

AIR FORCE

PUBLISHED BY THE AIR FORCE ASSOCIATION

MAGAZINE

Revolutionary change in military airpower is coming, spurred on by increasingly complex requirements of warfare. Here's a look at current USAF aeronautical developments and a preview of aircraft and engines of the future.

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AN EDITORIAL

Defense Is Affordable— If . . .

A POPULAR cry in Washington is that the United States cannot afford to pay for defense. The refrain resonates in the rest of the country now. That is partly due to the state of the economy, part to a wistful desire to avoid confronting tough choices, and to an egregiously large degree due to the Reagan Administration's inept handling of the issue.

The "debate" so far has been shallow and artificial. Inordinate attention has been focused on a few cases, such as the MX and B-1, while the bulk go unnoticed. The President and his people have seen the erosion of a fairly strong mandate to recover ground lost to clear threats. The outcome could be multiple cuts in the President's requests, yet still funding at high levels, and at the same time not spending the money wisely. As a result, the US could, within a few years, be in the worst possible situation: having spent bags of money for a defense establishment that is second best when challenged.

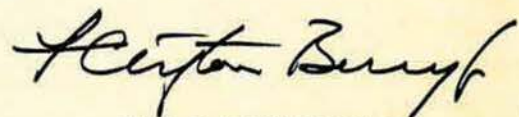
Can the US afford the defense it needs? You bet it can. Consider this: Business will spend about \$60 billion on commercial advertising this year, as much as it spends on its Air Force. Spending on soft drinks this year—about \$18 billion—is equal to that spent for USAF aircraft and missiles. "Can we afford it?" isn't the real issue. More important is how the US can get the best defense establishment—defined as one that wins the wars—at the very best price. Throwing money through the open window of vulnerability won't do. It must be apportioned wisely. That is the question to address.

It can be done, without spending beyond the modest real increases already requested. As a start, the Administration, Congress, and the public ought to press Secretary Weinberger and his entire establishment to husband the treasure prudently, and to tell about it so others can do the same. Mr. Weinberger hasn't made his case very well in this field. But Secretary Verne Orr figures the F-16 multiyear contract saves the country nearly a quarter of a billion dollars.

The 30-mm ammunition multiyear buy is saving \$34 million. Why not more? That's one case. Another: When USAF needed a B-52 weapons trainer, a contractor offered to build one for \$20 million. The Air Force took an old one out of storage and converted it for \$7 million. Let's see more of these and hear about them, because the Air Force is doing a lot along these lines.

A useful step hard to achieve in this age of micromanagement: give commanders and project managers true responsibility and authority. Stay out of their hair. If they fall short, relieve or reduce them. Keep off their backs. Right now, with everyone in the act, no one is truly accountable. That's expensive. It would be great to see project managers get substantial bonuses for bringing systems in ahead of time and under budget, or fined or prosecuted for failures and overruns.

Don't hold your breath for that day. But meanwhile, press for the best use of every defense dollar. We can afford it, and must.



BY F. CLIFTON BERRY, JR.
EDITOR IN CHIEF

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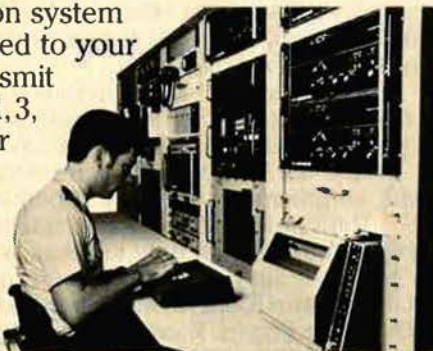
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AIRMAIL

The Freeze

With all due respect and humility, I object to positions being developed and disseminated by some of our church leaders in the United States on matters related to nuclear weapons.

I believe we should raise questions when our churches and synagogues in the United States take positions supporting the nuclear freeze movement. We should also question church leaders in the United States when they take a position on faith and morals related to the doctrine for employment of nuclear weapons, which must be considered as a matter of national defense and security for the United States.

I consider myself to be a staunch Catholic. I believe in the Lord our God with every fiber of my body and soul. In connection with these strong feelings about my faith, I believe strongly that I have done absolutely nothing that can be construed to be morally wrong in the last thirty-five years of my life in carrying out my responsibilities for the US government's development, production, stockpiling, and military utilization of nuclear weapons. Quite the contrary, I believe in my heart that in my small way I have made a genuine contribution to establishing an effective deterrent to nuclear war and, thank God, the US nuclear deterrent has, so far, been effective in preventing a nuclear war. I have been, and will continue to be, proud of every minute I have served the US Air Force, the Atomic Energy Commission, the Energy Research and Development Administration, and now the Department of Energy in the nuclear weapons program.

I served thirty years in the Air Force as a specialist in nuclear weapon safety, reliability, and stockpile management. I graduated from the Air Command and Staff College and the Air War College, completing my thesis on Nuclear Weapon Command and Control. Since retirement from the Air Force, I have worked for the Atomic Energy Commission, the Energy Research and Development Administration, and the Department of

Energy in a number of nuclear weapons assignments. For the past ten years, these assignments have included membership on National Security Council interagency groups developing US policy on the Threshold Test Ban Treaty, the Peaceful Nuclear Explosives Treaty, the Non-Proliferation Treaty, and the Comprehensive Test Ban Treaty. In that capacity, I was directly involved in assembling technical information regarding the verification of those treaties. I served on a number of US delegations negotiating the treaties and related arms-control matters with representatives of the Soviet Union in Geneva, Vienna, Moscow, and Washington.

Having stated these qualifications, I would state again, with all due respect and humility, that I would in no way presume to instruct church superiors on matters of faith and morals, but I have no compunction in stating unequivocally that I believe they are wrong in the positions which are emerging concerning the nuclear weapons program of the United States. It grieves me and disturbs me deeply when I see religious leaders moving in directions that could result in weakening the US nuclear deterrence and increasing the military advantage to the Soviet Union.

I am sure this is not intended by our church leaders, but I ask that they consider carefully who would benefit by a nuclear freeze. Who do they believe, in reality, would be frozen in deployment, testing, and production of nuclear weapons? We know that once such a treaty is agreed to and ratified by the United States that we will in all honesty live up to the terms of the treaty and that our democratic system of checks and balances will assure that we do. We can believe that such actions will dismantle the US nuclear weapons capability. We can also be sure that this dismantling of our nuclear capability has been a long-time objective of the Soviet Union. Having assured ourselves that the US nuclear weapons capability will be disadvantaged and rapidly destroyed, can we now be equally assured that we can verify the Soviet capability will also be

equally limited and dismantled? Can we believe that the Soviets will live up to the terms of a treaty? If they do not, will we have the ability to know when they are violating the treaty? Would we enter into any form of a contract in which we could not assure ourselves that the other party was living up to the terms of the agreement? We do not do this in normal business practice—why should we do it in the life-and-death terms of our national security?

As our church leaders should be most aware, the Soviet Union is a closed society. As such, it is directly opposite in its practices to our open society, where freedom of information prevails and it is extremely difficult to hide any government action that would violate a treaty. The Soviets do not have to be concerned about verification, because the United States will police itself. On the other hand, even under the best of conditions, including on-site inspection rights in the Soviet Union, it will not be possible for us to verify whether the Soviets are designing, developing, testing, producing, and stockpiling nuclear weapons.

I feel that it is most presumptuous of me to remind our church leaders of the duplicity, the godlessness, the lack of honor, and the proven record of the Soviet Union in matters of living up to agreements, unlawful invasions, and suppression of human rights. The reality of Soviet actions throughout the world must be most evident, especially to this nation's church leaders.

We must at all times be assured that the United States is not being placed at a disadvantage relative to maintaining effective nuclear deterrence. I urge our church leaders and other well-intentioned advocates to consider carefully the outcome of supporting a nuclear freeze. Such a freeze can only result in unilateral disarmament, which will jeopardize our ability to maintain an effective deterrent to nuclear war.

I beg our religious superiors not to rule on nuclear weapons matters in any manner that could be damaging

to US national security and the security of the free world.

Col. Robert T. Duff,
USAF (Ret.)
Frederick, Md.

Air Force-Navy Cooperation

As a Trojan, having attended the University of Southern California, it is perhaps second nature for me to beware of Greeks bearing gifts. As a retired Air Force officer, I am even more wary of Navy men bearing gifts.

I am, of course, referring to the article in the November '82 issue of AIR FORCE Magazine by Vice Adm. Gerald E. Miller, USN (Ret.) ("*The Promises and Pitfalls of USAF-Navy Cooperation*," p. 66). Your editorial ("*Blending Seapower and Airpower*," p. 8) provided caveats, and your recommendation of General Mommyer's book would prove most helpful to anyone interested in Air Force/Navy cooperation.

My own view of the Admiral's article is that it was disingenuous. In the cases of the Doolittle Raid on Tokyo and the launch of Air Force fighters into North Africa, the decisions for launch were guided less by a concern for mission accomplishment than they were by a concern, real or imagined, for the safety of the carriers. In the case of cooperation between the Navy and Marines and Air Force forward air controllers in I Corps in Vietnam—if there was joy on the part of the Navy about this chance to work with the Air Force, it was not evident to everyone.

[Former Secretary of Defense Robert] McNamara's scheme to develop an airplane to be used by both the Air Force and the Navy was probably stillborn, considering the candidate, but one couldn't say that the Navy was at all helpful in the venture. The Admiral does make a point about the E-2C being subordinate to the E-3A, but he should have added something about the selling job on the part of the Navy—in direct competition with DoD efforts on behalf of the E-3A—which urged buys of the E-2C. On the subject of aircraft sales, I doubt that the story of the Navy sale of the F-14 to Iran would encourage anyone in the Air Force to consider the Navy as anything other than self-serving.

In addition, does anyone think that, in the event of hostilities in Central Europe, there would be a Navy aircraft carrier in the Aegean Sea to launch sorties into Europe with recovery off the coast of Norway? Not bloody likely!

As you suggested in your editorial, there will surely be some heated com-

AIRMAIL

mentary about the Admiral's article. I sincerely hope so.

Robert L. Herman
Albuquerque, N. M.

The Air Force and Navy cooperation plan has an excellent chance of success, provided the Navy does not invent a new B-1 and the Air Force does not buy a supercarrier. Somewhere betwixt these choices are areas of solid military need on both sides, where mutually supportive roles can give the US an edge over the other guy.

I think the men in uniform will clearly recognize this, and make things work. Agreed, civilian administrators are not the ones to guide this cooperation—it is up to the men who fight the wars to use creative approaches, however unthinkable before.

Gen. Charles A. Gabriel and Adm. J. D. Watkins may have finally hit on an empirical way to gain combat superiority over the common enemy.

James B. Rivera
El Segundo, Calif.

JCS Reorganization

It seems to me that AFA's 1982-83 Policy Papers in the November '82 issue are deficient in not defining policy regarding the proposed reforms of the Joint Chiefs of Staff and the Joint Staff.

The recently retired Chairman of the Joint Chiefs of Staff, Gen. David C. Jones, discussed the problem in an interview in the July '82 issue ("*The System Will Change*," p. 38). In commenting on the need not only to save dollars but also to increase combat capability and effectiveness, General Jones stated: "I'm convinced it's the most important national security issue facing this country."

The AFA Policy Papers seemed to be most concerned with the need to augment the strategic nuclear forces and with the nuclear freeze movement—certainly issues requiring attention but not, I think, to the virtual exclusion of the need for reorganization.

As General Jones pointed out, there is support for reorganization in the civilian sector, particularly among the business community. But within the military, there is resistance—"Institutional resistance to change is very great."

Perhaps the AFA membership—with its dual civilian and military orientation—could play a useful role in facing the broader challenge of reorganization. As the General counseled, we need to "do it in a calm, reasoned way," rather than waiting until a major conflict "to make a change in the midst of a crisis," as unfortunately has too often been the case in the past.

Lt. Col. T. Russell Mager,
USAF (Ret.)
Tacoma, Wash.

No Longer Unnoticed

The article by William P. Schlitz ("*USAF and the National Space Transportation System*," p. 106, November '82) on USAF's investment in the National Space Transportation System was well done, especially regarding the Vandenberg launch site.

However, the article left out two important Air Force organizations—the Shuttle Activation Task Force, responsible for total activation of the Vandenberg launch site, and the 6595th Shuttle Test Group, the launch agency for STS operations from Vandenberg.

The awesome development and operations responsibility of these two organizations to bring Vandenberg on line as an operational STS launch and landing site should not go unnoticed. . . .

Mr. Schlitz is welcome to visit Vandenberg and talk more about the role and missions of these two fine organizations.

Lt. Col. Orlando C. Severo, Jr.,
USAF
Lompoc, Calif.

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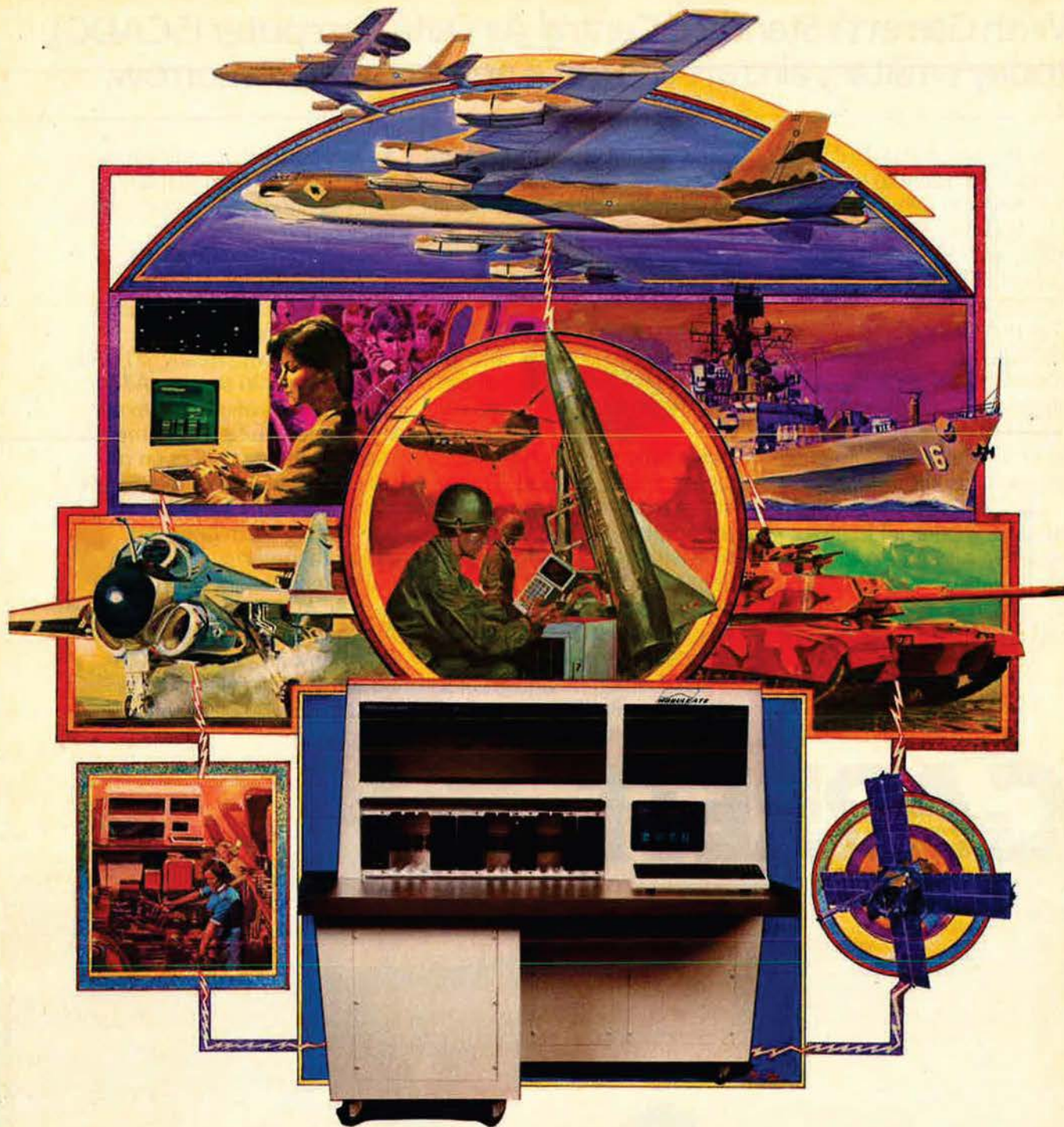
You published the poem "The Co-Pilot" in the November '82 issue of your magazine ("*There I Was . . .*" p. 136).

There is one problem about the poem, and that is that you do not indicate the author.

This poem was written in about 1941 by Capt. A. Keith Murray of the then-Colonial Airlines, Inc., which was later bought by Eastern Air Lines. This poem was published in the October 1942 issue of *The Air Line Pilot*, the monthly magazine of the Air Line Pilots Association, at which time the true credit was given.

I spent a great many happy hours with this true airline pilot and gentleman, and hate to see him deprived of the honor of being credited with the authorship of this much-published poem.

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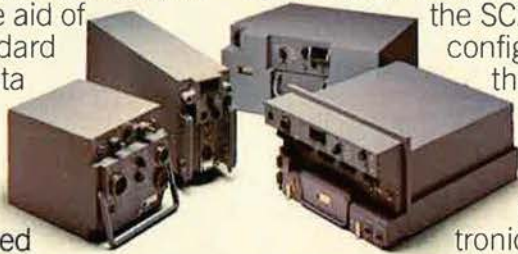
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and still resides in Oyster Bay, N. Y. I know that he would appreciate it if you would find a place in the next issue to give him his proper credit.

Maj. Eugene W. Garges, Jr.,
USAF (Ret.)
Manhasset, N. Y.

Ex-Spouse Benefits

The action of Congress in regard to the "ex-spouse benefits bill" ("*Bulletin Board*," p. 118, November '82 issue) is one more example of their lack of concern for servicemen and military retirees.

The bill (Title X, Public Law 97-252) is an apparent deliberate slap at the military retiree. The manner in which it was passed is reprehensible, to say the least. The provision that prohibits reopening of prior divorce settlements while allowing modification of past McCarty decrees retroactively denies the retiree his right to appeal, but supports appeals that may be made by the ex-spouse. The constitutionality of such a provision is questionable.

All military personnel, whether on active duty, in the Reserves, or retired, should contact their congressmen and ask them to undo the damage that has been done.

There are a few cases in California that are currently under appeal. Hopefully, they will reach the US Supreme Court. This is a slow and expensive process, but, if successful, many retirees will benefit from these cases. Financial assistance—as well as moral support—would be welcome.

Lt. Col. LeRoy W. Brown,
USAF (Ret.)
Upland, Calif.

Proud Weekend Warriors

In reference to your editorial in the October 1982 issue ("*Reserves Pull Their Share*," p. 8):

When I was in the "Regular" Air Force, I looked with displeasure at the Reserve and Air Guard members. I considered the "weekend warriors" to be pseudo-draft dodgers, putting in their six months of active duty and then returning to civilian life. I am ashamed to admit that I felt this way through my entire four-year tour, up until the day . . . I enlisted in the Air National Guard.

Actually, I didn't start out to enlist in the Guard. I had driven my brother-in-law out to the local base so that he could enlist. However, as it turned out, he was not accepted, while I was talked into enlisting. It was the wisest decision I have ever made.

I have to admit that it was a very shaky beginning. The aircraft were

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old combat-weary F-100s. I was told by the recruiter and several other base personnel that the "Lead Sled" was being phased out for F-4s. This, to me, was the real clincher, because I had worked on the F-4 in Vietnam and the Philippines.

It was during my tour with the Air Guard that I realized that they were not draft dodgers or second-class citizens, but highly skilled technicians. . . .

I do not feel that the term "weekend warrior" is derogatory or degrading. As your editorial stated, the Reserves and Air Guard provide an important and necessary contribution to the Total Force.

I am presently no longer a part of the Air Guard, though not by my choice. I suffered a minor heart attack, and the medics decided that I was no longer fit to stay in. . . .

While I was a member, I was proud—in fact, I am still proud—to be called a weekend warrior. In fact, if presented with the opportunity, I would give my right arm to go back.

Long live the Weekend Warriors!
R. C. Mattingly, Jr.
Kenner, La.

October Issue

The October 1982 issue of AIR FORCE Magazine was certainly well received throughout Air Force Reserve. The support of the Air Force Association has been instrumental in helping us maintain our Total Force capabilities, and we sincerely appreciate this fine tribute to our missions and our people.

As I begin my tenure as Chief of Air Force Reserve, I pledge to continue to work to meld effectively the talents and expertise of all our people into the mainstream active force. I am confident the outstanding coverage of our program in your magazine will make my job a little easier.

We are grateful for your help and continued interest in and support of Air Force Reserve.

Maj. Gen. Sloan Gill, USAF
Chief of Air Force Reserve
Washington, D. C.

Great! My sincere thanks and appreciation for the absolutely superb article on the Air National Guard in the October '82 issue of AIR FORCE Magazine.

We are receiving positive comments daily.

Maj. Gen. John Conaway, USAF
Director, Air National Guard
Washington, D. C.

Air Attachés

I want to thank you for publishing the article "Air Attachés Answer the Questions" by Mark Berent in the September '82 issue of AIR FORCE Magazine.

I also thought that you would like to know that our Directorate for Attaché Affairs has received a multitude of inquiries concerning the available attaché assignments that were printed with the article. Several inquiries have resulted in the interested parties actually being worked into the attaché system. . . .

I commend the Air Force Association for the sustained manner in which it supports our active force through the medium of your most professional and informative publication.

Brig. Gen. Schuyler Bissell,
USAF
Deputy Ass't Chief of Staff,
Intelligence
Washington, D. C.

All We Can?

Many of the 2,500 American military people still missing in Southeast Asia belong to the Air Force. We have a reputation for "taking care of our own."

The Air Force Association objective is to promote the interests of the Air Force and its people. It is within that interest to help these people, alive or dead, to be returned to the United States. More must be done by all concerned to put an end to the horrible suffering of these people and their families.

Is the Air Force Association doing all it possibly can?

Lt. Kathleen Conrad, USAF
Loring AFB, Me.

Armed Forces Broadcasters

Broadcasters and others who have served previously or who are now serving in military radio and television, as civilians or as service members, have formed an association—the Armed Forces Broadcasters Association. Supporters of military broadcasting and individuals now in the media are also eligible to participate, and corporate and associate memberships are also available.

The Association plans to support the professional growth of present and former military broadcasters, as well as provide an opportunity for social and professional contacts for all

members. A newsletter, job information center, seminars, and other programs are being planned or are already under way.

Individuals interested in learning more should contact the address below.

Armed Forces Broadcasters
Association
P. O. Box 12013
Arlington, Va. 22209

Kansas CAP

The Kansas Civil Air Patrol has several vacancies open. We feel that perhaps readers could assist us in filling these requirements.

The following vacancies are now open: Director of Administration, Plans and Programs Officer, Supply Officer, Public Awareness Officer, and Transportation Officer.

Interested persons should contact the address below.

Kansas Wing, CAP
Mail Stop 18
McConnell AFB, Kan. 67221

The Chosin Few

Anyone from any allied service who served at or around the Chosin Reservoir in Korea in November and December 1950 belongs to a very exclusive fraternity of honor. The survivors of the battle there are now uniting in a nonprofit association, with the goal of holding a major reunion in 1985. If you were there, would you consider becoming a founding member?

The name of the association is The Chosin Few. Membership already includes veterans from the Army, Air Force, Marine Corps, and Navy. We are now in the process of contacting survivors from the 41 British Marine Commandos and South Korean vets.

The membership fee is \$25 per year to cover costs of organizing and, hopefully, to create a lasting memorial to the men who died in those frozen mountains. The association, among its activities, will publish a newsletter or newspaper, provide updated membership lists, and produce a book compiled from actual newspaper and magazine accounts from the time of the battle.

Please contact the address below for more information.

The Chosin Few
253 Summer St.
6th Floor
Boston, Mass. 02210

Eighth Air Force Scouts

I am currently documenting the history of the Scouting Forces of the Eighth Air Force, 1944-45, and need help.

The exploits of this outstanding or-

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ganization are long overdue for revelation. Made up of bomber pilots who had completed a combat tour, this intrepid group volunteered for still another 150 combat hours in P-51s to scout the route and target for weather, target condition, and enemy opposition for bombers.

The history is well under way, thanks to ex-Scout personnel and USAF, but there are still a lot of blanks that need to be filled in by ground personnel and aircrew members of: the Scouting Force Experimental; the 1st, 2d, and 3d Scouting Forces; the 3d Weather and Scouting Force; the 55th, 355th, and 364th Fighter Groups; the 857th and 862d Bomb Squadrons; the Headquarters of the 65th, 66th, and 67th Fighter Wings; the 1st, 2d, and 3d Air Division Headquarters; the Headquarters of VIII Fighter and Bomber Commands; and Eighth Air Force Headquarters.

People I need to contact for critical information are pilots Earl Thomas, Fred Brown, Ernest Burge, Maynard Frey, Harold Strain, Robert Van Beynum, Clifford Buckles, Sumner Williams, Dale McCory, and Paul Ellsworth, plus Sergeants Hudson, Donahue, and Billisits.

We hope to form a Scouting Force Association and to hold a minireunion at the Eighth Air Force reunion in Houston, Tex., on October 13-16, 1983.

Please contact me at the address below.

Lt. Col. E. Richard Atkins,
USAF (Ret.)
P. O. Box 201
Arlington, Tex. 76012

Piccadilly Lily

The B-17F *Piccadilly Lily* was made famous by the book, movie, and television series *Twelve O'Clock High*. I am researching the aircraft's history. Some of the crew, the ground crew chief, and I are trying to locate the following people who were aboard or who worked on the plane during its history.

They are: Maurice Olson, Homer Fitzer, MacDonald Brink, John Ehlen, Emmett Evans, Cleveland Jarvis, Smith Young, Michael Rotz, Reed Hufford, Gerald Robinson, Harry Jenkins, Erwin Dunkin, Robert Spiller, and Avril Hanna.

We are also searching for relatives

of the men killed aboard the *Piccadilly Lily* when she exploded over Germany: Thomas Murphy, Alvin Barker, Elder Dickerson, Derrell Piel, Aaron David, and Marshall Lee.

We hope to hold a reunion. Please contact the address below.

David Aiken
502 Ball St.
Weatherford, Tex. 76086

WW II Liaison

I am seeking technical, operational, and photographic material and personal stories concerning liaison aircraft and personnel of World War II for a book I plan to write.

Relatively little has been written about the aircraft and men who accomplished so much in so many roles. I believe their story should be told.

I would appreciate any information. Are there any ex-liaison pilot or personnel organizations?

Please contact the address below.
Edward F. Arbogast, Jr.
518 E. Garfield
Cadillac, Mich. 49601

Collectors' Corner

The presence of USAF's 32d Tactical Fighter Squadron in my country has inspired me to collect items of any kind related to the best fighter plane in the world—the F-15.

Anyone who is willing to contribute to my collection can be assured of my sincere thanks, and will receive a photograph of a drawing that I made of a 32d TFS F-15 over Holland.

Anything related to the F-15 is welcome. Please contact the address below.

M. Verschoor
Jan Trooststraat 7
3078 HP Rotterdam
The Netherlands

I am a collector of US military aviation memorabilia. My collection is almost complete.

All that I need to complete it is Vietnam War paraphernalia—patches, photos, etc. (I plan to donate my collection to the Cradle of Aviation Museum.)

Please contact the address below.
Steve Schwartz
66 Barry Lane East
Old Bethpage, N. Y. 11804

I am an avid collector of US Air Force unit patches.

Anyone who would like to donate or sell their patches, please contact me at the address below.

Johnny Signor
3418 Carolyn Lane
Cocoa, Fla. 32922

Aeronautical engineering has come a long way since Kitty Hawk. It will go even further with the development of the X-29A.

Sponsored by the Defense Advanced Research Projects Agency, the X-29A program will be administered by the United States Air Force.

The flight test program, conducted by NASA, is scheduled for 1984. This working relationship between government, military and industry could pay big dividends in the advance of knowledge.

The X-29A program will do more than test the advantages of forward-swept-wing design. It will test a broad range of advanced aircraft technologies.

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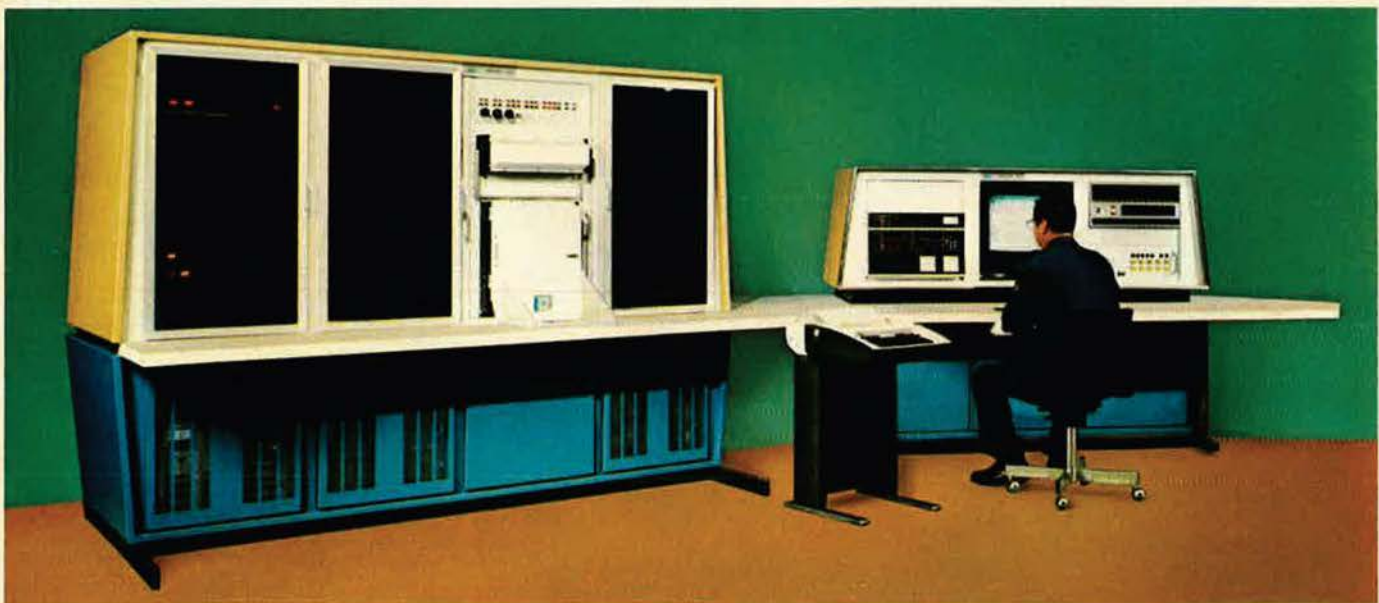
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Peacekeeper and the Protesters

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

White House Says Bishops Ignore Key Points on Arms Control, Deterrence.

Washington, D. C., Dec. 3



On November 22, President Reagan informed Congress of his decision to deploy 100 missiles—now known as the “Peacekeeper”—in a Closely Spaced Basing mode at Francis E. Warren AFB near Cheyenne, Wyo. Pointing out that previous Administrations—and his own—had studied a variety of basing modes, he explained that the “concept of deceptive basing, as employed in previous planning, was a fundamentally sound one for assuring the stability of land-based ICBMs in times of crisis.”

This approach, however, was marred by growing costs—in the range of \$40 to \$50 billion, compared with \$26.4 billion for Closely Spaced Basing—and by the fact that “the cost to our Western citizens in terms of water, land, social disruption, and environmental damage seemed unreasonable.”

He explained that “in reexamining how to base the missiles, we concluded that by pulling the launch sites much closer together and making them a great deal harder, we could make significant savings.”

The Administration’s plan, he said, is to “emplace 100 of these missiles (vs. the 200 in some of the earlier plans) in launch canisters that can be moved, if necessary, between closely spaced superhard silos. We plan to build only 100 such silos, but we will design the system so that we can add more silos later, again within the confines of a small land area, if the Soviets will not agree to strategic arms reductions, or if they persist in the development and production of more powerful and deadly weapons. We

would prefer that the Soviets dismantle SS-18s, rather than we build more holes. But we can accommodate either and maintain stability.”

Two factors primarily drive the MX requirement. The Soviets can destroy the US ICBM force, as configured at present, in a single attack, using less than one-fourth of their present ICBM force. Conversely, the US cannot “effectively threaten Soviet ICBMs even with a preemptive strike.”

MX, according to Defense Secretary Caspar Weinberger, solves both problems. MX can survive a first strike by the Soviets and leave the US with the “retaliatory capability to inflict on them such damage that they would not make that first strike. That is the essence of deterrence.” Further, because MX’s accuracy is twice that of Minuteman III, it provides credible counterforce capabilities against superhard Soviet military targets and will restore an important element of deterrence that is presently lacking.

The President’s decision in favor of Closely Spaced Basing—the basing mode recommended to him by the Air Force—was preceded, this writer learned, by an intensive review of several other options. These included the so-called “common missile,” meaning use of an essentially similar design by the Navy for its D-5 SLBM application and by the Air Force for the ICBM mission; abandonment of the strategic triad in favor of a dyad by phasing out land-based ICBMs; and commitment to CSB that from the outset would have included deceptive basing and the concurrent deployment of ballistic missile defenses.

While the President opted for a deployment arrangement that initially is to be confined to Closely Spaced Basing, the eventual retrofitting of ballistic missile defense and the addition of 200 extra silos to permit deceptive basing is not ruled out. Neither is the possibility of linking CSB with deep rock basing.

The addition of ballistic missile defense is not expected to become necessary before the turn of the century and probably will involve a sophisticated exoatmospheric (above the atmosphere in space) approach, rather

than the much less efficient low-altitude concept available now.

As the President told Congress, “We plan to continue research on ballistic missile defense technology—the kind of smart, highly accurate, hopefully nonnuclear weapons that utilize the microelectronic and other advanced technologies in which we excel. The objective of this program is stability for our ICBM forces in the ‘90s, a hedge against Soviet breakout of the ABM Treaty, and the technical competence to evaluate Soviet ABM developments. We currently have no plan to deploy any Ballistic Missile Defense system.”

The current research and development program on ballistic missile defense is pegged at about \$2.5 billion.

The MX is a four-stage ICBM that carries ten independently targetable nuclear reentry vehicles (RVs). These advanced RVs carry a warhead with a yield of 350 kilotons. MX is seventy feet long, ninety-two inches in diameter, and weighs approximately 192,000 pounds. MX has greater range and targeting flexibility than the Minuteman ICBMs. Its greater resistance to nuclear effects and its more capable guidance system provides the MX with a greatly enhanced hard-target kill capability.

The first three stages of the MX use solid propellant and provide the thrust needed to achieve intercontinental range. The fourth stage uses liquid propellants to carry out the maneuvers that properly deploy the RVs. Along with the liquid propellant, the fourth stage carries the computers

As this column went to press, the House of Representatives voted 245–176 to deny production funding—\$988 million—for the MX program in FY ‘83. In subsequent action, research and development funding for the missile’s basing was “fenced,” meaning that the funding was appropriated but can not be released until April 30, 1983. The Administration reportedly plans to continue to press Congress to permit eventual go-ahead on the full MX program.

and electronic equipment that guide and control the missile from the time of launch through the release of RVs. The MX guidance and control system uses an advanced inertial reference sphere (AIRS) that provides the flight computer with information on missile movement during flight.

The reentry system consists of two main subsystems—the deployment module and the shroud. The deployment module, attached to the fourth stage, carries the RVs. The titanium shroud covers the deployment module and protects the RVs during the first two stages of flight.

Over the life of the program, some 240 missiles are to be acquired, but no more than 100 are to be deployed at a given time. The remainder are spares and test systems. The 100 active missiles will be deployed in superhard capsules at close distances (about 1,800 feet apart) that maximize the phenomenon of fratricide while still far enough apart to prevent one weapon from destroying two capsules. The major features of the CSB concept are the superhardened capsule, close spacing, and array shape. The array itself is a linear configuration, fourteen miles long and one mile wide and oriented from north to south. The superhard capsules contain the MX missiles in their canister/launcher. Hardness levels will be in the 5,000 psi (pounds per square inch of overpressure) range against ground burst and as high as 130,000 psi against enemy warheads detonated in the air above. The geotechnical conditions at the Wyoming site were deemed extremely conducive for achieving high hardness levels, mainly because of the special qualities of the sandy soil that dissipate ground shock.

As a result, a nuclear warhead must come at least twice as close to an MX capsule in order to destroy it than is the case with a Minuteman III silo. Even if an MX silo tilts as much as fifteen degrees, it is still possible to launch the missile.

The system's two underground launch control facilities will be hardened to the same degree as the capsules and linked to the missiles by a network of fiber optics and HF (high frequency) communications, both of which are relatively resistant to the effects of EMP (electromagnetic pulse). For normal day-to-day operations the Launch Control Center provides command and control of the missiles. During and after an attack, survivable command and control would be provided by a small fleet of Airborne Launch Control Center (ALCC) aircraft and satellite relays.

As the Defense Intelligence Agency's special MX panel stated, "In the

IN FOCUS...

foreseeable future, we don't believe the Soviets can achieve in an operationally reliable form the precision time-on-target control required to avoid fratricide at the yields necessary for high-confidence kill of MX superhard silos. . . ."

The Escalating Nuclear Issue

The National Conference of Catholic Bishops—through its ad hoc Committee on War and Peace—recently issued a second draft of a Pastoral Letter in support of a "nuclear freeze" that unleashed a tidal wave of controversy. The pivotal contention of the proposed Pastoral Letter is that "not only should development and deployment of new weapons cease, the number of existing weapons must be reduced in a manner that reduces the danger of war." The notion that the US do so unilaterally and immediately caused the Administration to strongly criticize the Bishops' draft letter.

The White House's National Security Advisor, Judge William P. Clark, responding to the letter on behalf of President Reagan and other members of the Administration directly concerned with the issue, expressed regret about the Bishops' continuing "misreadings of American policies, and [that they] essentially ignore the far-reaching American proposals that are currently being negotiated with the Soviet Union on achieving steep reductions in nuclear arsenals, on reducing conventional forces, and, through a variety of verification and confidence-building measures, on further reducing the risks of war. Thus, while the Committee's draft calls for alternative approaches to current nuclear arsenals and strategies, it does so without presenting the citizen who is concerned with issues of peace and war with any information whatsoever about the initiatives undertaken by the United States to bring the world closer to arms reductions, peace, and reconciliation."

National Security Advisor Clark called the Bishops' attention to these major arms-reduction initiatives sought by the Administration:

"In the US-Soviet negotiations on strategic arms (START), which began on June 30, 1982, we are proposing to begin with a one-third reduction in the number of warheads on the land- and sea-based ballistic missiles and a

reduction in the most destabilizing systems of all, the land-based ballistic missiles, to about one-half of the current US levels. In a second phase, we propose to reduce the destructive potential of the remaining missiles to equal levels, lower than we now have, and we could include other strategic systems as well.

"In the US-Soviet negotiations on intermediate-range nuclear forces (INF), which began on November 30, 1981, we have proposed to begin with the total elimination of the forces considered the most destabilizing and threatening by both sides, the land-based missile systems. We and our NATO allies have offered to cancel plans for the deployment of US Pershing and ground-launched cruise missiles in exchange for the corresponding destruction of Soviet SS-20, SS-4, and SS-5 missiles. Other elements of the balance could be limited subsequently.

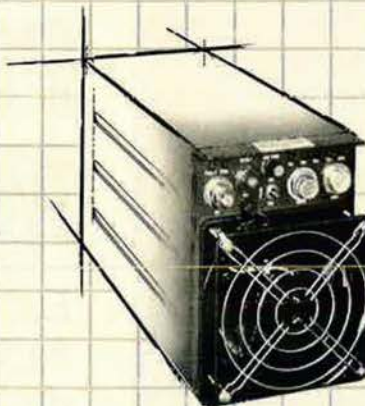
"In the multilateral negotiations on mutual and balanced force reductions (MBFR), the US and its NATO allies are proposing to the Warsaw Pact nations major initial reductions in military personnel to common ceilings and a wide range of new verification measures.

"In the areas of limiting nuclear testing and chemical and biological weapons, the US is actively participating in discussions in the Committee on Disarmament in Geneva to develop the verification and compliance procedures that would make such limitations truly effective. We are, of course, particularly distressed by the extensive and inhuman use by the Soviet Union and its allies of toxins and chemicals against the defenseless populations of Afghanistan, Laos, and Cambodia."

In response to the Bishops' opposition to elements of current US deterrence policy which overall they rated as "at most . . . marginally justifiable," Judge Clark offered this succinct explanation: "To deter effectively, we must make it clear to the Soviet leadership that we have the capability, and will, to respond to aggression in such a manner as to deny that leadership its political and military objectives and impose on it costs which outweigh any potential gains. This requires that we have the capability to hold at risk that which the Soviet leadership itself values most highly—military and political control, military forces, both nuclear and conventional, and that critical industrial capability which sustains war. For moral, political, and military reasons, it is not our policy to target Soviet civilian populations as such. Indeed, one of the factors that has contributed to the

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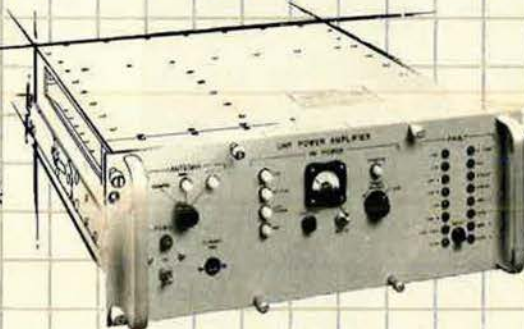


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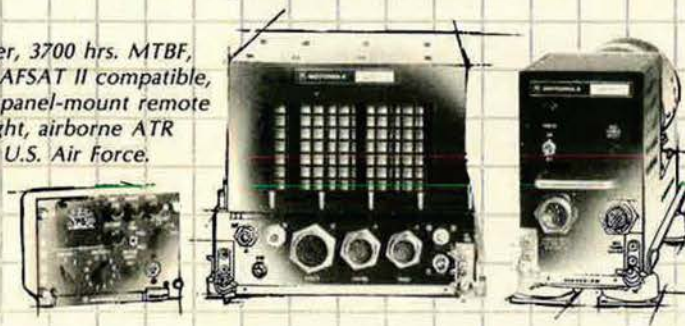
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No other airborne ECM system but the ALQ-161 offers these features with power management in all *four* dimensions: direction, frequency, time and amplitude. This multidimensional capability makes the ALQ-161 an essential system for the defense of the B-1B long range combat aircraft.

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For further information contact:
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Commack Road, Deer Park, New York 11729

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evolution of US strategic policy is the belief that targeting cities and populations was not a just or effective way to prevent war. An understanding of this point appears to be seriously missing from the draft letter."

To turn away from this course that has kept the peace for more than three decades of the nuclear age, the White House National Security Advisor warned the Catholic Bishops, "would increase the risks of war and endanger the cause of freedom throughout the world."

In a related speech, devoted to public misinformation about US nuclear capabilities, Judge Clark posed the rhetorical question of whether the US today possesses more or less explosive power, or megatonnage, than it did twenty years ago. He suggested that most Americans would "respond that we have more. The truth is that today's level is less than half that which existed during the Kennedy Administration. Similarly, if I were to ask whether we have more—or fewer—warheads than we had ten years ago, I am sure that most would respond that we must have more. The truth, however, is that in the course of the past decade, we have reduced the number in our arsenal by about a third."

Washington Observations

★ Gen. John W. Vessey, Chairman of the Joint Chiefs of Staff, told this writer that the present members of the JCS recognize there is no such thing as a "uniservice" war. Rather, future wars involving US forces will be fought by the Commanders in Chief of the unified commands that comprise members from all the services. "We as the [Joint] Chiefs," he said, "have to find the weak points in the seams [of these commands]—if there are any—and touch those up." The JCS treat as a "joint matter" such issues as mobility, intelligence, and command and control, he explained.

The Joint Chiefs are paying increasing attention to the CINCs as the "people who are going to fight our wars." They, therefore, decided that the "first thing we need to do is to understand thoroughly what [the CINCs] plan to do with today's forces. The CINCs themselves have come [to the Pentagon] to explain to the Chiefs their concepts . . . for their more serious war plans so that we as a body will then be able . . . to see what it is they got to carry out the jobs we have given them and what needs to be done in the way of force building and in the way of adjusting the orders we have given them for the war plans. If we told them to do things that can't be done, we need to understand this [in order to] make the necessary adjust-

IN FOCUS...

ments. This we did. We all agree that this was one of the most useful exercises the Chiefs ever engaged in."

As a result, General Vessey said, there will be closer coordination on "cross-service issues." The CINCs "will play a greater role, and this is already under way. The Secretary of Defense already has instituted [changes that give] the CINCs a larger voice," he explained. Turning to efforts to revamp the JCS structure, he said pending proposals by him and the Chiefs to the Secretary of Defense will weigh possible changes in terms of five criteria:

"Would the change help us go to war better? Does it give the National Command Authorities better military advice in a more timely fashion? Does it reinforce the role of the people who have to fight the war, the CINCs? Does it help the President and the Secretary of Defense with their toughest peacetime job, that is, how to build a defense budget? And does it maintain civilian control over the US military?"

Asked if the US could win a war with the Soviets at this time, General Vessey said, "I don't think we should march out and get into one because we have great confidence that we could win. But we are also confident that we would do very well. I don't say that we would win. . . . Also, what is a measure of winning?"

He stressed that "we have no plans to go into such a war. That is not our strategy. We don't want war with the Soviet Union, nuclear war, conventional war, or any war in between. We simply want forces strong enough to make it clear to the Soviets that should they attack us, the penalty would be too great."

In assessing the seeming rapprochement between the USSR and China, General Vessey did not expect the two Communist states to become "great friends." Any reduction of tension between the two countries would strengthen the prospects for peace. On the other hand, "if the PRC and the Soviet Union became allies against the West, that would be significant, but I don't see that."

★ Germany's new Defense Minister, Manfred Woerner, predicted in a recent Washington press conference that the Soviet Union would not engage in any consequential discussions on theater nuclear forces arms

accords until after his country's national election on March 6, 1983. He termed the German vote decisive in terms of whether or not NATO would commit itself to such weapons. The government of Chancellor Helmut Kohl, which has to stand for elections in March, he said, is "clearly an alliance-oriented government. This government has no tendency whatsoever toward neutralism. . . . The only chance to safeguard our interests is in a close alliance with the United States."

The new German Defense Minister took issue with the concept of field fortifications along the NATO/Warsaw Pact borders proposed by some US strategists. This, he said, "makes no military sense. If we have limited forces and the other side has two to three times the number of forces, fixed deployment makes no sense. We outflanked the Maginot Line in World War II and the Russians could do the same thing." He added, however, that the German armed forces have emplaced explosives in all bridges in the forward areas to slow down invading Pact forces.

The new German government, he suggested, is unenthusiastic about providing Patriot air defenses for US installations, but discussions on the subject are going on: "I am not excluding this possibility, but it would be difficult."

★ The Soviet Union, late in October, attempted to launch what appears to be the first mobile, MX-like design of the so-called "Fifth Generation ICBMs," a new family of highly advanced ballistic missiles that has been known to be under development. The test failed when one of the missile's stages, thought to be the first stage, exploded. The Soviet Union, in line with the current policy of cooperative measures, informed the US of the launch.

★ The Defense Advanced Research Projects Agency (DARPA), in conjunction with Air Force Systems Command, is working on a third-generation cruise missile with intercontinental range.

★ Among USAF's long-term technology programs are a jamming mini-drone with a loiter capability of about five hours, which is designed to paralyze an adversary's command control and communications; a "Transatmospheric Vehicle" with horizontal takeoff and landing capability to perform fast-response low-orbit space missions; and HAVE WEDGE, a dual-mode munition capable of alternating electro-optical and RF guidance. ■

Why the Teledyne CAE up-rated turbojet is best for the growth MQM-107 Target.

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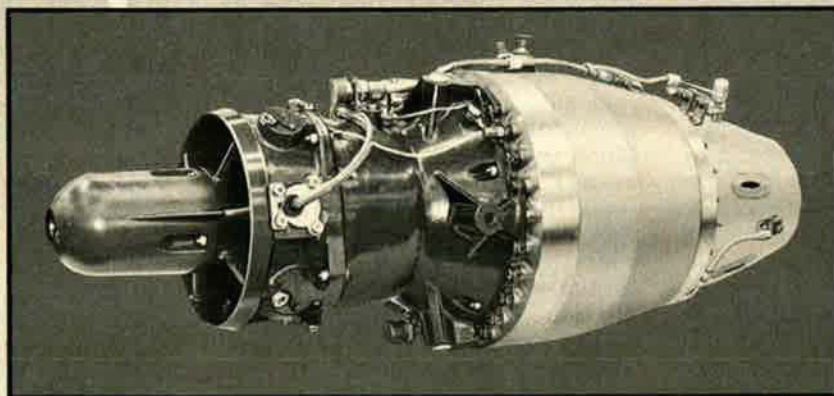
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CAPITOL HILL

By Kathleen G. McAuliffe, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Nov. 29 Panel Recommends DoD Cuts

The House Appropriations defense subcommittee reduced the President's defense request by \$18 billion despite its chairman's plan to cut \$33 billion by deleting some "nice to have . . . big ticket" weapons.

As in prior years, the House panel made a lot of small cuts in various programs to achieve the required savings instead of gutting a few major systems. It approved all major USAF programs except the Imaging Infrared (I²R) Maverick missile, which has experienced some development problems. The Army's Pershing II theater nuclear missile, set to be deployed in Europe in December 1983, was denied \$500 million. This was due in part to test-flight failures, but the recent moderately successful flight could reverse that decision in full committee. Overall DoD funding ultimately may depend on whether the bill passes the House and Senate during the lame-duck session. Also, the spending level may fall victim to popular amendments to cap growth rates in R&D and procurement.

A seven-to-five vote to fund MX was a welcome sign, but the real test will come in full committee, which is polarized ideologically on defense issues. One or two votes could make the difference between defeat and victory, so the Air Force is firming up soft support on the committee and trying to turn around skeptics. Some think anti-MX forces may have peaked in the House earlier this year when they lost by three votes in an attempt to delete procurement funds for MX.

In the Senate, Sen. Ernest Hollings (D-S. C.) questions the survivability of MX in a closely spaced basing (CSB) scheme and thinks he can defeat the missile procurement money during floor debate. However, the Senator, who some sources believe is trying to get political mileage out of his MX stance, lost by four votes in an earlier try at deleting MX funds. Since the Senate approved those funds prior to definitive basing plans, the outcome this time may not differ. While the November elections probably moder-

ated the defense stand of many in Congress, the GOP-controlled Senate still may be reluctant to reject a major strategic program proposed by a Republican President.

Committee "Balance" Sought

Rep. Patricia Schroeder (D-Colo.), a member of the Armed Services Committee, wants the House Democratic leadership to reverse what she claims is a pro-defense tilt of that panel. The congresswoman asked the Speaker of the House, who will figure prominently in committee assignments for the Ninety-eighth Congress, to appoint "national Democrats" to the six Democratic vacancies on the committee. This would make a total of "twelve cost-conscious Democrats and fifteen big spenders," but she claims such a mix still would not be representative of the Democratic party.

Mrs. Schroeder claims the appeal is based on her desire to reduce the deficit and revitalize the economy, but she has supported numerous amendments over the years to cut defense budgets and eliminate major weapon systems. Whether her petition will be heard is unclear, but her own committee leaders may well cite the more liberal Appropriations Committee as a "balance" to any pro-defense bias of the Armed Services panel.

MX and the ABM Treaty

There is concern in Congress over the possibility of eventually adding some form of Ballistic Missile Defense (BMD) to the \$26 billion MX/CSB and its implications for the 1972 Anti-Ballistic Missile Treaty now under review by the Administration. This may keep some Members of Congress from supporting MX, especially since the President, in advising Congress of his MX decision, said he was prepared to consider deception and "possibly" BMD if the Soviet buildup threatens MX/CSB.

The Army reportedly believes 100 defensive missiles would adequately cover MX/CSB and thus not violate the Treaty, which allows the US and USSR one ABM deployment site of up to 100 launchers and 100 intercep-

tors. One Air Force official told Congress that MX/CSB would compound Soviet attack planning by forcing them to structure the timing and spacing of their attacks in a very constrained way, presenting "as near an ideal ABM target as you could get."

Current plans, the President said, call only for continued BMD R&D to provide stability for "ICBM forces in the '90s, as a hedge against Soviet breakout of the ABM Treaty, and the technical competence to evaluate Soviet ABM developments."

Technology Transfer Probe

A Senate investigative panel released findings of a lengthy probe into the transfer of Western high technology to the Soviet bloc. It concluded that lax control by the Commerce Department of exports, especially "dual-use" technology—equipment with civilian and military applications—helped lead to Soviet acquisition of essential microelectronics, allowing them "to systematically build a modern microelectronics industry, which will be the critical basis for enhancing the sophistication of future Soviet military systems for decades."

Acquisition of US ballistic missile guidance and control technology, floating drydocks, and technology for an advanced early warning and control aircraft, anti-aircraft missiles, anti-submarine warfare, and aircraft carrier catapults were all cited as areas where the Soviets have developed at little cost sophisticated military systems from Western technology.

To stem the flow of critical technology the panel suggested: transferring enforcement of trade controls from the Commerce Department to the better-equipped Customs Service, stronger penalties for export violations, better determination of foreign availability of certain dual-use technology so as not to preclude US firms from competing abroad, a reduction in the number of restricted commodities, and improved intelligence to learn precisely what the Soviets need so as to prevent them from obtaining those technologies. ■

AEROSPACE WORLD

News, Views & Comments

By William P. Schlitz, SENIOR EDITOR



Northrop Corp. recently rolled out its new RF-5E Tigereye reconnaissance aircraft at Palmdale, Calif. Key features are the RF-5E's highly automated camera and sensor system, which allows operations around the clock. This aircraft and a second are bound for the Royal Malaysian Air Force.

Washington, D. C., Dec. 6

★ This past fall the Air Force gave yet another demonstration of its ability to project tactical forces over long ranges.

During the annual Reforger (Return of Forces to Germany) exercise, MAC C-141 transports airdropped more than 1,000 paratroopers and hundreds of tons of equipment in what was billed as "the largest nonstop strategic deployment of airborne forces to Europe in the history" of the 82d Airborne Division.

The StarLifters flew the troops and cargo ten and a half hours from Pope AFB, N. C., to two drop zones near Gelchsheim in northern Bavaria. The C-141s were refueled in the air twice and returned to Pope without landing after completing the drop.

According to officials, the paratroopers and equipment—including heavy trucks and howitzers—were all dropped in less than six minutes. Fifteen minutes following the drop the heavy equipment was ready for use.

Brig. Gen. William Overacker, MAC's 322d Airlift Division Commander who headed airlift forces for Reforger, called the airdrop "text-

book perfect—a graphic display of real strategic mobility."

The last of MAC's fleet of 269 StarLifters this past year completed modification that lengthened the fuselage and equipped it for aerial refueling.

★ USAF has given the green light to Sikorsky Aircraft to convert two UH-60A Black Hawks as the prototypes of a new combat rescue helicopter, the HH-60D Night Hawk.

Under a \$36.6 million contract, the company will undertake full-scale development of airframe modifications. Depending on future contracts, deliveries of operational versions of the Air Force's next-generation combat rescue helicopter are expected in mid-1986. USAF could order up to 243 Night Hawks.

According to officials, the Night Hawk will greatly enhance capabilities to conduct aircrew rescues deep behind enemy lines, in darkness or bad weather, and at treetop level to avoid radar detection.

Night Hawk is the Air Force's first new combat rescue helicopter since the Sikorsky HH-3s and HH-53 Jolly Green Giants of the '60s and early

'70s. The new helicopter is to replace most of these older aircraft.

The Air Force, meanwhile, is procuring a number of Black Hawks for aircrew training and familiarization.

★ The Helicopter Association International and the Maryland Institute for Emergency Medical Services Systems plan to cosponsor a National Medevac Helicopter Conference on April 18-20, 1983, in Crystal City, Va.

Objectives of the conference include:

- Considering FAA regulations for the construction of hospital helipads, with specific consideration for future requirements.
- Comparing the organization and cost-effectiveness of various helicopter operations.
- Exhibiting helicopters equipped for medevac.
- Presenting the latest in rotorcraft and medical technology.
- Discussing the characteristics of medical flight personnel used in medevac missions.
- Exploring the financing of a medevac helicopter service.

The hospital heliport is the fastest growing segment of helicopter operations in the US today, and one of the most successful. Hospital heliports in the US now number more than 900, compared to 699 in 1977 and thirty-four in 1964.

At least twenty-six states have active helicopter ambulance service.

For details on the conference call Susan Danker or Richard Saker: (202) 466-2420 or Telex 89-615.

★ "Classic" is a word that may be rather worn around the edges through overuse. But no other label seems to apply in the case of certain types of aircraft.

The Douglas DC-3 springs to mind. The cargo-hauling C-47 version of this aircraft labored mightily during World War II and thereafter. Even now, it reputedly is still in service somewhere around the globe.

In a "class" by itself, however, is the Lockheed C-130. In this age of jet-engine fast movers, the turboprop

C-130 Hercules continues to provide heroic service. After all, the first versions of the aircraft were ordered by the Air Force more than thirty years ago. Yet, it continues in production with basic and specialized versions performing a diversity of roles.

For example, within a recent two-week period Lockheed-Georgia Co. at Marietta announced the receipt of two contracts. One was from the Marine Corps for four advanced model KC-130T aerial tankers that can easily be converted to cargo transports.

The second contract calls for supplying the US Coast Guard with five HC-130 long-range surveillance aircraft that will be used in that and many other missions undertaken by USCG probably into the next century.

In justifying its selection of the HC-130, the Coast Guard cited the aircraft's long-range mission capability and "low-and-slow" controllability. "When missions demand longer time on station, crews can shut down two of the aircraft's four engines to conserve fuel," USCG said.

Through the years, more than forty versions of the Hercules have been built, a tribute to the aircraft's ruggedness and reliability.

★ The year 1983 has been dedicated as an "Air and Space Bicentennial" to commemorate 200 years of manned flight.

The US is to join with other countries to mark the development of flight since man's first ascent in a hot air balloon at La Murette in France in November 1783. A series of events around the US will feature air races, balloon rallies, expositions, and seminars.

And while recognition of the aviation heritage will have an international flavor, the support of government at all levels, aerospace industry, and the American public will "send an unmistakable message to the world that the United States intends to maintain its leadership in air and space science, technology, and engineering," according to officials of the United States Organizing Committee. The USOC is the umbrella organization sponsoring the bicentennial.

USOC board member Sen. Barry Goldwater has given five reasons why the event is important to the US:

- To increase public awareness of the importance of aerospace to American economic development and national defense;
- To make the American public more knowledgeable about the needs of aerospace, particularly for strengthening research and development;
- To educate Americans on the importance of aerospace exports and why that means jobs;
- To emphasize the need to improve scientific and technical training in schools and colleges; and
- To rekindle the spirit of American excellence and enterprise and the importance of maintaining US leadership.

★ The "Sands of Time" Kitty Hawk awards for 1982 were scheduled for presentation in December.

Recipients included:

- **Adm. Wesley L. McDonald, USN**, CINC of the Atlantic Fleet and a naval aviator for more than thirty years. Admiral McDonald is cited for his leadership in restructuring naval aviation to

meet national requirements and for guiding the introduction of the F/A-18 Hornet, AV-8B Harrier, and SH-60B Seahawk.

● **Robert A. Hoover**, corporate director of special projects for Rockwell International Corp. Mr. Hoover's career as test pilot, combat pilot, and demonstration pilot has spanned thirty-five years. During that time, he has flown more than 2,500 exhibitions while demonstrating 300 different types of aircraft. Air show aficionados are most familiar with Mr. Hoover and his demonstration Mustang.

● **Thomas V. Jones**, head of Northrop Corp. An executive with the aerospace giant since 1953, Mr. Jones is being recognized for his lifetime contributions to the industry and the nation.

● **Jerry Marti**, the nation's top male collegiate pilot, is being presented the Kitty Hawk Youth award. A member of the Oklahoma University Flying Aggies, Mr. Marti has been named top male pilot by the Aircraft Owners and Pilots Association for an unprecedented second year in a row.

For the second year, proceeds from December's presentation banquet will be used to provide scholarships for engineering graduate students enrolled in aerospace or related fields, according to the Los Angeles Chamber of Commerce which sponsors the awards.

★ A DC-2, said to be one of only five still around, was hauled from California's Santa Monica Airport to Long Beach by a group of Douglas Aircraft Co. retirees and volunteers recently.

It was the first step in a restoration project. The Douglas Historical Foundation hopes to raise \$150,000 to finance the restoration. The goal is to have the classic plane refurbished by May 11, 1984, the fiftieth anniversary of the DC-2's first flight.

This particular DC-2 was built in Santa Monica and delivered to Pan American Airways in 1935. Forty years later and after half a dozen owners (who used it for everything from hauling passengers to fighting forest fires) it was donated to the Donald Douglas Museum. The aircraft was presented by Stanley Burnstein, President of Continental Aviation Co., Tulsa, Okla.

The historical foundation is offering commemorative DC-2 pins. Ten dollar tax-deductible donations can be sent to the foundation, 3855 Lakewood Blvd., Long Beach, Calif. 90846.

★ This past year Pan American World Airways marked two important anniversaries: the fifty-fifth year of its first

International Search and Rescue Satellite System

The three men clung desperately to their capsized trimaran in the high seas and howling winds of October. Their last hope depended on the Emergency Locator Transmitter in operation since their boat capsized some 300 miles east of Cape Cod.

Orbiting above them was the Soviet search-and-rescue satellite COSPAS, which was monitoring their ELT frequency.

Meanwhile, the Air Force Rescue Coordination Center, Scott AFB, Ill., was processing information beamed by COSPAS. The Center had begun monitoring COSPAS after receiving reports that commercial aircraft were picking up the ELT signal. Once the distress position was determined, the Center notified the appropriate Coast Guard facility on the East Coast.

Soon, Coast Guard and Canadian Air Force aircraft located the unfortunate sailors and USCG cutter *Vigorous* rescued them.

COSPAS, which can orbit the earth in an hour, is the first satellite in a joint US, Canadian, French, and Soviet project under which four additional satellites will be orbited beginning this year. COSPAS has been used to locate aircraft downed in the US, the latest instance this past November.

While the distress site location program is to continue in an experimental stage for another year, its worth has already been demonstrated.

According to officials, advanced ELTs and Emergency Position Indicator Beacons are also under development to mesh with the frequency monitoring capabilities of the planned satellites. The American satellites, for example, will be able to provide a location accuracy of five to ten miles.

SCIENCE/SCOPE

A modified F-15 Eagle is proving its potential as a cost-effective, dual-role fighter that can serve as a strike aircraft without sacrificing air superiority capabilities. The U.S. Air Force is testing the Advanced Fighter Capability Demonstrator F-15 equipped with a radar enhanced with high-resolution mapping modifications. The aircraft has shown it's versatile enough to strike ground targets at night or in bad weather with the accuracy of daytime attack aircraft. Because the radar changes involve minor new hardware and some new computer software, the F-15 keeps its air-to-air features. It sees long ranges, searches large volumes of the sky, detects targets at all altitudes and aspects, and has a "look-down, shoot-down" capability to spot low-flying targets amid heavy ground clutter. The demonstrator is co-sponsored by Hughes Aircraft Company, supplier of the AN/APG-63 radar, and McDonnell Douglas, builder of the F-15.

Military operations will be revolutionized by a system that will allow all forces to communicate among themselves. The Joint Tactical Information Distribution System (JTIDS) Class 1 terminal will serve in the air and on the ground. It will, for example, link Airborne Warning and Control System (AWACS) radar aircraft with ground-based air defense networks. Targets would then be correlated so commanders on the ground would have more information on which to base their decisions. Hughes delivered the first production JTIDS terminal one month ahead of schedule to the U.S. Air Force and NATO by coordinating efforts among many contractors, suppliers, and government agencies. Also, production equipment was built just a step behind the developmental prototype.

A new military radio does double duty, serving as a soldier's high-frequency Manpack radio and as a lightweight, battlefield wireless telephone that operates at the push of a button. The radio, which uses the chassis of Hughes' Manpack radio, adds reliability and simplicity to tactical battlefield communications. It provides direct communications through preselected channels chosen by the operator from 280,000 frequencies. For direct radio-to-radio communications, the operator knows of incoming calls through a quiet beep or a blinking light.

The U.S. Army's Bradley M2 infantry and M3 cavalry fighting vehicles carry a gunner's sight that sees targets shrouded in darkness, smoke, or haze. The unit is called an integrated day/night sight. It directs TOW (Tube-launched, Optically tracked, Wire-guided) antitank missiles, cannon fire, and machine-gun fire with pinpoint accuracy. Hughes has delivered the 100th TOW weapon subsystem, which includes the sight unit, to complete the initial production contract. FMC Corporation is the M2/M3 developer and system integrator for the Army.

Now in its 17th year, Science/Scope remains among the best-read corporate advertising campaigns in history. The campaign was created to explain what Hughes does and how. About 160 different ads are produced each year, with a mix of over 175 paragraphs for use in over 80 publications serving over 60 nations. It is translated into Arabic, Chinese, French, German, Italian, Japanese, Korean, Portuguese, and Spanish -- 10 languages in all, including English. It consistently scores in the top 5% to 10% in readership surveys.

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scheduled flight, and the fifth anniversary of a "still-unchallenged record-setting round-the-world flight" by one of its jumbo jets.

In October 1927, a Pan Am Fokker F-7 trimotor took off from Key West, Fla., for Havana, Cuba, on a flight that took one hour and twenty minutes and inaugurated the first US flag international airline.

The F-7 carried seven sacks of mail,

AEROSPACE WORLD

and in the cockpit was Capt. Hugh Wells, navigator Edwin S. Musick, and flight engineer John Johansen. Musick eight years later would figure



Jay Coburn, left, and Ross Perot, Jr., with *The Spirit of Texas*, the first helicopter to circle the globe, following their landing at Andrews AFB in Maryland. See adjacent item for details of the record-setting feat.

prominently in opening Pan Am's Pacific routes to be flown by the famed China Clipper flying boat.

Fifty years later, in October 1977, a Pan Am Boeing 747SP (Special Performance) with 172 aboard left San Francisco and flew over the North Pole to London, on to Cape Town, and then over the South Pole to New Zealand. The final leg of the flight was the return to San Francisco for a total distance of 26,706 statute miles covered in fifty-four hours, seven minutes, and twelve seconds.

According to the airline, its fleet of forty-five 747s is the largest in the world and the Special Performance 747 is its premier jetliner.

In this commercial aviation footnote, Pan Am underlines some other "gee-whiz" figures that are impressive even to the jaded. For example, today the airline's SP routes include: Flight 5, a 6,914-mile nonstop between San Francisco and Hong Kong; Flight 801, a 6,745-mile nonstop between New York and Tokyo; Flight 25, a 6,594-mile nonstop between New York and Dhahran, and Flight 201, a 4,787-mile nonstop between New York and Rio de Janeiro.

The master of them all, according to Pan Am, is Flight 815, a 747SP that this past November inaugurated non-stop service between Los Angeles and Sydney. At 7,487 miles, and fourteen hours, forty-five minutes' flying time, Flight 815 is the longest non-stop flown by any airline.

★ This past fall, two Americans became the first to circumnavigate the world in a helicopter.

Any Landing You Walk Away From . . .

Capt. Ronald L. Cavendish and his 19th Bombardment Wing crew at Robins AFB, Ga., were returning from a low-level training mission when their B-52 began to lose pressure in its main rudder/elevator hydraulic system. The system is the principal means of controlling the aircraft's pitch.

As the bomber approached Robins the system lost all pressure and the bomber's nose lurched downward.

In the mid-1970s, a B-52 lost all pressure in the same system, but a veteran crew attempted to land the aircraft at Wright-Patterson AFB, Ohio. The bomber was destroyed, breaking up on impact. Miraculously, the crew survived.

"I remember just wanting to get the aircraft back up where I could have a chance to fly it," said Captain Cavendish about the in-flight emergency. "Using the air brakes and stabilizer trim to give me some pitch control, I was able to bring the aircraft back up."

For the next hour, Captain Cavendish flew the B-52 by using trim and air brakes. Since this required the use of both hands, the copilot, 2d Lt. Frank A. Boyle, took over control of the throttle.

"My first thought was that we should ditch the plane," said Captain Cavendish. "But after a few minutes of flying with the trim and air brakes, I became confident that we could land it."

Captain Cavendish polled the crew, and the unanimous re-

sponse was to stay with the ship. "The vote of confidence gave me exactly the support I needed," said Cavendish. "If those guys trusted me with their lives, I knew I could get us down."

A first approach was aborted when the nose dipped slightly. Cautiously, he tried again.

It had been some eight hours since the B-52 had roared off the Robins runway. That meant there was from ten to fifteen minutes of fuel left.

Warning the crew that the landing wasn't going to be "picture perfect," Captain Cavendish coaxed the bomber onto the steel-gray runway.

Gen. Bennie Davis, CINC SAC, termed the landing a feat of "unparalleled airmanship and bravery," adding, "The exemplary composure and skill Captain Cavendish displayed while under severe stress is in the finest tradition of Air Force combat flyers. . . ."

SAC's Commander also praised the crew, composed of Boyle, Capt. Ronald A. Nass, 1st Lt. Gerald E. Valentini, 1st Lt. James D. Gray, 1st Lt. Michael J. Connor, and TSgt. Ronald B. Wright.

Captain Cavendish has been nominated for the Air Force Distinguished Flying Cross. The others will be awarded Air Medals.

—By SSgt. Ralph D. Monson, USAF,
SAC News Service Editor, Offutt AFB, Neb.

Flown by twenty-three-year-old Ross Perot, Jr., and Jay Coburn, thirty-six, *The Spirit of Texas* completed the 24,000-mile journey in thirty days.

The Bell 206L-II LongRanger helicopter visited twenty-two countries during fifty-six refueling stops. It overflew a total of twenty-six.

The helicopter, taken off the assembly line, received major modification to give it additional range. Sophisticated navigation and communications equipment also was installed, as well as such survival gear as an emergency locator transmitter and popout floats on the skids.

For the flight between Japan and the Aleutian Islands, an American President Lines container ship was modified and positioned for a helicopter landing and refueling. Bucking headwinds, the helicopter landed at Shemya in the Aleutians with ten minutes of fuel.

Featured in an exhibit entitled "Around the World in Thirty Days," the helicopter is on indefinite display at the National Air and Space Museum in Washington, D. C.

★ In the tradition of free enterprise, a US company plans to construct facilities adjacent to the Kennedy Space Center in Florida to handle preflight processing, final assembly, and storage of communications satellites and other payloads to be flown on the Space Shuttle or expendable launch vehicles.

The new facility, scheduled to be operational in January 1984, is to be located on a forty-acre site in an in-

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dustrial park at the Titusville entrance to KSC. Astrotech International Corp. said that initial capability will be to handle up to twenty-five payloads annually with the potential for expanding that rate significantly.

Astrotech was formed in January 1981 to provide aerospace engineering, consulting, and facility management services to the international aerospace community, officials said.

Astrotech plans modern versions of the NASA buildings and equipment in use for more than twenty years in orbiting payloads. They'll be staffed by engineers and technicians with experience in NASA operations.

The company is banking on the anticipated rapid growth in the launch of commercial communications satellites through the 1980s and beyond. Shuttle launches alone call for more than forty such missions during the company's first three years of operation, officials said.

★ NASA officials are excited about a major breakthrough in aircraft engine technology.

The GE E³ engine core has been successfully tested as part of the Energy Efficient Engine (E³) program that is being conducted at the Lewis

Research Center in Cleveland, Ohio.

The program is providing new technology for future advanced turboprop, turboprop, and turboshaft engines for both commercial and military use. Some of this technology is already being utilized in new and derivative engine components, officials declared.

Program objectives are to achieve a twelve percent reduction in specific fuel consumption, a five percent decrease in aircraft direct operating costs, and a whopping fifty percent abatement in the performance deterioration of engine components.

Results of the recent tests of E³ technologies indicate that fuel consumption can be cut by fourteen percent and operating costs by ten percent. Other goals involving engine exhaust emissions also have been met, while verification of noise reduction goals await testing of the full engine, NASA said.

The core of GE's E³ engine has an all-new ten-stage compressor with a 23:1 pressure ratio. A two-stage high-pressure turbine incorporates advanced materials and aerodynamic design, and unique cooling techniques permit higher operating temperatures. Active clearance control, a low-emission combustor, and a full authority digital electronic control are part of the new design.

The Lewis-managed program is a \$206 million, cost-shared effort involving the independent development of advanced technology engines by both GE and Pratt & Whitney. Approximately ninety percent of the

Air Force and Navy Agree to Closer Ties

In late November, the Air Force and Navy made known the details of a formal plan for closer cooperation.

Present at the Pentagon announcement were Air Force and Navy Secretaries Verne Orr and John Lehman and the service Vice Chiefs, Gen. Jerome F. O'Malley and Adm. William Small.

The new Memorandum of Agreement (MOA) between the two services was termed a "major step forward in improving maritime operations and enhancing ongoing USN/USAF joint efforts." (The benefits of cooperation between the two services were outlined in the November issue of AIR FORCE Magazine.)

The new agreement, signed September 10, is the result of months of staff preparation and groundwork during which the need was recognized for "a much accelerated program of interservice cooperation in tactical training and exercising."

Beside the joint exercises, some to be sponsored by the Joint Chiefs, "we might even undertake, as time goes on, some joint development and procurement programs if of mutual interest," General O'Malley said.

The senior Navy and Air Force leaders also stated that they "expect the accelerated effort to provide operational commanders the most flexible, capable, and mutually enhancing mix of forces possible for joint operations." (See also p. 79.)

The specific initiatives include:

- Increased integration of naval and Air Force forces in tactical training exercises, including JCS-sponsored exercises.

- Increased cooperation in interoperable command control and communications equipment and procedures.

- Increased interservice use of existing and programmed tactical training schools.

- Increased interservice exchange duty for appropriate combat unit crew members.

- Increased cooperation in improving tactical weapons effectiveness.

- Increased interservice use of existing tactical weapons ranges and facilities for training and exercising.

- Joint efforts to develop, operate, and use a multiservice War-at-Sea range located in the vicinity of South Florida.

Maritime missions in which Air Force capabilities enhance the defense of sea lines of communications are outlined in the MOA: anti-air warfare counter-air operations, surveillance and targeting, command control and communications, aerial mine-laying, electronic warfare, delivery of Navy Special Warfare Forces, and aerial refueling.

In support of these missions, the Navy and the Air Force agreed to improve unit and operator effectiveness in joint maritime operations and to continue to work closely on developing tactical doctrine for maritime operations. They also decided to establish a joint training center at Key West, Fla., that will combine air superiority, surface warfare, and undersea warfare training for both services.

—M.B.P.



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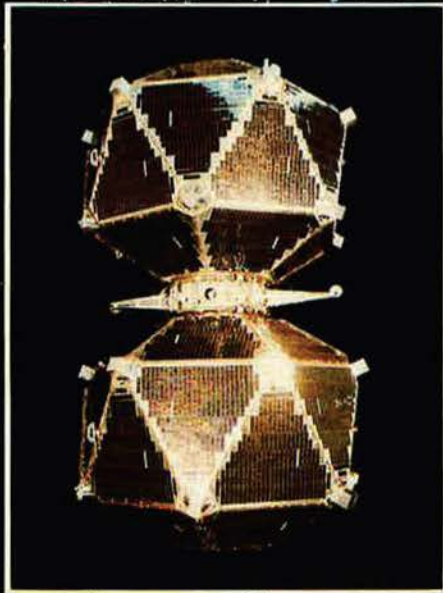
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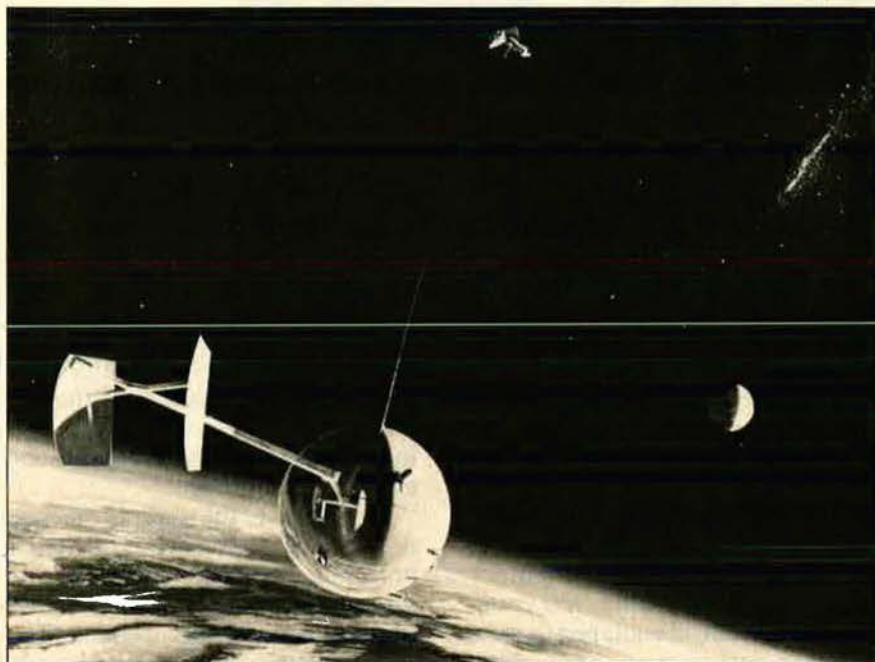
TRW

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total funding for both contracts is provided by NASA, and the balance by the two contractors. The program began in 1978 and will be completed in 1983.

★ NASA is looking into prospects for

AEROSPACE WORLD



In artist's concept, a tethered satellite gathers data on the upper atmosphere before being reeled in by the Space Shuttle. The satellite, also used to survey earth resources, could be on a cable sixty miles long. See adjacent item.

a tethered satellite for use in conjunction with Space Shuttle missions.

The satellite would be released from the Shuttle's cargo bay on a cable as long as sixty miles. This would make possible studies of the earth's upper atmosphere in the sixty- to ninety-mile (ninety-seven to 145 km) altitude range where extended orbits of conventional satellites are not possible. The Shuttle itself has a minimum orbiting altitude of 135 miles (217 km).

Among atmospheric investigations, the tethered satellite could economically gauge human-generated pollution and ozone depletion. According to officials, it could also provide previously unobtainable data involving petroleum and mineral deposits on earth, make possible high-resolution photos of the global surface, and perhaps aid in earthquake prediction.

Under the initial phase of a \$1 million contract, Martin Marietta Denver Aerospace is to undertake system definition, technology validation, and program planning. Target date for initial operation of the satellite would be the late 1980s.

The program would have international implications, with Italy building the satellite and NASA supplying the reel and related deployment hardware.

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★ **NEWS NOTES**—In November, internationally acclaimed balloonist **Maxie Anderson** and copilot **Don Ida** tried and failed in a third attempt to circumnavigate the globe in a helium balloon. The *Jules Verne* launched successfully from Rapid City, S. D., but sprang a leak to force the two down in Ontario, Canada. The attempt was his last, Mr. Anderson said.

A "tincan" sailor during World War II, **Adm. Arleigh Burke**, USN (Ret.), eighty-one, is to have a **new class of multimission destroyers** named for him, the first American in history to be so honored while living.

The Air Force has designated Northrop Corp.'s **new Tigershark tactical fighter the F-20**. The Mach 2-class aircraft was developed privately at the behest of the US government for a tactical fighter specifically tailored to meet the security needs of allied and friendly nations.

Died: Henry Tindall (Dick) Merrill, a pioneer aviator who in 1936 made the first transatlantic round-trip flight and who, counting his thirty-three-year career with Eastern Airlines, logged 41,709 flying hours, at Lake Elsinore, Calif., in October. He was eighty-eight. ■

AERONAUTICS & AIRPOWER

JANE'S AEROSPACE SURVEY 1983

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

The year 1982 in aerospace was not one that will live in fond memory, but its happenings and perils provide lessons for the future.

FEW people will recall the major events of the past year with nostalgia. From an aerospace viewpoint, the best that can be said about 1982 is that it will have ended by the time this survey is read, and that 1983 should be happier if politicians, manufacturers, and operators, military and commercial, have learned the lessons it should have taught them.

Most of the lessons were predictable. So, for example, while some of

the circumstances that decided the outcome of military confrontations in the Falkland Islands and Lebanon were unique to those conflicts, the general principles that they re-emphasized are of the greatest significance.

In neither case was the United Nations organization able to prevent initial aggression, because it is not equipped to do so. Equally, the concentration of NATO nations on building up an integrated force to deter the Warsaw Pact's military ambitions in Europe has left countries like Britain ill equipped to meet its other commitments throughout the world.

Had Britain's Royal Air Force possessed two or three squadrons of modern long-range bombers like the B-1 a year ago, the Falklands affair

might never have erupted into military action. A show of force by such aircraft, carrying but not dropping a mix of nuclear and conventional weapons, allied to a few unseen nuclear-powered (but not nuclear-armed) submarines in South Atlantic waters, might have kept the dispute—between countries with a long tradition of friendship—around a negotiating table.

In contrast, the type of nuclear deterrent force on which Britain's present government is spending \$18 billion it cannot afford over the present decade was useless. The Royal Navy's current Polaris submarines did not dissuade Argentina, which has no nuclear weapons, from invading the Falkland Islands. Nor did they influence in any way the eventual withdrawal of the occupying forces. The Argentine leaders knew, correctly, that Britain could never threaten them with nuclear-only, nonrecallable, ballistic



Royal Air Force Harriers being readied for an attack mission from HMS Hermes off the Falkland Islands. (Royal Navy)

missiles without incurring the hostility of almost every nation on earth.

Falklands Lessons

After twenty-five years of indecision and wrong decisions on defense by successive administrations, the British South Atlantic Task Force had to sail 8,000 miles into action, in one of the most inhospitable climates imaginable, with woefully inadequate weapons.

It has long been clear that any military force that ventures within reach of hostile airpower without airborne early warning (AEW) cover risks heavy losses. Even the air force of the small state of Israel could rely on its E-2C Hawkeyes to keep track of everything in the air during sorties over the Bekaa valley in Lebanon during 1982. By doing so, it was able to ensure the most impressive air-to-air combat results in history.

Britain's Task Force had no such cover. The AEW Gannets that once flew from Royal Navy carriers were scrapped years ago for budgetary reasons. The Royal Air Force's vintage Shackletons were incapable of undertaking such a demanding role so far from home. The Nimrods ordered to replace them will not be operational until 1984.

The Task Force was led by one aircraft carrier that was scheduled to be scrapped, and another that was about to be sold to Australia. With no air or naval bases available for its use within thousands of miles of the Falklands, and the last squadrons of Royal Navy Phantoms and Buccaneers disbanded long ago, it was admitted later by Admiral Sir Henry Leach, then First Sea Lord and Chief of Naval Staff, that "without the Sea Harrier there could have been no Task Force."

Just twenty Sea Harriers accompanied the fleet when it set out on its long journey south from the UK—twelve in HMS *Hermes* and eight in *Invincible*. Another eight followed on a container ship, and were supplemented by fourteen normally land-based Harrier attack/reconnaissance aircraft of the Royal Air Force. The only other fixed-wing combat aircraft, based on Ascension Island, 3,875 miles from the Falklands, were hastily armed maritime reconnaissance Nimrods, and

a handful of Vulcan bombers, saved from a retirement scrapheap and flown by crews who had to relearn very rapidly long-abandoned techniques of conventional bombing and flight refueling.

Lacking sufficient numbers of aircraft and effective airfield denial weapons, the Vulcans never closed the runway at Port Stanley. What was done kept the Argentine first-line Mirages, Skyhawks, and Super Etendards back on the mainland,

aircraft was lost in air combat, but two Sea Harriers and three RAF Harriers were brought down by enemy ground fire during low-level attack missions, and four more Sea Harriers were lost in accidents, plus one during training in the UK.

French missile manufacturers have claimed that at least four of the lost Harriers and Sea Harriers were destroyed by their Roland surface-to-air weapons exported to Argentina. The Royal Navy admits provi-



ABOVE: Hercules tanker and receiver, modified very speedily by Marshall of Cambridge for operations in the South Atlantic. LEFT: For Falklands service, RAF Nimrods were adapted quickly to carry bombs and missiles, in addition to installation of flight refueling probes.

damaged many aircraft on the ground, and destroyed the airfield support facilities.

What the small force of Sea Harriers achieved, side-by-side with British surface-to-air missiles, was summarized on p. 29 of the November '82 AIR FORCE Magazine. Of twenty hostile aircraft destroyed by the Sea Harriers in air-to-air combat, sixteen were shot down by AIM-9L Sidewinder missiles (of which twenty-seven were launched), and the rest by the aircraft's 30-mm guns. None of the British V/STOL

tionally to one aircraft lost apparently in this way, but points out that two of the others were brought down at Goose Green, where there were no Rolands.

Similar arguments concern the much-publicized devastation caused by the five Exocet sea-skimming antiship missiles launched from Super Etendard fighters of the Argentine Navy. Three of them hit ships, sending the cargo ship *Atlantic Conveyor* to the bottom and damaging the destroyer *Sheffield* (while engaged on hazardous radar picket duty in the absence of AEW aircraft) so severely that it had to be abandoned. The Royal Navy claims that the missiles that sank the *Atlantic Conveyor* were intended for the carrier *Invincible*, but were seduced away by decoys. This, too, is disputed by Aérospatiale, makers of Exocet.

Flexibility Is Key

Lessons of the fighting in the Falklands and Lebanon that cannot be disputed include the still-vital role in a modern defense force of the long-range manned bomber, because of its flexibility compared with land-based and submarine-based ballistic missiles. This had been recognized by President Reagan in 1981 when he ordered 100 B-1Bs for Strategic Air Command. The worry is that they will not begin

with a thrust-vectoring Sea Harrier armed with AIM-9L missiles.

It might be a mistake to expect the kind of air combat results achieved in the Falklands and Lebanon to be repeated by the same types of aircraft against MiGs and Sukhois over the Central Front in Europe. On the other hand, doubts concerning the range capability of the Harrier should have been quieted by the fact that four of the RAF pilots ferried their aircraft all the way

for use against Port Stanley EW and missile radars. Nimrods had their inherent missile-carrying capability reactivated so that they could carry bombs, Stingray homing torpedoes, and, later, Harpoon missiles. In only three to seven weeks Nimrods and Hercules were fitted with flight refueling probes and Hercules and Vulcans modified into tankers. These unprecedented speedy conversions enabled one Hercules pilot to complete a record twenty-eight-



ABOVE: First photo of the Sukhoi Su-25 Frogfoot attack aircraft. RIGHT: HI-SPOT pilotless airship, with planned 100-day endurance at 50,000-70,000 feet.

BELOW: Italy's Aeritalia G222 in projected AEW configuration. The model has six Mirach-100 drones under its wings.

to be operational until 1986, whereas the entire original force of 244 B-1s was intended at one point to be at readiness by now.

Equally apparent now are the attractions of V/STOL combat aircraft like the Harrier and Sea Harrier. For years those convinced of their unique capability have had to battle against prejudices and suggestions that such gimmicky "toys" lack adequate range and payload. To the enthusiasm of the Royal Air Force and US Marine Corps, based on a decade or more of operational experience, can now be added the more harrowing experiences of pilots of the Argentine Air Force.

From the start, the odds were not entirely in the Argentines' favor. Like the Luftwaffe's Messerschmitt pilots during the Battle of Britain in 1940, their aircraft were near the limit of their combat radius when they reached the Falklands from their home bases, and they could not use Port Stanley runway. A pilot who has already flown several hundred miles is in no fit state to cope



from the UK to a vertical landing on the unfamiliar deck of a ship in the South Atlantic, in two nine-hour hops, with the assistance of flight refueling tankers. The vulnerability of front-line runways also points to the advantage of V/STOL capability in any aircraft intended for close-support duty in combat areas.

Every nation in the world fortunate enough to possess a competent national aerospace industry should note the part played by the UK industry in support of the Task Force. Within days, RAF Harriers were adapted to carry Sidewinder missiles and naval two-inch rocket pods for which they had never been designed. Vulcans were equipped to carry Shrike antiradiation missiles

hour nonstop mission, and a Vulcan crew to fly the longest-range bomber sortie in history with the aid of no fewer than ten Victor tankers.

Survivability Concerns

Successes credited to the surface-to-air missiles and ground fire of both sides must revive fears for the survivability on the Central Front in Europe of large, comparatively slow, and unsophisticated attack aircraft like USAF's A-10A Thunderbolt II and the new Soviet Su-25 (NATO Frogfoot), of which the first photographs made available for publication appear in the 1982-83 *Jane's*. Even nap-of-the-earth flying and the use of ECM and targeting aids like LANTIRN, FLIR, and laser designator/seekers offer only marginal protection against the wall of fire that can be put up by troops and ships. This could impose severe limitations on the use of NATO first-line aircraft, far too many of which lack the all-weather capability that might afford them the protection of darkness and low visibility.

No less significant are fears for the survivability of all-important AEW and AWACS aircraft like the E-3A Sentry. Added to the lack of such types of aircraft able to fly from small carriers like the Royal Navy's *Invincible* class (except for a few hastily converted Sea King helicopters, deployed since the end of the Falklands fighting), there is urgent need for evaluation of low-cost, less-vulnerable alternatives.

Nearly a decade ago, Boeing and Teledyne Ryan flight-tested successfully their large Compass Cope RPVs, which could have been developed into unmanned AEW aircraft built of radar-transparent composites and able to remain airborne at great heights for more than twenty-four hours at a time. More recently, Lockheed Missiles and Space Co. proposed a 5,000,000-cubic-foot unmanned airship known as HI-SPOT, which could provide exceptionally long-duration AEW cover while operating at altitudes from 50,000 to 70,000 feet.

Airships and RPVs evoke little enthusiasm among flying people, who tend to think in terms of two fistfuls of shining metal, large guns, and a Machmeter. But surely an aircraft made of fabric and Kevlar, or an all-composites RPV, would be more survivable in the first crucial minutes of military action than 150 tons of slowly orbiting metal, however well protected by ECM/ESM.

Commercial Aviation Facing Turbulence

The problems that affect commercial flying, and those sections of the industry that support it, have proved almost insuperable during the past year. The only consolation is that, in this case, it is the financial well-being of the human victims that suffers, rather than life and limb.

Once-prominent airlines like Braniff and Laker have vanished. So have manufacturers, ranging from Ahrens Aircraft of Puerto Rico, whose AR 404 thirty-passenger four-turboprop transport

had seemed so promising, to New Zealand Aerospace Industries, that country's sole aircraft builder. Fortunately, another company has come forward to support, and eventually resume manufacture of, the latter's agricultural aircraft. But production of Lockheed's TriStar airliner will soon end, and a long list of former US general aviation types, from the Beechcraft Skipper to the Gates Learjet 20/30 series and Cessna's turboprop business

fair" financial deals that were said to explain massive penetration of the traditionally American commuter market by EMBRAER of Brazil. In fact, outside the Communist nations, Boeing remains the supplier of some sixty percent of the world's commercial airliners, which is adequate testimony to the quality of its products. At the same time, nobody can deny that the Airbus A300 has an immaculate safety record, and has been top of the table consis-



Pacesetters of the next generation of twin-turboprop airliners—Airbus Industrie's A310 with Boeing's 757 and 767 at the 1982 Farnborough Air Show. (Air Portraits)

range, have had their manufacture suspended during 1982 for periods ranging from weeks to indefinite.

The impact of Europe's Airbus Industrie on the market once dominated by US companies has become increasingly apparent. Lockheed has pulled out of the commercial jet business for the present. McDonnell Douglas was rescued from a situation that might have killed off the DC-10 by renewed orders for the military KC-10 tanker. Boeing has succeeded in retaining most of the larger-capacity airliner business in North America with its new 757 and 767; but the 767 has been rejected by the major airlines of one country after another in favor of Airbus Industrie's A310.

Many reasons for this have been suggested, including the same kind of government subsidies and "un-

tently in terms of on-time departures and minimum direct maintenance costs. Airbus was also first to develop and put into service the two-man forward-facing crew cockpit, which ended controversy about three-pilot crews being essential on scheduled services, and which was promptly adopted as standard fit on the Boeing 767.

New-Generation Airliner?

Today, the one potentially profitable major gap in the new-generation airliner inventory is for a twin-turboprop 150-seater. In a sound move to preserve its share of the market, Boeing has introduced the stretched 122/149-seat 737-300, while studying a completely new type. With the 757 and 767 absorbing so much of its available finance and capacity, it is in no hurry to add a 150-seat 7-7 to its range. Lockheed and McDonnell Douglas are even less interested; but Airbus Industrie, with the A300 long established and the A310 rolling off the line at a steady pace, has been able to devote increasing effort to the planned 150/179-passenger A320, of

John W. R. Taylor, the world's top aviation authority, here presents his reflections on aerospace in the year just past. A name familiar to AIR FORCE Magazine readers, John Taylor has edited Jane's All the World's Aircraft (JAWA) since 1959. He has written more than 220 books and countless articles in addition to the annual JAWA. He is a Fellow of the Royal Aeronautical Society, the Royal Historical Society, and the Society of Licensed Aircraft Engineers and Technologists.

which Air France has already indicated that it will order twenty-five, with an option on twenty-five more.

In an effort to hold its place in the airliner business, McDonnell Douglas has worked out a rather special leasing arrangement which persuaded American Airlines to cancel its order for fifteen Boeing 757s plus options on fifteen more. This operator will, it is said, take delivery of twenty DC-9 Super 82s, for which it will pay a monthly fee over an initial period of five years. If it finds it does not need all of the aircraft during that period, it will be able to return the surplus Super 82s to the manufacturer at an unrevealed penalty cost.

For its part, McDonnell Douglas will share any profit made by the Super 82 fleet above a mutually agreed minimum. All of which, if correct, sounds extremely unorthodox but could promote DC-9 sales and is indicative of the measures that manufacturers are being forced to consider if they wish to stay afloat.

The major airlines of the world, lacking usually the military business which secures the manufacturers' survival, face a daunting future. International Air Transport Association (IATA) Director Gen. Knut Hammarskjold, in his annual report in November 1982, said that the airlines will plunge even deeper into the red this year, following a combined loss of \$1.87 billion on scheduled services during 1982, compared with \$1.66 billion in 1981. Among problems confronting the industry is the need to find \$50 billion for urgent reequipment during the remainder of this decade, despite predicted accumulated losses of nearly \$10 billion over the six years to 1984.

Certainly, then, there is scope for new ideas like McDonnell Douglas's leasing scheme. The Belgian national carrier Sabena struggled through 1982 only after its personnel agreed to a seventeen percent cut in pay and introduction of an early retirement plan. El Al's employees, their jobs threatened by the airline's financial problems, became so angered by what they regarded as Israeli government delaying tactics that nearly 1,000 of them, with their families, invaded Ben-Gurion International Airport and

defied riot police to move them. A Boeing 747 and 707 were taxied by the protesters on to the runways, where the tires were deflated and hydraulics drained to immobilize the aircraft.

Knut Hammarskjold has no doubt as to why the airline industry is "performing a precarious balancing act—walking a financial tightrope between the abyss of bankruptcy on the one hand and the slippery slope of subsidization or

enty percent are based in the USA and USSR. Canada, Mexico, and Argentina have a high proportion of the others, with Cuba, East Germany, Japan, and New Zealand also up among the leaders. The total area treated doubled in the 1970s, when the number of aircraft increased by one-third. At the same time, standards of equipment and flight training improved, leading to a forty percent drop in accidents and a sixty percent drop in fatalities.



Carrying more than two tons of chemical in its titanium hopper, which forms an integral part of the fuselage structure, the NDN Fieldmaster makes a formidable addition to the world's fleet of agricultural aircraft. Some 26,000 fixed-wing aircraft and helicopters are used in agriculture worldwide. (Brian M. Service)

permanent bondage to the loan market on the other." He lists the causes as stagnant markets, cut-price fares, inflated costs, overcapacity, and government interference.

Agricultural Aviation

Not all of these factors carry across to explain the general aviation slump. There is, for example, an enormous, and increasingly urgent, need for more food production. In a report entitled *Development of Airborne Equipment to Intensify World Food Production*, the United Nations' Economic Commission for Europe (ECE) gave some thought-provoking statistics. For example, some 600,000,000 acres a year are currently processed from the air, mainly in highly developed industrialized areas, which represent only five percent of the world's total arable land.

Of some 26,000 fixed-wing aircraft and helicopters employed in agricultural work worldwide, sev-

But much, much more needs to be done. The ECE suggests, as a start, that each aircraft could handle fifty percent more acreage than at present and that, used properly, agricultural aviation could alleviate the world's entire food problem.

Yet, in the same year that the ECE report was published, Piper sold off its Pawnee line of sprayer/dusters, and the New Zealand manufacturer of the highly efficient Fletcher agricultural aircraft became bankrupt. Clearly, something is wrong somewhere. Equally clearly, it concerns the financial management of the business rather than the technical side, which has produced equipment entirely capable of doing what has to be done. Meanwhile, tens of millions of human beings starve.

Military Aviation Squeezed

Forgetting such moral issues, and returning to the specialized area of military aviation that is the prima-

ry concern of this magazine, we again find that financial constraints are threatening effectiveness. Belgium, one of the key NATO partners in Europe, grounded its air force for two months in the summer of 1982, and has cut the flying time of its combat pilots to 105 hours a year to reduce expenditures. One Arab country has been negotiating with UK manufacturer Luscombe Aircraft in order to increase the number of military aircraft available to its armed forces through the purchase of 500 microlights capable of launching air-to-surface missiles, carrying a machine-gun, or operating as pilotless "kamikazes" by diving into their target, armed with a warhead. At \$11,500 apiece, the microlights are less costly than some of the missiles they might carry, but is this what we shall soon mean by the term "airpower"?

At the other extreme, in 1982-83, is the AFTI/F-16 built by General Dynamics for USAF (see also p. 40). It is a truly remarkable aircraft that, when fully developed, will be able to skate through the air with wings level but with its nose and weapons skewed towards a target at, say, one o'clock to its line of flight. Fractions of a second saved

by this capability of a control-configured vehicle, compared with a conventional fighter that must bank and turn to fire its weapons, are expected to make all the difference in air combat.

The AFTI/F-16 will evaluate other new concepts, such as voice interaction, which means that the aircraft will perform certain functions automatically in response to spoken commands from the pilot. Sanity must surely lie somewhere between the \$11,500 microlight and the AFTI/F-16.

Space—A New Era?

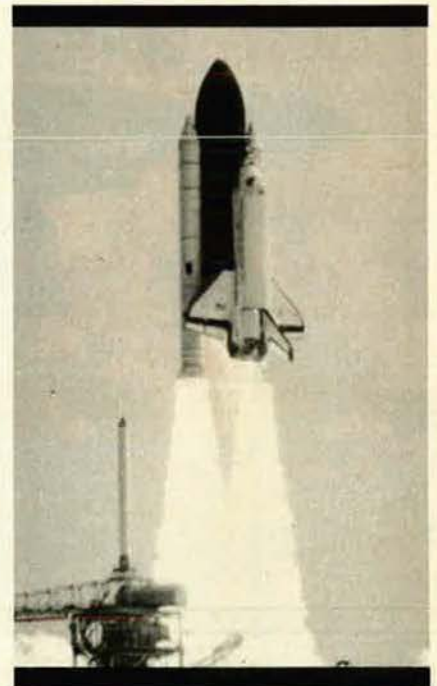
Meanwhile, what of the "space" aspect of aerospace in 1983?

The day this survey was written, British TV showed film of two satellites departing for geostationary orbit from the payload bay of the Space Shuttle Orbiter *Columbia*. However blasé one has become about US achievements in space, this must be applauded as the beginning of a new, more certain, less costly, and more capable phase in the utilization of orbital flight that will benefit everyone on earth.

The Soviet Union has made piloted and pilotless journeys between earth and an orbiting space

station almost as routine as commuter travel. Its counterpart of America's *Columbia* is no more than a small pilotless spacecraft at present. But it can be only a few years before the first large Soviet or US space station is erected in high earth orbit.

Space stations, Shuttle Orbiters, and combat aircraft that do as they are told are supreme examples of the technological capability of aerospace science in the 1980s. One air-



Blastoff of the Shuttle Orbiter Columbia, now operational as a satellite launch platform.

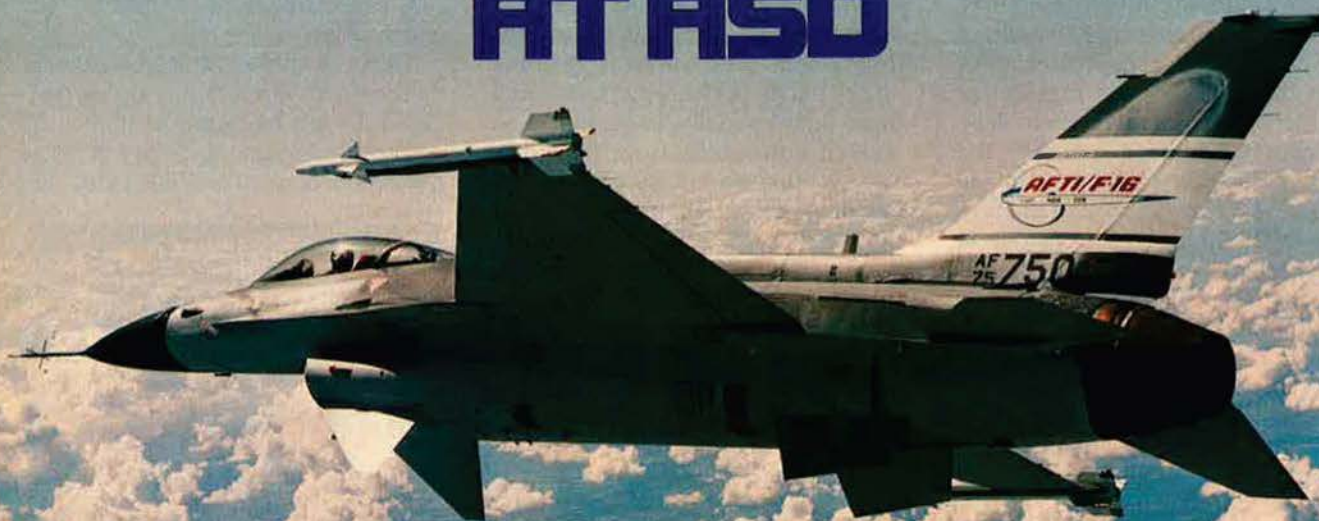


The "missiles" under the wings of this Mitchell SR-10 microlight are made of wood, but aircraft as simple and inexpensive as the SR-10 may soon become combat equipment of at least one Middle Eastern air force. Such aircraft could operate as pilotless "kamikazes," diving into their target armed with a warhead.

plane that flew for the first time on July 28, 1982, had its origin in an altogether different age. United States Aircraft Corp.'s twin-turbo-prop Turbo Express transport looks strangely friendly and familiar. Its fuselage is forty inches longer than one remembers, its tailplane more square at the tips, its engine nacelles more slim and streamlined; but even a best-range cruising speed of 215 mph cannot disguise its pedigree as an updated DC-3.

When N300TX started its original young life, nobody had been to the moon or learned to destroy a city with a single bomb. People still became excited at making aeroplanes rather than money. Perhaps it is true that "the only replacement for the DC-3 is another DC-3." Perhaps we can look back at 1982 with just a little nostalgia after all. ■

THE FUTURE FORMS UP AT ASD



Improved capabilities
for the near term
—with revolutionary
changes not far behind.

The amazing AFTI/F-16.

BY JOHN T. CORRELL
SENIOR EDITOR

THE future of military airpower is taking shape at the Aeronautical Systems Division (ASD), Wright-Patterson AFB, Ohio, and some aspects of it are revolutionary.

A fighter that can point itself sideways and shoot without changing its flight path, turn without banking, and climb without pitching its nose up. Voice controls in the cockpit. A helmet-mounted sight that lets a pilot acquire a target simply by looking at it. A wing that is able to alter its shape from root to tip and from leading edge to trailing edge with no break in the smooth contour of its upper surface. Integrated flight and fire controls that free pilots from the traditional tail chase mode of attack.

Such capabilities are not a gleam in some designer's eye. All are in the air for flight-testing, or soon will be. Nor are they gimmicks and toys.

"Our emphasis is not to make gee-whiz flying motions," says Col. Robert C. Barlow, Director of ASD's Flight Dynamics Lab. "The payoff is what you can get in faster, more accurate, more survivable weapons delivery."

ASD's Flight Dynamics Lab is also working on technology potentially applicable to the next-generation fighter, the eventual follow-on to today's F-15s and F-16s. Features could include supersonic cruise without use of the afterburner, short takeoff and landing (STOL), reductions in radar and infrared signatures, greater agility, increased efficiency, and fewer parts.

The most exotic Laboratory program is an exploratory look at a hy-

personic aerospace plane—officially called the Advanced Military Spacelift Capability (AMSC)—that would use conventional airfields and operate both in space and in the atmosphere.

The bulk of ASD's work, however, is directed at improved systems to meet closer-term requirements. First among these is the B-1B bomber (*see p. 58*). "Bringing the B-1 in to meet the commitment the President has made to the country has got to be our number-one priority," says Lt. Gen. Thomas H. McMullen, ASD Commander.

As the Air Force proceeds with modernization of its strategic systems and thinks ahead to the next generation of tactical systems, ASD is operating at an extraordinary level of activity. "Right now, there's more business that's fundamental to the future of the Air Force than

there has been in recent times," General McMullen says.

Development continues on the F-15 and F-16 fighters, enhanced versions of which will be evaluated for a dual air-to-air and deep interdiction role. The venerable B-52 bomber is getting its first avionics update since the vacuum tube days. The Air-Launched Cruise Missile (ALCM) is operational as of last month. Retrofit modifications are extending the performance and flying life of other aeronautical systems.

In all, ASD has 190 different programs—accounting for about twenty percent of the total Air Force budget—in progress. The technology is at hand to meet a great many operational needs. And as the technology base and acquisition programs move closer to each other, this trend has been ratified in an organizational realignment that makes the Wright Aeronautical Laboratories part of ASD. Formerly, the four labs—Flight Dynamics, Materials, Avionics, and Aero Propulsion—reported directly to Systems Command.

New Ways to Fly

The AFTI/F-16, a futuristic R&D aircraft that may rewrite the tactics manuals, made its maiden flight last summer. It's presently in a 275-sortie flight-test program at Edwards AFB, Calif., and attracting a great deal of attention.

AFTI is for Advanced Fighter Technology Integration, and it combines a number of maturing technologies into one airframe. There's no intention, however, to field AFTI itself as an operational system. Instead, it will test and demonstrate new features and attack profiles for incorporation into emerging systems, including the next-generation fighter.

Externally, it can be distinguished from production F-16s by its twin canards, or miniwings, beneath the engine inlet and by a piggyback dorsal fairing behind the cockpit that houses flight control equipment. The core technology, though, is a digital flight control system that adds an order of magnitude in computing power to what's available in existing fighters. These features, working together with an automated maneuvering attack sys-

tem, make some amazing things possible.

The digital fly-by-wire flight controls activate the canards and fine tune the flaps and horizontal tail, allowing the AFTI/F-16 to perform six flight maneuvers that cannot be executed by any other aircraft (see p. 42). It can make small, precise changes in flight path or attitude: move sideways while its nose continues to point directly forward, make a "flat" turn without banking or rolling, point its nose in a skidding-type maneuver in a direction different from its flight path, fly up



The mission adaptive wing, under fabrication by Boeing, will be able to vary its shape in flight with no break in the smooth contour of its upper surface.

or down without raising or lowering the point of its nose, climb or descend without changing angle of attack, and point its nose up or down without changing its flight path.

Traditionally, aircraft design has been a compromise, trading off maneuverability to achieve aerodynamic stability. Modern fly-by-wire systems, constantly manipulating an airplane's control surfaces, have lessened the compromise. The production F-16, for example, would have to be heavier except that its analog fly-by-wire controls compensate for relaxed static stability built into the airframe.

The digital fly-by-wire system and added control surfaces in the

AFTI/F-16 take the technology a big step further. The AFTI pilot can "task tailor" his aircraft so it operates equally well in any of four different profiles: normal (takeoff, cruise, landing), aerial gunnery, strafing, or bombing. The flying qualities for one mode do not have to be traded off against those for another mode.

A pilot with AFTI technology can turn, fire, and get away faster than he could in a conventional fighter. And with all the new moves his airplane can make, he stands a better chance of attacking heavily defended targets and coming out in one piece.

"In the air-to-air role, we're looking for the fastest possible conversion to kill," says Colonel Barlow. "In air-to-ground attack, we'll be flying very nonpredictable flight paths. In analysis, we've seen that, just by flying curved flight paths, survivability increases by a factor of about ten. We think that when the flight path is even more unpredictable, we'll do better than that."

Automated Attack

Thus far, the AFTI flight-test program at Edwards has concentrated on the airworthiness aspects of what ASD calls "the new way to fly," but Phase II of the testing will begin in 1984 and focus on weapons delivery with the Automated Maneuvering Attack System (AMAS). This will essentially make the pilot a total manager of the weapon system rather than a doer of small tasks.

"We want human beings to do the things they do best and machines to do the things they do best," Colonel Barlow continues. "Humans are marvelous at making decisions. Even the best computers don't make very good judgment calls. Yet when I ask for nulling of a tracking error, the computer can do that better than the most skilled pilot."

Any time he chooses, the pilot can override AFTI's automated controls if he thinks the situation calls for him to fly or fight in a more conventional mode.

AMAS gives the pilot such new attack profiles as weapons release without overflying the target. A Forward-Looking Infrared (FLIR) sensor/tracker pod feeds target information to the digital fire control computer, which figures the "aim-

ing error"—the difference between where the target is and where the weapons are pointing—and passes the data along to the flight control system, which lines the aircraft up for the shot or bomb release. A roll-stabilized radar altimeter enables high G maneuvering as low as 200 feet off the deck. Automatic fuzing tailors a bomb milliseconds before release for optimum effect.

The AMAS feature that inspires the most double takes, though, is the helmet-mounted sight. Projected on the pilot's helmet visor are half-inch crosshairs. He centers the crosshairs on the target and presses a button on his side stick controller. The airplane's sensors slew toward the target and lock on.

The pilot is freed from all but the most crucial tasks. Instead of being bogged down in a jungle of switches, dials, and buttons, he can keep his head up and his eyes outside the cockpit.

Voice Controls

Later AFTI flight tests will include voice controls in the cockpit. When the pilot climbs into the airplane, he loads a cassette recording of his voice into a box on his right. This tells the voice command computer exactly how this particular human pronounces each of the words that AFTI is programmed to understand. At present, the computer has a thirty-six-word vocabulary and is building toward fifty. It has the capability to expand to 100 words.

Once in the target area, the pilot might say, "Set bomb release range at 5,000 feet," and hear a synthesized voice answer, "Release range confirmed at 5,000 feet."

The objective is redistribution of the aviator's work load. With the number of hand and eye functions reaching the limit of what a pilot can handle, voice interaction is a logical step to bring his previously under-employed faculties of speech and hearing into action. The system was developed using tapes of pilots under stress and high Gs, with F-16 cockpit noises added in.

"We found that background noise is more critical than the voice changes under G or under stress," Colonel Barlow reports. "We've been able to get high enough recognition rates—in excess of ninety

New Ways to Fly

These are AFTI/F-16's decoupled modes in its longitudinal or vertical flight path:

→ means velocity vector α means angle-of-attack

VERTICAL TRANSLATION: During this mode AFTI/F-16 flies up or down without raising or lowering the point of its nose. This might be called AFTI/F-16's elevator effect since the aircraft's nose attitude never changes.

DIRECT LIFT: The AFTI/F-16 can climb or descend in altitude without changing angle-of-attack as a normal aircraft must do. This direct lift mode will permit small accurate target alignment, especially for delivering bombs.

PITCH AXIS POINTING: During this mode AFTI/F-16's flight path does not change, but its nose can be pointed up or down. This mode can be used in making small weapon pointing adjustments for accurately aligning the aircraft's gun during air-to-air or air-to-surface gunnery.

percent under all conditions—that we consider it certainly adequate for switching functions.

"Time is really critical when you're at low altitude. You don't have much time from when you understand where your target is until you release ordnance on it. Voice is the normal mode of human communication. Maybe that's the quickest

way we can communicate to the airplane what we want to do. We treat it as an option—not necessarily as the final answer."

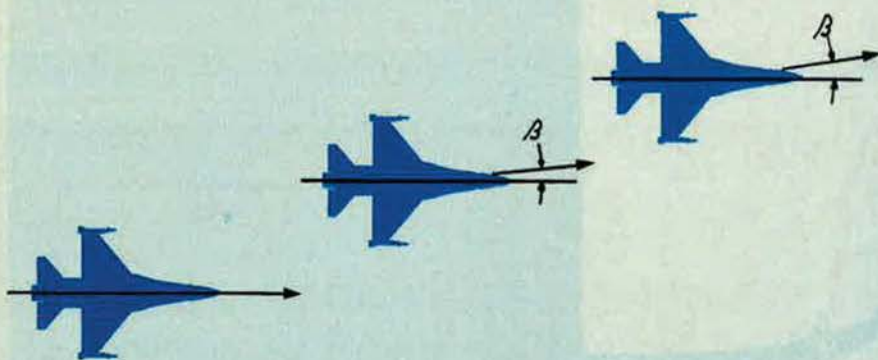
Voice control, like any approach that's radically different, draws its share of skepticism and scoffing. But the Flight Dynamics team has encountered skeptics before.

"We were getting sort of a ho-

These are AFTI/F-16's decoupled modes for flying laterally, or sideways, as it also flies forward:

→ means velocity vector

β means side slip angle



LATERAL TRANSLATION: AFTI/F-16 moves sideways while its nose continues to point directly forward.



DIRECT SIDEFORCE: In this wings level, or flat turn AFTI/F-16 turns without banking or rolling. The aircraft simply changes direction without any rotation about its roll axis.



LATERAL (YAW) POINTING: AFTI/F-16 points its nose in a direction different from its flight path. The aircraft performs a skidding-type maneuver: the aircraft flight path (direction of flight) remains unchanged while the pilot is able to point the nose right or left.

hum reaction on the IFFC/Firefly until we shot down an F-102 drone," says Colonel Barlow.

He refers to the Integrated Flight Fire Control/Firefly program, in which an F-15 fighter is outfitted with digital flight controls coupled to its fire control computer so that the two can operate together with unprecedented efficiency. The idea

is to improve on decades-old tactics. In aerial engagements, a pilot traditionally attacks another aircraft from behind, flying a path identical to that of his target. In ground attack, traditional tactics call for the pilot to dive and fly close over his target.

Last August, an IFFC/F-15 downed a delta-winged PQM-102

target drone with a two-second burst from its gun. The remarkable part is that the drone was approaching the F-15 from a near-frontal position and closing at 760 knots. Both aircraft were in sharp right turns, each pulling more than three Gs. Moreover, the F-15 was armed with relatively benign target practice ammunition, not the high-explosive rounds normally used in air-to-air combat.

Accuracy of the IFFC fire control system is such that a pilot can pursue his target from alongside or above, shoot it down from any attack angle, and be away quickly. When going after ground targets, he can fire while turning and need not fly over the target.

"So," continues Colonel Barlow, "all this modern wizardry is for real."

Mission Adaptive Wing

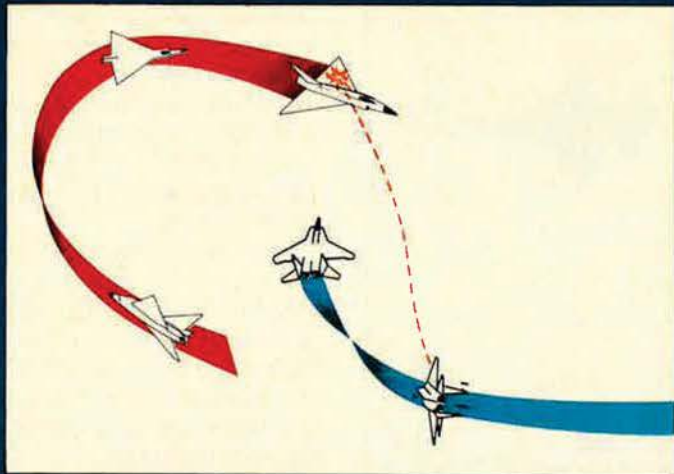
There's still more wizardry on the way in the form of a "mission adaptive wing" that will change shape, or "camber," during flight for better cruise range and maneuvering. The gains will come primarily from increased aerodynamic efficiency and reduced weight.

Internal mechanisms regulate the contour of the wing. No flaps, no spoilers, no faired surfaces. As one observer says, "It's the closest thing I can think of to what a bird does." Camber can be varied at leading edge and trailing edge, and from wing root to wingtip. Computers and sensors shape the flexible material of the wing to the contour desired.

The new technology wing itself is now being built by Boeing and will be flown on an F-111 aircraft at Edwards late this summer. The next-generation fighter is a possible candidate for mission adaptive wing technology.

ASD is demonstrating the feasibility of fiber optic flight controls—dubbed "fly-by-light"—in an A-7D test-bed aircraft at Edwards. The program is called Digital Tactical Aircraft Control (DIGITAC), and last March, the A-7 flew with a *single optical fiber* in its flight control system.

"It's a different variant of fly-by-wire where we're transmitting information by photons instead of electrons," Colonel Barlow says. "Digi-



The IFFC/Firefly F-15 downs a PQM-102 drone in a near-frontal attack with a two-second burst of ball ammunition. Digital flight controls coupled with the fire control computer free the pilot from traditional tactics.

tal fly-by-wire opened up a whole new world of flexibility, because we are now able to change the program with a chip. That's where we are right now—just beginning to exploit the digital.

"Fly-by-light will add a couple of significant advantages. You can push an awful lot more information through as compared with conventional wire. That's important, because we think smarter airplanes are the way of the future. Fiber optics also offer protection from electromagnetic disturbances."

Other developments are more down to earth—literally so. In FY '83, ASD's Flight Dynamics Labo-

ratory will begin a Short Takeoff and Landing (STOL) technology program.

"We find an almost complete void in the data base on the interaction of aircraft and soil," Colonel Barlow says. "We're looking at that, essentially to understand better what happens when one attempts to operate—or just taxi—over soft surfaces. We can land aircraft on carriers and absorb a pretty substantial impact, but we can't taxi across a rough surface right now. We're looking at the concept of smart landing gears."

General McMullen thinks the next-generation fighter is likely to

have STOL but not VTOL (Vertical Takeoff and Landing) capability. "The vertical part is just too big a price to pay," he says. "If you look at the VTOL fighters that exist now, really the AV-8 Harrier, it's generally used in a STOL mode. They use a ramp to help launch it. It gets a run at it, which makes it STOL by definition."

Derivative Fighters

But the next-generation fighter is not even officially on the drawing boards yet, so ASD continues to build on systems already in the force, especially the F-15 and F-16.

The F-15C/D, already flying with its first operational squadrons, is getting avionics enhancements to its radar and electronic warfare suites.

In 1984, the F-16C/D will begin

entering service at Nellis AFB, Nev. It will feature the so-called *Star Wars* cockpit—similar to AFTI's, with cockpit controls and multipurpose displays up forward where they're most convenient—and radar with double the range of that in the F-16A.

"The reason for wanting this additional range is to be able to take advantage of the AMRAAM [Advanced Medium-Range Air-to-Air Missile]," says Brig. Gen. George L. Monahan, F-16 program director. "You want to be able to detect the target early enough so you can launch when you get to the limits of the AMRAAM range."

Last year, the Air Force stood down the F-16 fleet for eighteen days to upgrade the emergency power unit. "There was a suspicion that a malfunction could interrupt electrical power to the fly-by-wire system and cause the pilot to lose control of the aircraft," General Monahan says. "We made the mod, and it's doing fine."

"The F-16 is the only operational airplane that's 100 percent fly-by-wire. It's working very well, but it must have a constant source of electrical power, zero interruptions. Additional mods are coming to give it redundant power sources. We'll have two sources of power going all the time, and if one of them crumps out, the pilot would never know it, except that a light will come on."

At the moment, though, the spotlight is on derivative E model concepts for both the F-15 and F-16, with the Air Force conducting an evaluation of them as candidates to meet its requirement for some 400 dual-role fighters. The aircraft selected will replace F-4s in a dual air-to-air and deep interdiction role.

The Air Force has avoided calling this evaluation a competition, leaving open the possibility of acquiring both the F-15E and F-16E in a split acquisition. The Senate Appropriations Committee, however, has served notice that it will not support full-scale development of both. It now appears that the decision may be full development of one of the E models and some "lesser upgrading" of the other.

Whatever the choice—and the decision is to be made by July—the dual-role fighter will be a two-place aircraft, able to attack ground tar-

gets in darkness and under the weather, using the Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system. LANTIRN is viewed by the Air Force as a priority development program. It includes a navigation pod and a targeting pod, both employing Forward-Looking Infrared (FLIR) technology. A LANTIRN-equipped fighter will be able to drop below cloud cover to strike in many conditions that would preclude visual flying, but it will not be an all-weather attack system.

"LANTIRN will give us the ability to navigate at low altitude at night, and even get into weather en route to the target," says General McMullen. "Right now, we're mostly limited to below the weather, daytime attack."

The F-16 contender in the dual role evaluation is the new XL model, first flown by General Dynamics last year. It is fifty-six inches longer than the F-16A, thanks to two plugs added in the fuselage, and it has a much larger wing of double-delta "cranked arrow" design. It offers up to forty-five percent more radius on internal fuel and carries twice the payload of the F-16A.

A number of F-15 configurations are flying to produce data for the evaluation, but the official concept for the F-15E is essentially a D-model aircraft enhanced with about 1,000 pounds of new avionics. Criteria in the Tactical Air Command statement of need do not include the synthetic aperture radar (SAR) demonstrated over the past two years by McDonnell Douglas and Hughes in the F-15 Strike Eagle prototype.

That radar has shown impressive results as an all-weather target acquisition system (see "Flying in the Enhanced Eagle," *AIR FORCE Magazine*, May '81). The SAR scans its target for a few moments before presenting a built-up image that is stronger than would be possible from direct pulse returns. The indicated tactic is for the aircraft to approach low, pop up to about 2,500 feet for the SAR to locate the target, then drop back down again. LANTIRN, on the other hand, keeps the mission closer to deck.

The Air Force has no immediate plans for the SAR, but since it basically involves a software change to

the existing Eagle radar, it could be added to the F-15 later on. USAF crews have flown the Strike Eagle, but the Air Staff does not yet have their evaluation.

The dual-role fighter buy will be conducted within the fighter acquisition totals: at least 1,395 through FY '92 for the F-15, and 2,165 through 1991 for the F-16. The timing would seemingly leave open the possibility of further derivatives of these aircraft. And modifications to retrofit them with new features are probable.

"The next thing out in the future is to watch very carefully what happens in the AFTI program and plan to incorporate that when it makes sense to do so," says General Monahan. "We want to make sure we don't miss opportunities to do smart things. We've only delivered about 500 of the 2,165 aircraft, so we're not even a fourth of the way there yet. We'll have 785 F-16As and Bs. From there on up to number 2,165 will be Cs and Ds, or some derivative, or both."

ALCM and B-52 Updates

Aside from the B-1B program, priority ASD efforts in the strategic area center on fielding the Air-Launched Cruise Missile (ALCM) and upgrading the old B-52 bomber, which will be the first aircraft employing ALCM.

In December, the 416th Bombardment Wing at Griffiss AFB, N. Y., became the first Air Force unit to reach initial operating capability with ALCM. Deliveries of the missile itself are on schedule, with a production rate of forty a month having been achieved last September.

During the past year, ALCM performed well in checkout flights. In one test, ALCM was launched off the California coast and ended its mission precisely over target in Utah, demonstrating the capacity of its navigation system to transition from overwater to overland flight.

Another test allayed concern that ALCM might have airflow and weight problems should it ice up in the captive carry mode on the B-52. A KC-135, trailing a special boom that resembled an oversize shower head, sprayed water on an ALCM in captive carry on a B-52 until three-quarters of an inch of ice formed on

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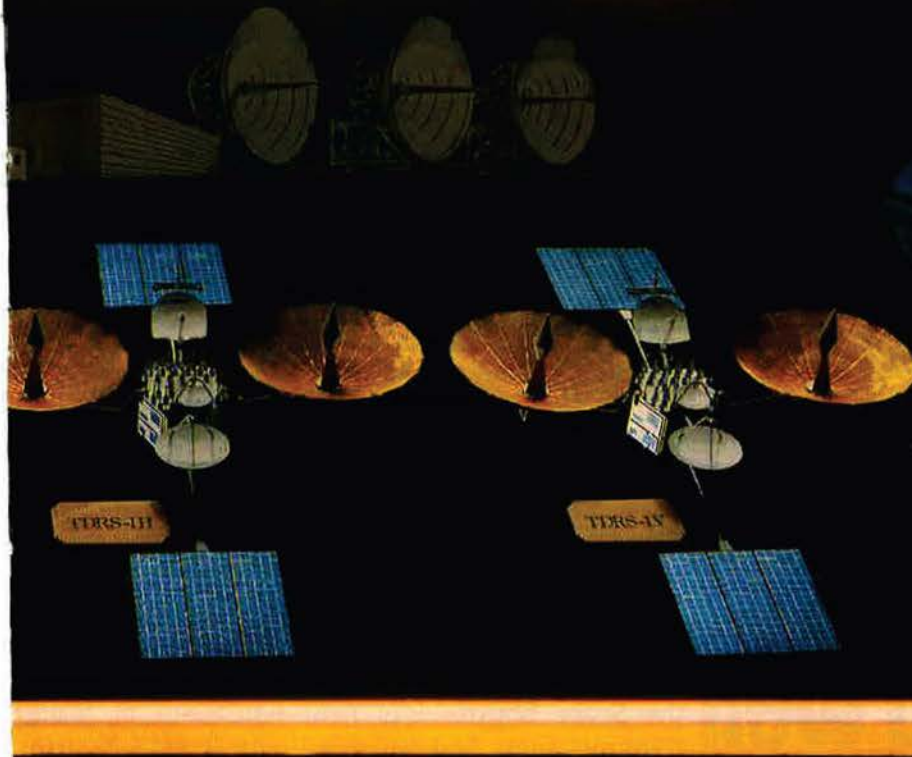
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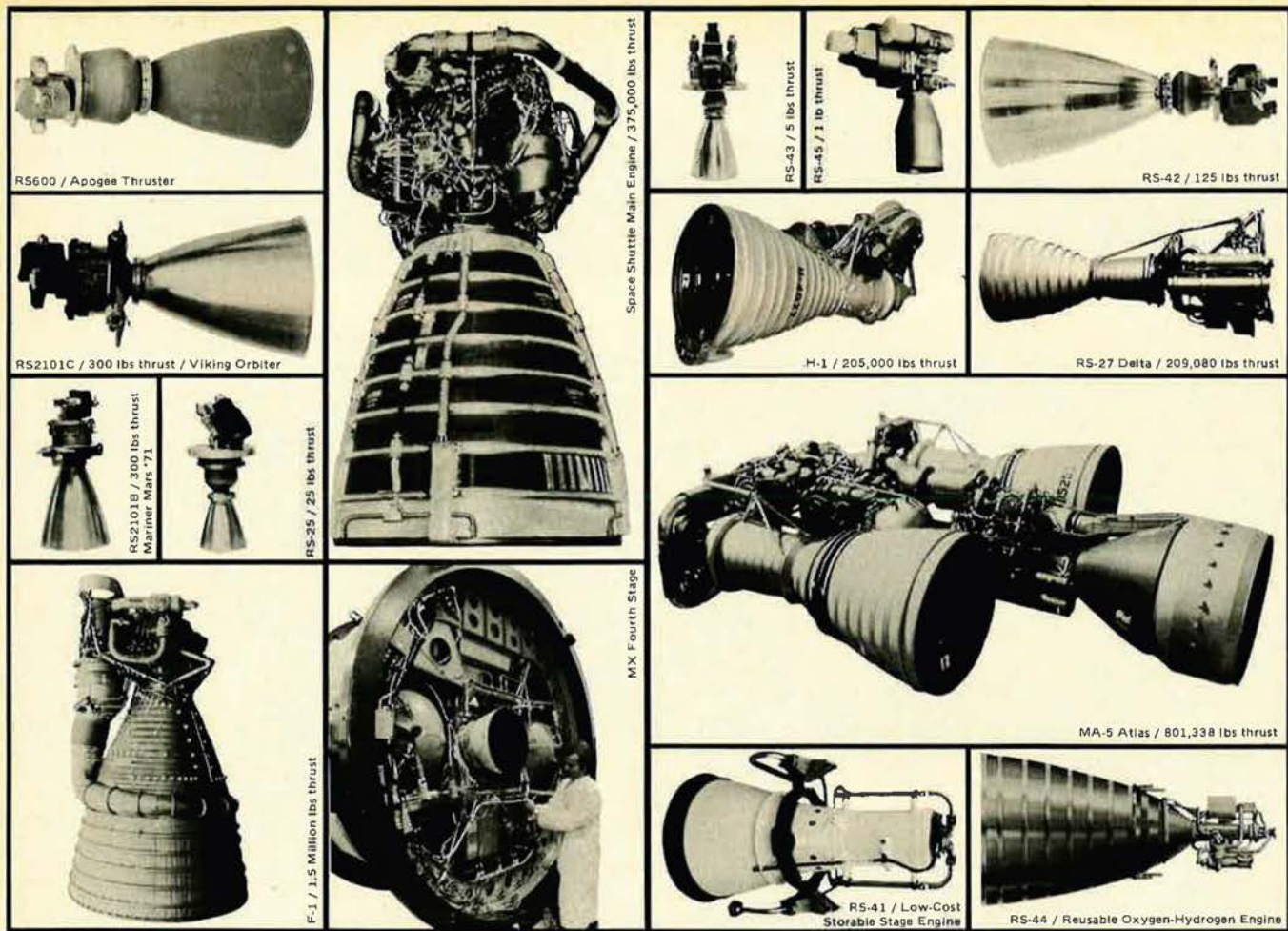
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portions of its outer surface. The icy missile then launched, flew its designated course for three hours and fifty-five minutes, and finished up over target.

Col. James E. Foster, ASD Deputy for Strategic Systems, says there have been no problems with the terrain contour matching (TERCOM) guidance system handoff of ALCM from the mother ship to direct flight.

"The B-52 has flown for as much as eight hours on its own guidance system, updated the ALCM, and released the missile with the ALCM flying over its first map with excellent accuracy," he says.

ASD's work is nearly complete on the B-52 Offensive Avionics System (OAS), an electronic bombing and navigation package to help the old BUFF align, target, and launch ALCM. A program to improve B-52 electronic warfare capabilities is in full-scale engineering and development.

Upgrading the B-52's old ASQ-38 radar is a matter of special emphasis.

"It was rapidly approaching the point where it was not supportable by Air Force Logistics Command," Colonel Foster says. "This is basically a reliability-maintainability update. It does not intentionally provide any increased performance." That effort, too, is in full-scale development.

Also in the works is a Common Strategic Rotary Launcher (CSRL), to be used by the B-52H fleet and eventually the B-1B and the Advanced Technology Bomber to carry ALCM as well as the Short-Range Attack Missile (SRAM) and other weaponry. ASD expects to pick a contractor for this launcher around April.

Early concept definition is beginning in the Advanced Strategic Attack Missile (ASAM), a follow-on to SRAM. One concept under consideration will pack at least the same capability into a weapon half the size. This would mean that a great many more missiles could be carried on a launcher.

Next-Generation Trainer

ASD is moving rapidly ahead on the T-46A, the Air Force's first new primary jet trainer since the T-37 entered service in 1958. First flight

is expected in 1985 with first deliveries to Air Training Command likely in 1986.

"The T-37 is an old airplane, and with the student load that's projected, we don't have enough of them," says Brig. Gen. Elbert E. Harbour, ASD Deputy for Airlift and Trainer Systems. "Beginning in 1986, there's a shortfall in trainers, and it worsens through the '90s. Additionally, the current trainer is not pressurized to the extent that you can take student pilots up to the altitude the airplane's capable of. It's a very early jet engine, and it uses lots of fuel. And it doesn't have very long legs on it.

"The drive was to get an airplane that's fully pressurized, so you can take it up to 25,000 to 30,000 feet. Civil air traffic is really increasing, so FAA is very reluctant to let us train much below 10,000. They hate to sterilize that airspace because you've got so many light airplanes."

Fuel consumption by the T-46A will average around ninety gallons an hour. Its greater range means a student pilot can launch with the option of recovering at a base up to 300 miles away if the weather gets marginal instead of skipping a training day when the forecast is iffy. Full pressurization will allow students to keep flying with light colds or minor ear blocks, rather than sitting out these ailments on the ground as is the case now.

Tankers and Airlifters

A number of actions—including a recent C-5A wing modification, re-engining of the KC-135, and the pending acquisition of the C-5B and more KC-10s—have improved the Air Force's serious tanker and airlifter problems, but have not totally cured them.

The KC-135 tanker was originally bought to support strategic bombers. Today, fighters and airlifters also need aerial refueling to carry out worldwide deployments, and there aren't enough booms in the sky to service the growing list of customers. The additional forty-four KC-10 tanker/cargo aircraft USAF intends to buy will help—and so will the reengined R model of the KC-135, which rolled out last June and made its first flight in August.

"The new CFM56 engine pushes

the thrust from about 13,000 pounds to nearly 20,000," General Harbour says. "That means you can get airborne on a shorter runway. But more important, you can now put more fuel on the -135. The tank capacity has always been greater than the engines had the power to lift airborne." The load will vary with the tanker's mission profile, of course, but on a 2,000-nautical-mile radius, the KC-135R will offload one and a half times the fuel dispensed by a KC-135A. The capacity difference: 203,000 pounds of fuel in the R, as compared with 189,000 in the A.

On airlift, General Harbour says that although the KC-10 and C-5B acquisitions "will certainly go a long way toward getting us out of a crucial shortfall, we still have a serious problem. One, there's a plain tonnage shortfall. The C-5B, with just fifty aircraft, won't fill that requirement, nor will the KC-10. Second, there's a particular shortage with the intratheater airlift. A major part of the mission is to get the Army to the war before the war gets out of hand. We can project a force anywhere, but how quickly and to what narrow sector can we do it? Certainly, we can put the airborne down, but there's more to it than that. Can we get in and out and re-supply?"

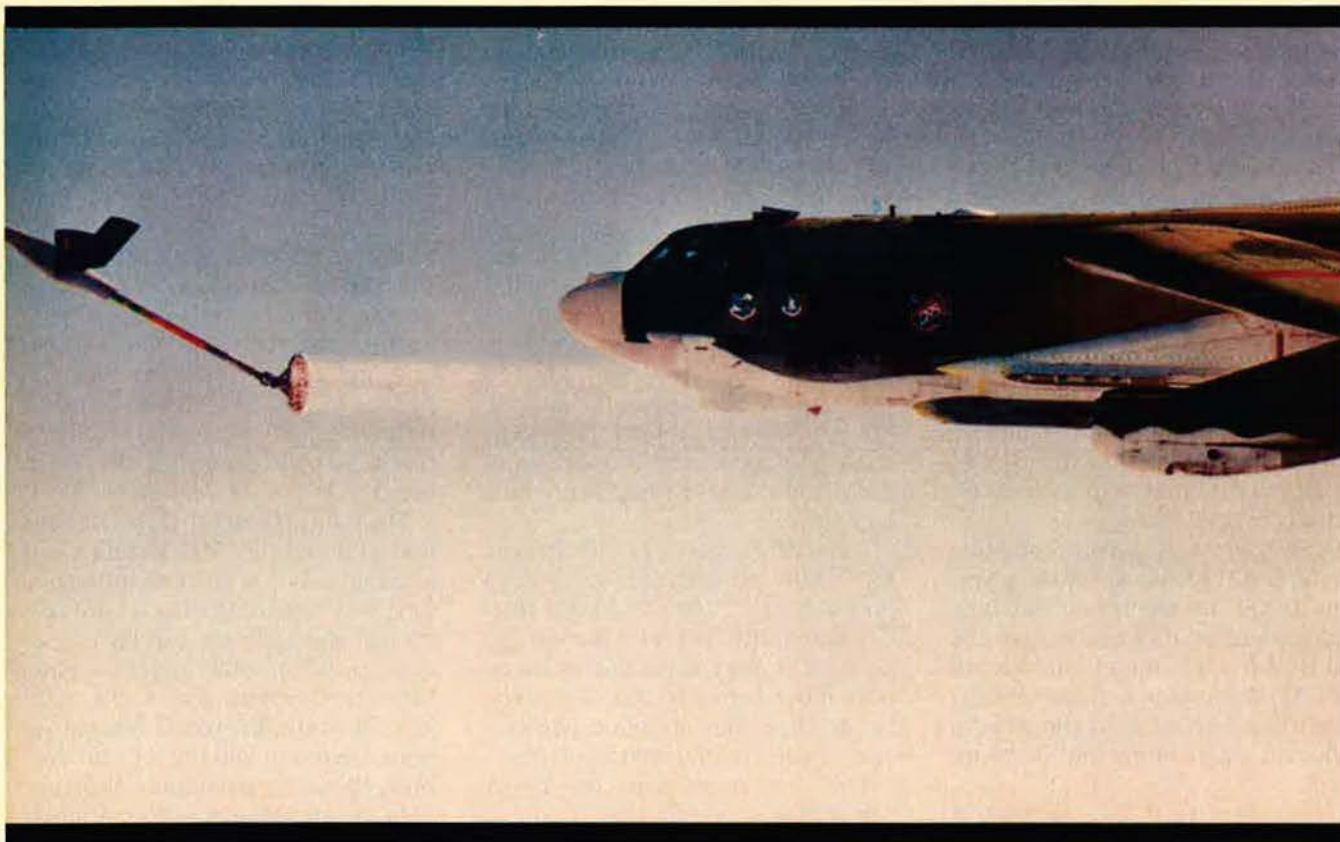
These gaps might be best filled by the C-17 inter/intratheater airlifter, which ASD will not field much before the end of the decade unless funding is accelerated. The C-17, smaller than the C-5 but bigger than the C-141, will be able to carry out-size loads, use smaller and rougher airfields, and take up less parking space on the ramp.

Friends and Foes

A number of ASD programs are aimed at improving the ability of airmen to recognize each other in the battle area. The major effort is development of the Mark XV IFF (Identification, Friend or Foe) system, a triservice, multinational project on which the US Air Force has lead responsibility.

The Mark XV will eventually replace the old Mark XII—a system that has not always inspired a great deal of confidence among its users.

"One of the things we've got to do is come up with a highly reliable



In a checkout flight last year, ALCM proved that icing up is no obstacle. A water-spraying boom built up ice on the missile, which was in captive carry on a B-52. Then launched, ALCM performed like a champion.

system that the pilot is going to be willing to use and feel that it's not going to make him vulnerable to the enemy if he turns it on," acknowledges Col. David L. Ewing, Combat Identification System program manager. The Mark XV, he said, will have greater range, be able to operate in a high-jamming environment, and be "a much more survivable system in terms of the enemy not being able to break in and use your own ID system against you."

As with the Mark XII, the new system will involve an electronic transponder query to which friends will be able to respond, but to which foes cannot. "It tells us if he's a good guy, but it won't tell us if he's a bad guy," says Col. Benjamin D. Crane, ASD Deputy for Aeronautical Equipment. The IFF will work in concert with such other means of identification as the formidable battle management sensors and computers of the E-3A Airborne Warning and Control System (AWACS). The preferred technique, however, is direct identification by use of electronic equipment on board the aircraft needing the information.

"For the first time, we're going to be fully NATO interoperable," says Colonel Ewing. "Not all the allies use the existing system."

One of the significant hurdles in the path of the Mark XV at the moment is difficulty in arriving at a NATO-wide frequency. Each nation has its own civil frequency control agency, and securing agreement among them is not proving easy.

The Far Future

Looking toward the far horizon, ASD is considering what might be done with the "aerospace plane" concept that enjoyed a flurry of interest in the 1960s.

"We do have a very early look at some sort of a machine that can operate either in space or in the atmosphere over long ranges," General McMullen confirms. "It would have the flexibility in both the time and place of landing so you wouldn't have to have a Cape Canaveral with everybody tied down and counted down for months ahead before you finally get it off. It would have the flexibility to go to different places and do useful things. We've had a session with industry, in which we told them our ideas and solicited theirs."

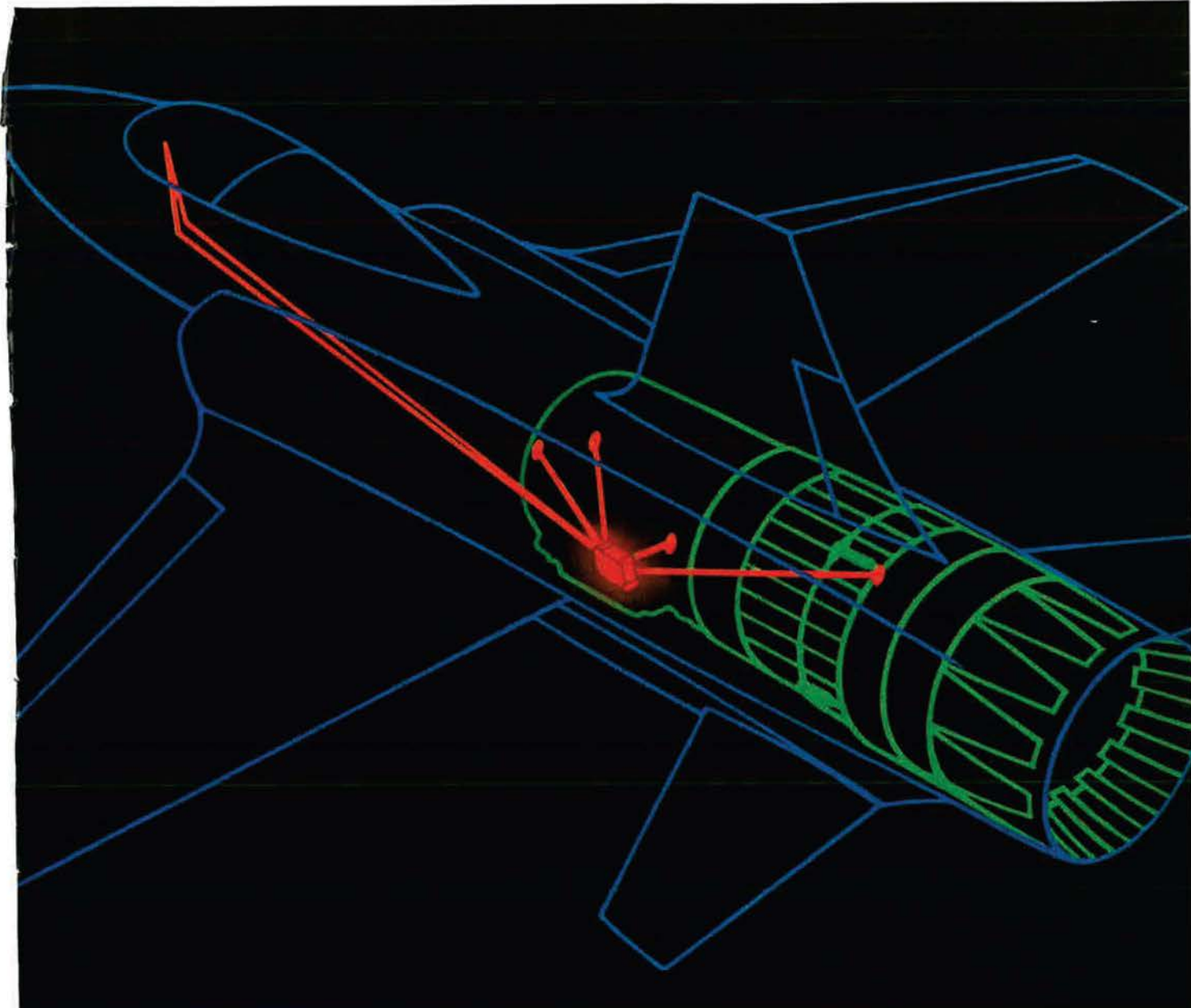
That session, a Trans-Atmospher-

ic Vehicle Symposium held at ASD last summer, has led to some exploratory concept contracts to help identify what the critical technologies might be should a decision be made to proceed with the Advanced Military Spacelift Capability (AMSC).

"Certainly there is no one configuration, no one concept that stands out," says Colonel Barlow of the Flight Dynamics Lab, "but there's a great deal of flexibility in the idea of rapid launch into almost any orbit one chooses."

The course that military airpower will take—either with systems as close as derivative model fighters or as distant as the aerospace plane—cannot be precisely foretold. That direction will be shaped by many factors, notably the availability of funding as well as by technological possibility.

Still, the steady, and sometimes spectacular, work being done at Aeronautical Systems Division does provide a substantial glimpse of what is likely to come. In those efforts, the future has already begun to form up. ■



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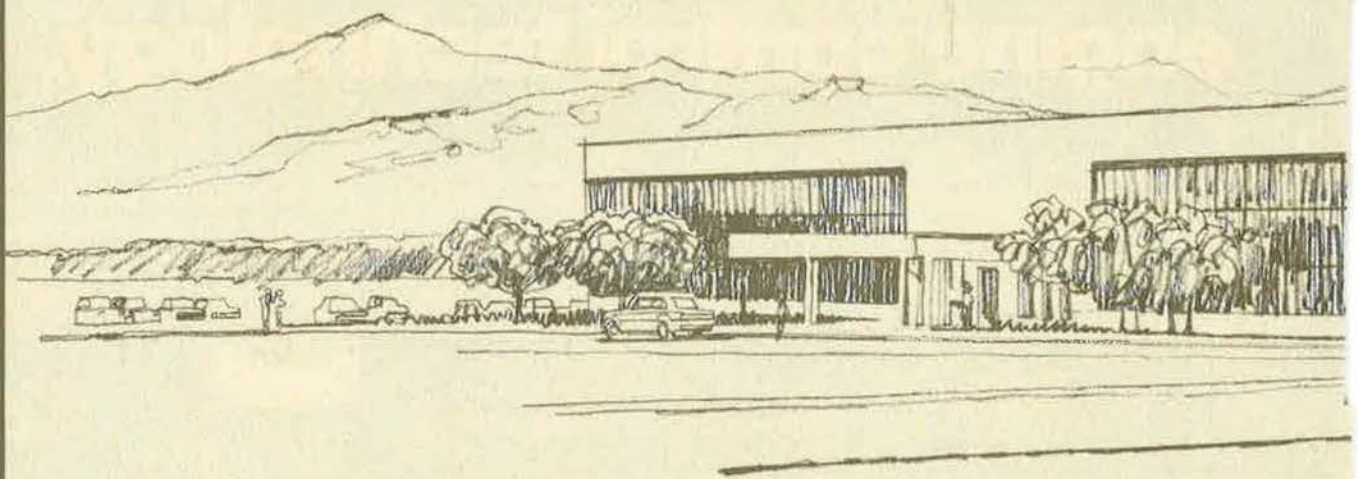
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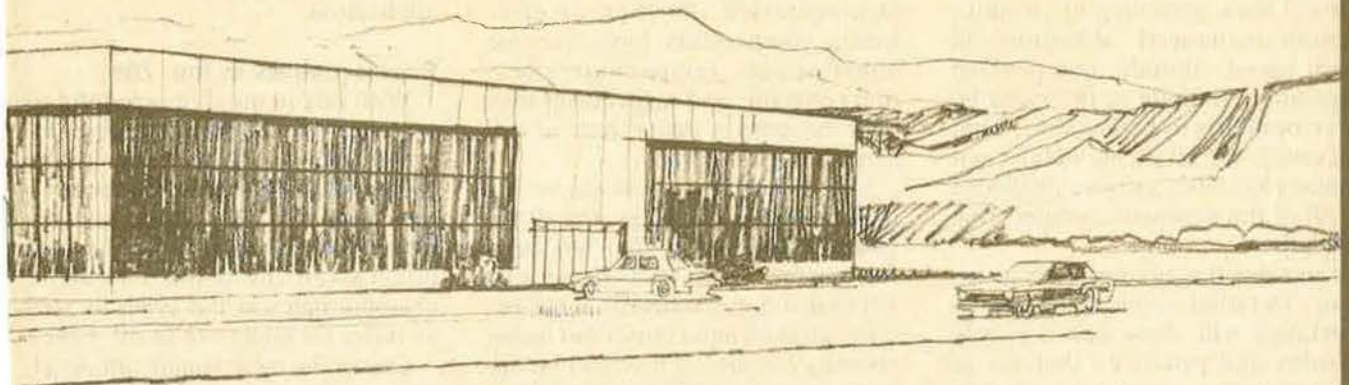
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NEW THRUSTS IN ENGINE DESIGN

BY COL. JAMES NELSON, USAF
DEPUTY FOR PROPULSION, AERONAUTICAL SYSTEMS DIVISION

Propulsion has always been the pacing item in aircraft development. Here's how the powerplants of tomorrow are coming along.

PROGRESS of powered flight has always been dependent on progress in powerplants. The Wright brothers had to develop an engine powerful enough yet light enough before they could succeed at Kitty Hawk in 1903. With Charles Taylor, the chief mechanic at their bicycle shop in Dayton, they designed and built their own twelve-horsepower engine, weighing only 180 pounds. It was as critical to their achievement as their more publicized aerodynamic concepts were. Coupled with their own propeller design, the engine enabled them to make the Kitty Hawk flight.

Nothing in the basic relationship has changed since then, because the natural laws governing aeronautics remain unchanged. Milestones in flight speed, altitude, and payload capability continue to be paced by developments in propulsion. That necessity for efficient, lightweight engines has been a severe challenge to all of the aeronautic engineering disciplines.

Consider the modern turbine engine. Detailed examination of its workings will show aerodynamic designs and practices that are at least as complex and demanding as those required for the airframes and avionics. Progress in engine mechanical designs has brought us from the Wrights' power-to-weight ratio of 1:15 (best in its 1903 day) to

the 8:1 thrust-to-weight ratios of today.

Advances in materials and heat transfer technology permit us to exploit the increased engine performance available from higher operating temperatures without paying the previously necessary prices in engine wear or in lost efficiency resulting from the need to raise coolant levels. Now, sophisticated internal cooling systems can use 1,000°F compressor air as the cooling medium, keeping combustor and turbine metal temperatures at or below 1,800–1,900°F. This capability, in turn, takes advantage of improved thermodynamic efficiencies—derived from gas stream temperatures of more than 2,500°F—and also improved aerodynamic efficiencies, derived from high compressor and turbine blade tip speeds. The result: improved thrust at less weight.

These improvements, however, always push at the outer limits of high temperature/high stress and weight reduction possibilities. The limits apply to the aerothermomechanical discipline, as well as those for materials, test facilities, and instrumentation. Further, as electronic components have become miniaturized, temperature/vibration resistant, and ruggedized, they have become a major part of advanced engine designs.

Fuel efficiency has always been a major driver of design in aircraft engines. Traditionally, that has been for reasons of payload, range, and internal volume tradeoffs. It has become an even more important factor recently because of its effect on operating costs. Military as well as commercial airline flight operations have been drastically curtailed because of the tremendous burden of fuel costs, which rose from ten cents a gallon in 1972 to more than a

dollar a gallon in the 1980s. Demand is also growing for improved durability, reliability, and maintainability to further reduce support costs.

These technical and economic challenges have made the engine business one that is characterized by an iterative design-test-analyze-redesign approach. This cycle is typically hardware intensive, requiring massive facility investments and resource commitments. Engines have a relatively long development period.

Compared with many other products, aircraft engines are manufactured at relatively low rates and volumes. Once a new engine is developed, it will often be employed in the development of several advanced aircraft concepts. There are typically derivative or growth versions of the engine for specific applications. Thus, the engine also tends to have a long life cycle that requires a strong, continuing base of support for parts and maintenance. All these factors have led to a condition where the number of aircraft suppliers worldwide is small, and there is fierce competition for each new application.

Developments in the '70s

With this in mind, it is helpful to examine the significant engine improvements and applications of the 1970s, which built upon the technology advances that came before. From that perspective we can best understand the expected engine characteristics of the 1980s as well as those we might see in the 1990s.

One of the most significant developments in major engine designs in the 1970s was the widespread application of high bypass turbofans to military and commercial subsonic transports. (Bypass ratio expresses the relationship of total airflow

through the engine fan to that which passes through the core of the engine high pressure combustor and high pressure turbine.)

Although turbofans with bypass ratios of 2:1 were developed and employed in the 1960s, and demonstrated fifteen to thirty percent savings in reduced fuel use compared to earlier pure turbojet designs, the dramatically higher bypass designs of the '70s provided a further reduction of twenty-five to thirty percent in specific fuel consumption—with a thrust increase of almost 300 percent.

The benefits of higher bypass ratios are illustrated in the accompanying chart, which looks at a sampling of turbofan engines over three decades. The first high bypass turbofan was the General Electric TF39, which was qualified in 1968 for the C-5 aircraft. Since then, a host of others—too many to chart here—have followed.

In general, for a given size of the core engine, as the bypass ratio increases, so does maximum thrust, while thrust specific fuel consumption (the index of fuel use to net thrust) generally decreases. Basic technology advances in these engines have allowed substantial increases in turbine rotor inlet temperatures. Improvements are seen in other characteristics as well.

Next Steps Ahead

The Pratt & Whitney 2037 is the first completely new high bypass design to appear since the introduction of the first-generation designs and their derivatives. It will achieve the excellent fuel specifics of the

TF39, but at a lower bypass ratio, higher pressure ratio, and higher turbine inlet temperatures. In addition, the 2037 will be a more compact design, with far fewer engine stages and parts. Already selected for the Boeing 757 and the Air Force C-17 prototype, the 2037 and its future derivatives will see wide application.

NASA has supported efforts by both Pratt & Whitney and GE to improve modern turbofan technology in the Energy Efficient Engine (E³) program. In the overriding interest of better fuel economy, as well as need for improved life and performance retention, the E³ bypass ratio has been increased along with overall pressure ratio. While turbine rotor inlet temperatures have increased only modestly, thrust to weight has decreased in order to provide more rigid designs. This allowance for weight increase reflects the importance of increased durability and life for reduced maintenance and overall life cycle cost.

While pressing ahead on turbofans, we must not overlook the potential of the modern propfan. Advanced high Mach number propeller designs are under investigation by NASA with Hamilton Standard. The tip speed, power loading, diameter, and structural characteristics of these highly swept aerodynamic propeller designs must be scaled up from the two-foot-diameter versions tested to date to twelve- to fifteen-foot diameters.

At ASD we are following these efforts with great interest for possible future Air Force applications. We are examining the possibility of

assisting in this program by providing test time at Arnold Engineering and Development Center for demonstration of advanced props with diameters up to nine feet. High-speed, lightweight gearboxes of 10,000 to 15,000 horsepower ratings (vs. the current 5,000 horsepower maximum) also must be developed to realize the potential of advanced turboprop engine installations. These developments, coupled to a new core engine, could make both the propfan and the advanced turbofan highly attractive for new, more fuel-efficient aircraft designs.

Characteristics of an advanced turboprop engine design are illustrated in the chart by the STS589, one of Pratt & Whitney's advanced designs incorporating the advanced propeller, gearbox, and high-technology core engine. The specific fuel consumption shown is based on operation at Mach 0.8 at 35,000 feet and assumes maintenance of eighty percent efficiency from a propeller of 13.5-foot diameter.

It is important to note that both the advanced high bypass and advanced turboprop designs are highly dependent on advanced engine core technology of the type pursued in the Air Force Advanced Turbine Engine Gas Generator (ATEGG) program, managed by our Aero Propulsion Laboratory and jointly pursued with the Navy. The trend is toward tremendous improvements in specific fuel consumption brought about by the high bypass designs and those expected from advanced turboprops or higher bypass ratio designs. The turboprop application will, of course, depend on success-

How High Bypass Ratio Helps

ENGINE	1960s		1970s				1980s		
	TF33	JT8D	TF39	TF34	JT9D-7	CF6-50	PW2037	E ³ (GE)	STS589
Bypass Ratio	1.4	1.0	8.0	6.3	5.0	4.4	5.7	6.9	infinity
Thrust	16,500	14,500	40,800	9,300	48,000	52,500	37,000	36,000	22,000
Thrust Specific Fuel Consumption	0.82	0.82	0.58	0.66	0.62	0.63	0.58	0.54	0.52
Thrust: Weight	4.2	4.4	5.4	6.3	5.4	6.0	5.6	5	4
Overall Pressure Ratio	15	17	26	22	23	30	32	36	28
Turbine Rotor Inlet Temperature	1,600	1,720	2,350	2,230	2,200	2,460	2,550	2,450	2,420

AUGMENTED TURBOFANS: A Boost for Bombers and Fighters

		1960s	1970s			1980s			
		TF30	F100	F101	F404	F110 DFE	F100 EMDP	SUPER CRUISE	TRANSONIC STOL
Thrust	Aug.	18,000	23,800	30,800	16,000	28,000	27,400	14-20,000	19,000
	Dry	10,800	14,700	17,400	—	16,600	16,700	10-13,000	12,000
Thrust Specific Fuel Consumption	Aug.	2.50	2.17	2.76	—	2.01	2.00	1.2-2.1	1-1.5
	Dry	0.63	0.72	0.58	—	0.67	0.85		
Thrust:Weight	Aug.	4.5	7.8	7.0	7.5	7.3	8.5	9-10	10
	Bypass Ratio	1.10	0.63	2.01	0.34	0.78	0.63	0.1-0.2	0.6
Overall Pressure Ratio		17	24	26	25	29	27	17-25	28
Turbine Rotor Inlet Temperature		1,970	2,560	2,550	2,500	2,650	>2,600	3,000-3,200	2,900

fully demonstrating its technological and economical superiority over the turbofan.

The importance of these subsonic high bypass designs is put in perspective by the Air Force's current yearly aviation fuel bill of \$4 billion to \$5 billion. Economic pressures are significant enough to make cost-effective the reengining of the KC-135 tankers from the original J57 turbojets to the high bypass CFM56.

Augmented Turbofans

Of equal importance to the widespread application of the high bypass ratio engine in the '70s, and perhaps of even greater military significance, was the application to fighter and bomber designs of augmented turbofans with high thrust-to-weight and low bypass ratios. The chart above, using the first operational augmented turbofan—the TF30 engine for the F-111—as a base shows the impact of this technology, reflecting major increases in thrust:weight, overall pressure ratio, and turbine rotor inlet temperatures. Thrust and Specific Fuel Consumption (SFC) values are shown for both augmented and maximum nonaugmented (dry) ratings. (Augmented, sometimes referred to as afterburning or "wet" operation, is a means of increasing thrust

through addition of fuel into an afterburner combined with modulation of the engine exhaust nozzle to the appropriate exit area for the flow temperature and pressure conditions created.)

Bypass ratios are lower for the fighter engine designs (F100, F404) than for the bomber engine (F101), where extended cruise at dry power/low SFC is most important. It is important to note that the technologies that provided high overall pressure ratio and high turbine rotor inlet temperatures for the high bypass fans are also used here.

It was the combination of this wide range of thrust available in these designs, along with fuel economy and light weight, that made it possible to design the extremely agile, highly maneuverable F-15, F-16, and F-18 fighter aircraft. Similarly, these same factors enabled high performance, long-range bomber design, as seen in the application of the F101-GE-102 engine for the B-1B.

In this decade we expect to see derivatives of these engines provide significant improvements to engine operations with reduced support costs. The Air Force established an Engine Model Derivative Program (EMDP) in the late '70s to provide for development and demonstration of improved derivatives of produc-

tion engine designs. Air Force support of Pratt & Whitney in development of a Digital Electronic Engine Control (DEEC) was initiated in EMDP in 1979. We have recently entered full-scale engineering development on this effort, leading toward an F100 with DEEC, and incorporating component improvements to double the life of the core, including the high stressed hot section.

Similarly, a derivative fighter engine (DFE) of the GE F101 will go into full-scale development this fall. This engine, now designated F110-GE-100, is in limited flight testing in both the F-16 and the Navy F-14, as well as in ground-based accelerated mission testing. It has shown excellent fuel specifics, operability, and durability. Having a core engine identical to that in the B-1B bomber, it provides us with an excellent opportunity for overall engine management supportability.

The F100 with a DEEC prototype control unit has been flown in the NASA F-15. The F101 DFE with a combined electronic/hydraulic control has been flown in the F-16 and the F-14. Both have shown significantly less tendency to stall as well as a reduction in the current requirement for careful pilot attention to throttle movement in some parts of the flight envelope. Neither engine will have to be trimmed in the field prior to aircraft installation, and both promise significant improvements in parts life and overhaul interval. These improvements are of such significance that both engine model derivatives are entering full-scale development. These

Col. James R. Nelson, USAF, is Deputy for Propulsion for Aeronautical Systems Division. He began his Air Force career in 1951, serving as a navigator in B-29s, KC-97s, and RB-47s. A graduate of the Air Force Institute of Technology, he holds a bachelor's degree in aeronautical engineering and a master's degree in aerospace engineering. Colonel Nelson has served as Commander of Aero Propulsion Laboratory and as Commander of Wright Aeronautical Laboratories. He assumed his present position in 1981.

designs will be in competition for Air Force engine buys for the F-15 and F-16 aircraft in FY '85 and beyond.

The chart also shows a follow-on F100 EMDP effort, which combines the F100 DEEC and long life core configuration with an advanced fan, fan turbine, and improved augmentor. This will provide an F100 for the future, retaining the improved operability and durability features but adding increased performance.

Beyond Derivatives

These derivatives promise increased operability, maintainability, and durability for existing systems, but the Advanced Tactical Fighter (ATF) for the '90s may require combining available technologies in a totally new engine. Current efforts include the Aircraft Propulsion Subsystem Integration (APSI) and Advanced Turbine Engine Gas Generator (ATEGG) programs—originated by the Air Force and now jointly supported with the Navy—the Advanced Turbine Engine Studies (ATES), and a potential Advanced Tactical Fighter Engine Project leading to full-scale engineering development in the late 1980s. Bypass ratios in designs under consideration range from very low (0.1 to 0.2) to medium, with thrust-to-weight ratios in the neighborhood of nine or ten.

These designs will bring higher operating temperatures, significantly improved fuel efficiencies, improved operability/stability characteristics with full authority digital electronic controls, and greatly improved durability at reduced life cycle costs. ATF requirements may include one or all of Short Takeoff and Landing (STOL), and supersonic persistence (Supercruise) capabilities.

Both STOL and Supercruise designs will benefit from integrated flight and propulsion controls. Lighter weight and higher thrust will help keep cost as well as system size down. STOL and Supercruise, however, are optimized differently.

The Supercruise design favors lower bypass ratio, lower overall pressure ratio, and higher turbine rotor inlet temperatures more than does the design for Transonic STOL. This emphasizes the challenge facing the Air Force and in-

dustry in defining ATF requirements. Our direction will depend on the relative importance of Supercruise and STOL—and such related requirements as range, payload, and agility—so we must decide carefully.

Engine integration with the aircraft in terms of inlet and nozzle design and flight/propulsion controls must be done better than ever before. We estimate that improvements in aircraft design for Supercruise at Mach 1.8 can double the cruise range of current supersonic-capable—but basically subsonic cruise—aircraft when operated at supersonic cruise speeds. Engine designs can provide similar gains so that a supercruiser with both improved aerodynamics and improved engine design could cruise continuously at Mach 1.8 with max range capability nearly equivalent to current designs cruising at Mach 0.9.

The chart on this page shows the dramatic increases in thrust to weight achieved in the past twenty years, and that achievable with development technology which will provide the improved system capability.

"ilities" and Options

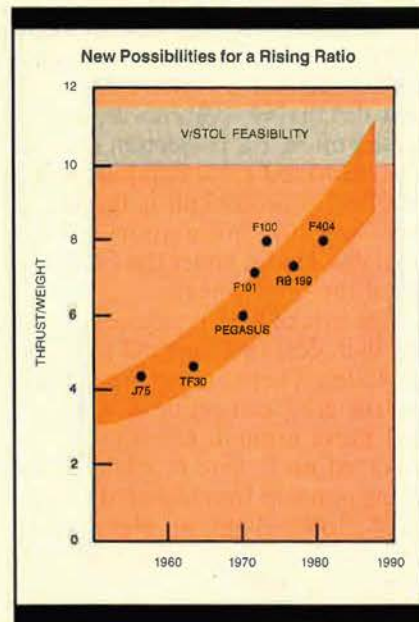
Further, just as our current emphasis for the advanced F100 and F110 designs includes major improvements in operability, maintainability, and durability with resultant reduced costs, we fully intend to stress the "ilities" up front in advanced designs. Our new de-

velopment philosophy, including the application of the Engine Structural Integrity Program (ENSIP) and accelerated mission testing (AMT) during the development process, is being applied to current and future full-scale development and acquisition programs to assure such balance.

Of equal importance, but often neglected, are the needs for improved instrumentation, analysis, and test techniques. Improved test capabilities, such as that represented by our Aeropropulsion System Test Facility at AEDC and Compressor Research Facility at Wright-Patterson, will provide major new design/test verification capabilities. Installation of digital electronic controls will make application of improved engine diagnostic and health monitoring systems much easier and more effective, both for maintenance activities at the operating bases and at the depots for repair, refurbishment, parts tracking, and overall engine management.

We at ASD see the propulsion emphasis of the '80s focusing around derivative engines to upgrade current systems, followed toward the end of the decade by new technology engines for advanced aircraft that will be coming along. These engines will incorporate new compressors and turbines with fewer rotating parts. They will offer higher cycle temperatures with improved cooling. They will have full authority digital electronic controls for better stability and flexibility. Materials and design will provide for greater durability. We will see diagnostic systems for improved maintenance and engine management.

It is evident that propulsion has been the pacing item of the tremendous advances in both military and commercial aeronautical systems since the inception of powered flight. Further major advances are possible, but they will require extreme care in matching the engine to system needs early in the system definition phase. Careful integration with the aircraft and its systems will be required and, if we are to be able to better support the engine over its life, much more emphasis will have to be given to operability, maintainability, and durability as part of the original design. ■



FINALLY... THE B-1B

BY CAPT. MICHAEL B. PERINI, USAF
CONTRIBUTING EDITOR



On October 2, 1981, President Reagan announced a comprehensive plan to revitalize America's strategic forces. Included in his program is the modernization of the nation's long-range bombers.

REMEMBER 1955? Dwight D. Eisenhower was President, Rock and roll music was just about to sweep the nation, led by the uninhibited performances of Elvis Presley. And the Department of the Air Force, only eight years old as a separate service, was flying a brand-new strategic bomber—the B-52 Stratofortress.

For twenty-eight years various

versions of the B-52 have been on guard—forming the backbone of USAF's Strategic Air Command. Help is on the horizon, however, to replace the aging B-52 with a sleek new bomber—the B-1B.

The aircrew for the new strategic bomber will consist of the pilot, copilot, offensive systems operator, and defensive systems operator seated on ACES II ejection seats in a pressurized crew compartment. Access to the cockpit is through a downward-opening door and retractable ladder under the fuselage, aft of the nose wheel.

The aircrew convenience package includes a hot cup and a chemical toilet. There are no bunk beds, but the crew can get up and stretch and move around. Crew members reported no fatigue problems after flying nonstop from Edwards AFB, Calif., to England, an eleven-hour and twenty-five-minute flight, in September 1982.

The aircraft, made principally of

aluminum alloys and titanium, is hardened to withstand nuclear blast and overpressure. The structure of the B-1B is conventional, apart from the diffusion-bonded titanium wing carry-through and the boron-composite spine running from the wing box to add strength and stiffness to the aft fuselage. The B-1B has been modified from the B-1A (the original B-1) to increase maximum takeoff weight from 395,000 pounds to 477,000 pounds, primarily to accommodate a full complement of cruise missiles.

The fuselage, which blends, F-16 style, into the variable-sweep wing, is a large fuel tank with space left for the aircrew, a great deal of avionics, and three internal weapons bays.

A movable bulkhead separates forward and intermediate weapon bays, a modification introduced to accommodate the long AGM-86B cruise missile and to increase fuel capacity. The aircraft can carry a full range of nuclear and nonnuclear



Clockwise from left: USAF aircraft technicians perform preflight checks on the B-1A at Edwards AFB, Calif. A KC-135 refuels the bomber en route to England. Flying low approaches at Andrews AFB, Md. The four B-1A prototypes have served as test-beds for the B-1B. View from the tail of a B-1A at Edwards AFB.

weapons loads weighing up to 125,000 pounds.

The Air Force is pursuing the development of a common rotary launcher for internal weapons carriage on strategic bombers, including the B-1B. The launcher could be used for nuclear bombs, SRAMs, and ALCMs, and will be compatible with future conventional weapons including the Medium-Range Air-to-Surface Missile (MRASM).

Similarities and Differences

Though eighty percent common with the B-1A, there are differences (see chart, p. 60). The new version is the same length (147 feet long), is slower at higher altitudes, retains the low-altitude speed, is slightly heavier, carries a bigger payload and more fuel, and boasts a substantially reduced radar cross section. The bomber will have fixed engine inlets designed to optimize the aircraft's high-subsonic, low-altitude penetration mission. Below the cockpit are small canard surfaces, structural mode control vanes that improve low-level ride comfort for

the crew and that greatly enhance aircraft fatigue life. Finally, the landing gear has been strengthened to handle heavier gross takeoff weights. (For a full technical description of the B-1, see "Jane's All the World's Aircraft Supplement," AIR FORCE Magazine, December 1982 issue.)

The B-1A design was frozen early in the fly-by-wire era, and mechanical flight controls were specified for reliability. All control surfaces are operated electrohydraulically by rods, cables, pulleys, and bell-crank levers.

Both offensive and defensive electronics systems are much improved over the original B-1A. The offensive avionics include an improved forward-looking/terrain-following radar, an improved data bus interface, a highly accurate inertial navigation system, a link to the Air Force Satellite Communication System, and much of the new Offensive Avionics System (OAS) pack-

age being installed in B-52Gs and Hs. The avionics suite provides the capability to accept future growth in mission requirements.

The heart of the defense avionics package is the ALQ-161 Defensive Avionics System. Made up of more than 100 "black boxes," this flexible, reprogrammable system detects and analyzes automatically the range of Soviet early-warning, ground-controlled intercept, and surveillance and multiple threat radars. The electronically steered phased-array antennas are mounted in the wing-glove leading edges and in the tail. The system consumes about 120 kilowatts of power in an "all-out" jamming mode. This is equivalent to about 120 microwave ovens cooking meals at once.

Another part of the defensive avionics system is the tail warning system and such expendable decoys as chaff and flares.

All the main system computers on the B-1B are identical and com-

municate over a standard military data bus called 1553B.

The Electrical Multiplex (EMUX) system will control power distribution to various subsystems—avionics equipment, landing gear, engine instruments, and fuel system. The EMUX will eliminate approximately 32,000 wire segments and more than eighty miles of wiring. The system will weigh two-thirds less than a conventional wire bundle arrangement.

Four 30,000-pound-thrust General Electric F101-GE-102 augmented turbofan engines will power the B-1B. More than twelve years and \$600 million have been invested in testing and development. This includes 23,800 hours of factory and flight testing. The engine core is identical to that of the F101 DFE (Derivative Fighter Engine). The CFM56 high-bypass turbofan engine also shares much of this common core.

The engines can be easily started. The first crew member to the ladder flicks a switch on the nose gear that starts two auxiliary power units, each of which is located between two engines. The pilot or copilot can then throw four switches that will start the engines simultaneously. According to General Electric officials, the engine is virtually smokeless, with total emissions being significantly lower than those of most military engines.

"The Air Force is getting an engine that will be warranted, completely up to date—using technology that is proven," said Ned Hope, Jr., General Manager of GE's F101 Project Department at Evendale, Ohio.

Acquiring the B-1B

The production schedule for this bomber is challenging. To understand better the status of the program, we need to look briefly at its start almost thirteen years ago.

The original B-1A was the outcome of a succession of several Defense studies, begun in 1962, leading to the Advanced Manned Strategic Aircraft (AMSA) requirement in the mid-'60s for a bomber to replace the B-52. To meet the B-1A requirement, Rockwell International's Los Angeles Division (now North American Aircraft Operations) was given the contract for the B-1A airframe,



The main differences and improvements between the B-1B and the B-1A are listed here (the aircraft pictured is, of course, a B-1A): (1) new offensive avionics system; (2) movable weapons bay bulkhead; (3) simplified over-wing fairing; (4) simplified nozzle and neutral engine; (5) low radar cross section inlets and redesigned nacelles; (6) increased external stores capability (weapons and fuel); and (7) revised defensive avionics system. Other major differences (not shown) are: increased takeoff gross weight (477,000 pounds); composite structural Mode Control System, weapon bay doors and flaps; tail warning radar; air turbine starter revised gearbox; Advanced Centrally Integrated Test System and Electrical Multiplex.

and the General Electric Co. was awarded the F101 turbofan engine contract in June 1970.

Eventually, four aircraft were built and tested, with the first test flight in December 1974. The original B-1A program called for the procurement of 244 bombers, including prototypes, with full delivery by 1985. On June 30, 1977, however, President Carter canceled the production program but allowed the research and development phase to continue. His decision kept the door open for a possible restart.

With the election of Ronald Reagan and changed congressional and public attitudes toward national defense, the prospects for procuring a new strategic bomber increased.

Congress acted quickly by authorizing and appropriating funding in the 1981 Defense Act for a new strategic multirole bomber, directing the Air Force to evaluate several alternatives and report back. The bill also stipulated that the bomber be operational prior to 1987 and be able to perform the missions of a nuclear weapons delivery platform, a cruise missile carrier, and a conventional bomber.

On October 2, 1981, President Reagan announced his decision on a strategic modernization program to include production of 100 B-1Bs. The new bomber would be a part of a major effort to modernize America's strategic forces. The President's program to modernize the

bomber force also included retiring B-52Ds, modifying B-52G/H models to carry cruise missiles, outfitting existing KC-135 tankers with new engines to increase refueling capability, and continued research and development of an Advanced Technology Bomber (ATB).

But is the B-1B the answer? Can it penetrate? Senior Air Force officials believe that by the 1990s the B-52 will no longer be an effective long-range penetrator. Stated simply, being able to penetrate air defenses is a function of an aircraft's speed, altitude, radar cross section, ECM capability, evasive capability, and the depth of the air defenses/interception screen it must face on the way to the target.

Critics of the program have charged that the B-1B is an interim aircraft. In a recent interview with *AIR FORCE Magazine*, Maj. Gen. William E. Thurman, Deputy for B-1B at Aeronautical Systems Division (ASD), addressed the issue: "It is not an interim bomber, nor will it be obsolete once it is built."

While smaller than the B-52, the B-1B can launch more quickly and operate from shorter runways than can the B-52. In addition, the aircraft's greater speed, automatic terrain-following capability, improved defensive avionics, and reduced radar cross section will give the B-1B a much greater penetration capability than its predecessor.

The decision to build the B-1B was based largely on the results of a Bomber Penetration Evaluation (BPE) conducted during the late '70s and early '80s using a B-1A. The BPE showed that a combination of smart electronics, tactics, and human resources could defeat the advanced defenses that the Soviets were likely to field in the 1990s. These tests included computerized analysis and flight tests of the B-1A and its avionics systems against simulated known and predicted Soviet air defense systems.

"Acquiring the B-1B while continuing to pursue advanced technology is the most cost-effective approach," testified former USAF Chief of Staff Gen. Lew Allen, Jr., at a Senate hearing shortly after the President's announcement to build a new bomber.

"It will enable the United States to field a flexible and extremely ca-

pable bomber in the middle of this decade—a bomber that will be able to penetrate Soviet air defenses well into the 1990s and will perform as an effective element of our strategic forces for more than two decades. At the same time, it will allow the time necessary to pursue the development of an advanced technology bomber," he emphasized.

Using Stealth technology, the B-1B will be tough to track. The aircraft will have only 1/100th the radar cross section (RCS) of the B-52. This will allow the B-1B to employ fundamentally new electronic countermeasures techniques that cannot be used effectively by the B-52 because of its large RCS.

Keeping Costs Down

On January 20, 1982, USAF awarded Rockwell International's North American Aircraft Operations two contracts totaling more than \$2.2 billion. The first is a full-scale development contract, valued at \$1.317 billion, and requires Rockwell to finalize the B-1B design, modify two of the original B-1A bombers (second and fourth) at Edwards AFB, Calif., and conduct a flight-test program.

The second award is an \$886 million production contract for building the first B-1B and obtaining long lead items for subsequent early production lots. Long lead items include strategic materials, such as titanium, and high demand parts and subsystems, such as connectors and specialized electronic components that must be ordered well in advance to meet production schedules.

A ceiling on the cost of the B-1B program has been set by Congress at \$20.5 billion (FY '81 dollars). The \$20.5 billion pays for research and development, 100 aircraft, initial supply of spare parts, B-1B-unique maintenance training equipment, logistics support equipment and technical order data, and the ability to carry Air-Launched Cruise Missiles.

In recent months, several audit groups have reported cost estimates ranging from \$23.6 billion to \$41 billion—all above the official Air Force figure. Air Force officials, however, remain firm and highly confident of their funding estimates.

Special safeguards have been im-

plemented by DoD to assure that costs for the B-1B program do not exceed the \$20.5 billion ceiling established by Congress. Some of the major safeguards include:

- No changes in the acquisition program or major configuration changes without approval of the Deputy Secretary of Defense.

- Using a minimum of invention and a maximum of "off-the-shelf" equipment from current aircraft programs.

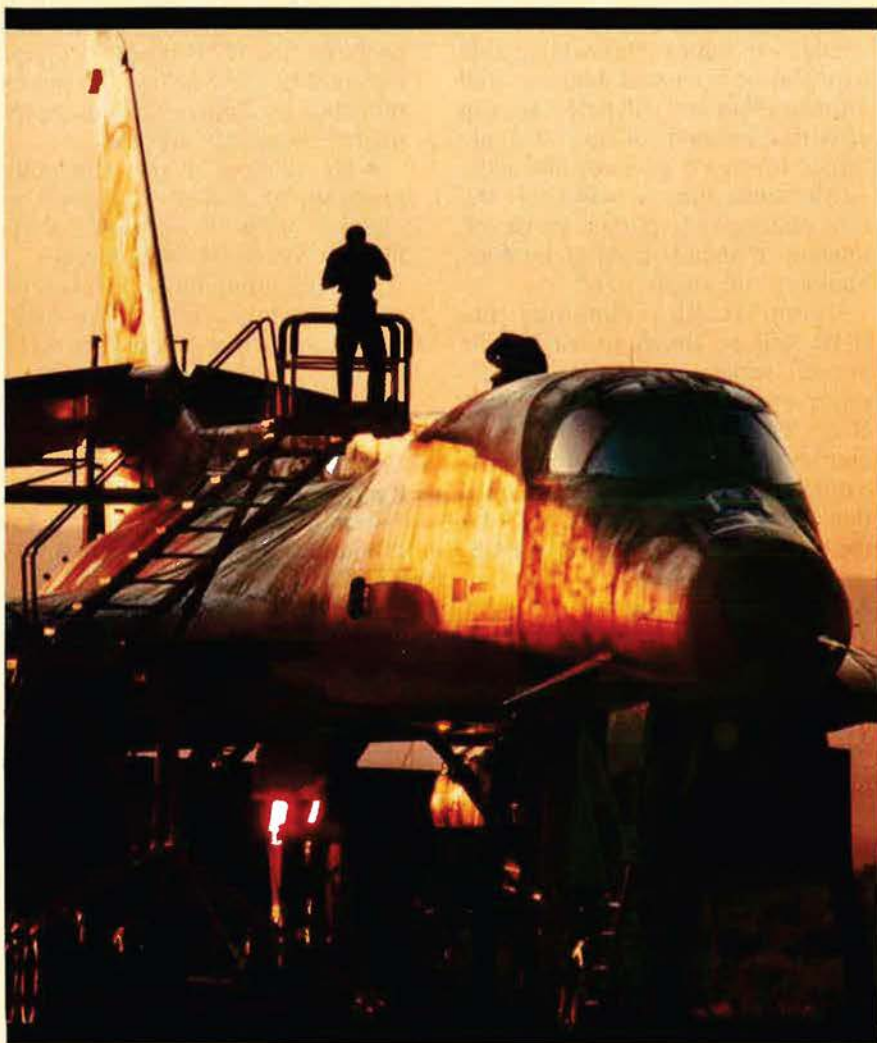
- Proceeding with a vigorous multiyear contracting program.

Both the Air Force and the contractors are overseeing this highly visible program very carefully. For example, new Management Action Centers have been established at Rockwell and ASD's B-1B Program Office at Wright-Patterson AFB, Ohio, to keep track of the acquisition and production programs. Furthermore, a biweekly "how goes it" meeting is held with the Secretary of Defense. At these meetings particular attention is paid to actual vs. planned expenditures, personnel requirements, potential changes in the airplane, and development and production status of each of the four associate contractors and the major subcontractors.

The business of the day-to-day monitoring of the B-1B program, however, is assigned to the B-1B Program Office. The role of this program office and its staff is unique. Instead of managing a single prime contractor as do other program offices, the B-1B program office acts as USAF's integrating contractor among the four associate contractors.

Rockwell International is responsible for the airframe and achieving aircraft design integrity. The Boeing Military Airplane Co. has the role of developing and producing the offensive avionics as well as integrating all avionics efforts and providing the controls and displays for the aircraft's defensive system. Eaton Corp.'s AIL Division is responsible for defensive avionics, and General Electric's Aircraft Group is producing the turbofan engine.

The B-1B Program Office also manages the B-1B development program, a concurrent production program, a flight-test program, and the support system development program. General Thurman says his



A B-1A prototype is serviced at Edwards AFB, Calif. More than \$6 billion has been invested in research and testing the bomber. According to senior Air Force officials, the B-1B production program is "ahead of schedule and under costs."

staff is working hard to find ways to keep costs down. "We are even looking at aircraft support items—everything from wheel chocks to automatic test equipment already in the Air Force inventory and/or in commercial use to determine if they can be used as is, or modified and used, rather than developing something new simply to put a B-1B label on it.

"Of the 272 aircraft 'black boxes,' all but fifty-seven came from either off-the-shelf equipment or modifications of off-the-shelf equipment."

The B-1B Project Office is using the Automated Management System, the first program office to do so. This system provides real time data on virtually every aspect of the B-1B program. When fully operational this year, project office workers will be linked by computer with

Rockwell North American Aircraft Operations.

No Show Stoppers

In addition to the four associate contractors, the program includes more than fifty major subcontractors and more than 3,000 suppliers and vendors. Over the full term of the program, Rockwell plans to place about \$6 billion worth of work with them.

Rockwell estimates that 58,000 people will be working on the B-1B program at its peak. Of that number, 22,000 will be Rockwell employees in El Segundo and Palmdale, Calif.; Columbus, Ohio; and Tulsa, Okla.

Tooling, components, and such critical materials as titanium, steel, and aluminum, stored when the B-1A production program was canceled, are steadily being delivered to Rockwell facilities as well as to

other major subcontractors throughout the US.

The production statistics as of November 15, 1982:

- 16,300 of 18,000 engineering drawings completed.

- 41,000 of 61,000 manufacturing orders released.

- 54,000 of 58,000 tool orders released.

- 16,000 new parts fabricated for the first two production aircraft.

In addition, six of twenty-two five-axis milling machines, which cut and grind metals in almost limitless configurations, are already in use.

To augment facilities and support equipment, Rockwell plans to initiate contracts for approximately \$400 million over the next four years. About ninety percent was obligated in 1982, according to Rockwell officials.

Early last year, construction began on an \$83 million, 950,000-square-foot final assembly complex at Palmdale, Calif. The new complex will support existing B-1B facilities at Palmdale, which Rockwell operates at nearby Air Force Plant 42.

"There are no show stoppers at this point," said Sam Iacobellis, Executive Vice President and B-1B Program Manager for Rockwell's North American Aircraft Operations. "The B-1B production program is well under way, and we are dedicated to meeting the cost and schedule requirement of our contract with the Air Force."

The Air Force seems to concur. In July 1982, it gave Rockwell "high marks" following an intensive Production Readiness Review (PRR) conducted by the Manufacturing Directorate of the B-1B Program Office. The PRR was designed to determine progress by Rockwell in meeting specifications, schedules, and cost requirements of the contract.

General Thurman said that he was pleased with the way the program was going: "The stewardship both on the program office side and with the associates indicate we are ahead of schedule and under costs. Commands like SAC and AFLC have been very temperate in their demands for newer items and capabilities for the aircraft. As a consequence, the B-1B program has now

all aspects of being fully successful because of the entire team effort."

The highly concurrent production program for the bomber calls for engineering design review of the first B-1B to occur approximately four months after production start. Final design review should take place about a year later, with the first production B-1B rollout planned for October 1984. The aircraft's first flight is contractually scheduled for March 1985, but it is now expected to occur in December 1984 or earlier, according to Rockwell officials.

The first aircraft delivery to SAC will be in 1985, with the first fifteen aircraft in place by September 1986. The production level will build to a maximum planned rate of four aircraft per month with the 100th aircraft schedule for delivery by June 1988.

Rugged Testing

Though production of the B-1A was discontinued in June 1977, the research and development program continued until April 1981. The total program investment was more than \$6 billion. These dollars bought years of testing, including more than 25,000 hours of wind-tunnel tests and 7,550 engine flight hours. In addition, highly loaded structures were subjected to fatigue testing equivalent to three lifetimes.

Prior to the flight of B-1A No. 4 to England in September 1982, the B-1A's total flight time was 1,895.2 hours. Early in the flight-test program, which began in December 1974, the B-1A proved its major design points, including low-level penetration at nearly the speed of sound. On October 5, 1978, the No. 2 B-1A achieved a top speed of Mach 2.22 in the program.

B-1A prototype No. 2 will again be flight-tested in April to evaluate many of the new B-1B design features for stability and control and for flutter and weapon systems test. B-1A aircraft No. 4, which will incorporate the remainder of B-1B improvements and be used for verification testing of the offensive and defensive avionics systems, will start flights in the summer of 1984. Verification testing on B-1B production aircraft No. 1 is scheduled for completion in mid-1986.

The development test program in-

The SDT: A Tool as Big as an Airplane

How about a tool as large as an airplane? In El Segundo, Calif., Rockwell International is using one—the System Development Tool (SDT). What might look to be a three-dimensional highly complicated jigsaw puzzle is actually a full-scale replica of the B-1B.

The SDT will never fly. But the work being accomplished within its metal framework will allow the other 100 aircraft the Air Force plans to buy to do so.

Wires, coaxial cables, and tubes are bent throughout the massive structure to determine the exact route of the internal systems. For example, workers can see where a clamp should go, how much material is needed to get from one point to another, what part needs to be put into place first, and at what angle tubes or wire should bend. The tool allows workers to figure out how and where to place the 146,000 pieces of wire that go into the aircraft.

Although its basic components were originally built prior to B-1A production cancellation in 1977, the SDT has undergone design changes to update it for use in the B-1B program. It was first built and used as a group of separate components. Later, the SDT team at Rockwell assembled the parts, making it a single structure.

Rockwell is not the only user of the tool. Subcontractors on the B-1B program also use the SDT data to figure out the wiring and tubing on their portions of the aircraft.

After a mockup piece of tubing is fitted and formed on the SDT, it is put on a numerically controlled machine to have its specifications recorded. That machine in turn feeds the specifications into a bending machine, which forms pieces to be used in the actual production of the B-1Bs.

The SDT, which will be a necessary tool until the last B-1B leaves the plant, has several other uses—for example, helping develop modification kits and changes to be made on later B-1Bs. It will also be used as a training device for people who will work on actual B-1B parts and as orientation to Air Force personnel and pilots.



B-1B contractors are using the System Development Tool (SDT), located at Rockwell International's El Segundo, Calif., facility, to determine the exact route of wires, coaxial cables, and tubes that will go into the bomber.

cludes a two-team approach made up of members from SAC, the Air Force Flight Test Center at Edwards AFB, Calif., the contractors, and the B-1B program office.

"It's the most innovative and operationally oriented flight-test program ever. We are placing a tremendous amount of importance on planning. Every test hour is vital. For example, pilots will have available backup missions to complete if a problem occurs in the primary test mission," said Col. Mike Baran, Chief of Test and Deployment in the B-1B Program Office.

Though the B-1B program is

going extremely well, there are still some things to watch—any slippage or reduction of authorized funding, erosion of political support, supply of strategic materials, and stability of the supplier and subcontractor base.

General Thurman remains optimistic. "Thirty years from now we'll look back and say that this weapon system was one of the finest investments we made in protecting our freedom."

The key, of course, will be the aircraft's flexibility to adapt to new technologies, tactics, and threats in tomorrow's world. ■

MINUTEMAN'S THIRD DECADE

OUR THOUSAND ACES IN THE HOLE

BY PEARLIE M. DRAUGHN, RESEARCH LIBRARIAN



Minuteman launches at Vandenberg AFB, Calif., are conducted periodically to test the reliability of the system.

IN EARLY 1961, the United States Air Force made this prediction:

"In days not too far distant a network of prairie dog-like holes will dot the landscape of our Western plains. Nestling below these holes, in silo-shaped sentry boxes, will stand intercontinental ballistic missiles primed to fire in the name of freedom at the flash of a signal."

This prediction was on its way to becoming a fact at 10:59 a.m. on February 1, 1961, when the United States Air Force Minuteman, America's first solid-fuel-propelled ICBM, made its first test launch from Cape Canaveral, Fla.

Now into its third decade of operational service, the Minuteman force is the backbone of SAC's strategic inventory. One thousand Minuteman missiles are deployed: 450 Minuteman IIs and 550 Minuteman IIIs. They are in hardened and dispersed

launchers at six Air Force installations in the Western US: Malmstrom AFB, Mont. (the first Minuteman base to become operational); Ellsworth AFB, S. D.; Minot AFB, N. D.; Whiteman AFB, Mo.; Francis E. Warren AFB, Wyo.; and Grand Forks AFB, N. D.

Each launcher is approximately ninety feet deep and twelve feet in diameter, with two underground equipment rooms around the silo casing extending twenty-eight feet below the surface.

Survivable and diverse communications also ex-

ist at each base so that the launch crew officers can monitor and, if necessary, launch the missile when ordered by the National Command Authorities of the United States.

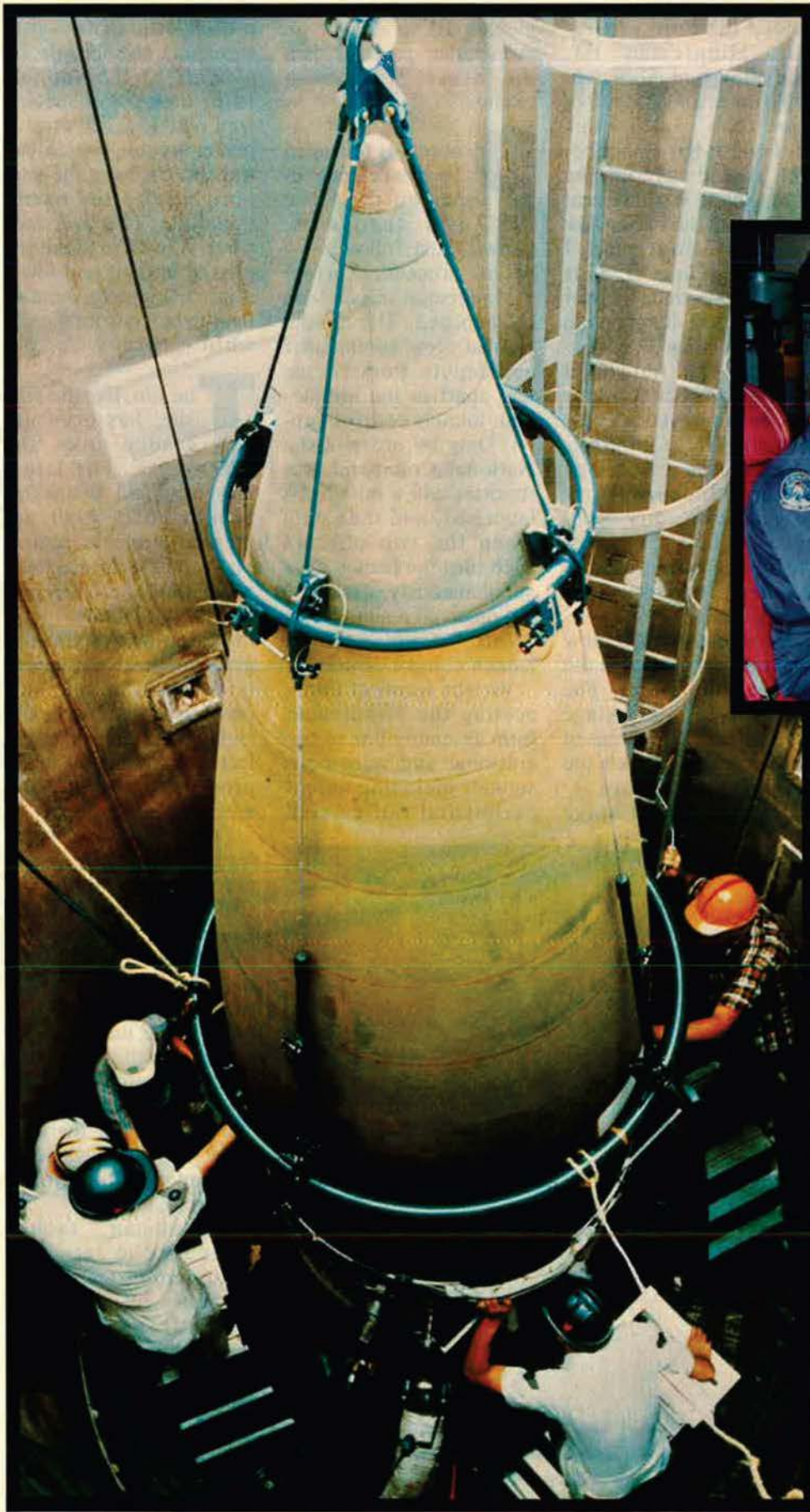
Minuteman's development dates back to the mid-1950s and the early days of the Air Force ballistic missile program. A concept for a solid-fuel ICBM was being discussed even as development work progressed on liquid-fueled Atlas and Titan ICBMs and the intermediate-range ballistic missile (IRBM) Thor. There were a number of problems with the solid-fuel idea, though, ranging

from insufficient thrust to great difficulty controlling the burning rate of the chemical cakes.

Bernard A. Schriever—then a major general and Commander of the Western Development Division (WDD) of the old Air Research and Development Command—ordered the establishment of a small "solid-propellant weapon system office" to study the neglected field of large solid-propellant rocket motor development.

By the end of 1957, the year of the original Soviet Sputnik, WDD had prepared a complete weapon system development plan for a solid-propellant missile. This met the requirements for the Minuteman and the IRBM Thor. Approval for the Minuteman program to begin finally came, with a target date for the first 150 missiles to be operational by mid-1963.

Minuteman would be



Only by order of the National Command Authorities can a missile be launched, and then only when the two officers each turn the launch keys simultaneously . . .

LEFT: The Minuteman silo is ninety feet deep and twelve feet in diameter. ABOVE: Crews must follow very precise procedures before a missile can be launched.

smaller than its liquid-fuel predecessors, primarily because of its three-stage solid-fuel rocket motor. The use of solid fuel eliminated some fuel tanks, plumbing, and supporting equipment needed in liquid-propellant missiles.

What Minuteman pioneers had in mind was a weapon that would be cost-effective, simple to operate, easy to maintain, and faster to launch.

Minuteman I, or LGM-30, the original three-stage solid-fuel system, went on alert in 1962—ahead of schedule. Eventually, 800 Minuteman I missiles would stand strategic alert before this early model was phased out in 1974.

Minuteman II (LGM-30F) joined SAC's inventory in 1965. It is longer than its predecessor, and it also has greater range, accuracy, and an improved guidance sys-

tem. In June 1970, SAC fielded the third generation—Minuteman III, with a range of more than 7,000 miles and a speed of more than 15,000 miles per hour. It has a pointed-arch shroud covering the nose, giving it a different shape from the two earlier models—Minuteman I and Minuteman II. It is also 5,000 pounds heavier and two feet longer than the Minuteman II.

It has an improved third-stage rocket motor and an improved reentry system. These improvements enable it to deploy Multiple Independently Targetable Reentry Vehicles (MIRVs) together with penetration aids to counter antiballistic missile systems.

Minuteman III's new capability is packed in the missile's top stages. The solid-fueled, third-stage motor has been increased in diameter to match the missile's second stage.

The new third stage

makes it possible for Minuteman III to deliver an even larger payload than the other Minuteman models.

Procedures to launch the missile have remained the same over the years. Crews must follow very precise procedures before a Minuteman missile can be launched. The missile combat crew commander and deputy work twelve feet apart in the Minuteman launch control center. Only by order of the National Command Authorities can a missile be launched, and then only when the two officers each turn the launch keys simultaneously after having received a similar key "vote" from another launch control center.

Various forms of transporting the Minuteman from assembly line to operational site were conceived, including an experimental rail-carried

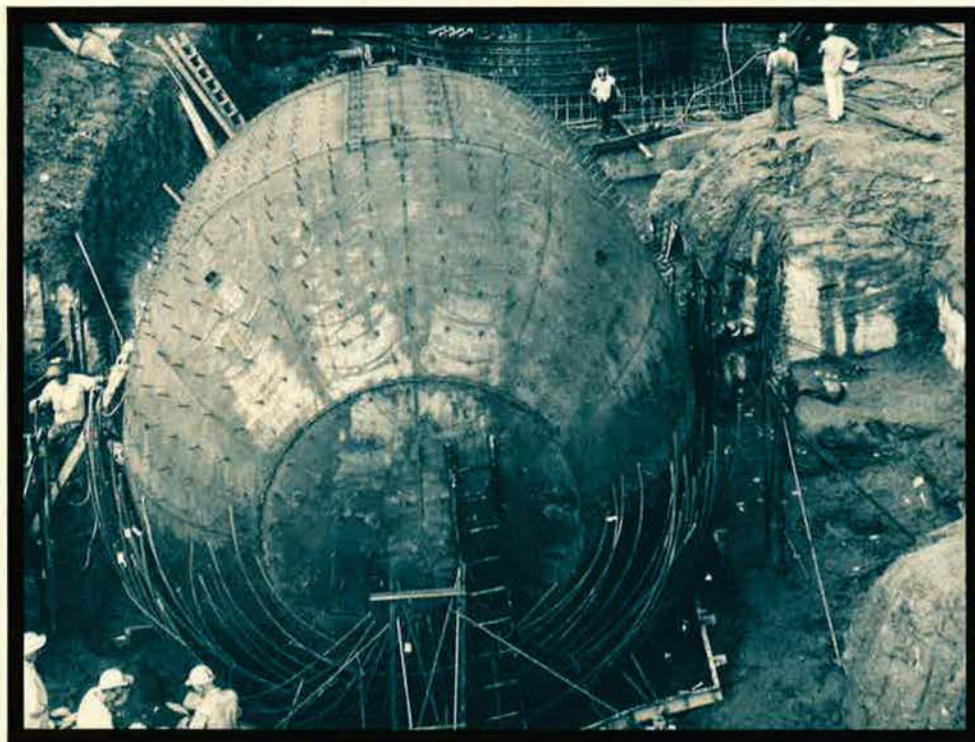
system. The eventual approach—still in use—is to transport the missile by aircraft to the support base, then use a specialized vehicle called a transporter-erector, which can transport it from the support base to the operational site. This oversized truck is used to stand the missile upright and lower it into the underground silo or to pull it from the silo when necessary.

The silo, like the missile, has been upgraded over the years. The latest silo upgrade program, completed in 1980, increased hardness against blast and electromagnetic pulse, thus improving pre-launch survivability. Also included in the silo-upgrade program was a newly designed missile suspension system, a shock-isolated floor, a debris collection system, and an improved launcher closure mechanism.

Officers and NCOs selected for a missile assignment attend training initially at Chanute AFB, Ill. Following the formal classroom experience, upgrade proficiency training is conducted at the Minuteman unit.

A tour of duty for a Minuteman crew is twenty-four hours, during which the members of the crew work, sleep, and eat below ground in the Launch Control Center.

Minuteman, though never fired in anger, has been demonstrated successfully by more than 590 R&D and operational test launchings. Even with the advent of the MX missile, Minuteman is expected to remain operational and on guard for America for years to come. ■



A Site Activation Task Force gets silo construction going at Grand Forks AFB, N. D., in the early days of the Minuteman program.

VIEWPOINT

More Harm Than Good

By Gen. T. R. Milton, USAF (Ret.)

At their conclave in Washington last November, the National Conference of Catholic Bishops drafted a pastoral letter that, if ratified next May, would have a far-reaching and divisive effect on both the Church and America's armed forces.

I am their leader, so I must follow them.

—Alexandre Ledru-Rollin (Interior Minister of French provisional government, 1848)



It all began in the sixties with ban-the-bomb marches generally led by individuals from the radical fringe. Those of us doing time in the Pentagon became accustomed to all of the solemn little groups posted outside

the River Entrance protesting the way we made our living. The inference was clear that we were all pining for the day when we could push the button. Still, it is a free country, and no one really minded the protesters so long as they kept their distance. Besides, it was fruitless to attempt an explanation to those misguided souls that Armageddon could best be forestalled by preparedness.

Somehow or other, the nuclear disarmament movement has grown dramatically in recent years, perhaps spurred on, as both President Reagan and NATO's Secretary General Joseph Luns have suggested, by some deft organizational assistance from the KGB. Whether or not the Soviets have had a hand in the game, the fact is that nuclear disarmament has become a popular cause. Of the nine states with a nuclear freeze referendum on the ballot this past November, eight voted in favor of it. Now, perhaps reacting in the manner of M. Ledru-Rollin, enter America's Catholic bishops.

At their conclave in Washington last November, the bishops drafted a pastoral letter, subject to ratification next May, that would provide teaching guidance to America's 50,000,000 Catholics. Since the draft letter was supported by seventy percent of the bishops in November, the likelihood of ratification appears good. And, since the Roman Catholic Church is a disciplined body as churches go, the pastoral letter promises to have a far-reaching and divisive effect on both the Church and Amer-

ica's armed forces. The prospect of this is deeply disturbing to those of us who are both Catholic and military.

The bishops' letter denounces as immoral the use of nuclear weapons or even the intent to use them. It condemns any targeting of nuclear weapons near cities or any first use of these weapons. In short, the bishops have placed themselves in the lead of the unilateral disarmament movement, for that is surely what this sort of language means. The Berrigan brothers, along with Protestant Reverend William Sloane Coffin and other religious leftists, must be experiencing a certain glow.

What the bishops have done is challenge the basic strategy of both the United States and the Atlantic Alliance—a strategy that defers to the Soviets the first hostile move. Our nuclear weapons are meant to match their nuclear weapons, one threat to offset the other. In the case of NATO, nuclear weapons are also intended as the equalizer, something that may be used if Europe is on the verge of falling to a Soviet attack. All things considered, including the remarkably long period of peace in Europe, it has been a pretty fair strategy.

There is something distinctly odd about Catholic bishops joining this unilateral disarmament movement and thus serving the cause of the atheists in Moscow. But what is truly disturbing about this draft pastoral letter is its potential effect on Catholics in the military. What is a Catholic skipper of a Trident submarine to think when his church tells him his job is immoral? What of the SAC bomber pilots, or, for that matter, CINCSAC himself when, as has happened, he is a Catholic?

The National Conference of Catholic Bishops has departed from the path traditionally traveled by the Catholic clergy. Whatever misconceptions people may have had about Catholics, no one until now has ever accused them of being soft on the matter of national defense.

Looking back on World War II, we did some terrible things to Germany. There was Hamburg, for instance, subjected in 1943 to a merciless day and night, week-long attack by the RAF and ourselves. We hated doing it, most of us, but it was war. Hitler had done even more terrible things, and it was us or them. Our job was made easier, or at least less distasteful, by the clear support of our chaplains. If God wasn't necessarily on our side, at least He wasn't against us. All the while, of course, German aviators were getting similar reassurance. Priests on both sides aligned themselves with the spiritual needs of their

flocks and not with matters of strategy.

War is a terrible business, and nuclear war may be the worst kind of war yet. We have no proof of that, but since wars have progressively grown more destructive with the development of weapons, it is probably true. Certainly, the decimation of French nobles at Crécy by a new instrument of destruction, the British longbow, increased the lethality of armed combat. It has gone that way ever since. Once at war, nations tend to do what they can to survive and win. Perhaps, as the antinuclear community contends, there can be no winner in a nuclear war. Without arguing that one, although Soviet doctrine does hold a different view, there remains the question as to whether a United States stripped of nuclear weapons would be able to exert any influence at all in this increasingly dangerous nuclear-armed world.

A long time ago, Sir James Barrie, who, in a lighter moment, had written *Peter Pan*, gave an address to the students of St. Andrews University. It was a few years after World War I. Barrie was the retiring rector of the University, and his subject was courage. There are a couple of sentences in that address to which I would like to call to the attention of the bishops.

There is a form of anaemia that is more rotting than even an unjust war. The end will indeed have come to our courage and to us when we are afraid in dire mischance to refer the final appeal to the arbitrament of arms.

It is worth remembering there was no war on the horizon, nor even a threat of one, when Barrie said those words. He was not, in any case, a jingoist.

Nuclear weapons are miserable things: so are machine guns, surface-to-air missiles, and napalm. The carnage at Waterloo was horrible, as it was at Gettysburg and the Battle of the Somme. Nothing would be closer to heaven on earth than a world disarmed and bent on peaceful co-existence. Nothing, alas, is more impossible of attainment.

We have kept the Minutemen in their silos for more than twenty years, contributing in their own ominous way to the peace the bishops seek. The MX, more accurate, more powerful, and less vulnerable, can make a similar contribution if only the mindless emotion of the antinuclear crowd does not prevail.

Meanwhile, the bishops should think hard about the damage they may do if they decide to circulate their letter. ■

BLACKS IN US AVIATION

THE PIONEERS

Since the beginning of powered flight, black Americans have been steadfast in their determination to overcome barriers of racial discrimination and economic privation to share in the wonders of flying. Here is a brief historical sketch of the early days.

BY WILLIAM P. SCHLITZ
SENIOR EDITOR

IT WAS 1917, and in an open field in rural East Texas nine-year-old Thomas Allen had come face to face with his future.

The sight of an airplane high above the southwest community was no longer a novelty, but to have one land in your backyard certainly was. The aircraft had been forced down with a broken propeller and was awaiting repair. Thrilled beyond measure, the black youngster had been posted to guard this precious machine against the meanderings of livestock.

But consciously or not, for Thomas Allen the stage had been set: Someday, he himself would fly.

The historic powered flight of the Wright brothers in 1903 had led to an era in which the Thomas Allens of America—both black and white—looked skyward. But participation by blacks in the dawning age of flight would not come easily. Racial discrimination, deeply embedded in American life, constituted an almost insurmountable barrier. Then, too, it was costly to fly—even to learn how—and blacks occupied the lower rungs of the economic ladder.

In the early aviation community there was even the widely held belief that black people lacked the aptitude to fly or, for that matter, master the technical skills associated with flying.

The record is clear, however, that while blacks for the most part were denied access to the white aviation world in the early years, they were imbued with the same spirit of adventure that was universal among the pioneer aviators. Despite the

obstacles, they built and bought their own airplanes to learn to fly, acquired their own airfields, erected their own hangars, and sought training as mechanics.

Later, during aviation's formative period, the black aviation subculture produced its own folk heroes of flying—barnstormers, stunters, parachutists, balloonists, and the rest.

Leading the Way

A man on a quest for equality and a woman who wouldn't take no for an answer when it came to learning to fly formed the vanguard of black Americans in aviation.

The man, the first US-born black fighter pilot, would never fly for his native land.

Eugene Jacques Bullard, born in Columbus, Ga., in 1894, as a young man stowed away on a ship bound for France to escape bigotry. There, early in World War I, he fought as an infantryman with the Foreign

Legion and was wounded at Verdun. Subsequently, he was given flight training and assigned to the Lafayette Flying Corps. At the front, the French poetically dubbed him the "Black Swallow of Death." With America's entry into the war, his application to join the American Air Service was turned down.

In all, the French awarded Bullard fifteen decorations, including the Croix de Guerre and the Legion of Honor. He made his home in Paris following the Armistice and joined the underground in World War II. Eventually, Bullard returned to the US and, after a series of menial jobs, died in 1961.

Bessie Coleman, born in 1893, was one of five children raised in Atlanta, Tex., by a mother who took in washing to support the family after abandonment by her husband. From the beginning, she was an achiever and, following high school, even managed a semester of college before finances ran out.

Air and Space Museum's "Black Wings" Exhibit

A number of uncommonly distinguished Americans are featured in a new exhibit at the National Air and Space Museum in Washington, D. C.

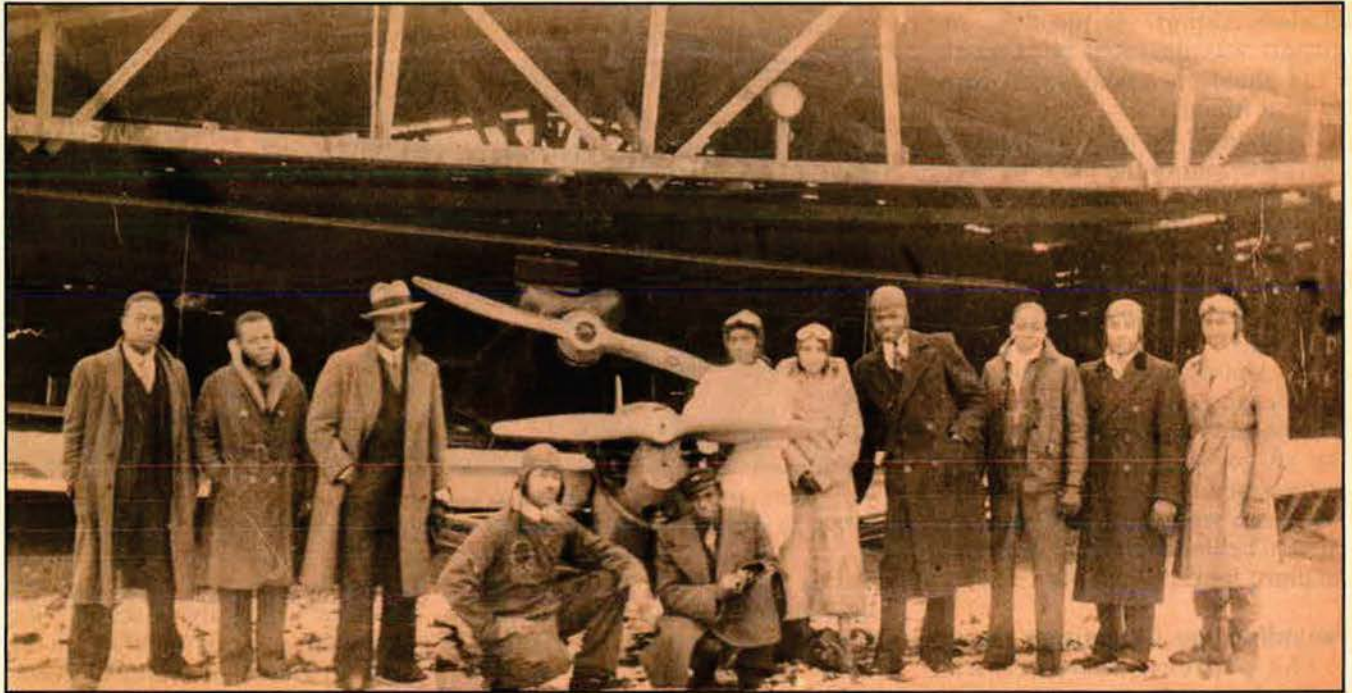
The exhibit, entitled "Black Wings: The American Black in Aviation," reflects the participation and contributions of blacks dating from the earliest days of powered flight to the present.

The exhibit's subject matter was compiled by Museum curators Von Hardesty and Dominick Pisano.

In conjunction with the exhibit, the Museum plans a symposium on blacks in aviation in late February 1983 and publication of a Museum-sponsored book on the subject to coincide with the symposium.

Material provided by the Museum is the basis for two articles to run successively in the January and February issues of AIR FORCE Magazine. The first, presented here, covers the early black aviation pioneers to the late 1930s. February's article will depict the founding of black military aviation at Tuskegee Institute up through the present black involvement in the nation's space program.

The two articles are not meant to be historically comprehensive. Rather, the objective is to offer a glimpse into a chapter of American aviation history that for too long has been overlooked.



Members of the Challenger Air Pilots Association, one of the first black flying clubs in the US, formed the nucleus for aviation activities in the Chicago area. Founder John C. Robinson is third from left. (Photo courtesy of Harold Hurd)

While living as a young woman in Chicago, Miss Coleman became obsessed with the objective of learning to fly. Two major obstacles prevented this: She was a woman and black. Backed by Robert S. Abbott, publisher of the black Chicago weekly *Defender*, she sailed for France. There, in a more liberal environment, she was admitted to flying school.

Back in the States, Bessie Coleman earned money performing around the country as a stunt flyer and parachutist. Her dream to establish a flying school for blacks ended with her death in a flying accident in 1926. But her determination to pursue a flying career set an example that lured following generations of blacks to aviation.

By organizing flying clubs, blacks in the 1930s learned to pool their resources to build and buy airplanes. Equally important, leaders began to emerge.

Centers of Black Aviation

Chicago and Los Angeles became early hubs of black aviation, most likely because growing numbers of blacks there had begun ascending the economic ladder. In the Windy City in 1931, John C. Robinson, one of the earliest black pilots, and a

small group of aviation enthusiasts formed the Challenger Air Pilots Association, one of the first black flying clubs in the US.

The Challenger group, barred from established airports in the area, first set up shop at Robbins Airport at the black township of Robbins, Ill. There, they cleared the land, built a hangar, and began to

acquire aircraft. Janet Bragg, a Challenger member and nurse by profession, bought the group's first aircraft.

Then, catastrophe struck. A violent windstorm demolished the Robbins hangar and the group's three aircraft. This setback brought Challenger operations temporarily to a halt, but, through the interces-



Aviatrix Willa Brown, center, and Cornelius R. Coffey, right, started a flying school at Chicago's Harlem Airport. The school later was funded under the Civilian Pilot Training Program. (Photo courtesy of Harold Hurd)

sion of John Robinson, the group was allowed to relocate to Chicago's Harlem Airport. At the time, the airport was operated by a white, Fred Shumacher, who would prove to be a friend.

"Although we were assigned to the lower end of the field, we were still segregated," recalls Challenger charter member Harold Hurd. "They wanted to run us off, but Shumacher backed us up. He told them: 'At least these people pay their bills.'"

Mr. Hurd's own interest in aviation began early, and at age seventeen he and two friends began building an airplane from scratch in a garage they rented for \$8 a month. But times were hard and when the trio fell behind in the rent, the black landlord locked them out.

Founding the Challenger Group

The project, however, had aroused interest among the area's black and white aviation enthusiasts alike. More important, though, it led to friendships with John Robinson and Cornelius R. Coffey, another of the earliest black pilots, and ultimately to the founding of the Challenger group. This group was to have a profound influence on the development of black aviation in the Chicago area.

Cornelius R. Coffey and John C. Robinson were two auto mechanic friends who had become so interested in flying that they had pooled their money and bought an airplane. In a spirit of cooperation, a white, Charles Abbott, sold them the plane and taught them to fly it.

The two kept the aircraft at "Acres Airport," a onetime farm where a barn had been converted into a hangar and a farmhouse into bachelors quarters where Coffey and Robinson rented a room.

Since pilots were required to be mechanics as well, the two duly inquired by mail about formal instruction at the Curtiss-Wright Aeronautical School in Chicago. The response was favorable, and they began sending money orders as prepayment for a mechanic's course.

Eventually assigned to a class being formed, the two young blacks put the school's staff into a quandary when they showed up. "People attended the aeronautical school from southern states that were



Early pilots were their own mechanics. Here a class at the Curtiss-Wright Aeronautical School in Chicago. (Photo courtesy of Cornelius R. Coffey)

strictly segregated, and the staff thought our presence would be disruptive," remembers Mr. Coffey. "They tried to return our money, but when our white employer, Emil Mack, heard that, he was outraged. He promised to hire whatever legal help was necessary to press our case. With that kind of backing we stood firm," added Mr. Coffey.

The first few weeks "we took a lot of abuse," Mr. Coffey recalls. Observing this, a white instructor and former World War I pilot, Jack Snyder, called the class together and put his foot down, ending the harassment.

On graduation, Coffey and Robinson were told that the school's doors would never be closed to blacks and that "if we could get a large enough group together to make up a class, we'd be employed as assistant instructors," Mr. Coffey recalls. "And that's when the Challenger group of about thirty students signed up."

Subsequent to the stint at the Curtiss-Wright School, Mr. Coffey established his School of Aeronautics at Harlem Airport to offer flight instruction to Chicago's expanding black aviation community.

(Time has not slowed Mr. Coffey's pace. Today, he is an FAA-designated aircraft mechanic examiner as well as an aircraft safety inspector. He keeps his Piper Tripacer 22 in a hangar rented at Lewis University in Lockport, Ill., where he taught flying for six years.)

Besides Janet Bragg, the Challenger group had a number of other women aviators as members. Willa

Brown, for example, was co-operator of the Coffey flying school. She went on to serve as an officer in the Civil Air Patrol and on FAA's Women's Advisory Board.

The California Connection

Los Angeles rivaled Chicago as a center for black aviation in the 1930s. As early as 1929, a small group of aviation enthusiasts organized the Bessie Coleman Aero Club to promote air-mindedness in the black community.

President of the Bessie Coleman Aero Club was William J. Powell, one of the nation's first licensed pilots. He was instrumental in mobilizing black business and community leaders to underwrite the club's first airplane—a Waco 9—named the *Oscar Depriest* after a Chicago congressman and early civil-rights activist. (Depriest was the first black elected to the US Congress since Reconstruction. It was he who in 1932 appointed Benjamin O. Davis, Jr., as the only black in the Corps of Cadets at the United States Military Academy. Davis was the son of the only black officer serving throughout the nation's armed forces [other than several chaplains]. On graduation, Davis and his father would be the only two black line officers serving in the armed forces until World War II.)

In 1934, Powell published *Black Wings*, in which he described the pioneering achievements of the Los Angeles aero club. A visionary proponent of aviation, Powell appealed to black men and women to under-

take careers in the field. Besides becoming pilots, Powell urged blacks to consider such other aviation professions as aircraft designer and airline entrepreneur.

While this was wildly optimistic, since even basic equalities would be a long time coming, it was heady and encouraging stuff for young people caught in a seemingly unending economic downturn.

Black aviation in Los Angeles achieved a measure of fame in 1932 with the transcontinental flight of James H. Banning and Thomas C. Allen. (The lad from East Texas, through sacrifice, perseverance, and true grit, had achieved his goal of becoming an aviator. He had also become a master aircraft mechanic.)

Banning and Allen belonged to the Bessie Coleman flying club, but its aircraft had been repossessed in the wake of the stock market crash.

So in a \$400 airplane "put together from junk," remembered Mr. Allen, the two took off from Los Angeles bound for New York and a rumored \$1,000 prize being offered to the first blacks to make the flight. At the outset they had a mere \$100 in pocket for expenses and were christened the "Flying Hobos."

The succession of hops from airport to airport in traversing the "southern route" cross-country encompassed twenty-one days during which the intrepid duo logged a total of forty-one hours, twenty-seven minutes flying time.

A Death, a Success Story

Banning was killed in an air crash at San Diego less than a year after the flight with Allen. Born in 1890, Banning had been denied flight training at schools in a number of cities because of his race. A white Army officer finally taught him to fly, and, when the US Department of Commerce established licensing procedures in 1926, he became one of the first licensed black pilots.

Thomas Allen in his youth had migrated with his family from East Texas to Oklahoma City. There during his salad days he was drawn to the local airport. Finally, he struck a bargain with the white airport manager to work for lessons—weeks of chores for a few precious minutes of instruction.

Progress was steady, but Allen's

solo was blocked by the manager's demand for a \$500 security bond.

One day, as Mr. Allen relates it, the manager had temporarily left the airport. Several of the mechanics, none the better for alcohol, urged the seventeen-year-old to solo—and he did.

When the airport manager saw the aircraft—a war-surplus "Jenny"—wheeling about over the city, he stormed back in a rage, but was mollified by the mechanics, who told him: "Say, that's good advertising. If you can teach a Negro boy to fly, you can teach anyone," Mr. Allen recalls without rancor.

Aviation pioneer Allen cites several occasions during the transcontinental journey with Banning when whites assisted the black aviators. For example, word of their landing in Wichita Falls, Tex., was duly published in the local newspaper. In noting the arrival of the "Black Birds," as he dubbed them, the white reporter who wrote the story mentioned the historic purpose of their trip. When a group of the curious then gathered at the airport, the reporter exhorted them to pass the hat to finance continuation of the venture.

Banning and Allen eventually arrived at Roosevelt Field on Long Island to a tumultuous welcome by the black and white communities alike and became the toast of New York. Nationwide, as well, blacks regarded the flight as symbolic of what black aviators could accomplish despite the barrier of bigotry.

The \$1,000 award, however, went aglimmering. And on the subsequent return flight to the West Coast, their aircraft—the *Eagle Rock*—was destroyed near Pittsburgh while the pair was stunt flying to earn expense money. Unhurt, Banning and Allen returned to Los Angeles by bus, tickets courtesy of the Pittsburgh *Courier*.

In the Los Angeles area, small aircraft manufacturers struggled in the Depression years. Companies like Lockheed or Butler would fill an order for a handful of planes and then suspend operations until the next contract. An experienced mechanic, Mr. Allen moved from job to job to support himself and his flying.

With America's entry into World War II, Mr. Allen began a twenty-

year stint with the Douglas Aircraft Co. Today he is retired but not inactive and is on the staff of the Space and Aviation Hall of Fame in Oklahoma City.

Other Airways, Other Aviators

In the 1930s, black stunt pilots and parachutists, backed up by daredevil motorcyclists on the ground, performed at numerous air shows around the country. The spectators, mostly black, thrilled to the performances of such stunt parachutists as Willie "Suicide" Jones and Dorothy Darby.

C. Alfred Anderson (who later became "Chief" Anderson, a flying instructor of Tuskegee Institute fame) and Dr. Albert E. Forsythe teamed up to pioneer long-distance flights. In July 1933, they became the first blacks to complete a round-trip transcontinental flight—between Atlantic City, N. J., and Los Angeles.

The two topped this feat the following year with their Pan American aircraft tour that included the Bahamas, Virgin Islands, and West Indies. The venture was particularly daring because it required numerous landings and takeoffs in undeveloped and uncharted terrain. Despite the aviation pioneering and trail-blazing aspects of this aviation first, the adventuresome pair received scant attention from the nation's white press.

Another black aviation enterprise with an international flavor also went largely unreported in white newspapers. Though ultimately unsuccessful, it aroused considerable interest in the black community. John Robinson, president of Chicago's Challenger group, traveled to Ethiopia in 1935 to advise Emperor Haile Selassie on building an Ethiopian Air Force. Robinson recruited a number of pilots and technicians from the Chicago area to join him in East Africa. However, Italy invaded before the plan came to fruition, and Robinson narrowly escaped with his life.

Forecast of War

In the late 1930s, with war in Europe and the strong possibility of America being drawn into it, the Congress decided on a military buildup. One measure was to underwrite the Civilian Pilot Training



Chauncey E. Spencer of Chicago flew as a stunt pilot and parachutist. Here, center, following a successful jump at an air show in March 1939. Black aero clubs sponsored many such events. (Photo courtesy of Harold Hurd)

(CPT) program in association with educational institutions and flying schools around the nation. The formal military flying cadet training program just couldn't be expanded quickly enough.

Meanwhile, Chicago's black aviators had organized the National Airmen's Association of America with Cornelius Coffey as president. It was the first serious effort at creating a national organization for black aviators.

One objective of the NAAA was to act as an agency to keep the nation's active and prospective black aviation enthusiasts informed on essential matters.

Another objective was to have historic national implications. In considering legislation setting up the CPT, the Congress had excluded black institutions. Furthermore, in planning its wartime emergency expansion, the Army Air Corps had made no provision whatever for incorporating blacks in its ranks.

This situation was noted by a black lobbyist for government employees, Edgar G. Brown, who also kept tabs on legislative matters pertaining to America's black community. Brown alerted the NAAA and urged it to dispatch representatives to Washington to confer with officials on these vital matters.

Toward this end, two NAAA pilots—Dale L. White and Chauncey E. Spencer—were tapped for a well-publicized flight from Chicago to Washington. The two arrived in Washington to learn that Brown had

arranged a meeting with a little-known US Senator—Harry S. Truman. When Truman heard their objectives, he promised to help.

Other prominent public figures—among them Eleanor Roosevelt—rallied to the cause of the black aviators. This movement and pressure from other black organizations with political influence resulted in legislation that included black educational institutions under the CPT program. These were the roots that led ultimately to the formation of the all-black Army Air Forces squadrons that fought in Europe in World War II. While desegregation was still a long time coming, these

events nevertheless constituted a major milestone in the nation's history.

Several black educational institutions—among them Tuskegee in Alabama and Howard University in Washington, D. C.—were funded under the CPT program. Among the commercial establishments was the Coffey flying school at Chicago's Harlem Airport.

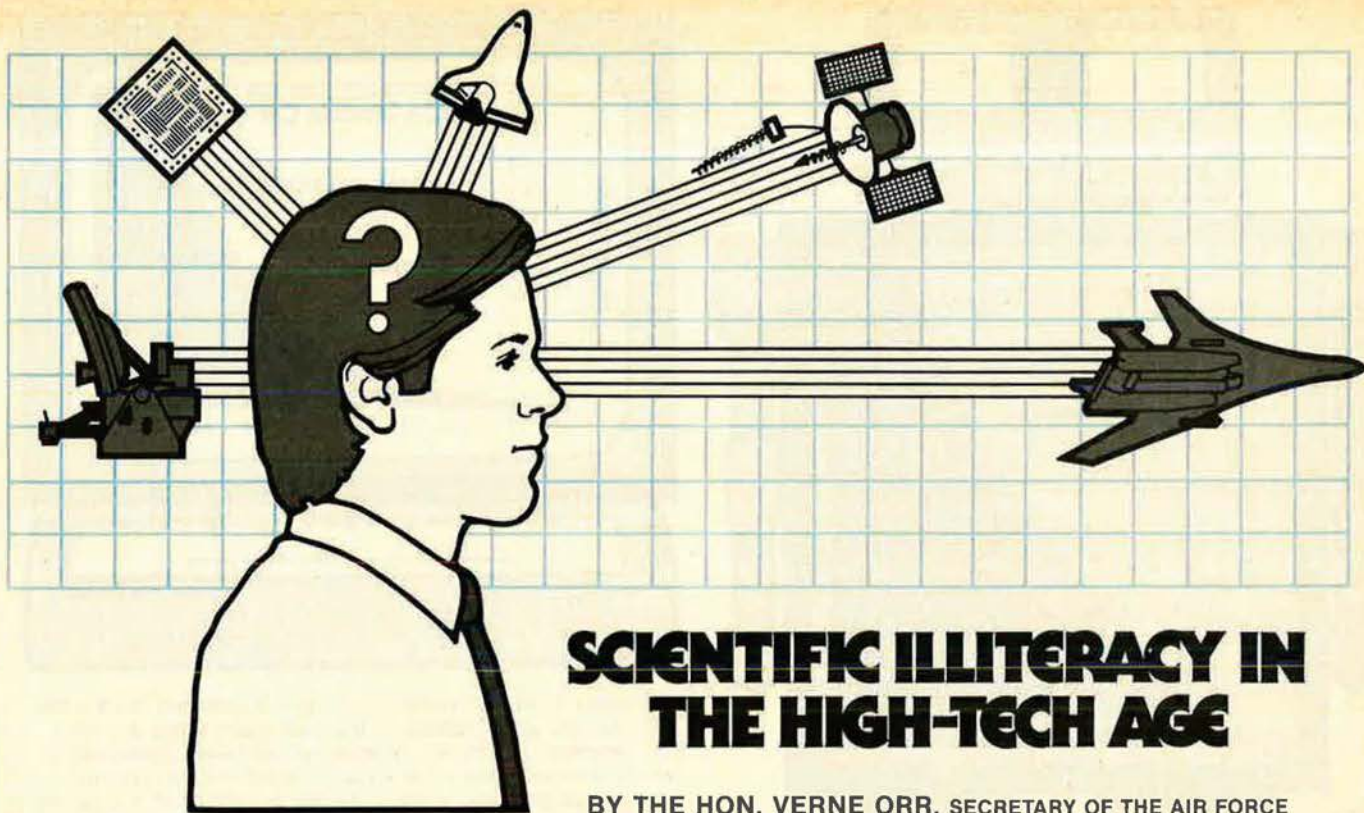
The End of the Beginning

By 1941, the pioneering phase for black aviators in the United States had ended. But while old stereotypes had been shattered, segregation persisted. However, considering the odds, progress had been made. For example, the number of licensed pilots had reached 102, a tenfold increase in one decade. Breakthroughs of this nature demonstrated the enduring interest of blacks in flight. And, moreover, the unquenchable desire to participate on a basis of full equality in civil and military aviation.

AIR FORCE Magazine plans to publish in next month's issue the second installment in this depiction of black aviation in America. World War II generated a series of events and forces that led ultimately to desegregation of America's military services. This was another major national landmark that created an altered context in which blacks would find increasing entry into the broader spectrum of US society. ■



First Lady Eleanor Roosevelt was an advocate of equal opportunity for black Americans. During a visit to Tuskegee flying school she joined "Chief" Anderson for a plane ride around the facility. (Photo courtesy of C. Alfred Anderson)



SCIENTIFIC ILLITERACY IN THE HIGH-TECH AGE

BY THE HON. VERNE ORR, SECRETARY OF THE AIR FORCE

The declining ability of American young people to handle math and science will handicap the technology-oriented Air Force of tomorrow unless action is taken today.

AS AN educator, a businessman, and now a federal official directly involved with the defense of our nation, I am disturbed by a trend that has been developing in this great country over the past twenty years. That is the growing scientific illiteracy of many of our youth. This trend is in direct opposition to the past, present, and future direction of technology.

As technology leaps ahead, the requirement for a scientifically literate citizenry, able to master the implications of the new technologies, grows ever more important. Indeed our nation's very technological advantage in defense and the future ability of our economy to compete in world markets may eventually be at stake.

It is important before proceeding with this discussion to outline important trends affecting this country and our Air Force.

The numbers of eighteen-year-olds (already down four percent) will decline another twenty-one percent by 1992. The minority portion of this population is increasing, fueled both by immigration levels and higher birth rates. Public school mathematics achievement scores and Armed Forces Vocational Aptitude Battery test results (especially on the mechanical and electronics portions) vary significantly by the sex, racial background, and geographic region of those tested.

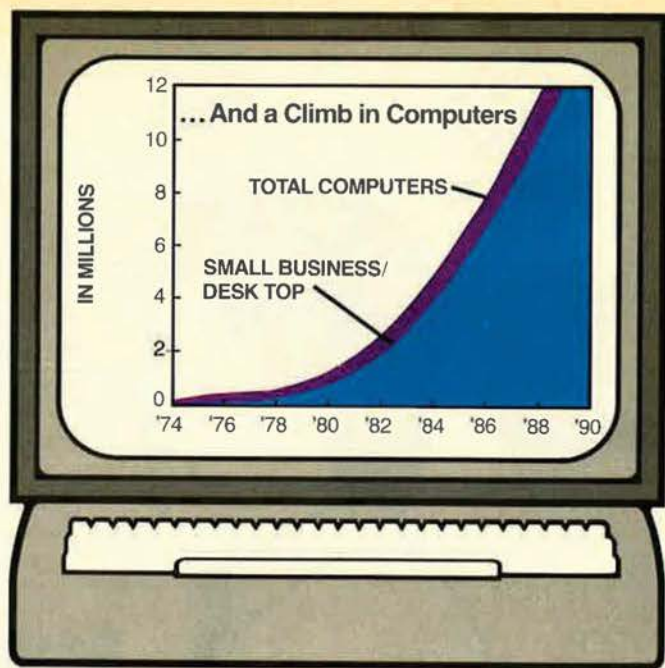
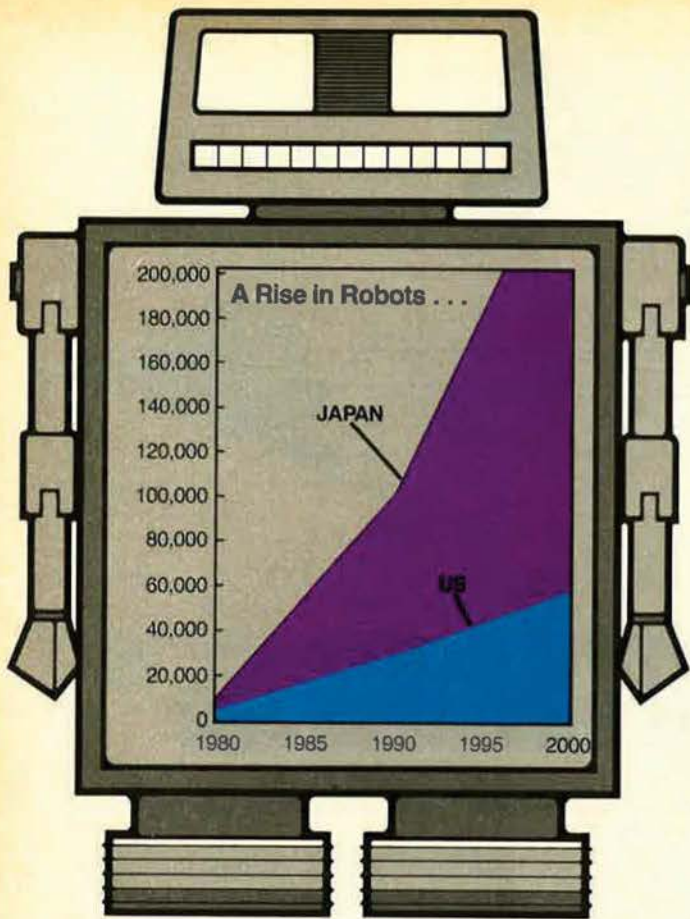
While our enviable recruiting and retention record meets our requirements today, we face stiffer recruiting challenges over the next decade as the numbers of technically proficient young men and women eligible for military service decline and their opportunities in the job market improve.

Particularly from the standpoint of human resources, American industry is transitioning from basic manufacturing to information and knowledge processing. This transition is creating skill imbalances as we move toward a labor force composed of more highly technical white-collar jobs and away from semiskilled jobs in heavy industry. This discussion is limited to the "high-tech" portion of the job market.

Three revolutions make this transition possible—computers, telecommunications, and robotics—all stemming from development of the microprocessor. *Fortune* Magazine reports that fully one-half of the capital equipment purchased by the private sector is in high-technology categories. That portion has doubled since 1972.

One of the great dilemmas facing industry is the decision regarding the choice of retraining their present work force for these newer skills—often difficult because of age and education—or hiring people from the marketplace already possessing the needed skills. To the disadvantage of the Air Force, many companies are choosing to hire people with the needed skills rather than make the expensive investment in retraining programs. As American industry transitions to these new technologies, and skill imbalances are created, more and more skilled and experienced Air Force people find they possess highly marketable skills—even in today's job market.

For example, a recently released study by the General Aviation Manufacturers Association projects a potential shortfall of 40,000 aircraft mechanics by 1990. This projection is based on several factors: The spectacular growth forecast for general aviation once the economy improves, the unusually high attrition expected (Air Force civilian mechanics mirror this trend—about one-half become retirement eligible during the 1980s), the broad transferability of aircraft maintenance-type skills



The chart on the left shows how Japan is expected to pace the world in the use of robots for the next twenty years. A "robot" is a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks. The chart above shows the dramatic increase in the number of computers expected to be in use in the US by 1988. An IBM study indicates that by 1986 there will be one computer for every ten employees in this country. Computer growth is fueled principally by public acceptance of the small business and personal computer.

to other areas of the economy requiring electronic, hydraulic, and diagnostic mechanical skills, and the small number of civilian schools offering aircraft maintenance courses.

That same study found that many other industries require the unique skills possessed by aircraft mechanics. Shortages of avionics technicians are already evident.

Air Force planners estimate that by the year 2000 the Air Force requirement for people with high electronic aptitudes will increase by about one-third. The general and mechanical aptitudes also will experience slight growth with a corresponding decline in requirements for those in the administrative category.

Today a background in mathematics or science is desirable in 118 skills and more than seventy percent of the Air Force's enlisted force. Technical requirements of the Air Force's sister services are also increasing. Between 1980 and 1982, Army technical skill requirements increased thirty-four percent. Ongoing force modernization will further increase that percentage. The Navy anticipates a seventeen percent growth for people with mathematics, scientific, and technical skills by 1987.

My concerns are heightened by the fact that these same changes are under way in the private sector. For example, only about 225,000 computers were in use in 1975. By 1985, there are projected to be about 6,000,000. Many experts believe that one of the primary limiting factors to this potential growth may well be the numbers of people required to service and program these machines. A recent survey by the American Electronics

Association found that, by 1985, the electronics industry plans to double their recruiting of technicians from the military.

Telecommunications was a \$15 billion business in 1980. An industry study projects growth to more than triple by 1990. The acceptance by the public and growth of this medium for communications, chiefly teleconferencing, may reduce business travel significantly by the 1990s.

According to the Robot Institute of America, there will be a twelvefold increase in industrial robots in the United States by 1990. The General Electric Co. estimates the annual market for industrial robots to be about \$4 billion today. They project that to grow to \$30 billion by 1990. GE currently uses 200 industrial robots in their own manufacturing operations. By 1984 they expect to have about 1,000 in operation. The Bureau of Labor Statistics projects almost a million new robot manufacturing jobs by 1990. Thousands of highly skilled people will also be needed to maintain and service these machines. Robot technicians must possess those previously mentioned skills of the aircraft mechanic.

The Air Force established a Space Command in Colorado Springs in September 1982. (Air Force involvement was featured in the November 1982 AIR FORCE Magazine.) Rapidly expanding national space programs will require people, whether Air Force members, civilian employees, or contractor-employed, with unprecedented skill levels and technological sophistication to support the Space Command mission. Training programs are lengthy, sophisticated, and expensive. Given current trends, we must ensure an adequate supply of

American technicians in the future if we are to build, operate, and maintain these systems.

Academic Trends

Between 1963 and 1980, mean Scholastic Aptitude Test (SAT) scores in mathematics dropped thirty-six points. This decline in math skills came during a period of unparalleled technological progress. The people responsible for that progress are growing older—the scores of those coming on are lower. What is most disturbing, however, is the fact that the number of students scoring in the lowest group during this same period increased by about forty percent. This may be due in part to increasing numbers of students taking the SATs.

According to the National Academy of Sciences, only about one-third of our high schools offer enough mathematics courses to qualify a graduate to enter an accredited engineering school. One-half of our high school students no longer take a mathematics course past the tenth grade. About one-half of public school mathematics teachers are either unqualified or uncertified—currently teaching on emergency certificates. As a logical result, remedial mathematics course enrollments in public four-year colleges have increased by more than seventy percent in just the past five years.

Shortages of mathematics and science teachers have reached serious proportions. An Iowa State University survey finds forty states reporting shortages—many critical—of public school mathematics, physics, and chemistry teachers. During the 1970s, the number of teachers being trained fell seventy-seven percent in mathematics and sixty-five percent in the sciences. The same Iowa State study predicts these shortages will remain through most of the 1980s.

The sad fact is that many mathematics and science teachers are leaving the teaching profession and entering business and industry for economic reasons. This testimony is corroborated by other statistics. A National Science Foundation study disclosed that only about sixteen percent of US high school seniors take a year of chemistry, and that less than ten percent take physics.

These downward academic trends are becoming evident in something for which Americans have always been noted—inventiveness. Since 1965 the percentage of US patents awarded to foreign nationals has increased about twenty-five percent. With the increasing emphasis on mathematics, science, and high technology in other parts of the world, this trend may continue its growth.

Academic Application Comparisons

According to Paul DeHart Hurd, Professor Emeritus at Stanford University, American elementary teachers devote an average of forty-four minutes to mathematics and twenty minutes to science each day. During a week of instruction totaling only about twenty-five instruc-



Air Training Command's Col. Loyd J. Anders makes a T-37 maintenance point with Secretary Orr at Randolph AFB, Tex.

tional hours, children will receive less than two hours of science and less than four hours of arithmetic. Both our allies and our economic and ideological competitors, including the Soviet Union, East Germany, the People's Republic of China, France, and Japan, are moving toward twelve-year programs of public education.

The school year in those countries averages about 240 days a year—twenty-five percent more time than is devoted to education in the United States. The school day is six to eight hours long and the school week is either five and a half or six days. The academic instruction time in each subject exceeds that of the United States at all grade levels. (According to Dr. Isaac Wirsiip, Professor of Mathematics at the University of Chicago, the typical Soviet science student takes one to two years more algebra, eight years more geometry, one to two years more calculus, four years more physics, three years more chemistry, three and one-half years more biology, one year more astronomy, and three years more mechanical drawing than an American counterpart.)

National education publications emphasized the importance of science and mathematics to both economic and cultural pursuits. Scientific knowledge is considered essential for living in a modern world.

Most experts agree that we already have a developing national engineering shortage in selected disciplines. American engineering schools currently have faculty shortages of about ten percent. Foreign students are increasingly constituting a major portion of our engineering school enrollments, and earned one-half the doctorates granted by American engineering schools in 1981. Aeronautical engineer production has dropped more than forty percent since 1970 while employment growth projections range more than seventy percent by 1990. The Soviet Union is graduating almost 300,000 new engineers a year—many working in defense-related jobs. In comparison, the United States graduated about one-fifth that number last year.

Although I do not advocate matching the Soviets in a numbers game (there are differing viewpoints as to the overall quality of Soviet education), I do know this trend is not conducive to our future security. The Japanese—having decided that their future rested in development of high technology—tripled their engineer production during the 1970s, while we in the United States doubled our production of lawyers. On a per capita basis, the Jap-

Verne Orr was appointed to his post by President Reagan, with whom he served in the California state government and during the Presidential campaign and transition. He served in the Navy in World War II, and was discharged from the Naval Reserve in 1951 as a lieutenant commander. He earned a bachelor of arts degree from Pomona College and a master's in business administration from the Stanford Graduate School of Business.

anese now graduate almost two and one-half times more engineers than American schools produce. The evidence of this Japanese effort is on view in automobile and electronic equipment showrooms all across America, and in many countries we like to consider as in our economic sphere of influence.

Impacts of Technological Trends

The combination of our growing reliance on technology and concurrent trend toward scientific illiteracy of American youth has serious implications for our ability to compete economically in an increasingly technologically oriented world. It has even more serious repercussions for defense. One of the keys to our military strategy has for some time been to build fewer but technologically superior weapons to overcome the numerically superior forces of potential adversaries.

Maintaining that overall technical edge is absolutely crucial to this strategy. Recent conflicts in the Falklands and the Mideast have proven conclusively that the mastery of technology is far more crucial than simply possessing that technology. Modern sophisticated weapon systems in the hands of well-led, well-trained people who were given freedom of action in the skies and on the battlefield again proved a devastating combination.

Our growing scientific illiteracy and the massive transfer—by overt and covert means—of our most sophisticated technologies to the Soviets is most disconcerting and downright alarming when combined with the massive technical education programs of the Warsaw Pact.

The current trends are unacceptable if America wants to remain competitive in a technologically oriented world. Not everyone has to be a fully qualified scientist or mathematician. However, there is a very real need to be scientifically literate—to at least understand basic scientific principles to make informed decisions. I must also caution that we cannot afford to overreact and eliminate balanced educational programs—but there is no question that both the quantity and quality of mathematics and science courses must be improved.

The Need for a New National Commitment

The most important goal needed at this time is a renewed national commitment (the same kind of emphasis that existed after the launch of Sputnik by the Soviet Union in 1957) on the part of all Americans to upgrade our precollege (and thus college) education in mathematics, the sciences, and technologies. I do not mean to imply that this educational lag is not shared by other countries—or that there are not steps under way in many areas across this country because of increasing concern voiced by many parents dismayed at the education of their children. Many local school systems are once again emphasizing high standards of academic achievement and adding courses in mathematics and science.

But clearly this movement must take hold on a national scale—in all geographic regions of the US. Development of the full potential of women and minority students is clearly needed. Any child displaying a talent for mathematics and science must be encouraged to pursue studies and careers in these areas. In that regard, the mean SAT score in mathematics rose three points in 1982, the first increase in memory. While encouraging, it

is hardly a trend. Current trends are totally unacceptable to a technologically oriented Air Force poised on the threshold of space operations. Accordingly, it is the ideal time for the Air Force to become involved. We have an obligation to assist the reawakening of America to the importance of science and technology to our national well-being.

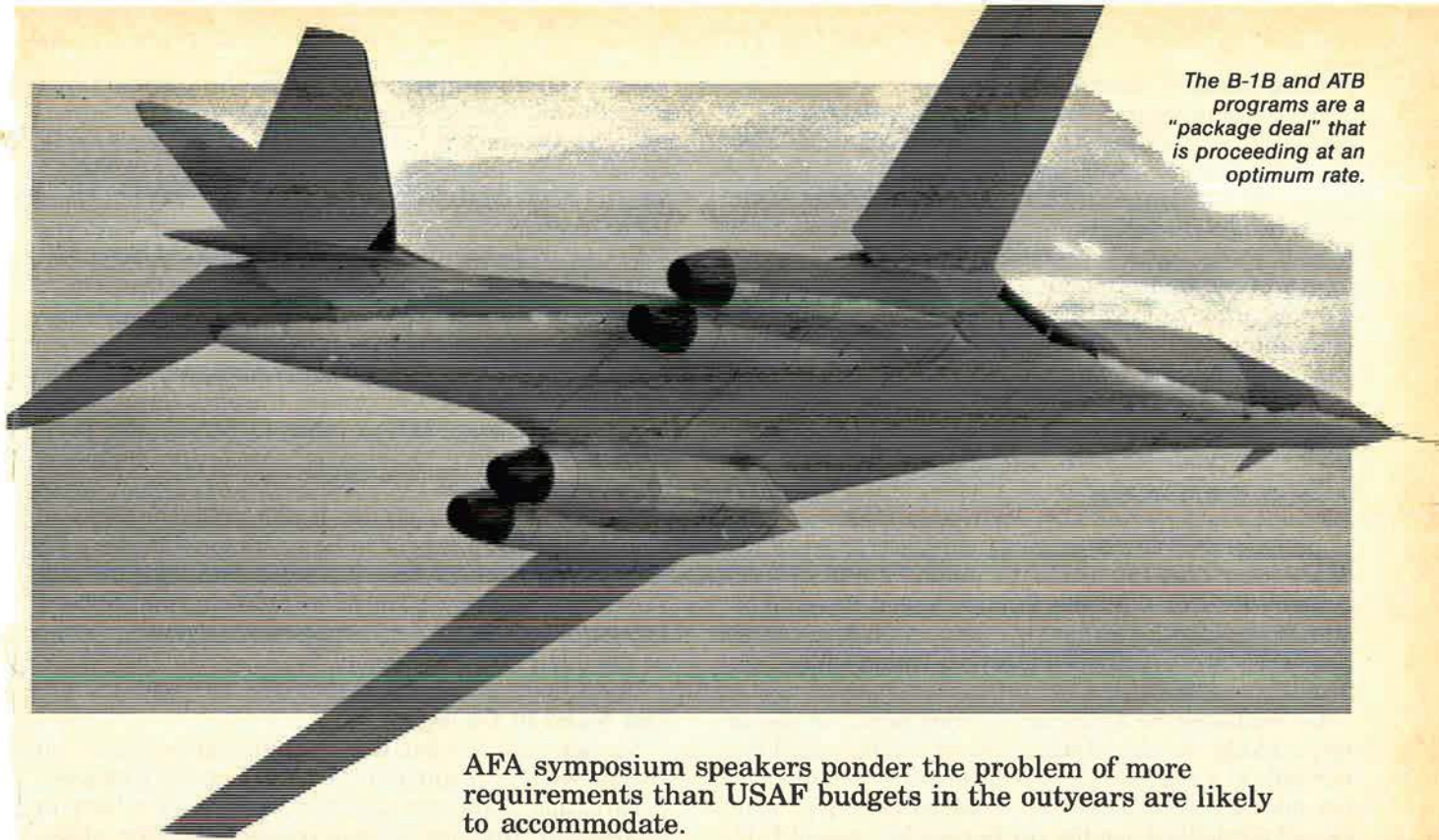
I would like to discuss briefly some efforts now under way. One Air Force program that has made a difference is Electronic Security Command's pre-college technical orientation program (PRETOP). Using minimal resources, PRETOP is a lively combination of words, music, and slides, designed to interest youngsters in both the impact and importance of technology and to demonstrate that mathematics and science courses can be fun. The program has stimulated great interest in the sciences in the San Antonio, Tex., schools.

The National Science Foundation recently formed a Commission on Pre-College Education in Mathematics, Science, and Technology to examine this problem and propose solutions. The commission consists of many distinguished American educators, scientists, and other experts. Gen. Lew Allen, Jr., our recently retired Chief of Staff, is serving as a member. The American Society of Engineering Education is sponsoring the National Engineering Action Conference (NEAC) that is examining ways not only to increase the supply of engineers available to all sectors, but to enhance their productivity as well.

I recently wrote to the presidents of the national engineering professional societies and to Air Force commanders mainly responsible for the bulk of our engineers, soliciting their cooperation in ensuring Air Force engineers were given every opportunity to join and participate in the activities of the professional societies. This is important not only to ensure the technical currency of our people but to establish better communications between the military and the private sectors, as well as kindle some of that cooperative spirit needed to tackle national problems of this magnitude.

I perceive a need at this critical juncture for a coordinated Air Force-wide program to assist this reawakening. All of us can speak out on the need for scientific and technical literacy. We can attend and sponsor science fairs, speak to elementary and secondary school career days through PRETOP-type programs, and sponsor special open houses and exhibits on our bases. Most of our large laboratories, development centers, and bases are near major metropolitan areas, so we have the capability, more than any other one organization, to reach the majority of American youth.

The Air Force has an obligation both to itself and to the nation to do all that we can to assist efforts to improve the scientific and technical literacy of our young people. Among the keys to success are closer cooperation between academia, the private sector, government, and the military. Innovative solutions will be needed to solve potential Air Force recruiting and retention problems downstream. With a clear understanding of the trends and their implications, I am certain the entire Air Force family will respond to this challenge—as we have to all others in our illustrious history. The long-term future of our Air Force and the national well-being depend upon it. ■



The B-1B and ATB programs are a "package deal" that is proceeding at an optimum rate.

AFA symposium speakers ponder the problem of more requirements than USAF budgets in the outyears are likely to accommodate.

The Finite Limits of Affordability

BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

THE central question raised by the Air Force Association's national symposium "The US Air Force: Today and Tomorrow" was complex and disturbing: How can the nation meet the growing Soviet threat in the face of a worsening budget crunch, rising defense costs, and the diversionary effects of the nuclear freeze movement? There were no easy, comfortable answers. As Under Secretary of the Air Force Edward C. Aldridge told the AFA meeting, which was held in Los Angeles, Calif., October 21-22: "The decade of so-called détente witnessed the most massive Soviet buildup of military power in history. They increased their defense spending by forty percent, while American defense spending actually declined in the same real terms."

Enumerating a number of unilateral steps by the US to slow weapon production—including cancellation of such nuclear weapons programs with a potential hard target kill capability as the Mk 17 reentry vehicle—he said the Soviets reciprocated with an "unprecedented deployment of military capability." Last year alone, he explained, the Soviets "launched 100 satellites to our thirteen launches; they have produced 200 new ICBMs while we in this country debate the production of a new ICBM." As a result, the Soviet ICBM force now boasts 5,500 warheads compared to 2,900 on the US side. Further, "they built tanks to a ten to one advantage over the US; they outnumber the US by more than three to one in

general-purpose submarines; they have built a 7,300 to 3,800 fighter aircraft advantage over the US."

Air Force Chief of Staff Gen. Charles A. Gabriel acknowledged the "glaring problem" that results from the fact that there are more approved programs than the budget envisioned for the outyears can accommodate. He explained that the "Air Force has so many national programs that we have darn little flexibility in what we can spend on our own, and that's where we get into a box."

While General Gabriel declined to make any predictions about "what will be cut," he said that the problem is "bigger than the Air Force. . . . We have to look at what the other services are procuring" in order to make joint adjustments that, in spite of cuts, safeguard the requirements of a balanced force. The "smart thing" to do, he warned, is not to stretch out programs, which drives up costs, but to "do them sequentially. The problem is external factors and pressures, such as OSD, Congress, and the budget process. It used to be that the chokepoints were technology; now it's the external factors." Some "hard decisions" concerning program adjustments and changes lie ahead, he said.

Gen. Robert T. Marsh, Commander of Air Force Systems Command, told the AFA symposium that the Air Force is "face to face with the reality of the rising costs of military capabilities that threatens to price us right out of the market. We risk being fiscally incapable of obtaining the necessary capabilities and force structure." General Marsh stressed, however, that "I cannot offer any quick and easy way for turning back the tide of rising costs."

Freeze Notion "Unrealistic"

In the symposium's keynote address, Secretary Aldridge argued against the "unrealistic notion" of a nuclear freeze that would serve only to perpetuate "the enormous and dangerous asymmetries in US and Soviet force levels—especially in conventional forces, intermediate-range nuclear forces, and strategic defensive forces of all kinds." Additionally, he said, "there are existing grave vulnerabilities in our strategic offensive nuclear forces, which put our entire nuclear deterrent at risk if left deficient and in its present state."

In the case of intermediate-range nuclear missiles in Europe—where the Soviets have more than 600 and the US as yet none—the US has proposed that each side hold the deployment to zero. This prompted Secretary Aldridge to ask rhetorically, "Why aren't the streets full of antinuclear folks demanding support for the President's plan?" If the US is to attain equitable arms-control accords with the Soviets keyed to reduced, equal force levels, "we have to reject . . . freeze notions that serve only to provide the Soviet Union with advantages."

In discussing the Air Force's current priorities, Secretary Aldridge disclosed that to boost readiness and sustainability of the tactical and airlift forces, flying hours per pilot are to be increased by about twenty percent. He acknowledged that the Air Force's buy rate of F-15s and F-16s is below the "desired rate; however, we have made a conscious decision not to expand our force structure if we cannot maintain them in ready condition with highly trained aircrews, and with the necessary spare parts and munitions to fly combat missions over sustained periods."

Because of the increasing use of space for military support functions, there are plans to transform the Air Force's Space Command "in the near future" into a unified command "which fully integrates the space activities and space utilization of the Army, Navy, and Air Force." He rejected the contention that the establishment of SPACECOM leads to the militarization of space: "On the contrary, we should look on these activities as a major step toward the preservation of peace. The mission of Space Command is to provide accurate and timely global information to decision-makers, to monitor provisions of international treaties, and to provide a capability to warn against surprise attack."

The increasing reliance on space necessitates the development of the means to enforce this country's right of access and free passage, which boils down to development of an antisatellite (ASAT) capability to deter threats to US space systems from the operational Soviet ASAT, he pointed out. The President, he added, directed the Air Force to proceed with the development of the system and to plan for its deployment. Flight testing of the US ASAT is scheduled for next year. Some technological and financial hurdles remain, he said, adding that "putting all the pieces together is a tough technological problem. But we are optimistic we can do it. The asymmetry that exists between ourselves and the Soviets is unacceptable and needs to be rebalanced with a deployed [US] ASAT."

Turning to a new, space-related advanced technology effort—the ballistic intercept missile (BIM) that is being explored by the Defense Advanced Research Projects

Agency (DARPA) and the Air Force—he said that while this concept has "certain attributes" that look attractive, the Air Force is "noncommittal on its future applications until we see the results of continued studies." This as yet tenuous concept involves the use of spaceborne sensors to acquire, track, and attack airborne targets with conventionally armed terminally guided re-entry vehicles launched from ballistic missiles. These missiles in turn could be launched from large airborne platforms, such as strategic bombers.

Rejecting the contention that the Air Force was developing the Advanced Technology (Stealth) Bomber at a less than optimum rate in order to protect the B-1B program, Secretary Aldridge said the two developments are a "package deal. . . . We have a bomber program that consists of the B-1B that is doing fantastically well and that we fully expect to be operational in the mid-'80s. We are proceeding at a rapid rate with the Advanced Technology Bomber to follow in the 1990s. I know of no one in the Air Force who is playing down one or the other of these designs."

The Need to Change

Service parochialism and institutional resistance to change were highlighted by General Gabriel. Change—in particular significant change—"isn't an easy thing to accomplish. Bringing it about requires sacrifice, struggle, and strong convictions. The process is a tough one which requires that we not throw out the baby with the bath water—that we preserve the important things we already have as we discard outmoded concepts and parochial ideas. We can't mortgage the present for the future or the other way around."

Among the issues that warrant innovation, he said, are tactical missiles. The importance of manned fighters must "not blind us to the potential value of conventionally armed missiles. I'll take anything that will help us bust Warsaw Pact airfields. If we view such a development as a threat to the manned aircraft, we may find ourselves behind the power curve."

Terming conventionally armed standoff weapons concepts such as Project Axe (a ballistic missile used to deliver submunitions over long distances) "exciting," he said that if NATO commanders could push a button when war breaks out and "within ten minutes have forty-six [Warsaw Pact] airfields out of action for hours only—not even a day—that would be most useful. Those [enemy] aircraft airborne at the time would have to go to auxiliary bases where they lack shelter and support. We could go after them and perhaps win the war in the first few days," General Gabriel pointed out. But there is a catch: "The other side would also do it" the same way. Further, the Axe missiles would have to be deployed in hardened silos, which entails major political difficulties in Central Europe.

Nevertheless, there is a clearcut requirement to put enemy runways out of action quickly: "When war starts, SACEUR will need some time to . . . get border crossing authority so he can do something about it, and that would take several hours. So, a quick-reaction weapon would be very useful to us." For the time being, however, the feasibility of concepts of the Project Axe type is not yet proven, especially so far as accuracy and submunitions are concerned, he pointed out.



The Air Force is evaluating both the F-16XL (top) and a derivative of the F-15 to augment the long-range interdiction mission of the F-111, with emphasis on low-level, under the weather operations in the European theater.

Similar uncertainties plague MRASM (Medium-Range Air-to-Surface Missile), that in a program sense is “not very healthy,” in the main because of lagging submunition development. The overriding problem with MRASM and a number of other standoff weapons—including a design involving terminal guidance and a range of twenty miles to keep the launching aircraft just outside of the enemy’s terminal defenses—is “not the platform but the killing effect. We don’t have the submunitions to do the job we need to do in the second echelon. We simply don’t have an airfield attack munition even though we have been crying for one for years. Right now, all we can do is fly right over the airfield and drop dumb bombs—or drop smart bombs if we want to go higher, which is not very healthy.” MRASM, he stressed, could be used very effectively by SAC’s bomber force in the conventional force projection role, “if we can ever make it work.”

Joint Operations

Another area undergoing change is joint operations—“the effective combination of air, land, and sea capabilities. We can’t fight alone effectively today and we will need even closer cooperation in the future.” Interservice competition, General Gabriel noted, has been with us “since the beginning of time, and we have been slow in making the needed changes—but we’re proceeding with them. We are taking concrete steps to better integrate air and land force operations, to enhance Air Force contributions to maritime operations, and to develop the complementary capabilities we need to do the job.”

A recently concluded memorandum of agreement be-

tween the Air Force and the Navy “acknowledges that we can do the job better—together. Our first efforts will be directed toward sea-lane defense. We plan to hone our skills for doing this through a joint training program and realistic joint exercises.”

Other help the Air Force can extend to the Navy includes “indication and warning, surveillance and targeting, command control and communications, aerial mine-laying, electronic warfare, delivery of Navy Special Operations Forces, and aerial refueling,” he told the AFA meeting. The memorandum of understanding, General Gabriel explained, is not yet implemented, but has been forwarded for review to the CINCs of all unified and specified commands.

The Joint Chiefs of Staff recently called the CINCs to the Pentagon to “brief [them] how they are going to fight [wars likely to occur in the areas under their jurisdiction]. We know we can’t fight all the wars simultaneously and that we have to go sequentially.” Purpose of the consultation, he explained, was to establish what “forces are needed in each area, where shortfalls are, and how we divide them up. That is why we are working with the Navy and the other services to avoid any duplications and to see how we can do better with what we have.”

The Navy’s primary requirement from the Air Force is air defense. USAF’s F-15s, AWACS E-3As, and RF-4Cs have good interoperability with shipboard equipment and, in concert, can provide important surveillance and air cover support for the Navy, he stressed. In the case of the Atlantic Fleet, for instance, the principal orientation in war would be the North Atlantic, with the result that there might be no carriers and, hence, no air cover in the Mediterranean. “We, therefore, would go in and provide air cover for the surface ships in the Med to protect them from the Backfire bombers coming from [airfields in nearby regions of the Soviet Union]. There are similar concerns in the Aleutians in the Pacific,” General Gabriel said.

Another crucial support function the Air Force is prepared to take on for the Navy, according to General Gabriel, is aerial mine-laying, surveillance, and recce, using SAC’s B-52 bombers. “We are doing this in the Indian Ocean as well as the Atlantic and Pacific.”

Lastly, the Air Force could perform ship attack, but this is not “the Navy’s greatest concern. They do that very well,” he said. Nevertheless, in isolated cases, when there are no US Navy ships in the vicinity, the B-52 will be able to use the Harpoon missile to attack hostile surface ships, he explained.

Because of USAF-Navy cooperation “we will need new concepts for maritime warfare; we will have to improve the interoperability between Air Force and Navy systems. We and the Navy will increase aircrew exchanges, use each others schools more, increase cross training, and increase exchanges of technical information. And those are only the first steps,” according to the USAF Chief of Staff.

He added that the future implications of those joint steps are significant because as new maritime warfighting concepts are developed, changes in other areas will ensue as well: “The challenges will be great, but the opportunities for improving America’s defense posture will also be great.”

Changing Global Requirements

An important set of changes in the Air Force mission, General Gabriel suggested, flows from the increasing likelihood that the "speed and violence" of lower level conflicts, not necessarily involving the Soviet Union or its surrogates, will increase dramatically. As more and more sophisticated weapons come into worldwide use, it is vital for the United States that "our forces are flexible, can deploy rapidly anywhere in the world, and can fight effectively in widely varying conditions." Airpower is well suited for these types of conflicts because it provides theater commanders with the best and most responsive means to deliver firepower accurately and rapidly over long distances as well as provide associated reconnaissance and intelligence concerning the enemy's location, strength, and intentions, General Gabriel pointed out.

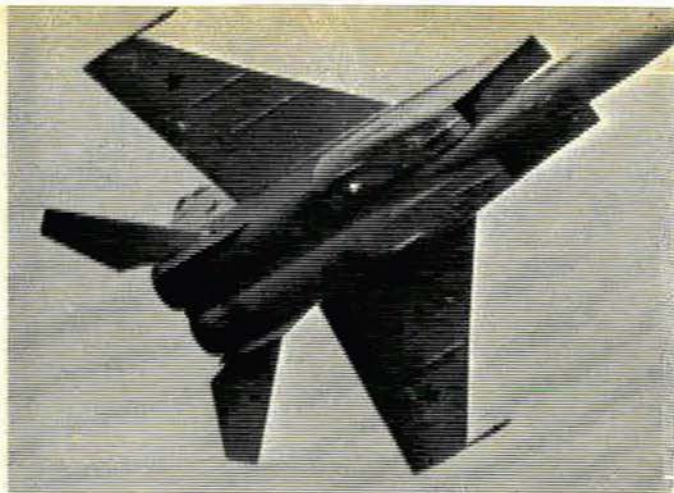
Those changing requirements, in turn, are likely to induce changes in traditional roles and missions: "Airpower promises to be the first on the scene, and it will be called on to perform wide-ranging missions. The disposition of ground forces is likely to be such that airpower will have to provide the principal means of defense until adequate ground forces can be brought into position—just as the Israeli Air Force did in the Yom Kippur War. In Southwest Asia, air interdiction may be the only way to slow a Soviet invasion," according to General Gabriel.

An element of the Air Force mission that is bound to undergo truly dramatic change in the future, General Gabriel predicted, is space. Today, he said, "we are on the threshold of military uses of space. Our technology is out in front of thinking on the role space should play. While some would like to keep it a 'sanctuary' and relatively free of military systems, this may not be possible."

Turning to specific weapon systems, USAF's Chief of Staff stressed the imperative of finding the means to augment the F-111s in the long-range interdiction mission with emphasis on low-level, under- and in-weather, and night operations. As a result, the Air Force is evaluating both the F-15E and the F-16E for this mission. Although he "would like both" of these derivatives in the Air Force inventory, he conceded that "this might not be possible. We will get the best for the money," he said, adding that "following the comparative evaluation now in progress, we will take the best of these systems in the missionized air-to-surface role."

In the strategic nuclear area, he said that at this time the follow-on version of the air-launched cruise missile (ALCM) is not envisioned to have intercontinental range, "although some people are looking at this." The cost of such a long-range vehicle appears to be too great. The Air Force, therefore, is concentrating on enhancing ALCM's survivability by means of Stealth and other new technologies, General Gabriel said.

While there is merit in adding fifty Minuteman IIIs to the ICBM force—as a replacement for the aging Minuteman IIs—that possibility is "hanging by a thin thread right now." Such an upgrade "would give us an additional 100 Mk 12A warheads for about \$15 million, and that looks like a real bargain." But because of the SALT limit on MIRVed systems, "we would have to take some [SSBNs out of the submarine fleet], and that is a hard



As exemplified by the MiG-25 Foxbat, and its twin, the Foxhound, Soviet tactical air doctrine is oriented toward longer-range radars and missiles rather than maneuverability.

decision that will have to be made [by the Joint Chiefs of Staff]."

Boosting the Technology Base

The key to the long-term security of the US is inextricably tied to the development and acquisition of weapons with ever greater capability, General Marsh, the AFSC Commander, pointed out. Two fundamental factors create this requirement: The need to offset the size of the Soviet arsenal and the fact that they have invested \$120 billion more in research and development than the US has over the last ten years "to achieve quantum improvements in the sophistication of their weapons."

But there is a dilemma because "there is a finite limit to what we can afford," he said, acknowledging that "the costs of our new systems are rising along an alarming curve when compared to their predecessors. However, the military capability of these systems also increased dramatically." General Marsh explained that combat capability is the "key word here—not complexity, sophistication, or expense considered individually." To argue for simplicity for its own sake, he said, is "specious and naïve and irrelevant to capability, which is the ultimate issue. It simply does not matter how many of the less complex, less expensive weapons we could buy for the same amount now being spent if those weapons do not provide the capability needed to deal effectively with the threat. The economies would be false if they fail to deter and, if necessary, defeat an enemy."

Unfortunately, he warned, "all is not well. Our technology development efforts have not received the fiscal support and dedicated talent they require. Recent studies have identified unambiguously the need for increased investment in technology base programs and for structuring an approach" to reduce the risk of pursuing technological blind alleys. AFSC, he said, is applying "scenario-based planning [using] a forecast of the future threat and world conditions to determine the minimum essential capabilities for future weapon systems. We then back off from there and evaluate, as best we can, the technologies available to produce those capabilities and assess the affordability of each."

Among the areas of technology that warrant special attention, he said, is materials technology. Needed urgently is a strong heat-resistant material that can be

molded to "give us design flexibility of reentry vehicles." Equally important is the development of stronger and lighter materials to put large structures in space. Materials of this type are requisite for the design of large space structures that in turn can open the door for "greatly enhanced military capabilities—space stations, large platforms with increased sensor or communications capabilities, space weaponry platforms, industrial production facilities, and others."

In the same context, he told the AFA meeting, there is a pronounced need for efficient, lightweight propulsion devices to reposition space systems, such as changing orbital planes or altitude. This, he explained, "is a critical requirement for increased responsiveness and survivability of space systems. Surely, moving one satellite to another area where it is suddenly needed must be cheaper than building and launching two satellites to achieve the same effect."

A related Air Force concern hinges on what he termed "man-in-space technologies," including better suits for extravehicular activities and "a lifeboat to rescue stranded astronauts." These are needed to preserve the option of putting man in space to do things like "on-orbit repair, on-orbit construction, and on-orbit reconfiguration and modification of satellites using plug-in modules."

In the area of weapons technology, General Marsh stressed the need for "more work on everything from the development of optical pattern recognition capabilities for tactical and strategic missiles to the generator and accelerator technologies for directed energy weapons."

In the tactical arena, he disclosed that there are efforts under way "to develop the technology necessary to build missiles that can identify military targets, regardless of the background or geographic location—that is, missiles that actually see. Naturally, the great advantage here is that the aircraft never has to visually or electronically acquire the target." The obvious and pervasive payoff would be "more targets destroyed with fewer losses, fewer aircraft, and less cost."

General Marsh was equally intrigued by technologies facilitating the interaction of man and machine. "Of particular concern are the work loads of aircrews and command and control operators. They are being stressed by increasing work loads and reduced time to accomplish a variety of tasks. . . . We need more effort in human metrics, measuring, and evaluating work loads [and] more effort in developing voice recognition and visual display technologies. There is a potential here for applications that allow pilots to command their aircraft verbally or to use helmet-mounted displays of video or radar data to provide 360 degrees of visibility."

The resultant option to integrate various aircraft control systems, sensors, and computers into one control system, he explained, "makes it possible to further reduce aircrew work loads and increase mission effectiveness. The integrated control system of the future may provide automatic, integrated engine and control surface adjustment based on the aircraft's sensing its environment and flight conditions."

Although sophistication of this level won't come cheap, General Marsh suggested that a "smart airplane that works with its pilot to find the target, destroy it, and

survive could well be cheaper in the broadest sense than two, simpler aircraft to do the same job."

One thing is certain, he emphasized: "If we do not pursue the technology now, we won't have to worry about these cost/capability tradeoff questions later. . . . The bottom line in the technology development effort isn't cost but security. The situation is really quite simple—a sizable investment in the technology base today ensures our tomorrow. There is no way around it."

An obvious area of deep and perennial concern is program stretch-out, the AFSC Commander told the AFA meeting. Stretch-out equates to "busted cost estimates." In the case of the three-year stretch-out of the F-15 program, for instance, cost went up by about \$1.6 billion when production rates slipped from the anticipated thirteen to fourteen aircraft per month to a peak of nine per month, he said, warning that "if we don't acquire the B-1B on schedule and, therefore, don't produce the aircraft at the planned rate," a one-year stretch-out would increase the cost by an estimated \$1 billion.

The Logistics Challenge

"The single criterion by which we measure everything in AFLC is combat capability," Gen. James P. Mullins, Commander of Air Force Logistics Command, told the AFA meeting. Using modern data-processing and communications technology, he said, AFLC is "in the process of building and testing models to boil down raw data in terms of achieving this combat capability. We are taking a comprehensive and honest look at what military actions might be necessary—we are determining what weapon systems will be needed to take these actions—and we are working closely with the other operational commands to ensure that these systems will be available and supportable."

AFLC's virtually automatic, computerized process, he added, "will also permit us to respond immediately to any unforeseen occurrence—the loss of a certain production capability—or a surprising shift in an evolving conflict—or in many conflicts occurring simultaneously throughout the world."

In assessing the vexing problem of stockpiling enough material to meet the initial surge of a high-intensity war long enough for industrial capability to gear up, on the one hand, without accumulating unreasonable quantities that eventually will become obsolete, on the other, General Mullins said the answer hinges on "how much of what do you stockpile? For that determines when you need new production." The fundamental challenge that ensues is to "maintain the kind of industrial capacity we will need for that production—particularly, when as now, you need it early on—either because you can't afford to stockpile too much or you are afraid of obsolescence."

In AFLC's assessment, there are two basic approaches to defense production. "On the one hand, we can do as we have always done, and give free enterprise virtually all of the responsibility. Or the whole job can be done organically, like the Soviets do. There is also, of course, the possibility of something in between." He explained that "because of the episodic nature of defense purchases—because of the cyclical patterns of

feast or famine in our defense industry—the ability to operate at a profit is chancy at best.”

As a result, the US lost almost half of its defense contractors over the past fifteen years—down to 3,500 from an original 6,000—he said, adding that “the procurement and support of defense materials in this country is clearly unsatisfactory, especially when one considers the challenges and threats we are likely to face in the future.” He suggested that “we have some difficult decisions to make regarding our ‘arsenal of democracy,’ decisions about funding and commitment, profit and loss, depreciation and taxation. And I believe we have to find new or different ways of doing things. Innovations may be in subsidized competition, nonrestrictive controls, less episodic procurement practices—or even a totally dedicated military industry—one that somehow preserves ingenuity.”

The Tactical Challenge

“The real question is will we have enough resources to make our game plan viable against the Soviets? My opposite number has 108 fighter wings while the Air Force has thirty-four and a half. . . . He has three new fighters under development compared to an authorization of \$23 million for next year for our next fighter.” This was how Gen. W. L. Creech, Commander of Tactical Air Command, framed the tactical airpower challenge.

While he gave glowing marks to the quality and training of USAF aircrews, he expressed strong concerns about the US lag in “fielded technology.” Although on balance Soviet technology is not better than this country’s, their “fielded technology is catching up and in some areas surpassing us. . . . Indeed, I worry that we may have hit sort of a technological plateau in fielded technology.”

In the area of air-to-air combat, he said, the Soviets are going for longer-range radars and missiles rather than maneuverability. As the recent Israeli Air Force experience demonstrated, modern air combat hinges on what he termed the “point/shoot mode. In that kind of environment, the fellow who has the first look/first shot clearly has the advantage.”

Another area of grave concern to the TAC Commander is command and control, which, he said, “may well be our Achilles’ heel. Our systems are easy to jam and AJ [antijam provision] is very costly. . . . We must pay greater attention to not just communications and radar jamming but also to electronic countermeasures for our fighters.”

The fact that Compass Call, a C-130-based jamming system, is finally being fielded is a real plus, he stressed. “We have four now and more will follow. It is the first capability we have ever had to take away the enemy’s free ride in the use of his communications, and the effect, I assure you, is going to be devastating.”

The Soviets, on the other hand, have “tremendous capabilities to disrupt our command and control and we need to be much smarter and quicker in fielding AJ systems of all kinds,” including digital, voice, and such data systems as JTIDS (Joint Tactical Information Distribution System).

“If you ponder the fact that the HAVE QUICK communications system—that we use with great success in



The Space Shuttle is the key to placing large space platforms in orbit. USAF maintains that the cost of ground and airborne terminals must be reduced in order to make them affordable.

Red Flag [exercises]—is just now entering the inventory, even though we have known full well that the enemy had the capability to cut our communications and reduce our mission effectiveness by fifty percent, it gives you pause,” he suggested.

In a related area, the TR-1 and PLSS (the Precision Location Strike System that he said “is to emitters what the E-3A is to aircraft”), when fielded, “will let us know where the enemy systems are, destroy some, jam others, and let us avoid those that we can’t counter.” These systems need to be tied to the PAVE MOVER moving target indicating radar to form a ground attack center. In this connection he expressed concern about the twin programs known as Joint STARS and the common missile.

The Joint Surveillance and Target Acquisition Radar System (Joint STARS) seeks to develop a common core moving target indicator radar for both the Air Force and the Army. USAF is the executive agency of this program. The Army, on the other hand, is the executive agent in charge of a program to develop a common missile that can be used in conjunction with Joint STARS. General Creech termed the two programs a “shotgun wedding,” owing to the fact that the two radars and two missiles are “sort of designed for different purposes. I am very positive about our ability to sort through these conflicting requirements and come up with, if not a common, at least a joint solution that will have the economy of scale.”

The Air Force needs a system that makes it possible to launch missiles against various targets from a moving platform at high speed, which is quite “different” from the requirements of the Army’s ground forces, he said.

Assessing Congress’s decision to deny funding of the advanced tactical communications system SEEK TALK, the TAC Commander said the requirement for

such a system "has not gone away. It's still around under a different name, HAVE CLEAR." JTIDS, which he said is "desperately needed" to tie AWACS to the defense nets on the ground, is "somewhat larger, bulkier, has a great deal more user complexity," and might not have the same AJ margin that SEEK TALK would have provided. The cost of either a full-up JTIDS or SEEK TALK system is somewhere between \$500,000 and \$750,000 per aircraft, meaning that with about 8,300 radios involved "you are talking between \$4 billion and \$5 billion."

Underscoring the importance of advanced air-to-air missiles to tactical air warfare, General Creech said, "The smarter they become and the farther out they go, the better we like it. That's why we want AMRAAM [the advanced medium-range air-to-air missile]. It doesn't have to be illuminated all the way to the target. About halfway to the target it takes over by itself, and you can go on to other targets and launch multiples." He added that it may become necessary to "go to much longer ranges" than currently planned for AMRAAM.

He rejected the contention that the Air Force was afflicted by a "Red Baron" syndrome that sought to ignore the revolutionary impact of advanced missile technology and asserted that "we are pushing forward in air-to-air missile sophistication about as fast as we should."

The Air Force, General Creech told the AFA meeting, does not plan to acquire any AV-8B Harrier V/STOL fighters. "If I were a Marine," he said, "I would want it, but it doesn't carry a great deal [in terms of] the range/payload curve we need to fight in Central Europe, for UK basing, the Rapid Deployment Joint Task Force," and other Air Force missions. "We are not ready to go to V/STOL and STOL with that kind of penalty in payload and performance. The Harrier would be at a severe disadvantage against [modern] Soviet fighters. It is a first-class aircraft for a specialized role." The Air Force might become interested in V/STOL or STOL capabilities when thrust-to-weight ratios advance to a level that can "give us the kind of payloads, weapon systems carriage capabilities, and ranges we have today," he added.

Stressing the importance of building up strategic air defense, he said TAC's air defense squadron at Langley AFB, Va., has been converted to F-15s from the aging F-106s, with the McChord AFB, Wash., squadron scheduled to transition to the new aircraft this summer. The equivalent of three and half wings of fifteen squadrons is assigned to air defense by TAC. There is the option to augment this force with about 250 fighters from the training complex "under certain scenarios," according to General Creech.

The result is a "reasonably capable force when it is tied to the OTH-B [over-the-horizon backscatter long-range radar] to give us strategic warning concerning the axis of attack [of the approaching Soviet bombers], which lets us get our E-3As on station." Such a "limited war-fighting capability," General Creech pointed out, is of crucial importance in the case of a "precursor attack" by Soviet bombers against vital command and control centers in this country. If the Soviets succeed in putting "five nuclear weapons on five selected locations, [they would be able to] decapitate the National Command

Authorities, and that is why air defense is very important."

The capabilities of USAF's tactical forces, General Gabriel and General Creech agreed, in spite of some deficiencies, are formidable. If the present game plan is sustained, General Creech said, "we will be as successful, if war comes, as the Israelis were in microcosm" in their air war with Syria. General Gabriel said he is "extremely confident that we would come off well in air-to-air engagements. Our crews are better, we are better motivated, and our tactics are the best. They are the same tactics the Israelis are using."

The Space Challenge

"The nagging question is: Can the dependence on space that we have today be continued in case of war?" according to Lt. Gen. Richard C. Henry, Vice Commander of Space Command and Commander of AFSC's Space Division. He explained that the ability to give "assured support to our operating forces depends to a large extent on our capacity to exercise command and control over the orbital force structure in place in the event of war. In order to improve the survivability of our control network, we are decentralizing and distributing the nodes that can receive and dispatch the signals involved with spacecraft control. We also are working on cross-orbit relays to improve flexibility and reduce dependence on fixed stations, especially overseas."

Overall, the requirement is to move from "centralized control and execution to centralized control and decentralized execution" within the space-related command and control mechanism, General Henry told the AFA meeting.

AFSC's Space Division has accomplished a great deal over the past ten years in increasing the survivability of space systems, General Henry said: "We have on orbit today spacecraft with hardened electronic circuitry to make nuclear attack more difficult. We launched intentionally spacecraft as spares and have proven the feasibility and practicability of that technique to give us depth and resilience in our orbital force structure. And we have been, and continue, to incorporate AJ into the electronic umbilical in the spacecraft and on earth." Additionally, the Division is working with the Air Staff on a comprehensive survivability architecture study that eventually will involve all operating commands and the other services, he said. Stressing the interdependence between different systems on orbit, he explained that the Air Force is pursuing "macrosystems engineering," meaning that the transponders and sensors of a given system are being "hosted" by various satellites with differing primary functions.

The Space Division Commander suggested that future trends are likely to favor large space platforms. "We need larger space platforms to bring down the cost of our earth terminals and make them affordable," he said. The lion's share of the costs of space systems is in the terminals which—especially in the case of strategic bomber terminals—are "just too high. If we have larger platforms on orbit with greater power coming down, then we can reduce the cost of the terminals," according to General Henry. ■

(The proceedings of the second session of the AFA symposium will be covered in next month's issue.)

AIRMAN'S BOOKSHELF

First of the Few

Fighter Pilot, by Lt. Col. William R. Dunn, USAF (Ret.). University Press of Kentucky, Lexington, Ky. 40506, 1982. 234 pages, including appendix and index. \$18.

Bill Dunn was not only the first American fighter ace of World War II; he also is a great storyteller and an accomplished aviation artist whose painting of the action in which he became an ace graces the dust jacket of this book. In colorful prose, with a sense of humor that can only be described as robust, Dunn writes about his seven years of combat in World War II with the RAF's Eagle Squadrons and with the US Army Air Forces in Europe and the CBI.

Dunn's early life probably predestined him to become a fighter pilot. He worked as a cowboy and rodeo rider while accumulating a good bit of flying time. At the outbreak of the war, he went to Canada, hoping to join the RCAF, but ended up in the Canadian Army, seeing action on the Far Shore at the time of Dunkirk. During the Battle of Britain, he shot down two Stukas from a gun pit, and finally was mustered into the RAF to help rebuild the depleted ranks of that service.

After some humorous and hair-raising flying training experiences, he went into combat as a Hurricane pilot with No. 71 Eagle Squadron after only eight hours of operational training and one simulated combat mission. But on-the-job combat training focuses the attention wonderfully, as he soon found out.

With amazing recall, Bill Dunn describes in vivid detail the air-to-air battles in which he shot down three Me 109s and was himself shot down into the English Channel. On the day he won his fifth victory while flying a Spitfire, Dunn was seriously wounded and spent several months in the RAF convalescent hospital at Torquay. Some of his most hilarious anecdotes are about life in the hospital.

Earlier, and typical of his fighter pilot approach to life, Dunn had bet

friends he could fly through the supposedly impenetrable balloon barrage that protected London. How he did it you'll have to read for yourself.

In June 1943, Dunn transferred to the AAF to become a P-47 pilot with the 406th Fighter Group, flying in an entirely different kind of combat. Most of the 406th's missions were armed recce and, after D-Day, close support with "none of the fighter pilot glamour of the early war days . . . nothing more than flying directly into the firing barrels of hundreds of anti-aircraft cannon and machine guns," several times a day in lousy weather most of the time. His account of the 406th's first D-Day mission, which he led, is guaranteed to make anyone who has been there a bit damp under the arms.

After finishing his tour with the 406th in late 1944, Dunn was assigned to the CBI, where he flew a number of missions in P-51s. After V-J Day, he was made an advisor to the 4th Fighter Group of the Chinese National Air Force, flying twenty-eight missions against the Chinese Communists until January 1947 when he was sent home.

In an Epilogue, Dunn tells how he was passed over for promotion because, he believes, of a mix-up in records. He then enlisted in USAF, rising rapidly to the rank of chief warrant officer and participating in the battle of Saigon during the Tet offensive. When he retired as a lieutenant colonel in January 1973, the British air attaché, Air Commodore "Paddy" Harbison, and his staff flew out to Aerospace Defense Command at Colorado Springs to pay tribute to the man who had fought, and bled, and who became the first American ace, flying with them in those perilous days when the fate of England still hung in the balance.

The icing on this delectable cake is a thirty-page appendix in which Bill Dunn gives a cockpit view of the flying and fighting qualities of the Hurricane, Spitfire, P-47, and P-51, and a through-the-windscreen assessment of the Luftwaffe's Me 109 and Fw 190. Some of this appendix is an adapta-

tion of Dunn's articles in AIR FORCE Magazine (September '76 and July '77 issues).

A few readers may think Bill Dunn's comments on former enemies who now are allies, and on military and civilian strategists, a bit intemperate, but *Fighter Pilot* is not to be read for instruction in grand strategy. It is a personal account of an air war the likes of which will not be seen again, and it is destined to find a place among the better books of that genre.

—Reviewed by John L. Frisbee,
former Editor, AIR FORCE
Magazine.

The Fight for Jerusalem

Among Lions, by J. Robert Moskin. Arbor House, New York, N. Y., 1982. 401 pages, with maps. \$16.95.

This is an excellent account of the 1967 battle for the city of Jerusalem—a symbol of faith revered by Christians, Jews, and Muslims alike.

In the fighting in 1948, the newborn state of Israel had lost to the Arabs the heart of Jerusalem—the "Old City" and its holy places.

The 1967 conflict between Israel and Egypt was characterized by tank battles in the Sinai desert and aerial warfare, all well researched and documented. The short bloody battles that took place in Jerusalem have been almost totally neglected. Robert Moskin remedies this.

For thousands of years there had been bloodshed in Jerusalem over national, ethnic, and religious issues. The events of June of 1967 were a continuation of these struggles, with the city's streets, homes, and gardens once again the battlefield.

The conflict can be summarized succinctly. On Monday, June 5, Israel attacked Egypt in a preemptive—and highly successful—strike. Later that morning, Jordan, in response to urgent Egyptian requests, began shelling Israeli positions in general and Jerusalem in particular. In the afternoon, the Jordanian army assaulted and captured a ridge south of

the city. The Israeli Jerusalem Brigade then counterattacked and retook the ridge.

That night, the Israeli Harel Brigade, made up of tanks and mechanized infantry, moved onto a hill north of the city.

Two hours after midnight on Tuesday, the 55th Brigade of Israeli paratroopers charged uphill to attack the heavily defended central section of the city, dotted with Jordanian strong points. It was courageous, but the question whether the head-on attack was necessary remains unanswered. There was no air support and the Israelis were pitted against the core of the Jordanian defense.

The Jordanian soldiers defending Jerusalem were primarily Bedouins, who fought bravely and with professional skill. However, they were eventually overwhelmed.

When Ammunition Hill north of Jerusalem was finally taken, there was still the decision whether to invade the Old City with its holy places. The Israeli Minister of Defense, Moshe Dayan, wanted to surround the city and await a surrender. However, cabinet member Menachem Begin was concerned that there was the danger that a UN-arranged cease-fire would leave the Old City in Jordanian hands. After much debate, the cabinet agreed with Begin and the attack was ordered for 5:00 a.m. on Wednesday, June 7.

The Jerusalem Brigade led the attack through the "Dung Gate" at 7:45 a.m. It was followed by two units of the 55th Brigade. After short but intense battles, the fighting was over early that afternoon. The Israelis were jubilant. They finally had complete control of Jerusalem.

The author covers these battles from the viewpoint of those who actually fought them, relying liberally on personal accounts. It also contains stories of the inhabitants of the city on both sides of the conflict. Moskin portrays the problems, frustrations, successes, and failures of the front-line troops.

The author analyzes the strengths and weaknesses of both sides and concludes that while the Jordanian troops fought bravely, the Israelis had better equipment, training, and tactics. But, above all, they had experienced battlefield leaders.

—Reviewed by Ben Catlin, AFA
Special Assistant for Defense Personnel Matters.

New Books in Brief

Bellanca C.F.: The Emergence of the Cabin Monoplane in the United States, by Jay P. Spenser. Volume 6 in

the "Famous Aircraft of the National Air and Space Museum" series, this volume details the origins, development, history, and the Museum's restoration of the little-known C.F. The C.F. was the most efficient airplane of its time, exhibiting performance characteristics far beyond those of contemporaries. However, with thousands of surplus Curtiss Jennies available after World War I for rock-bottom prices, no market could be found for the C.F., and only one was built. The greater significance of the C.F. was that it was the first successful cabin monoplane built in the US, and pointed the way to future designs. Author Spenser provides a full accounting of the C.F. story and its creator, Giuseppe Bellanca, and concludes the book with a detailed look at the C.F.'s restoration by Museum craftsmen. With illustrations, notes, and appendices. Published for NASM by the Smithsonian Institution Press, Washington, D. C., 1982. 96 pages. \$7.95.

Fortress Without a Roof, by Wilbur H. Morrison. The "fortress" of the title is Hitler's "Fortress Europe," and refers to President Roosevelt's comment that "Hitler built a fortress around Europe, but he forgot to put a roof on it." An account of the allied Combined Bomber Offensive, author Morrison relies on war diaries, interviews, and documentary sources to recreate and reevaluate the strategic air war against the Third Reich. He details the dark early days, when successful strategic air war seemed impossible to all but a visionary few; the wrangles between British and Americans over day vs. night bombing; and Eisenhower's diversion of strategic airpower to support the Normandy invasion just as its effect was being felt. Interspersed with the narrative are anecdotes from combat participants, which bring to the reader a taste of the terrors of air war. With photos, bibliography, and index. St. Martin's Press, New York, N. Y., 1982. 322 pages. \$16.95.

Mission to Mars: Plans and Concepts for the First Manned Landing, by James E. Oberg. An examination of the feasibility of and rationale for a manned expedition to the Red Planet, this book argues forcefully that such a mission, using existing technology, is possible, and that there are compelling scientific, economic, and political reasons to make the attempt. The author addresses in detail the "nuts-and-bolts" aspects of the flight, and examines Soviet intentions for planetary exploration and the potential for human colonization and "terraform-

ing" of Mars. The author draws heavily on the proceedings of the "Case for Mars" colloquium held in 1981 at the University of Colorado at Boulder. With illustrations, appendices, bibliography, and index. Stackpole Books, P. O. Box 1831, Harrisburg, Pa. 17105, 1982. 221 pages. \$14.95.

The Rocket Team, by Frederick I. Ordway III and Mitchell R. Sharpe. The "rocket team" of the title is the group of scientists and engineers who were first assembled with Wernher von Braun at Germany's Peenemünde research station and who subsequently came to America to form the nucleus of the US's ballistic missile and space programs. This well-researched book covers the modest beginnings of rocketry in Germany in the 1920s up through the American space effort of the 1960s, with central emphasis on the development of the V-weapons by von Braun's group at Peenemünde. The foreword is by the late Wernher von Braun. With illustrations, appendices, bibliography, and index. MIT Press, Cambridge, Mass., 1982. 462 pages. \$9.95.

Skyraider, by Rosario Rausa. The Douglas A-1 Skyraider, designed virtually overnight by Edward "Mr. Attack Aviation" Heinemann, proved a sturdy and reliable workhorse that came to be called the "Flying Dump Truck" because of its seemingly limitless combat load. A prop-driven plane that survived well into the jet era, Skyraiders served with distinction in Korea and Vietnam, even shooting down a couple of MiGs during the latter conflict. Author Rausa, a former Skyraider pilot, has written an admiring story of this remarkable aircraft and the equally remarkable men who took her into battle. With an introduction by Ed Heinemann, and illustrations, appendices, bibliography, and index. The Nautical & Aviation Publishing Co., Annapolis, Md., 1982. 239 pages. \$17.95.

Stunt Flying in the Movies, by Jim and Maxine Greenwood. This book gives the reader a behind-the-scenes look at the men and women who took movie stunt flying into the wild blue. A true-life adventure story, this book is a fast-paced and well-documented history of aerial stunting from the days of wing-walkers and plane-change artists to the sophisticated wizardry of today's pilots and technicians. With photos, bibliography, and index. Tab Books Inc., Blue Ridge Summit, Pa., 1982. 245 pages. \$21.95.

—Reviewed by Hugh Winkler,
Ass't Managing Editor.

THE BULLETIN BOARD

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

National Salute to Veterans

A trio of Vietnam veterans was selected by AFA President David L. Blankenship to represent AFA at several national events that took place in Washington, D. C., during the week of November 8-14, designated as Salute to American Veterans Week. AFA Board members Ellis Nottingham and David J. Smith and AFA's Man of the Year for 1982, Thomas W. "Tony" Anthony, were the designees for this week, which saw more events aimed at honoring veterans than the nation had hosted for a good long while—with Vietnam veterans particularly singled out for appreciation. Additionally, many AFAers came to Washington either on their own or as members of their state-sponsored delegations, arranged through each governor's office.

The week, which included national participation in Veterans Day activities, November 11, was marked by many state and local observances tied to veteran recognition. In Washington, D. C., government-sponsored activity was intertwined with events

sponsored by the private, nonprofit Vietnam Veterans Memorial Fund organization. The latter group staged a parade in tribute to Vietnam veterans and also dedicated the Vietnam Veterans Memorial.

In addition to the parade, the week's Washington events included a candlelight vigil at the Washington National Cathedral with round-the-clock reading of the names of those killed or missing in action in Vietnam; an entertainers' show headed by stars Jimmy Stewart and Wayne Newton; a religious service at the National Cathedral; a ceremony at Arlington National Cemetery; and unit reunions, receptions, and get-togethers.

The week was also designated National Disabled Veterans Week. Marking that occasion, Rep. G. V. "Sonny" Montgomery (D-Miss.), Chairman of the House Veterans Committee, noted, "This special group of veterans has paid a great price for our prosperity, strength, and freedom. For this reason we owe them, and indeed all our nation's veterans, our profound and humble respect."

Perhaps the most moving event during the week was the dedication of the Vietnam Veterans Memorial, a monument that has been embroiled in controversy since its inception. However, during this week, as thousands of Vietnam veterans participated in recognition activities and the parade and got the "welcome home" that many felt they had never had, a spirit of reconciliation surfaced in Washington and was reflected by private observers and media reporters. Although the design of the controversial Memorial is still not acceptable to everyone—and perhaps never will be—many seemed to share the feelings generally expressed by veterans at the dedication that, regardless of what they personally might think of the Memorial design, it's a visible recognition, in the nation's capital, that Vietnam veterans are remembered.

Reemployment Rights Hot Issue

Reemployment rights for veterans were strengthened by two recent actions, one judicial, one legislative.

In a Michigan case, a veteran was awarded \$19,000 in back pay when a court ruled he should have been reemployed even though his former employer had sold the business while he was in the service.

The Michigan veteran worked as a staff announcer for a Munising, Mich., radio station for about two years. In 1973 he went in the Army, served two years, and was honorably discharged. He made a timely application to get his old job back, but first was told that no openings existed, and was then offered a temporary position, which he turned down.

The Office of Veterans Reemployment Rights (Labor Department) took up his case and recommended that the Justice Department file suit on his behalf. The suit was won, and, in an unusual twist, the court noted that even though the radio station was under new ownership, the new owners were aware of his claim "and the circumstances had not so changed as to make it impossible or unreasonable to reinstate the veteran." The court



The first all-women crew to fly a CT-39 Sabreliner mission gets a "well-done" from Brig. Gen. Jack W. Sheppard on the flight line at Scott AFB, Ill. General Sheppard, DCS/Personnel at Hq. MAC, was a passenger on the flight. The aircraft commander, 1st Lt. Yvonne Beswick, center, and copilot, 2d Lt. Gayle Westbrook, are assigned to the 1402d Military Airlift Squadron, Maxwell AFB, Ala. (USAF photo by Sgt. Gale Houseknecht)

ruled that both the new and original owners were jointly liable for the damages.

Meanwhile, recent congressional legislation has addressed a point that has been at odds between the Labor Department and the Department of Defense—that is, is a Guard or Reserve member who takes additional training duty (beyond the usual unit drills and regular annual training) of more than ninety days' duration within a three-year period entitled to job protection? For example, would an Air Reservist who goes off to load-master school for four to five weeks be entitled to his job back?

Defense has said "yes." Labor has said "no." Evidently, lawyers in both departments had drawn different messages from previous court action involving such training. Spokespeople for both DoD and Labor now tell AIR FORCE Magazine that pending legislation, if enacted, will spell out that attendance at authorized training courses, no matter the length, will grant the reservist the right to re-employment. We hope that the point is clarified soon. Reservists have a right to a definitive answer to this question.

Agent Orange Concern Continues

The controversy over treatment of Agent Orange-exposed veterans continues unabated, as Congress, private groups, the VA, and the veterans

themselves raise charges and countercharges.

At year end, the General Accounting Office, investigative arm of Congress, weighed in with a report accusing the VA of failing to provide thorough examinations, and of not giving "adequate information to veterans" about some of the possible side-effects linked with exposure to the chemical. The VA, perhaps stung once too often in this regard, took the somewhat unusual step of issuing a specific public rebuttal to the GAO report. The rebuttal noted that the report "leaves several misconceptions that could hurt rather than help veterans concerned about Agent Orange exposure."

The VA's "information sheet," from its Chief Medical Director, Dr. Donald L. Custis, underlined the following points:

- Veterans concerned about Agent Orange do receive and will continue to receive a thorough health check when they come to VA;
- Any Vietnam veteran can come to any of the 172 VA medical facilities and get a full examination, free of charge, for any illness that is possibly related to Agent Orange exposure;
- VA's response to veterans concerned about Agent Orange has been immediate, responsible, and compassionate.

Meanwhile, another group, the private, nonprofit National Research Council, the action arm of the Na-

tional Academy of Sciences, aired its advice to the VA to hold up on its proposed Agent Orange study (see *related item in December '82 "Bulletin Board"*) until the Air Force's "Ranch Hand" study is completed. "Ranch Hand" is examining veterans assigned to aircrews that sprayed Agent Orange. The committee felt that results of this study "should have a significant impact on the directions, methods, and procedures of the proposed VA study." However, the VA, noting that the "Ranch Hand" study's completion is far in the future, and that the National Center for Disease Control has already been asked to do the VA study, indicated that it would continue on its own course.

Finally, and undoubtedly in response to all of this activity, the VA has come out with Volume One, Number One, of a new publication, "Agent Orange Review." It notes that the Review—a slick-paper, really quite readable wrapup of Agent Orange news—will be published "periodically" for concerned veterans and their families. Names for the mailing list will come from the Agent Orange Registry maintained by each of the VA's medical facilities.

Reenlistment Rate Soars

Last year saw one of the most significant reenlistment rates for first termers in Air Force history—fifty-seven percent. This good news had some element of "bad news" for a few.

Because of this increased retention rate, many first-term airmen will have to wait a few more months before being promoted to senior airman. This will bring the senior airman promotion point to right around thirty-six months in service. Previously, promotion to senior airman was a prerequisite for reenlistment eligibility. Now that some promotions will occur after the thirty-six-month point, the reenlistment process will be separated from the promotion system.

There's also another side to the reenlistment coin. The soaring first-term rate also means that the Air Force can take steps to improve the quality of the career force. Accordingly, second termers and career sergeants (E-4) with more than ten and less than sixteen years in service who have not been picked for promotion to staff sergeant by date-of-separation will be barred from reenlisting.

Affected airmen can request waivers, and base commanders have been delegated approval authority. If the waiver is approved, those sergeants will be allowed to reenlist for three years—but must be promoted during that time to warrant further reenlist-

Worldwide Locator Helps Find Old Friends

Air Force Association members frequently query AFA Headquarters for assistance in tracking down friends and acquaintances with whom they served in years past.

The following information about the Worldwide Locator at the Air Force Manpower and Personnel Center will be of assistance in many of these cases. AFA members are urged to keep this information handy for future use.

Requests for locator service should be mailed to HQ AFMPC/MPCD003, Randolph AFB, Tex. 78150. The military address of active-duty members will be mailed directly to the requester.

To locate either active-duty or retired members, requesters should give all known information about the individual, including full name, service number, and grade. In cases where service numbers aren't known, dates and places of birth, organizations, and dates of assignments may be used to establish identities.

To contact retired members, requesters should send along a letter to the retiree in a sealed, stamped envelope with return address and name of the individual to be contacted. That envelope and all available information on the person to be contacted should be placed in another envelope and mailed to the Worldwide Locator, where it will be addressed and forwarded. The individual receiving the letter thus has an option of answering the letter without an invasion of his or her privacy.

Active-duty, retired, National Guard, Reserve, and family members may use the service at no charge. Military-related requesters must state that connection so they will not be billed. Public law requires others to pay a search fee, set by DoD at \$2.85 per name researched. No action will be taken on requests from the general public until charges are received. Checks and money orders should be made payable to AFO RAFB. Fees are nonrefundable, even in unsuccessful searches, because of the time and expense involved in completing the search.

In certain cases, such as separated members searching for character witnesses when applying for VA benefits, or upgrading discharges when trying to reenter the military, no fees will be charged. A full explanation of circumstances must be given.

ment consideration. Prior-service enlistees entering the service as airmen first class (E-3) are exempt from the policy for one reenlistment. Likewise, demoted sergeants whose separation is scheduled before the next promotion cycle may extend their enlistment for thirty days past the next scheduled promotion date. If they're selected for promotion, they may reenlist. If not, they must exit on their adjusted date of separation.

Short Bursts

Successful Air Force suggesters are now benefiting from **dramatic increases in suggestion award prizes.** For example, a creative thinker or tinkerer who formerly earned just under \$2,000 for a suggestion that saved \$760,000, can now count on receiving \$7,000. An awardee who used to get \$5,000 for saving \$4 million can now reap \$25,000.

Kadena AB, Japan, has been named the latest winner of the **General Curtis E. LeMay Morale, Welfare, and Recreation Award,** which recognizes the base with the most outstanding MWR program. Type, variety, and quality of MWR programs are considered.

In a refreshingly candid and welcome comment on the actions in some parts of the country to **charge tuition to children of uniformed members attending public school,** Secretary of Defense Caspar Weinberger says "DoD will continue to take all necessary legal steps to pre-

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vent any disruption of our military dependents' education. . . . I remain committed to ensuring that no military dependent is denied a free public education."

This month, **Blue Cross of Washington/Alaska** will add **Arizona, California, Nevada, and New Mexico** to states it services for CHAMPUS claims processing. (See related item, December '82 "Bulletin Board".) The toll-free number for questions from claimants in those states is 800-426-8802. The mailing address is Seattle, Wash. 98111, with different P. O. box numbers for each state listed above, in order, of 1808; 1231; 2616; and, for New Mexico, 21364.

Plans to **man ground-launched cruise missile (GLCM) sites in Europe** continue to get top attention. The Air Force has established a twelve-month unaccompanied tour for **Comiso, Sicily.** No dependents are authorized because Comiso has no base exchange, commissary, dependent medical support, or dependent schools.

The Air Force's recent **promotions to lieutenant colonel** yield these statistics: The 2,337 majors pinning on silver leaves represent thirty-two per-

cent of all eligibles (the below-the-zone selection rate was three percent). **Doctors** had a fifty-two percent selection rate, while **dentists** scored seventy-two percent, although that only counts five selectees of seven eligible. Eight hundred and eighty selectees were **pilots, 153 navigators,** and 1,304 **nonrated.** Of the 190 BTZs, an even 100 were pilots, eleven navigators, and the other seventy-nine were nonrated.

Both the **Air National Guard** and **Air Force Reserve** exceeded their **recruiting goals** in 1982, the ANG for the fourth consecutive year and the Reserve for the eighth year in a row. The success allowed the Guard to meet a 100,000 authorized strength level, the highest such level in ANG history.

Speaking of the ANG, its **102d USAF Clinic** at Otis ANG Base, Cape Cod, Mass., has won the 1982 **Theodore C. Marrs Award,** emblematic of being rated the number-one ANG clinic—from more than 100 potential winners.

DoD has okayed the Humanitarian Service Award for direct participants in the disaster relief operations to **victims of the Tumaco, Colombia, earthquake,** December 13–30, 1979. If you think you qualify, base CBPOs have details.

Prosecution of almost all **in-service drug offenses** has been shifted under Article 134 of the UCMJ. The practical effect is to provide for **stiffer sentences for convictions.** Article 134

SENIOR STAFF CHANGES

PROMOTIONS: To be **Major General:** Clarence R. **Autery;** Carl N. **Beer;** Schuyler **Bissell;** William P. **Bowden;** William J. **Breckner,** Jr.; Donald D. **Brown;** Thomas L. **Craig;** William H. **Greendyke;** Alfred G. **Hansen;** Thomas J. **Hickey.**

Harley A. **Hughes;** Ralph H. **Jacobson;** James G. **Jones;** Donald P. **Litke;** James P. **McCarthy;** Thomas G. **McInerney;** Merrill A. **McPeak;** George L. **Monahan, Jr.;** Joe P. **Morgan;** Robert C. **Oaks;** William E. **Overacker.**

Maurice C. **Padden;** Richard W. **Phillips, Jr.;** Craven C. **Rogers,** Jr.; Thomas W. **Sawyer;** John A. **Shaud;** Monroe T. **Smith;** John H. **Storrie;** William T. **Twinting;** Russell L. **Violet;** Harold J. M. **Williams.**

RETIREMENT: M/G Harry A. **Morris.**

CHANGES: B/G Melvin G. **Alkire,** from DCS/Engineering & Services, Hq. AFLC, Wright-Patterson AFB, Ohio, to Dep. Dir., Engineering & Services, DCS/L&E, Hq. USAF, Washington, D. C., replacing M/G Clifton D. Wright, Jr. . . . M/G William M. **Charles, Jr.,** from DCS/Plans, Hq. ATC, Randolph AFB, Tex., to Cmdr., Sheppard TTC, ATC, Sheppard AFB, Tex., replacing retired M/G Harry A. Morris . . . M/G Charles J. **Cunningham, Jr.,** from Dep. Dir. of Prgms. & Eval., DCS/P&R, Hq. USAF, Washington, D. C., to Dir. of Prgms. & Eval., DCS/P&R, Hq. USAF, Washington, D. C., replacing M/G (L/G selectee) William J. Campbell . . . B/G Hansford T. **Johnson,** from-

Ass't DCS/Plans, Hq. SAC, Offutt AFB, Neb., to Dep. Dir. of Prgms. & Eval., DCS/P&R, Hq. USAF, Washington, D. C., replacing M/G Charles J. Cunningham, Jr.

M/G James E. **McAdoo,** from Cmdr., Hq. 14th AF (AFRES), Dobbins AFB, Ga., to Vice Cmdr., Hq. AFRES, Robins AFB, Ga. . . . M/G Charles **McCausland,** from DCS/Plans & Prgms., Hq. AFLC, Wright-Patterson AFB, Ohio, to DCS/Log. Ops., Hq. AFLC, Wright-Patterson AFB, Ohio, replacing M/G Jack W. Waters . . . Col. (B/G selectee) Monte D. **Montgomery,** from Spec. Ass't to DCS/Log., Hq. ATC, Randolph AFB, Tex., to DCS/Plans, Hq. ATC, Randolph AFB, Tex., replacing M/G William M. Charles, Jr. . . . B/G William M. **Shaw, Jr.,** from Vice Cmdr., Warner Robins ALC, AFLC, Robins AFB, Ga., to DCS/Engineering & Services, Hq. AFLC, Wright-Patterson AFB, Ohio, replacing B/G Melvin G. Alkire.

B/G Charles P. **Skipton,** from Vice Cmdr., San Antonio ALC, AFLC, Kelly AFB, Tex., to DCS/Plans & Prgms., Hq. AFLC, Wright-Patterson AFB, Ohio, replacing M/G Charles McCausland . . . B/G Leo W. **Smith II,** from Cmdr., 57th AD, SAC, Minot AFB, N. D., to Ass't DCS/Plans, Hq. SAC, Offutt AFB, Neb., replacing B/G Hansford T. Johnson . . . B/G Samuel H. **Swart, Jr.,** from Dep. Dir. for Op. Support, DCS/P&O, Hq. USAF, Washington, D. C., to Cmdr., 57th AD, SAC, Minot AFB, N. D., replacing B/G Leo W. Smith II . . . M/G Jack W. **Waters,** from DCS/Log. Ops., Hq. AFLC, Wright-Patterson AFB, Ohio, to Cmdr., Int'l Logistics Ctr., Hq. AFLC, Wright-Patterson AFB, Ohio, replacing retired B/G A. Paul Bruno. ■



Maj. Gen. Kenneth L. Peek, Jr. (second from right), former AFMPC Commander and now USAF Director of Personnel Plans, was recently inducted into the Order of the Sword, the highest honor enlisted members can bestow on their leaders. Among those at the Randolph AFB, Tex., ceremony were, from left: Maj. Gen. Robert D. Springer, AFMPC Commander; Maj. Gen. Doyle E. Larson, Commander, ESC; Gen. John W. Roberts, USAF (Ret.); General Peek; and CMSgt. W. D. "Bud" Humphries, AFMPC Senior Enlisted Advisor. (USAF photo by Robbin Cresswell)

convictions carry up to ten years' confinement at hard labor as opposed to, say, the two years allowable under Article 92. The new change also gives guidelines aimed at helping courts work through different situations.

For example, possession of thirty grams of marijuana (about an ounce)

could result in **five years at hard labor**—less than thirty grams drops the recommended punishment to **two years' confinement**. The change also **adds five years** to a sentence if the drug offense takes place on board a vessel or aircraft or in a missile launch facility. ■



One of the most popular exhibits at a recent Air Force Flight Test Center open house and air show at Edwards AFB, Calif., was this MAC C-5A Galaxy, here engulfing a stream of interested sightseers. The annual event also featured A-10s, the B-1, the SR-71, the TR-1, and the F-16XL. (USAF photo by SSgt. Thomas Cocchiaro)

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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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AFA's Achievements in 1982

Message from the Publisher and Executive Director

In this special section, AIR FORCE Magazine is proud to take notice of the Air Force Association's progress in 1982. In reflecting on the year just ended, we found much to be proud of. Thus, we decided to share some of the "findings" with you, our members and readers.

The achievements of AFA in 1982 reflect the successful efforts of thousands of persons who volunteer their time and talents to advance the goals of the Association. However, the key ingredients of guidance and leadership came from AFA's top elected officers. For 1982, the men at the top were: Vic Kregel, AFA's Board Chairman until September, following two years as the Association's President; his successor as Chairman, Judge John G. Brosky, who completed his Presidential term in September and who now serves as Board Chairman;

and AFA's current President, Dave Blankenship, whose term began in September.

These men, through AFA's Board of Directors, its working committees, regional and state officers, and chapter officers and members, "got out the word" and provided the sparks that made the AFA machine run so well in 1982. Their evident dedication and commitment to AFA's goals are reflected throughout the organization and its individual members.

The extent of commitment of the volunteer members of the Air Force Association is a source of continuing pride and inspiration to all of us on the headquarters staff. We on the professional staff exist to serve AFA and its membership by executing the objectives laid down in AFA's Constitution as directed by AFA's National Officers and its Board

of Directors. We are indeed fortunate to have such selfless and capable elected officials.

The results of AFA's 1982 activities augur well for 1983 and the following years, whether for the national organization, chapters, or individual members. We of the staff pledge ourselves to continue to do our part to maintain this healthy momentum and advance AFA to ever higher levels of excellence and achievement.

—Russell E. Dougherty, Publisher of AIR FORCE Magazine and Executive Director, the Air Force Association.

Membership. AFA membership, which has tripled in the past twenty years, continues to climb. As 1982 ended, the total had topped 180,000. Life memberships more than doubled last year, and now stand at 7,250—up from 3,515 the previous December, and way up from the modest total of 975 as recently as 1976.

An analysis of the membership rolls shows substantial representation from all parts of the aerospace community, but the biggest single cluster is active-duty Air Force people, who account for 37.4 percent of the total.

Field Organizations. More than three-fourths of AFA's members are now affiliated with chapters—an all-time high in participation at the grass-roots level. The number of chapters is up, too, and now totals 306. Of these, thirteen are new chapters chartered in 1982. That includes AFA's first six chapters in foreign countries—five in the Far East, and one in Great Britain.

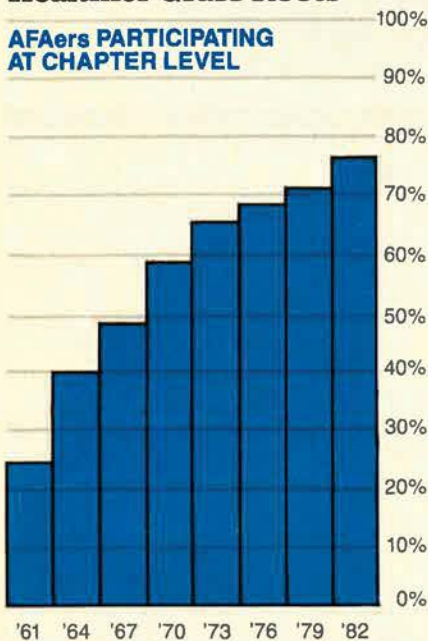
A new state organization, AFA's forty-first, was chartered in South Dakota last year. Twenty-seven states held conventions in 1982. That's a new record, and so was the total of 345 voting delegates at the AFA National Convention in September. (Nonvoting registrants and others attending put the grand total well above 7,000.)

The trend toward greater participation in AFA at the local level continues. It's likely another state organization will be chartered soon. A number of new chapters are forming Stateside. And



Healthier Grass Roots

AFAers PARTICIPATING AT CHAPTER LEVEL



applications are in for five more chapters in Europe.

On Capitol Hill. Five times last year, congressional committees called on AFA to testify on: military pay, ICBM posture, the GI Bill, airlift, and reorganization of the Joint Chiefs of Staff. All year long, AFA was in regular contact with House and Senate staffs to provide and obtain information on issues of interest to AFA members as expressed in the Statements of Policy on people, programs, and systems adopted at the AFA National Convention last fall.

Even before newly elected members of the Ninety-eighth Congress arrived in Washington, they were hearing from AFA. On November 9, just days after the election, the Association, in cooperation with the Association of the US Army and the Navy League of the United States, mailed a 100-page "Status of Our Armed Forces" report to all eighty-four freshmen senators and congressmen. Copies were also distributed on the Hill to incumbent members and staffers.

When Congress is in session, AFA chapters and elected leaders receive analytical weekly or biweekly reports on legislative actions and committee hearings, compiled by AFA national staff people who work with Congress and the Administration on a daily basis.

National Symposia. The past year

saw a major expansion of the Association's national symposia program. The objective was to present authoritative opinions and reliable factual data on pressing Air Force and national security requirements to public opinion makers and industry executives. Audience reaction and ensuing media coverage justify the assertion that this objective was met.

In addition to the now well-established annual symposium in Los Angeles, Calif.—held October 21–22 under the title "The US Air Force: Today and Tomorrow"—three new events were staged. In recognition of the pervasive importance of command and control as well as electronic warfare, AFA held a highly productive and acclaimed symposium on "Electronics and the Air Force." The event, staged in cooperation with Electronic Systems Division of Air Force Systems Command, took place near Hanscom AFB in the Greater Boston area. Another new symposium, themed "Airlift: Key to Modern Military Mobility," was held in St. Louis, Mo., in conjunction with Military Airlift Command. The promulgation of a national policy on space and the formation of Space Command prompted the Association to hold a new symposium, entitled "Space: Military Opportunities and Challenges," during the 1982 National Convention in Washington, D. C.

We will expand our symposia program further in 1983 by including programs dealing with logistics and tactical airpower.

Communications. An increasingly important part of AFA's work is the outreach effort by chapters and members to inform the public on airpower and national defense issues. A central library, now offering six different films, forty-four videotapes, three sound/slide shows, and speech material on fifteen

topics, has been set up at national headquarters. In 1982, twenty-two chapters, six state organizations, and one regional organization drew on these products. One state organization, for example, showed the film "Soviet Civil Defense and US Security" fourteen times to a total of 750 people.

AFA's national events received excellent coverage in the news media. The National Convention, for instance, attracted 198 news media representatives, the most to cover it in more than a decade. All three major television networks were on hand, as was the Cable News Network.

There was solid evidence in 1982 of a growing awareness by the media of AFA as a reliable, informed news source on issues ranging from MX and space-based lasers to people programs. During the year, senior staff members were frequently contacted by national and international media for background on defense topics, and AFA's national symposia generated extensive news coverage, both nationally and in the local areas where they were held. Most dramatic of this coverage was a four-and-a-half-hour telecast of AFA's Space Symposium by C-Span, the Cable Public Affairs Network, which reaches 11,000,000 American households.

Aerospace Education Foundation.

A new thrust for the Foundation is the commitment to work, nationwide, for an improvement in the technological and scientific literacy of America's students. A number of activities are under way, and a special symposium, the National Laboratory for the Advancement of Education, will focus on identifying and recommending solutions to this problem and will be held in conjunction with this year's AFA National Convention.

The Aerospace Education Founda-



AFA's top elected leaders in 1982 (from left): President David L. Blankenship, Board Chairman John G. Brosky, and former Board Chairman Victor R. Kregel.



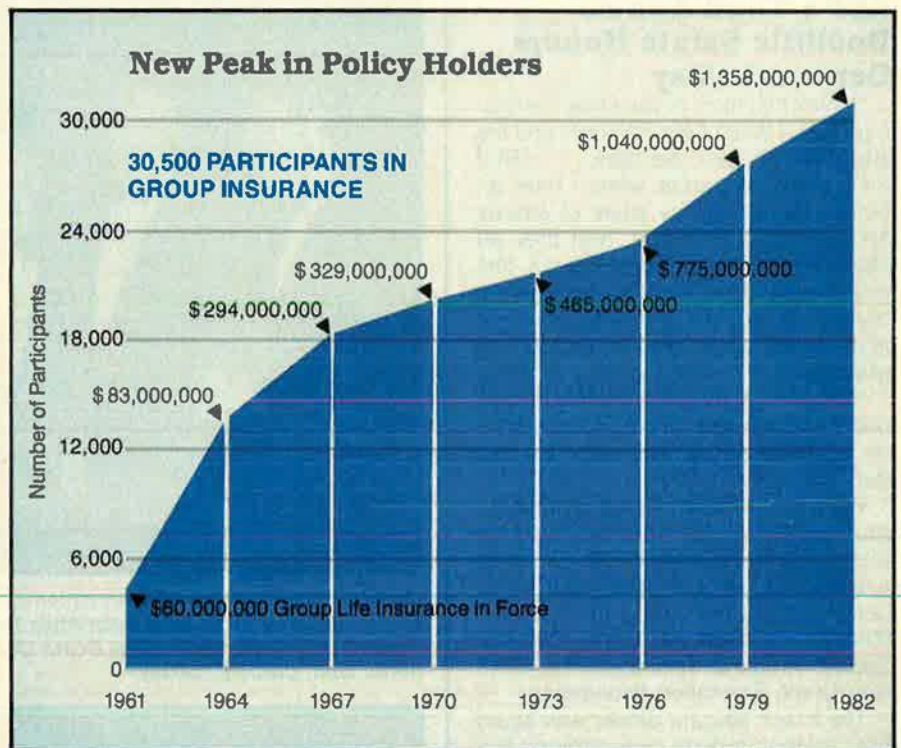
One of the first Aerospace Education Foundation Ira C. Eaker Historical Fellow awards was presented to Sen. Barry Goldwater, left, by General Jimmy Doolittle during 1982's Salute to the Crusaders for Airpower.

tion and the Air Force Historical Foundation are working together more closely. The two Foundations are exploring areas of mutual interest, and look forward to cooperative publication of two books: a biography of Gen. Carl A. Spaatz and a book on air warfare featuring twelve different aerospace leaders.

The Foundation currently has 273 individual and nineteen corporate fellows in its General Jimmy Doolittle Educational Fellowship program, and thirty-eight individual and two corporate fellows in the newer General Ira C. Eaker Historical Fellowship program.

Councils. AFA's Enlisted and Junior Officer Advisory Councils had a productive year. In addition to their contributions to the formulation of AFA's Defense Manpower Issues policy paper, each council put together a special project of specific interest to their peers.

The junior officers studied officer-ship, and the enlisted council analyzed the expectations of leadership between lower ranking airmen and enlisted leaders. Air University became aware of these studies and asked to evaluate them for possible use by curriculum de-



velopers at AU's professional military education schools.

Finances. AFA's many activities—promoting airpower, supporting the needs of the Air Force and Air Force people, and working with Congress, the Administration, and the Pentagon—are worthwhile, but they are also expensive.

Regular sources of income, such as dues, magazine advertising, and insurance, do not cover it all. For many years, AFA has labored with an annual operating deficit and has relied on nonoperating income—from investments, for example, and interest on insurance reserves—to fill the financial gap.

A concerted effort was undertaken to reverse this trend. In 1982, AFA reduced its operating deficit significantly, but the deficit itself is still too high for comfort. Closer management and specific cost control measures, along with enhanced operating revenues, are top-priority items for 1983.

Insurance. Some 42,000 AFA members are now insured under one or more of AFA's group insurance programs. The largest of these plans is the life insurance program, with more than 30,000 participants and more than \$1.3 billion of insurance in force. Coverage was sharply increased during 1982 for all participants under age sixty-five, and a record thirty percent dividend, totaling \$1.35 million, was declared.

These twin actions make this program more attractive than ever. For most age groups, the average cost per thousand dollars of coverage is now lower than that of any competitive program.

Participation in AFA's three medical insurance programs (Hospital Indemnity, ChamPlus®, and Medicare Supplement) also increased significantly during the last year, led by AFA's ChamPlus® plan that now provides CHAMPUS Supplement coverage to more than 4,000 members. Premium rates for this coverage—for both retired and active-duty members—are generally below market rates. Continued growth in participation is expected, particularly among new retirees.

During 1982, AFA's insurance office responded to more than 20,000 requests for information, issued close to 6,500 new and/or amended certificates of coverage, and issued nearly 2,500 claim payments in an aggregate amount of close to \$3.6 million.

Inquiries about coverage are invited, and use by members of a special toll-free telephone number (800-424-5150) for direct connection with AFA's insurance office is encouraged.

Headquarters Location. The work of the Building Committee and Executive Committee on developing a new AFA headquarters location is proceeding on schedule, with encouraging results so far.

AEF's Third Annual Doolittle Salute Honors General LeMay

"I think that most of you know my feelings about Washington dinners and are surprised to see me here. . . . [But] throughout my career, while I have received more than my share of awards and things of that sort, and they all mean something to me, of course, this recognition of my work from my peers means more than anything else—at least to me it does—and Helen and I are grateful. . . .

"I should say that I'm certainly in sympathy with the aims of the Foundation—we all need all the education we can get."

With these words—part of a short, gruffly affectionate acknowledgment that brought the some 200 guests to a standing ovation—Gen. Curtis E. LeMay accepted recognition at the third annual General Jimmy Doolittle Salute, which is sponsored by AFA's Aerospace Education Foundation.

The black-tie gala dinner was again held at Washington's awe-inspiring National Air and Space Museum. The first Salute, in 1980, honored General Doolittle himself. Last year's Salute paid tribute to General Ira Eaker. This year, General LeMay, the Air Force's fifth Chief of Staff, was honored.

The top-level guests in attendance—among them, Congressman Melvin Price (D-III.); Chairman of the Joint Chiefs of Staff Gen. John W. Vessey, Jr., USA; Air Force Secretary Verne Orr; Air Force Chief of Staff Gen. Charles A. Gabriel; senior industrial executives; and elected leaders of AFA and the Foundation—heard Russell E. Dougherty, AFA and Foundation Executive Director, serve as master of ceremonies. General Dougherty was filling in for the Foundation's Chairman of the Board, Sen. Barry M. Goldwater, who had just entered the hospital for successful open-heart surgery. General Dougherty read Senator Goldwater's telegram to General LeMay:

"Unfortunately, my route from Phoenix to Washington suffered a little bypass, and it will take a few more days until I'm back on the road. In the meantime, I deeply regret that I cannot be with you tonight as you receive this well-deserved honor. The contributions which you have made to the Air Force and our nation can never be adequately repaid as an indication of the esteem and affection we all feel toward you. With best wishes, Barry Goldwater."

In addition to recognition of the Aero-



Guests at the third annual Foundation-sponsored Doolittle Salute honoring General LeMay included (from left): artist Attila Hejja; AFA Board Chairman John G. Brosky; General Jimmy Doolittle; Loral Board Chairman Bernard Schwartz; and guest of honor Gen. Curtis E. LeMay.



Three SAC Commanders in Chief and a JCS Chairman (from left): former CINC SAC General LeMay; current JCS Chairman Gen. John Vessey, USA; former CINC SAC Gen. Russell Dougherty; and current CINC SAC Gen. Bennie Davis.

space Education Foundation's corporate Jimmy Doolittle and Ira Eaker Fellows (see p. 97), the evening also featured a special nod to a select group of individual Jimmy Doolittle and Ira Eaker Fellows. This special recognition was themed, as General Dougherty succinctly put it, to man's continuing attempt to master air and space. Dr.

Don C. Garrison, AEF President, and General Doolittle brought forward and honored a select group of aviation pioneers, all of whom either hold or who will be awarded a Foundation Jimmy Doolittle or Ira Eaker Fellow.

As the dinner guests' attention was directed to the aircraft on display at the Museum that were involved in various



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AFA's 1983 SYMPOSIUM SCHEDULE

□ Five National AFA Symposia have been scheduled for the year 1983. Dates and locations, as of press time, are listed here. Firm details will appear in AIR FORCE Magazine well ahead of each event. **MARK YOUR CALENDARS NOW!**

□ Registration fee for each Symposium includes all presentation sessions, coffee breaks, and meal functions. For information and registration, call Jim McDonnell or Dottie Flanagan at (202) 637-3300, Air Force Association, Suite 400, 1750 Pennsylvania Ave., N.W., Washington, D. C. 20006.

April 28-29

Electronics and the Air Force

Colonial Hilton at Wakefield, Mass.



June 23-24

Airlift and Mobility

Stouffer's Riverfront Towers, St. Louis, Mo.

September 14

Tactical Airpower

Sheraton Washington Hotel, Washington, D. C.

October 6-7

Logistics

Dayton, Ohio

November 17-18

National Defense

Hyatt at Los Angeles Airport



General Doolittle pauses at the Salute with Frank W. McAbee, Jr., President of the Government Products Division of Pratt & Whitney Aircraft.



Three AFA leaders—all native Oklahomans—recently gathered in Tulsa to present to Rep. James R. Jones (D-Okla.) an AFA Special Presidential Citation in recognition of the Congressman's outstanding work in obtaining congressional approval of tax legislation of great benefit to all veterans organizations, including AFA. Pictured are (from left): AFA National President David L. Blankenship; former AFA National President and Board Chairman Harold C. Stuart; Representative Jones; and Jess Larson, former AFA National President and Board Chairman.

historic flights, the pioneering airmen of these flights were singled out.

First to be recognized was Maj. Gen. Leigh Wade, USAF (Ret.), the only living pilot from the group of four brave crews who, in 1924, made the first around-the-world flight. One of these planes, a Douglas World Cruiser—although not General Wade's—hung proudly above the audience as General Wade was honored.

With attention then moving to the Bell X-1—*Glamorous Glennis*—which hangs high in the Museum, the first of its pilots, retired Brig. Gen. Charles E. "Chuck" Yeager, came forward. Yeager, who broke the sound barrier in this craft, has been called the "quintessence of the right stuff." The audience acknowledged this wholeheartedly.

The next plane highlighted, also flying in tethered splendor in the Air and Space Museum, was the X-15. The X-15 was characterized by its first test pilot as being able to "eventually carry men to the fringe of space and, more importantly, return them to earth." Certainly the X-15 was, as General Dougherty noted, "in some respects our first Shuttle."

Honored X-15 pilots at the Salute included the first man to fly at twice the speed of sound, A. Scott Crossfield; the Air Force's second winged astronaut and the man who eventually became the principal X-15 pilot, retired Air Force Maj. Gen. Bob Rushworth; and the recently retired Vice Commander of

the Air Force Flight Test Center at Edwards AFB, Calif., retired Air Force Col. William J. "Pete" Knight. Colonel Knight made sixteen flights in the X-15 and, in 1967, he set a still-unbroken record for

this aircraft with a blistering speed of Mach 6.7, or 4,200 mph.

Two other aviation pioneers—the first Air Force project pilot for the X-15, retired Maj. Gen. Bob White, and one of

Honor Roll of Corporate Jimmy Doolittle Fellows

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 Vought Corp.

Honor Roll of Corporate Ira C. Eaker Fellows

Pratt & Whitney Aircraft Group
 Rockwell International Corp.



AFA National President and Mrs. David L. Blankenship, left, join in discussion during the eleventh annual Los Angeles Ball with Assistant Secretary of the Air Force and Mrs. Edward C. "Pete" Aldridge.

Honorary Ball Chairmen General Jimmy and Mrs. Doolittle are escorted through the Grand March. The honor guard was provided by the 63d Military Airlift Wing at Norton AFB, Calif. The 15th Air Force Band of the Golden West, March AFB, Calif., also supported the fund-raiser.



the last X-15 pilots and commander of the second Space Shuttle flight, Col. Joe Engle—were not able to attend the Salute, but both were also honored.

As one of the guests commented, it was "a perfect night in a perfect place."

—By James A. McDonnell, Jr.

SCAMP and AEF Benefit From Eleventh Annual Air Force Ball

The theme of 1982's Los Angeles Air Force Ball—the eleventh celebration of this annual event—was space. Glass bowls, which were etched with the Western Hemisphere and rested atop a depiction of the surface of the moon, were the table centerpieces illustrating this theme. Throughout the ballroom at the Los Angeles Century Plaza Hotel, space-related items from the television and movie industry, including intricate models from the set of the television show *Battlestar Galactica*, set a futuristic tone.

Once again, recipients of funds raised by this gala black-tie event were SCAMP, or Scholarships for Children of American Military Personnel, and AFA's educational affiliate, the Aerospace Education Foundation. Almost \$1 million has now been raised for these worthy organizations by the annual Air Force Balls.

The President and Mrs. Reagan sent a congratulatory telegram to the Ball. The President, who served as Honorary Chairman for the first Air Force Ball, said in part: "It is encouraging to see [the Ball] not only continue, but prosper and bear fruit. The scholarships you



SCAMP recipients pause with TV actress Constance Towers, who sang the National Anthem at the Ball, and Charlton Heston, who assisted in presentation of the scholarships. Recipients included (from left): Kelly John Crittenberger, Dean R. Lagerwall, Martin T. Collins, and Steven D. Nakagawa.



Maj. Gen. William Lyon, USAF (Ret.), General Chairman of the Ball, with the military hosts: Lt. Gen. John J. Murphy, left, Fifteenth Air Force Commander; and Lt. Gen. Richard C. Henry, Space Division Commander.

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Acquire quality limited-edition aviation art and support AFA's awards programs at the same time.

The Air Force Association is proud to offer signed and numbered fine quality prints of the aviation art of Keith Ferris and Bill Phillips.

Your purchase of these prints supports the expanded awards programs of the Air Force Association. Through exclusive agreement with The Greenwich Workshop, \$35 of the purchase price of each print will be applied to the new AFA awards named for Generals LeMay, Tunner, Chennault, and Power—awards that recognize outstanding crews in strategic bombers, airlift, fighter/attack, and missileery.

Greenwich Workshop is producing only 1,000 prints of each painting, of which 300 are reserved for AFA and are being offered to AFA members first.

Order now—be among the first AFAers to own these quality prints!



Copyright © 1981 William S. Phillips

ADVANTAGE EAGLE by Bill Phillips—Bill says, "The term 'Advantage Eagle' will be heard as long as the F-15 'Eagle' is flying. This F-15 is an 'A' version assigned to the 'Triple Nickel' 555th TFS at Luke AFB. A Navy F-4, ahead in the distance, is engaged in low-level dissimilar air combat maneuvering to evade the F-15. But the Eagle has the advantage." 27½" x 22½" Price: \$135.



SUNRISE ENCOUNTER by Keith Ferris was a hit of the 1982 Air Force Art Collection show. Keith says, "This F-16 is assigned to the 34th Tactical Fighter Squadron of the 388th TFW, Hill AFB in Utah. The action takes place over the Nellis Range north of Las Vegas. This afterburner view of the plane emphasizes the fantastic 25,000-pound thrust engine. . . . It also shows off the unit markings, armament, and the 360-degree view of the pilot has from his bubble canopy." 23" x 23½" Price: \$145.

Order both prints now, before the limited edition is gone!

The Greenwich Workshop Gallery
2600 Post Road
Southport, Connecticut 06490

Please send:

_____ copies of "Advantage Eagle" at \$135 each
_____ copies of "Sunrise Encounter" at \$145 each

(Please add \$10.00 for shipping. No additional charge for two or more prints shipped to the same address)

Name _____

Address _____

Telephone _____

Indicate method of payment:

Payment enclosed VISA MasterCard American Express
(Connecticut residents add 7½% sales tax)

Account Number _____

Expiration Date _____

Signature _____

SOVIET AEROSPACE ALMANAC



The March issue of AIR FORCE Magazine will once again feature the Soviet Aerospace Almanac—a comprehensive examination of Soviet strategic and tactical aerospace forces, including organization, deployment, doctrine, and concepts... trends and missions of the Soviet space program with emphasis on reconnaissance... Soviet aerospace design bureaus' practices in aircraft design and production... technology transfer, what's critical and what's being done... a Jane's-prepared Gallery of Soviet Aerospace Weapon Systems... plus many other features... a year-round reference issue... a great advertising opportunity. **Closing for reservations is January 21, copy by February 4.**





Air Force Chief of Staff Gen. Charles A. Gabriel congratulates SCAMP recipient Martin T. Collins as actor Charlton Heston looks on.

have provided to the children of the United States armed forces personnel killed in action, missing in action, or prisoners of war in the Southeast Asian conflict are noteworthy. Those scholarships show them that many of us care about their future and want to help them prepare for that future, with the full knowledge that nothing can ever fully repay them for the sacrifices their families have made for our nation."

This year's honorary chairmen were General and Mrs. Jimmy Doolittle. William Lyon, President and Chairman of the Board of the William Lyon Co. and President of AirCal, served as the Ball's General Chairman. Entertainment was provided by the Strolling Strings. Celebrities Lorne Greene, who opened the program, and Charlton Heston, who assisted in presenting the scholarships, again lent their support to this event, which has become a "must" on the West Coast society circuit.

—By James A. McDonnell, Jr.

Unit Reunions

Valiant Air Command

The Valiant Air Command Air Show will be held on March 12–13, 1983, at Tico Airport, Fla. (west of Cape Canaveral). **Contact:** Col. Bob Reid, VAC, P. O. Box 621, Cape Canaveral, Fla. 32920. Phone: (305) 475-0800 or 472-2356.

30th Bomb Group Ass'n

Members of the 30th Bomb Group, Seventh Air Force, will hold a reunion on October 7–8, 1983, at the Shangri-La in Afton, Okla. **Contact:** John S. Allison, 30th Bomb Group Association, 19 Lowndes, Charleston, S. C. 29401, either for more information about the reunion or about membership in the new 30th BG Association.

68th Bomb Wing

Members of the 68th Bomb Wing will hold a reunion on April 8–10, 1983. **Contact:** Mack Blevins, Box 7306, Drew Station, Lake Charles, La. 70606.

73d Bomb Wing Ass'n

Veterans of the 73d Bomb Wing, along with B-29 Groups 497th, 498th, 499th, and 500th; Service Groups 65th, 91st, 303d, and 330th; plus attached and assigned units on Saipan during WW II, will hold their reunion on May 12–15, 1983. **Contact:** 73d Bomb Wing Association, 105 Circle Dr., Universal City, Tex. 78148.

91st Bomb Group Memorial Ass'n

Members of the 91st Bomb Group will return to their former duty station at Basingbourn, England, to celebrate the fifth anniversary of the Prop Memorial dedica-

tion, on April 29–May 7, 1983. **Contact:** Joe Giambrone, 303 Brookdale Ave., Glenside, Pa. 19038. Phone: (215) 886-7311.

584th Bomb Sqdn.

A reunion for the 584th Bomb Squadron will be held on May 5–8, 1983, in Nokomis, Fla. **Contact:** William J. Miller, P. O. Box 761, Nokomis, Fla. 33555. Phone: (813) 488-3632.

38th Tactical Missile Wing

The 38th Tactical Missile Wing Committee would like to hear from personnel interested in holding a reunion.

The reunion date and site are to be determined upon receipt of additional input from personnel. For details, write the address below.

Maj. Harold P. Edwards,
USAF (Ret.)
808 Jamestown Rd.
O'Fallon, Ill. 62269

Class 48-B

I am trying to obtain names and addresses of former students, instructors, and support personnel of the Pilot Class 48-B for a reunion in September 1983, to be held in Dayton, Ohio.

Please contact the address below.

James T. Pace
1530 Dorsal St.
Merritt Island, Fla. 32952

49th Air Depot Group

I need to update our unit reunion mailing list. I would like to hear from anyone who served or knows of someone who

served with the 49th Air Depot Group (Headquarters, Repair, and Supply Squadrons or attached units) during WW II—Stateside or South Pacific.

Please contact the address below.

Howard W. Caylor
107 Cherokee Lane
San Antonio, Tex. 78232

Phone: (512) 494-2926

457th Bomb Group

I would like to hear from members of the 457th Bomb Group and the 748th Bomb Squadron.

Please contact the address below.

Clarence R. "Butch" Moore
6160 Little Dutch Creek Rd.
Cedar Hill, Mo. 63016

Coming Events

April 8–9, **South Dakota State Convention**, Sioux Falls . . .
June 3–4, **Arkansas State Convention**, Little Rock . . .
June 17–19, **Texas State Convention**, Bryan/College Station . . .
July 15–17, **Pennsylvania State Convention**, Philadelphia . . .
August 11–13, **California State Convention**, Sunnyvale . . .
September 11–15, **AFA National Convention**, Washington, D. C.

All members under age 65 now eligible to apply

NEW, RECORD BENEFIT

CURRENT BENEFIT TABLES

Including Substantial Benefit Increases for Policyholders Under Age 65
(effective May 31, 1982)

Member's Attained Age	STANDARD Premium: \$10 per month Basic Benefit*		HIGH OPTION Premium: \$15 per month Basic Benefit*		HIGH OPTION PLUS PLAN Premium: \$20 per month Basic Benefit*	
	Former Coverage	New Coverage	Former Coverage	New Coverage	Former Coverage	New Coverage
20-24	\$85,000	\$100,000	\$127,500	\$150,000	\$170,000	\$200,000
25-29	85,000	95,000	127,500	142,500	170,000	190,000
30-34	65,000	70,000	97,500	105,000	130,000	140,000
35-39	50,000	55,000	75,000	82,500	100,000	110,000
40-44	35,000	37,500	52,500	56,250	70,000	75,000
45-49	20,000	22,500	30,000	33,750	40,000	45,000
50-54	12,500	15,000	18,750	22,500	25,000	30,000
55-59	10,000	11,000	15,000	16,500	20,000	22,000
60-64	7,500	8,000	11,250	12,000	15,000	16,000
65-69	4,000	4,000	6,000	6,000	8,000	8,000
70-74	2,500	2,500	3,750	3,750	5,000	5,000

AVIATION DEATH BENEFIT* (for pilots and crew members)

Non-war related: Ages 20-34—Payment of ½ the scheduled benefit. (Applies to Standard, High Option and High Option Plus Plans)
Ages 35-74—Payment of the full scheduled benefit. (Applies to Standard, High Option and High Option Plus Plans)

War related:	\$15,000	\$22,500	\$30,000
EXTRA ACCIDENTAL DEATH BENEFIT**	\$12,500	\$15,000	\$17,500

*AVIATION DEATH BENEFIT: The coverage provided under the Aviation Death Benefit is paid for death which is caused by an aviation accident in which the insured is serving as pilot or crew member of the aircraft involved. Under this condition, the Aviation Death Benefit is paid in lieu of all other benefits of this coverage. Furthermore, the non-war related benefit will be paid in all cases where the death does

not result from war or act of war, whether declared or undeclared.

**EXTRA ACCIDENTAL DEATH BENEFIT: In the event of an accidental death occurring within 13 weeks of the accident, these AFA plans pay an additional lump sum benefit as shown in the tables, except as noted under AVIATION DEATH BENEFIT above.

OTHER IMPORTANT BENEFITS

COVERAGE YOU CAN KEEP. Provided you apply for coverage under age 65 (See "ELIGIBILITY") your insurance may be retained at the same low group rates to age 75. **FULL TIME, WORLD WIDE PROTECTION.** The policy contains no war clause, hazardous duty restriction, combat zone waiting period or geographical limitation.

DISABILITY WAIVER OF PREMIUM. If you become totally disabled at any time prior to age 60 for at least a 9-month period, your coverage will be continued in force without further payment of premiums as long as you remain disabled.

FULL CHOICE OF SETTLEMENT OPTIONS. All standard forms of settlement options, as well as special options agreed to by the insured and United of Omaha, are available to insured members.

CONVENIENT PAYMENT PLANS. Premium payments may be made by monthly government allotment (payable to Air Force Association), or direct to AFA in quarterly, annual or semi-annual installments.

DIVIDEND POLICY. AFA's primary policy is to provide maximum coverage at the lowest possible cost. Consistent with this policy, AFA has provided year-end dividends in all but three years (during the Vietnam War) since the program was initiated in 1961, and basic coverage has been increased on seven separate occasions.

ADDITIONAL INFORMATION

Effective Date of Your Coverage. All certificates are dated and take effect on the last day of the month in which your application for coverage is approved, and coverage runs concurrently with AFA membership. AFA Group Life Insurance is written in conformity with the insurance regulations of the State of Minnesota. The insurance will be provided under the group insurance policy issued by United of Omaha to the First National Bank of Minnesota as trustees of the Air Force Association Group Insurance Trust.

EXCEPTIONS: There are a few logical exceptions to this coverage. They are: **Group Life Insurance:** Benefits for suicide or death from injuries intentionally self-inflicted while sane or insane will not be effective until your coverage has been in force for 12 months.

The Accidental Death Benefit and Aviation Death Benefit shall not be effective if death results: (1) From injuries intentionally self-inflicted while sane or insane, or (2) From injuries sustained while committing a felony, or (3) Either directly or indirectly from bodily or mental infirmity, poisoning or asphyxiation from carbon monoxide, or (4) During any period a member's coverage is being continued under the waiver of premium provision, or (5) From an aviation accident, either military or civilian, in which the insured was acting as pilot or crew member of the aircraft involved, except as provided under AVIATION DEATH BENEFIT.

ELIGIBILITY

All members of the Air Force Association are eligible to apply for this coverage provided they are under age 65 at the time application for coverage is made.

*Because of certain restrictions on the issuance of group insurance coverage, applications for coverage under the group program cannot be accepted from non-active duty personnel residing in New York.

PREMIUM: \$2.50 per month		
Member's Attained Age	Life Insurance Coverage for Spouse	Life Insurance Coverage for each child*
20-39	\$20,000.00	\$4,000.00
40-44	15,000.00	4,000.00
45-49	10,000.00	4,000.00
50-54	7,000.00	4,000.00
55-59	5,000.00	4,000.00
60-64	3,000.00	4,000.00
65-69	2,000.00	4,000.00
70-75	1,000.00	4,000.00

*Children under six months are provided with \$250 coverage once they are 15 days old and discharged from the hospital.
Upon attaining age 21, and upon submission of satisfactory evidence of insurability, insured dependent children may replace this \$4,000 group coverage (in most states) with a \$10,000 permanent individual life insurance policy with guaranteed purchase options.

Please Retain This Medical Bureau Prenotification For Your Records
Information regarding your insurability will be treated as confidential. United of Omaha Life Insurance Company may, however, make a brief report thereon to the Medical Information Bureau, a nonprofit membership organization of life insurance companies, which operates an information exchange on behalf of its members. If you apply to another bureau member company for life or health insurance coverage, or a claim for benefits is submitted to such a company, the Bureau, upon request, will supply such company with the information in its file.

Upon receipt of a request from you, the Bureau will arrange disclosure of any information it may have in your file. (Medical information will be disclosed only to your attending physician.) If you question the accuracy of information in the Bureau's file, you may contact the Bureau and seek a correction in accordance with the procedures set forth in the federal Fair Credit Reporting Act. The address of the Bureau's information office is P.O. Box 105, Essex Station, Boston, Mass. 02112. Phone (617) 426-3660.

United of Omaha Life Insurance Company may also release information in its file to other life insurance companies to whom you may apply for life or health insurance, or to whom a claim for benefits may be submitted.

NOW AVAILABLE (30% Dividend—1981)



APPLICATION FOR AFA GROUP LIFE INSURANCE



Group Policy GLG-2625
United of Omaha Life Insurance Company
Home Office Omaha Nebraska

Full name of member _____
Rank _____ Last _____ First _____ Middle _____

Address _____
Number and Street _____ City _____ State _____ ZIP Code _____

Date of birth _____ Height _____ Weight _____ Social Security Number _____
Mo. _____ Day _____ Yr. _____

This insurance is available only to AFA members

- I enclose \$15 for annual AFA membership dues (includes subscription (\$9) to AIR FORCE Magazine).
- I am an AFA member.

Name and relationship of primary beneficiary

Name and relationship of contingent beneficiary

Please indicate below the Mode of Payment and the Plan you elect:

Mode of Payment

Monthly government allotment (only for military personnel). I enclose 2 month's premium to cover the necessary period for my allotment (payable to Air Force Association) to be established.

Quarterly. I enclose amount checked.

Semi-Annually. I enclose amount checked.

Annually. I enclose amount checked.

Standard Plan

Member Only	Member And Dependents
<input type="checkbox"/> \$ 10.00	<input type="checkbox"/> \$ 12.50
<input type="checkbox"/> \$ 30.00	<input type="checkbox"/> \$ 37.50
<input type="checkbox"/> \$ 60.00	<input type="checkbox"/> \$ 75.00
<input type="checkbox"/> \$120.00	<input type="checkbox"/> \$150.00

Plan of Insurance

High Option Plan

Member Only	Member And Dependents
<input type="checkbox"/> \$ 15.00	<input type="checkbox"/> \$ 17.50
<input type="checkbox"/> \$ 45.00	<input type="checkbox"/> \$ 52.50
<input type="checkbox"/> \$ 90.00	<input type="checkbox"/> \$105.00
<input type="checkbox"/> \$180.00	<input type="checkbox"/> \$210.00

High Option PLUS Plan

Member Only	Member And Dependents
<input type="checkbox"/> \$ 20.00	<input type="checkbox"/> \$ 22.50
<input type="checkbox"/> \$ 60.00	<input type="checkbox"/> \$ 67.50
<input type="checkbox"/> \$120.00	<input type="checkbox"/> \$135.00
<input type="checkbox"/> \$240.00	<input type="checkbox"/> \$270.00

Names of Dependents To Be Insured	Relationship to Member	Dates of Birth			Height	Weight
		Mo.	Day	Yr.		

Have you or any dependents for whom you are requesting insurance ever had or received advice or treatment for: kidney disease, cancer, diabetes, respiratory disease, epilepsy, arteriosclerosis, high blood pressure, heart disease or disorder, stroke, venereal disease or tuberculosis? Yes No

Have you or any dependents for whom you are requesting insurance been confined to any hospital, sanatorium, asylum or similar institution in the past 5 years? Yes No

Have you or any dependents for whom you are requesting insurance received medical attention or surgical advice or treatment in the past 5 years or are now under treatment or using medications for any disease or disorder? Yes No

If YOU ANSWERED "YES" TO ANY OF THE ABOVE QUESTIONS, EXPLAIN FULLY including date, name, degree of recovery and name and address of doctor. (Use additional sheet of paper if necessary.)

I apply to United of Omaha Life Insurance Company for insurance under the group plan issued to the First National Bank of Minneapolis as Trustee of the Air Force Association Group Insurance Trust. Information in this application, a copy of which shall be attached to and made a part of my certificate when issued, is given to obtain the plan requested and is true and complete to the best of my knowledge and belief. I agree that no insurance will be effective until a certificate has been issued and the initial premium paid.

I hereby authorize any licensed physician, medical practitioner, hospital, clinic or other medical or medically related facility, insurance company, the Medical Information Bureau or other organization, institution or person, that has any records or knowledge of me or my health, to give to the United of Omaha Life Insurance Company any such information. A photographic copy of this authorization shall be as valid as the original. I hereby acknowledge that I have a copy of the Medical Information Bureau's prenotification information.

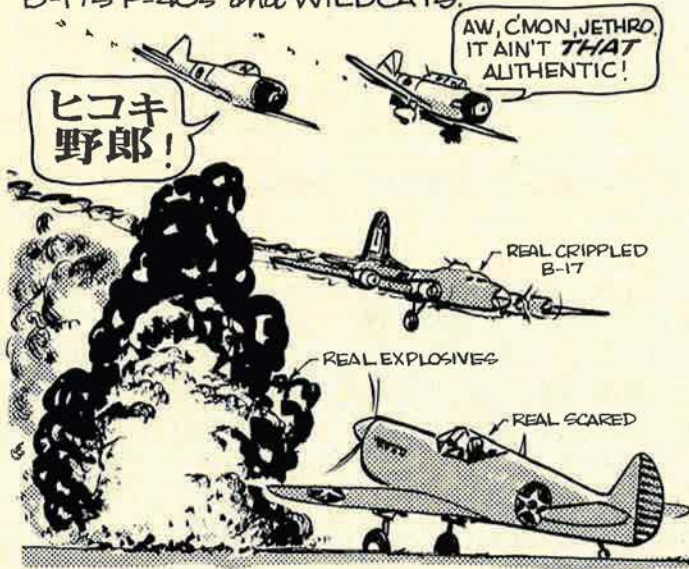
Date _____, 19 _____

Member's Signature _____

Bob Stevens'

"There I was..."

ONE SCENARIO OPENS WITH THE ATTACK ON PEARL HARBOR. THE "TORA, TORA, TORA" GANG MAKES LIFE MISERABLE FOR THE B-17s P-40s and WILDCATS.

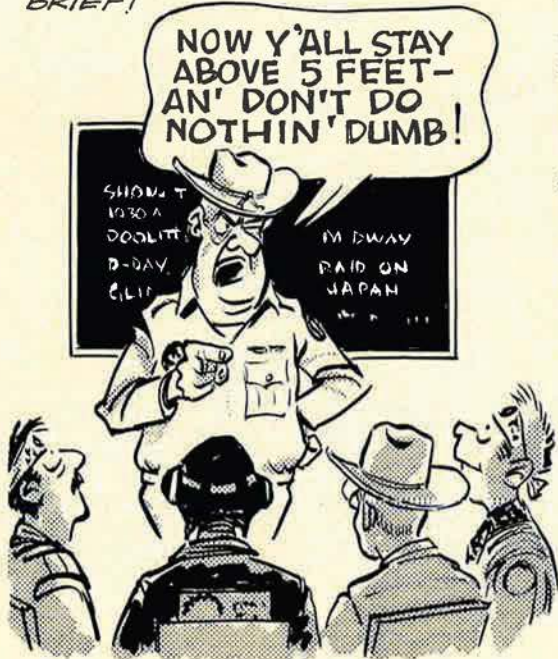


EARLY EVERY OCTOBER THE CONFEDERATE AIR FORCE FIGHTS THE MAJOR AIR BATTLES OF WWII OVER REBEL FIELD, HARLINGEN, TEXAS. THE MACHINES ARE AUTHENTIC- FOREIGN & DOMESTIC- and THE ACTION REALLY GRABS YOU! TENS OF THOUSANDS OF SPECTATORS THRILL TO "THE GHOST SQUADRON"-A PROUD HERITAGE OF THE AIR.

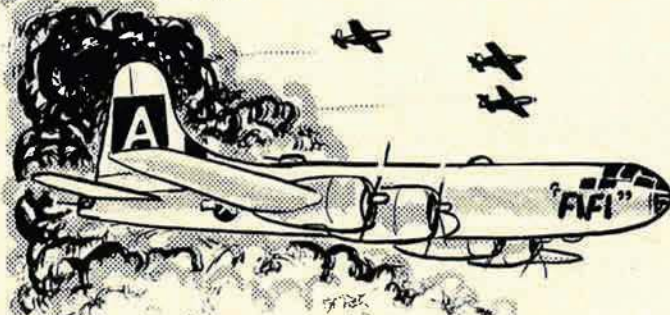
ANOTHER OPENING RECREATES THE BATTLE OF BRITAIN WITH *REAL* SPITS, ME-109s and HEINKELS!



THE FAA KEEPS A STRICT WATCH ON THE PROCEEDINGS-HOWEVER, A CAF BRIEFING IS JUST THAT-BRIEF!



THE BOMBERS ARE THERE, TOO, -FLYIN'! FOLLOW THE NUMBERS: 17, 23, 24, 25, 26 and THE '29!



AS THE SHOW ENDS WITH CLOUDS OF SMOKE OVER JAPAN, A MISSING MAN FORMATION REMINDS ALL THAT WE, and FUTURE GENERATIONS, SHOULD BE PROUD OF THIS NATION'S ACCOMPLISHMENTS. THESE PLANES -and THE MEMORY OF THOSE WHO FLEW THEM- MUST BE PRESERVED!

"ETERNAL VIGILANCE IS THE PRICE OF LIBERTY", ...

Thomas Jefferson





**A TRAINER TO PUT THE WORKHORSE
HELICOPTER THROUGH ITS PACES...**

BECAUSE SPERRY KNOWS HOW TO LISTEN.

Sperry's CH-53 Operational Flight Trainers enable U.S. Marine Corps aviators to put the multi-mission workhorse Sea Stallion through all its paces. To do this, we used original mathematical modeling techniques to simulate the unique aerodynamics and engine operations of rotary-winged flight.

The dynamic cues provided by a six-degree-of-freedom motion system are enhanced by a full daylight, six-window, six-channel, computer-generated imagery system. This visual system provides a 196-degree horizontal and 60-degree vertical field of view, featuring both land and sea environments.

Sperry simulation systems for fixed-wing aircraft include the operational flight trainer for the F/A 18 Hornet, the newest combat plane for the U.S. Navy and Marine Corps, and the weapons system trainer for the Navy's most sophisticated EW aircraft, the EA-6B Prowler.

For the VTXTS Program, Sperry has been selected to develop the simulation and training systems for the Navy's new generation of jet training aircraft.

In other applications, Sperry simulation and training systems are being used to improve the firepower effectiveness of infantry and armor personnel, to ensure the readiness of guided missile frigate crews, and to train Trident submarine crewmen in navigation and shiphandling.

To learn more about what we're doing—and can do for you—in the broad field of training and simulation, just talk to us... we listen.

Write to Sperry Corporation, Electronic Systems, Great Neck, NY 11020. Attention: Marketing Department.



 **SPERRY**



F-15 Eagle. Because we can't afford an umbrella that leaks in the rain.

Are all umbrellas alike? They are, until they've been used a few times. Until the wind blows. Until some fail to stand up to abuse and use.

Tactical air forces are umbrellas. Protection for our ground forces and for our shores. If our armed forces fail we don't just get wet, we get defeated.

Our tactical umbrella must work at all times. Clouds or darkness cover most nations 70% of the time. Aircraft that cannot fight in such conditions are "synthetic" armament, loud and impressive on parade day, but "ceremonial cannon" of no consequence to hostile

forces that simply evade their limited capabilities.

Tactical air forces flying the F-15 Eagle provide a defensive umbrella our forces can depend on, with radar and all-weather missiles to command the sky day or night, good weather or bad. No weakness is left for an enemy to exploit. Nothing is left to the whims of good fortune.

Sophisticated in appearance and function, simple in design and operation, Eagles are superior to weapons they oppose, superbly matched with the skills of the men and women who must maintain and fly them.

**MCDONNELL
DOUGLAS** 