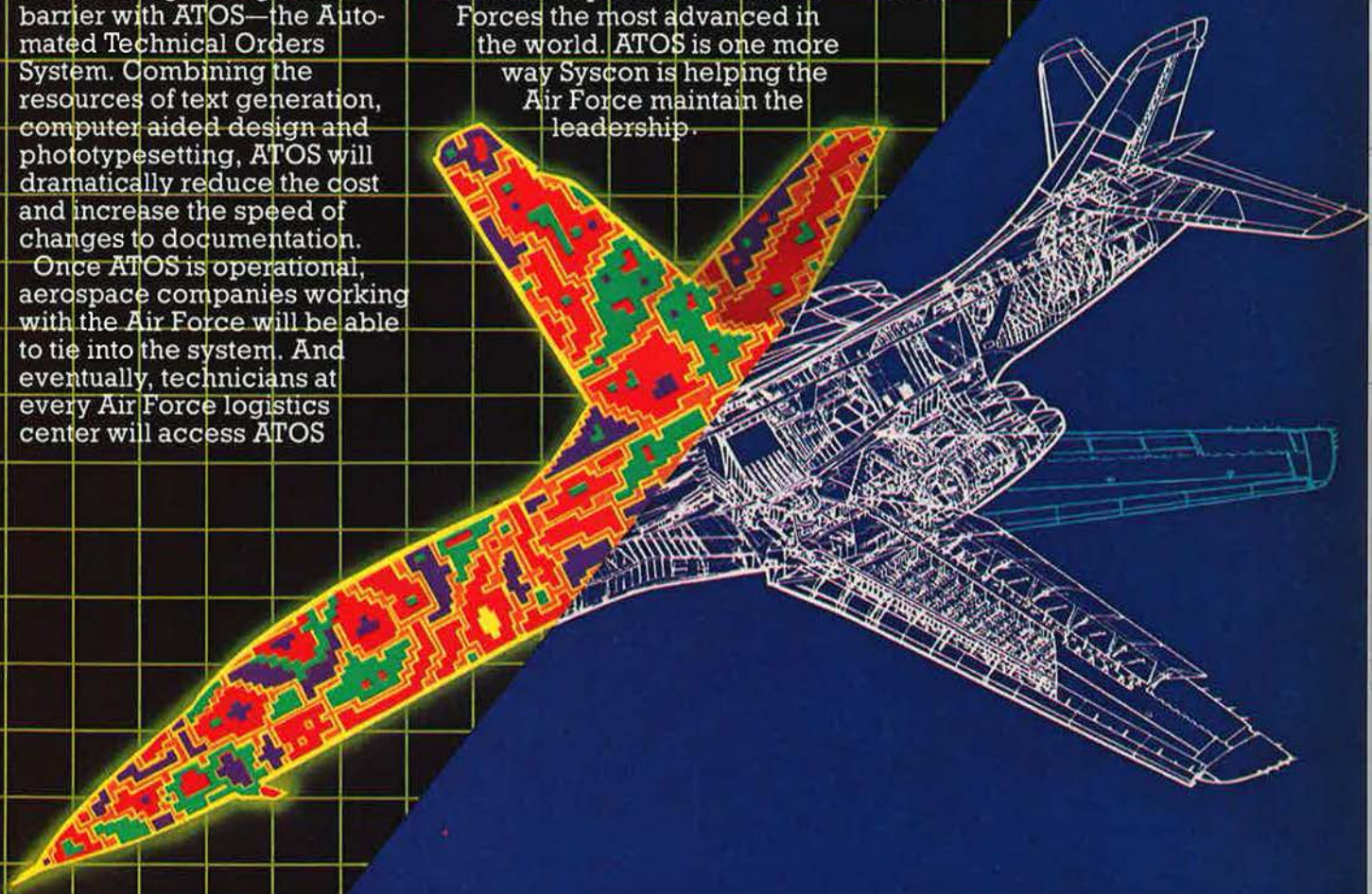

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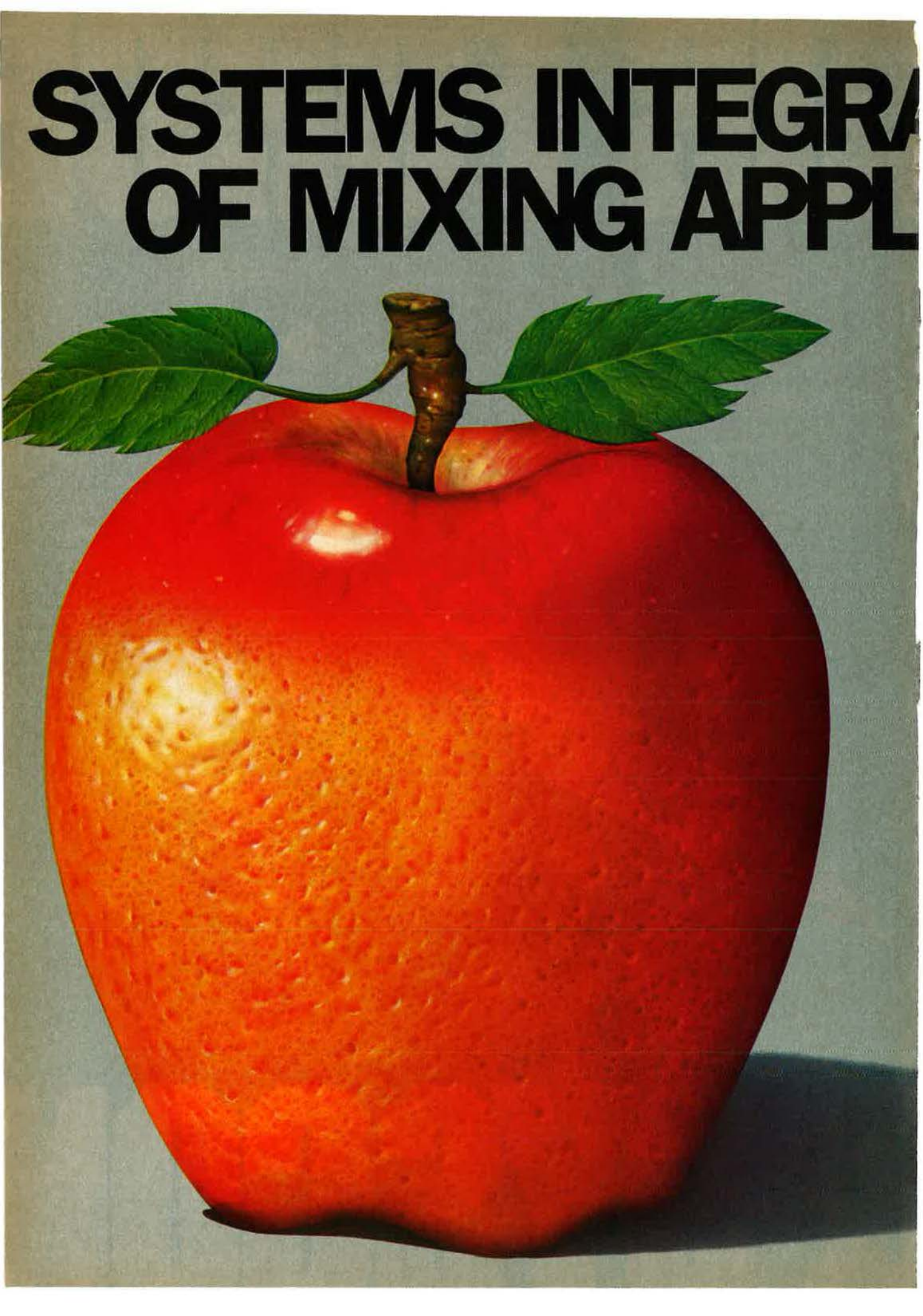

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AEROSPACE WORLD
News, Views & Comments

By James P. Coyne, SENIOR EDITOR

Washington, D. C., Nov. 27 ★ A revolutionary new wing mounted on an Air Force F-111 is now in the early stages of test flying by the Boeing Military Airplane Co. at Edwards AFB, Calif.

Boeing and the Air Force expect the smooth, variable-camber wing will result in a twenty-five to thirty percent improvement in aircraft range and maneuverability. It will improve handling, allow tighter sustained maneuvers for evasive action and survivability, extend range, increase fatigue life, and provide a more stable weapons platform and a more comfortable "ride," resulting in reduced crew fatigue.

Unlike a conventional wing, the new mission adaptive wing (MAW) does not use flaps, slats, ailerons, or spoilers. The wing changes its camber (shape) in flight through the use of internal hydraulic actuators while the flexible outer composite "skin" maintains a smooth surface. The flight tests under way at Edwards are to demonstrate how the wing improves maneuverability, payload, range, and fuel efficiency.

The MAW was built by Boeing under a joint Air Force/NASA Advanced Fighter Technology Integration (AFTI) F-111 program managed by Aeronautical Systems Division's Flight Dynamics Laboratory at Wright-Patterson AFB, Ohio. The F-111 was chosen as the test-bed because its variable sweepwing permits simulation of a variety of military aircraft. The F-111's subsonic, transonic, and supersonic speed capability will enable scientists to determine how the MAW will perform under various combat profiles.

Wind-tunnel tests have shown that the variable-camber wing will improve buffet-free lift by sixty-nine percent and sustained lift by twenty-five percent. It will reduce supersonic cruise drag by seven percent and subsonic cruise drag by six percent.

The $24 million contract covers about seventy-five flights in a two-phase test program. Phase I, which runs through next May, will involve manual control of the system. Phase II, in which automatic modes will be tested, will run until May 1987.

The wing will be digitally programmed for different automatic flight modes of cruise camber control to minimize drag, maneuver camber control to maximize dynamic efficiency, maneuver load control to increase G-pulling capabilities, and maneuver enhancement to increase responsiveness. Gust loads will be alleviated by flexing the wing to keep the bending movement below critical levels, thus reducing wing loading. This could permit construction of a lighter wing.

The system will permit extremely rapid, automatic adjustments to the variable camber. For example, the trailing edge of the wing will be able to move through thirty degrees of deflection in about one second. In the automatic mode, the pilot will select the altitude, Mach number, and maneuver condition he desires, and then the digital computer in the flight control system will select the optimum wing shape for those conditions.

MAW technology will provide significant enhancements to military interceptors, tactical fighters, and strategic bombers, Boeing said. There are possible commercial applications, especially for short-range transports that spend a significant portion of their flight profile climbing to cruise altitude and descending.

★ In a November 14 statement to the Senate Armed Services Committee, Secretary of Defense Caspar W. Weinberger gave one measure of how micromanagement of defense has increased in recent years.

"Between FYs '70 and '85, the number of reports and studies requested by Congress increased from thirty-six to 458, an increase of almost 1,200 percent, with no apparent end

An F-111 fitted with a revolutionary new variable-camber wing is shown just before the start of an extensive, two-stage test program at Edwards AFB, Calif. The wing relies on internal hydraulic actuators and a flexible composite skin to accommodate changing flight conditions.

in sight," he said. "We recognize that such oversight is appropriate where matters of broad policy and program accountability are involved. However, in many instances, issues of this nature are not involved.

"Many of these studies and reports are quite complex and time-consuming. Moreover, the time and energy devoted to their completion detract from higher priority projects within the department."

★ For the first time, a spaceflight was shortened by a crew member's illness. Last November 22, Cmdr. Vladimir Vasyutin, commander of Soviet orbiting space station Salyut 7, developed an unspecified health problem that required aborting the mission in order to save his life. The commander and his two crew members returned to earth in their Soyuz T-14 space capsule.

The return, and the reason, were announced by Tass, the official Soviet news agency, about an hour after the capsule touched down on the steppes of Central Asia. Normal returns from orbit are announced about twenty-four hours before they are scheduled to take place.

Western space reporters speculated that Commander Vasyutin's illness was probably related to kidney stones or his appendix. His two companions were reported by Tass as "feeling not bad." One crew member had been aboard the space station since last June; the commander and the other crew member joined him in orbit on September 17.

★ Five new locations have been added to the list of candidate installations under consideration for potential deployment of the new, small intercontinental ballistic missile system (SICBM), the Air Force has revealed.

After screening more than 4,200 locations in the US for deploying SICBMs in either randomly moved hard mobile launchers or hardened silos, the Air Force announced last spring it would begin gathering data on forty-six potential basing areas in nine states *(see "Aerospace World," July '85 issue, p. 38).* An additional basing mode is now being considered involving stationing the mobile system on existing Minuteman complexes. These are at Ellsworth AFB, S. D., Minot AFB and Grand Forks AFB, N. D., Whiteman AFB, Mo., and Malmstrom AFB, Mont., bringing the total number of potential basing areas to fifty-one. F. E. Warren AFB, Wyo., which was in the original list of forty-six, is also under consideration for the additional basing mode.

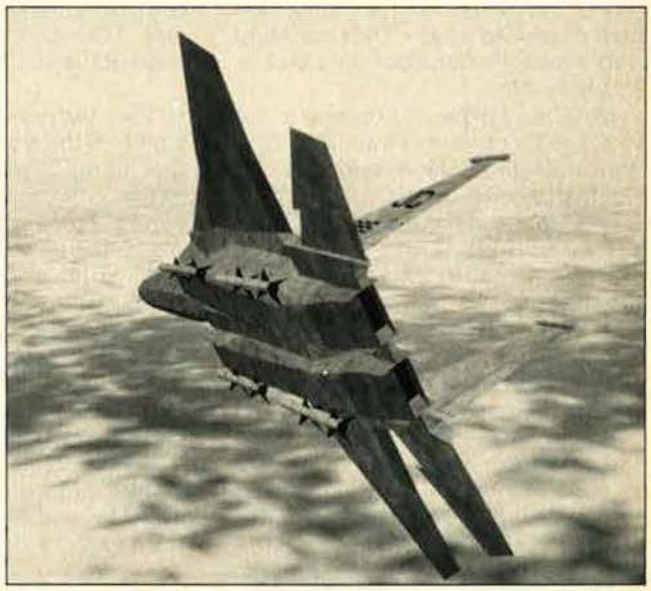
Decisions on how and where the first missiles will be based will be made in late 1986. The SICBM system is projected to be initially operational by the end of 1992. The Air Force emphasized that research into survivable basing modes for the SICBM continues, and if new deployment opportunities are identified, additional areas and installations in the US may be considered.

★ USAF has designated Hughes Aircraft Co., Los Angeles, Calif., to complete development of a new low-level navigation system that will enable military pilots to fly low over unfamiliar territory safely at near supersonic speeds without having to wrestle with flight charts.

The Integrated Terrain Access and Retrieval System (ITARS) will display color-coded surface features and man-made structures. The system will constantly update terrain data, which pilots can call up at the touch of a button. They will be able to see the information in a look-down, or map, mode or look-ahead mode. Information can also be displayed on the head-up display (HUD).

By using stored terrain information, pilots can fly more safely and increase survivability. ITARS will automatically interface its stored data with other systems aboard the aircraft. The data will help in navigation, terrain following and terrain avoidance, weapons delivery, mission planning, and threat avoidance. The system will also blend inputs from the aircraft's sensors into the battle picture. ITARS will eliminate the need for the pilot to perform these tasks.

The system will also be useful in enabling pilots to "prefly" missions in the simulator, safely acquainting them with the terrain and location of



New heights in realism are being reached by modern simulation technology. This computer-generated model of the McDonnell Douglas F-15 STOL prototype was produced by General Electric's Compu-Scene IV, which is now being used by Lockheed, McDonnell Douglas, and Sikorsky in major new research facilities.

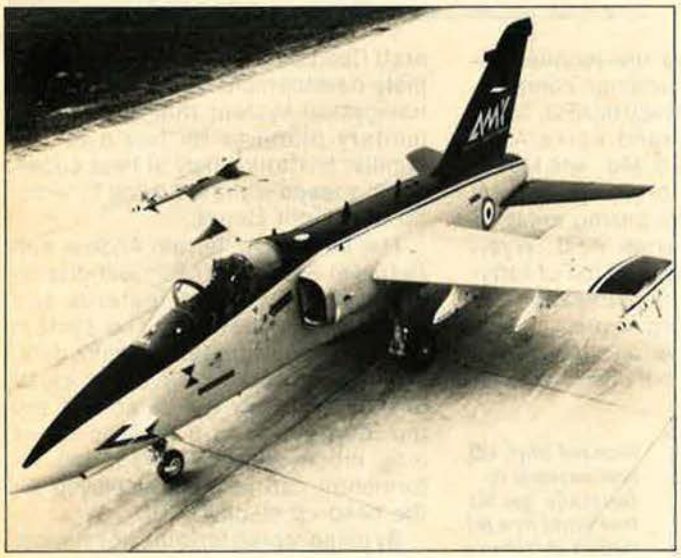
Richard Burt, US Ambassador to Germany, got his first flight in a jet fighter at Bitburg AB late last year. After his F-15 ride, he commented, "As a fighter pilot, I'm a pretty good ambassador. My heart was in the flight, but my stomach wasn't." He also met with German officials in the Bitburg area.

probable threats and enabling them to select planned ingress and egress routes that limit exposure to detection and enemy threats.

The initial version of the system will be able to store up to 10,000 square miles of terrain data. Since it is a modular system, it can be tailored to fit the needs of the particular aircraft in which it is installed. ITARS can be expanded to cover 250,000 square miles of terrain data. Digital map information for the system comes from a data base produced by the Defense Mapping Agency's Aerospace Center in St. Louis, Mo.

ITARS is a follow-on program to the Airborne Electronic Terrain Map System (AETMS) begun in early 1980. A flyable prototype of AETMS was delivered in 1982 and proved the feasibility of ITARS. Hughes will deliver two ITARS systems for flight testing late this year.

★ First flight of the first Brazilian-assembled AMX combat aircraft took place at Embraer's manufacturing facility in São José dos Campos. The Aeritalia-Aermacchi-Embraer AMX, an Italian-Brazilian joint venture, is powered by the Rolls-Royce Spey 807 engine.



The first Brazilian-assembled AMX combat aircraft has flown over Embraer's manufacturing plant at São José dos Campos. The joint Italian-Brazilian tactical fighter has been very impressive in demonstrations. It can perform close air support, strike, and interdiction missions.

The AMX, which gave an impressive performance at last year's Paris Air Show, was developed to meet Italian and Brazilian tactical fighter aircraft needs. Initial production is expected to be 187 aircraft for Italy and seventy-nine for Brazil.

It is scheduled to enter service with the Italian Air Force in 1987, replacing the G91 and F-104G fighters in the close air support, interdiction, and strike roles. It will also be used to supplement the Tornado in the reconnaissance role.

The AMX is scheduled to enter service with the Brazilian Air Force in 1987. It will be employed for close air support, interdiction, and strike. It is another in a long line of successes for Brazil's remarkable aircraft industry *(see "Aerospace Booms in Brazil," June '85 issue, p. 112).*

AEROSPACE WORLD

★ The largest jet engine testing facility in the world has reached Initial Operating Capability (IOC) and will begin major engine testing this spring. The Aeropropulsion Systems Test Facility (ASTF) at Arnold AFS, Tenn., is the only facility in the United States that can simulate full flight conditions on the ground *(see "Big Wind at Tullahoma," January '85 issue, p. 78).*

The ASTF gives the Air Force the capability to test engines that haven't even been designed yet—up to 75,000 pounds of thrust. Currently, the most powerful air-breathing engine in the US inventory develops about 50,000 pounds of thrust. "This plant was designed to meet expected engine test requirements well into the twenty-first century," said Col. Casper H. Klucas, ASTF program manager.

Two new systems installed in the facility are for highly sophisticated computer data collection and control. With them—the Test Instrumentation System (TIS) and the Automatic Test Control System (ATCS)—Arnold now has the capability to simulate all types of flight conditions, from temperatures as low as minus 100 degrees Fahrenheit to as high as 1,020 degrees F, in all types of atmospheres and weather conditions, and at the same time to monitor the performance of engines being tested.

The TIS utilizes about 2,000 data collection channels in each engine test cell, making it one of the largest and most capable real-time collection systems in the world. But, big as it is, the test facility has been designed so that it can be expanded. Additional engine test cells may be added, with the power supply and air-handling system increased accordingly.

★ Research and development of the GPU-5/A 30-mm gun pod has been successfully completed, and responsibility for the weapon has been transferred from Air Force Systems Command's Armament Division to Air Force Logistics Command, USAF has announced. Deliveries to both Air Force and Air National Guard units using the weapon system will be completed by the end of February.

The GPU-5/A system, manufactured by the General Electric Co. of Burlington, Vt., consists of a four-barrel, 30-mm Gatling gun, a self-contained pneumatic drive, and a closed-loop helical ammunition feed system. The pod holds 353 rounds of GAU-8 ammunition, with a firing rate of 2,400 shots per minute.

The pod was developed to provide a capability similar to the tank-killing capability of the A-10's internal gun. Procured primarily for use on the A-7 and F-4, its compatibility has also been demonstrated on the F-15, F-5, A-4, F-16, and A-10. It provides a quick-reaction, antiarmor capability for rapid deployment forces.

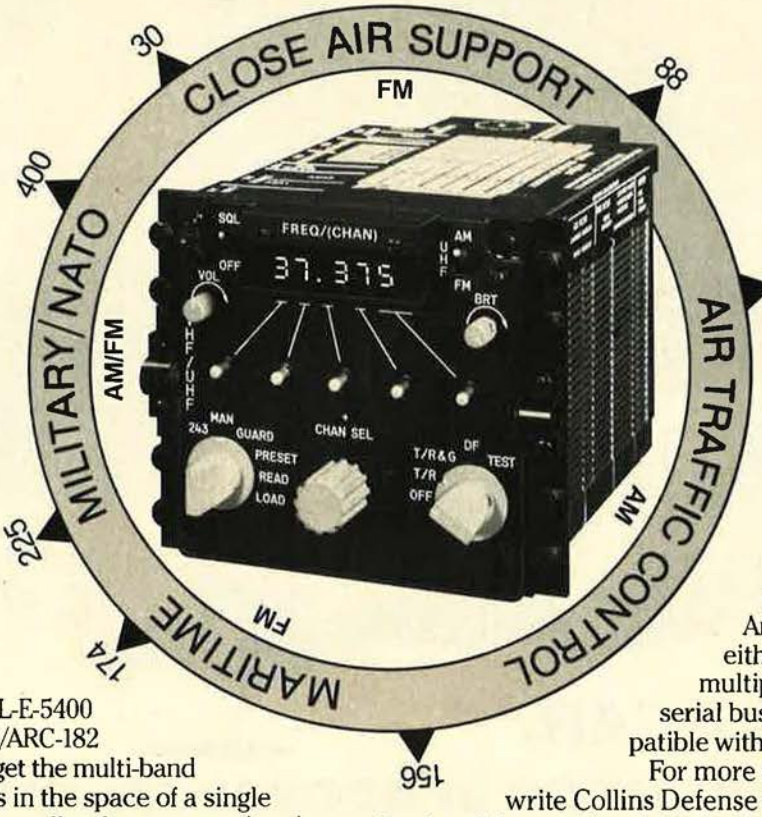
A foreign military sales agreement for the GPU-5/A has been concluded with one foreign country. Additional sales are expected in the future, the Air Force announcement said.

The weapon system is a success story not only in speed of development and level of performance but also in cost. The unit price decreased from $940,000 in 1981 to $335,000 in 1984. Armament Division attributed the significant savings and fast development to the close working relationship between the division and General Electric.

★ Siren, claimed by its manufacturer to be the world's first intelligent naval decoy, is the latest device developed to keep antiship weapons like the Exocet from hitting their targets.

Manufactured by Marconi Defence Systems in England, Siren is launched automatically from a ship when radar detects an approaching missile or electronic receivers pick up

Air, land and sea forces band together.



The Collins AN/ARC-182 Airborne Transceiver. The most compact multi-mode/ multi-band communications system.

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In addition, the Collins AN/ARC-182 features a built-in test that quickly detects and isolates faults to the module level for rapid maintenance. Its rugged design makes it ideal for a variety of aircraft, shipboard and ground applications. Various mounting hardware is available to suit nearly every application for single or dual (auto relay) applications. And it can operate from either a MIL STD 1553 multiplex data bus or built-in serial bus system, and is compatible with Have Quick appliques.

For more information, call or write Collins Defense Communications, Rockwell International, Cedar Rapids, Iowa 52498. USA phone (319) 395-2461. TELEX 464-435.

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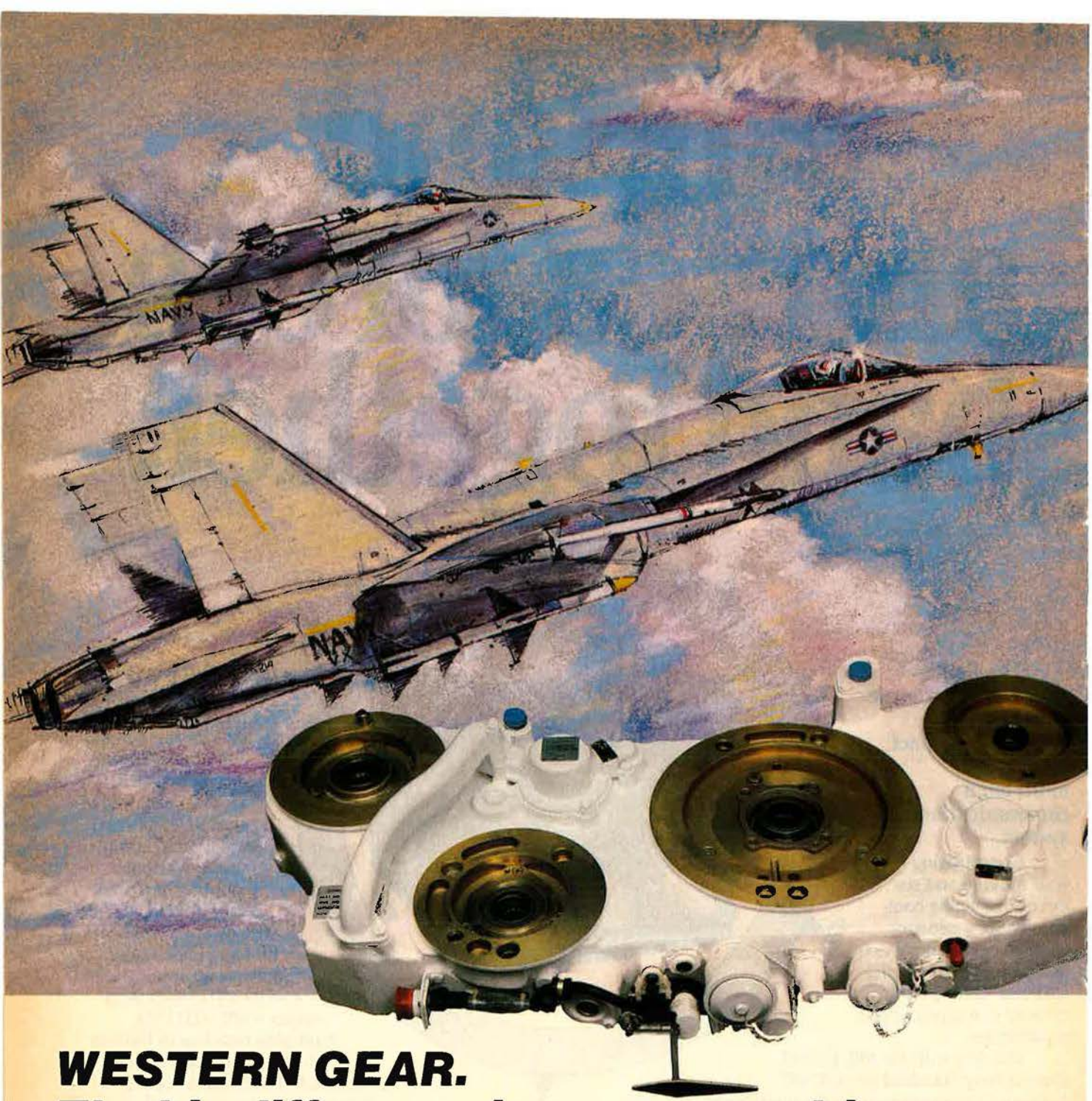

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emissions from an approaching aircraft or missile. A Siren round is propelled to a preset altitude, from which it descends by parachute, radiating jamming signals. If the approaching missile is a heat-seeker, a Siren decoy is launched to deploy flares.

Jamming can also be accomplished by deployment of chaff. Selection of the round—radar jammer or heat emitter—is automatic.

★ A new 26,000-pound-thrust turbojet engine built by Pratt & Whitney, West Palm Beach, Fla., has completed a series of flight clearance tests that qualifies it for installation and flight testing in an Israeli F-4 Phantom jet fighter. Israel has selected the PW1120 to power its new Lavi fighter aircraft.

The flight clearance tests were designed to qualify the new longer afterburner section required to make the PW1120 compatible with the F-4 airframe. An actual first flight of the engine in an F-4 will take place in "the next few months," a Pratt & Whitney spokesman said.

Qualifying the engine in the F-4 is a significant milestone for the company, which, with Boeing, is trying to promote a worldwide F-4 reengining program that would make the aircraft a capable fighter into the next century.

"There are more than 800 F-4s in service around the world with sufficient service life remaining to make reengining and modernization a practical option," said Gene Lehmann, PW1120 project manager. Powered by two of the new engines, an F-4 "Super Phantom" will have fifty percent greater acceleration than it has now, the company claims.

★ McDonnell Douglas has begun flight tests in the F-15 Eagle of the US Air Force's new Joint Tactical Information Distribution System (JTIDS). The Eagle is the first fighter to be used in testing the new system.

JTIDS gives the pilot an instant readout of the location of both enemy and friendly forces in his area of operations. Using a color display panel in the cockpit, he sees the exact position of other aircraft as well as surface-to-air missile launch sites. Aircraft are identified on the "screen" as friendly, hostile, or unknown. Direction of movement is also indicated.

Tests are being conducted at McDonnell Douglas facilities in St. Louis, Mo. They will continue until February, when the aircraft will be turned over to the Air Force for follow-on testing. All future F-15s and a large percentage of F-15s now in the inventory will be equipped with JTIDS.

★ In advanced fighters, faster speeds, higher altitudes, and possible adverse aircraft attitudes in flight will expose crew members to increasingly hazardous conditions on bailout, so the Air Force has awarded the Boeing Military Airplane Co. (BMAC) a contract for conceptual design of a crew escape capsule for future advanced fighters. The $420,000 study is expected to take about twenty-eight months.

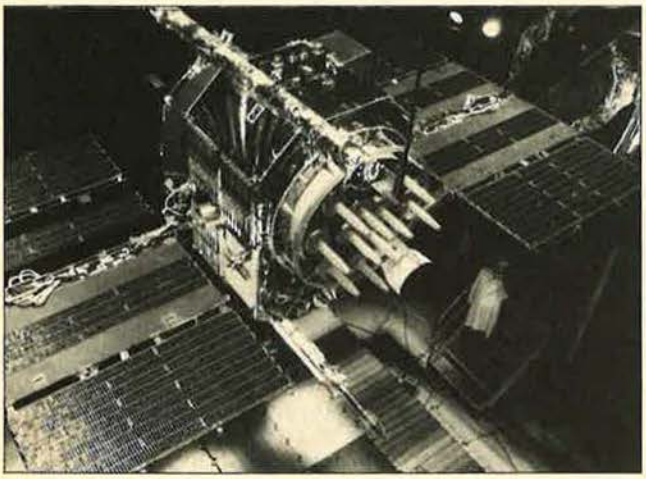
Boeing will study both single and two-place recoverable and nonrecoverable system concepts and will build a single-place capsule mockup for ASD's Flight Dynamics Laboratory. Such technologies as selectable thrust rocket motors, thrust vector control, microprocessor control systems, and automatic stability and control will be studied. Boeing is already investigating these technologies for open ejection seats under the Air Force's CREST program.

An enclosed crew escape system will provide escape capability over nearly 100 percent of the flight envelope, it is believed. A capsule will also provide protection from windblast, chemical/biological elements, and temperature extremes and will provide improved survival for landings in bodies of water.

The capsules will be designed to provide safe escape capability throughout the speed range from zero to 900 knots and altitudes from the surface up to 100,000 feet.

★ Marshal Aleksandr I. Pokryshkin, second-ranking Soviet World War II

AEROSPACE WORLD



Rockwell's Navstar Global Positioning System satellite has successfully passed a four-month series of tests at the Arnold Engineering Development Center, Arnold AFS, Tenn. The tests proved its ability to withstand the extremes of heat and cold in space.

Kenneth E. Adelman, Director of the US Arms Control and Disarmament Agency, is given a briefing on the operation of a B-52 Short-Range Attack Missile (SRAM) loader during a visit to the 319th Bomb Wing at Grand Forks AFB, N. D.

AEROSPACE WORLD

ace with fifty-nine victories over German opponents, has died, it was announced last November by Soviet authorities.

He is reported to have flown more than 600 sorties against the Germans, during which he took part in 156 dogfights. One of only a handful of Soviet pilots to be awarded the title of Hero of the Soviet Union three times for his performance in war, he was a member of the Presidium of the Soviet Union.

★ Everything you ever wanted to know about aviation and aerospace is contained in the latest edition of *US and World Aviation and Space Records,* recently published by the National Aeronautic Association. The NAA has been the US representative to the International Aeronautics Federation (FAI), the world governing body for competitive aviation, since 1905.

More than fifty percent of all records are held by Americans, the NAA says, and the organization's goal is to increase the US share by encouraging private, commercial, and military pilots to break existing records and set records in new categories.

The new edition, which is the "only complete and official listing," covers records for spacecraft, aerospacecraft, airplanes, gliders, seaplanes, amphibians, vertical lift aircraft, balloons, model airplanes, human-powered airplanes, hang gliders, helicopters, autogyros, motorgliders, and racing planes.

Types of records include altitude, distance, speed over various distances and courses, and time-to-climb. The 206-page book is available for $7.95 plus $2 postage and handling from the NAA, Suite 550, 1400 Eye St., N. W., Washington, D. C. 20005.

★ **HONORS**—The Air Force Organizational Excellence Award for meritorious service has been won by the **Deputy for B-1B** at Aeronautical Systems Division (ASD), Wright-Patterson AFB, Ohio. Lt. Gen. Thomas H. McMullen, ASD Commander, made the presentation to Maj. Gen. Peter W. Odgers, deputy commander for B-1B, at Wright-Patterson.

The award citation noted that "the innovative management techniques and technical expertise demonstrated by the deputy for B-1B have kept this complex, number-one priority program within budget and ahead of schedule." The first operational B-1B was delivered to Strategic Air Command last June 29, exactly thirty years after the first B-52 entered the inventory.

The Marine Corps's new AGM-65E Laser Maverick, under the left wing of this McDonnell Douglas AV-8B Harrier, recently completed a series of ground and flight tests at Patuxent NAS, Md.

The **Civil Air Patrol** has received the 1985 Military Airlift Command Distinguished Citizen Award. Col. Robert S. Michelsen, Commander of MAC's Aerospace Rescue and Recovery Service, presented the award to Brig. Gen. William B. Cass, National CAP Commander, during the CAP's National Board Meeting in New Orleans, La. The organization was praised for outstanding humanitarian service during search and rescue operations.

McDonnell Douglas test pilot **William W. Lowe** has won the Iven C. Kincheloe Award for outstanding professional accomplishment in flight testing. The award, named after a USAF captain killed during a test flight in 1958, is given annually by the Society of Experimental Test Pilots. Lowe won the award for his work in testing the AV-8B Harrier II combat jet fighter during a fourteen-month period at Edwards AFB, Calif. He is the fourth McDonnell Douglas test pilot to receive the award.

The Gen. Lew Allen, Jr., Trophy for 1985 has been presented to **Lt. Col. Deryl S. McCarty,** Commander, 3d Aircraft Generation Squadron (AGS), Clark AB, the Philippines. The award is given annually to the most outstanding USAF officer who is frequently and directly involved in activities supporting the flying mission. It is named after the former USAF Chief of Staff.

Colonel McCarty's highly rated organization supports the 3d TFW at Clark, which flew more sorties and loaded more munitions than any other organization in Pacific Air Forces last year.

The Air Force's top humanitarian recognition, the Cheney Award, was presented by USAF Chief of Staff Gen. Charles A. Gabriel to **Capt. John C.**

For the first time, US Marine Corps CH-53 Super Stallion helicopters have been refueled in flight while carrying Light Armored Vehicles (LAVs). The 23,000-pound LAVs are used to support amphibious and other combat operations. With in-flight refueling, the Super Stallions can provide fast LAV support from more than 100 miles behind the battle line.

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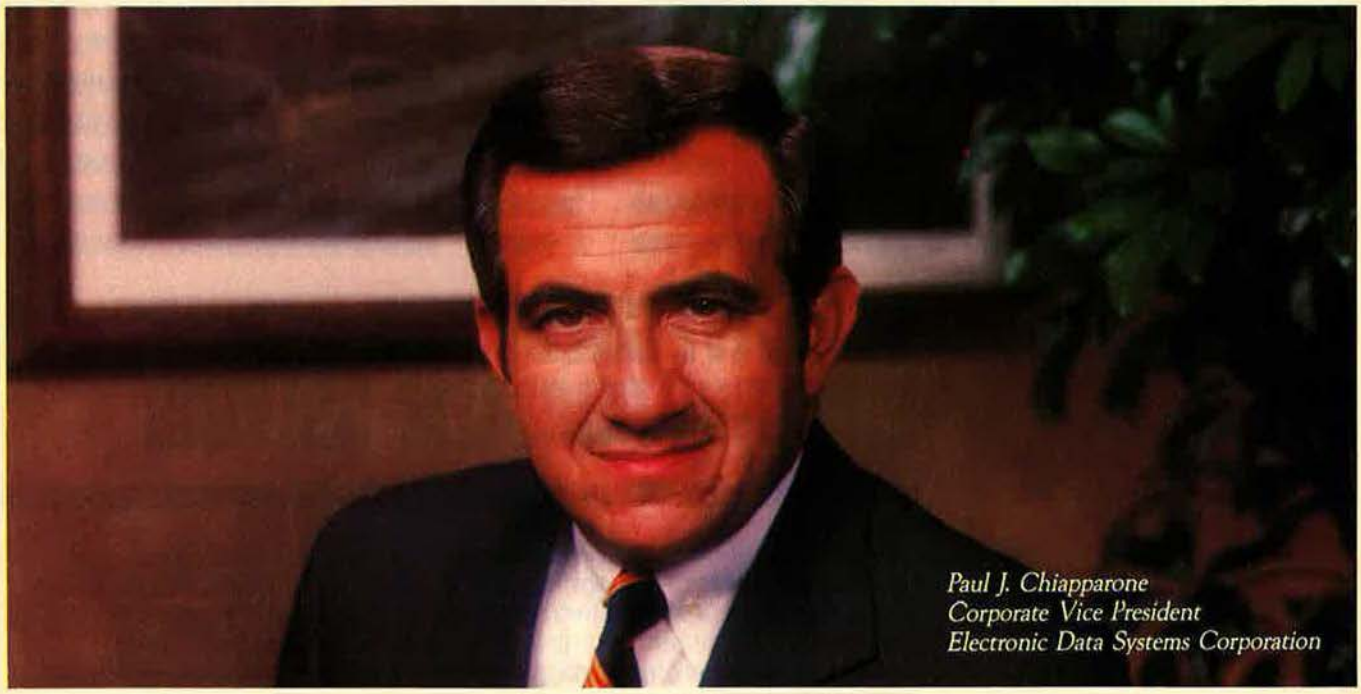

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Ritchie of the 58th Tactical Training Wing, Luke AFB, Ariz. The award is presented annually for "an act of valor, extreme fortitude, or self-sacrifice in a humanitarian interest performed in connection with aircraft."

Captain Ritchie, while assigned to Hickam AFB, Hawaii, landed his flamed-out T-33 on an air base parking ramp after flying it over a heavily populated area, saving lives as well as his aircraft.

In October, retired USAF Gen. Edwin W. Rawlings himself presented the annual Gen. Edwin W. Rawlings Energy Conservation Award for Air Force Logistics Command to **Robert W. Boutz,** Chief, Energy Management Section, 2854th Civil Engineering Squadron, Tinker AFB, Okla. General Rawlings is a former AFLC commander who established the award in 1979.

Mr. Boutz was credited with directing energy conservation activities enabling Tinker AFB to achieve an end-of-year facility energy reduction of 19.1 percent, which equates to an annual saving of more than $1 million.

AEROSPACE WORLD

★ **RECORDS—Lt. Col. Charles E. Townsend** has logged more than 4,000 hours of flying time in the F-106 Delta Dart. He is an instructor pilot and flight commander in the Air National Guard's 102d Fighter Interceptor Wing at Otis ANGB, Mass. "It's a milestone no one else has ever reached before, and no one else will again," he said. The aircraft is leaving the Air Force inventory. Colonel Townsend's wing is slated to receive F-16 Fighting Falcons. He said he has never "dented a tail or blown a tire."

Capt. James D. Mahoney, 49th Tactical Fighter Wing, Holloman AFB, N. M., is the most experienced F-15 pilot in the Air Force, according to a USAF announcement, passing both his 1,000- and 2,000-hour F-15 marks in flying ceremonies for the President of the United States.

Good maintenance enabled him to fly a record 4,000 hours in the F-106 Delta Dart, says Lt. Col. Charles E. Townsend of the ANG's 102d Fighter Interceptor Wing at Otis ANGB, Mass.

Captain Mahoney hit 1,000 hours in the F-15 while flying in a ceremony for President Reagan over Yorktown, Va., in 1981. He logged his 2,000th Eagle hour in a flyover for the President last August 15 in San Francisco, Calif.

★ **AEROSPACE EDUCATION**—The Tenth Annual Aerospace Education Leadership Symposium on Aviation History will be convened at the US Air Force Academy, Colorado Springs, Colo., January 16 and 17. This symposium, aimed at educating youth on aerospace, is attended each year by about 150 educators and administrators. Participants this year will include Dr. Paul Garber, Historian Emeritus, National Air and Space Museum; Scott Crossfield, former X-15 Chief Test Pilot and first man to fly at twice the speed of sound; Col. Francis S. Gabreski, USAF (Ret.), top US living ace; and Kenneth Goss, Managing Director of the Air Force Association's affiliate, the Aerospace Education Foundation.

The next Air War College Aerospace Power Symposium, with the theme "The Impact of Space on Aerospace Doctrine," will be held at the College at Maxwell AFB, Ala., March 10–12. For information on attending or on submitting abstracts of prospective papers, contact Lt. Col. Donald W. Bishop, AWC/XP, Maxwell AFB, Ala. 36112-5522. ■

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It's almost time to see if USAF can really get both brilliant performance and a bargain price in its next-generation aircraft.

Acid Test for Aeronautical Technology

BY JAMES W. CANAN, SENIOR EDITOR

THE Air Force is fast approaching the acid test for its highly touted, advanced aeronautical technologies.

It has just begun evaluating the first hard evidence from the aerospace industry to determine whether its use of those technologies will indeed enable it, as it claims, to build a next-generation fighter of brilliant performance at a bargain price.

The blue-chip Advanced Tactical Fighter (ATF) program is the case in point. The proving ground is Air Force Systems Command's Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio.

The stakes for USAF and the nation are huge.

By the mid-1990s at the very latest, USAF will direly need a new air-superiority fighter capable of clearly overmatching the superb Soviet fighters expected to be operating in abundant numbers by then.

The new US fighter, the ATF, will have to fly and fight far better—not just marginally better—than the F-15, yet cost scarcely more than the F-15 in proportion to the ATF's far greater capability.

The ATF must be affordable, because if it isn't, despite the high promise of its performance, it will never come to pass. Today's definition of an affordable price for a new fighter, at a time of increasing pressure against defense spending, is a lot tighter than yesterday's.

This is why USAF felt compelled to set its price goal for the ATF very low—even shockingly low. It put the seven competing contractors in the ATF program on their mettle to come up with proposals for a fighter that will do all the wonderful things USAF wants it to do at a production flyaway cost not to exceed $35 million (in Fiscal Year 1985 dollars), assuming production of 750 ATFs at a rate of seventy-two per year.

USAF also pegged the ATF's maximum gross takeoff weight when fully loaded for the air-superiority mission at 50,000 pounds—considerably less than the 68,000 pounds of the F-15C.

Just last month, the ATF contractors—Boeing, General Dynamics, Grumman, Lockheed, McDonnell Douglas, Northrop, and Rockwell International—were to have submitted their technical, cost, and pricing proposals for ATF development, production, and maintenance.

The Cost/Capability Conundrum

Now it will be up to ASD and its ATF contractors to demonstrate that high technology and reasonable costs are not, *ipso facto,* antithetical, as is popularly assumed. ASD

Lockheed artist's depiction of USAF's Advanced Tactical Fighter. The seven aircraft companies in the ATF competition have submitted their ATF design and cost proposals. The program will vigorously test USAF's ability to build a fantastic fighter at relatively low cost.

must prove the validity of its claim that the latest and best technologies of digital avionics, propulsion, materials, and manufacturing, for example, can be combined to build, operate, and sustain a marvelous fighter far more efficiently, reliably, and inexpensively per pound than ever before.

"We face big challenges in the matter of ATF operational effectiveness vs. cost," acknowledges Lt. Gen. Thomas H. McMullen, ASD's Commander. "With all the technology we're pushing for in the ATF, one of the challenges will be to determine what the cost of the performance will actually be.

"Our statement of needs on the ATF is the most detailed of any I've ever seen," General McMullen says, "so we believe we have a good basis for making our determinations. We'll be focusing on what the Air Force requires of the fighter. If this doesn't match up with the unit cost goal, we'll have the contractors go to work on tradeoffs."

Some Air Force officials gravely doubt that the ATF cost and performance goals can ever be made compatible. They fear that if USAF is forced to raise its cost ceiling in order to accommodate performance, the ATF program may become a bloody battleground for future budgetary brouhahas. They also fear that if USAF compromises on its ATF performance requirements in order to accommodate costs, the fighter may not be able to hack its demanding missions.

General McMullen refuses to borrow trouble on either count. "We're in for some hard work on the ATF program, but in no way do I feel pessimistic about the outcome," the ASD Commander declares.

ASD's track record in upgrading weapon systems with newly available advanced technologies has been solid enough to justify General McMullen's upbeat approach to the problem of reconciling ATF cost and performance requirements.

A prime example is ASD's success at modernizing the F-15 and F-16 fighters, an evolutionary process of preplanned product improvement (P^3I) that may be more difficult in many ways than building a new fighter with new technologies thoroughly integrated on the drawing boards.

Plenty of Success Stories

Belying conventional criticisms of US military R&D and procurement programs, ASD has earned many more high grades than low ones for its management of hundreds of programs representing well over half of USAF's total R&D and procurement budget.

Along with its fighter-upgrade programs, ASD can also cite the electronically rejuvenated B-52 bombers, the B-1B bombers now in production, the air-launched cruise missiles and rotary launchers common to both bombers, the Advanced Technology Bomber (ATB) that General McMullen says is "going very well" in development, and many other programs that exemplify its increasingly sure-handed touch with new aeronautical technologies and techniques.

Against all odds, ASD now seems to have come out of the woods in its development of the Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system. LANTIRN, consisting of technologically complex navigation and targeting pods and a head-up display (HUD), will make it possible for tactical aircraft to attack targets at night and under the weather in a profound enhancement of capability.

The Imaging Infrared (IR) Maverick, a launch-and-leave missile brought to maturity by ASD, has come through recent testing in fine shape. IR Mavericks are being deployed right now with USAF A-10s at RAF Bentwaters in the United Kingdom, presaging their proliferation in attack fighter units and the great improvement of those units' standoff precision firepower.

Eventually, LANTIRN and the IR Mavericks will join up aboard a wide array of USAF attack aircraft, thanks to ASD.

ASD's management of the C-5B, C-17, and MC-130H Combat Talon upgrade programs also marks its proficiency with major systems, to say nothing of its proficiency with technology programs increasingly tailored for the quickest possible application to such systems.

However, the toughest test of ASD's prowess lies ahead in the formidable form of the ATF program. ASD's stewardship of that program over the next few years through the fighter's demonstration/validation (demval) phase and on into full-scale development will decide the makeup and the quality of USAF's tactical fighter force structure coming up on and well into the twenty-first century.

To the Air Force, almost nothing is more important than that tactical force structure.

The affordability problem arises at a time when dismal budget outlooks have already hurt USAF. It had a great deal to do with putting the new T-46 trainer on hold and has caused two other significant changes as well.

The Air Force canceled its plan for the F-16F swing-role fighter that it had intended to devote primarily to the interdiction mission. It has put its two F-16XL experimental fighters, forerunners of the F-16F that featured slightly elongated fuselages and cranked-arrow wings, into "flyable storage," a euphemism for retirement.

This F-16XL featuring cranked-arrow wings is one of two such aircraft that USAF has now consigned to "flyable storage." The F-16XL had been picked for development and production as the F-16F swing-role fighter. Budget constraints forced USAF to forgo the F-16F and to concentrate instead on the dual-role, deep-interdiction F-15E fighter.

The Air Force has also shelved for the time being a Johnny-come-lately requirement for a close air support/battlefield air interdiction (CAS/BAI) aircraft to succeed the A-10 in the 1990s. The prevailing sentiment in the Air Force is that the F-16Cs now being delivered to operational units will do the CAS/BAI mission well enough and that F-16Cs destined to be upgraded

Test-bed aircraft in the Advanced Fighter Technology Integration (AFTI) F-16 program is put through its paces. Among many achievements, this program has proven out an advanced, digital, fly-by-wire flight control system that makes for major improvements in aircraft maneuverability and that is applicable to existing USAF fighters. (Photo by Erik Simonsen)

even more as they come off the production line (with LANTIRN, for example) will do it even better.

The requirement for a follow-on CAS/BAI aircraft, perhaps the F-20 or a reengined and reconfigured A-7 called the Strikefighter, originated at the level of the Secretary of the Air Force early last year. It suffered the disadvantage of only lukewarm advocacy or of outright opposition in most high-level blue-suit circles, even though it caught on at Tactical Air Command (TAC).

The requirement reportedly took Secretary of Defense Caspar W. Weinberger by surprise. According to one USAF official, Mr. Weinberger decided that in view of all the other weapons the military would be forced to trade away in the budget crunch, the Air Force should not presume to add a new close air support aircraft to its already endangered list of weapons priorities.

So USAF stopped working up its RFP for the aircraft, and there the matter lies.

"This is an issue the Air Force will probably continue to agonize over, but for now, it's dead," declares a USAF officer who had been involved.

Munitions, Platforms, and Priorities

Now the Air Force is coming under increased pressure to give somewhat higher priority to developing and deploying wider varieties of air-to-ground standoff precision guided munitions (PGMs) and to back off a bit from its greater concentration on weapons delivery platforms.

Under Secretary of Defense for Research and Engineering Dr. Donald A. Hicks, who succeeded Dr. Richard D. DeLauer in that job last year, told AIR FORCE Magazine that he is urging USAF "to make a slight change in its priorities toward more standoff weapons," because "we all have to try to do everything we can to make our aircraft and our pilots survive, to make the attack mission easier.

"It's a matter of balance," Dr. Hicks continued. "We all want to kill the targets in the best way possible and avoid flying over them. The Air Force believes in that too. The only thing we're discussing here is how much [in the way of new standoff weapons]."

Noting his background as a Northrop Corp. executive, with emphasis on R&D, Dr. Hicks declared that "it would be hard for anyone to accuse me of being against airplanes."

However, he also said, "If we

can't manage our [pilot and aircraft] losses, we wouldn't have an Air Force very long."

USAF has no basic quarrel with all that. Its leaders believe, however, that its new and future ground-attack aircraft, armed with such standoff weapons as the IR Maverick and the GBU-15 IR guided bomb, will be capable of attacking effectively and of surviving bountifully against present and foreseeable Soviet air and ground defenses.

ASD has developed the navigation, flight-control, fire-control, and other avionics that will make it increasingly possible for USAF attack aircraft to employ evasive tactics en route to ground targets and to expose themselves less and less to enemy fire.

Much credit for this goes to the experimental work and testing done in the Advanced Fighter Technology Integration (AFTI) F-16 program, an Air Force-Army-Navy-NASA program managed by ASD at Wright-Patterson.

The AFTI/F-16 program has proven out, in test aircraft at Edwards AFB, Calif., an advanced, digital, fly-by-wire flight-control system that ASD's General McMullen says is "opening up new dimensions in aircraft maneuverability."

The AFTI Payoff

This is no pie-in-the-sky project. F-16Cs will be outfitted with flight controls based on the AFTI/F-16 experimentation, and the F-15E dual-role deep-interdiction fighter, now heading for production, will feature a triplex digital flight-control system that owes a lot to AFTI/F-16 experimentation.

Right now, in its Phase II, the AFTI/F-16 program is concentrating heavily on many new means of enabling ground-attack pilots and aircraft to get to and away from their targets unscathed.

A key endeavor here is a digital terrain management and display system. It will enable attack aircraft to find their way to targets in much the same manner that cruise missiles do, courtesy of their covert terrain-following and terrain-avoidance systems, the three-dimensional digitalized terrain maps stored in their flight-management computers, and the cockpit instrumentation and displays that enable the pilot to take advantage of all of that capability.

The AFTI/F-16 program's work on pilot voice control of some aspects of his increasingly complex flying task is also highly germane to the ground-attack (as well as to the air-combat) mission.

If this work pays off in the form of operational systems, a pilot will be able to determine his fuel status and his airspeed and to call up certain radar information, for example, by vocally querying his sensor-computer-display systems in those regards. He won't have to look down into the cockpit and handle instruments.

With special emphasis on the integration of computerized fire controls and flight controls, the AFTI/F-16 program is geared mainly to designing the pilot into the cockpit, and not out of it, even while proceeding toward ASD's goal of virtually automating USAF's high-performance aircraft.

The keys to this are advanced sensors, digital data and signal processors, multiplex distribution of their outputs, and increasingly sophisticated software.

"What we are addressing," says Lt. Col. Donald Ross, ASD's AFTI/F-16 program manager, "are the pilots' increasingly heavy work loads in both the air-to-air and the air-to-ground scenarios.

"In air-to-ground, we are being driven down to lower and lower altitudes and to higher maneuverability in order to survive. Time on target is also being compressed," Colonel Ross says.

In densely defended territory, ground-attack pilots must now prepare to allow themselves a maximum of only about fifteen seconds from the time they put their sensors on their target to the time their weapons are away.

"We need our systems to be able to respond to that, and that's what we're working on," Colonel Ross sums up.

Despite its outstanding success and the demonstrable applicability of its wonder-working wares to current USAF fighters, the AFTI/F-16 program has been victimized by the defense budget crunch. New work scheduled to begin in the current fiscal year went unfunded, and the future looks iffy.

More Punch for Squadrons

The future is brightening, however, for USAF's operational tactical squadrons.

There are three big reasons for this: the successful testing and the operational debut, this month, of the IR Maverick standoff missile; the infusion into the force structure of F-16Cs and Ds, which will be continually upgraded in coming production lots; and the flowering of the F-15E dual-role fighter now scheduled to take to the air near the end of this year.

The IR Maverick had its problems. Its designer, Hughes, made a number of engineering changes to its guidance and control section. Now it is not only much more reliable but also performs much better.

A major problem was the wiring in its eleven tiny, custom-built, hybrid circuit devices. Hughes and ASD redesigned those devices, made them simpler and less labor-intensive to build, and cut their number to seven.

As a result, the IR Maverick's reliability is now so high that its mean time between maintenance actions is twice as long as ASD had required for its production and its initial operational capability.

Last September and October, in twenty-three live test launches at Nellis AFB, Nev., IR Mavericks scored twenty-two direct hits on a variety of vehicles. Subsequent captive-carry, target-acquisition tests over Wisconsin with production missiles were also very successful.

Eleven of the hits were made from F-16, A-7, F-4E, F-4G, and A-10 aircraft in test launches conducted by the Air Force Tactical Fighter Weapons Center at Nellis. Another eleven hits (out of twelve launches) were made by IR Mavericks from A-10s in a test series conducted by the Air Force Operational Test and Evaluation Center headquartered at Kirtland AFB, N. M.

ASD was well satisfied. Col. Robert S. F. Jennings, its IR Maverick (AGM-65D) program manager, says the tests showed the missile to be "a highly reliable and effective air-to-ground weapon" that "will add a significant new dimension to the capability of our tactical air forces."

Much more capable than its TV-

guided predecessor now in operation, the IR Maverick has a built-in "G bias" that enables it, when launched down very low, to climb for a better view of its target, a precise lock-on, and better range.

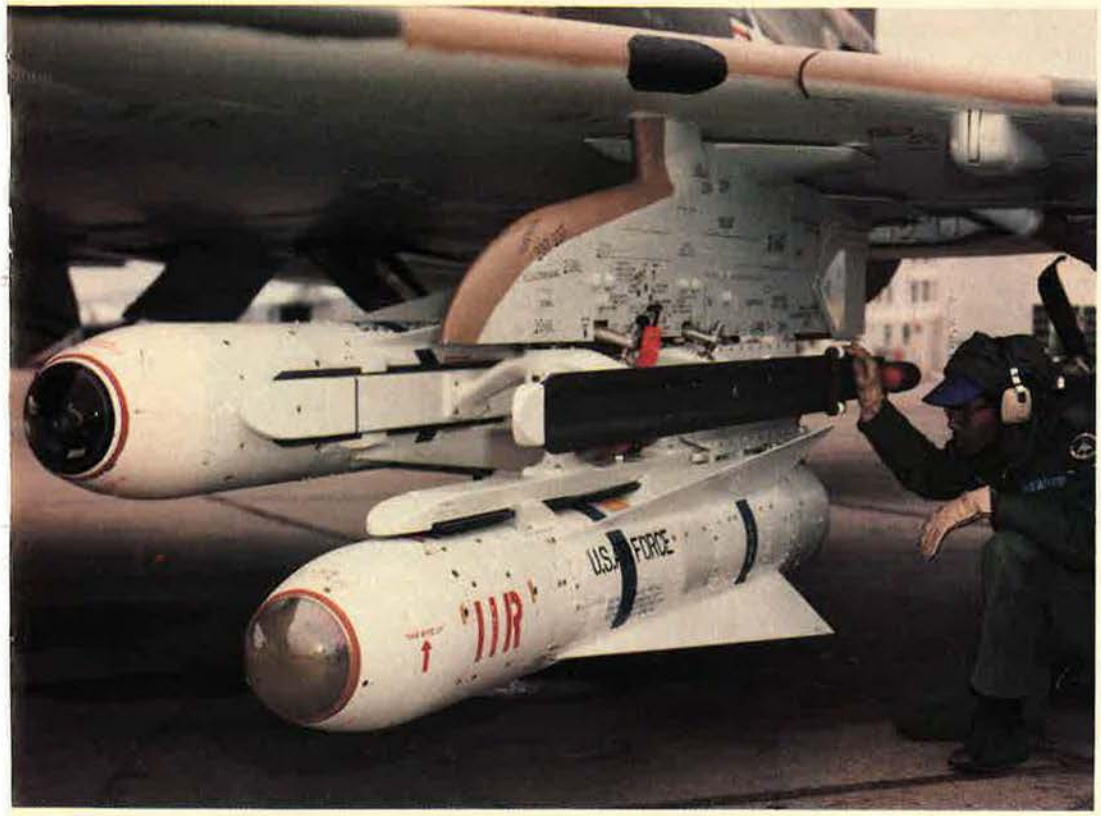
This means, says Colonel Jennings, that the launching aircraft, as at Nellis, "can hug the desert floor" while launching the missile and can then immediately leave the target area.

scheduled for production by the first of this year, and more than 1,000 are expected by next June 1. USAF has designated Raytheon as second source for IR Maverick production and plans to procure 60,644 of the missiles.

It bought less than half as many of the TV-guided Mavericks (AGM-65A and B models), which are now deployed worldwide with US and allied air forces. There is a lot of

Ds now coming off the line. ASD has an elaborate schedule for building a host of new systems into production F-16Cs and Ds incrementally through the first quarter of 1989.

"The February 1989 airplane will be as different from the December 1988 airplane as that one will be from those in production today," explains Maj. Gen. Ronald W. Yates, ASD's F-16 program director.



Imaging Infrared (IR) Maverick missiles are checked out prior to a test flight. The IR Mavericks performed with resounding success in tests late last year at Nellis AFB, Nev., and are now being deployed with USAF's A-10s at RAF Bentwaters, UK. A big improvement on their TV-guided predecessors, the IR Mavericks will greatly enhance the standoff capability and enrich the tactics of ground-attack aircraft.

At first, the A-10 pilots in particular had some misgivings about all this. They are trained to eyeball what they're shooting at. They felt uneasy about dispatching a missile toward a target many miles away (the IR Maverick's range is classified) that showed up only as a spot on their scopes.

The A-10 pilots soon became enthusiastic, however, once they realized that the IR Maverick gives them much greater flexibility in developing tactics to confuse the enemy and in using the terrain to screen their aircraft as they launch and leave.

USAF's A-10s at RAF Bentwaters, UK, are now being armed with IR Mavericks. The first squadron is scheduled to be fully operational next month.

More than 250 IR Mavericks were

commonality between the TV and IR variants, but the latter is "a much better and better-built missile," Colonel Jennings says.

F-16C/D Deploying Overseas

F-16C fighters and dual-seat F-16D trainer variants now have their overseas deployment orders. They will begin replacing air-to-ground F-4s at Ramstein AB, West Germany, this month. They will supplant F-16As and dual-seat Bs at Hahn AB, West Germany, next June. By then, they will have been deployed with squadrons in Korea as well.

Just as the F-16Cs and Ds embody improvements over the lighter, less sophisticated As and Bs, mostly in avionics, so will future Cs and Ds be much different and much more versatile fighters than Cs and

The Multi-Stage Improvement Program (MSIP III) for F-16Cs and Ds is aimed at incorporating new systems into production fighters as the systems become ready. They include a new inertial navigation system, wiring for LANTIRN, the IR Maverick, and the Advanced Medium-Range Air-to-Air Missile (AMRAAM), a new gear box, a new HUD, the combined ALR-69 radar, a new identification, friend or foe (IFF) system, terminals and displays for the Global Positioning System (GPS) navigation satellites, the Airborne Self-Protection Jammer (ASPJ), the Precision Location Strike System (PLSS), and the General Electric F110 engine.

That engine has begun sharing production in F-16Cs and Ds with Pratt & Whitney's F100-PW-220 engines. Both powerplants greatly im-

prove on the P&W F100 engines aboard the F-16As and Bs.

The F-16Cs and Ds to be introduced at Hahn AB, West Germany, will be powered by the GE engines.

Over the years, F-16Cs and Ds embodying the new systems will replace in operational units the older Cs and Ds that don't have those systems. They, in turn, will be assigned to Guard and Reserve outfits, just as As and Bs are now being assigned. Some will be retrofitted with new systems.

Not all the F-16Cs and Ds in future production will contain each and every new system yet to come, however. The new systems built into each new fighter will depend on the unit and the mission for which that fighter is destined.

For example, there will be 250 LANTIRN F-16Cs. Their production will begin only when the full-up LANTIRN system—targeting pod, navigation pod, and HUD—is itself ready for production, probably in 1988.

Once the LANTIRN F-16Cs have come through production, successor F-16s will be produced without LANTIRN aboard.

Making the F-16 MSIP III program come out just right by factoring new systems into the production of F-16Cs and Ds and then out again presents "a monumental management challenge," says General Yates.

Many of those systems are shaping up as "multibillion dollar programs in and of themselves" involving "new computers and new software" and are, taken altogether, "far bigger than what we started working with on the original F-16s," the General adds.

Advanced microelectronics and software technologies are the keys to many of the subsystem improvements slated sequentially for the F-16Cs and Ds.

ASD recently chose Westinghouse, which builds the fighters' Programmable Signal Processor (PSP), to design, build, and demonstrate a new PSP incorporating very-high-speed integrated circuits (VHSICs) for lighter weight, less bulk, greater reliability, and swifter processing.

The F-16C and D PSPs, the brains of the fighters' APG-69 fire-control radars, will thus be among the first US military systems to embody VHSIC technology.

VHSIC technology will also be incorporated in the Integrated Communications, Navigation, and Identification Avionics (ICNIA) system that ASD is developing for the ATF.

That development program will have its operational uses well before the ATF comes into being, however, and is one of ASD's bright hopes for cutting fighter costs even while utilizing advanced technologies.

"We're looking at a mini-ICNIA, without all the waveforms of the full system, that we hope to put on F-16s—probably F-15s too—as a predecessor to the full system on the ATF," General McMullen explains. "ICNIA is going to help us make big progress in terms of a cheaper, more operable, and more reliable set of avionics systems."

As shown in this mockup, the F-15E dual-role fighter's cockpits will feature the latest in display technologies and are being designed to make the front-seater's and backseater's very demanding tasks as manageable as possible. USAF is bullish about its F-15E development program. Its managers at Aeronautical Systems Division (ASD) predict that the F-15E will be a "superb" aircraft well-suited to "the longest, lowest, toughest tactical Interdiction mission in the Air Force."

F-15E With LANTIRN, AMRAAM

Meanwhile, USAF recently decided that the F-15E dual-role fighter will supplant the F-16C as the first to be outfitted with LANTIRN and the AMRAAM missile in tactical units.

Both LANTIRN and AMRAAM

were originally destined for IOCs aboard F-16s in order to enhance the fighters' capability in their primary ground-attack mission and in order to give them much more punch in the air-combat regime than they now have with their short-range IR missiles.

The F-15E did not exist when that decision was made, however. Now that the F-15E is fast approaching production, USAF believes that it has first claim on LANTIRN and AMRAAM because its highly demanding dual-role requirements present the greatest immediate need for them.

F-15Es will go operational with LANTIRN about a year before F-16Cs do. USAF is ordering its first eight F-15Es in the current fiscal year and plans to buy 392 of them—enough for four operational wings and one training wing—into the early 1990s.

A two-seater, the F-15E will weigh 81,000 pounds fully loaded, compared to the 68,000 pounds of the F-15C. The increase in the F-15E's structural weight will account for only about 2,000 pounds of the total increase. The remainder will be due mostly to the dual-role fighter's vastly increased weapons carriage and fuel capabilities.

Among other major changes in the F-15E are its increased G capability, its highly advanced cockpits, its ten percent greater reliability, its longer range, and its triple-redundant, digital flight-control system.

"The F-15E is going to have the longest, lowest, toughest tactical interdiction mission in the Air Force," asserts Col. Michael J. Butchko, ASD's F-15 program director. "It is going to be just a superb weapon system."

Given its demanding mission (each F-15E will go it alone, not in formation), the dual-role fighter also will require the latest and best in electronic countermeasures gear. ASD officials are convinced that its new Tactical Electronic Warfare System (TEWS) will give it just that.

Just like all digital systems aboard the F-15E, the TEWS will be programmable in accordance with missions and threats as they come. In fact, the F-15E will be nearly as "software intensive" as the B-1B bomber, and the work load of its two crew members will be almost as heavy, in many instances, as that of the four crew members aboard the B-1B.

In designing the F-15E, ASD, TAC, and McDonnell Douglas set out to make things as easy as possible for its pilot and its backseater. Those two crew members will be able to call up all the flying and fighting information they need from their sensors and computers for viewing on the HUD and on the color and monochromatic display screens—three in front, four in back—directly in front of them.

Only the frontseater will be able to fire the aircraft's air-to-air and air-to-ground missiles. The backseater will run the radar acquiring the targets. On all displays, each will be able to see what the other sees.

Like the F-16s, the F-15E must be able to accommodate either the GE F110 engine or the P&W F100-PW-220 engine. This is no problem for the F-16, but it means that the engine bay of the F-15E must be a little larger than the bays of F-15 forerunner variants. The GE engine is about one inch too large in diameter for the original F-15 engine bay.

McDonnell Douglas is thus rebuilding the aft fuselage of the F-15E with a light, strong titanium structure that actually cuts the cost of that section by a quarter of a million dollars per airplane.

Toward ATF Demval

This is exactly the kind of cost saving that ASD wants to bring about through the use of advanced materials on the Advanced Tactical Fighter. Given the low cost goal now set for the ATF, such savings will be crucial.

Later this year, ASD will select three or perhaps four of the seven competing ATF contractors to carry the program through the concept demonstration/validation stage. One of them, or a team of them, will be chosen to begin full-scale development of the fighter, aiming at first flight in 1991.

The ATF will have to be capable of cruising at supersonic speeds without using its afterburner, turning on a dime, attaining unsurpassed range with internal fuel only, showing extremely low radar and IR signatures, and taking off and landing on very short, very narrow airstrips just in case the strips get torn up along their full lengths and breadths by enemy fire.

All the advances that the companies and ASD have made in technologies for existing fighters and bombers and in the AFTI/F-16 and AFTI/F-111 programs (the latter is testing a variable camber wing that may well apply to the ATF) will be brought to bear in making all such ATF requirements attainable and affordable.

The engines are crucial to this. Both the GE and P&W ATF demonstrator engines "have been very successful so far," says Col. Albert C. Piccirillo, ASD's ATF program manager, "and should be running by the end of next summer."

Those highly advanced engines have been in the demval phase for nearly two years. Their early success is a major reason for Colonel Piccirillo's optimism about reconciling ATF cost and performance goals.

ASD now has every reason to believe that the ATF's engines, with their advanced materials, great improvements in aerodynamics, and sharp reduction in the number of stages, will indeed constitute a breakthrough in balancing performance against costs—most especially in the unprecedented reliability and maintainability that they promise.

Those engines are expected to embody nozzles for reversing and vectoring thrust, capabilities that will be crucial to the fighter's maneuverability and STOL characteristics.

In this regard, an F-15 now being modified by McDonnell Douglas for ASD as a STOL test-bed aircraft is scheduled for first flight in two years. Wind-tunnel tests of a model of that aircraft got under way last October, and results so far are very promising.

"We expect that the technologies [in the test-bed aircraft] will provide STOL capability in the F-15 with no weight penalty to its up-and-away capability," declares David Selegan, ASD's STOL test-bed deputy program manager. "We also believe that those technologies will increase—not penalize—the aircraft's combat capability, and we're expecting a ten percent to thirteen percent increase in its range factor." ■

What's Happening in Aeronau

NAME AND MISSION	STATUS	CONTRACTOR
Deputy for Aeronautical Equipment (AE)		
Chemical/Biological Defense This program provides Air Force-unique chemical defense equipment, including individual and collective protection, detection, warning, and decontamination equipment/material necessary to conduct sustained combat operations in a chemical warfare environment.	RDT&E and Production	Many
Combat Identification Systems Acts as the DoD executive agent for combat identification systems and evaluates active and passive identification techniques for application to USAF weapon systems platforms. Currently developing Mark XV IFF as a secure, antijam, high-reliability, triservice, and NATO-interoperable replacement for the current Mark XII IFF.	Definition, Evaluation, Development	Veda, Inc.; Bendix; Texas Instruments
Modular Automatic Test Equipment (MATE) System A standardized USAF management system governing procedures, architecture, and hard/software tools for acquisition of systems employing automatic test equipment (ATE). Objective is to preclude proliferation and reduce life-cycle cost of system-peculiar ATE.	Development/Production	Many
Avionics Subsystems Acquires standardized avionics systems for use in several aircraft systems. Programs include standard and precision inertial navigation units, standard central air data computer, digital audio distribution system, microwave landing system avionics, standard ground collision avoidance system, and standard flight data recorder.	RDT&E/Production	Many
Productivity, Reliability, Availability, and Maintainability Program (PRAM) Reduce current and potential USAF operations and support costs without sacrificing operational systems effectiveness by (a) improving the reliability, maintainability, and supportability of USAF operational systems, subsystems, and equipments as well as the productivity, effectiveness, and efficiency of USAF maintenance and support organizations; (b) exploiting lower life-cycle cost alternatives in systems configurations through use of current technology components and adaptation of common equipment for multiple requirements and applications; and (c) developing new RDT&E approaches that better accommodate life-cycle cost considerations in system development, such as improved specifications, standards, and testing techniques.	Continuing	Many
Life Support Provides centralized management to develop life-support equipment/subsystems, such as improved aircrew helmets, flight clothing, and survival equipment, to assure maximum aircrew capability throughout all mission environments, including emergency situations.	Development/Production	Many
ACES II Ejection System ACES II is a standardized state-of-the-art ejection system for such high-performance aircraft as the A-10, F-15, F-16, and B-1B.	Production	Douglas Aircraft; Weber Aircraft
Common Support Equipment These programs develop improved aircraft ground-support equipment capable of supporting several types of aircraft. Current programs include ground power generator, large aircraft start system, universal aircraft towbars, and standard hydraulic test stand. These programs develop equipment to support Air Base Survivability and Base Recovery After Attack. Current programs are mobile aircraft arresting system, camouflage concealment and deception, aircraft ground mobility system, and portable airfield lighting.	RDT&E/Production	Many
Advanced Avionics Modular Integrated Communication, Navigation, and Identification Avionics (MICNIA). Interdivisional (ASD/ESD) program office to plan for FSD initiation on the MICNIA program, targeted for FY '88. Uses a modular avionics architecture with hierarchical software design, shared processing, and graceful degradation attributes. Will integrate five waveforms on the F-15 and F-16 aircraft, beginning retrofit in FY '93. Planned for use of VHSIC technology and standard line-replaceable modules, aimed at significant increases in R&M, with reduction in size and weight.	Continuing	None
Deputy for Airlift & Trainer Systems (AF)		
C-17A Development and acquisition of the C-17A airlift system for the rapid deployment of today's modern Army from the CONUS directly to overseas areas of conflict and for airlift of outsized cargo over both intertheater and intratheater ranges close to the forward areas. This direct-delivery dimension, combined with an outsize airdrop capability, will significantly enhance airlift support to combat forces in the field and improve the mobility of our general-purpose forces.	Full-Scale Engineering Development	McDonnell Douglas
T-46A Development and production of a training aircraft to replace the aging, operationally deficient T-37B. T-46A system characteristics include fuel-efficient twin F109-GA-100 turbofan engines, a pressurized cockpit, ACES II ejection system, improved performance, better adverse weather capability, greater range, and reduced maintainance costs. The Air Force will acquire forty-three aircraft initially.	Full-Scale Engineering Development/Production	Fairchild Republic; Garrett
C-5B Acquisition of fifty C-5B aircraft will partially fulfill the immediate need for additional intertheater airlift capability to support national strategy goals and the mobility requirements of a modern-day Army. Delivery and acceptance by USAF of the first C-5B occurred in December 1985. This aircraft is basically a C-5A with configuration changes intended to improve reliability. The C-5B will provide airlift of substantial payloads, including outsize cargo, over intercontinental ranges.	Production	Lockheed-Georgia
KC-10A Acquisition of an advanced tanker/cargo aircraft possessing both refueling and cargo mission capability. Augments existing KC-135 tanker fleet by providing rapid deployment of tactical aircraft and their support equipment and personnel to any point worldwide. Sixty aircraft are planned; thirty-nine have been delivered.	Production/Deployment	Douglas; American Airlines

ics at ASD

NAME AND MISSION	STATUS	CONTRACTOR
KC-135 Improved Aerial Refueling System (IARS) Development and test of new and improved aerial refueling systems and subsystems to improve upon the 1950s technology of the current KC-135 Air Refueling (AR) system.	Development	J. C. Carter; Sargent-Fletcher; XAR Industries; Dataproducts New England
HH-60A Development and acquisition of a highly survivable combat rescue helicopter able to function effectively in worldwide geographic, climatic, and day/night low-level terrain-masking flight conditions. The ninety-aircraft program provides for installation of necessary avionics and modifications on the production UH-60A helicopter to meet combat rescue mission requirements.	Full-Scale Engineering Development/Production	IBM; Sikorsky; General Electric
MC-130H Combat Talon II This program addresses the shortfall in Combat Talon I special operations aircraft by the addition of twenty-one aircraft with integrated avionics, improved navigation accuracy, terrain-following radar, and electronic countermeasures. The aircraft will be assigned to the Special Operations Forces of Military Airlift Command.	Production	IBM; Lockheed-Georgia
C-130H Domestic and Foreign Military Sales The C-130H Domestic and Foreign Military Sales Program provides cargo, search and rescue, and tanker aircraft for both US domestic and foreign users.	Production/Deployment	Lockheed-Georgia
C-23A This program acquires eighteen aircraft to provide assured theater distribution of critical spare parts in Europe.	Production/Deployment	Short Brothers Ltd.
C-20A This program provides worldwide air transportation for the President and Vice President of the United States, Cabinet members, and other high-ranking dignitaries of the United States and foreign governments. The eleven-aircraft C-20A program replaces the aging C-140B fleet and provides the Special Airlift Mission (SAM) fleet with intercontinental range and ability to operate from short runways. The C-20A provides a fuel-efficient, low-maintenance, and longer-range system.	Acquisition/Operations	Gulfstream Aerospace
C-12F/C-21A This program replaces the current CT-39 fleet, acquired in the late 1950s and early 1960s, with 120 off-the-shelf business-type jet (C-21A) and turboprop (C-12F) aircraft.	Lease/Operations	Gates Learjet (C-21A); Beech Aircraft (C-12F)
Air National Guard Support Aircraft (C-22B) Acquisition, modification, and support of four commercially available Boeing 727 aircraft to be operated by the Air National Guard for use as operational support airlift aircraft.	Modification	Boeing
Joint Vertical Lift Aircraft (JVX) (CV-22A) The CV-22 program will fill the need for an aircraft with increased Special Operations Forces (SOF)/Rescue capabilities by using the tilt-rotor design demonstrated on the Bell XV-15 and other advanced technologies. The CV-22 will have the maneuverability and lift capability of a helicopter and speed of a fixed-wing aircraft. The CV-22 is intended to complement the SOF HH-53H and MC-130 aircraft.	Development	Bell-Boeing
Airdrop Program Development and test of new and improved airdrop systems in coordination with the Joint Technical Airdrop Group. Approved activities include development of aircraft aerial delivery equipment, enhancement of airdrop capability, and conduct of system studies of improved airdrop concepts for existing and future aircraft.	Development	None
Deputy for Avionics Control (AX)		
Cost-Effective Avionics Ensure cost-effective, supportable, mission-capable avionics. Reduce life-cycle cost, increase availability and reliability, and improve effectiveness by assisting in insertion of promising technologies into future avionics. Reduce and control unnecessary proliferation of avionics by developing and advocating the use of such architectural and interface standards as MIL-STD-1553, -1589, -1750, and DOD-STD-1788. Promote rational standardization by using USAF-designated standard and AFSC/AFLC-preferred avionics subsystems in new/modified aircraft avionics baselines.	Continuing	PSS, ARINC, TASC, SASC
Deputy for B-1B (B-1)		
Deputy for B-1B Largest of ASD programs, with a baselined budget of $20.5 billion (in FY '81 dollars), the B-1B program provides Strategic Air Command with a new, highly survivable, long-range penetrating heavy bomber. Modernization of this vital leg of the strategic triad allows aging B-52s to move to full-time cruise-missile standoff roles. First operational B-1B entered testing at Edwards AFB, Calif., in October 1984. First delivery to SAC at Dyess AFB, Tex., was on June 29, 1985, with Initial Operating Capability (fifteen aircraft) scheduled for September 1986. The full complement of 100 B-1Bs will be delivered by the end of 1988.	Development/Production/Deployment	Rockwell International; Boeing Military Airplane Co.; Eaton Corp., AIL Div.; General Electric
Deputy for Engineering (EN)		
Avionics Integrity Program (AVIP) The Avionics Integrity Program (AVIP) is an ASD initiative to improve the readiness and life characteristics of avionic products. AVIP is patterned after the Aircraft and Engine Structures Integrity Program (ASIP/ENSIP). Two documents are being developed by AVIP for use in avionics development: a standard for a management program and a product-specific MIL-PRIME process specification. Ultimately, the contractors will be required to prepare an avionics integrity master plan (AIMP) that will be submitted as a separate document with any proposal for avionics development. The AIMP will be evaluated as a major source-selection criterion and be incorporated into the development contract.	Application/Continuing Development	Electronic Systems Division; Honeywell Systems & Research Center
Value Engineering This program seeks to reduce program costs by using conventional value-engineering techniques as well as innovative approaches for the latest state-of-the-art technology insertion into current systems that are already in production.	Ongoing	All current acquisition contractors

NAME AND MISSION	STATUS	CONTRACTOR
Senior Engineering Technology Assessment Review (SENTAR) A SENTAR panel has been established as the focal point for review of the AFSC Laboratories' Advanced Technology Development (6.3) programs, including both ongoing efforts and proposed new starts. The panel will assess the objectives of the programs, the technical approach, the potential payoff to aeronautical systems and subsystems, the proposed technology transition criteria, and the readiness of technologies for transition to ASD development and acquisition programs. Panel assessments will place emphasis on focusing new 6.3 programs so as to establish the technology base for applications to future aeronautical weapon systems and equipment developed under the cognizance of ASD.	Ongoing	None
Product Assurance Consistent with ASD's strong commitment to product excellence, ASD engineering has adopted the concept of "product assurance" to ensure balanced attention to quality, reliability, supportability, producibility, and value in the design of new aeronautical systems. A product assurance engineering division consolidating specialists from these disciplines has been established within the Directorate of Systems Engineering. It provides a "Lead Engineer for Product Assurance" to assist each SPO's Chief Systems Engineer in assuring that product assurance is considered in the Air Force's requirements-setting and design-review processes. Additionally, an ASD "corporate" product assurance office has been established to provide overall policy guidance, make independent assessments on specific programs, and establish measures of success for reporting to the ASD and AFSC commanders.	Ongoing	None
MIL-PRIME Program The MIL-PRIME program is an initiative to enhance the streamlining of the acquisition process by improving the quality of the specifications and standards put on contract. The goal of the program is to eliminate overspecification through the process of tailoring documents to the specific weapon system's needs. This will be done by imposing requirements in terms of performance parameters and limiting the contractual application of documents referenced in specifications and standards. Each MIL-PRIME document consists of a specification or standard that can be tailored to the needs of a specific acquisition situation. An associated handbook contains rationale, guidance, and lessons learned for each requirement and its associated verification.	Ongoing	None
Generic Integrated Maintenance and Diagnostics (GIMADS) The GIMADS program, managed by the ASD Deputy for Engineering, was established to investigate problems being experienced with today's on-board diagnostics, external automatic test equipment, and manual troubleshooting techniques. The program will include development of systems engineering tools and techniques for determining an optimum mix of fault-detection and fault-isolation elements for a given weapon system.	Initial Planning	To be determined
Very-High-Speed Integrated Circuits (VHSIC) Exploitation In order to maximize the benefit of developing VHSIC technology, the Deputy for Engineering is making a concerted effort to facilitate early application of available VHSIC parts into the development of new weapon systems. A comprehensive training program is being developed and will familiarize engineers with available VHSIC parts and their capabilities. Every effort will be made to perform the necessary tradeoffs to assure that the tremendous advantages of this new technology can be realized as quickly as possible.	Ongoing	None
Aircraft Structural Integrity Program (ASIP) The technical requirements of the program were completely revised and updated last year in keeping with the MIL-PRIME program. The new MIL-PRIME specification, MIL-A-87221, "Aircraft Structures, General Specification For," February 28, 1985, replaces thirteen specifications of aircraft structural requirements. ASIP itself is being updated to reflect the latest programmatic aspects of the system acquisition process and to promote those discipline (loads, stress, durability, etc.) and interdiscipline activities needed to ensure that a system program is complete from an engineering viewpoint.	Ongoing	None
Air Transportability Engineering The Air Transportability Test Loading Agency (ATTLA) is the Air Force focal point for all requests for air transportability engineering analyses and aircraft test loading as part of the DoD Engineering for Transportability Program, per AFR 80-18. ATTLA provides criteria and guidance to program offices on air transportability matters during all stages of system acquisition and development of equipment. It also analyzes technical data for suitability for airlift certification.	Ongoing	None
Crew Station Design Facility (CSDF) This program uses full-mission, real-time simulation as a human engineering tool to assess crew work load and evaluate cockpit layout and instrumentation. This facility currently consists of an F-16C, an A-10, and a C-18 cockpit simulator with their associated visual and motion systems. A small cadre of government employees conduct the experiments, while the contractor personnel operate, maintain, program, and modify the simulators.	Ongoing	Singer-Link
Electromagnetic Pulse Survivability Military Standardization Program (EMSP) The purpose of this program is to develop specifications and standards for aircraft hardness to electromagnetic pulse (EMP) and also to coordinate technology developments from various USAF hardware and research programs to develop an electromagnetic transient survivability baseline for aircraft systems and subsystems.	Development	None
Deputy for Reconnaissance/Strike and Electronic Warfare (RW)		
Low-Altitude Navigation and Targeting Infrared for Night System (LANTIRN) LANTIRN is an integrated system consisting of navigation pod, targeting pod, and head-up display, which displays forward-looking infrared (FLIR) video. It provides the tactical air forces with the capability to conduct close air support and interdiction missions at night and under adverse conditions.	Full-Scale Development	Martin Marietta
Precision Location Strike System (PLSS) PLSS accurately locates and classifies enemy radar emitters and provides near real-time guidance commands for precision attacks against all types of enemy air defense systems.	Full-Scale Development	Lockheed Missiles & Space Co.
EF-111A Upgrade Program This program focuses on updating the ALQ-99E processing and jamming subsystem of the EF-111A Tactical Jamming System (TJS) to counter radar threats through the 1990s. The primary role of the EF-111A TJS is to screen attack aircraft from radars supporting hostile defensive weapon systems.	Full-Scale Development	Eaton Corp., AIL Div.
ALQ-131 Block III/Seek Ram The Seek Ram program incorporates Have Exit and Pave Mint techniques and reliability/maintainability improvements for the ALQ-131 pod system.	Full-Scale Development	Westinghouse/ Raytheon

NAME AND MISSION	STATUS	CONTRACTOR
Tactical Countermeasures Dispenser Upgrade (AN/ALE-47) The ALE-47 program will provide a dispensing system capable of interfacing with radar warning receivers, jammers, tail warning systems, and other aircraft systems to provide threat adaptive programming of expendables in multiple threat environments.	Full-Scale Development	None
Tactical Reconnaissance System (TRS) Ground Segment The Tactical Reconnaissance System technical concept features an integrated tactical reconnaissance sensor suite (on a TR-1 air vehicle) and a data link, both up and down, for communication of information and data. It prepares exploitation reports in near real time and rapidly disseminates these reports via common user and dedicated communications circuits.	Operational	Ford Aerospace
TRS Side-Looking Airborne Radar/Advanced Synthetic Aperture Radar System (ASARS) ASARS-2 is a high-resolution radar imaging system designed to be flown on the TR-1 aircraft. It produces high-quality imagery at long standoff ranges in strip mapping and spotlight modes. Real-time image processing and exploitation is accomplished on the ground through ASARS deployable processing station (ADPS) and ASARS exploitation cell (AEC) of the TRS Ground Station.	Production	Hughes Aircraft Corp.
EW Area Reprogramming Capability (ARC) The ARC is a highly interactive man/computer system to improve EW reprogramming response time in countering a change in the electromagnetic environment.	Full-Scale Development	Teledyne
F-4G Wild Weasel Performance Update Program (PUP) The purpose of the PUP is to maintain the defense suppression capability of the F-4G Wild Weasel into the 1990s through a new signal processor, receiver group, and an increase in frequency coverage.	Full-Scale Development	McDonnell Douglas
Infrared Search and Track System (IRS&T) IRS&T is designed to detect and track distant airborne threats.	Demonstration & Flight Test	None
ALQ-131(V) ECM Pod Receiver/Processor Component The pod receiver and processor will provide additional threat identification capability for the AN/ALQ-131(V) Block II electronic countermeasures (ECM) pod.	Production	Westinghouse
TR-1 Aircraft The TR-1 is a high-altitude, subsonic, long-endurance aircraft based on the current (1979) U-2 configuration. It is able to perform in any weather under all light conditions and can provide continuous near real-time (NRT) battlefield standoff threat assessment and penetration surveillance and analyses.	Production	Lockheed
Have Charcoal The purpose of this program is to develop improved infrared countermeasure jammers to protect high-value Air Force aircraft from selected infrared-seeking missiles.	Ground- & Flight-Test Program	Northrop; Sanders & Associates; Loral Electro-optical Systems
Technique 101 Subsystem/F/FB-111 Monopulse CM Technique 101 will provide improved electronic countermeasures into the 1990s through demonstration and integration of advanced countermeasures techniques.	Full-Scale Development	Raytheon
USAF Electronic Warfare Evaluation Simulator This facility upgrade will provide the capability in an indoor laboratory environment to simulate numerous radar threats.	Upgrade	General Dynamics
Integrated Electronic Warfare System (INEWS) INEWS is a joint Air Force/Navy effort to design and develop a next-generation electronic warfare system. This system will take advantage of emerging technologies to provide full spectral warning and countermeasures response capability for combat aircraft of the 1990s. INEWS will be integrated with other avionic subsystems on the Air Force Advanced Tactical Fighter (ATF) and the Navy Advanced Tactical Aircraft (ATA).	Concept Exploration	ITT/Litton; Hughes/Loral; Raytheon/Northrop; TRW/Westinghouse; Sanders/GE
MJU-10/B IR Flare The MJU-10/B flare provides IR antimissile diversionary protection for the F-15 aircraft.	Production	None
Airfield Damage Assessment System (ADAS) ADAS is a high-resolution, airborne/ground-based sensor system capable of locating, identifying, and classifying airfield damage. It is also able to identify a minimum operating strip (MOS) following a conventional attack.	Full-Scale Development	None
Airborne Self-Protection Jammer (ASPJ) (ALQ-165) F-16 Integration ASPJ is a joint Navy/Air Force program to develop an internal electronic countermeasures capability for self-protection of tactical aircraft. The system enhances mission success and aircraft survivability when confronted by modern, diversified, radar-controlled weapon systems.	Full-Scale Development	ITT/Westinghouse
Airborne Self-Protection Jammer (ASPJ) (ALQ-165)/Comprehensive Power Management System This project adapts the receiver/processor to provide an enhanced power management capability for the ALQ-131 electronic countermeasures pod.	Full-Scale Development	ITT/Westinghouse
Deputy for Tactical Systems (TA)		
F-15E Dual-Role Fighter This two-seat version of the F-15 will provide capability for long-range, night, and adverse weather delivery of air-to-ground munitions as well as enhanced air-to-air ability. Primary improvements include advanced cockpit technology, LANTIRN, ring laser gyro inertial navigation system, digital flight-control system, conformal fuel tanks, a nine-G airframe, and a configured engine bay capable of accepting either the General Electric F110-GE-100 or Pratt & Whitney F100-PW-220 engine.	Development	McDonnell Douglas Aircraft
F-15 Multi-Staged Improvement Program (MSIP) MSIP provides improvements to ensure F-15 air superiority into the 1990s. Improvements include a Programmable Armament Control Set (PACS), improved (speed, memory, supportability) central computer, MIL-STD-1760 incorporation, improved (speed, memory, ECCM, supportability) radar, and an expanded Tactical Electronics Warfare System (TEWS).	Development, Production	McDonnell Douglas Aircraft

NAME AND MISSION	STATUS	CONTRACTOR
Advanced Tactical Fighter (ATF) The ATF program will develop the Air Force's next-generation air-superiority fighter for operational service starting in the mid-1990s. The ATF concept, planned to be validated during the Demonstration/Validation phase starting in FY '86, is expected to include advanced propulsion, flight-control, and fire-control technologies; significant avionics integration; advanced system survivability features; "designed-in" supportability characteristics; and superior subsonic and supersonic maneuverability as well as nonafterburning supersonic persistence and a greatly increased combat radius. The program includes the development/demonstration of advanced technology fighter engines under the Joint Advanced Fighter Engine (JAFE) project.	Concept Exploration/ Demonstration/Validation	Boeing; Grumman; General Dynamics; Rockwell International; McDonnell Douglas; Lockheed; Northrop; General Electric; Pratt & Whitney
Air Force Infrared (IR) Maverick (AGM-65D) An air-to-ground launch-and-leave missile that is rocket-propelled and precision-guided by an infrared sensor, this day-and-night, limited-adverse-weather munition is designed primarily to counter armored fighting vehicles and fortified structures.	Procurement	Hughes Aircraft Co.; Raytheon Co.
Navy Infrared (IR) Maverick (AGM-65F) Similar to the Air Force AGM-65D, but with software optimized for use against ship targets, a larger warhead, and delayed fuzing.	Full-Scale Engineering Development	Hughes Aircraft Co.
Marine Corps Laser Maverick (AGM-65E) Shares the delayed fuzing and larger warhead features of the Navy IR missile (AGM-65F), but uses a laser seeker for positive identification of targets in a close air support environment.	Procurement	Hughes Aircraft Co.
F-5E/F Tactical Fighter Aircraft Procurement programs primarily for Foreign Military Sales. Currently buying aircraft for USAF (to support FMS training) and for Bahrain. Coproduction programs include shipsets for Korea and Taiwan.	Acquisition	Northrop Corp.
RF-5E Reconnaissance Aircraft Procurement/development for Saudi Arabia of specially configured RF-5E aircraft, Long-Range Oblique Photography (LOROP) camera, and Photographic Processing and Interpretation Facilities (PPIF).	Procurement/Development	Northrop Corp./Goodyear Aerospace Corp.
F-20 Tigershark Aircraft Contractor-developed/funded fighter, designed primarily for Foreign Military Sales. One aircraft currently undergoing extensive flight test at Edwards AFB, Calif., in anticipation of future sales. Foreign and USAF/USN personnel have participated in demonstration flights over the past three years.	Development	Northrop Corp.
Tactical Electronic Warfare System (TEWS) Intermediate Support System (TISS) TISS will provide the user with a test system capable of supporting the new state-of-the-art TEWS suite (ALR-56C and ALQ-135 bands 1,5 and 3). TISS will also support the existing TEWS and contains growth provisions for future TEWS updates. Stimulus/measurement capability through 40 GHz and digital testing up to 32 MHz are two examples of the extended capabilities of this full-MATE (Modular Automatic Test Equipment) system.	Development, Production	McDonnell Douglas
Low-Altitude Warning Systems (LAWS) An in-house-developed lead-computing terrain-clearance warning system for use by tactical fighter aircraft during hard maneuvering close to the ground. This system provides CFIT protection for ±150° bank angle maneuvers and accelerated dives (semi-inverted loaded pulls) as well as steady dives and rising terrain.	Refinement and Tactical Environment Testing	None
Mishap Investigation Visual Aid Development An in-house development analysis process for providing visual aid data in the form of videotapes of real-time computer graphics displays of simulation mishap maneuvers. The process starts with a simulation of the mishap maneuver, which is then displayed on a color CRT as it would appear from actual and simulated eyewitness reference points. Transparent map overlays and variable aircraft scaling have also been used to enhance the utility of this visual aid process in support of Mishap Investigation Boards. State-of-the-art computer hardware has been ordered to provide improved simulation for analysis and presentation of results.	Continuing Refinement	None
Deputy for Development Planning (XR)		
Transatmospheric Vehicle (TAV) To identify concepts for and evaluate the military effectiveness of an aircraft system with quick-reaction, global-range capability operating from military airfields in CONUS and performing multiple missions.	Preconcept Definition	Science Applications International Corp.; Subcontractors: Boeing, Rockwell, General Dynamics
Cruise Missile Defense Mission Analysis To examine the need for strategic atmospheric defense and identify and evaluate the effectiveness of aeronautical systems concepts to defend against the post-1995 air-breathing threat.	Preconcept Definition	Battelle; others to be determined
Tactical Mobility Mission Analysis To develop a comprehensive data base to support MAC preparation of Statement of Operational Need for our next-generation tactical airlifter in the twenty-first century. To establish an analysis capability to perform continuing analyses as necessary in the mobility mission area.	Preconcept Definition, Source Selection	SAIC; GRC; others to be determined
Reconnaissance-Attack-Fighter Training System To develop concepts for an advanced jet pilot training system (including curricula, simulations, training devices, aircraft, etc.) to train Air Force student pilots more efficiently and effectively so that they can transition from the trainer to the operational fighter-attack-recce aircraft of the twenty-first century (*i.e.*, F-15C/D/E, F-16C/D, ATF, and beyond).	Preconcept Definition	Battelle Columbus Laboratories; others to be determined
Follow-On Wild Weasel (FOWW) To provide recommendations for future Wild Weasel airframe and configuration for use in the 1990s and beyond.	Preconcept Definition	Quest; others to be determined
Far-Term Fighter Force Modernization Investigation To maintain the F-15, F-16, A-10, and F-111 as first-line fighters through the early twenty-first century. This force modernization effort will identify key new technologies and will develop plans to incorporate these technologies into our current tactical aircraft.	Defining Configuration Options	SAIC; General Dynamics; McDonnell Douglas; Fairchild
High Reliability Fighter Concept To develop viable configurations for future tactical fighters with minimum-maintenance and self-sufficiency characteristics. A specific goal is to develop concepts enabling a tactical fighter to operate autonomously and to be fully mission-capable for 250 flight hours with little or no maintenance.	Preconcept Definition	To be determined

NAME AND MISSION	STATUS	CONTRACTOR
Embedded Training Concepts for Tactical Aircraft To define concepts in which various training functions will be integral or intrinsic to an operational aircraft. For instance, embedded computer-generated threats and targets weapon release and scoring could provide a quantum advance in continuation training, both in conjunction with training at ranges and at arbitrary locations. The embedded trainer would be part of the aircraft design.	Preconcept Definition	Quest; DRC
Military Airlift Survivability Study (MASS) To conduct a vulnerability analysis of current airlifters (C-130, C-141, C-5) and perform a cost tradeoff study analysis of possible actions to increase survivability against current and future threats. The long-term objective is to form the baseline of "lessons learned" on survivability enhancements to be included in the original design of future airlifter aircraft.	Defining Configuration Options	IITRI; Subcontractors: Lockheed, Boeing
High Mach Vehicle Mission Application Study To postulate future Air Force mission applications requiring vehicles operating in hypersonic envelopes of Mach 3–6, Mach 6+, and single-stage-to-orbit.	Under Study	System Research Lab (primary); Frontier Technology Inc. (sub)
High Power Microwave Technology To determine relevance of high-power microwave technology to future offensive and defensive capabilities of aeronautical weapon systems.	Study/Analysis	Battelle Columbus (primary); Pacific Sierra
Aeronautical/Space Assets Interface Investigation To identify opportunities for aeronautical systems to operate in conjunction with space-based systems. This is a cooperative approach among ASD, SD, ESD, FTD, Space Command, and others. The result of this effort will be recommendations for future aeronautical and space systems concepts.	Preconcept Definition	Battelle Memorial Institute; others to be determined
Vanguard The AFSC Development Planning process and methodology that plans for the research, development, and acquisition of a force structure that would allow us to counter the threat throughout a twenty-year time frame. Through analysis, Vanguard identifies deficiencies in the capabilities of the current and programmed forces to counter the present and growing threat. This establishes goals for improving this capability. Satisfying these goals, then, will allow us to achieve the capability necessary to counter the threat throughout a twenty-year time span.	Preconcept Definition	None
Strategic Offense 21 To identify future strategic aeronautical systems and supporting technologies. Key emphasis will be placed on holding relocatable targets "at risk," countering a reactive threat, and surviving in an extended-conflict scenario.	Preconcept Definition	SRL; Frontier; Goleta
Strategic Penetration Investigation Feasibility Analysis of Penetration Aids Investigate practical means to maximize the ability of strategic aeronautical systems to survive enemy defensive actions.	Preconcept Definition	Boeing
Lemming To investigate a deceptive active countermeasure against homing guided missiles.	Preconcept Definition	Perceptronics
Deputy for F-16 (YP)		
F-16 Multimission Fighter The F-16 Fighting Falcon is a single-engine, lightweight, high-performance, multimission fighter capable of performing a broad spectrum of tactical air warfare tasks, including air-to-air and air-to-surface combat. Improvements added through the Multinational Staged Improvement Program (MSIP) will result in F-16C/D models with the capability to employ advanced systems, such as Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) and Advanced Medium-Range Air-to-Air Missile (AMRAAM). In addition to the US and its F-16 consortium partners (Belgium, the Netherlands, Denmark, and Norway), F-16s have been ordered by Israel, Egypt, Korea, Pakistan, Venezuela, Turkey, Singapore, and Thailand.	F-16A/B Production/ Deployment; F-16C/D Production/Deployment	General Dynamics (prime); Pratt & Whitney (F100 engine), General Electric (F110 engine); SABCA (final assembly-Belgium), Fokker (final assembly-Netherlands); Fabrique National (Belgium), Kongsberg (Norway), Phillips (Netherlands)-F100 engine
Deputy for Advanced Technology Bomber (YS)		
Advanced Technology Bomber Engineering development of an advanced manned penetrating bomber employing low observables technologies, with an Initial Operating Capability in the early 1990s.	Development	Northrop; Boeing; Vought; General Electric
Deputy for Simulators (YW)		
T-46 Development of a prototype T-46A Operational Flight Trainer (OFT) complex and acquisition of ten production complexes. An OFT complex consists of four simulated T-46A cockpits. Two complexes will be located at each undergraduate pilot training base and one complex at the pilot instructors' training facility.	Development	Reflectone
B-52 Offensive Avionics System (OAS) Block II Development/production of nine B-52 Weapon System Trainer (WST) and four Offensive Station Mission Trainer (MT) modification kits.	Ongoing	Singer-Link
B-1B Development/production of a training system to meet the training needs of all B-1B crew members. Included are five WSTs, which simulate all four crew positions, two MTs, which simulate only the offensive/defensive positions, and Cockpit Procedures Trainers (CPTs).	Development & Acquisition	Boeing
F-16A/C Procurement of forty-two OFTs, twenty-one Digital Radar Landmass simulators, twenty-seven Electronic Warfare Training devices, and five LANTIRN simulators.	Continuing Development & Acquisition	Many
F-15 Ongoing production of the F-15C/D OFTs will result in a total buy of fourteen simulators. Development of the F-15E WST has begun and will lead to production of six F-15E simulators.	Continuing Development	Goodyear

NAME AND MISSION	STATUS	CONTRACTOR
Advanced Tactical Fighter (ATF) Program addresses weapon system concept development, concept validation, and full-scale development for the next-generation manned tactical fighter aircraft.	Planning	None
C-17 Aircrew Training System Development and acquisition of a total contracted aircrew training system for C-17 pilots and loadmasters. Also included will be the operation and maintenance of the system.	Planning	None
C-5 Aircrew Training System (ATS) Production of an aircrew training system to meet the training needs of all C-5 crew members. Included are WSTs, CPTs, and Computer-Aided Instructions (CAI) that simulate all four crew positions. The contractor guarantees a trained crew member.	Production	United Airlines Aircrew Training
EF-111A Development and procurement of two OFTs to support EF-111A Tactical Jamming System (TJS) training.	Testing R&D Unit	AAI
C-5/C-141 ARPTT Development of one prototype and production of six units that provide fundamental visual, audio, flight-control, and buffet cues necessary for realistic air refueling training.	Continuing Development & Acquisition	Reflectone
Guided Bomb Unit (GBU-15) A standalone part-task trainer (PTT) to provide training for tactical weapon system officers in GBU launch and guidance tasks. Three PTTs will be used for the F-4E and one for the F-111.	Planning	To be determined
KC-135/MB-26 Refurbishment of all nineteen MB-26 CPTs with digital system and visual system that provides peripheral cues for engine-out training.	Planning	To be determined
Simulator Development Activity Engineering development of aircrew flight simulator techniques and training devices to satisfy current training requirements.	Ongoing	Many
Data Base Transformation Program A joint development project initiated through the Joint Logistics Commanders to develop a standard simulator digital data base and common transformation programs.	Ongoing	Many
Simulator Modularity Design Program Continuous development and validation that will capture functional commonality existing across most flight simulators.	Ongoing	Many
Reliability and Maintainability Program Multitask effort to study and develop ways of improving reliability and maintainability of simulators.	Ongoing	Many
Simulator Ada Integration Develop design/cost metrics for future simulator acquisitions using the Ada higher-order language.	Preacquisition	To be determined
LANTIRN Development/production of PTTs in F-15E, F-16, and A-10 configuration to train aircrews in LANTIRN switchology, symbology, and modes of operation. A second program, the LANTIRN CORE, will be developed and integrated with the F-16 and A-10 simulators to provide a real-time simulation of the LANTIRN mission.	Planning	To be determined
HH-60A Training System Development/production of a training system to meet the training needs of HH-60A crew members. Included are one WST, one CPT, ten PTTs, a Training System Support Center, a Management Information System, and curriculum and contractor logistics support, management, and operation.	Planning	To be determined
C-130 Weapon System Trainer Visual System Production of nine follow-on units to the highly successful visual systems at Little Rock AFB, Ark., and Pope AFB, N. C. Two of these systems are being procured for USN/USMC. Units include integration with C-130 Operational Flight Trainers, real-world visual data base for low-level tactical training, Low-Altitude Parachute Extraction System (LAPES), training, assault landing practice, and night-vision goggle operation.	Production	General Electric
Tanker-Transport-Bomber (TTB) Procurement of twenty-nine OFTs using already existing, off-the-shelf capabilities to allow initial and continuation training of TTB crews.	Planning	To be determined
C-130 Aircrew Training System (ATS) Develops a total aircrew training system for all C-130 courses and converts to contracted training.	Planning	To be determined
Generic Infrared Training System (GIRTS) Development/procurement (quantity 110) of standalone devices to support imaging infrared training.	Planning	To be determined
Deputy for Strategic Systems (YY)		
Common Strategic Rotary Launcher (CSRL) A rotary launcher for internal carriage of weapons common to the B-52H and the B-1B. The CSRL development program will develop a multipurpose launcher that is capable of uniform or mixed weapons payloads and that can accommodate current and projected cruise missiles, short-range attack missiles, and gravity weapons.	Full-Scale Development/Production	Boeing Military Airplane Co.
ALQ-172 Electronics Countermeasures (ECM) Set Major modification of the ALQ-117 ECM set on B-52H aircraft to provide an ECM defense against agile and monopulse surface-to-air-missile and advanced interceptor threats.	Production	ITT Avionics Div.
OAS Block II Software A software program that optimizes the B-52's capability to meet increased weapon system requirements. Block II will increase present capabilities and allow the addition of the new Strategic Radar, the Common Strategic Rotary Launcher, and future weapon systems intended for integration on the B-52.	Full-Scale Development	Boeing Military Airplane Co.
Short-Range Attack Missile (SRAM) II Development and manufacture of a Short-Range Attack Missile to augment and ultimately replace the AGM-69A SRAM-A. The SRAM II will have greater range, improved lethality, and better reliability and maintainability.	Pre-FSD Activity—Competitive Proposal Phase	To be determined
Strategic Mission Data Preparation System (SMDPS) Phase II Software A software development that will upgrade and expand existing B-52 automated flight-plan-generation capabilities to include B-1 and B-52 OAS Block II and CSRL.	Full-Scale Development	Boeing Military Airplane Co.

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Deployable Strategic Mission Data Preparation System (DSMDPS) Integrates the SMDPS hardware and software into a shelter group transportable on KC-135 aircraft.	Development	Boeing Military Airplane Co.; B&M Technologycal Services Inc.
AGM-86B Air-Launched Cruise Missile (ALCM) Acquisition of the ALCM, including development and production of performance improvements and integration with the CSRL and B-1.	Production	Boeing Aerospace Co.
Attack Radar Set (ARS) Upgrades the reliability, maintainability, and supportability of the F/FB-111 Attack Radar Set (ARS), correcting the current decreasing trend in the availability of the attack radar. The program provides for a field verification test as a means to verify the guaranteed reliability.	Full-Scale Development/Production	General Electric Co.
Terrain Following Radar (TFR) Upgrades the reliability, maintainability, and supportability of the F/FB-111 Terrain Following Radar (TFR). This program will increase the Mean Time Between Failure (MTBF) of the TFRs. The program provides for a field verification test as a means to verify a guaranteed reliability.	Full-Scale Development/Production	Texas Instruments
Digital Flight Control System (DFCS) Acquires replacements for the electronic portion of the F/FB/EF-111 flight control system to correct safety deficiencies and improve reliability and maintainability. The development effort is scheduled for contract start in FY '86.	Full-Scale Development	To be determined
GLCM Procurement of mobile cruise missiles to perform the theater nuclear mission. Enhance deterrence by increasing nonstrategic nuclear capability, improving survivability of the theater nuclear forces, and increasing flexibility in the employment of dual-capability aircraft.	Production	General Dynamics/ Convair Div.; McDonnell Douglas Astronautics Co.
Deputy for Propulsion (YZ)		
F101-GE-102 Engine for the B-1B Development and acquisition of the F101-GE-102 engine for the B-1B bomber. This engine shares a common core with the F110 fighter engine.	Production	General Electric
F110-GE-100 Engine for the F-15 and F-16 Development and acquisition of the F110-GE-100 engine for the Alternate Fighter Engine (AFE) program. This engine will be installed in new F-16C/D aircraft and potentially in new F-15Es. Production procurements will be competed each year with the P&W F100-PW-220 for a share of the F-15/F-16 market.	Production	General Electric
F100-PW-220 Engine for the F-15 and F-16 An evolutionary program to improve F100 durability and operability for the Alternate Fighter Engine competition. Increased durability to 4,000 TAC cycles or nine years' operation is accomplished through the improved life core. Operability improvements gained from the digital electronic engine control (DEEC) provide the -220 with unrestricted throttle movement throughout the flight envelope. The -220 is in production for incorporation into the F-15C/D/E and F-16C/D.	Production	Pratt & Whitney
F109-GA-100 Engine for the T-46A Acquisition of the F109-GA-100 turbofan engine to power USAF's T-46A next-generation trainer aircraft. This engine has both reduced fuel consumption and low noise level. It will join the Air Force inventory in the fall of 1986.	Full-Scale Development	Garrett
F108-CF-100 Engine for the KC-135R Acquisition of the commercially available and procured CFM56 engine for use in reengining the KC-135 fleet. Plans call for modification of approximately 360 aircraft through the year 1991 with this highly fuel-efficient engine.	Production	CFM International
F100 EMD/IPE (Engine Model Derivative/Increased Performance Engine) for the F-15 and F-16 Improved performance versions of existing fighter engines will be required to improve F-15 and F-16 system capability into the 1990s. The F100 EMD program is demonstrating an increased-performance version of the Pratt & Whitney F100 engine. Follow-on full-scale development of a derivative F100 engine is in progress.	Advanced Development/Full-Scale Development	Pratt & Whitney
F110 IPE for the F-15 and F-16 The F110 IPE will demonstrate an increased performance version of the F110-GE-100. This engine will compete with the F100 IPE for F-15 and F-16 aircraft through the late '80s and early '90s.	Advanced Development	General Electric
Advanced Tactical Fighter Engine This program is developing two types of advanced-technology engines: the General Electric GE37 and the Pratt & Whitney PW5000. These engines will compete for use in the Advanced Tactical Fighter in the early 1990s.	Advanced Development	Pratt & Whitney; General Electric
T700-GE-401 Engine for the HH-60A Acquisition of a turboshaft engine for integration with the HH-60A Night Hawk combat rescue helicopter (triservice program). This engine provides 1,690 shaft-horsepower per engine to support the USAF search and rescue mission.	Production	General Electric
Engine for the CV-22A (JVX) Acquisition of a turboshaft engine for integration with the CV-22A Advanced Vertical Lift Aircraft (triservice program). This multimission VTOL aircraft for the 1990s and beyond is planned for the Air Force special operations role.	Source Selection	None
F112 Engine for the Advanced Cruise Missile This is a small turbofan engine for an advanced cruise missile.	Ongoing	Williams International
Engine Component Improvement Program Provides continuing engineering support for all air-breathing engines used in manned aircraft in the Air Force inventory. This effort is directed toward correcting safety of flight conditions, improving durability/reliability/maintainability, developing repair procedures, and reducing the life-cycle cost of engines. Twenty-one families of engines are currently being supported.	Continuing	All major engine contractors

NAME AND MISSION	STATUS	CONTRACTOR
Automated Ground Engine Test Set (AGETS) AGETS is diagnostic ground-support equipment being developed and procured for the F100-PW-100 and F100-PW-200 engines. It is a computer-aided integrated test system that automatically acquires measurement data during F100 engine operation. This data is used to affect engine control system trim adjustments and identify and isolate faulty engine components. AGETS will reduce time and trim and fuel usage by about fifty percent and greatly enhance engine diagnostic capability.	Production	Pratt & Whitney
Propulsion Technology Modernization (Tech Mod) Advancing and implementing state-of-the-art technology into manufacturing systems. It increases productivity and efficiency, thereby reducing acquisition cost. Tech Mod advances all manufacturing activities, specifically focusing on test, assembly, heat treatment, coatings, conventional and nonconventional machining, tooling, materials handling, manufacturing and management information systems, and advanced forging, castings, and bearings.	Ongoing	General Electric; Pratt & Whitney; GTEC; Williams International
F117-PW-100 (PW2037) Engine for the C-17 Acquisition of the commercial PW2037 turbofan engine to power the C-17A aircraft. This fuel-efficient engine provides 37,600 pounds of thrust.	Development	Pratt & Whitney
F113-RR-100 Engine for the C-20A Engine management support for procurement of the commercial Rolls-Royce Spey 511-8 engine. This engine is being used to power the C-20A Special Airlift Mission aircraft (C-SAM).	Procurement/Deployment	Rolls-Royce
T101-PW-100 Engine for the C-23A Engine management support for procurement of the commercial P&W PT6A-45R turboprop engine. This engine is being used to power the C-23A European Distribution System Aircraft (EDSA).	Procurement/Deployment	Pratt & Whitney
PT6A-42 Engine for the C-12F Engine management support for procurement of the commercial Pratt & Whitney PT6A-42 turboprop engine. This engine is being used to power the C-12F Operational Support Aircraft (OSA).	Procurement/Deployment	Pratt & Whitney
TFE-731-2A Engine for the C-21A Engine management support for procurement of the commercial Garrett TFE-731-2A turbofan engine. This engine is being used to power the C-21A Operational Support Aircraft (OSA).	Procurement/Deployment	GTEC
JT8D-7B Engine for the C-22 Engine management support for the procurement of the commercial Pratt & Whitney JT8D-7B turbofan engine. This engine is being used to power the C-22 Air National Guard Support Aircraft (ANGSA).	Procurement/Deployment	Pratt & Whitney
TF39-GE-1C Engine for the C-5B The TF39-GE-1C engine has reentered production after more than ten years and is used to power the C-5B aircraft. This high-bypass turbofan provides 41,100 pounds of thrust.	Acquisition/Operational	General Electric
Air Force Wright Aeronautical Laboratories **Avionics Laboratory (AA)**		
Very-High-Speed Integrated Circuits (VHSIC) This is an integrated circuit technology development program that will result in very high operating speed chip designs, pilot production capability, and initial system brassboards. The objective is to extend the US integrated circuit technology base by one or two orders of magnitude in density and throughput, resulting in high-performance, compact, reliable electronic systems.	Phase 1: Qualification for Production; Phase 2: Development	Phase 1: Honeywell; Westinghouse; Hughes; IBM; TRW; Texas Instruments Phase 2: Honeywell; IBM; TRW
Pave Pillar The objective of this program is to demonstrate a next-generation system of avionics that will restrain cost, complexity, and proliferation of both airborne electronic equipment and associated test equipment while improving mission effectiveness. This will be accomplished using common modules, fusion algorithms across sensor systems, fault-tolerant system architecture, and such high-performance reliable component technologies as VHSIC.	Definition	Boeing; General Dynamics; Grumman; Lockheed; McDonnell Aircraft; Northrop; Rockwell
VHSIC 1750A Computer An expandable, modular computer system consisting of a MIL-STD-1750A processor module, bulk memory module, external input/output module, and support equipment module. It is classified as a VHSIC insertion program to develop computer building-block modules. Advantages over current very-large-scale integrated circuit technology, besides the expandable, modular architecture, include two to four times throughput improvement, greater environmental operational capabilities, significantly reduced size, and greater reliability.	Development	TRW; Westinghouse
Common Signal Processor (CSP) Development program for a modular, high-performance, reliable, VHSIC-based, digital signal processor for next-generation avionics. It can be configured and programmed to satisfy a wide range of applications, such as radar, communications, electronic warfare, and electro-optical systems.	Development	To be determined
Integrated Communication Navigation Identification Avionics (ICNIA) ICNIA combines existing and planned near-term communications, navigation, and identification (CNI) functions in the 2 MHz to 2 GHz frequency domain into one airborne radio system for use in tactical aircraft and Army LHX helicopters. The system will incorporate VHSIC and Radio Frequency Large-Scale Intergration (RFLSI) technologies and fault-tolerant architecture to greatly increase mean time between mission critical failures. Reliability, maintainability, and supportability considerations have significantly influenced the system design, which will enable a two-level maintenance concept to be implemented.	Development	TRW; ITT/Texas Instruments
Advanced Target Acquisition Sensor (ATAS) The objective of this program is to develop and demonstrate second-generation forward-looking infrared sensor technology for targeting and reconnaissance applications. The capability being developed will be a major improvement over current operational systems.	Development	Hughes Aircraft
Infrared Search and Track System (IRSTS) ECM-resistant, passive-detection technology being developed to enhance long-range radar fire-control systems for air-to-air fighter intercept missions. A high-sensitivity infrared sensor combined with advanced signal-processing equipment will provide high-resolution detection and multitarget track capabilities.	In Flight Test	General Electric; ITT Avionics
Ultra-Reliable Radar (URR) A program to demonstrate an advanced airborne radar with a mean time between critical failure (MTBCF) rate that is an order of magnitude greater than that of current radars. The development model radar will utilize	Development	Westinghouse

NAME AND MISSION	STATUS	CONTRACTOR
advanced technologies, such as electronically scanned active element arrays, VHSIC-based common signal processing, and Pave Pillar-compatible fault-tolerant architectures.		
Integrated Inertial Reference Assembly (IIRA) A program to improve system functional reliability through the development of a multifunction inertial reference system capable of satisfying the performance and survivability requirements of navigation, flight control, and weapon delivery. The development system will utilize strapdown ring laser gyros and VHSIC-based MIL-STD-1750A processor modules and a fault-tolerant architecture to greatly increase mean time between mission failures.	RFP Preparation	To be determined
Air-to-Air Attack Management This program will demonstrate, via man-in-the-loop simulation, improved survivability and lethality of single-seat fighter aircraft in a multitarget air-to-air combat scenario. These objectives will be met by increased pilot situation awareness and controlled work load, to be provided by innovative control and display technology integrated with advanced fire-control algorithms.	Source Selection	To be determined
Coronet Prince Prototype A program to package existing countermeasures technology into an aircraft pod and demonstrate its effectiveness against ground-based optical/electro-optical tracking systems. The prototype pod will be suitable for use on high-performance tactical and special-purpose aircraft. Its performance during aircraft maneuvers and its effect on aircraft operation will be evaluated to establish a baseline design for a full-scale development program.	Design	Westinghouse Electric Corp.
Silent Attack Warning System (SAWS) This advanced development program will provide hardware to demonstrate a state-of-the-art infrared detection system for missile and aircraft warning. Key to this new development is improvement in the false alarm rate and in detection probability over earlier IR threat warning systems.	Design	General Electric; Honeywell; Texas Instruments
Cruise Missile Advanced Guidance (CMAG) Program to develop and demonstrate advanced missile guidance technology capable of providing precision autonomous terminal guidance for standoff missiles. Guidance concepts may employ CO_2 laser radar measurements and pattern recognition to provide midcourse guidance to high-value fixed and mobile targets.	Development	General Dynamics; McDonnell Douglas
Survivable Penetration and Attack A joint program with Flight Dynamics Laboratory to develop terrain-following/terrain-avoidance/threat-avoidance (TF/TA^2) algorithms and an integrated avionics/control system that will provide a high-performance tactical aircraft with the capability to perform low-altitude high-speed maneuvering, penetration, and attack missions automatically. An emphasis is being directed toward reducing visibility to threat resources, reducing detectable emissions, and improving pilot work load.	RFP Preparation	To be determined
Panoramic Cockpit Control and Display System (PCCADS) Program to demonstrate the technology to automate and simplify many of the display and control functions for fighter aircraft. This new approach will use essentially the entire fighter cockpit instrument panel as an electronically controlled display.	Development	McDonnell Douglas
Embedded Computer Resources Support Improvement Program This program will develop, incorporate, and demonstrate software supportability of new technologies as they are included in the software support capability at the AFLCs. An extendable, modular, and flexible prototype of a next-generation support capability will be developed to provide the support tools and environment required for the rapid reprogramming of embedded computer software.	Development	To be determined
Advanced Graphics Avionics Display System (AGADS) The AGADS program will develop a brassboard prototype graphics generator capable of supporting advanced pictorial display formats. Emphasis will be on generation of three simultaneous color raster scenes in real time and within a specified volume constraint. Demonstration of AGADS will include a flight management algorithm, terrain/cultural data bases, threat data, and randomly generated pop-up threats.	Development	Lear Siegler, Inc.
EW Reliability Improvement Program This task will demonstrate the ability to increase mean time between failure (MTBF) of candidate EW subsystems by one to two orders of magnitude. Approach is to freeze technical system parameters (*e.g.*, bandwidth, gain, power output, spurious signal levels) and focus attention on "weak sister" component improvement in subsystems.	Development	TRW, Electronic Systems Group; Northrop, Defense Systems Div.; Westinghouse, Defense & Electronic Center
High Power Countermeasures Program to define, develop, and flight-test an improved standoff jamming capability that permits operation of jammer in sanctuary. The system will provide very high effective radiated power and electronically steered, fast switching, narrow-beamwidth, multiple-beam jamming.	Definition	Raytheon Co.; ESD
Flight Dynamics Laboratory (FI)		
Advanced Fighter Technology Integration (AFTI/F-16) The AFTI/F-16 research program objective is to develop, integrate, and flight-validate technologies that will improve the lethality and survivability of future advanced military fighters. Technologies include a digital flight-control system, an automated maneuvering attack system, conformal IR sensor/tracker, digital terrain management and display system, voice interactive avionics, and a helmet sight.	In Flight Test	General Dynamics
X-29 Advanced Technology Demonstrator The X-29 research program objective is to develop, integrate, and flight-validate advanced aerodynamic, structural, and flight-control technologies of a forward-sweptwing aircraft that can provide new design options for future military and commercial aircraft. Technologies include an aeroelastically tailored forward-swept-wing utilizing composite wing box covers, discrete variable camber, relaxed static stability, and digital flight controls with full-authority close-coupled canards and three-surface pitch control.	In Flight Test	Grumman Aerospace
STOL and Maneuver Technology The program objective is to develop, integrate, and flight-test advanced technologies to provide a short-takeoff-and-landing (STOL) capability for supersonic fighters while enhancing cruise performance and maneuverability. An F-15 fighter will be modified with a two-dimensional thrust vectoring/reversing exhaust nozzle, an integrated flight/propulsion control with STOL displays/controls, and a rough-field landing gear. It will be tested to demonstrate routine and effective operation from a battle-damaged/repaired runway at night and under weather and enhanced maneuverability throughout the flight envelope.	Aircraft Modification	McDonnell Aircraft

NAME AND MISSION	STATUS	CONTRACTOR
AFTI/F-111 Mission Adaptive Wing The AFTI/F-111 research program objective is to develop and flight-test a smooth-skin variable-camber wing system that will increase range, maneuverability, and survivability for tactical and strategic missions by using automatic wing configuration control to maintain peak aerodynamic efficiency. The approach is to modify the TACT F-111 aircraft wing with smooth-skin variable-camber mechanisms that are operated by a newly developed digital computer control system.	In Flight Test	Boeing
Variable Stability In-Flight Simulator Test Aircraft (VISTA/F-16) The VISTA/F-16 program will design, build, and flight-test a new six-degree-of-freedom in-flight simulator to replace the Laboratory's NT-33A. The unique VISTA modifications and systems will be incorporated into a new F-16D aircraft during construction. Changes include a model-following flight-control system, reconfigurable front cockpit, increased chord and span multisegmented flaperons, added drag devices and side-force surfaces, and a programmable head-up display. The completed VISTA/F-16 aircraft will be used for flight control, display, and controller research and development; pre-first flight simulation and familiarization; and test pilot training.	RFP Preparation	To be determined
Adaptive Flutter Suppression Flight Demonstration The objectives of this program are to develop and flight-demonstrate an adaptive flutter suppression system. Such a system will eliminate the need to restrict with flutter placards the operational envelopes of fighter aircraft carrying external stores. The adaptive concepts incorporated into the active feedback system will automatically adjust to changes in flight condition, fuel loading, and store configuration and to the structural dynamic differences among aircraft of the same model.	RFP Preparation	To be determined
Integrated Control and Avionics for Air Superiority (ICAAS) The ICAAS program will develop and demonstrate key control and avionics technologies that will enable cooperating fighter aircraft to engage and defeat multiple airborne threats. The design approach will stress functional integration of target sensors, fire control, flight control, weapons, and interface with the pilot. Significant improvements in beyond-visual-range attack and pilot situation awareness are expected compared to current systems. Demonstration will include piloted simulation and flight test.	Draft RFP Released	To be determined
Materials Laboratory (ML)		
Computer Integrated Manufacturing Computer Integrated Manufacturing (CIM) is a major initiative that will demonstrate massive cost and span time reductions through improved integration of all manufacturing functions, on and off the factory floor. In addition to information management technologies, three different large-scale fabrication demonstration programs are in progress: Integrated Sheet Metal Center (ISMC), Advanced Machining System (AMS), and Integrated Composites Center (ICC).	Manufacturing Technology	Boeing Military Airplane Co.; General Dynamics Corp.; McDonnell Douglas Corp.
Composite Materials Research and Development A wide variety of important new composite materials systems (fiber-reinforced organic resins) is under development to exploit their unique performance attributes for Air Force aircraft, spacecraft, tactical missiles, cruise missiles, and long-range strategic missiles. A highly integrated approach is being pursued in these developmental efforts. For each composite materials system, R&D is being performed on fibers, matrix materials, fiber/matrix interfaces, mechanics of fiber/matrix interaction, processing, quality control, and environmental effects.	Research & Exploratory Development	McDonnell Douglas Corp.; Boeing Co.; Lockheed; University of Dayton Research Institute; other numerous universities, small businesses, and aerospace companies
Advanced Powder Metallurgy Structural Alloys Rapid progress is being made in the laboratory's comprehensive powder aluminum and titanium structural alloy R&D program. It is structured to maximize the recent advances in rapid solidification technology that have opened up major new alloying possibilities heretofore impossible. This program couples research, exploratory development, and advanced manufacturing technology contractual efforts with a strong in-house research effort in characterization and processing to create and put into production superior aluminum alloys having improved strength, corrosion resistance, and longtime use at 650°F and new, low-density, high-strength titanium alloys with sustained 1,300°F operating capability.	Research Exploratory Development Manufacturing Technology	Lockheed; Rockwell Science Center; General Electric Pratt & Whitney; Lockheed-Calac; Boeing Co. Alcoa; Northrop
GaAs Research and Manufacturing Technology Progressive exploratory development programs are under way to improve the yield and establish the optimum processes for growing high-quality GaAs crystals for microwave devices for satellite communications, space-based and airborne active array radars, electronic countermeasures, and missile seekers. Results will be utilized in the Manufacturing Technology program that will address generic manufacturing issues and demonstrate new techniques for low-cost processing to make higher performance and more reliable GaAs devices.	Research Exploratory Development Manufacturing Technology Procurement	Massachusetts Institute of Technology; General Telephone and Electronics Texas Instruments; Rockwell International; Stanford University To be determined
Laser Hardened Materials—Tactical Subsystems Hardening Advanced development is being conducted to provide technology options to systems designers and developers for laser protection of tactical systems and their optical and electro-optical subsystems. The methodology includes studying the system mission scenario, establishing hardening requirements, developing technology options, and assessing payoffs and penalties through comprehensive testing of actual hardware or comparable brassboards.	Advanced Development	Martin Marietta Corp.; Texas Instruments, Inc.; McDonnell Douglas Corp.
Manufacturing Technology for Advanced Propulsion Materials A new manufacturing technology initiative has been established to provide production capabilities for engine components incorporating advanced materials systems that provide significant engine performance improvements. Manufacturing methods are to be established for titanium and superalloy integrally bladed rotor (IBR) designs; superalloy fabricated turbine blade and vane designs; titanium aluminide cases, rings, and vanes; graphite polyimide composite fan airfoils and front frames; and carbon-carbon composite liners and nozzles.	Manufacturing Technology	General Electric; Pratt & Whitney

NAME AND MISSION	STATUS	CONTRACTOR
Composites Supportability The increased application of advanced composites in USAF systems has led to the establishment of new programs to develop increased in-house engineering expertise in advanced composite materials technologies relating to supportability and to a series of contractual programs to attack user composites supportability issues. These programs will address the technologies of composite inspection, repair techniques, repair materials and processes, and repair process quality control for field, depot, and battle-damage situations. It will also include establishing data for repairs performed during the manufacturing process, materials and structural failure analysis, and personnel training. Work will also be performed to develop advanced repair technology (materials, processes, and equipment) for materials of the future, such as thermoplastics and polyimides.	Exploratory Development	Northrop Corp.; General Dynamics Corp.; Boeing Co.; Southwest Research Institute; Iowa State University; other universities, small businesses, and aerospace companies
Aircraft Composite Structure Manufacturing Manufacturing technology activities are being pursued to provide primary advanced composite structures for large aircraft to improve operational efficiency and to automate the shop floor and above for composite components of fighter aircraft. The objectives are to establish and validate manufacturing technology for large aircraft composite wing and fuselage structures in order to produce these structures at a reasonable and predictable cost and to decrease cost and increase quality for fighter-type aircraft. For these applications, automated fabrication methods are being emphasized. The established targets vs. conventional aluminum structures for reduced part count and lower manufacturing cost and weight will be verified in the planned component demonstrations.	Manufacturing Technology	Rockwell International; Boeing Co.
Aero Propulsion Laboratory (PO)		
High-Performance Turbine Engine Initiative Focuses resources and generates programs necessary to demonstrate a revolutionary advancement in turbine engine technology through the 1990s. This is an integrated program between the Aero Propulsion Laboratory and the Materials Laboratory of AFWAL to ensure that individually developed materials and component technologies are compatible with the overall objective of a 100 percent engine technology improvement (*e.g.,* thrust to weight) over the Joint Advanced Fighter Engine (JAFE) technology level.	Exploratory Development	Pratt & Whitney; General Electric Co.; Allison Gas Turbine Div., GMC; Teledyne CAE; Garrett Turbine Engine Co.; Williams International
Joint Technology Demonstrator Engine (JTDE) A complete technology demonstration engine sponsored by the Navy and Air Force Aircraft Propulsion Subsystem Integration (APSI) program, these experimental engines consist of advanced high-pressure core components from the Advanced Turbine Engine Gas Generator (ATEGG) program combined with advanced low-pressure and adaptive components.	Advanced Development	Allison Gas Turbine Div., GMC; Garrett Turbine Engine Co.; General Electric Co.; Pratt & Whitney Aircraft; Teledyne CAE
Joint Advanced Fighter Engine (JAFE) A competitive advanced development program to accelerate the development of critical propulsion system technologies for ATF and to demonstrate and validate the entire propulsion system design.	Advanced Development	General Electric Co.; Pratt & Whitney Aircraft
Variable-Flow Ducted Rocket Demonstration This missile propulsion concept, when combined with advances in aircraft, fire control, and missile subsystems, can contribute to air-to-air superiority in the post-1995 time frame. An integral rocket ramjet that utilizes a fuel-rich solid propellant gas generator for ramjet fuel can provide a two- to fourfold improvement in total range over rocket propulsion for an equivalent size.	Exploratory Development	Many
Spacecraft Power To provide evolutionary and revolutionary improvements in spacecraft power systems while achieving significant reductions in weight and volume, accompanied by increased survivability. Advances are made through higher-efficiency solar cells, solar concentrator and planar arrays, high-energy-density rechargeable batteries, nuclear power, thermal management systems, dynamic and thermionic energy-conversion devices, power conditioning components, and electrical energy storage concepts.	Research/Exploratory & Advanced Development	Many
Solid-Fuel Ramjet Propulsion A technology program to improve the performance and demonstrate tactical acceptance of hydrocarbon-fuel engines and to develop and demonstrate boron fuels in a solid-fuel ramjet engine. This involves environmental testing of established engines with both previously tested and advanced hydrocarbon fuels; development of both intermetallic and metallized boron fuels; and demonstration of these fuels in a full-size, flight-type engine. Since the solid-fuel ramjet is extremely rugged and conceptually is the simplest and least costly of all ramjet types, these technologies are directed primarily toward tactical applications. However, as boron fuels become established, solid-fuel ramjet technologies will be candidates for longer-range applications as well.	Exploratory Development	Atlantic Research Corp.; United Technologies Corp., Chemical Systems Div.
Aviation Turbine Fuel Technology A program to improve the availability and lower the cost of military jet fuel produced from hydrocarbon resources, which include petroleum, heavy oil shale, tar sands, and coal. Fuels from these feedstocks with varying properties are being analyzed and tested. This will allow fuel specifications to be defined that ensure acceptable quality and compatibility of aviation fuel with present and future aircraft and engines. Improvements in safety and aircraft range through the use of higher-density fuels are under investigation.	Research/Exploratory & Advanced Development	Many
Aircraft Power To advance aircraft electrical and hydraulic power system technology through the development of a nonflammable hydraulic system, advanced battery systems, a highly reliable fault-tolerant electrical power system, and the associated generation, distribution, actuation, and control components. Program objectives are to reduce life-cycle costs, increase power extraction efficiency, decrease weight, and improve specific fuel consumption.	Exploratory Development	Many
Compressor Research Facility A modern component test facility, fully automated and computer-controlled and -designed to support both exploratory and advanced development efforts in compressor technology for the improvement of gas turbine engines.	Operational	In-House
Missile Fuel Technology A program to develop high-energy-density fuels for volume-limited turbine and ramjet-powered missiles. Fuels with higher energy content on a volumetric basis have been shown to significantly increase the range of air-breathing missiles, such as the air-launched cruise missile. Current programs are concentrating on the formulation of slurry fuels containing aluminum, boron, and carbon and of boron-augmented solid fuels. Combustion evaluation and fuel system design are being investigated concurrently.	Research & Exploratory Development	Many

NAME AND MISSION	STATUS	CONTRACTOR
Aircraft Fire Protection A program to improve the fire safety and related combat survivability of aerospace systems through analytical, experimental, and full-scale demonstrations. This is accomplished by assuring the capability and the timely availability of fire and explosion prevention design criteria, containment and hardening measures, and detection and suppression equipment for future Air Force needs.	Research/Exploratory & Advanced Development	Many
Aerospace Lubrication A program to assure the availability of optimum lubrication-system-condition monitoring techniques to meet the needs of USAF air-breathing propulsion and power systems. Lubricants, lubrication techniques, and test methods are being developed and evaluated to resolve current problems and meet projected requirements. Improved rolling element bearing and seal designs as well as gas- and solid-lubricated bearings for special applications are also being investigated.	Research & Exploratory Development	Many
4950th Test Wing		
ARIA Scoring Systems Provide state-of-the-art broad ocean area coverage of reentry vehicles for weapon system testing. Functions previously requiring both EC-135 and P-3 aircraft will be combined in the EC-18 ARIA aircraft. The Sonobuoy Missile Impact Location System (SMILS) will acquire and process missile impact data. Impact locations of multiple reentry bodies will be determined precisely by SMILS, using either deep ocean transponders or Global Positioning Satellites. Associated programs will collect optical data on reentry vehicles during the terminal phases of flight and will sample meteorological parameters from the surface to 80,000 feet.	Development	Applied Physics Laboratory (Johns Hopkins University); E-Systems, Inc.
EC-18B Conversion This effort is modernizing the current EC-135 Advanced Range Instrumentation Aircraft (ARIA) fleet by converting used Boeing 707-300 series commercial aircraft and reconfiguring them as EC-18B ARIAs. The EC-18B has a larger volume and payload than the EC-135s, allowing it to hold the existing Prime Mission Electronic Equipment plus the new ARIA Scoring System. Modification of the first aircraft was completed in January of FY '85, and a successful flight-test program was completed at Edwards AFB, Calif., in June of FY '85.	Production	None—Air Force modification
Microwave Landing System (MLS) Tests MLS is a new type of precision approach, missed approach, departure, and landing guidance system that will replace ILS as the standard precision landing system. It provides the capability to fly high-angle approaches, curved approaches, and segmented approaches, thus reducing noise and allowing precision approaches in areas of high terrain. Flight tests are scheduled for FYs '86 and '87 in a C-141 to obtain data needed to develop approach criteria for large aircraft and evaluate operational characteristics of the system.	Development	Lear Siegler; Bendix Corp.
Mark XV Identification, Friend or Foe (IFF) The Mark XV IFF program is intended to test the next generation of IFF equipment for the Air Force, Navy, Army, and NATO. It is designed to be a secure, antijam, high-reliability system that can operate in an ECM environment. The first phase of testing involves one NKC-135 aircraft flying 310 hours from Wright-Patterson AFB, Ohio, and/or Patuxent River NAS, Md. Eglin AFB, Fla., and Edwards AFB, Calif., are also possible test sites. The second phase of testing, also referred to as "Service-Unique Testing," calls for the 4950th Test Wing at Wright-Patterson AFB to support Mark XV IFF testing in specified environments for the three services (Air Force, Navy, and Army). This second phase will take place in FY '88 and FY '89 and will probably have more 4950th Wing flight activity than the first phase. Initial testing will focus heavily on the digital signal processing capability, target resolution, and new IFF interrogation techniques.	Development	Bendix; Texas Instruments
ECCM/Advanced Radar Test Bed (ARTB) In support of the ECCM master plan, the ECCM/ARTB is an airborne platform for developmental test and evaluation of advanced radar systems and ECCM techniques, to include multisensor integration. This unique Air Force resource will support development of the B-1, F-15, F-16, and ATF radar systems and advanced technology programs into the 1990s. The area of ECCM and system vulnerability analysis is growing steadily in importance due to tactical considerations. The test-bed represents a major step in the Air Force's ability to evaluate sensor systems in a realistic environment and early in system development. The test-bed, currently under design development, is scheduled for employment in FY '88.	Development	None
C-5B The C-5B test program is a contractor-sponsored production acceptance test and evaluation (PAT&E) of new-production C-5 aircraft. The Air Force is conducting qualification operations testing and evaluation (QOT&E) and operational testing and evaluation (OT&E) concurrently with the contractor's test program. The C-5B has forty systems that have been updated since C-5A production ended. The 4950th Test Wing is also responsible for technical order publication verification and validation.	Continuing	Lockheed-Georgia Co.
Testing Off-the-Shelf Aircraft Provides evaluation of civil aircraft against specific military requirements. Areas of evaluation include ground handling, maintenance, flying qualities, performance, and human factors. Test results are used extensively in the source-selection process. A wide range of Technical Order Management and development services are provided to determine suitability for various maintenance levels and specialties in the Air Force. Recent evaluations of off-the-shelf aircraft have resulted in the selection and procurement of the C-12, C-18, C-20, C-21, C-22, and C-23 aircraft.	Continuing	Various aircraft manufacturers
Aerodynamic Evaluations of Modified Aircraft Aircraft utilized for advanced systems test often undergo significant external modifications. Radomes, antennas, special fairings, shaped protrusions, and movable turrets that have at one time or another been added to the 4950th Wing's aircraft to accommodate test requirements in the aircraft's performance, stability, and control and handling qualities are evaluated using approved flight-test techniques prior to the start of actual system evaluation. Aero-eval results are then incorporated into flight certifications and are documented for further use.	Continuing	Many
Aircraft Systems Testing A variety of aircraft components is evaluated under the management of 4950th Wing flight-test directors. Avionics, control and braking systems, aerial refueling projects, and communications equipment are tested prior to Air Force procurement. Engineering support is provided for many tests, including acceptance flight testing for the C-23 and C-5B.	Continuing	Many

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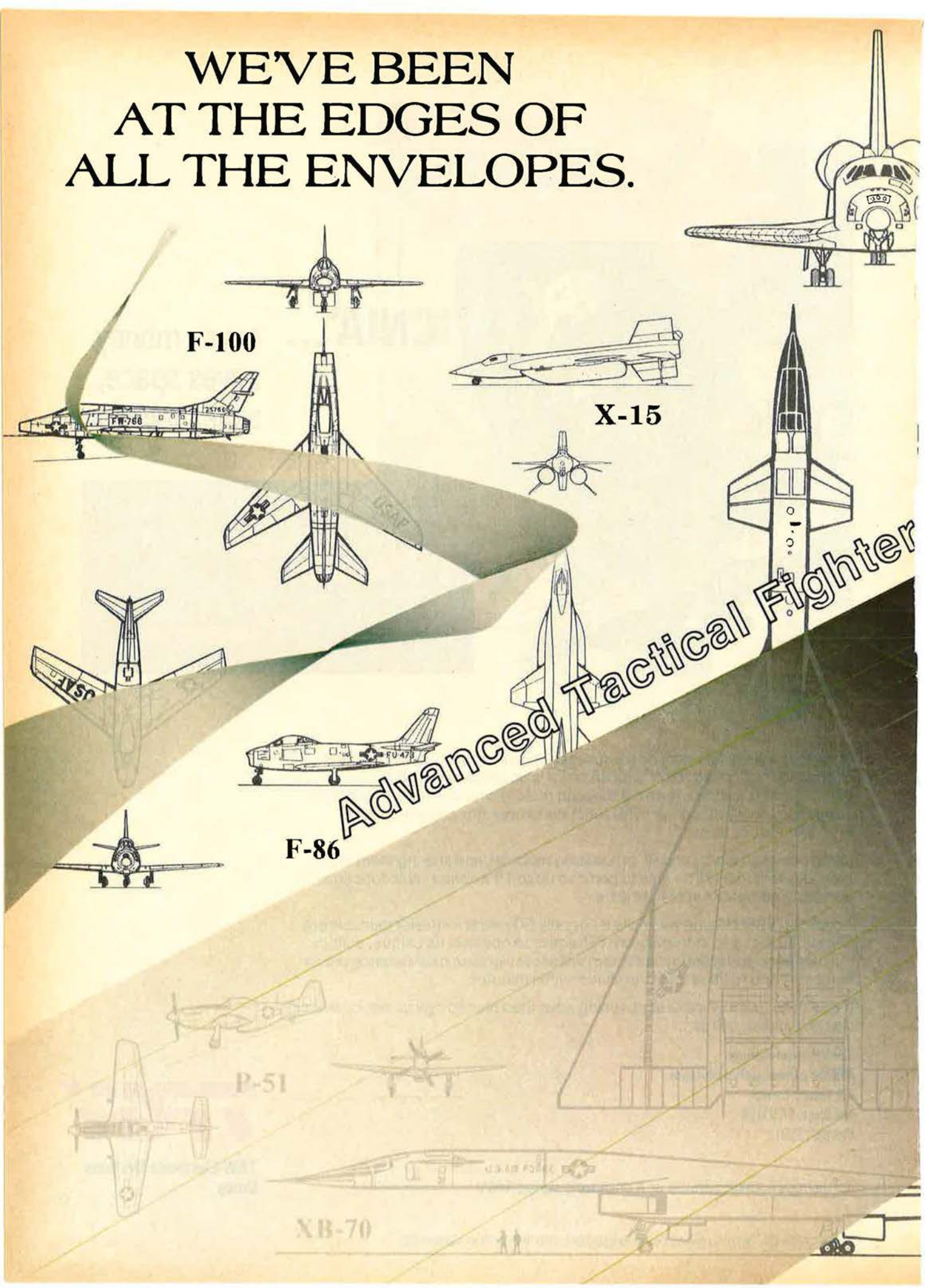

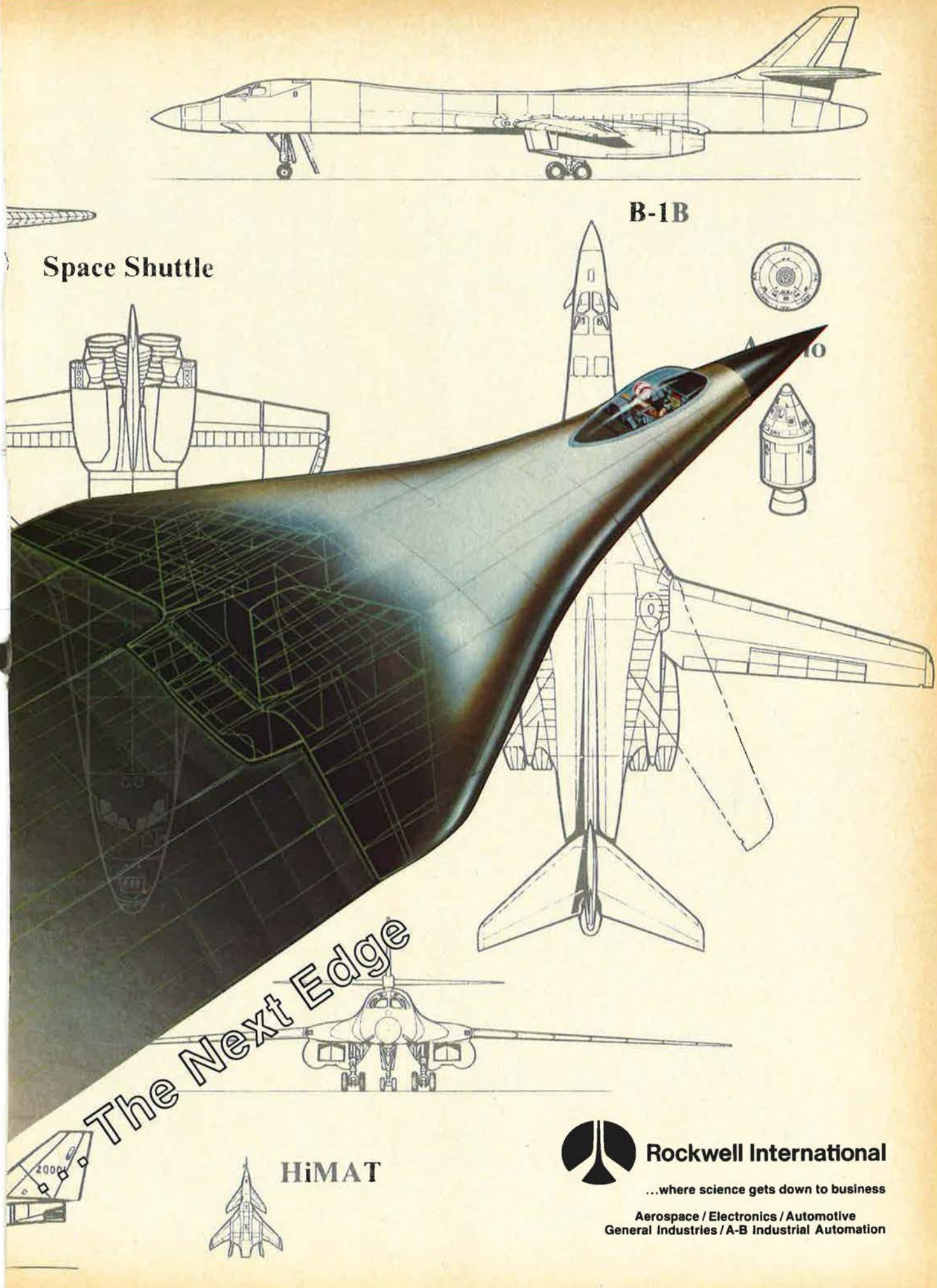

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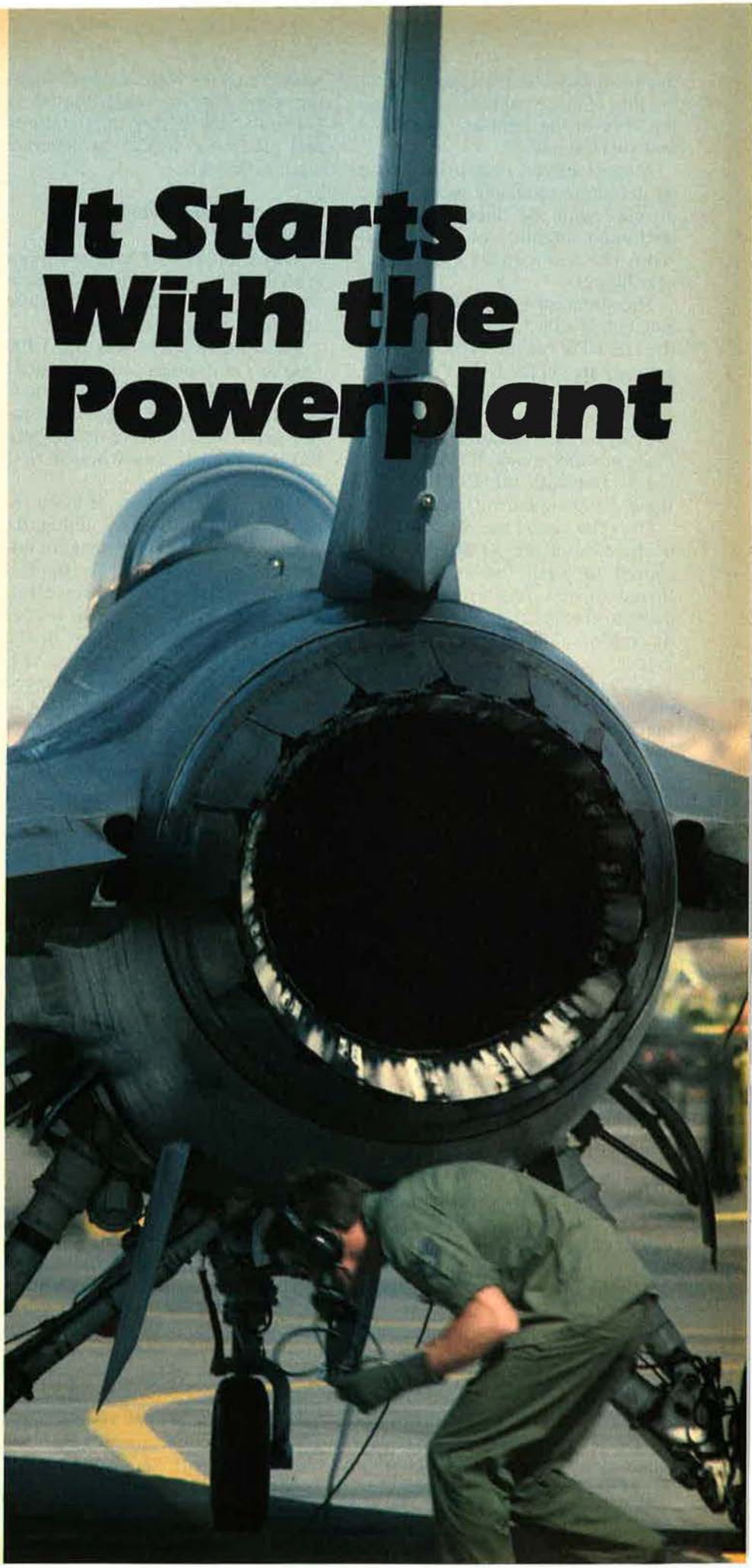
It's no longer taken for granted that fighter engines become less reliable as they run hotter and their thrust increases.

A STAFF REPORT



IN 1943, Lockheed "Skunk Works" engineers, led by Kelly Johnson, undertook a top-secret project to build America's first jet fighter.

They designed the aircraft, which they called *Lulu Belle,* around a jet engine to be manufactured in England. The engine was delivered to the Skunk Works after the airframe had been built and only seven days before the aircraft's first flight.

Then the problems began. During the engine's final runup the day before the flight, its ducts collapsed and it self-destructed. Another engine was delivered and worked fine. The XP-80 took to the air.

The Army Air Forces decided, however, that it wanted a fighter with more thrust and greater payload. It contracted with General Electric Co. for a bigger, more powerful engine.

This meant that the airframe would have to be enlarged by eighty percent. The Skunk Works went at it. Only 132 days later, the YP-80A *Gray Ghost,* forerunner of the P-80/F-80 series of fighters, was ready to fly.

The story is still pretty much the same. Fighters are still being designed around engines, as were the F-15 and the F-16 in order to accommodate the Pratt & Whitney F100

engine, and the performance and reliability of those engines are the major keys to the fighters' capability and sustainability.

Almost never is a production fighter altered to make its structure dovetail with the dimensions of a particular engine; yet this is currently the case with the F-15E dual-role fighter.

The standard F-15 airframe's engine bay is a bit too small to accept the GE F110 engine. Thus, the engine bay area of the F-15E's aft fuselage will be built slightly larger and with lighter materials than those of previous F-15 variants. This will make possible a match between the F-15E and both the F110 and the P&W F100 engine variants.

Over the years, the Air Force, as in the case of the XP-80, has continued to push for ever-greater thrust in new fighter engines in order to give successive generations of fighters all the more performance.

For example, the Air Force wanted the F-15 to perform far better than the F-4 in the air-superiority role. The GE J79 engine in the F-4 had a thrust-to-weight ratio of roughly 4 to 1. The P&W F100 engine destined for the F-15 was designed for an 8 to 1 thrust-to-weight ratio.

This caused problems. The F100 had all the pizzazz the Air Force wanted, but it consequently proved to be much less durable and reliable than desired.

So the Air Force and P&W began working greater durability into the F100 engine, and the Air Force put durability and reliability on a par with performance in its requirements for subsequent new fighter powerplants.

Until recently, there was no way of getting around a simple truth with respect to high-performance fighter engines: the hotter they ran, the less durable they were. This meant that their performance had to be traded off against their durability, or vice versa.

Now, however, the Air Force and its engine manufacturers are demonstrating that the time-honored tradeoff between the performance and the durability/reliability of fighter engines may no longer be necessary. New technologies now make it possible to build lighter-weight engines with far fewer rotating stages that are tough enough to withstand the higher temperatures and pressures needed to generate greater thrust.

Upgrade and Development Programs

Those technologies have been brought along in a synergistic succession of fighter engine upgrade and development programs.

The first of them was the F100 engine Component Improvement Program (CIP). It introduced new features in the F100 engine that today make the F100 five times more durable than it was when it first flew.

Other key endeavors of more recent origin are the Alternate Fighter Engine (AFE) program that got under way in the early 1980s, the follow-on Increased Performance Engines (IPE) program begun a year ago to get more thrust out of the engines that emerged from the AFE program, and the Joint Advanced Fighter Engine (JAFE) program to develop highly advanced next-generation engines for USAF's Advanced Tactical Fighter (ATF).

The AFE program is a joint Air Force-Navy effort that was instituted, as the Air Force put it, "to encourage competition [between P&W and GE] and to build more durable engines."

The program is managed by Air Force Systems Command's Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio. From it came the F110-GE-100 engine and the F100-PW-220 engine.

Because of the fierce competition it fostered between the two engine contractors for shares of the lucrative USAF-Navy fighter engine markets, the AFE program has also been described as "The Great Engine War."

"Round one of that war went so well that we're still reaping the benefits," says an Air Force official. "Both engines are great. They do exactly what they're supposed to do. The [companies'] warranties guarantee it."

In February 1984, the Air Force split its fighter engine business between GE and P&W. It contracted with GE for 126 engines for F-16 fighters and with P&W for forty-one engines for F-15 fighters.

Those engines will be installed in production aircraft this year.

Last January, the Air Force reapportioned its annual fighter engine contracts, awarding GE a contract for 184 engines and P&W a contract for 159 engines. All the GE engines and forty-five of the P&W engines will be installed in F-16s. The remaining 114 P&W engines will be installed in F-15s.

Another reapportionment of engine contracts is expected this month. USAF reckons that, over a twenty-year life cycle, the competition between the engine manufacturers will save from $3 billion to $4 billion and will greatly strengthen the US fighter engine industrial base. USAF plans to reapportion its fighter engine contracts each year until production of both engines runs out.

Meanwhile, the IPE program will have matured. The engines being developed in that program will be higher-thrust versions of those developed in the AFE program—fifteen to twenty percent more thrust, in fact, and at no sacrifice of durability and reliability.

F-15 fighter gets an engine change in Sudan. USAF deployed F-15s, KC-10s, and AWACS aircraft there in 1983 after Libya invaded neighboring Chad. Sustaining such a far-flung deployment is heavily dependent on aircraft engines' reliability and performance. With new technologies, USAF is showing that reliability and performance need not be antithetical in fighter aircraft powerplants.

That is a tall order, but USAF is confident it can be done. The Air Force spelled it out for Congress last year as follows:

"The goal of the IPE program is to produce higher-thrust engines while maintaining at least the current AFE levels of durability, operability, reliability, maintainability, and life-cycle cost. Both contractors will draw on their latest demonstrated component technologies to achieve higher thrust, including such improvements as more efficient compressors, higher temperature combustors and turbines, and state-of-the-art digital engine controls."

IPE engines are expected to be backed by warranties comparable to those of the AFE program engines, and they, too, will compete for annual Air Force production contracts.

No Compromises

Fighter engines that are capable of running very hot, yet very reliably, are an absolute must for USAF. Given the threat, USAF cannot afford to compromise on either their performance or their reliability.

Gen. Lawrence Skantze, Commander of Air Force Systems Command, put this into perspective last year at an Aerospace Education Foundation Roundtable.

"In the evolution of maintaining an adequate deterrence, we as a nation and we as an Air Force have to face up to the fact that it is a continual contest," said General Skantze. "As we evolved with the F-15 and the F-16 force through the mid-1970s, we began to recognize, for example, that the Soviet Air Forces in the fighter category were moving from primarily a defensive, protect-the-homeland capability to more and more of a clearly definable offensive force able to project their power across the FEBA and into enemy territory. That's become more apparent as we understand more about the Su-27, the MiG-23 and its variants, and the later aircraft that are coming along."

Dr. Wayne A. Schroeder of the Senate Appropriations Subcommittee on Defense told Roundtable participants that one way to answer that threat was to increase the thrust of next-generation engines.

Thrust should be increased to the range of 29,000 to 30,000 pounds, he said. "I believe we need it because our [fighter] aircraft are getting heavier. Failure to develop increased-thrust versions could result in declining air-to-air capabilities, thrust-to-weight ratios, and excess power available for maneuvers."

The US will need "as many high-performance aircraft as we can get" against two-engine supersonic Soviet aircraft, Dr. Schroeder said.

If all goes according to schedule, the higher-thrust, improved-performance engines will be ready to test by 1989. Once again, the entries will be from General Electric and Pratt & Whitney. "Meeting the thrust level shouldn't be a problem for either company," said one Air Force officer. "The two contractors are meeting our needs very well and are keeping the cost down."

In the meantime, the AFE contestants are well into the flight-test phase. The F100-PW-220 first flew in an F-15 on April 10 last year. The preproduction engine completed

eight test flights at Edwards AFB, Calif., then went for cold-weather tests in Florida at Eglin AFB's environmental simulation chamber. The Eglin tests involved temperatures as low as minus forty degrees Fahrenheit and validated cold-starting requirements under such conditions as ice formation on engine inlets. The F100-PW-220 has also been tested in fifteen flights on an F-16 at the Flight Test Center at Edwards AFB.

Technical data on the F100-PW-220 has undergone verification checks by maintenance personnel at both Eglin and at Nellis AFB, Nev. According to Capt. Len Cwiklik, engine integration manager, workers have been impressed with the engine's built-in troubleshooting capability. Personnel are able to isolate faulty components in half the time required on the current engine; no trim runs have been required after component replacement.

Engine trim refers to fuel control adjustment. Powerplants are sometimes retrimmed in order to compensate for thrust deterioration caused by, among other things, foreign deposits and material erosion. As an engine accumulates operating time, these deposits and erosion can disrupt the flow of gas and air. Elimination of the engine trim requirement on both AFE entries contributes to maintenance man-hour reduction, fuel cost savings, and increased engine flight hours. There are other contributing factors as well, including improved materials, high-pressure turbine cooling, and new combustor designs.

Categories of Benefits

Differences between the Alternate Fighter Engines are minimal in terms of performance. Their benefits are comparable and can be summed up in four categories, as follows.

- *Operability/Reliability/Safety.* There are no throttle restrictions. Stalls, stagnations, and afterburner blowouts are essentially eliminated. The engine responds rapidly to throttle changes. Engines can jump from idle to maximum afterburner in four seconds and demonstrate improved speed control in close formation. There are also air-start improvements. The engines have a large envelope, simple procedures, and a high first-attempt success rate.
- *Readiness/Durability/Maintainability.* The engines have a longer life expectancy, and the engine trim requirement has been eliminated. They also feature self-diagnosis and fault reporting.
- *Life-Cycle Cost.* Maintenance man-hours, support equipment and spares requirements, and fuel for maintenance have all been reduced.
- *Performance.* The engines are expected to provide high thrust over service life without detuning.

Meanwhile, the F100-PW-100 engine now powering the F-15 has been used to evaluate a new system: the Digital Electronic Engine Control (DEEC).

During qualification testing, the DEEC saw more than seventy flights in an F-16. Last summer, forty-one DEEC units were sent to Nellis AFB for installation in F100 engines. Thirty-four of those specially configured engines were installed in seventeen twin-engine F-15s belonging to the 57th Fighter Weapons Wing. The others were set aside as spares. By the end of October, the Eagle Aircraft Maintenance Unit at Nellis had put the DEEC engines through more than 1,850 flight hours.

The DEEC replaces standard hydromechanical controls. According to ASD's Captain Cwiklik, the electronic controls have demonstrated several advantages. These include quicker engine acceleration, unrestricted throttle movement throughout the flight envelope, continuous trim monitored thirty times per second, and a drastically reduced stall/stagnation rate.

"This evaluation will be valuable," said Captain Cwiklik, "since it will allow pilots and maintenance people to gain very valuable experience with the characteristics of the new system long before it becomes part of the Air Force inventory."

The new controls will be standard equipment on the F100-PW-220 engines. Those engines are scheduled to be installed on F-15C/D aircraft beginning next summer.

ASD compares the early test runs of the DEEC system to trying out a new electronic fuel control in a new car.

"The service evaluation has proceeded smoothly and has provided a great deal of data concerning the engine's operation," Captain Cwiklik said.

Engines for the ATF

By the time the engines from the IPE program are in operational service, the Joint Advanced Fighter Engine (JAFE) program's engines should be ready for the Advanced Tactical Fighter.

Much of the information on those engines is classified. Their early development is on schedule, and the JAFE technology demonstrator engines will be running by 1987. The flyable engines for the ATF will evolve from the ground demonstrators.

Later this year, ASD will winnow the seven contractors now competing for ATF development contracts. The three or four contractors chosen for ATF concept development will then be in position to give the engine developers specific details on the ATF's prospective configuration and other parameters.

ASD and the engine companies already have a good idea of the ATF's size and weight. All they will need to clinch their development work will be the final, single ATF design to be selected by ASD in 1989.

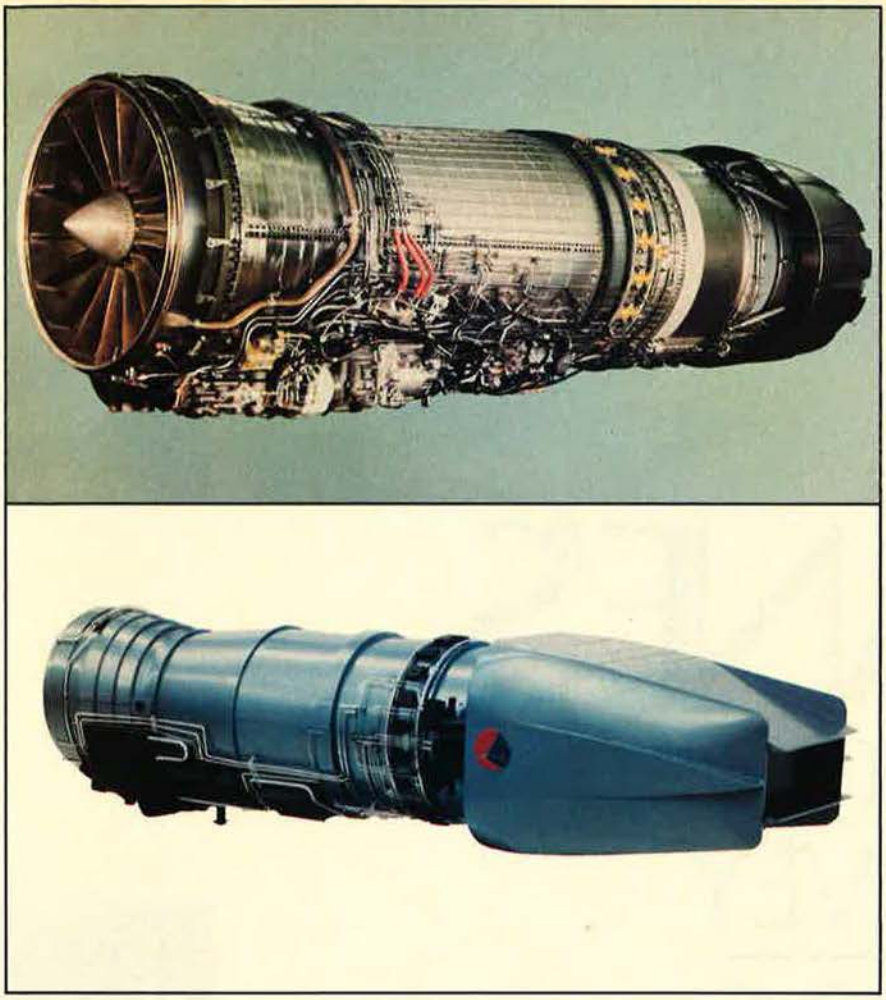
JAFE demonstrator engine contracts were awarded in 1983 to P&W for its PW5000 engine and to GE for its GE37 engine.

Initial tests of those demonstrator engines, which are now at least eighty percent complete, are scheduled to begin in August. The first production models are scheduled for completion in early 1993.

The winner of the JAFE engine competition will possibly be chosen as early as 1988. USAF may designate the losing company as second-source producer of the engine and may split the business between the companies, just as it now does with the engines from the AFE program.

ATF specifications call for sustained supersonic cruise in non-afterburning power, reverse and vectored thrust for short takeoffs and landings, and for enhanced maneuverability.

The PW5000 engine entry in the JAFE competition will probably feature new aerodynamics, the capability to withstand higher temper-



TOP: General Electric's F110-GE-100 engine. ABOVE: Pratt & Whitney's conceptual rendering of its PW5000 engine. The GE engine emerged from the USAF-Navy Alternate Fighter Engine (AFE) program to enter production for both services' existing fighters. The PW5000 is Pratt & Whitney's entry in the Joint Advanced Fighter Engine (JAFE) program for the Advanced Tactical Fighter.

atures, many more revolutions per minute, and new materials.

P&W describes its entry as a low-bypass-ratio augmented turbofan employing advanced materials. Advanced single-crystal blade designs will be used along with thermal barrier coatings for increased high-temperature performance and for increased service life as well.

The P&W engine will also feature a "floatwall" combustor, using advanced structural and cooling techniques for enhanced durability.

Cooling the Combustors

Combustors are cooled by air passing through their chambers. A relatively small portion of the air entering combustors actually mixes with the engine fuel. Most of it bypasses the fuel nozzles and flows along to cool the burner surfaces and to mix with burned gas before entering the turbines.

This technique cools the combustors well enough under most engine temperature conditions, such as those during takeoff and cruising. But it can be sorely tested by the rapid throttle movements that fighter pilots must make and by the sharp temperature spikes induced while accelerating and decelerating in combat conditions. Too many such movements over too long a time can cause "thermal fatigue" in fighter engines. To offset this, the engines in the JAFE program feature "shingle liner" combustors—inner leaves that "float," the better to dissipate heat and thus to alleviate thermal fatigue.

The floating-leaves concept was developed in ASD's Advanced Technology Engine Gas Generator program and was proved out in its Joint Technology Demonstrator Engine program.

Although the shingle liners are heavier and more expensive, USAF engine experts believe their payoff in terms of reliability and durability will be worth the price.

Reduced compressor and turbine stages are also on the JAFE agenda. Among the newer blade properties will be reduced crack propagation rates, greater damage tolerance, and improved high-temperature capabilities.

General Electric is working on a dual-cycle scheme combining the best operating characteristics of both subsonic and supersonic powerplants. The GE37 may feature composites in nonrotating structural parts.

Both the P&W and GE engines are also expected to feature ceramic seals and advanced powder metal alloys in their turbine disks. Both are also expected to have full-authority digital controls on their demonstrator models.

The two engines will probably have fifty percent fewer parts than current fighter engines. The contractors plan to reduce the stages through higher rotational speeds and increased aerodynamic loading in the fans and compressor phases. More effective blade aerofoils should also help make this possible.

The JAFE's mean time between failure is expected to be about 400 hours, far exceeding that of engines now in use. In addition, front-line maintenance equipment will be greatly reduced.

Chief among the performance characteristics will be rapid vector changes, reverse thrust, smokelessness, and the ability to go supersonic without reheat. Engine inlets and exhaust will be designed to satisfy the minimum heat/radar requirement of the ATF.

Before the winner is selected, the entries will endure about 850 hours of core and engine tests, plus about 250 hours of accelerated mission tests featuring short-cycle mission profiles.

Compared to engines in current fighters, the JAFE program engines are expected to provide about a fifty percent improvement in reliability. That reliability goal, which would be a monumental improvement, was written into the JAFE program at its inception.

The Air Force is determined to meet it. ■

It's wide of the mark to suggest that Soviet designers do little except copy the West—but it is true that they are assisted tremendously by technology transfers.

JANE'S AEROSPACE SURVEY 1986

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

THE 1985–86 edition of *Jane's All the World's Aircraft*, published at the beginning of last month, contains photographs of the Sukhoi Su-27 counterair fighter known to NATO as Flanker. This is the Soviet counterpart of the USAF McDonnell Douglas F-15. It would be easy to make a quick study of its twin-fin, twin-engine layout and feel that "copy" would be a better word than "counterpart," but this would be a great mistake.

Configurations of two aircraft designed to do the same job often tend to be similar. Antonov's big An-124 Condor resembles the Lockheed C-5 Galaxy. The now-abandoned Tupolev Tu-144 supersonic airliner had much in common with the Anglo-French Concorde. In each case, the differences are as significant as the similarities.

What *is* important is that the Su-27 bears a marked relationship to the Mikoyan design bureau's new MiG-29 Fulcrum. Note the twin fins and twin underwing engine ducts with wedge air intakes, the way the cockpit is set high above long wing-root strakes, and the sharply down-swept rear fuselage, giving the pilot a superb all-round view. Also shared by the new fighters is a basic armament of six AA-10 medium-range radar-homing air-to-air missiles. Such features suggest that the new generation of Soviet designers may work together, and exchange ideas, much more than do financially motivated private industry engineers in the West.

It can be assumed that Soviet television was not permitted to screen film of a current Su-27 and that the photographs in *Jane's* must therefore depict a prototype or early production model as much as seven or eight years old. The only, even less informative picture seen earlier in the West, published in the US *Congressional Record* and clearly taken from overhead by satellite, suggested that production Flankers have missile rails mounted on squared wingtips and fins moved outboard from the top of the engine trunks to a narrow shelf on each side.

In this refined form, the Su-27 is estimated to span about 47 ft 7 in, with an overall length of 69 ft, takeoff weight of 44,000–63,000 lb, maximum speed of Mach 2.35 at height, Mach 1.1 at sea level, and combat radius of 930 miles. Its turbojets are each estimated to give about 30,000 lb st with afterburning. Up to 13,225 lb of bombs are believed to form one of the alternative weapon loadings for a secondary attack role.

Flanker is thought to have achieved initial operational capability last year. This places it close behind the MiG-29, of which about thirty examples were operational by the spring of 1985, according to DoD, with export deliveries to India due to have started by now.

The Sukhoi Su-27 Flanker counterair fighter aircraft is comparable to USAF's F-15 Eagle.

In the F-15 Class

The Su-27 is in the class of USAF's F-15; the MiG-29 is smaller and might be compared with the General Dynamics F-16 Fighting Falcon. Wingspan is estimated at 33 ft 7½ in, length 50 ft 10 in, max takeoff weight 36,375 lb, speed Mach 2.2 at height, Mach 1.06 at sea level, and combat radius 500 miles. Two 18,300 lb st afterburning Tumansky R-33D turbofans give the MiG a thrust-to-weight ratio better than even, and it would be reasonable to expect both Fulcrum and Flanker to set new Soviet standards in terms of maneuverability and turning rates.

They are, of course, very different in concept from their immediate service predecessor, the MiG-31 Foxhound, of which more than seventy were operational last spring. Derived from the MiG-25 Foxbat, this big two-seater lacks their maneuverability, but the fact that its basic configuration dates back to the early 1960s does not make it by any means a dead duck in the scenario of modern air combat.

Reports of a talk given to the AFA national military electronics symposium in April 1985 by Donald Latham, Assistant Secretary of Defense for Command Control Communications and Intelligence, suggest that "the USSR is now ahead of the US in the key areas of infrared sensors, medium-range air-to-air missiles, and the application of digital technology" and that the MiG-31 is superior to existing US fighters, with "better avionics, a better C^3 system to work into, and a better air-to-air missile." He also said that it is "faster [and] has greater combat range, and [the Soviets] are producing it like gangbusters."

If that is truly DoD's assessment of the MiG-31, there could be no better reason for USAF to push even harder for its next-generation advanced tactical fighter (ATF) *and* to make certain that it will do everything needed in a fighter of the 1990s.

Designed in the USA?

At this stage, it should be made clear that whereas suggestions that Soviet designers do little but copy Western designs are dangerously wide of the mark, they *are* assisted tremendously by US technology transfers to less than reliable friends and by the shady activities that the press describes as "spy scandals." Three paragraphs extracted from a September 1985 US government paper entitled *Soviet Acquisition of Militarily Significant Western Technology: An Update* fill in some of the detail. Focusing on the fire-control radars of the Su-27 and MiG-29, they state:

"The Soviets estimated that by using documentation on the US F-18 fighter, their aviation and radar industries saved some five years of development time and 35,000,000 roubles (the 1980 dollar cost of equivalent research activity would be $55 million) in project manpower and other developmental costs. The manpower portion of these savings probably represents more than a thousand man-years of scientific research effort and one of the most successful individual exploitations ever of Western technology.

"The documentation on the F-18 fire-control radar served as the technical basis for new look-down/shoot-down engagement radars for the latest generation of Soviet fighters. US methods of component design, fast-Fourier-transform algorithms, terrain-mapping functions, and real-time resolution enhancement techniques were cited as key elements incorporated into the Soviet counterpart.

"Moreover, F-18 and F-14 documentation served as the impetus for two long-term research projects to design from scratch a new radar-guided air-to-air missile system. The documentation also was instrumental in formulating concrete specifications to develop new Soviet airborne radar countermeasures equipment against the F-18 and F-14."

The same US paper lists "several hundred examples of Soviet military equipment and weapons benefiting from Western technology and products." Added to the natural engineering talent of Soviet designers, this loads the dice heavily against the West and provides a powerful argument against satisfaction with money-saving second-best.

Condor Up Close

What has been written so far about the MiG-29 and Su-27 must be regarded as provisional. Facts and figures will be refined and detailed as more reliable information becomes available, and there is still much to learn. In contrast, the 1985 Paris Air Show made it possible to study in detail two of the Soviet Union's major new military aircraft, as readers of the August 1985 and October 1985 *Jane's* Supplements in this magazine will know.

The Kamov Ka-32 Helix exhibited at Le Bourget was, of course, stripped to represent the exportable civilian model of this twin-turbine helicopter. But it had started life as a shipboard antisubmarine airframe, as was evident from still-visible features, such as IFF and radar-warning and ESM antennas. The big Antonov An-124 Condor was one of three examples flown by that time and was likewise in civilian guise. Nobody would have tried to conceal its ability to carry main battle tanks and mobile missile systems had one been discourteous enough to press the point. In the event, one respected the courtesy with which bureau chief designers Mikheyev of Kamov and Balabuev of Antonov devoted several hours to personal briefings for *Jane's*.

Such occasions reflect well the rapport and trust that exist between aircraft engineers of all nations and that contribute so much to the completeness and accuracy of each edition of *Jane's*. Even problems of language disappear in the company of such good friends as Sergei Sikorsky, whose willingness to act as interpreter and intermediary alone makes possible interviews of

The world's largest aircraft, the Antonov An-124 Condor, lifted a record-breaking 188 tons during a flight in the summer of 1985. (Photo by A. T. Hogg)

immense value to both *Jane's* and AIR FORCE Magazine.

Soviet Heavy Lifters

On just one occasion in June 1985, a Soviet helicopter engineer replied unexpectedly in English after the writer's apology for speaking no Russian. Observing the small gold cross on my lapel, he said with a smile, "We can blame our inability to understand each other's language on the Tower of Babel in your Bible. And, of course, the Tower could have been completed with one of our helicopters to lift the pieces." Interesting.

Both the Ka-32 and the An-124 shown in Paris have, in fact, demonstrated their heavy lift capabilities by setting payload-to-height records. The twenty-one records now held by the Antonov are especially noteworthy. It raised 377,473 lb to a height of 35,269 ft in the summer of 1985, which exceeded its own nominal max payload by more than twenty-three tons and bettered by fifty-three percent the record set by a Lockheed C-5A Galaxy in December 1984.

All of this indicates that the technology gap that once existed between the capabilities of the aircraft industries of East and West is no longer wide enough to offset a Soviet numerical superiority in operational aircraft of 2½ to 1. Soviet transport aircraft designers can now, for the first time, utilize big turbofans like the Lotarev D-18T, which is rated at 51,650 lb st and offers a respectable specific fuel consumption (SFC) of 0.36 lb/h/lb st at that takeoff rating. Comparable SFC for the US 51,000 lb st General Electric CF6-50C is 0.39 lb/h/lb st, but there are many unknowns, including the reliability and life of the D-18T.

Nonetheless, there are few categories of military aviation in which the West can still claim clear leadership. Those who decide military budgets would be well advised not only to ensure that standards are maintained but that every effort is made to remedy obvious shortcomings for so long as world peace depends on a balance of power.

NATO's Slow Progress

Last year's Aerospace Survey drew attention to three major areas of weakness in NATO's current and planned inventory: the failure to build on unrivaled expertise in short takeoff/vertical landing (STOVL) capability, the lack of a survivable airborne early warning and control (AEW&C) system, and an unwillingness to match Soviet advances in the military helicopter inventory. Sadly, there have been only limited improvements during 1985.

With production of the McDonnell Douglas/British Aerospace AV-8B Harrier II combat aircraft building up for the US Marine Corps and Royal Air Force, the smaller pioneer forces of first-generation Harriers will soon be supplemented by worthwhile numbers of STOVL "bomb trucks." A future AV-8B mid-life improvement program to fit high-performance wings, added to the fifteen percent additional thrust that Rolls-Royce is already getting from the aircraft's Pegasus engine on the test bench, could quieten those who continue to criticize the payload/range figures without appreciating that they are adequate in an aircraft that can go where the ground forces go.

None of the much-heralded alternatives has yet fulfilled its promise, with the possible exception of the more limited Soviet Yak-38 Forger. USAF and Lockheed are evaluating a $1.3 million twenty-nine-month study of STOL techniques, including one system that releases a charge of high-pressure gas into the landing gear struts, causing the aircraft to jump upward. This leaves unsolved a few little problems, such as how to jump down again between craters when returning from a sortie. But the capability is so important that one wishes them well.

Whatever one may think of such crude techniques, there is no doubt

Lockheed is adapting its venerable C-130 Hercules to compete for the airborne early warning and control mission.

that Lockheed continues to set the pace in exciting, practical sophistication. A decade after this company's SR-71A, flown by USAF crews, set three of the seven absolute world records for airplanes, there is still no other aircraft that can approach the SR-71A's performance. Soon, we expect to see first photographs of Lockheed's Stealth (low observables) reconnaissance fighter that may or may not be designated F-19. The latest *Jane's* contains only conjectural drawings of such an aircraft. It also offers a small photograph of a previously unknown variant of the high-flying TR-1 reconnaissance aircraft with what appears to be an AEW&C radome pylon mounted above the fuselage. This photograph, like all others in the book, was taken quite openly, or it would not have been accepted.

It reflects the effort that Lockheed is devoting to AEW&C. With its early warning adaptations of the P-3 Orion and C-130 Hercules, it has made effective AEW radar cover available to nations that could never afford more specialized aircraft.

For the future, its Solar HAPP long-endurance solar-powered RPV holds out even greater promise through vastly improved survivability. The Solar HAPP nonmilitary demonstrator is not expected to fly before 1993, but perhaps some of this long waiting period can be spent in developing a small lightweight radar capable of functioning throughout the year-long missions that a vehicle of this kind will make possible. At the present time, the mean time between failure (MTBF) of much military avionics is so appalling that the last 364 days of such a mission by an AEW Solar HAPP would probably be wasted in frustrating silence.

Into the Gap

In the military helicopter field, the West has nothing at present in the class of the mighty Mil Mi-26 Halo and air-to-air combat Kamov Hokum. Nor does the Mi-26 represent the limit of Soviet thinking in terms of heavy lift. Conversation with Mil and Kamov engineers at the 1985 Paris Air Show revealed no hesitation in progressing to an Mi-12 Homer type of twin-rotor development for the Mi-26, should the demand arise for vertical lifting of loads heavier than Halo's twenty-two tons.

In this sector, at last, a start is being made to fill the glaring gaps in the inventory of the West. Boeing is to complete its prototype XCH-62 heavy-lift helicopter, on which work was suspended under 1975 cost-cutting measures. Currently, this is a one-vehicle research program limited to 115 hours of flight testing, but having proved the capability of such an aircraft to lift a twenty-two-and-a-half-ton payload, it will be surprising if interest evaporates at the end of the initial test period.

Similarly, the US Army's LHX program for a family of light scout/attack/utility helicopters to replace its current UH-1, AH-1, OH-6A, and OH-58 inventory might produce an effective counterair type. Following selection of the Bell/Boeing V-22 Osprey tilt-rotor aircraft as prime candidate to meet the Joint Services Vertical Lift Aircraft (JVX) requirement, it was a surprise to learn that tilt-rotor designs had been eliminated from consideration as LHX contenders in favor of a pure helicopter. This may, however, bring us back to the vital need to ensure Stealth, or low observables, characteristics. Despite the addition of infrared suppressors and chaff/infrared decoy dispensers on the latest US and Soviet combat helicopters, they remain difficult to conceal. Tilt rotors might add to the problem, as becomes apparent when one recognizes the importance of suppressing the signature of the much smaller fan at the front of a fighter or bomber engine.

Boeing Vertol's prototype XCH-62 helicopter could point the way to heavy-lift rotary-wing aircraft for the West.

SDI vs. Conventional Airpower

Given unlimited funding, the West has such expertise at its disposal that it would have no difficulty in maintaining the balance of conventional airpower that is essential to prevent major wars and deal with

lesser confrontations. At the present time, it is mesmerized by panaceas. President Reagan believes, for example, that successful development of SDI weapons would remove all fear of strategic nuclear attack and perhaps lead to a new accord between East and West through shared technology. If this really happened, it would answer everyone's prayers, but is it realistic?

Space physicist Dr. Robert Jastrow is reported to have said that for $60 billion America might get a system ninety percent effective against Soviet ballistic missile attack. This sounds encouraging until one considers the effect of the remaining ten percent of the Soviet Union's 8,500 strategic nuclear warheads penetrating the SDI umbrella to fall on US cities and adjacent targets. Nor would an improvement to 100 percent interception of incoming warheads solve all defensive problems. The nuclear deterrent, with all the dangers inherent in its needless proliferation, has kept the world free of major war for forty years. Its complete neutralization might bring back the old cycle of 1914–18/1939–45 type conventional wars, at which the steamroller forces of the East excel. In any case, nuclear weapons cannot be uninvented.

By abandoning SDI, or restricting it to a research effort, the US would save sufficient money to ensure an adequacy of conventional forces. It already has a superb basis on which to build. The B-1B, even in its deliberately degraded form, still represents the pinnacle of achievement in manned bomber design. Armed with a huge clutch of air-to-air missiles, it could also deal with the threat of long-range interceptors picking off one by one, over the mid-Atlantic, the transport aircraft so vital to the buildup and resupply of NATO forces in Europe at a time of crisis.

At the conventional fighter level, whatever the capabilities of the latest MiGs and Sukhois, there are few fighter pilots who would not put USAF's F-15 and the RAF's new Tornado F.2 at the top of their list of desirable mounts. Nobody doubts the quality of Western airpower; its weaknesses stem from a governmental emphasis on affordability that prejudices quantity and urgency. The best fighters are only good enough when there are sufficient numbers of them on the day they have to go into action. The same is true of such transports as the much-needed C-17, all-weather combat rescue helicopters, and modern, efficient trainers.

Airframes are only the starting point. This becomes clear when one considers the British Nimrod AEW.3, which is supposed to be the RAF's new AEW&C aircraft, complementing the USAF/NATO E-3 Sentry and plugging a dangerous gap in Europe's defensive wall. Inadequacies in its radar have already delayed the aircraft's operational availability by years; there is some doubt that it will ever perform its full planned functions.

Surely there is sufficient avionics expertise in the West to correct speedily shortcomings in such key equipment as the Nimrod's radar, if the exigencies of NATO effectiveness were put before commercial profit and national pride. Study of the MiG-29 Fulcrum and the Su-27 Flanker suggests that Soviet designers are comparing notes increasingly to ensure optimum results. Nor should we overlook the major, if unwitting, contribution made by the West to the look-down/shoot-down radars of these formidable fighters. Even the best Western engineers could use a little similar help at times.

USAF's F-15 Eagle remains the world's premier air-superiority fighter. (USAF photo by TSgt. Bob Williams)

Khrushchev's Warning

It was the late Nikita Khrushchev who said, some thirty years ago, that there was no need for the Soviet Union to fight, as it would bury the West economically. He played the buffoon with such obvious relish and regularity that his observations were seldom taken seriously, but this particular comment should never be forgotten.

At one extreme it should make the US think again about whether

the unpredictable cost of SDI will represent money well spent when, for example, the key factor in the development of USAF's planned advanced tactical fighter (ATF) for the 1990s is said to be affordability. Similarly, the UK government should think again about the £11 billion, at least, that it intends to spend on Trident missile submarines when greater concentration on essentials might have kept dry the feet of soldiers who advanced over the hills of the Falkland Islands a few years ago. At a more technological level, wiser budgeting might have ensured that the Royal Navy did not find itself with three light aircraft carriers but only two carrier air groups, each with just five Sea Harriers and nine Sea King helicopters. One of the ships must, it seems, go to sea without any aircraft, either fixed-wing or rotating-wing, to fly from its deck.

The economic squeeze extends throughout NATO. In particular, high fuel costs have severely restricted the flying of some West European air forces in recent years. During 1985, *Jane's Defence Weekly* reported that the Royal Netherlands Air Force was finding that many of its pilots lacked experience: "This does not mean they are not well trained, or are not good pilots, but may result from the restriction to only 180 hours' flying a year."

When the story appeared, the RNethAF had twenty-five fewer pilots than it needed, suggesting that one of its F-16 squadrons might have to be grounded in 1986. The Royal Norwegian Air Force had only forty-five pilots for its fleet of sixty-eight F-16s in August 1985, according to its Chief of Staff. This included fully and partially operational pilots and a number of instructors from No. 332 Operational Conversion Unit. As in the Netherlands, it seems that Norway's airlines are also short of pilots, though they offer better pay and conditions than do the air forces.

Readers of AIR FORCE Magazine will need no reminder that the original program to provide USAF with sixty-nine Sikorsky HH-60D Night Hawk all-weather combat rescue helicopters and eighty-six reduced-capability HH-60Es was watered down to ninety HH-60As without all-weather capability and is now threatened with total extinction.

In a similar fashion, the intention to procure 650 Fairchild T-46A primary jet trainers to replace aging T-37s is in the congressional balance. At every stage of competitive tendering, progression to prototype development, and eventual production, cost exerts as much influence as technological and operational quality.

The disease has now become infectious. Despite having a vastly improved, supersonic, Harrier-type V/STOL aircraft in mockup form in BAe's Kingston factory, the Royal Air Force must be content with the multinational European Fighter Aircraft (EFA), selected on the basis of shared minimal cost and maximum export potential rather than what the RAF really needs. Sometimes, as in the case of Concorde and Tornado, international collaboration produces a winner. More often it generates the kind of combat aircraft able to carry only a single bomb or missile by the time its external load limit has been absorbed by pods of target-seeking/designating avionics, active and passive countermeasures, and a fuel tank or two.

France has been criticized for its alternating hot and cold attitude toward the EFA and for committing Europe to two competing programs by continuing to finance its own Dassault-Breguet Rafale fighter. If, in so doing, it believes it will give its air force precisely what it needs, when it wants it, who will say that France is wrong? It abandoned STOVL pretensions long ago, and the past thirty years have demonstrated repeatedly that what the Armée de l'Air flies is attractive to export customers worldwide, even if it might have limitations in a major war.

Germany's MBB has proposed this design for the fitful European Fighter Aircraft program.

Legal Killings

The current uncertainties in mili-

tary spending have come at the worst possible time for the aerospace industries of the West. Commercial business was already suffering from the recession. Suddenly, the smaller US companies in particular began to feel the effects of a new threat to their financial viability.

American readers of AIR FORCE Magazine should be familiar with the litigation procedures that extract large sums in damages from any company or person who appears vulnerable. Such legal activity has, so far, had little effect in Europe. It comes as something of a shock to an Englishman, therefore, when he reads in the Experimental Aircraft Association's magazine *Sport Aviation* how "Beechcraft recently lost a $2.5 million suit arising from the crash of a 1958 Travel Air. The jury found that Beech had negligently designed and built the airplane in spite of the fact that FAA twice tested the airplane and found it in compliance with federal aviation regulations! Another manufacturer says product liability costs have made building small airplanes too expensive. Cessna attributes $17,000 of the price of a 152 to legal expenses."

Little wonder that the 152 no longer appears in Cessna's current product range in the 1985–86 *Jane's*. Nor do Cessna's 152 Aerobat, Cutlass, Cutlass RG, Turbo Skylane, Stationair 8, Turbo Stationair 8, 340, Ag Truck, Ag Husky, 421 Golden Eagle, and Citation I business jet—a total of twelve models. And this is only the thin end of a mighty wedge.

Britain's *Pilot* magazine quoted Bob Martin of Beech as saying that "liability costs rather than market forces had prompted Beech to shut down production lines for its two- and four-seat models and that in the future the Bonanza would be the company's smallest model." So, farewell to the Sierra 200, Sundowner, etc.

Pilot went on to quote David Dann from Lloyds of London, who warned that the gravity of the situation is impossible to overstate. "There is an ever-increasing tendency on the part of the jury to impose high awards purely on an emotional basis. . . . Fair compensation is no longer the standard." It is easy to understand why Cessna has agreed to be acquired by General Dynamics and why small US manufacturers are moving under the umbrella of great corporations with large bank accounts and clever lawyers.

It may be felt that the fate of such companies as Beech and Cessna is not important so long as the major manufacturers survive. But people who fly B-1Bs and F-15s learn to fly on Cessna T-37s. Navy Tomcat pilots begin on Beechcraft T-34Cs. There may not even be the same inflow of airminded youngsters in the future now that the organizers of flying meets must ask participants to provide immense third-party insurance cover to protect them from possible financial ruin after an accident. Anyone who agrees to demonstrate a light aircraft at a military air show in the UK must now insure adequately to provide Crown Indemnity of £2 million. In the US, the Experimental Aircraft Association had to pay an *additional* $150,000 in premiums for reduced insurance cover at the 1985 Oshkosh Fly-In.

The sad story concerns every aspect of flying. Manufacturers of homebuilt aircraft, including even Burt Rutan, are getting out of the business rather than risk claims from people who suffer actual or imagined injury after constructing aircraft from plans or kits. Experience has shown that the designer might be judged liable for sums running into millions of dollars even if he knows that the amateur constructor has not followed the instructions or has introduced "improvements" of his own.

Mr. Bumble, in Charles Dickens's *Oliver Twist,* uttered the sad judgment that "the law is a ass, a idiot." It can only continue to incur disrespect if excessive liability claims are allowed to ruin individual businesses, entire industries, and, in this instance, the achievement and enjoyment of flying created during eighty years of our century.

USAF's proposed next-generation trainer aircraft, the Fairchild T-46A, now hangs in the congressional balance.

A Great Year

Despite the looming threat of Nikita Khrushchev's predicted economic burial and the worst-ever year for accidents to commercial airliners, aviation has a happier facet at the close of 1985. Early flight trials of Grumman's futuristic forward-sweptwing X-29A have gone well, as have those of the NASA/USAF mission-adaptive wing on a Boeing-modified F-111. Either of these concepts, or both, could make future combat aircraft smaller, lighter in weight, and less costly than current types, but more agile and efficient.

In November, Boeing announced the largest order for commercial aircraft in history when United Air Lines placed a $3.1 billion contract for 110 twin-jet 737-300s and up to six 747-200Bs. By the beginning of October, the 4,759 jetliners already delivered by Boeing had flown a total of nearly 60,000,000,000 miles and carried more passengers than the entire population of our planet.

Good Year in Europe

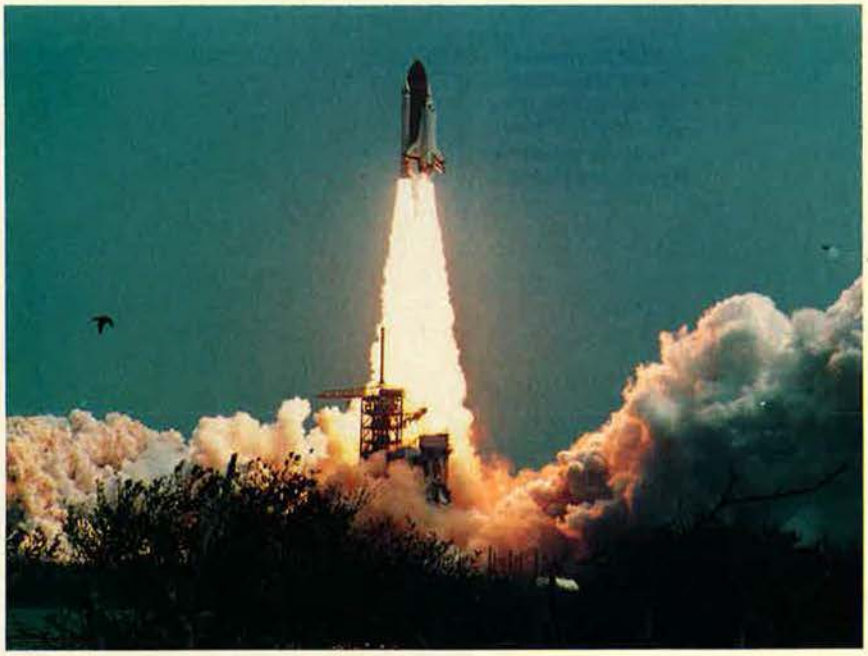
In Europe, Airbus Industrie has also had a good year, with 469 of its twin-turbofan A300/310/320s sold and 326 A300s and 310s delivered by October. Few people would have predicted such an impact on the air transport market by a European newcomer, and there could be no greater testimony to the money-making quality of Airbus products than to see them flying now in Pan Am livery.

It has, in fact, been quite a year for relative newcomers to our industry. Having already made substantial inroads into even the US domestic market with its Bandeirante and Brasilia commuterliners and having flown the first of its locally assembled AMX tactical combat aircraft built in partnership with Aeritalia and Aermacchi of Italy, EMBRAER of Brazil has sold Tucano trainers to the Royal Air Force, Egypt, and, indirectly, Iraq. ENAER, the new aircraft manufacturer in Chile, has initiated two-way trade with Spain by building CASA C-101 Aviojet attack/trainers under license and exporting its own Pillán piston-engine basic trainers in kit form to CASA for the Spanish Air Force.

In Indonesia, the firm of Nurtanio, under the dynamic Prof. Dr. Ing. Habibie, has even more ambitious plans. Already building and exporting transport aircraft and helicopters under partnership programs, it intends to meet national requirements for military combat aircraft by the end of the 1990s.

From a purely personal viewpoint, Thursday, April 25, 1985, will be remembered as something very special. It began with a three-hour, thirty-seven-minute crossing of the North Atlantic in Concorde G-BOAC, continued with a takeoff from Washington and acceleration to Mach 2.02 on the flight deck of the same aircraft, and ended with a casual hop in a Cessna 402C of Gull Air from Miami to West Palm Beach. The contrast between the flights was extreme in almost every respect but their sheer delight. At our hotel that evening, my wife wrote to the youngsters back home that it had been one of the great days of her life. There was another on the twenty-ninth, when we were able to witness the unforgettable sight and sound of the Space Shuttle *Challenger* beginning its Spacelab 3 mission from Kennedy Space Center.

Yes, it *was* a great year! ■



Space Shuttle* Challenger *lifts off from the pad at Kennedy Space Center in April 1985 to carry out its Spacelab 3 mission.

John W. R. Taylor has served more than twenty-five years as editor of the world-renowned Jane's All the World's Aircraft. *A Contributing Editor of* Air Force *Magazine with his bimonthly "Jane's Supplements," he also compiles or edits the galleries of aerospace weapons for both the USAF Almanac and Soviet Aerospace Almanac issues of this magazine. Mr. Taylor was trained as an architect and later worked as an aircraft designer under Hawker's legendary Sydney Camm. He has written more than 200 books and thousands of articles and is a Fellow of the Royal Aeronautical Society, the Royal Historical Society, and the Society of Licensed Aircraft Engineers and Technologists. He is also a newly named Member of the French National Academy of Air and Space.*

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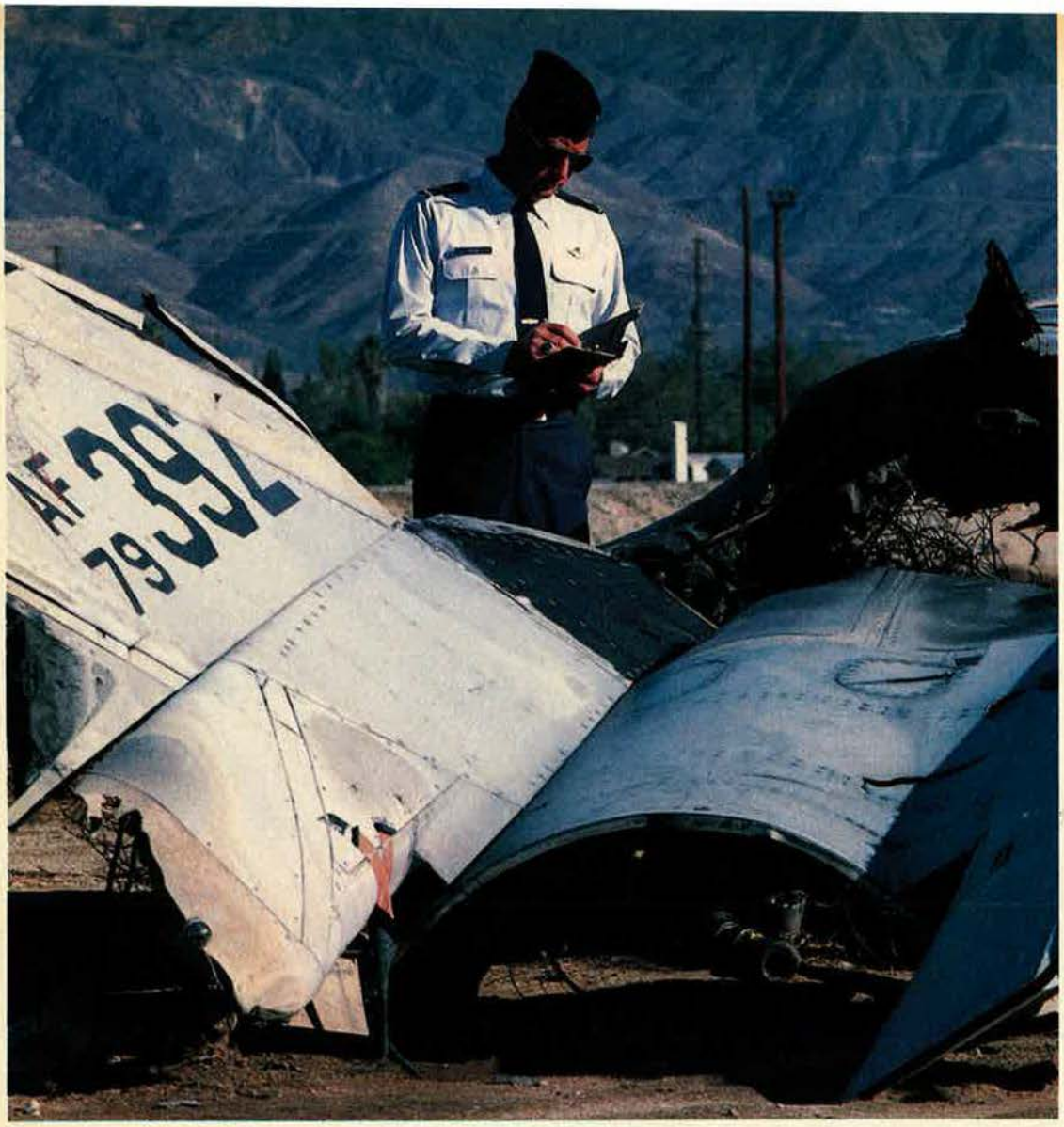


Maj. Michael J. Kaye of the Air Force Inspection and Safety Center at Norton AFB, Calif., practices mishap investigation procedures on an F-16 carcass at AFISC's Crash Lab. AFISC trains more than 1,300 safety people each year. (Photo by Bob King)

The Air Force is flying safer than it ever has before—partly it's the machines, but mostly it's an attitude.

USAF's Safer Skies

BY JEFFREY P. RHODES, STAFF EDITOR

BY ITS nature, flying is dangerous. In fact, the military was involved in a fatal accident before the Aeronautical Division of the Signal Corps paid for its first airplane. On an operational test flight of the Wright Military Flyer, Lt. Thomas Selfridge was killed when the plane, with Orville Wright at the controls, crashed at Fort Myer, Va., in 1908.

The Air Force's flying safety record has since improved dramatically. When the final figures are tallied, 1985 will likely show the lowest accident rate ever—approximately 1.6 Class A mishaps (accidents involving the loss of an aircraft, a fatality, or more than $500,000 worth of damage) per 100,000 flying hours—and the accident statistics date back sixty-four years.

What is more amazing than the rate reduction, however, is that the

Air Force has achieved this record while flying more technologically advanced aircraft for more hours under more demanding and realistic training conditions than in the past.

As some examples, the destroyed rate for F-15s (3.6) is half the rate of the F-4 at the same point in its career, and the rate for the F-16 (7.2) makes the Fighting Falcon the safest single-engine fighter the Air Force has ever flown.

"Safety is being built into new airplanes," said Col. Rolland W. Moore, Jr., Deputy Director of USAF's Directorate of Aerospace Safety at the Air Force Inspection and Safety Center (AFISC) located at Norton AFB, Calif. "Due to new technology, we know a lot more about new aircraft in the early stages of their life spans. Before, we didn't have the means to determine what an airplane could do, and we had to find out from experience."

"We have really improved safety at realistic training exercises like Red Flag," added Maj. Gary R. Morphew, the F-4 project officer at AFISC and a trained mishap investigator. "It was a case of walking before learning to run. When Red Flag started, accidents really piled up—almost to the point it would not be economically feasible to continue it. However, continued safety consciousness has allowed us to transition to a point where we are flying tougher missions with more planes in a denser environment and are losing less aircraft. Safety really pervades out there now."

Dropping Rates, Not Airplanes

Exactly how successful has the Air Force been in reducing mishaps? In 1922, the first year records were kept, the Army Air Service flew 65,000 hours, or about the same as one A-10 wing today. There were 330 major accidents in 1922. Using the present formula, the rate works out to 506 accidents per 100,000 hours. By far, 1922 was the worst rate year ever.

The worst year for numbers of accidents was 1943, when, at the height of World War II, more than 20,000 major accidents occurred. Flight hours peaked that year at 32,000,000, however, and the rate fell to sixty-four accidents per 100,000 hours. Statistics also show that by the end of 1943, 1,200 more aircraft and 1,100 more crewmen were lost because of mishaps than were lost in combat. Not coincidentally, Gen. H. H. "Hap" Arnold, Chief of the Army Air Forces, started the safety program that year.

The rate took a decided downturn in 1960, but that was mainly attributable to a change in accident reporting criteria. However, the rate continued to make a gradual decline. By 1978, the mishap rate was three per 100,000 hours, the rate that many observers felt "was the cost of doing business." However, the rate would drop still lower.

"The rate went from 2.9 [in 1979] to 2.3 [in 1982] and then in 1983 made a twenty-five percent drop downward to a then-record 1.7," said Colonel Moore. "We knew it was no fluke—the mishap pattern had been altered. One big reason for the change is that accident-prone aircraft, like the F-100, are out of the inventory. The main reason, though, is that the attitude is there. Commanders now equate safety with readiness."

That has not always been the case, though.

"It has been a process of maturation," said Maj. Michael J. Kaye, an F-15 pilot and project officer at the Center. "Safety as a professional aspect of flying is now ingrained. Pilots are beginning to see that a by-product of safety is efficiency. They're being allowed to fly the airplanes the best way they can, and they know they can do it safely."

Brig. Gen. Albert L. Pruden, Jr., the Director of Aerospace Safety, added, "Everybody knows and understands we don't have enough resources to indiscriminately waste them. Commanders and pilots realize that a crash due to mishap is a resource that is no longer available for use against an adversary. That, to me, has been the fundamental change in attitude."

Accidents and Their Causes

The most preventable accidents (and the ones easiest to determine causes for) are those that the Air Force calls "logistics-related," or having to do with equipment. The rate for these accidents has been brought way down in the past few years and is currently in the 0.5 to 0.6 range. The reduction by nearly fifty percent in five years reflects the phasing out of older aircraft, modifications to the existing inventory, increased management effectiveness—especially in the areas of maintenance and spare parts—and acquisition of newer, safer airframes.

To give mishap investigators the broadest possible training, the Crash Lab has remains of numerous types of aircraft and helicopters to train on. Here Major Kaye inspects the remnants of a Piper Aztec. (Photo by Bob King)

The area of most concern in logistics accidents has always been engines. Half of all logistics mishaps are related to engines, and, in 1984, one-third of those accidents were with the Pratt & Whitney F100-PW-200 engine in the F-16. Corrections to the F100 problem are already under way or are being developed, but the problem has not completely disappeared.

Sixty-nine percent of the engine mishaps can be traced to two root causes. Lapses in quality assurance and quality control at all levels, from the manufacturer to unit-level maintenance, accounted for thirty-

six percent of the malfunctions. The other one-third of the accidents were because of unclear or incorrect technical data.

"The maintenance side of the house is vitally important to the safety program," said General Pruden. "We stress the same kind of leadership and attitude there as we do with the flight commanders. We have decreased these accidents drastically, and we must continue to do better in this area."

The solution to lowering the aircraft mishap rate even more lies in the operations area, or, even more specifically, in the human factors that contribute to accidents. "Logistics problems are easy to fix. It saves lives, and it is easy to justify the costs," noted Major Morphew. "If we could figure out ways to improve a pilot's attitude and judgment, we could probably get them funded. It is hard to quantify what can be done with human factors."

Seventy-four aircraft were lost during 1983–84 because of operations-related mishaps, and of that total, fifty-two airplanes (about seventy percent) crashed because of collisions with the ground or because the pilot lost control of the aircraft. The other twenty-two airframes were lost as a result of midair collisions and because of landing and takeoff accidents. One was lost when the pilot ran out of fuel and had to eject. In all thirty-two collisions with the ground during 1984, the aircraft were destroyed and the crews were killed.

The causes leading to controlled flight into terrain (CFIT) stem mostly from the operator of the airplane and the man/machine interface. The predominant factor in these mishaps is channelized attention on something other than terrain avoidance, although spatial disorientation (SDO) is another substantial contributing cause. Fatigue, distraction, task saturation, and mission stress are the other major elements. In a majority of accidents, at least two of these factors are present.

Preventable Mishaps

The reasons behind control loss, more so than with CFIT, lie squarely on the shoulders of the pilot. In almost every case, these losses can be traced to lapses in basic flying knowledge, technique, or skills. As with logistics mishaps, these types of mishaps are preventable.

On the other hand, there is one contributing factor in CFIT and control-loss accidents for which the pilot is not entirely responsible—G-induced loss of consciousness (GLC). In the past, aircraft could not sustain the high-G loads today's fighters can. The G-forces also came on much slower, and pilots were able to compensate. But with the instantaneous response of fly-by-wire controls, the airplanes can build up to nine Gs rapidly with just a touch of the control stick.

"In the physiological field, GLC is a growing problem and one we must continue to direct our efforts to," said General Pruden. "We have to continue to improve the man/machine interface."

Most of the midair collisions in 1983–84 occurred during formation maneuvering prior to or after a practice air-to-air engagement. As a matter of fact, only two midair collisions occurred while "hassling," or performing air-to-air combat maneuvers.

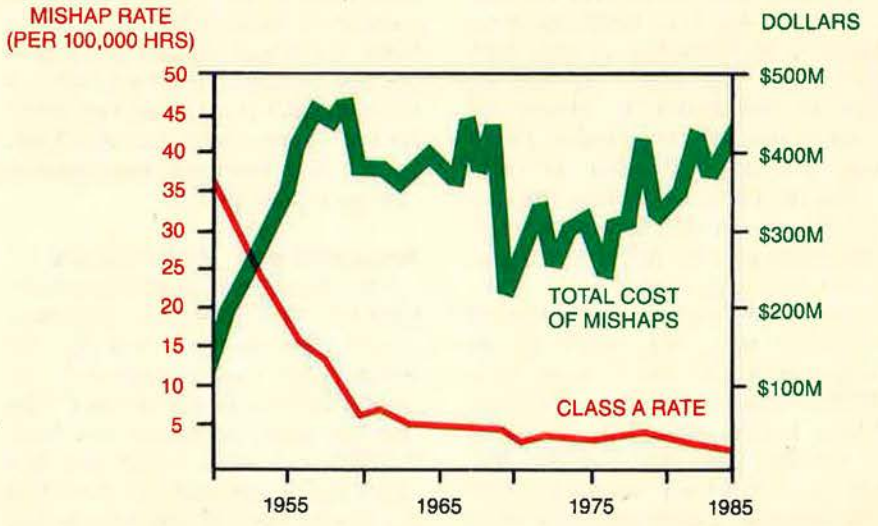
Other accidents, such as bird strikes (which caused $19 million in damages but only one Class A mishap in 1984) and weather-related accidents, can be avoided, for the most part, by better planning. Bird migration patterns are known, and weather forecasting is getting better, so pilots who fully use the available resources can generally steer clear of trouble. These areas are the random element, however, and may be managed, but not controlled.

Some mishaps could be called "dumb" accidents. One veteran pilot with 3,500 hours in fighters gave an example of one that *almost* happened. "One moonless night, near the end of flying school, I entered the landing traffic pattern. Another, faster aircraft called on the radio, entering traffic behind me. As I turned from downwind to base leg, I suddenly saw the onrushing lights of what I thought was the other aircraft, only a few hundred feet away!

"Instantly, I closed the throttle and began diving to escape. The other aircraft seemed to be diving with me. After what must have been a 1,000-foot dive (out of a traffic

Flight Safety History

Class A Rate and Then Year Dollars



The Class A mishap rate (red line) has dropped markedly, but because of more expensive aircraft, the total cost of the accidents (green) has risen.

pattern 1,500 feet above the terrain), I realized the lights were steady white, not the blinking red and green wingtip lights of another aircraft, so I pulled out of the dive, broke out of the traffic pattern, and reentered on downwind. Looking out, about five miles across the Texas plains, I saw the lights were on top of some oil derricks. If I had not pulled out, the accident report would have read 'Fatal—Cause Unknown,' but it would have been a dumb way to lose a pilot and an aircraft."

Learning From Mistakes

Most of the accumulated knowledge from all types of mishaps comes from the reports of safety investigation boards. The reports generated by the crash boards are one of the cornerstones of prevention efforts.

Upon notification of an aircraft loss, the nearest base dispatches a team that includes people trained in accident investigation to take a superficial look at the crash site and secure the area. An interim board meets while the permanent board president is chosen. The investigator sent out may or may not be qualified in the type of aircraft that crashed, but is impeccably versed in accident investigation. The recorder and flight surgeon don't have to, but usually do, come from outside the unit that lost the aircraft. Once assembled, the permanent board takes over the inquiry.

The survivors, if any, are the primary sources of information on what happened. The crash site, however, is the detailed record of the accident. Investigators check to see if anything came off the plane that could have caused the crash, if there is any evidence of fire, and if the impact angle, the distribution of wreckage, or any other physical factors indicate where the finger of blame can be pointed.

"We are given thirty days to find an answer after a crash," said Major Morphew, who sat on the boards investigating the crash of Gen. Jerome F. O'Malley's CT-39 last spring and the B-1B crash in 1984. "It is a puzzle game. We piece the wreckage together and look for a cause. We normally spend a week to ten days looking at the site and then another ten days reviewing records. After that, we write the report."

"The mishap board provides information to appropriate agencies," added Colonel Moore. "We are not an action agency, though. The Safety Center makes recommendations and follows up, but agencies like Logistics Command are the ones that have to take the action."

Confidentiality Controversy

There has been controversy of late about the confidentiality that the boards confer to witnesses. "The mishap investigations are not meant as disciplinary measures," Major Morphew noted. "The boards meet to prevent another mishap. By not swearing in witnesses and by getting contractors to tell us what they have found without fear of reprisal, we get people to discuss the mishap freely and find the cause."

Part I of the board's final report, where the facts found are delineated, is released to the public. Part II, which includes all testimony and hypotheses of the board members, is not released for the reasons cited above.

While accidents are the hard way to learn safety lessons, the Safety Center also has numerous, less painful ways to get the message out to the field.

The Safety Education Division manages the Air Force's safety education and safety training courses, which school more than 1,300 safety people per year at the wing and group level.

The best disseminators of safety information, though, are such periodicals as *Flying Safety,* one of four publications from the Safety Education Division. *Flying Safety,* along with *TAC Attack, The MAC Flyer,* and *Combat Crew* (safety magazines published by the major commands) all chart trends, give first-person accounts of accidents, and, through such mascots as Rex Riley, Fleagle, and C. R. Terror, provide gentle reminders about the need always to think safety.

The Reports and Analysis Division also keeps tabs on such joint-use aircraft as the A-7 and F-4. The Air Force flies more safely than both the Army and Navy, but because of different conditions, the rates are not really comparable. "Safety is one of the areas where a lot of information trades hands," said Major Kaye. "We give copies of our reports to the Army and Navy, and they reciprocate. It helps prevent making the same mistake again."

While 1985 was the best safety year ever for the Air Force, the number of major commercial airline accidents reached a new high. The worst accident in aviation history, however, was this collision of two Boeing 747s at Tenerife in March 1977. A total of 583 people perished.

All of these—accident reports, courses, periodicals, and the more than 2,000 full-time safety officers throughout the Air Force—aid the Safety Center in its goal to identify and correct safety problems.

Improvements on the Horizon

Two items currently receiving a great deal of attention at the Safety Center are the need for both increased G-protection and the ground proximity warning system (GPWS). Both of these things are coming in the not-so-distant future and will be of great benefit.

Since the end of World War II, G-suits have been designed to inflate

and slow the flow of blood to the pilot's feet. Other than the change from being water- to air-filled garments, the basic design of the suit has changed very little. When the F-15 and, later, the F-16 came on line, accidents caused by G-induced loss of consciousness increased dramatically.

"Grunting"—or pushing against the G-suit—has traditionally been a way for pilots to stave off GLC. Recently, though, physical fitness and special cockpit exercises for the pilots to cope with the sudden stress have been emphasized.

The Air Force also has been developing a new ready-pressure/high-flow G-suit that "anticipates" high-G maneuvers and inflates before, instead of during, the turn or bank. This allows the pilot to withstand the higher forces. Until the new G-suit becomes fully operational, which will likely be within a year, pilots will have to fight grayout or blackout in the traditional manner.

"A workable ground proximity warning system is vitally important," noted General Pruden. "We are working hard to get some system, because we just can't keep unintentionally flying aircraft into the ground." The military, unlike the commercial airlines, which have had mandatory GPWS since 1976, does not stipulate the system, even for ground attack airplanes.

This past summer, two different types of GPWS were tried out on A-10s. The first system, tested at Edwards AFB, Calif., involved a separately installed computer developed by Sundstrand Data Control, Inc. The other system, which was tested at Eglin AFB, Fla., last July, uses the computer already aboard the A-10. Further testing and modifications will be necessary before either system can be deployed.

The GPWS will help eliminate collisions with the ground caused by distraction and crashes where ground clearance was misjudged.

After every airline crash, the media parade out pictures of the search for and recovery of the so-called "black boxes," or crash-survivable flight data recorders (CSFDR). These data recorders (which are actually painted orange) are the primary source for causative information on the crash. Unfortunately, the military does not have these recorders on any but the most modern aircraft.

"We have done analyses, and seven to fifteen percent of the mishaps in which the plane was destroyed may not have occurred had CSFDR information from previous mishaps been known," Major Kaye said. "Often times we have to have another mishap to determine the causes."

"Black Boxes" Required

After years of work by AFISC and other safety agencies, the Department of Defense has issued a military standard requiring flight data recorders on all new aircraft.

"When the F-15E was first proposed, several agencies said that since it was not a 'new' aircraft, it would be exempt from the new standard," Major Kaye recalled. "We worked together, though, and got a recorder put in. It often comes down to a question of what gets funded."

Flight data recorders are needed now more than ever before because of cockpits with cathode ray tube displays. "All information disappears from the CRT once the power goes off," said Major Morphew. "And with fly-by-wire controls, there is not much mechanical evidence left at the crash site."

"The savings in both time and money would be tremendous," Major Kaye added. "The problem could be solved, and the accident board would come to the right conclusion the first time. The board could spend less time on what happened and go on to the why."

In order to retrofit existing airframes with crash-survivable flight data recorders, all of the plane's electronic equipment would have to be "broken into" in order to make the connections. At present, this modification is considered too costly.

"One of the things I'd like to see the Safety Center get more involved with is systems safety engineering," General Pruden said. "The earlier we can get involved in a system, the safer I think we can make it. We can take the experience we have gained and put it to good use.

"We are seeing enough mishaps with spatial disorientation and task saturation that we need to be working toward lessening the pilot's work load. We have made improvements in display technology, but we still need to make cockpits simpler."

Training is another area where safety can be taught. Undergraduate pilot training has been cut to 175 hours, and many feel that the reduction in hours only pushes the risk of accidents to the operational units. "When does a pilot develop the proper judgment?" asks Major Morphew. "We need to get entry-level pilots to reach a higher level sooner."

Simulator training is an answer, but only a partial one. "Our pilots gain valuable experience and knowledge from a hands-on standpoint in a much more forgiving environment," General Pruden observed. "I don't think, though, that one hour in the simulator equals one hour in a real airplane." Once again, tradeoffs have to be made between the costs of actual flying and the long-run safety benefits of live experience.

Dual-track pilot training, which the Air Force used in the late 1950s, would bring a big safety advantage by separating pilots into the relatively distinct areas of fighter/attack/reconnaissance and transport/tanker/bomber flying. But two roadblocks spring up immediately—the cost of acquiring transport/tanker/bomber training aircraft and the question of how to decide what criteria should be used to separate pilots into the two tracks.

The Safety Center is aiming for a 1.25 Class A mishap rate within the next five years. With the progress that has been made in beating down the logistics rate and the progress that is being made, although not to the degree that is hoped for, on the human factors involved in operations-related accidents, that rate is well within reach.

"There is no reason we can't be at 1.25 or better in the next five years," General Pruden concluded. "There are things already in being—concern by commanders at all levels over how we are operating aircraft throughout the flying business—that will make it possible."

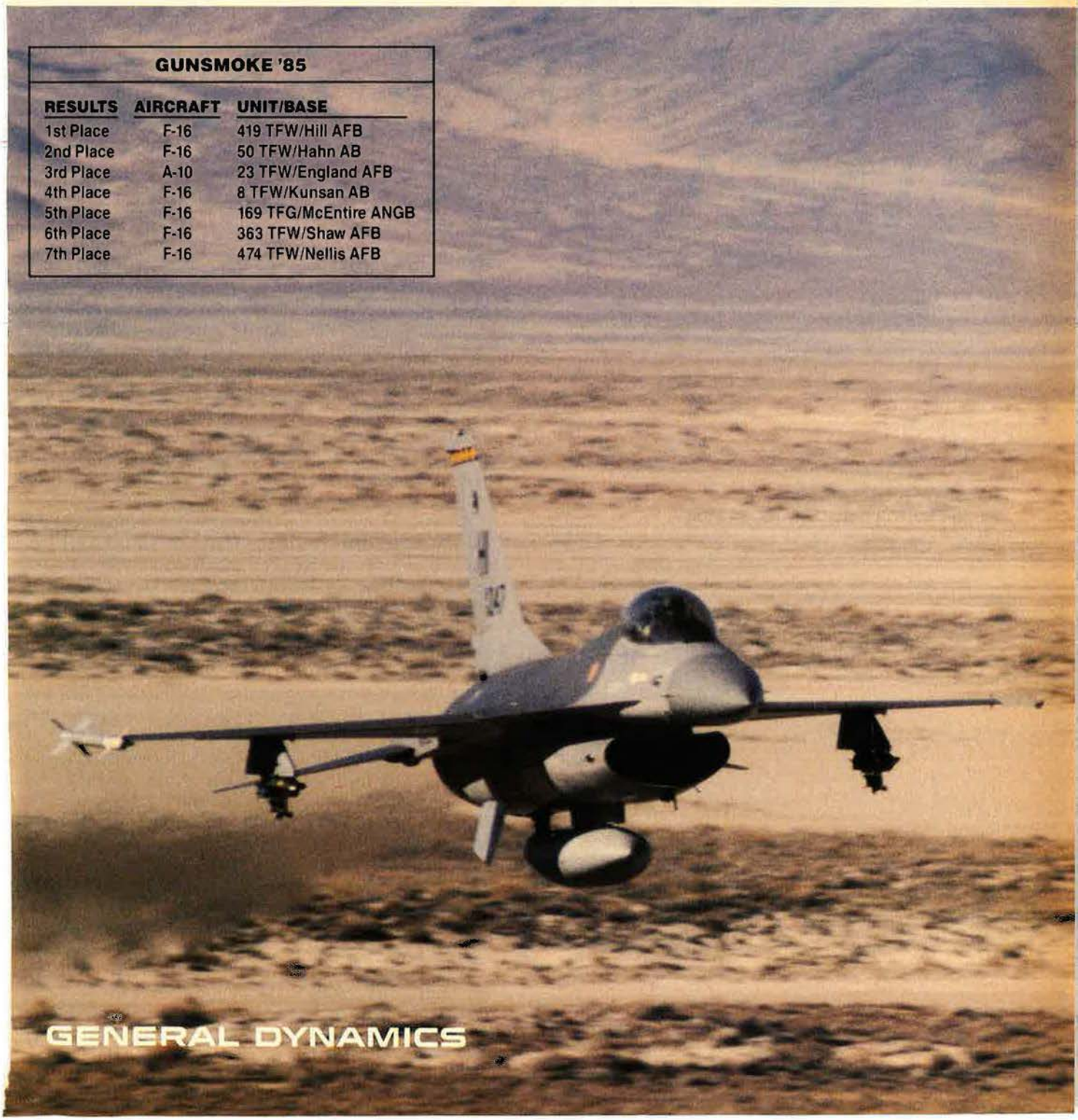
"Safety is now an integral part of flying. We have our foot in the door and our idea in their minds. Everybody who flies has a stake in safety," noted Major Kaye. ■

THE F-16 FIGHTING FALCON. UNSURPASSED PERFORMANCE . . . AGAIN!

The six teams flying F-16s dominated Gunsmoke '85 . . . sweeping top team and individual honors. Participating in this worldwide U.S. Air Force fighter-attack competition were 17 teams flying four different types of aircraft. Congratulations to all the F-16 pilots and ground crews on their outstanding performance.

GUNSMOKE '85

RESULTS	AIRCRAFT	UNIT/BASE
1st Place	F-16	419 TFW/Hill AFB
2nd Place	F-16	50 TFW/Hahn AB
3rd Place	A-10	23 TFW/England AFB
4th Place	F-16	8 TFW/Kunsan AB
5th Place	F-16	169 TFG/McEntire ANGB
6th Place	F-16	363 TFW/Shaw AFB
7th Place	F-16	474 TFW/Nellis AFB



No matter what some congressmen say, USAF combat capability is up. It could drop in a hurry, though, if the defense budget is gutted.

PROGRESS, PRIORITIES, AND FANTASIES

BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

Two central findings emerged from the Air Force Association's national symposium "The Air Force: Today and Tomorrow," held in Los Angeles, Calif., on October 24–25, 1985. On the one hand, the House Armed Services Committee chairman's claim that the taxpayers' $1 trillion investment in national defense over the past few years produced not one iota of additional military capability is egregiously false and diametrically opposed to all relevant evidence. Conversely, Congress's recently implemented or planned cutbacks in defense funding threaten to inflict a calamitous toll on military capability in the years to come.

Air Force Chief of Staff Gen. Charles Gabriel told the AFA meeting that cuts in the Pentagon's Five-Year Defense Plan over the past ten months total almost $300 billion, with the Air Force's share coming to about $75 billion: "Reductions like this can't be made without cutting into the muscle—we've had to terminate forty programs and have had to stretch and delay many others." He suggested that more cuts are yet to come, driven primarily by two factors: "The federal deficit and the perception on the part of the American people that we are wasting defense dollars."

Defense spending, General Gabriel asserted, is not the reason for the deficit. The defense portion of federal outlays dropped from an average of forty percent in the 1950s to about twenty-six percent at present. The Pentagon's share of the gross national product (GNP), moreover, is down to a little more than six percent in FY '85, compared to between eight and nine percent during the Eisenhower and Kennedy years.

Air Force Under Secretary Edward C. Aldridge, Jr., keynoter of the AFA program, warned that Congress "isn't going to give us the manpower levels we need. We will have to find ways to do the job with fewer people." The House Armed Services Committee's contention that there were no gains in military strength from the $1

trillion investment in defense, according to the Secretary, is "garbage. There is no way for anybody to go out into the field and observe combat capabilities, crew morale, proficiency, safety records, and so on and make such a claim."

General Gabriel stressed that the American people need to be told what "they are getting for their money. For example, the combat capability of our fighters in the air-to-air role has almost doubled since 1980. Pilots flying today's airplanes with improved missiles, spares, and support would expect to kill more than twice as many attacking fighters as they could have if we were still at the 1980 equipment levels. The air-to-ground picture is even better, with pilots expected to destroy almost three times the number of targets they could have with the 1980 force."

Gunsmoke '85, USAF's worldwide tactical bombing and gunnery competition completed a few days prior to the AFA symposium, was, General Gabriel said, "the best ever. The winning team's score in Gunsmoke '81 would have earned only tenth place in this year's competition." Secretary Aldridge added that the "Top Guns" at Gunsmoke '85 achieved significantly better average circular errors probable (CEPs), a standard for measuring accuracy, than in previous years. This year's CEPs were sufficient to score direct hits on tank targets on a single-shot basis.

Progress for USAF

Gen. Earl T. O'Loughlin, Commander of Air Force Logistics Command, provided the AFA meeting with a comprehensive accounting of Air Force progress since 1980. USAF's aircraft inventory will be up by six percent by the end of this fiscal year, meaning 515 additional aircraft, mainly modern tactical fighters of the F-15 and F-16 type. At the same time, the number of tactical pilots increased from 6,429 in 1980 to 7,542 at present. Average flying hours in the tactical force now run at about 142 per year, compared to 108 in 1980. Peacetime spares funding—which translates directly into mission-capable rates—has increased some 230 percent and now equates to 100 percent of USAF's requirements, according to the AFLC Commander.

The same is true for War Readiness Spares Kit (WRSK) funding. Dramatic gains have also been made in spare engine availability, up by 362 percent in the case of the F-15s, F-16s, C-5s, F-4s, and F-111s. These spare engines, in the main, are kept "on the shelf" to support wartime requirements. Complementing this buildup in spare engines are boosts in fighter engine reliability that almost double the time between engine failures on such aircraft as the F-15 and F-16.

The mission-capable rate of USAF's aircraft has increased by twelve percent since 1980, in spite of the increase in the number of aircraft in the operational force. This achievement was made possible in part by a twenty-two percent decrease in the number of aircraft grounded for lack of parts.

The fuel offload capability of the aerial tanker fleet is up by twenty-three percent because of new KC-10s entering the inventory and the reengining of existing KC-135s, according to General O'Loughlin. On the strategic side, 103 B-52s (ninety-nine B-52Gs and four B-52Hs) have been modified and equipped with state-of-the-art, digital, nuclear-hardened bombing and navigational systems to accommodate twelve air-launched cruise missiles each. An additional ninety-two B-52s are scheduled to undergo these modifications needed for ALCM carriage. Of the 1,715 ALCMs contracted for by the Air Force, about 1,450 are in the inventory; the remainder are to be delivered by October 1986.

The AFLC Commander warned the AFA symposium that the presently bright picture could darken quickly in case of funding cutbacks. Backing off the commitment to fund war reserve spares at the required levels "seriously reduces our chances of surviving the early stages of conflict." He cited by way of an example that "100 percent full WRSK funding for the F-16A yields two-thirds more fully mission-capable (FMC) aircraft than if WRSK were funded at only thirty-five percent of the required level." This ratio assumes that twenty out of twenty-four aircraft remain fully mission capable at the end of a thirty-day war surge. Translating these statistical benchmarks into combat capability, the AFLC Commander estimated that "our tactical forces can now execute seventy-seven percent more combat sorties during any potential contingency than they could in 1980."

GABRIEL: Defense spending isn't driving the deficit.

The Tactical Perspective

Both General Gabriel and the Commander of Tactical Air Command, Gen. Robert D. Russ, agreed during the AFA symposium that misunderstandings associated with the C-Status Reporting System, a tool for measuring combat readiness, contributed to the charge that increased defense spending has not paid off. C-ratings, USAF's Chief of Staff said, "are good for internal management, but they don't measure improvements in combat capability." General Russ added that C-ratings help focus a commander's attention on specific problem areas, but don't "adequately measure combat capability." The Air Force is looking at new and different measurement approaches for gauging combat capability.

It is axiomatic, General Russ suggested, that the side that has the best pilots, planes, and weapons during a war usually wins. Looking at the aircraft component of this prescription, General Russ said both quality and numbers are important. The number of "combat-coded" tactical fighter wings has increased "by more than two wings since 1980, and with the procurement levels already approved in the '85 budget, we will be at thirty-eight wings by 1987, just two wings short of our mid-term forty-wing goal."

Hand in glove with the numerical growth of the tactical air forces (TAF) has been an increase in quality.

This gain comes from the addition of capable, modern systems, modification of existing aircraft, and command and control and electronic warfare upgrades. The number of critically important E-3 AWACS aircraft, for instance, has grown from twenty in 1980 to thirty-three at present. Also, the EF-111 dedicated radar-jamming platform has been fielded, while the F-4G "Wild Weasel" force has acquired additional lethality with the new HARM antiradiation missile, according to the TAC Commander. Moreover, the advent of the EC-130H Compass Call, designed to degrade the enemy's command control and communications capabilities, may well represent the "most significant addition to our offensive electronic warfare force," according to General Russ.

ALDRIDGE: Critics' claims of no gains is "garbage."

Since 1980, the tactical air forces have also made great strides in precision weapons and, concomitantly, gained "greatly improved survivability, lethality, and sortie effectiveness. For example, with the F-4 in 1980, it would have taken some sixty-six Mk 82 conventional bombs and eleven sorties to neutralize a typical enemy target, such as a power-generation facility. Today, using . . . the TV-guided GBU-15, we have increased our capability some ninety-eight percent, and we can achieve the same probability of kill with only one bomb and one sortie." An additional major benefit is the standoff feature of the new generation of weapons, which "reduces our exposure to enemy defenses and decreases our possible losses in combat."

Similar gains have been made in air-to-air weapons. Since 1980, the F-4's ability to destroy an enemy aircraft has been bettered by some eighty percent through the addition of infrared missiles, and that of an F-15, employing the latest AIM-7 radar missile, has been improved by almost sixty percent. Because of technical improvements, more and better training, and a forty-five percent increase in the number of overseas deployments, TAC's average aircraft mission-capable rate is up forty-four percent from 1980, meaning "day to day, some eighty-five percent of our aircraft are capable of flying their wartime mission."

Future Tactical Requirements

Because the Soviets hold overwhelming leads in "sheer numbers" of combat aircraft, the Air Force must use "technological superiority as a force multiplier," Gen. Lawrence A. Skantze, Commander of Air Force Systems Command, argued. From 1972 to 1982, he asserted, the Air Force "bought a decade of air superiority with the F-15." But the Soviets are pulling up with similar capabilities. Their MiG-29 and Su-27 are twin-engine, high-performance fighters with improved range, thrust-to-weight ratios, and maneuverability. The Air Force response to these supersonic, all-weather fighters with look-down/shoot-down radars and beyond-visual-range missiles has been the Advanced Tactical Fighter (ATF) program and the Advanced Medium-Range Air-to-Air Missile (AMRAAM). Stressing the importance of keeping the qualitative edge in the decades ahead, General Skantze warned that "our needs are driven by the threat, not the budget."

In limning ATF's primary performance requirements, General Russ said the aircraft "must have expanded usable speed and altitude envelopes to improve survivability and deny potential enemy sanctuaries." The ATF design must also be tailored toward reduced infrared, radio, and visual signatures as well as the ability to take off and land on shorter runways or sections of runways. Another ATF criterion cited by the TAC Commander involves advanced aerodynamics to enhance lift, reduce drag, and improve maneuverability. These features, in concert with light, tough composite materials, "will mean more fight per pound."

Notwithstanding the importance of the ATF's performance, cost remains the make-or-break criterion of this new Air Force program, according to General Russ: "That is the reason why we have given it a $35 million price tag." General Skantze elaborated that the recently issued request for proposal (RFP) sets a "goal" of building ATF at a rate of seventy-two aircraft a year at $35 million each. Over the next three years, the feasibility of this cost goal is to be established during the program's demonstration and validation phase, he added.

ATF, the AFSC Commander pointed out, represents "one of the greatest technological and cost challenges the Air Force and its contractors face in this century. We have to breathe a lot of advanced technology into one package to give TAC an affordable plane that combats emerging threats. Over the next several years, we will be balancing performance and supportability requirements with technical potential and costs." Stressing the cardinal importance of the Advanced Tactical Fighter to the air-superiority mission, he said the aircraft's "efficient acquisition must proceed by first determining technological potentials to meet mission requirements; second, costing them; third, making intelligent tradeoffs between the two; [and] fourth, building hardware with sound business strategies—in other words, reducing and managing risk."

O'LOUGHLIN: Capabilities are up across the board.

TAC, according to its Commander, seeks specific

traits for ATF, to wit, that it be a reliable "pilot's airplane in which man and machine function as one integrated weapon system," especially in terms of flight control and avionics features. In combat, he added, "the pilot should not have to divert his attention from outside of the cockpit or remove his hands from the controls. Voice command will allow interaction with the aircraft, while the pilot simultaneously engages the enemy." Also, "helmet-mounted sights, artificial intelligence, and improved sensor trackers will provide a true head-up capability [and] cut pilot work load up to eighty percent." Cost considerations, he added, dictate that ATF be a single-seat fighter. Because the aircraft must be simple to fly, simple to fight with, and simple to maintain, ATF's "supportability, maintainability, and reliability are as important as its performance."

The AMRAAM Challenge

Because of its active seeker that permits a fighter to launch and leave or to fire on several targets during a single pass, "I consider AMRAAM the most important tactical weapon currently under development," General Russ told the AFA symposium. "Although the program has had some initial development difficulties," the TAC Commander explained, "I am encouraged by the results of recent reviews and the restructuring of the development process. We have had four live fire tests, and all have been successful."

AMRAAM, General Skantze suggested, has drawn "almost as much fire from skeptics as it will deliver to enemy aircraft." Part of the technical challenge associated with AMRAAM, the AFSC Commander explained, was to take "the equivalent capability of the F-16 radar and package it into the nose of a seven-inch diameter tube. . . . AMRAAM's early development schedule took longer than forecast, and delays threatened the program. We knew the schedule was a risk, but accepted it because of the [pressing] requirement for the missile."

He added that the Air Force is chagrined because AMRAAM failed to enter the operational inventory as originally scheduled, but recognizes that "if the program were killed today, we [would] have to reinvent the missile tomorrow—possibly at a higher cost." Underscoring the formidable and indispensable combat leverage that AMRAAM will provide for the current family of US and NATO fighters, General Skantze suggested that "AMRAAM will [also] be the teeth in the Advanced Tactical Fighter."

Both commanders agreed that development of a tail-controlled Sparrow—contrary to the contentions of influential staff members of the House Armed Services Committee—would not constitute an acceptable substitute for AMRAAM. As General Russ put it, "It's a pretty good idea, but it's only a minor mod[ification] to an existing system. It doesn't give us what we need." Such a modified version of Sparrow, he asserted, lacks an active seeker and is no match for the launch-and-leave, multiple-target, and improved electronic countermeasures capabilities of AMRAAM. According to the TAC Commander, "Nobody is arguing about the need for AMRAAM, just about its costs." He questioned the prudence of debating (in 1985) a cost difference of $200 million in 1995 or 1996 on a $7.2 billion program.

With the fielding of the ATF about ten years away, TAC is concerned with filling gaps over the near term, especially "our limited capability to operate around the clock from the forward edge of the battle area into the second echelon and beyond," General Russ said. The answer is the F-15E, which "will modernize our day-and-night, long-range, surface-attack capabilities while fully retaining the ability to be used for theater air defense." In 1986, the Air Force plans to buy the first eight F-15Es. Over time, General Russ said, the Air Force hopes to acquire a total of 392 F-15Es. The navigation system of the E model, he mentioned, "will have a tenfold increase in reliability over the F-15's current system."

RUSS (L): Quality and numbers are important. SKANTZE (R): The threat determines our needs.

Another new system TAC counts on to bolster the TAF's ability to fight around the clock is LANTIRN. This system, General Russ emphasized, "is one of the most potent technologies currently under development and is designed for use on the F-15E and F-16." LANTIRN, he predicted, will make it possible to double the sortie rates during the winter months in Europe and virtually to eliminate night as a sanctuary for the enemy. The LANTIRN system's navigation pod has been test-flown successfully over an aggregate distance of more than 40,000 miles at altitudes of less than 500 feet, according to General Russ. He added that the system's other component, the targeting pod, "is a little behind the nav pod in its development, but appears to be progressing well." The pilots flying these tests at high speeds on the deck in terrain-following modes "are unanimous in the view that the system is highly effective, that it works, and that it makes night attack doable in single-seat as well as two-seat aircraft," the TAC Commander pointed out. General Skantze added that development of both LANTIRN pods is now "on track," with the prime contractor, Martin Marietta, "doing a super job."

The recent decision by the US Navy to forgo its own version of the Joint Tactical Information Distribution System (JTIDS) and instead use the system the Air Force is developing was hailed by General Russ as a victory for common sense: "I am glad we finally got together." Even though the Navy's needs in terms of combat data differ somewhat from those of the Air Force, developing one system for use by USAF, the Army, and NATO and another for the Navy made only limited sense, he suggested. By going to one system, all users will benefit because of lowered costs. EJS, the enhanced JTIDS proposed by the Air Force as a secure voice communications net, also might be "helped" by the Navy's decision to accept a joint system. TAC, he

added, is in the process of reviewing EJS requirements with an eye on establishing whether or not all the features proposed originally are actually needed.

Low-Intensity Conflict and Terrorism

A key element of the Air Force's and the US Army's drive to enhance this country's ability to cope with low-intensity conflict and state-sponsored terrorism is "Initiative Seventeen," according to General Gabriel. This initiative, one of thirty-five agreed to by the Chiefs of Staff of the two services, provides for the formation of a joint Center for Low-Intensity Conflict. Originally, General Gabriel said, the Army planned on such a center at its Training and Doctrine Command (TRADOC) headquarters and the Air Force at TAC, but the two services subsequently decided to tackle the problem jointly.

USAF's Deputy Chief of Staff for Plans and Operations, Lt. Gen. Harley Hughes, told the AFA meeting that formation of the Army/Air Force Center for Low-Intensity Conflict signifies that the two services recognize a key challenge facing the nation, "the need to be able to conduct successful operations in a low-intensity conflict." Explaining that he and his counterpart on the Army staff are currently working on the mission statement, General Hughes said, "The idea is for the Center to be the first step in improving our posture for conducting low-intensity conflict. We want to elevate the awareness of the use of aerospace power in these types of operations and gain the capabilities to carry out those missions. We will also take a hard look at the combined Air Force and Army roles and identify strategies to make sure that [we can] carry out those roles." Once the roles and missions have been sorted out, he said, a "game plan" will be drawn up to "bring the Navy and Marines aboard" and to make the Center a DoD-wide agency.

HUGHES: Joint force development is making headway.

Overall, General Hughes told the AFA symposium, the joint force development process initiated by the heads of the Army and Air Force two years ago is making considerable headway, culminating in nineteen joint agreements during its first year. The single most significant achievement of the joint force development process is that the Army and Air Force "are participating across service lines in developing our program objective memorandums," according to General Hughes. These POMs are the central planning and budgeting blueprints of the services and the integral components of the Five-Year Defense Plan. The joint force development process is being extended through all levels of the Army and Air Force and eventually might include the Navy and the Marines as well, General Hughes said.

The Air Force, General Gabriel said, leads the other services in efforts devoted to combating terrorism. The Air Force started a "full-court press" on measures to thwart terrorism following the bombing of USAFE headquarters at Ramstein AB in Germany in August 1981. These measures range from awareness campaigns to setting up counterterrorist units. Terming state-sponsored terrorism the "most frustrating kind of warfare there is," he said the Air Force is working with the other services and those of other free world nations on a range of counterterrorist measures.

In the field of Special Operations Forces (SOF), the Air Force is the lead agency in the development of JVX (now designated the CV-22 Osprey), a long-range, joint-service, advanced vertical lift aircraft capable of being refueled, the USAF Chief of Staff said. Other SOF assets under USAF's purview are also being built up, he said, including the acquisition of an additional twenty-one MC-130 Combat Talons. These aircraft are night and adverse weather transports used primarily for infiltration and resupply of Special Forces and Navy SEAL teams. The number of HH-53C Pave Low helicopters is also to be increased—to eighteen from the present total of seven—he said. Over the long term, however, the Air Force plans to transfer the SOF rotary-wing mission to the Army: "The Army has 8,000 copters, and we have fewer than 200. Eventually, we are going to run out of HH-53 Pave Lows," and the choice then would be for the Army to pick up this mission or for the Air Force to buy some more rotary-wing aircraft, he suggested.

The SOF mission resides in Military Airlift Command, whose Commander in Chief, Gen. Duane H. Cassidy, told the AFA meeting that "we have some fifty upgrades of SOF funded and under way," involving, among others, the AC-130 gunships, MC-130 Combat Talons, and HH-53 Pave Lows.

Military Airlift Requirements

MAC's strategic lift capability, General Gabriel said, has gone up in capacity by thirty percent since 1980: "This added capacity is enough to transport an entire airborne division to Europe in the first ten days of a war."

General Cassidy stressed that MAC's principal requirement was for the C-17, not additional C-5Bs beyond the fifty aircraft the Air Force has already programmed for. Terming the C-17 a "self-sufficient new aircraft that is affordable in the outyears," General Cassidy pointed out that this new design benefits from engines that are common with some civilian airliners, is cheaper to operate than the C-5B, can operate into austere fields, and can be put "through" airfields easily and without choking ground facilities. The C-5, he acknowledged, "is a great aircraft, but it's an older design, and we need a new aircraft."

Airlift requirements are determined in a major way by the evolution of military doctrine. Key here, he said, is the AirLand Battle concept's emphasis on deep strike and rapid movement: "To support the AirLand Battle, we will need more capable and survivable intratheater airlift aircraft for tactical mobility, reinforcement, and sustainment."

The C-17 will go a long way toward providing an "inter- and intratheater capability of flying long distances into lots of airfields." He cautioned, however, that the C-130 force—beyond the next fifteen years—won't be likely to provide the airlift needed to support US ground forces into the next century. As a result, MAC ultimately "will need a much more capable tactical airlift aircraft that will ensure the battlefield mobility the Army must have." Because the AirLand Battle doctrine mandates that airlift must be as independent of runways as possible, the next tactical airlifter, "if not a VTOL aircraft, should, at least, have the capability of very short or rolling vertical takeoff. Additionally, this aircraft must be survivable in a high-threat battlefield and be able to overcome the main bottleneck of austere runways and the overly long time it takes to onload and offload cargo."

In terms of future airlift needs, the Army's new Light Infantry Division concept is a mixed blessing, General Cassidy suggested. While the Light Infantry Division—devoid of outsize equipment—is designed to reduce airlift requirements in low-intensity conflicts, this condition could be turned around in mid- to high-intensity conflict. Under those conditions, "our airlift requirements may increase . . . because the deployable 'non-divisional units' that augment the Light Infantry Division would move by air, rather than move by sea—which is how they would go if they were deployed with a regular infantry division."

Resupply requirements of the Light Division would also accelerate in mid- to high-intensity conflict, since such a unit is self-sustaining for only forty-eight hours compared to five days for a regular division, the head of MAC reported. In addition, the Light Infantry Division may well increase the requirement for intratheater airlift in even low-intensity conflicts because it lacks organic air or ground transportation, General Cassidy suggested.

MAC's Airlift Master Plan is one of the means for setting the Command's intertheater capacity goals, according to General Cassidy: 66,000,000 ton-miles per day, to be realized by 1998. The device for gauging intratheater airlift needs is the Airlift Concepts and Requirements Agency (ACRA), made up of MAC and Army TRADOC personnel who jointly size the "intratheater airlift needs of the unified commanders," General Cassidy explained.

The Strategic Umbrella

When asked at the AFA meeting whether the seeming present predominance of top leaders with tactical background might not skew the Air Force's order of priorities away from strategic requirements, General Gabriel answered: "We stand on our track record. If we don't have the 'top hammer,' the strategic nuclear [capability], then you can forget the rest . . . because [without it] we can't deter at lower levels." He expressed concern that "our strategic offensive force modernization plans have been dealt a severe blow by congressional action to cap Peacekeeper [MX] deployment at fifty missiles. This is a far cry from the 200 missiles originally planned and puts us at only half the number recommended by the Scowcroft Commission," a body appointed by the White House to plumb strategic force requirements.

"We believe," USAF's Chief of Staff said, that the consequences of this cutback "are severe enough to warrant a thorough examination of the overall triad force structure. Our plan is to develop a comprehensive strategic road map—a road map that will ensure deterrence well into the next century."

Building blocks of the strategic forces road map "will include development of alternatives that can permit more survivable basing for the small ICBM and an examination of future strategic bomber force structure needs." Further, General Gabriel said, "the road map will assess our needs in light of budget, arms control, and operational requirements. Our approach will be

CASSIDY: C-17 will be affordable in the outyears.

measured and deliberate over the course of the next year. Our goal will be maximum triad capability configured to minimize, as much as possible, problems associated with an eventual transition to a strategy based on strategic defense capabilities."

Arms control, General Gabriel said, is a "puzzle that has taken on a new look" by dint of the "heavy-sell Soviet proposal for significant nuclear arms reductions." Expressing concern over the Soviet position, he said "banning SDI research, development, and testing, which is not verifiable, effectively leaves the Soviets with a monopoly in these areas. Second, limiting discussions only to systems capable of striking either the US or Soviet homelands holds us in check while leaving the field wide open for them." He added that "the pot on our side, in the Soviet view, would start out with all of our strategic forces—our ICBMs, bombers, and submarine-launched ballistic missiles as well as theater forces, our Pershing II missiles and ground-launched cruise missiles stationed in Europe, and our dual-capable aircraft located in Europe and the Far East." But "on their side, it's a different picture. None of their intermediate-range forces—for example, their Backfire bombers or SS-20 missiles—would be included, because the Soviets claim that these systems cannot strike the continental US."

Another major catch of the Soviet proposal is that it imposes one-sided restrictions on US modernization, according to General Gabriel: "They have modern nuclear forces deployed today, while we are only beginning to field our new-generation systems. Consequently, accepting this provision would place us in a position of severe disadvantage."

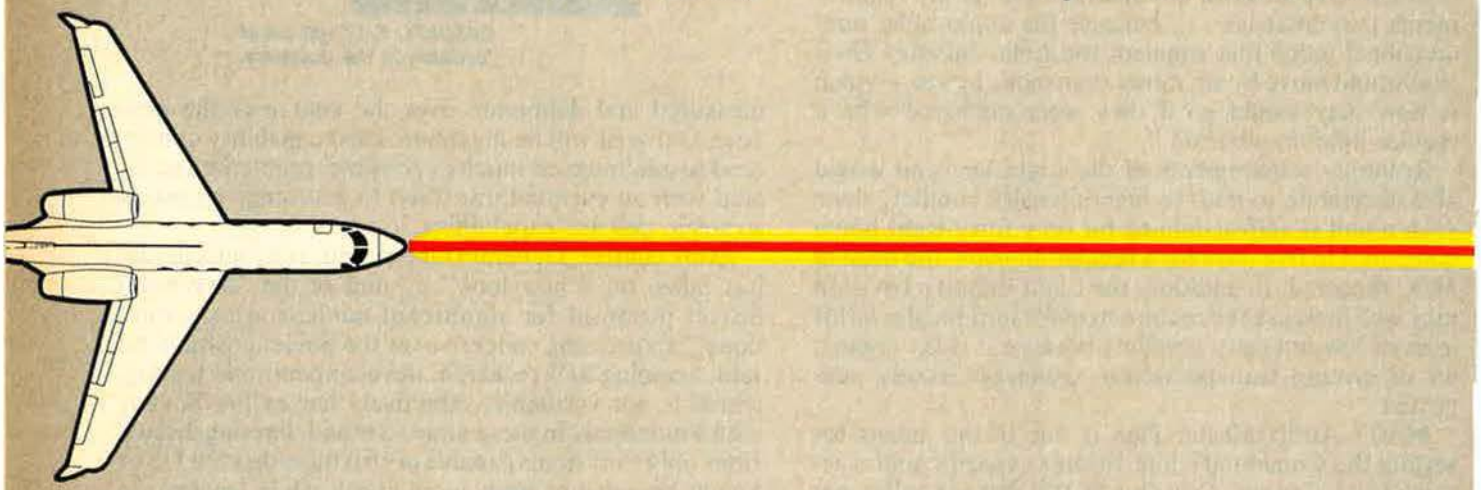
In summary, General Gabriel said, "We should sit down and talk seriously with the Soviets, but we have to keep our eyes open. At best, the proposal is a place to start talking. Let's hope it's the latter, but we'll have to wait and see." ■

Airfield capacity will increase significantly when flexible MLS replaces ILS as the primary precision approach system.

Landing on Microwaves

An FAA Beech King Air makes an MLS landing approach during commissioning of the MLS at Valdez, Alaska.

BY C. V. GLINES



READERS who remember "flying the beam" during World War II know all about the difficulties of plowing through the weather to a safe landing via the four-legged low-frequency ranges in the 200–400 kilocycle band. It wasn't easy. Static was always a problem, and too many of us were led astray by false cones, scalloping of the beam legs, interference from other electrical sources, and tuning glitches. And, of course, your ears always seemed to be playing tricks on you. Many who thought they were on the beam broke out of the overcast to find that they were not aligned with the runway.

Then came the days of the very-high-frequency visual omnirange radio (VOR) operating in the 108–117.95 megaHertz band and VHF radio communications in the 118.00 to 135.95 mHz band, followed by ultrahigh frequencies (UHF) in the 200 to 3,000 mHz range. These frequency bands are relatively free from atmospheric and precipitation static, providing clear navigation and communication information when most needed.

Safer and More Precise

With VHF and UHF came cockpit instruments to make landing approaches safer and more precise: the course deviation indicator (CDI), improved automatic direction finder (ADF), and, later, distance measuring equipment (DME) in the UHF band (962–1,213 mHz). The instruments in the aircraft permitted pilots to fly the instrument landing system (ILS), which is designed to permit landings under lower ceiling and visibility conditions than is possible with the older low-frequency radio ranges.

An ILS provides accurate course alignment and glide slope descent information during an approach to a runway. It is one of two precision approach systems in use. The other is the radar approach, which requires no avionics equipment in the aircraft except a radio transceiver for communicating with ground controllers.

ILS has been the world's standard precision approach system since 1948. It has undergone many improvements in performance and dependability and has served the world's aviation community well. But ILS has its limitations. It cannot handle the ever-increasing air traffic and the need for even more precision so that aircraft can land in con-

ditions of zero or near-zero visibility. For the frequencies used by ILS, antennas cannot be built large enough to be completely independent of ground effects. This causes problems of interference, weather effects, and multipath reflections. It also requires expensive ground site preparation.

There are a maximum of forty channels available for ILS. This limits capability in some locations, especially in such crowded traffic areas as the Los Angeles basin. But perhaps the main limitation of ILS is that it provides only a single, narrow (plus or minus three degrees to plus or minus six degrees) course and a single glide path limited to four degrees on the upper side.

Solution to ILS Problems

There is an answer to the ILS problem. It's called the Microwave Landing System (MLS). It is now being tested and perfected, and it will replace ILS and become the primary precision approach system in the 1990s. Its main advantage is that it provides many paths to a single runway from different azimuth angles and varied glide slope angles, which can accommodate the differing flight capabilities of helicopters, STOL aircraft, and various types of fixed-wing general aviation and commercial aircraft. Once flight procedures are developed, this flexibility will increase airport capacity significantly.

MLS received its name from the region of the electromagnetic spectrum in which it will operate (5,031 to 5,090.7 mHz), fifty times the ILS localizer frequency and sixteen times the ILS glide slope frequency. These higher frequencies allow the use of smaller antennas that will be much more independent of ground effects. Such antennas can propagate signals without using the ground for beam shaping, thus greatly reducing the cost of site preparation. They will permit the use of scanning beam techniques to minimize multipath reflections that can develop from buildings, aircraft, vehicles, terrain, and water. They will also be less susceptible to interference from such other electromagnetic sources as FM broadcasts and power lines.

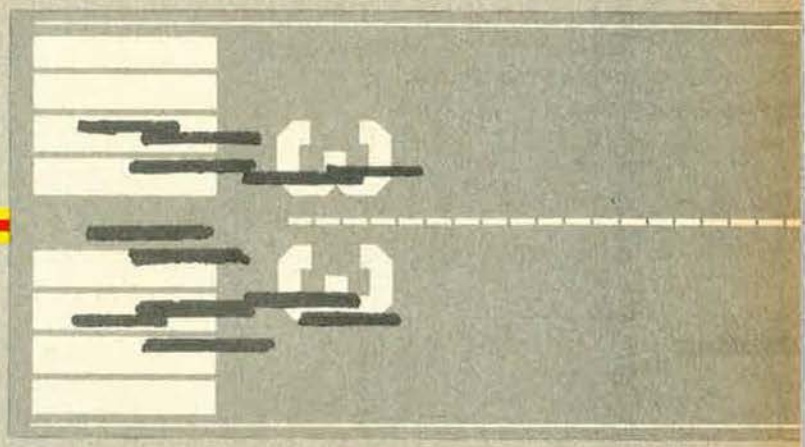
Pilots will welcome the impressive operational advantages that MLS has over ILS. For example, the accuracy at the threshold of all MLS-equipped runways will make autoland operations possible, regardless of instrument flight rules minimums. According to one MLS manufacturer, Bendix, "There are no bends, no false courses, no false paths, no wiggles, and no bumps in an MLS approach." Instead of a straight-in approach, pilots can make segmented or curved approaches, a distinct advantage over ILS. From their perspective in the cockpit, the instruments look the same; retraining will not be a problem.

Another advantage of MLS is that the pilot can select the azimuth and elevation for his approach. Certain types of aircraft can have lower operating minimums at some locations. For example, an obstacle such as a building, tower, or mountain may limit the decision height (DH) for an airliner on a three-degree ILS approach to 400 feet, but an aircraft that can fly a higher approach angle might be able to operate to 200 feet.

MLS can operate on any one of 200 channels, enough to fulfill any possible future need for landing system channels. It is this increased flexibility that will allow an increase in airport capacity and result in fuel savings, more acceptable noise-abatement procedures, and fewer traffic delays. MLS will be especially valuable for short takeoff and landing (STOL) and rotorcraft operations.

MLS also may make wake vortex avoidance easier by allowing light aircraft trailing heavy aircraft to approach and land at higher glide angles.

The wide-angle proportional guidance allows aircraft to acquire the MLS signal and verify that it is correct before the turn on to the final approach. It also will reduce overshoots of the final approach course.



While the use of microwave frequencies seems like a breakthrough for aircraft operations, it is not a new idea. It was actually proposed for ILS instead of VHF/UHF in the 1940s, but was rejected because microwave technology was too primitive at that time. Since the early 1960s, many military and some civil systems have been introduced at microwave frequencies. There have been about sixty of them in the past twenty-five years, all designed in search of a system better than ILS. But the prospect of having many types of approach systems in use in different parts of the world meant that international operators would have to carry several different types of avionics. It was obvious that a world standard would have to be developed that would satisfy all users, civil and military.

New World Standard

In 1967, the Radio Technical Commission for Aeronautics (RTCA) formed a special committee to develop the technical requirements for a single system that could be endorsed by the International Civil Aviation Organization (ICAO), the aviation arm of the United Nations, and thus become the standard replacement for ILS worldwide. ICAO established an operational requirement for "a new nonvisual precision approach and landing system," and a number of potential systems were developed and tested in Australia, West Germany, Great Britain, France, and the United States. In all, twenty-three different techniques were evaluated to determine the signal format for a universal system. In 1978, ICAO selected the Time Reference Scanning Beam (TRSB) concept, proposed by the US and Australia, as the new world standard.

One of the highlights of the ICAO activity was a demonstration program carried out in 1977 and 1978 that was designed to gain as much information as possible on the various proposed systems. The US demonstrated the TRSB system at twelve locations around the world as a means of testing it in a wide range of operational situations and environmental conditions. The demonstrations were conducted with Boeing 727 and 737, Convair 580 and 880, Douglas DC-6, de Havilland Twin Otter, and North American Rockwell T-39 aircraft. The tests were conducted at Cape May, N. J.; Buenos Aires, Argentina; Tegucigalpa, Honduras; JFK Airport, N. Y.; Charleroi, Belgium; Dakar, Senegal; Nairobi, Kenya; Shiraz, Iran; Kristiansand, Norway; Brussels, Belgium; and two airports at Montreal, Canada.

The tests conducted during the development of MLS in this country focused primarily on the engineering aspects of the system and on demonstrating operational capabilities. In 1979, the Federal Aviation Administration (FAA) began a service test and evaluation program under visual flight rules (VFR) conditions to gain the experience necessary to develop terminal instrument procedures (TERPs) that pilots would use. Ground installations were completed at Washington National Airport, Philadelphia, and Clarksburg, W. Va. Participants were Ransome and Aeromech Airlines and two helicopter operators (Sun Oil and Keystone).

Since 1978, ICAO has developed the requirements that will assure that all air and ground systems will be interoperable worldwide. Now, seventeen years after ICAO issued its development objective, MLS is in the early stages of a three-phased implementation program in the United States under the direction of the Federal Aviation Administration. Phase I provides from twenty to thirty MLS ground systems to be installed over a two-year period. These installations will demonstrate MLS capability, refine the siting and operational parameters, and provide the requisite experience and guidance for subsequent installations.

Phase II includes the installation of about 900 systems to be purchased over a ten-year period and installed on a priority basis, favoring networks of airports that link to major city airports or hubs. The final phase will provide an additional 300 systems over a three-year period to complete the planned MLS implementation. In all, there will be about 1,250 systems installed in the United States at an estimated cost of $1.656 billion in 1984 dollars. This will be about double the number of ILS facilities in use in the US today.

Worldwide, it is estimated that 400 to 500 MLS installations will be operational by 1990, 2,500 by the year 2000, and 3,000 as the worldwide transition from ILS to MLS is completed. It is possible that both the US and worldwide programs may be accelerated during the earlier years, thus shortening the transition period for the changeover from ILS to MLS. At present, the FAA is obligated to maintain ILS through 1995 with the same quality of service as the incoming MLS. ILS may be retained until 2000 if there is sufficient need. According to FAA officials, when sixty-seven percent of instrument operations at an airport are on MLS, then the ILS at that site will become a candidate for removal.

Military Applications

The military services are vitally interested in MLS, and the Air Force has been designated as the lead service for the conversion program that will be managed by the Air Force Systems Command's Electronic Systems Division. The DoD objectives are as follows:

- Maintain civil, military, and NATO interoperability.
- Provide an off-airfield precision landing capability.
- Develop an easy-to-deploy mobile/tactical system.
- Increase siting flexibility.
- Increase system survivability.

From 320 to 330 fixed-base systems are planned by DoD and will be phased in at a pace consistent with the civil schedule. Avionics for large USAF aircraft will be modified commercial receivers that will be installed first in certain Military Airlift Command C-130 aircraft. Total Air Force requirements are estimated at 8,300 receivers. The Navy and Marine Corps will equip about 6,100 aircraft; the Army will procure about 1,200 receivers for its 4,500 aircraft.

According to Maj. Herbert A. Vollmar, USAF Liaison Officer to the FAA, the overall DoD requirement may eventually total 18,900 MLS receivers, which will mean an aircraft retrofit rate of about 1,100 per year over the entire transition period. FAA officials hope the Defense Department's Civil Reserve Air Fleet (CRAF) program will include MLS equipment for the aircraft committed by the commercial airlines. They believe such a requirement will get the MLS program moving along at a faster pace.

The services are especially interested in the mobile capability of the MLS and the fact that a system less complex and simpler than ILS equipment can be transported to a tactical site and be made operational by two people within thirty minutes. Only a short cable is needed to link the system's azimuth and elevation elements.

According to Col. Rodney J. Sayles, MLS program director at Electronic Systems Division, "The mobile MLS system will greatly enhance the capabilities of the military's wartime aircraft launch and recovery operations into austere airfields as well as our numerous humanitarian and rescue missions."

The world's first MLS (a Bendix system) was installed at Valdez,

Alaska, the southern terminus of the Alaska oil pipeline. It was commissioned on November 16, 1982, and has been used by ERA Helicopter Co. for its de Havilland Dash 7 operations between Anchorage and Valdez. The introduction of MLS there allowed a 6.2-degree descent angle, thus lowering the decision height from 3,840 feet to 1,000 feet. As the pilots gained experience, the DH was lowered to 500 feet.

Other US installations are now in place at Cadillac, Sturgis, and Bellaire, Mich.; West Houston Airport (Lakeside), Tex.; Clarksburg, W. Va.; East Hartford, Conn.; West Palm Beach, Fla.; and Richmond, Va. All are non-federal installations (installed by "private parties") except Richmond, which is the first site funded by a state and the FAA. The first military site commissioned was at Shemya AFB in the Aleutians, primarily for the use of Strategic Air Command aircraft. Two systems are being installed in Canada at Jasper-Hinton and Ottawa.

As the program gets under way in the States, other nations are actively preparing for their MLS future. Japan, Canada, Great Britain, France, West Germany, and the USSR are testing equipment and preparing to issue specifications to industry for procurement soon.

According to C. L. Longman, FAA's MLS expert in the Office of Flight Operations, the process of changing a major world landing system has proven to be long and tedious. "It's been a chicken-and-the-egg kind of thing," he says. "Not many users would spend the money to equip their aircraft because there weren't any ground stations. There weren't any ground stations because there weren't any aircraft that could use them. However, beginning in 1986, all that will begin to change as we complete the first of three multiyear procurements."

FAA is working diligently to define the true ground station performance to support low weather operations. "We must achieve a high level of system integrity," Mr. Longman says. "We must define what the failure modes are and determine how we can continually monitor the systems in place. Fortunately for everyone, MLS is extremely accurate, so it is not and will not be a problem."

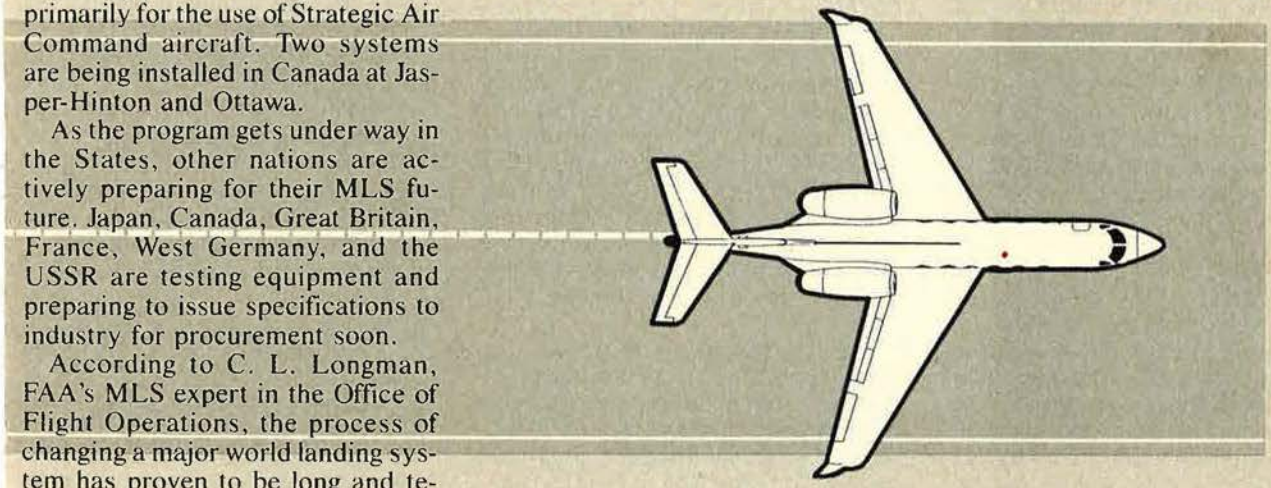
Operational by Stages

The FAA target capability is to be operational at Category II (100-foot decision height and runway visibility range [RVR] below 1,800 feet down to 1,200 feet) by the end of 1987 and Category IIIA (full autoland with fifty-foot decision height and from 1,200- to 700-foot RVR with fail-passive autoland capability) by the end of 1988. Meanwhile, an Air Force C-141 will be used at Wallops Island, Va., to establish the terminal instrument procedures for large aircraft. The outcome will determine how curved and segmented approaches should be flown by military and civil jumbojets. Various scenarios have been flown in simulators to arrive at some preliminary procedures.

Hazeltine received a contract in January 1984 for 172 to 208 systems to be procured over a five-year budget period at a cost of $154 million. A total of 500 systems will be ordered during the 1987–91 period at $598 million; 542 systems will be procured in 1992–96 at $995 million. The first 178 to 208 system installations will begin in October 1986 and will be completed by January 1989, depending on FAA appropriations. This will complete Phase I and begin the Phase II network of installations, which is scheduled for completion before 1995. Phase III will be completed before the turn of the century.

Meanwhile, however, there are the non-federal demonstration projects at Washington National Airport (Ransome Airlines); Richmond, Va. (many users); La Guardia and Boston Airports (Eastern Air Lines); Newark, N. J., and Gatwick, England (People Express); and at New York City heliports at Wall Street and Battery Park.

At Richmond last August, the first FAA-sponsored demonstration program began, with twenty privately owned general aviation aircraft participating. The aircraft owners were furnished with $10,000 receivers in return for their participation, half given by Bendix and half by Sperry. The FAA is paying for the installation of the receivers and the publicly owned supplemental-type certificate for each type of aircraft in the program. The twenty owners have agreed to make at least ten MLS landing approaches each month and to complete pilot questionnaires for the approaches.



The FAA has sponsored a number of programs to be certain that MLS receivers will be available in time to be used with the initial MLS ground installations. Receivers in the $8,000 to $10,000 price range can now be purchased from at least two manufacturers. The FAA anticipates that the cost will eventually be reduced to the $2,500–$5,000 price range as the program progresses.

MLS has been a long time in coming, but it is almost here. Its advent signals a new era in aircraft operations. ■

C. V. Glines, a retired Air Force colonel, is a free-lance writer, a magazine editor, and the author of numerous books. His articles appeared frequently in this magazine during the 1960s. Last year, his contributions to AIR FORCE *Magazine included "The Fabulous Fortress" (July), "Doolittle's Greatest Contributions" (September), and "The Grand Old Gooney Bird" (December).*

AIRMAN'S BOOKSHELF

The RAF at War

A Time for Courage: The Royal Air Force in the European War, 1939–1945, by John Terraine. Macmillan Publishing Co., New York, N. Y., 1985. 816 pages, with photos, notes, appendices, bibliography, and index. $29.95.

With vivid images of high contrails, brave men, and engines revved beyond the red line, John Terraine here traces the valorous history of the Royal Air Force from the confusion and defeat of 1939 to the great victory of 1945. Neither an attempt at historical reinterpretation nor an analysis of strategic doctrine, *A Time for Courage* nevertheless succeeds brilliantly as a panoramic chronicle of the RAF from the German invasion of Poland to V-E Day.

Mr. Terraine's primary thesis is as clear, credible, and hard-hitting as a 2,000-pound bomb: airpower in World War II was the key element on both sides and the determining factor in the outcome of the struggle in the European theater. In the early days of the war, when the Germans enjoyed air superiority, their Panzer-led armies were invincible. By 1943, however, the Allies had wrested control of the skies, and the Allied armies proved consistently victorious. In essence, the author argues that the overall military situation for both Germany and England was directly proportional to the success of their respective air forces.

The evolution of the Royal Air Force was neither easy nor painless. In the late 1930s, fundamental doctrine, strategy, and even tactics were in a state of hopeless disarray. The proponents of precision bombing were at odds with those who advocated area bombing as the RAF's standard doctrine. To fly at maximum speed and sling the bomb load in a rather helter-skelter fashion was the prevailing philosophy in the late 1930s. As one RAF senior official observed, "I do not consider it practical politics to *expect* a pilot to slow up in order to increase bombing accuracy."

Nevertheless, under the wise, creative direction of Air Marshal Sir Edward Ellington, an effective RAF was born in spite of an incredible amount of political and military obstruction that would have dismayed, if not outright defeated, a less determined commander. Ellington, perhaps more than anyone, was responsible for the development of radar, four-engine bombers, and the superlative workhorses of the war, the Supermarine Spitfire and the Hawker Hurricane fighters.

Ellington's pivotal decision (seconded by Sir Hugh Dowding) to refrain from basing Fighter Command in France during the trying summer of 1940 was crucial, Mr. Terraine argues. "Fighter Command, by the end of the Battle of France, was in a seriously weakened condition in relation to what Dowding never ceased to consider its primary purpose—the defence of Britain against 'the knockout blow.' "

The Luftwaffe attempted its "knockout blow" in the subsequent Battle of Britain, during which the life expectancy of the average RAF fighter pilot was only a short four to five weeks. But the RAF doggedly persevered and finally triumphed in this key episode of World War II. And while the gallant pilots of Fighter Command captured the imagination of the world with their victory, the final question posed by the author remains. What if Dowding had lost his great gamble? What if the loud arguments of his many fellow officers had been correct and his decisions irreversibly and disastrously wrong?

England won the desperate Battle of Britain in sixteen hard, costly weeks. The next great struggle, the Battle of the Atlantic, was to consume four years and irreplaceable numbers of Britain's finest young men. It, too, was ultimately won by sheer luck, much professional skill, and a narrow margin. Ill-equipped but manned by superb pilots, the RAF's Coastal Command, called the "Cinderella outfit" by the author, performed magnificently and kept open the vital lines of supply.

While these great aerial contests wore on, Air Marshal Sir Arthur Harris was building a superlative Bomber Command. In the face of early defeats and heavy losses, Harris single-mindedly pressed forward his attacks on both German heavy industry and civilian morale. In the end, though, heavy carpet bombing proved insufficient by itself to break the will of the enemy. Rather, German morale was not irrevocably broken until the Allied advance into Germany proper.

Mr. Terraine argues convincingly that the Nazi fighting machine was invincible so long as the Luftwaffe held the upper hand. When the Luftwaffe was finally broken, the Allies were assured of eventual final victory. Strong planes and determined pilots played the crucial role in the course and outcome of World War II. Though the Luftwaffe made possible quick German victories at the war's outset, the Germans eventually lost the war because their air force, in the final analysis, simply could not successfully contend with the greatly expanded and superbly professional RAF and Allied air forces.

The great figures in the RAF's pantheon of heroes—Ellington, Tedder, Dowding, and Harris—fill the book, but they are always accompanied by the ghosts of "the aircrews, the flyers, the ones who left their burnt bones scattered over all of Europe." They are the real heroes of this violent, remarkable time.

Although it is not perhaps fashionable nowadays to call a book "definitive," *A Time for Courage* richly deserves such an accolade. Relying on primary sources from a myriad of governmental archives and depositories, the book yields a veritable gold mine of facts, statistics, and interpretations. Highly readable and professional, this authoritative study offers an exciting, often poignant day-by-day account of the RAF's defeats and victories during a long, difficult, six-year period.

A major book, *A Time for Courage* will be appreciated by laymen, historians, and the aging veterans who flew, fought, and bled in the flak- and

tracer-filled skies of a Europe more than forty years past.

—Reviewed by William Teague. Dr. Teague teaches US history and government at the University of Texas at Dallas and writes regularly on military history for regional and national publications.

The Winners of Company K

The Men of Company K: The Autobiography of a World War II Rifle Company, by Harold P. Leinbaugh and John D. Campbell. William Morrow & Co., New York, N. Y., 1985. 318 pages with photos. $18.95.

This book takes an unusual approach: it is the collective autobiography of a World War II rifle company. But it works for two shining reasons. The first is the intense dedication, the incredible amount of research, and the articulate, good-humored, but bitterly realistic prose of the authors, two prewar college chums thrown by chance into duty as lieutenants in Company K, 33d Infantry Regiment, 84th Infantry Division, US Army.

Second, the book works because of the intensely emotional ties that bound together so many survivors of an experience. That experience, ghastly as it obviously was, became the central hundred days of their lives. Collectively, they tell their own story, and they tell it well in revealing quotations.

Here are 200 young Americans, mostly draftees, fresh out of training at Camp Claiborne, La. Nearly all are within a year of their twentieth birthday. Company commander Capt. George Geiszl was, at twenty-two, the "old man." Hard-nosed and iron-assed, he "firmly believed we were the best outfit in the division" and "just maybe the best rifle company in the whole goddam Army." You're not far into the book when you realize that the company was built in Geiszl's image and would remain that way. This is all the more remarkable when you consider that he was severely wounded while charging a German-held hedgerow in his fifth day in combat. You knew he'd be back, and he was, only two months later. Geiszl was the kind of guy to lead these men in whatever kind of combat they happened to be in.

It was tough combat. Company K landed at Omaha Beach on November 2, 1944, from an assembly area in England. They were then trucked across France via Paris, across Belgium, and barely into Holland, near where the Belgian, Dutch, and German borders meet and where the Siegfried Line loomed. It was some objective for green kids who had yet to be shot at and who had been told exactly nothing about what to expect. Wisdom would come fast enough, with cynical competence right behind it.

What follows is a day-by-day, almost step-by-step, casualty-by-casualty account of a very small piece of a very large war. It grabbed this reviewer like no other tale of war ever has—not even the macho posturing of a Hemingway, not even *The Red Badge of Courage* or *The Forty Days of Musa Dagh.*

It's all there, right down to the ethnic mixture, which might have been assembled by Central Casting. But it is all the more authentic, because it is real. You find them all, from the company intellectual (actually, there were several, because by November 1944 the men of the Army Specialized Training Program [ASTP] had been plucked from the nation's campuses to fill the depleted ranks of the infantry preparatory to the final push into Germany) to the city slicker and country bumpkin, from factory and field. They would age quickly and become very good at their new and nasty trade.

We walk through their war with these guys. One hundred days doesn't sound like much in the context of a lifetime, but it can be a lifetime. And it was for thirty-six men of Company K.

The company's first battle involved breaching the Siegfried Line. No milk runs, no warming up in light action, no blooding, as they say—just a big objective taken in a month of sharp fighting with Germany's best. After that, a sharp detour south into the Ardennes took the company to the Battle of the Bulge—no breather, that. It was then back to the Roer, across it and the Rhine, and eventually to a linkup with the Russians on the Elbe.

Don't get the idea that this book is a simple chronology. It is heavily larded with first-person accounts by individual soldiers that are cleverly strung together in a sharp, realistic narrative—a word-picture that lives and breathes.

Interspersed are chapters on the home front, the home front of these particular men—their sweethearts, wives, and parents, and accounts of hospital stays, some of which were the first stop on the way home and for others a welcome pause for refreshment on the way back to their home-away-from-home—Company K.

You'll find yourself drawn into this book. It is tremendously evocative to one who shared some of these experiences (though not in such a hostile environment of terrain and climate), but it will appeal as well to anyone who wasn't there but who wonders what it was like. The children and grandchildren of that generation will be awed by their sacrifices.

This reader became intensely involved with many of the men as persons—some more than others, as in daily life. The reader will find himself turning back to the picture sections to recall what George Pope looked like—then and now—or to see Sergeant Keller or Sabia, or the co-authors, who are admirably self-effacing throughout. A sterling addition is an appendix that tells as much as possible about the whereabouts and activities of the survivors.

The men of Company K were winners. So is their story, as they tell it themselves.

—Reviewed by John F. Loosbrock. Mr. Loosbrock, a World War II combat veteran of the 1st Infantry Division, is Vice President for Public Affairs of the Aerospace Industries Association and a former Editor in Chief of AIR FORCE *Magazine.*

New Books in Brief

Army Air Force Lyrics, by Lt. Col. J. K. Havener, USAF (Ret.), with cartoons by Bob Stevens. Both the boredom and the gusto of the average airman often gave vent during the war years to humorous marching songs, musical parodies, and assorted drinking ditties. Colonel Havener has here assembled the lyrics to more than fifty such songs, spanning subjects ranging from the frustrations of cadet days to the exhilaration of going home. AAF veterans of World War II are sure to find a chuckle. Aero Publishers, Inc., 329 West Aviation Rd., Fallbrook, Calif. 92028, 1985. 104 pages. $4.95.

Jane's Avionics 1985–86, edited by Michael Wilson. The burgeoning world of avionics is explored in this fourth annual edition in thorough *Jane's* fashion. Communications, data processing, flight control, navigation, radar, and other various electronic devices are cataloged, described, and in many cases pictured. In his Foreword, editor Wilson overviews recent developments in the international avionics industry and discusses at depth the advent of fly-by-wire technology and its impact on aircraft design. With glossary and index. Jane's Publishing, Inc., New York, N. Y., 1985. 526 pages. $100.

THE BULLETIN BOARD

By James A. McDonnell, Jr., MILITARY RELATIONS EDITOR

DoD Authorization Bill Passes

After much backing and filling, Congress, late in 1985, finally passed the FY '86 Defense Authorization Bill, and the President signed it into law in November. While the next act in this drama was still to come at press time, knowledgeable Capitol Hill observers told AIR FORCE Magazine that it was "likely" that the necessary accompanying appropriations bill, funding the upcoming fiscal year authorizations, would be passed "shortly before Christmas." As you read this, it may already have become law.

In any event, the Authorization Bill, which probably predicts the future state and shape of the Defense Department with some accuracy, contains these features, some of which kick in sooner and some later in the fiscal year.

- A three percent military pay raise, retroactive to October 1. It is being paid now.
- Several travel pay improvements, such as increasing the dislocation allowance from one month's allowance to two month's worth. The family separation allowance would also increase from $30 per month to $60. PCS mileage rates would go to 15¢ a mile for one person, 17¢ for two, 19¢ for three, and 20¢ per mile for four people.
- A cost-shared dependent dental plan. In essence, this would be a dental insurance plan. The cost-sharing feature would be based on a monthly premium with payroll deduction. Benefits would include full coverage for preventive, diagnostic, and emergency services and eighty percent coverage for fillings and dental repair services. (Even if the Appropriations Bill affirms this, it would not be effective before September 30, 1986.)
- Retirees face a cut in the military retirement fund of some $2 billion this fiscal year. The Pentagon must propose permanent changes to the program that would save that amount. All officials, however, stress that changes adopted will not affect anyone now in the military or already retired.
- An okay for dependent students to fly space-required to Stateside residences or schools from an overseas area, not including Alaska and Hawaii.
- Authorization for advance housing allowance payments during PCS moves.
- An extension of the test of the flat-rate per diem for one additional year.

As mentioned, the final monetary picture for the services won't be clear until the Appropriations Bill is passed. Preliminary work on that has surfaced one aspect sure to bring some complaints—an attempt to require military installations to purchase liquor in the state in which they are located. This will allow states to tax the alcoholic beverages. Such a provision had also been attached to the Senate Authorization Bill, but was dropped after strong protests by the House. DoD is not keen on the proposal, because it fears it will destroy a central purchasing system and drive up costs for both DoD and the eventual purchaser.

Time will tell what the final results will be on this and other parts of the big funding measure. A senior Air Force official noted that the "quality of life" items in the Authorization Bill were significant—"not everything we needed or wanted, but not bad."

Arnold Air Society Marks Veterans' Day

The Arnold Air Society, the national AFROTC Honor Society—and an AFA affiliate—mounted a national Veterans' Day vigil. It was designed to show the veterans of the US "how thankful we are for their service," said Salvador Arango, the East Texas State University AAS Commander.

The event, beginning in Texas, swiftly spread to other campuses. AAS Brig. Gen. Steven Hiss, the AAS National Commander, urged each participating school to place a guard at the flag for a twenty-four-hour period. A total of 155 campuses took part, with about 5,500 AFROTC cadets joining in.

Different ceremonies were held in different locations. Pennsylvania State University hosted their local congressman in a patriotic program. East Texas State University sponsored a speech by a returned POW. At Clemson University, a joint program with the Army ROTC was conducted. Other activities included parades, AFROTC displays, flyovers from local bases, and many, many others.

Society officials are pleased with the success of this project. As one

AFA bade farewell to Secretary of the Air Force Verne Orr and his wife Joan with a dinner prior to his retirement on November 30. On the left, Mrs. Orr receives a Jimmy Doolittle Fellowship from California State AFA President Gerald Chapman and Aerospace Education Foundation President George Hardy. On the right, AFA President Marty Harris presents a special award to the Secretary.

summed it up, "We firmly believe it is because of those who served before us that we may serve today."

Credit Cards for BXs

At press time, it was almost certain that Stateside base exchanges would phase in the authorized use of credit cards for Christmas shopping, and overseas exchanges are expected to start "sometime soon."

Credit cards are programmed for use in main exchange stores, clothing sales stores, some exchange concessions, and convenience stores. Base barber shops and other outlets offering personal services are not using the plastic money.

While the specific credit card companies furnishing the services were still to be selected at press time, it was expected that MasterCard and Visa may be among those finally chosen. Use of credit cards is expected to increase exchange sales by about six percent. It is expected that the Navy and Marine Corps exchange systems will shortly follow the credit card practice—however, they may not accept the same credit cards eventually chosen by the Air Force and Army.

Former AFA JOAC Chairmen Meet

In what had to be a unique event, four former chairmen of AFA's Junior Officer Advisory Council recently held a reunion at Maxwell AFB, Ala., at the dedication of the Monument to Powered Flight. *(For more on the JOAC, see "Eye to Eye on the Personnel Concerns," p. 218, September '85 issue.)* On hand *(see photo)* were Col. Thomas F. Seebode, the first JOAC chairman and now Director of Plans and Programs at the Air War College; Col. David L. Hosley, the second JOAC chairman, currently Air University DCS/Plans and Programs; Col. Douglas A. Patterson, the fourth chairman, presently spending a year as an Airpower Research Fellow with the Airpower Research Institute; and the eighth chairman, Lt. Col. (Col. selectee) Clyde J. "Jack" Downey, deputy base commander at Rhein-Main AB, Germany.

Four former chairmen of AFA's Junior Officer Advisory Council recently met at the dedication of the Monument to Powered Flight at Maxwell AFB, Ala. They are (from left) Col. Douglas A. Patterson (1972 chairman), Col. Thomas F. Seebode (1969), Col. David L. Hosley (1970), and Lt. Col. (Col. selectee) Clyde J. Downey (1976).

The Monument to Powered Flight, an inspiration of Air University Commander Lt. Gen. Thomas C. Richards, commemorates the choice by the Wright brothers in 1910 of the Kohn Plantation—now the site of Maxwell AFB—as the location for the world's first school of aviation. The monument, a stainless-steel, full-size replica of the Wright Flyer, marks that historic event in aviation history.

New Checks on the Way

If you get a government check, you will shortly receive your last familiar green, punch-card check and will instead be looking at a lightweight paper voucher that ranges in color from light blue to pale peach. It will feature a full-length engraving of the Statue of Liberty on the left side and a close-up of the statue's head and torch on the right side.

The reasons for the changeover are varied, but essentially reflect the fact that technological changes have made the punch-card version obsolete. Conversion is expected to save the taxpayers about $6 million annually in paper and in storage costs.

As a plus, the new check is also more difficult to alter or counterfeit. It contains more than a dozen security features—three times as many as the old one. Security safeguards are included in the paper, the ink, and the design.

The first Air Force people to receive the new checks will be Reservists and Guard members, probably this month. At about the same time, Social Security recipients will get the new version. In February, the IRS will begin using the form for tax refunds; on April 1, retirees will join the parade, along with the nearly 2,000,000 federal employees.

By mid-1986, all checks should be of the new hues. The government issues some 600,000,000 checks annually. In the Air Force, officials expect little confusion since more than ninety-one percent of active duty, eighty percent of the retirees, and eighty-two percent of the civilian work force have their pay deposited electronically. However, Uncle Sam is worried about the rest and about all others who get the new paper—the concern is that skeptics will doubt its authenticity or, worse, accidentally throw it away because it's the "wrong color."

In World War II, "Lucky Strike Green" went to war when dyes used in a favorite green cigarette package of the day were diverted to the war effort. We might say that, after forty years, the "green" has now become a government retiree.

Air National Guard Director Maj. Gen. John B. Conaway unveils the AFA Chief Master Sergeant Dick Red Award during the plaque's dedication ceremony at Andrews AFB, Md. Those in attendance included AFA Executive Director Russell E. Dougherty, AFA Assistant for Programs and Awards Brenda G. Beauregard, and AFA Assistant Executive Director James A. McDonnell.

Short Bursts

The **Veterans Administration** has begun referring **delinquent accounts** to private credit reporting agencies. "No one likes to have a bad credit rating," says VA Administrator Harry N. Walters. "We hope that this move will give the veterans who are delinquent the incentive to clear up outstanding debts." During the last re-

porting year, the VA collected $91 million that had been delinquent. Next step—tapping tax refunds to help pay off the indebtedness, most of which stems from past overpayments of educational benefits.

Speaking of veterans, records show **twenty-three Civil War widows** still collecting benefits—fifteen from the North and eight from the South. Also on the rolls are **sixteen Indian War widows.**

The Air Force says, "Don't give your **ID cards** to unauthorized people." One example cited is letting a car dealer hold the ID while the owner is road-testing a car. Regulations specifically prohibit allowing anyone else possession unless "surrendered to or confiscated for cause by authorized DoD authority."

Assistant Secretary of Defense for Reserve Affairs James H. Webb, Jr., has gone on record as endorsing an annual muster of Reservists who do not belong to organized units. He notes that it need not be simultaneous, but could be accomplished by having each Reservist in the Individual Ready Reserve report in for a single day, spreading the whole muster across a year.

In what has become almost routine, the **Air Force chess team** again garnered top honors in the twenty-sixth annual Armed Forces Chess Championship Tournament held at the American Legion Hall of Flags in Washington, D. C. The blue-suiters have won eleven times during the twenty-four years that teams have competed. They've also captured individual first-place champions in sixteen years, but the highest they could muster this year was second, wrapped up by **1st Lt. Bobby G. Moore,** Holloman AFB, N. M.

Smoking has been banned on MAC medical flights not only for patients but also for attendants, passengers, and the crew. The ban—permanent on C-9s and being tested on C-141s and C-130s—was made, says Command Surgeon General **Brig. Gen. Vernon Chong,** "to encourage everyone, particularly patients, to stop smoking."

THE BULLETIN BOARD

Pat Golub, Youth Center Director at Brooks AFB, Tex., has been named the Air Force's Youth Center Director of the Year. She edged out 176 other directors to capture the award. (USAF photo)

Top commissaries for 1985 are **Peterson AFB,** Colo., and **Misawa AB,** Japan. They win the L. Mendel Rivers competition. The late Mr. Rivers was a South Carolina congressman and staunch supporter of the commissary system.

If you apply for an evaluation of your **possibly service-connected condition** and are rated "zero," don't despair. VA says several positive things flow from this. The most important is that the rating establishes service connection, entitling you to free, priority treatment by the VA if the condition worsens. It also provides basic entitlement, and future evaluations need only be concerned with degree.

Australia will be celebrating its bicentennial in 1988, recognizing 200 years of European settlement. Many events for US veterans who served "down under" are planned. Contact the American Australian Bicentennial Foundation, 1910 K St., N. W., Washington, D. C. 20006, for details. "Make a Date for Eighty-eight" is their motto.

The best Air Force recruiter for 1985 is **MSgt. Edward D. Fender** of Omaha, Neb. He brought in more than 100 people last year. The top rookie recruiter was **SSgt. Joseph Pawloski,** Utica, N. Y.

Senior Staff Changes

PROMOTIONS: To be **Major General:** Jimmie V. **Adams;** Marcus A. **Anderson;** James T. **Callaghan;** James S. **Cassity,** Jr.; Donald L. **Cromer;** Fredric F. **Doppelt;** Robert F. **Durkin;** Robert D. **Eaglet;** George E. **Ellis;** Richard F. **Gillis;** Richard B. **Goetze,** Jr.; John E. **Griffith;** Michael D. **Hall;** William K. **James;** Wayne O. **Jefferson,** Jr.

Peter T. **Kempf;** Donald J. **Kutyna;** Thomas A. **LaPlante;** Donald A. **Logeais;** Donald L. **Marks;** Paul H. **Martin;** Robert P. **McCoy;** Charles D. **Metcalf;** Thomas R. **Olsen;** Richard A. **Pierson;** Cecil W. **Powell;** Robert L. **Rutherford;** Martin J. **Ryan,** Jr.; John C. **Scheidt,** Jr.; Alexander M. **Sloan;** Richard J. **Trzaskoma;** John H. **Voorhees.**

RETIREMENT: M/G John W. **Ord.**

SENIOR ENLISTED ADVISOR CHANGE: CMSgt. J. C. Riley, to SEA, Hq. ATC, Randolph AFB, Tex., replacing retired CMSgt. Robert W. Carter. ■

A1C Stephen Davis, one of some 100 students at the Naval Technical Training Center in Pensacola, Fla., who tutor elementary school children, helps Leckam Disouryavong study as part of the Operation Saturday Scholar Program. (US Navy photo by Rod Duren)

AFA's Chairman of the Board, Ed Stearn, presents AFA's National Security Award to SMSgt. Charles P. Jewell of Hickam AFB, Hawaii. Sergeant Jewell was the top graduate of Class 85-E at the Senior NCO Academy. (USAF photo)

A Triumph of Will

The cockpit was in flames, but Bill Jones would not yield until his job was done.

BY JOHN L. FRISBEE
CONTRIBUTING EDITOR

By 1967, the US had been at war in Southeast Asia, at first covertly then overtly, for a decade. It was a strange war conducted under a strategy of "gradualism," run by civilian theorists, and masterminded by a Secretary of Defense whose middle name was Strange.

At home, it was business as usual, with little increase in Air Force budgets, a declining aircraft inventory, and a shortage of young pilots—a result of peacetime training quotas and aircraft losses in the war zone that were approaching 1,000. More than 2,500 older pilots had to be returned to the cockpit.

Among the more venerable SEA pilots was forty-six-year-old Lt. Col. William A. Jones III, a West Pointer whose earlier experience had been in SAC bombers and troop-carrier aircraft. Now he was commanding the 602d Special Operations Squadron, based at Nakhom Phanom in northeast Thailand and equipped with World War II-vintage A-1 Skyraiders, popularly known as Spads.

Early in the morning of September 1, 1968, Bill Jones took off on his ninety-eighth combat mission, leading a flight of four A-1s that was assigned the task of locating an F-4 pilot who had been shot down somewhere northwest of Dong Hoi in North Vietnam. Colonel Jones was on-scene commander for the rescue effort. As usual during the monsoon season, the weather was bad—poor visibility and clouds that blanketed the tops of hills in the search area. Jones sent two of his A-1s into high orbit while he and his wingman, Capt. Paul Meeks, spent an hour flying a low search pattern over an area where the downed pilot, Carter 02 Alpha, was reported to be hiding.

Finally, an F-100 pilot made contact with the survivor several miles to the east, in territory well defended by 37-mm guns and automatic weapons. Now Carter 02 Alpha had to be pinpointed and the guns silenced so a chopper could come in for the pickup. As Colonel Jones made repeated low passes over the area, his A-1 was shaken by a violent explosion, apparently from a shell that detonated just below his Spad. He regained control, decided the plane was still flyable, and continued the search until he was rewarded by a call from the downed man, who reported that an A-1 was directly over him. Almost simultaneously, Jones came under attack from an AA gun that fired down on him from the top of a hill. The gun was too close to the F-4 pilot to risk calling in fighters, so Bill Jones attacked with rockets and his four 20-mm cannon.

On his second pass, Colonel Jones's A-1 was stitched with automatic weapons fire that ignited the rocket motor of his ejection seat. The blast of flame seared his neck, face, arms, and hands. Heading for a clear area, he tried, despite excruciating pain, to report the whereabouts of Carter 02 Alpha. His calls were blocked; then his transmitter went dead. There was nothing to do but eject or be consumed by the fire.

Col. William A. Jones III was an A-1 pilot in Vietnam in 1968.

He pulled the ejection handle that jettisoned his canopy, but "nothing else happened," except that the rush of air intensified the flames.

As he prepared to go over the side, the fire began to die down, and Bill Jones decided not to bail out. He would return to Nakhom Phanom if he could and report the location of the pilot and enemy guns. His flight instruments were useless, most of the windscreen gone, his eyes swelling shut, the pain—especially in his hands—almost unbearable, and the weather deteriorating. His only chance was to tuck into his wingman and follow him home. The flight to NKP took forty tortured minutes, ending with manual extension of the landing gear and a no-flap GCA approach through heavy overcast and turbulence.

When Jones was lifted from the blackened cockpit, his hands looking "like mozzarella cheese," he refused a sedative until he had described the precise location of the F-4 pilot and the enemy guns. Later that day, Carter 02 Alpha was rescued.

On recovering from his burns, Bill Jones, who was to be awarded the Medal of Honor, was assigned to duty at Andrews AFB, Md., and promoted to colonel on November 1, 1969. In a supreme irony, Colonel Jones, who had survived more than twenty years of flying high-performance aircraft and nearly 100 combat missions, was killed in the crash of his private plane before the presentation ceremony could be held. President Nixon presented the medal posthumously to Colonel Jones's widow and three young daughters.

After the ceremony, Bill Jones's youngest daughter, nine-year-old Mary Lee, gave the President a copy of her father's book, *Maxims for Men-at-Arms,* illustrated with his own pen-and-ink drawings. Colonel Jones had received the first copy of the book the day before his death. ■

VIEWPOINT

The Quest for Unity

By Gen. T. R. Milton, USAF (Ret.), CONTRIBUTING EDITOR

Military forces operate best when they operate singly—but potential crises are too big for any one service to handle on its own.

We should all be most grateful that the November summit meeting ended in handshakes and good humor instead of in threats. As one of the frivolous benefits, both the Air Force and the Army anticipated bowl games for their academies instead of an increased alert status.

Other summits, however, have ended in similar harmony, only to have things go sour soon after. Geneva in 1955 will serve as an example. President Eisenhower and that jolly pair, Bulganin and Khrushchev, parted in a spirit of friendship. The American President had even, according to Bulganin, disclosed the secret of the dry martini.

Three years later, Berlin was the focus of another war-threatening crisis, and four years after that came the scary Cuban missile confrontation. We can hope for better results this time, but there are no signs as yet that it is safe to drop our guard. Military strength, along with the ability and will to use it, is the basic credential for summit attendance.

With a few exceptions, there seems to be general agreement that our military strength has recovered these past four years, although, according to some critics, perhaps not in quite the right way. But you can't please everyone anyway. The question now being debated is whether or not the defense bureaucracy is up to the task of directing that strength.

Sen. Barry Goldwater, a staunch friend of the services, has questioned the very ability of the United States defense organization to carry on a successful war. A staff report to Senator Goldwater's Armed Services Committee furnishes ammunition for his charge. This 642-page document is a thoughtful analysis of US military organization and performance over the years. Its essential conclusion is that the military services, far from being unified, are powerful and rival entities.

It didn't take 600 pages to uncover that elementary fact, but the report is also aimed at solutions, among them one that would remove the service chiefs from their operational role as members of the Joint Chiefs of Staff and enhance, instead, the stature of unified commanders. The JCS Chairman would be the principal military advisor to the Secretary of Defense, but he, like the service chiefs, would not be in the chain of command. The Secretary of Defense emerges, in this concept, as the commander in chief of all operational commands.

We learned a long time ago that there is nothing new under the sun, and these ideas on defense reorganization are not new either. The last time this country appeared content with its military hierarchy was during World War II. The very magnitude of that war, along with the blessed fact that computers and satellite communications had yet to appear, gave the military supremos great latitude.

Even the Joint Chiefs, close at hand in Washington, operated with scarcely any civilian interference. The Secretaries of War and the Navy were not included at Yalta, the first and perhaps most misguided summit, but instead saw their military chiefs accompany President Roosevelt to the Crimea.

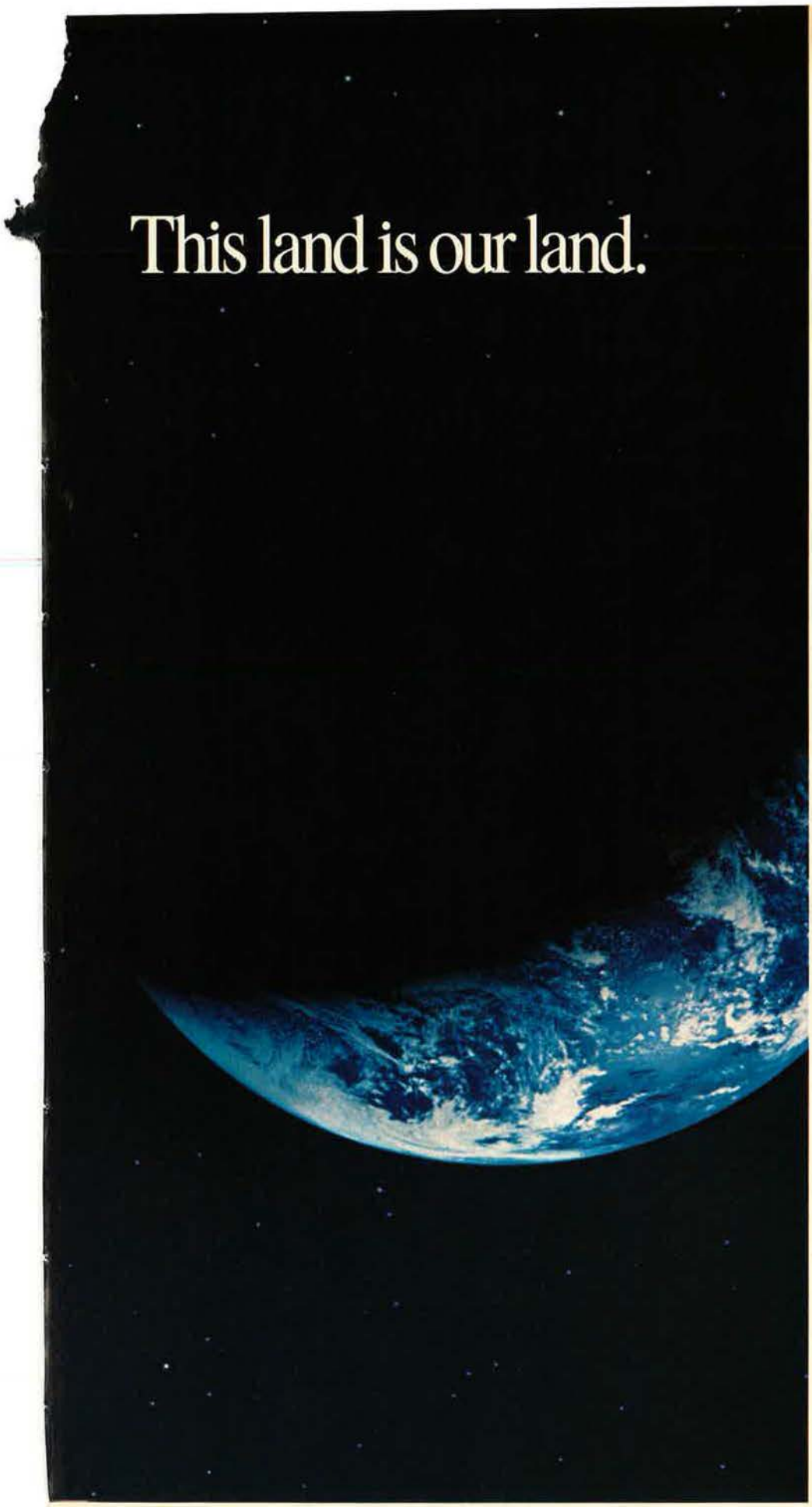
Present unhappiness with the quality of advice coming from the uniformed sector cannot be taken as dissatisfaction with senior military personalities themselves; by any realistic standard, our present military chiefs have come to their jobs better equipped than were their World War II forebears. Nevertheless, accusations mount as to the useless nature of compromised military advice, logrolling that takes the place of serious budget decisions, and service parochialism undercutting the authority of unified commanders. Desert One and Grenada are cited as examples of both parochialism and the inability of our services to work together.

In all fairness, much of the criticism is warranted. It also has a long history. Twenty-three years ago, for instance, Gen. Thomas D. White, then retired as Air Force Chief of Staff, wrote a column in *Newsweek* expressing disillusion with the Joint Chiefs system. "The country," he said, "is not getting the kind of military advice it must have and could have." General White saw a dangerous contradiction in a system that has service chiefs sitting in judgment on their own budgets, an anomaly that could only be dealt with by compromise.

Since the time when General White wrote his column, we have had six Presidents and our longest war, and the same charges are being made. It is easier to point out the faults in the system than it is to make constructive change, for any major alteration in the structure carries with it certain dangers. Several of the proposed reforms, in fact, are downright frightening in all of their implications for the long term.

Our military forces still operate best when they operate singly. Unhappily for that viewpoint, the potential crises are too big for one service to handle. In recognition of that, we have unified commands. The trouble is, as the report notes, the commanders may be unified, but their underlings are not. Service retribution often awaits the innocent who indulges in enthusiastic joint behavior. Unified commanders plainly need expanded authority over the forces allocated to their commands.

Still, thoughtful examination of the defense structure, like the Senate staff report, is healthy and constructive. One way or another, this review will leave its mark. ■



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AFA INTERCOM

By Robin L. Whittle, AFA DIRECTOR OF COMMUNICATIONS

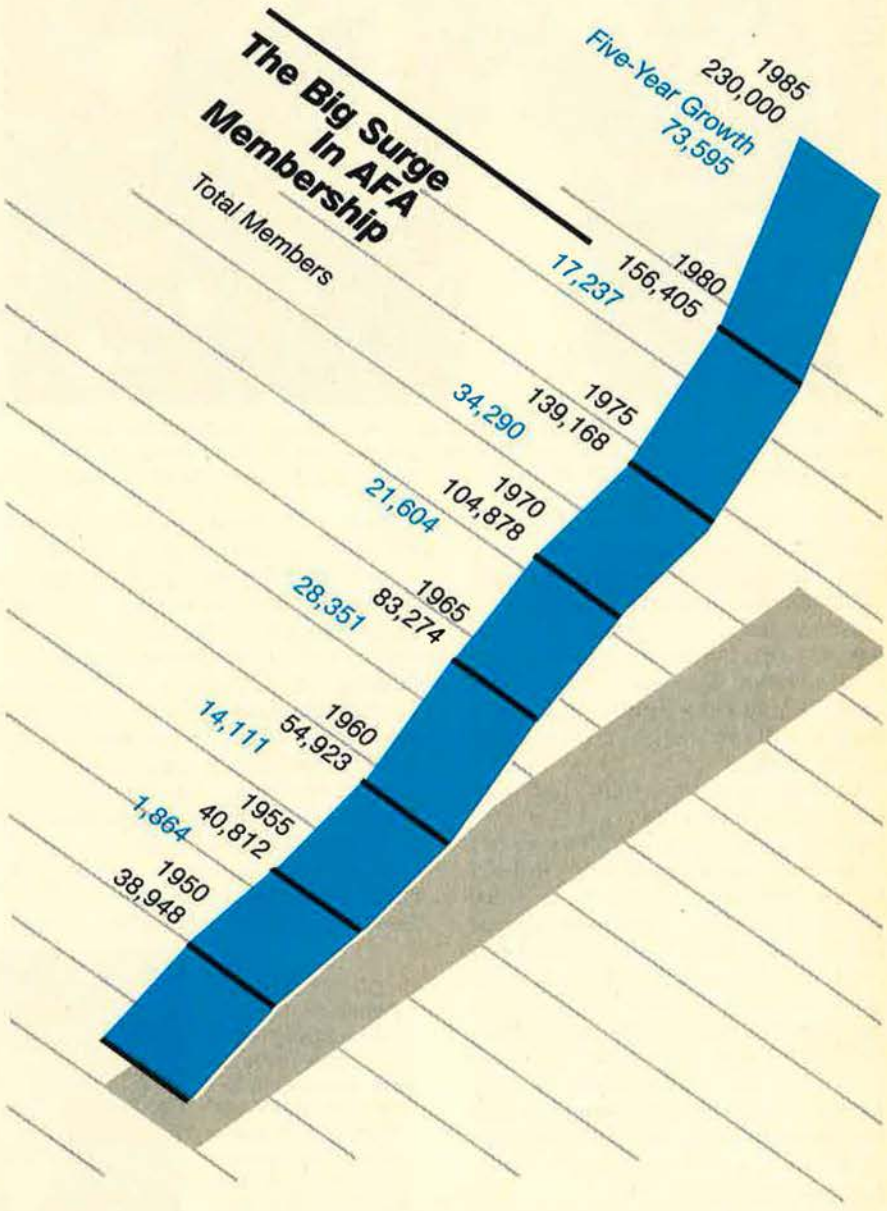
A Year of Growth for AFA

AFA's tremendous growth in membership continued throughout 1985. Net growth for the year was 12,000 members, increasing AFA's total membership to 230,000, with all categories of membership (active duty, civilian, Reserve, Guard, and retired members) sharing in this growth. The five-year membership growth for the 1980–85 period totaled 73,595, which is the equivalent amount of growth experienced by AFA from 1965 through 1980 *(see chart).*

Growth in Life Membership over the last several years has been particularly spectacular, and this trend continued during 1985 with the addition of nearly 5,000 Life Members for a total of 23,500.

Geographically, the largest concentrations of members are in California and Texas, which together account for twenty-five percent of total membership. Aside from these two states and Florida and Virginia, no other single state accounts for more than four percent of AFA's total membership. The balance of the membership is spread evenly throughout the country.

The year was likewise a good one for AFA field organizations. With 310 domestic chapters and forty-two state organizations, AFA's field network continued to expand during the year. But nowhere was that expansion more remarkable than with overseas units, which now number thirty-two chapters worldwide.



AFA's Active Grass Roots

Marvin T. Hicks reports that top award winners at the Florida AFA convention were **Rep. Bill Nelson** (D-Fla.), who received the highest civilian honor, the Gen. Lewis H. Brereton Award, for his strong support of aerospace programs, and **Maj. Gen. Thomas S. Swalm,** Commander, Tactical Air Warfare Center at Eglin AFB, Fla., who was honored with Florida AFA's Jerry Waterman Award, the highest honor the state bestows on an active-duty Air Force officer. Other top honors went to **Robert P. Reynolds,** Cape Canaveral Chapter, who was named Florida AFA Member of the Year for the single outstanding contribution to Florida AFA, and **Norman Abramson,** Central Florida Chapter, who was honored as Florida AFA Man of the Year for untiring devotion to AFA activities and superb organizational ability.

AFA's Eglin Chapter won the Florida State President's Award for Special Events for its strong support of the Air Force Enlisted Men's Widows and Dependents Home Foundation and the Bob Hope Show. Busy convention activities included addresses by General Swalm, AFA National President **Marty Harris,** former Assistant Secretary of the Air Force **Joe F. Meis,**

INTERCOM

and **Dave Noerr,** AFA Assistant Executive Director/Field Organizations, who conducted a well-received workshop for AFA leaders.

A crossed-sabers ceremony was one of the highlights at the Arizona AFA convention, reports **Ed Przybys,**

Then-Arizona AFA President Meryll Frost and his wife Pauline entered the Arizona AFA convention banquet under the crossed sabers of the Northern Arizona University AFROTC unit. NAU professor Col. Robert Groshner was banquet speaker.

Sedona Chapter Vice President, who helped arrange the program along with **Florence Henninger,** Sedona Treasurer. **Col. Robert Groshner,** Professor of Aerospace Studies at Northern Arizona University and the keynote speaker, discussed the "quality of Air Force personnel" and noted that "the Air Force has never been in better hands."

Colonel Groshner's ROTC unit conducted the saber ceremony at an evening function during which a number of awards were presented. **Robert Koele,** manager of the First State Bank of Sedona, **Sherman Loy** of Guardian Security Services, and **Ted Kurtz** of Sedona Airport Services were honored as AFA community partners by then-State President **Meryll Frost. Louis Lipphardt** was honored with the Outstanding Service Award, and **Joanne Reifenstein** and the **Northern Arizona ROTC Detachment** were each honored for outstanding support of AFA.

Thirty-nine outstanding civilian employees from Air Force installations in the San Antonio area were honored recently by AFA's Alamo Chapter at its Dan Berkant Awards Banquet at Randolph AFB, reports **Bob McCullough,** Texas AFA Communications Director and AFA National Director. Named in memory of a former Alamo Chapter leader, the Berkant Awards honor civilians who have distinguished themselves in support of USAF and AFA. Honorees from Kelly AFB included **George C. Araujo, Julius G. Gonzales,** and **Jack E. Davenport,** 149th Tactical Fighter Group, ANG; **O. H. Dawson** and **Frank D. Wing, Jr.,** San Antonio ALC; **James E. Hayes, Ruben Lee,** and **Gary Mackenzie,** 433d Tactical Airlift Wing, AFRES; **Delores I. Lewis** and **Raymond F. Dietrich,** Electronic Security Command; **Linda P. Olivarez, Marilyn A. Miller,** and **John V. Perry,** Air Force Commissary Service; and **June F. Forte** and **Jerry R. Stringer,** Air Force Service Information and News Center.

On behalf of the Colorado Springs/ Lance Sijan Chapter, Chapter President Glenn Griffith, left, received the Colorado Chapter of the Year Award from Colorado AFA President Tom Ratterree during the most recent state convention.

Honorees from Lackland AFB were **Ralph E. Clark, Patricia Cruse,** and **Norma S. Herrera,** Wilford Hall Air Force Medical Center; and **Louise E. Lueb, Patrick Bowden,** and **Robert L. Koger,** Military Training Center. From Brooks AFB: **Margaret Salvatierra, Julia Hilburn,** and **Robert Reyes,** Aerospace Medical Division. Randolph AFB: **Jolene D. Hughes, Marilyn Dobeck,** and **Helen Ball,** Air Training Command; **Edna Juarez** and **Robert Blake,** Air Force Recruiting Service; **Jeanne La Fontaine, James J. O'Brien,** and **Avery J. Hamm, Jr.,** Air Force Manpower and Personnel Center; and **Mark R. Restly, Opal S. Hahn,** and **Roger L. Booker,** 12th Flying Training Wing.

Honored from Fort Sam Houston were **Matilda S. Fuentes, Franklin W. Napier,** and **Gerald R. Carden,** San Antonio Real Property Maintenance Agency; and **Charles A. Grant,** San Antonio Contracting Center.

A special AFA Citation was presented to the Defense Language Institute's English Language Center at Lackland AFB for "unique contributions to international understanding and friendship" and support of AFA. **Col. John M. Kilborn,** Commander of the English Language Center, accepted the award. Also honored, as mentioned in last month's "Intercom," was **Charles O. Kilpatrick,** publisher of the San Antonio *Express-News,* who received the Walter W. McAllister Patriotism Award, which is named for the late mayor emeritus of San Antonio.

Joe Kellogg, Alamo Chapter Vice President for Randolph AFB, served as overall coordinator for the Berkant Awards Banquet. **Patty Mason** chaired the awards committee, **Dave Stoltz** headed up the ticket committee, **TSgt. Doreen Leopold** served as facilities committee chairman, and

Charlotte Loos helped out as AFA administrative assistant.

Texas AFA is sponsoring its annual Earle North Parker Essay Contest for high school seniors throughout the state. Five awards—$1,250, $750, $500, and two in the amount of $250—will be presented for the best essays on the topic "America's Freedom Isn't Free." The winning essays submitted to participating AFA chapters will be forwarded to the AFA-Texas State Office, where the five statewide winners will be selected, according to **Marina S. Furman,** Alamo Chapter scholastic committee chairman.

Mobile Chapter member **Carl J. Lund** was inducted into the Alabama Aviation Hall of Fame in November. He joins former Mobile Chapter President **John Dyas,** who was inducted last year. AFA National Director **Frank Lugo** is one of the seven appointed members of the Alabama Aviation Hall of Fame board of directors, and he, too, is a past Mobile Chapter president. According to Dr. Lugo, Lund started his flying career as a teen with his own homebuilt glider. He was a test pilot, with Charles Lindbergh, in experimental and production test flights of B-24 bombers during World War II and served as a pioneer corporate pilot with the International Paper Co., securing a perfect flying safety record over thirty-two years.

"On behalf of the thirty-six Army, Navy, Air Force, and Marine Corps officers assigned to the US Military Observer Group (USMOG), serving as unarmed military observers with the UN in the Middle East, I would like to thank the Air Force Association for your support of our annual Fourth of July celebration here in Lebanon," wrote **Lt. Col. William L. Colvin, USA,** Senior US Military Observer, in a letter to AFA recently. The celebration was staged for 700 officers and their family members from more than twenty countries who are serving with the US in UN peacekeeping forces in Lebanon. "Our objective was to give our guests the best possible showing of the American lifestyle, culture, and traditions," Colonel Colvin wrote. "Your contribution and support greatly helped us do this. Together, we 'knocked their socks off' as we hoped we would," he concluded. AFA has contributed to this celebration for the last several years.

Then-New Hampshire AFA President Robert McChesney, right, and Norm St. Pierre, left, manager of the golf course at Pease AFB, N. H., recently presented an AFA award to Col. Bernard E. Kane, Commander of the 509th Combat Support Group at Pease AFB. Colonel Kane was accepting the award on behalf of the winners of the annual AFA golf tournament, Gary Peabody and Dan Buckson, Jr.

AFA's Battle Creek Chapter recently honored the 110th Tactical Air Support Group at Battle Creek ANGB, Mich., for obtaining an "overall excellent" ORI rating. Accepting the award from AFA National Director Howard Strand, left, was Col. Ronald Seley, Commander of the 110th.

Chautauqua Chapter officials in Jamestown, N. Y., celebrated the Chapter's twentieth anniversary during its annual military ball on October 26, reports **Richard Barkstrom,** Chapter Vice President and Communications Director. **Robert Dewey,** one of 131 living World War I overseas flyers, was the guest of honor . . . AFA's David D. Terry Chapter in Jacksonville, Ark., ended the 1985 membership year with more than 1,600 members in the central Arkansas area, thus achieving more than 100 percent of their goal. This enabled the Chapter to put $5,000 in a scholarship fund in memory of Lance Cpl. Michael Sands, who was killed in Vietnam, according to President **Bob Byrd** and Membership Chairman **Rudy Wacker.** Elected to serve in 1986 are **Art Brannen,** President; **Ed Ladd,** Vice President; **Rosalie Brannan,** Secretary; and **Buddy McAllester,** Treasurer.

"We're probably number one in the state," declared outgoing Robert H. Goddard Chapter President **Bob Griffin** in characterizing the Chapter's showing in the state and national awards circle. Mr. Griffin, who turned over the reins to **Bob Ruck** in October, was referring to numerous honors at national and state levels garnered by Chapter members in 1985. **TSgt. Clarence W. Ranow** received AFA's national Citation of Honor, as did **William T. Cross. Col. Jack B. Coleman** earned AFA's Meritorious Award for Support Management. **Judy Donato,** who helped organize Chapter events, received two awards—a national AFA Medal of Merit and a Meritorious Service Award from the state.

At the California state convention in San Diego in August, **Maj. Gen. Donald W. Henderson** was honored as Military Man of the Year, and the 659th Aerospace Test Group was named Military Unit of the Year. **Col. Lawrence Gooch** received an Exceptional Service Award, the Goddard Chapter

(Continued on p. 112)

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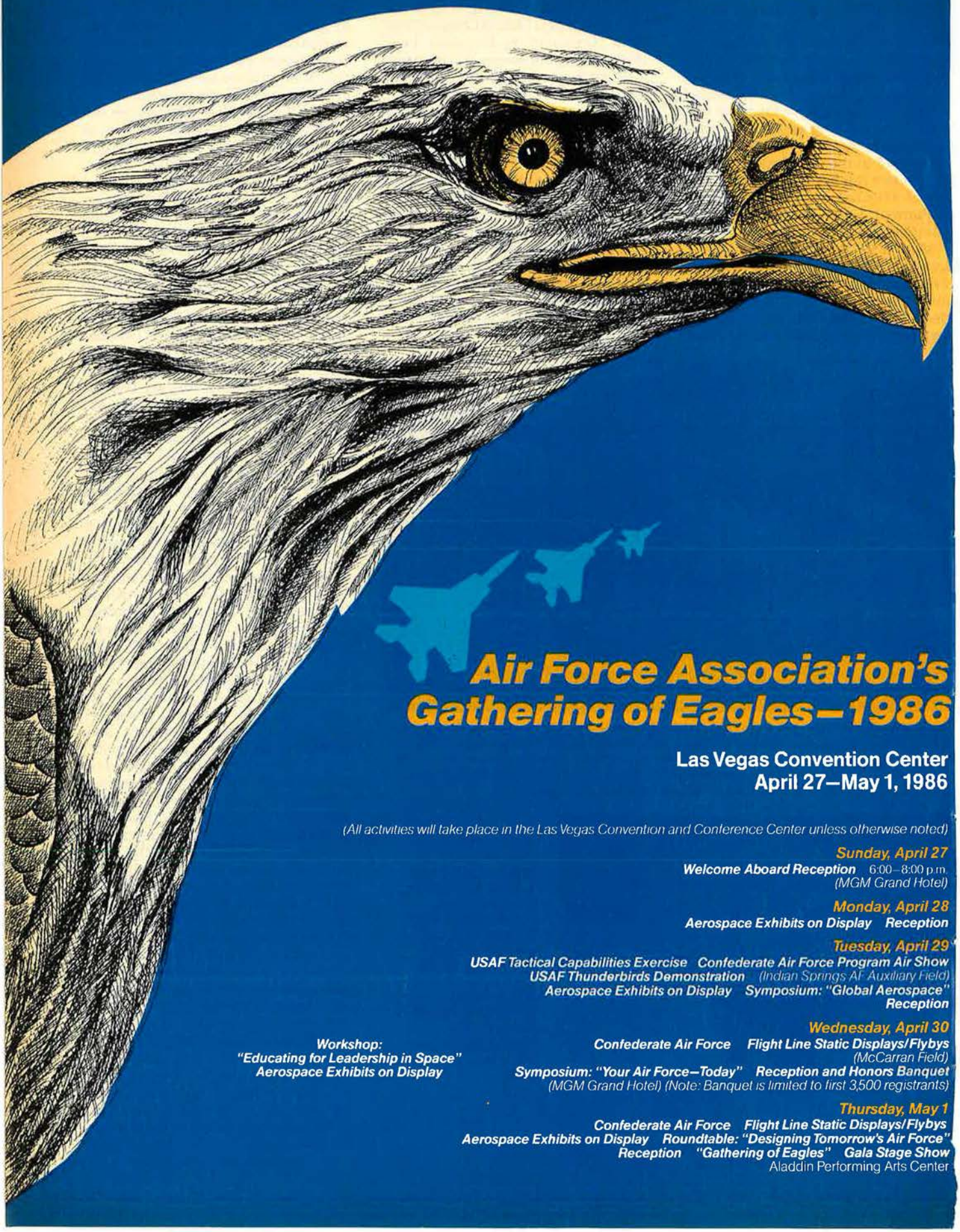


Air Force Association's Gathering of Eagles—1986

Las Vegas Convention Center
April 27—May 1, 1986

(All activities will take place in the Las Vegas Convention and Conference Center unless otherwise noted)

Sunday, April 27
Welcome Aboard Reception 6:00–8:00 p.m.
(MGM Grand Hotel)

Monday, April 28
Aerospace Exhibits on Display Reception

Tuesday, April 29
USAF Tactical Capabilities Exercise Confederate Air Force Program Air Show
USAF Thunderbirds Demonstration *(Indian Springs AF Auxiliary Field)*
Aerospace Exhibits on Display Symposium: "Global Aerospace"
Reception

Wednesday, April 30
Workshop:
"Educating for Leadership in Space"
Aerospace Exhibits on Display
Confederate Air Force Flight Line Static Displays/Flybys
(McCarran Field)
Symposium: "Your Air Force—Today" Reception and Honors Banquet
(MGM Grand Hotel) (Note: Banquet is limited to first 3,500 registrants)

Thursday, May 1
Confederate Air Force Flight Line Static Displays/Flybys
Aerospace Exhibits on Display Roundtable: "Designing Tomorrow's Air Force"
Reception "Gathering of Eagles" Gala Stage Show
Aladdin Performing Arts Center

WHEN SHOULD I REGISTER?

is important that you egister as soon as you an—TODAY, if possible. as Vegas hotels are ormally booked to capacity uring the April/May time eriod each year. Conse- uently, to ensure you are ble to reserve the hotel of our choice—AT the very pecial AFA rate—you must nake your reservations mmediately. Seating at Wednesday's Honors Banquet and Thursday's Gala Stage Show is limited, o sign up *now* to guaran- ee that you will be able to articipate fully in all events.

See you in Las Vegas!

	Postmark Date Prior to February 28, 1986		Postmark Date On and After March 1, 1986 (and on site)	
ckage #1 *ll activities including nors Banquet— ited to first 3,500 istrants)*				
A Member/Patron	☐ $205		☐ $250	
A Spouse/ Dependent	☐		☐	
	☐		☐	
	☐		☐	
n-Member	☐ $235		☐	
ckage #2: *ll activities except nors Banquet, ed., April 30)*				
A Member/Patron	☐ $155		☐ $200	
A Spouse/ Dependent	☐		☐	
	☐		☐	
	☐		☐	
Non-Member	☐ $185		☐	

(Please print or type)

Application for Hotel Reservations

Please list three choices of hotels:

1st _____

2nd _____

3rd _____

Room will be occupied by:

Name _____

Affiliation _____

Street _____

City _____ State _____ Zip _____

Type of Accommodation

___ Single Rate ___

___ Double Rate ___

___ 1 B/R Suite Rate ___

___ 2 B/R Suite Rate ___

Date of Arrival: _____

_____ Hour _____ AM-PM

Date of Departure: _____

_____ Hour _____ AM-PM

Fill out this form completely and mail to:

"AFA Housing Bureau"
Las Vegas Convention & Visitors Authority
3150 Paradise Road
Las Vegas, Nevada 89109-9096

Note:

1. The AFA Housing Bureau will handle all reservations. Do not contact hotels. If changes need to be made after receiving confirmation, contact hotel directly.
2. A deposit of one night's lodging must be sent directly to the hotel once you receive confirmation.
3. Room assignments will be made on a first-come, first-served basis.
4. If a block of rooms is required, attach a list of individuals needing rooms to this form with arrival and departure dates and times.

Hotels and Rates

HOTELS	Single	Double	1-Bedroom Suite	2-Bedroom Suite
MGM Grand	$77	$77	$178-up	$260-up
Caesar's Palace	70	70	200	300
Flamingo Hilton	60	60	150-up	240-up
Dunes	58	58	180	250
Imperial Palace	60	60	150	210
Maxim	38	38	–	–
Continental	45	45	–	–
Alexis Park (All Suites)	70/90	70/90	–	–
Tropicana	42	42	125	250
Hacienda	55	55	100	165
Marina	42	42	100	150
Sands	55	55	125-up	225-up
Desert Inn	75	75	150-up	225-up
Frontier	54	54	185	225
Riviera	55	55	150	200
Sahara	55	55	90-up	180-up
Landmark	52	52	95-125	–
Las Vegas Hilton	64	64	–	–
Mardi-Gras (All Suites)	33	33	–	–

REGISTRATION FORMS MUST BE ACCOMPANIED BY U.S. DOLLAR CHECK, MONEY ORDER PAYABLE TO "AFA," OR CREDIT CARD AUTHORIZATION.

What Name/Title on your Registration Badge(s):

Your Name: _____

Other Registrants: _____

_____

_____

_____

_____

_____

Your Address: _____
Street Address

_____
City State Zip

_____
Country

Phone Number: (____)_____

Send this form and your payment to:

"Gathering of Eagles"
Air Force Association
1501 Lee Highway
Arlington, VA 22209-1198

☐ I enclose $_____ U.S. Dollars (in check or money order only) for _____ Registration Packages

or:

☐ Charge $_____ U.S. Dollars to my credit card, as indicated:

☐ AM EX
☐ VISA
☐ MasterCard

Account number: _____

Expiration date: _____

Cardholder's signature:

_____

Northeast Region—A Banner Year in Communicating

If there is one thing that is obvious to every AFA field leader, it is the quality and nearly endless flow of excellent information received from national headquarters. Produced by a dynamic professional staff, the publications are second to none among those of military-oriented organizations.

It then becomes a challenge for the regions, states, and chapters to "pass the word" to their members. It is not an easy task if one lacks the system and resources to do it.

When we first started to assemble material for this AIR FORCE Magazine feature, I knew the chapters and states of the Northeast Region were doing a good job of communicating with our people. It wasn't until we had it all in one place at one time that I realized the range of information available in the region.

In addition to the region's approximately forty monthly chapter newsletters, each state produces a quarterly news bulletin: New Jersey's *WingTips,* New York's *Runway,* and the Pennsylvania *Flier,* which go to all members in these respective states. Our region is given further cohesion through publication of our regional newsletter, *The Northeaster,* which is leadership-oriented and distributed throughout the region and nationally.

Further, the region produces an annually updated *Northeast Region Almanac,* which is a chronology of events, people, conventions, AFA elections, awards, etc., that keeps the entire region abreast of the year's activities. There are, perhaps, another ten major chapter functions conducted throughout the region for which "above average" publications are produced, and all of them are an integral part of the region's strong communications network.

Jack P. E. Kruse is AFA's National Vice President/Northeast Region.

Of equal importance to the region's success are the extensive awards programs conducted in the three states. Over many years, New Jersey, New York, and Pennsylvania have been developing, producing, and presenting an impressive array of framed parchments, plaques, and trophies that cover all areas of AFA field operations. The unanimous feeling throughout the region is that such honors as these are the best way to say "thank you" for the work done by members who give unselfishly of their own time and talents.

To augment and complement state and chapter honors, we have initiated a Northeast Region Awards Program to credit impressive contributions sustained over time and to bridge the gap between state and national-level awards programs. This represents just one more step upward for the progressive Northeast Region, which I am so very proud to represent.

—Jack P. E. Kruse, National Vice President/Northeast Region.

At a recent Northeast Region conference, the Region honored its past national vice presidents for their many contributions to AFA and its activities in the three-state region. The Region recently instituted a regional awards program to bridge the gap between state-level and national recognition of active AFAers.

New Jersey

New Jersey AFA and its eighteen chapters recently completed a smooth presidential transition from Gil Freeman, who ended his term, to Jim Young, who took over in October. In addition to the president, New Jersey AFA elects three vice presidents, a secretary, and a treasurer. These officers, together with all chapter presidents and past state presidents, constitute the Executive Council, the governing body of the state organization. This Council meets eleven times throughout the year.

There is no question that 1985 proved to be a very successful year for New Jersey AFA. Activities got under way as New Jersey hosted the Northeast Regional Conference at the Seaview Country Club near Atlantic City. A record number of state and chapter leaders—107—attended the superbly organized event, which included formal presentations and a videotaping session. Participants were interviewed on camera, and the results were aired during a Sunday wrap-up brunch. The session familiarized regional leaders with video while enabling newcomers to get to know one another.

New Jersey's major annual event is the state convention, which is held each year at Cape May. The 1985 program, which attracted an overflow crowd of nearly 300 AFAers, featured Gen. Robert T. Herres, then Commander and now Commander in Chief of Air Force Space Command; National President Marty Harris; a host of aerospace industry leaders; and nine visiting air attachés from allied and friendly nations. This was a tough act to follow and the most successful convention to date.

Another annual event is the New Jersey "Fall Ball," which had grown to unmanageable proportions over the years and which was purposely scaled down to its original concept of an in-house event to honor New Jersey's national award win-

ners. Nonetheless, this year's affair attracted close to 200 guests.

At the chapter level, the list of major chapter events is growing significantly and rapidly. New Jersey AFA contains the Thomas B. McGuire, Highpoint, Garden State, Union-Morris, Mercer County, Atlantic City, and Rosendahl Chapters.

Look out, 1986!

New York

New York AFA and its nineteen chapters elected Bob Root for a second term as state president. He had previously served two years as vice president. Bob Holland is the immediate past New York president.

The New York AFA state board, which consists primarily of the elected state officers, chapter presidents, and past state presidents, meets four times each year in various sections of the state and is the governing body for New York AFA.

To select an annual highlight from among the many events held in the Empire State is difficult, particularly when considering the annual Air Force Salute put on by the Iron Gate Chapter in New York City. There is no chapter function on the East Coast that can quite compare with this event. It is in a class by itself, and justifiably so. Since 1963, Iron Gate's contributions to Air Force-oriented charities from the Salute's proceeds are now well into the millions of dollars.

The annual New York state convention heads the list of statewide events and is always a gala affair. The 1985 event, hosted by the Lawrence D. Bell Chapter in Niagara Falls, featured Under Secretary of the Air Force Edward C. "Pete" Aldridge as guest of honor and principal speaker. In addition to a well-attended and unique "President's Reception" staged at the Niagara Aquarium, the three-day event included a poignant POW-MIA memorial service at the American Falls that was broadcast live over a local radio station. Throughout the convention, WHLD-AM interviewed guests and sent these segments back to hometown radio stations.

Rosendahl Chapter member Ron Montgomery was recently honored at the New Jersey Fall Ball with a National Medal of Merit and the New Jersey Aviation Education Award for his work in acquiring and restoring a vintage FJ-3 Fury aircraft. With Mr. Montgomery is his wife Carol.

New York chapters were active in a number of unique ways. Among leading New York AFA chapters are the Plattsburgh, Genessee, Chautauqua, Colin P. Kelly, Westchester, and Nassau-Mitchel Chapters.

New York AFA is on the move!

Pennsylvania

Pennsylvania AFA and its eighteen chapters elected Jack Flaig for his second term as state president. He follows Tillie Metzger in that position. Other elected Pennsylvania officers include a vice president, secretary, and treasurer and three elected regional directors for the east, central, and western parts of the state. These individuals function as vice presidents for their respective geographic areas and report directly to the state president. The elected state officers, chapter presidents, and past state presidents make up the governing body of Pennsylvania AFA.

Pennsylvania AFA's primary thrusts are aerospace education, strong support of Air Force junior and senior ROTC and Civil Air Patrol, and getting young people at the college level to lean toward careers critical to the Air Force. Pennsylvania AFA was actively involved in supporting the 1985 national Arnold Air Society and Angel Flight Conclave held in Pittsburgh for some 1,200 cadets, Angels, and AFA supporters.

Another key event was the Pennsylvania state convention, which was held in Pittsburgh and attracted nearly 200 people to hear Maj. Gen. Jack Watkins, Commander, 1st Strategic Air Division, SAC.

Outstanding among statewide events was a full day of planned events at Penn State University that featured local AFROTC and Air Force recruiting units. Sponsored by the Stuart E. Kane Chapter, the event drew more than 500 people who heard AFA Executive Director Russ Dougherty speak on a number of important topics. His speech generated extensive news coverage for the event. Also active and outstanding during the year were the Airport #1, Olmsted, Walker-Mon Valley, Pocono, Greater Pittsburgh, Beaver Valley, Altoona, and Steel Valley Chapters.

Pennsylvania AFA has arrived!

***The Northeast Region does an outstanding job of "getting the word out" to its members through a number of topflight publications. Included among the Region's efforts are New Jersey's* Wingtips, *New York's* Runway, *Pennsylvania's* Flier, *and the Region-wide newsletter,* The Northeaster. *The Region also publishes its annual* Northeast Region Almanac.**

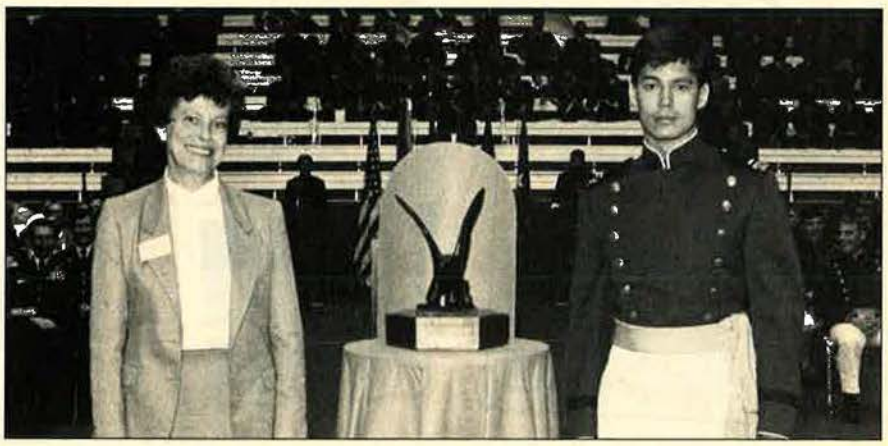
INTERCOM

When Florida Highlands Chapter President **Roy Whitton** realized that not one applicant had been processed from his county to any of the military academies, he decided something should be done. So he contacted **Ruth Handley,** Highlands County Superintendent of Schools,

Local Chambers of Commerce, the Aerospace Associates at Vandenberg AFB, Calif., and AFA's Goddard Chapter recently sponsored Doolittle and Eaker Fellowships for Maj. Gen. Jack L. Watkins. Pictured are, from left, Joe Sesto, Bob Griffin, Roy Alexander, General Watkins, Ed Stearn, and Dick Kline. (Photo by Bruce Fall)

was given the Exceptional Service Award for Communications, and **Tony Castro** earned a Meritorious Service Award. Mr. Griffin received a national Exceptional Service Award and was named California Man of the Year at the state convention. "I can't believe we did so well," Mr. Griffin said proudly. Goddard Chapter officials presented their own honors recently. Recipients of the Engineer and Engineer Technician awards included **Lt. Thomas A. Cristler, Bruce W. Gleason, Stan Podlaseck, Capt. Donald P. Seyler, Lt. Col. James H. Simmons,** and **J. T. Young.**

and suggested a seminar for high school principals, guidance counselors, and career advisors to publicize the academies and ROTC scholarships. The result was a seminar in November at the South Florida Community College that featured representatives from all branches of the services. **Rep. Tom Lewis** (R-Fla.), whom Mr. Whitton contacted during the preliminary planning, provided help and support for the seminar. **Maj. Dave McSpadden,** coordinator of Air Force Academy/AFROTC Affairs at the University of Central Florida, and **Dr. Catherine Cornelius,** President of



Air Force Academy Cadet James R. Meckoll was recently honored by AFA's Iron Gate Chapter for his demonstrated proficiency in the T-41 aircraft. Cadet Meckoll, who has since entered the Euro-NATO Joint Jet Pilot Training program at Sheppard AFB, Tex., received the honor from AFA national staffer Dottie Flanagan, who is also a member of the Iron Gate National Salute Committee.

La Mode Du Golf

COTTON CLASSICS!

Style #1910, $18.50
Features: *4 button placket; 2 pieced fused collar; Pearl buttons; Right side pocket with flap; Double needle tailoring; collar stays; Full golfer cut.*
Sizes: *S-M-L-XL-XXL*
Colors: *White, Navy, Camel, Red, Kelly Green*

Style #2400, $15.50
Features: *Ladies version-2 Button placket; Fashion knit collar; Banded sleeves; Long rear tail.*
Sizes: *S-M-L-XL*
Colors: *White, Bone, Navy, Kelly Green, Lavender*

CASHMERLON™!

Style # 1001, $22.50
Features: *Full turnback cuff; fully fashioned saddle shoulder; full golfer cut.*
Sizes: *S-M-L-XL-XXL*
Colors: *White, Navy, Chocolate, Burgundy*

Style #2001, $22.00
Features: *Ladies Version-Full turnback cuff; fully fashioned; raglan sleeve.*
Sizes: *S-M-L-XL*
Colors: *White, Lt. Blue, Navy and Plum*

ALL WEATHER WEAR!

Style #JK 1700, $31.00
Features: *100% nylon water repellent rain jacket; noise resistant fabric; heavy zippers; hidden hood; action knit under arms allows for free and easy movement; Two front zip pockets.*
Sizes: *S-M-L-XL-XXL*
Colors: *Lt. Blue, Navy, Camel*

Style #JK 2700, $30.00
Features: *Ladies version of JK1700*
Sizes: *S-M-L-XL*
Colors: *Yellow, Navy, Plum*

Style #	Color	Size	Quantity	Price
		Shipping and handling		3.00
		TOTAL AMOUNT ENCLOSED		$

Enclose check or money order made payable to the Air Force Association and send to AFA, 1501 Lee Highway, Arlington, VA 22209-1198. (Virginia residents please add 4 percent sales tax.)(Please allow six to eight weeks for delivery.)

1-86

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This Is AFA

The Air Force Association is an independent, nonprofit, aerospace organization serving no personal, political, or commercial interests; established January 26, 1946; incorporated February 4, 1946.

OBJECTIVES: The Association provides an organization through which free men may unite to fulfill the responsibilities imposed by the impact of aerospace technology on modern society; to support armed strength adequate to maintain the security and peace of the United States and the free world; to educate themselves and the public at large in the development of adequate aerospace power for the betterment of all mankind; and to help develop friendly relations among free nations, based on respect for the principle of freedom and equal rights for all mankind.

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NATIONAL VICE PRESIDENTS

Information regarding AFA activity within a particular state may be obtained from the Vice President of the Region in which the state is located.

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Cabin John, Md. 20818
(703) 821-0387
Central East Region
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Philip G. Saxton
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Portland, Ore. 97230
(503) 255-7872
Northwest Region
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(ex officio)
Chairman, JOAC
Offutt AFB, Neb.
Steven T. Hiss
(ex officio)
National Commander
Arnold Air Society
West Lafayette, Ind.

the South Florida Community College, also helped plan the event.

Col. Ronald Seley, Commander, 110th Tactical Air Support Group, was honored by AFA's Battle Creek Chapter recently for obtaining an "overall excellent" ORI rating. The award was presented by AFA National Director **Howard Strand,** whose last assignment prior to retiring in 1981 was as Commander of the 110th . . . AFA has added three new chapters—the Miami, Fla., Chapter, led by **Stanley Bodner;** the Terre Haute-Wabash Valley, Ind., Chapter, led by **Dave Shimic;** and the Sgt. Charlton Heston Chapter in Waterbury, Conn., led by **Dennis Theriault.**

Former AFA National Director **Joe Falcone,** who is now Connecticut AFA Vice President, was a guest of the Royal Air Force's 617th Squadron at RAF Marham, Kings Lynn, Norfolk, England, in October. He was escorted by **Flt. Lt. Mike Barnard, RAF,** a graduate of RAF Cranwell, the equivalent of the US Air Force Academy. Joe was escorted to several RAF bases, where he had an opportunity to see current RAF aircraft as well as many deserted USAAF airfields. He also visited RAF Mildenhall, home of the 306th Strategic Wing (SAC), commanded by **Col. Lynn Berringer. Capt. Dwight Hartman,** an Academy graduate, escorted Joe during his visit to Mildenhall. ■

UNIT REUNIONS

American Defenders of Bataan and Corregidor
The American Defenders of Bataan and Corregidor will hold a reunion on May 4–11, 1986, at the Sheraton-Twin Towers in Orlando, Fla. **Contact:** Ralph Levenberg, P. O. Box 337, Henderson, Nev. 89015. Austin Patrizio, 414 Richmond Pl., Leonia, N. J. 07605. J. Vater, 18 Warbler Dr., McKees Rocks, Pa. 15136.

Caterpillar Ass'n
The Caterpillar Association will hold two reunions in 1986. One will be held on February 21–22, 1986, at the Ramada Inn in Fort Myers, Fla., and the other on July 25–27, 1986, at the Daytonian Hilton in Dayton, Ohio. **Contact:** Lt. Col. Johnny Brown, USAF (Ret.), P. O. Box 1321, Kenosha, Wis. 53141. Phone: (414) 658-1559.

Selman Army Airfield
A reunion honoring those who served at Selman Army Airfield during World War II will be held on April 18–20, 1986, at the Holiday Inn-Holidome in Monroe, La. **Contact:** Anita A. Akin, Convention and Visitors Bureau, 1333 State Farm Dr., Monroe, La. 71202. Phone: (318) 387-5691.

11th Bomb Group
Members of the 11th Bomb Group will hold a reunion on July 2–6, 1986, in Sacramento, Calif. **Contact:** Robert E. May, P. O. Box 637, Seffner, Fla. 33584. Phone: (813) 681-3544.

11th Service Squadron
The 11th Service Squadron will hold a reunion on May 2–4, 1986. **Contact:** John J. "Jack" Heckler, 76 E. Harbor Dr., Teaticket, Mass. 02536. Phone: (617) 540-1303.

13th Bomb Squadron
Members of the 13th Bomb Squadron will hold a reunion on April 10–13, 1986, at the Holiday Inn in Savannah, Ga. **Contact:** P. C. Billac, 43 Cornus Dr., Savannah, Ga. 31406. Phone: (912) 352-9358.

23d Bomb Squadron
The 23d Bomb Squadron will hold a reunion on June 4–6, 1986, at the Colonial Hotel in Williamsburg, Va. **Contact:** George J. McDowall, 1620 Calvary Ct., St. Cloud, Minn. 56301. Phone: (612) 251-7550.

Class 41-B
A forty-fifth-year reunion is in the planning stages for spring or summer 1986 for members of Class 41-B. **Contact:** Col. Robert G. Carnahan, USAF (Ret.), 6 Foxhall Ct., Silver Spring, Md. 20906.

49th Fighter Squadron
The 49th Fighter Squadron, 14th Fighter Group, will hold a reunion on July 11–14, 1986, at Griffiss AFB, N. Y. **Contact:** Sheril D. Huff, 3200 Chetwood Dr., Del City, Okla. 73115. Phone: (405) 677-2683.

65th Fighter Squadron
Members of the 65th Fighter Squadron, 57th Fighter Group, will hold a reunion on May 30–June 1, 1986, at the New Imperial House and the Air Force Museum in Dayton, Ohio. **Contact:** John N. Morrison, HCR 68, Box 74, Thomaston, Me. 04861. Phone: (207) 354-2490.

73d Bomb Wing Ass'n
Members of the 73d Bomb Wing, including personnel from the 497th, 498th, 499th, and 500th Bomb Groups; the 65th, 91st, 303d, and 330th Service Groups; and attached assigned units on Saipan during World War II will hold a reunion on May 8–11, 1986, at the Royal Sonesta Hotel in New Orleans, La. **Contact:** Glenn E. McClure, 105 Circle Dr., Universal City, Tex. 78148.

INTERCOM

444th Fighter Interceptor Squadron
The 444th Fighter Interceptor Squadron will hold a reunion on June 20–22, 1986, at the Airport Holiday Inn near Charleston AFB, S. C. **Contact:** Wallace Mitchell, 535 Mimosa Rd., Sumter, S. C. 29150. Phone: (803) 469-3297 (home) or (803) 775-1281 (work).

Air Force Ground Crews
I would like to hear from Air Force ground crew veterans who served in Southeast Asia and who are interested in forming an association. You can contact me at the Landmark Hotel during the "Gathering of Eagles" event in Las Vegas, Nev., or at the address below.

Jack S. Douglas
P. O. Box 9097
Salt Lake City, Utah 84109

Patterson Army Airfield
I would like to hear from officers and enlisted personnel who served at Patterson Field from 1942–45 for the purpose of planning a reunion.

Please contact the address below.

Erwin J. Michaels
5327 S. Ashland
Countryside, Ill. 60525

Pueblo Army Airfield
The Pueblo Historical Aircraft Society has scheduled a reunion for July 20, 1986, and would like to hear from crews who served at Pueblo Army Airfield, Colo. The Society would also like to borrow such items as patches, any pictures that would be available of the base for constructing a model of it, and a base logo.

Please contact the address below.

William Feder, Sr.
Pueblo Historical Aircraft Society
P. O. Box 7433
Pueblo West, Colo. 81007
Phone: (303) 547-3402 (office)
(303) 547-2285 (home)

Wright Field
I would like to hear from anyone who served at Wright Field during World War II so that we can plan a reunion. Flight test, aeromedical, aircraft, armament, propeller, powerplant, and equipment laboratory personnel are invited.

Please contact the address below.

George J. Burrus III
Hidden Harbour
21 Lake Eloise Lane
Winter Haven, Fla. 33880
Phone: (813) 324-2089

Classes 44-F and 44-G
I would like to hear from members of Classes 44-F and 44-G for the purpose of planning a reunion.

Please contact the address below.

Frank B. Thornburg, Jr.
9400 Briarwood Blvd.
Knoxville, Tenn. 37923-2117

80th Troop Carrier Squadron
I am attempting to put together a reunion for my World War II outfit, the 80th Troop Carrier Squadron of the 436th Troop Carrier Group. The target date at present is August/September 1986. The reunion site will be St. Louis, Mo.

Please contact the address below for additional information.

William R. Elmendorf
1015 Lantern Lane
Lebanon, Ill. 62254
Phone: (1-618) 537-2454

Eagle Watch

Watch this space each month for updates on the activities planned for AFA's exciting Gathering of Eagles. The Gathering of Eagles, to be held from April 27–May 1, 1986, in Las Vegas, Nev., promises to be the aerospace event of the decade!

In addition to those organizations listed on p. 222 of the September 1985 issue, p. 140 of the October 1985 issue, and p. 130 of the December 1985 issue of AIR FORCE Magazine, the following groups will attend the Gathering.

1st Troop Carrier Squadron
443d Troop Carrier Group
Mr. David J. Orth
11506 E. Whitmore
Hughson, Calif. 95326

8th Air Force Historical Society
Mr. Elmer Fessler
3111 N. W., 173d Terrace
Opa-Locka, Fla. 33055

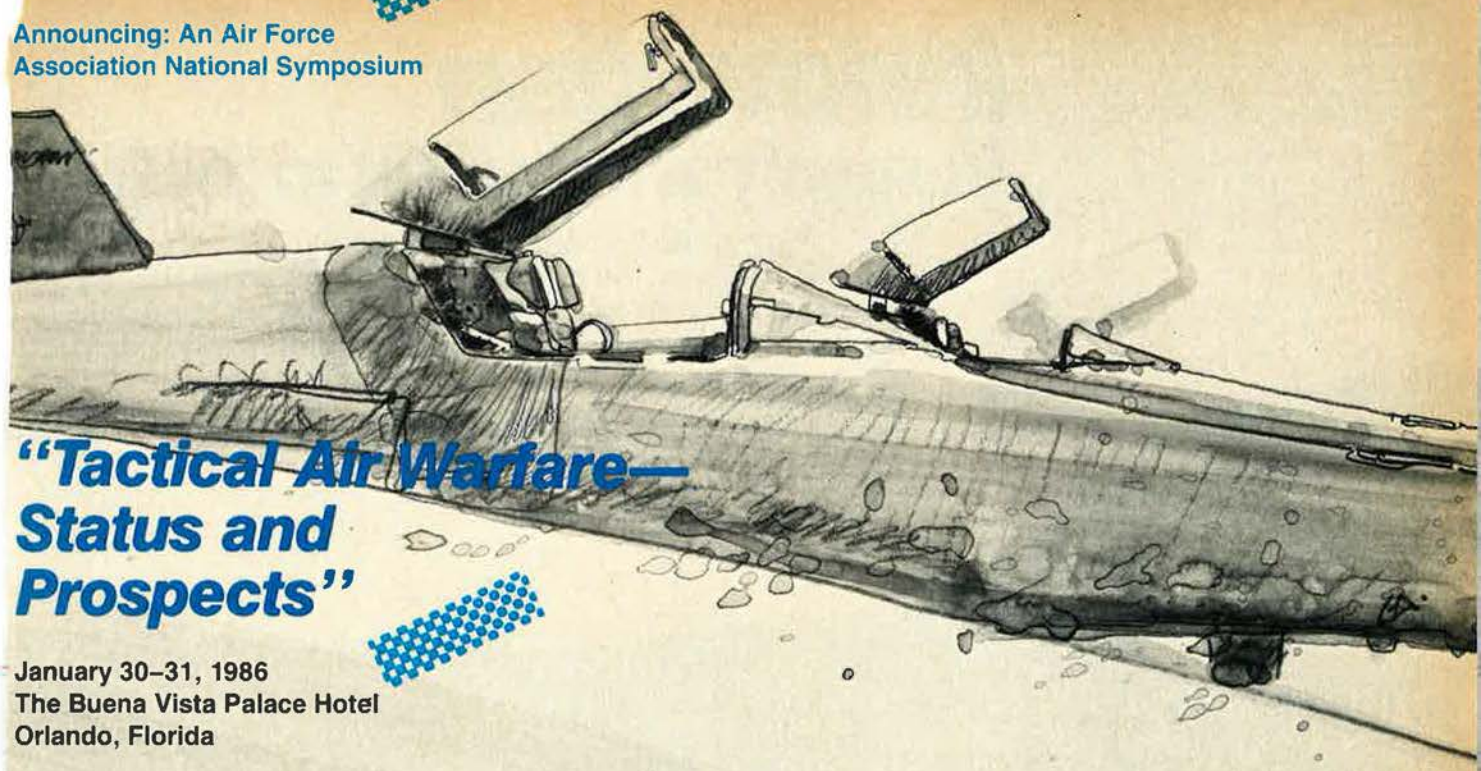
459th Bomb Group
Col. Frank Knepper, USAF (Ret.)
241 Paseo Recortado
Green Valley, Ariz. 85614

F-86 Sabre Pilots Association
Mr. James Gregg
12219 Montego Plaza
Dallas, Tex. 74230

If your group has been listed in this space but you have not yet signed up, notify the contact listed. If you or your alumni group has not considered attending the Gathering of Eagles, we recommend that you take action today. Remember, eagles don't flock—they gather. We encourage all interested individuals and affinity groups that want to gather with us to *sign up now!*

If you are interested in how this might be worked out, call Rick Harris, AFA Headquarters, (703) 247-5800, and get all the details.

Announcing: An Air Force Association National Symposium



"Tactical Air Warfare—Status and Prospects"

January 30–31, 1986
The Buena Vista Palace Hotel
Orlando, Florida

You won't want to miss this year's edition of one of AFA's most important programs. In conjunction with the Tactical Air Command, we are again sponsoring a timely Symposium to provide in-depth assessments of tactical air requirements as well as the technical developments, doctrine and evolving Soviet threat that will affect tactical air warfare into the twenty-first century. Theater air defense, defense suppression, tactical command and control, electronic warfare, and close air support will all be extensively explored.

The tentative lineup of distinguished speakers includes:

Gen. Robert D. Russ, Commander, TAC (Keynote)
Gen. Duane H. Cassidy, Commander in Chief, MAC
Gen. Charles L. Donnelly, Jr., Commander in Chief, USAFE
Gen. Robert W. Bazley, Commander in Chief, PACAF
Gen. George B. Christ, USMC, Commander in Chief, Central Command
Gen. Fred K. Mahaffey, USA, Commander in Chief, Readiness Command
Dr. Donald A. Hicks, Under Secretary of Defense for Research and Engineering
Mr. Donald C. Latham, Assistant Secretary of Defense for C³I
Lt. Gen. Thomas H. McMullen, Commander, Aeronautical Systems Division, AFSC
Maj. Gen. Gordon E. Fornell, Commander, Armament Division, AFSC
Maj. Gen. Thomas S. Swalm, Commander, USAF Tactical Air Warfare Center
Maj. Gen. Gerald L. Prather, Commander, AFCC
Maj. Gen. Robert A. Rosenberg, Director, Defense Mapping Agency

We know you will want to take advantage of this topical, important Symposium as well as the many attractions in the Orlando area. Space is expected to be limited, so sign up now. Registration for all Symposium events is $200 ($225 for non-AFA members).

For information and registration, call Jim McDonnell, Dottie Flanagan, or Sara Ciccoli at (703) 247-5800.

Special Note: AFA's Florida state organization is sponsoring a gala Salute to the Florida Air Guard. This black-tie dinner will be held Friday evening, January 31. For information, call Mr. Norman Abramson at (305) 356-6560 or Mr. John Combs at (305) 369-8134.

REGISTRATION FORM

A 1986 Air Force Association National Symposium

"Tactical Air Warfare—Status and Prospects"

January 30–31, 1986

Registration closes Friday, January 17, 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.) _____

My check covering the Symposium fee for AFA individual or Industrial Associate member of $200, payable to the Air Force Association, is enclosed. This fee includes one (1) Reception/Dinner ticket. (Note: Fee for non-member is $225)

_____ Mark here if an extra guest Reception/Dinner ticket is desired. Enclose $75 for the additional ticket.

Innovation

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Bob Stevens'

"There I was..."

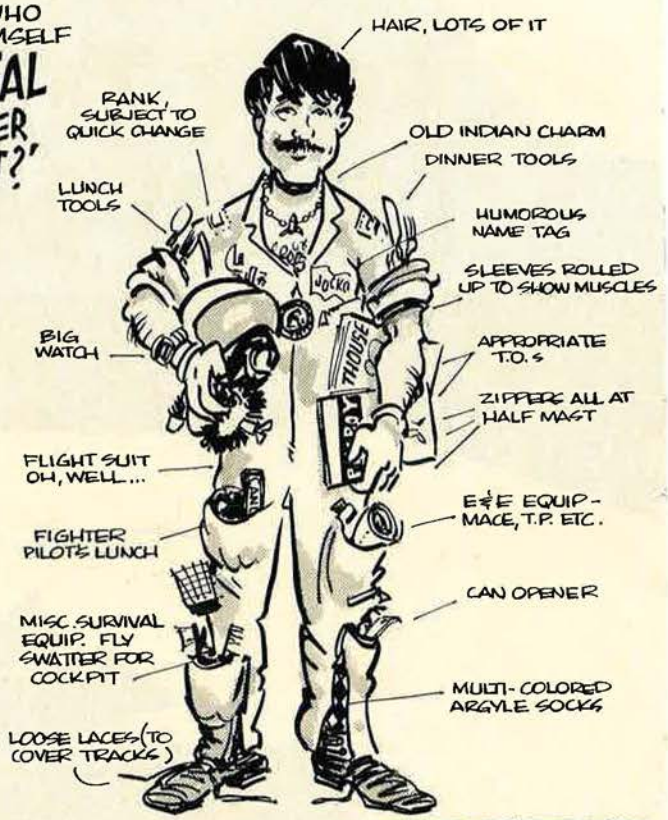
...VISITING AF RESERVE OUTFITS AT BERGSTROM AFB. THE AIR RESERVE FORCES MAKE UP **40%** OF OUR TOTAL FORCE! SURPRISED? WE WERE! YOU CAN FORGET "WEEKEND WARRIORS" and HAND-ME-DOWN EQUIPMENT; THESE PEOPLE ARE READY ***NOW***... and WITH WELL-MAINTAINED MACHINERY!

THE RESERVES HAVE DISHED IT OUT TO THE REGULARS SINCE DAY 1 (REMEMBER "SHERE'S TO THE REGULAR AIR FORCE"?) THEY CAN ALSO LAUGH AT THEMSELVES

REGULAR AIR FORCE
(as seen by the regulars)

GUESS WHO CALLS HIMSELF 'THE REAL FIGHTER PILOT?'

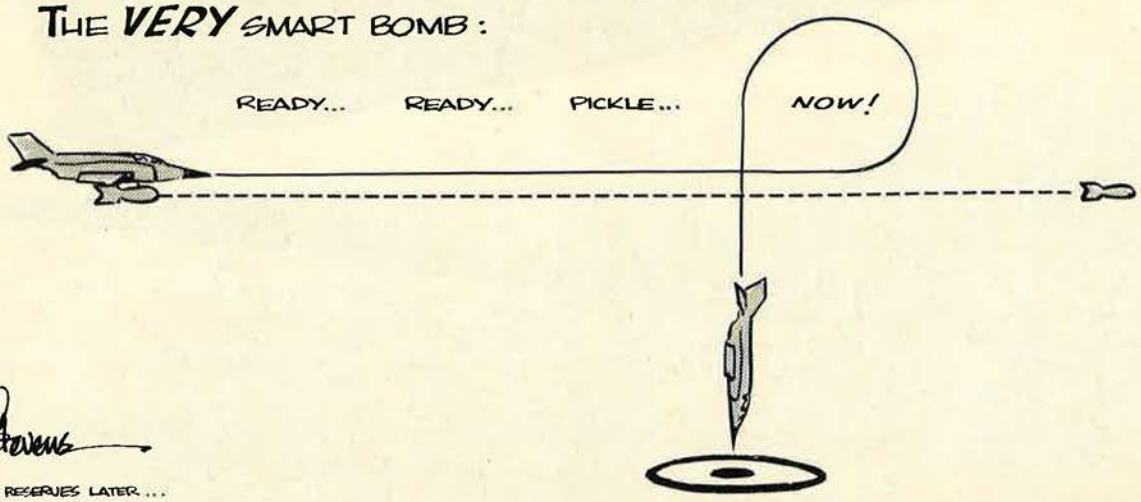
AIR RESERVE FORCES
(as seen by themselves)



MANY THANKS TO TONY PERALTA, TUSCON, & MAJ LEE GRAVES and Lt/c "BILLY BUCK" TRIMBLE, 704 TFS BERGSTROM AFB, TX

THE 704th TFS's "DOOFER BOOK" - THE EQUIVALENT OF A REGULAR OUTFIT'S "HOG BOOK" - COUGHED UP THIS BEAUTY:

THE ***VERY*** SMART BOMB:



Bob Stevens

MORE RESERVES LATER...

COLLINS HF: Introducing the HF-9000 series. Slim, trim and only 23 lbs. Built for the new generation of narrower, lighter tactical aircraft, Collins' HF-9100 system weighs one-third less than similar military performance equipment, and is sized down to about 800 cu. inches. Yet it delivers 175 watts PEP over the 2.0 to 29.9999 MHz frequency range. ■ Pilots will find the Collins HF-9100 easy to operate with 20 programmable preset channels. All available at the flick of a single switch. ■ Two microprocessors make possible automatic operation plus Built-In Test (BITE). Also, the direct digital frequency synthesizer provides the frequency agility required in tactical situations. ■ The HF-9000's use of fiber optics not only saves weight, it eliminates the effects of electro-magnetic interference and can handle large amounts of data in a very short time. This is essential to cost-effective system growth, part of Collins' Pre-Planned Product Improvement Program. ■ For information on the Collins HF-9000 series, contact Collins Defense Communications, Cedar Rapids, Iowa 52498, U.S.A. (319) 395-2690, Telex 464-435. ■ **COLLINS HF says it all.**

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HF FOR TOMORROW'S LEAN MACHINES.

THE F-15: KEY PLAYER ON THE USAF TEAM.

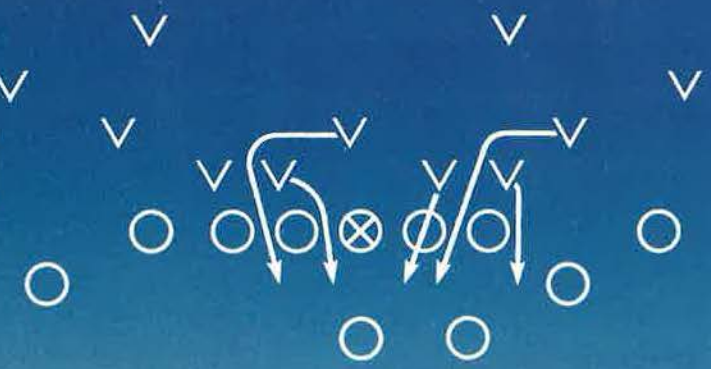
THE MISSION: RAPID DEPLOYMENT. GET U.S. AIR FORCE AIRPOWER TO ANY TROUBLE SPOT IN THE WORLD. FAST. Rapid deployment is a crucial USAF mission required to meet our global commitments. Why? Because situations that require USAF support can occur anywhere in the world with little warning.

Rapid deployment requires versatile and reliable fighters that can travel great distances to get to the fight.

The USAF chose the F-15 Eagle for the rapid deployment mission. The Eagle has the range and speed to reach any area in the world quickly and safely. Its conformal fuel tanks allow it to travel between continents without refueling. It's the only U.S. fighter ready to meet and beat any airborne threat in the world from now through the 1990s. Its combat readiness and safety record are excellent.

For a strong defense, America counts on the USAF. And the USAF counts on the F-15 Eagle.

BLITZ.



MCDONNELL DOUGLAS