

AIR FORCE

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MAGAZINE

TOWARD THE TOTALLY INTEGRATED AIRPLANE

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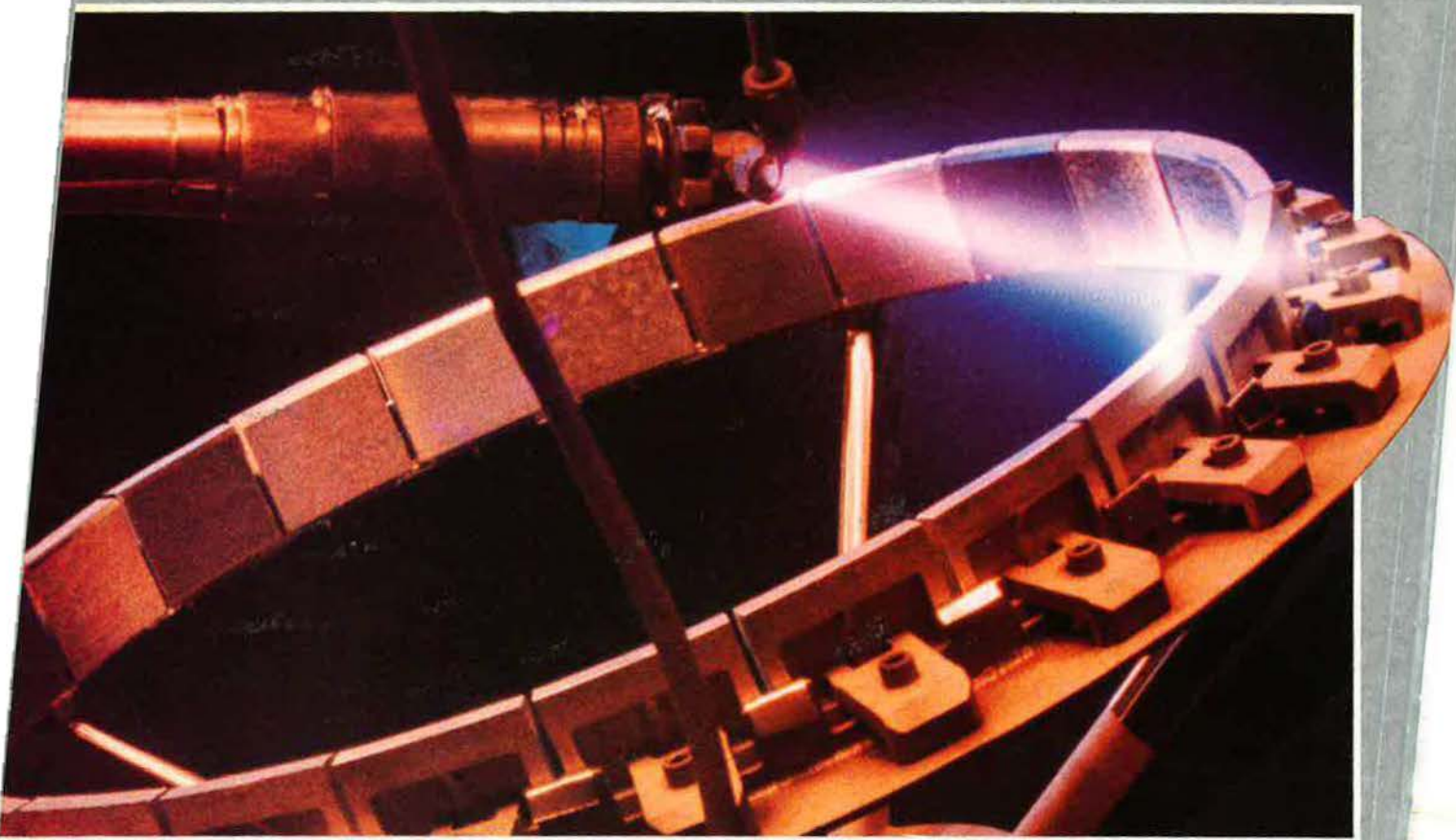
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Page 34



Page 68



about the cover: Miraculous advances in aeronautics have set to improve on the most important component of all—the pilot. A special section on "Aeronautics" begins on p. 34. Cover photo by Thomas W. Adcliffe)

Special Section: Aeronautics

- Toward the Totally Integrated Airplane** / By James W. Canan 34
A technology of technologies will be keyed to the human "supercomputer."
- Report From the Bicycle Shop** / By Lt. Gen. Thomas H. McMullen, USAF 42
An update on work at ASD.
- Jane's Aerospace Survey 1984** / By John W. R. Taylor 54
A top aviation authority predicts a "pioneering new age."
- The Care and Feeding of Gas Turbines** 64
By Brig. Gen. Thomas A. LaPlante, USAF
Managing more than 64,000 engines is big business.

Features

- Half of the Lesson** / Editorial by Russell E. Dougherty 4
Recognizing the horror of nuclear war is not enough.
- The Soviets Test a New ICBM** / By Edgar Ulsamer 17
And make plans to deploy cruise missiles on submarines near the US coasts.
- AFROTC Bounces Back** / By William P. Schlitz 68
Public attitudes and career opportunities have done it.
- Valor: Crisis in the Cockpit** / By John L. Frisbee 73
John Morgan had his hands full with a wounded pilot and a battered bomber.
- The Prospect for Superhard Silos** / By Edgar Ulsamer 74
The Soviets take the lead in silo survivability.
- Blue Christmas Coming Up** / By James W. Canan 78
The Air Force did its part during the Grenada rescue operation.
- Scoping the Spares Problem** / By John T. Correll 82
The worst of it is caused by inadequate data.
- Intercom: AFA's Achievements in 1983** 93
A forward-looking year-end report reviews AFA progress.

Departments

- | | | | |
|-----------------------------|----|-----------------------------|-----|
| Airmail | 9 | The Bulletin Board | 88 |
| In Focus . . . | 17 | Senior Staff Changes | 90 |
| Aerospace World | 24 | Intercom | 93 |
| Index to Advertisers | 31 | Field Organizations | 97 |
| Capitol Hill | 32 | Unit Reunions | 100 |
| Valor | 73 | There I Was . . . | 104 |

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Camel overhead! Gunfire from below! As the Red Baron fell, a new concept of air combat was taking shape.

Who actually downed the legendary Baron Manfred von Richthofen on 21 April 1918? Even though RAF pilot Capt. A.R. "Roy" Brown received credit, did he really fire the fatal shot as he believed? If so, how could von Richthofen continue flying for more than a minute with a chest wound that should have been fatal in seconds?

If instead, a ground gunner did it, then which one? A rifleman? Antiaircraft artilleryman? Machine gunner?

The question may never be totally, positively answered. But there's no dispute that air warfare has changed greatly since that memorable World

War I battle. Combat in the skies has become more tightly controlled and disciplined. And of course planes have grown larger, stronger, faster...able to perform a host of missions.

Hazards to flyers have changed too. Today, for example, an aircraft's very survival may hinge on its ability to pinpoint quickly, from a dense electromagnetic environment, those signals that come from enemy missile-guiding radar. This is an area where IBM expertise is demonstrated. Air Force F-4G fighters carry our AN/APR-38 Wild Weasel receiver system which can automatically detect, classify and locate hostile radar signals.

1. France, 21 April 1918. In fierce dogfight, German Fokker triplanes and Albatros aircraft vs. British Sopwith Camels, novice RAF pilot Wilfred May drops out due to jammed guns, heads for base. German squadron commander Baron Manfred von Richthofen dives in pursuit.

Richthofen closes in despite May's evasive turns. RAF squadron leader Capt. A.R. "Roy" Brown, a Canadian, sees May's peril, dives toward Richthofen and when almost directly overhead, fires into triplane. Richthofen reportedly slumps.

2. Brown drops out of chase.

6. Richthofen crashes, is found dead, fatally wounded by a single shot.



With this information, the F-4G fighter crew can then take appropriate action.

Other high-performance aircraft, too, gain increased effectiveness from IBM systems. The Navy's F-14 has one that displays navigation, target and weapons delivery information in an easy-to-grasp presentation. We're also aboard the Air Superiority F-15 Eagle, the F-111D and F, the A-7D/E Air Force/Navy craft, and others.

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to marshal many specialized systems to a common purpose. We have also applied this skill to anti-submarine warfare, navigation, and electronic support measures, plus a wide range of other fields.

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3. Richthofen continues gaining on May, passing over fire from Australian riflemen, machine gunners and anti-aircraft batteries. Pieces of triplane reportedly break off.

4. May returns to base at Bertangles.

5. Richthofen's triplane turns unsteadily, swerves, heads downward.

This ad is one of a series.
Historical facts verified by Historical Evaluation
and Research Organization.

Half of the Lesson

By Russell E. Dougherty, EDITOR IN CHIEF AND PUBLISHER

IN LATE November, the ABC television network aired *The Day After*, an emotional docudrama teaching half a moral lesson: that nuclear war, terrible beyond belief, must be prevented. Perhaps this part of the lesson was needed by the public. No convincing was necessary for military professionals who have spent their careers studying the nature of nuclear warfare and whose highest calling has long been to provide a capable deterrent to nuclear war—of any intensity.

The question now is whether or not the public and the makers of frightening films are willing to learn the other half of the moral lesson: What is required of us if we are to continue to deter nuclear conflict?

The easiest way for the United States to avoid war would be to disarm unilaterally and to let Moscow have its way in the world. To most Americans, however, a United States standing politically and economically isolated, a supplicant to the Soviet Union, would not be acceptable. Even if we postulate a fantasy wherein both superpowers eliminate nuclear weapons completely, the West would be hostage to the Soviet *chemical* arsenal! Or, with a growing number of other nations acquiring nuclear weapons, we might extend this fantasy to envision a nuclear-free America being coerced or intimidated by some nuclear-armed Khomeini or Qaddafi of the future.

We must not be misled into thinking that our only choices are "Red or dead." I like Gen. Andy Goodpaster's answer to that: "I'd rather be *neither* than *either*." And we can—if we will.

For decades, US strategic policy has been to possess adequate military power, in conjunction with its allies, to convince the Soviet Union that it could not hope to achieve any lasting advantage through military aggression—and that the Soviets could not hope to win a nuclear war. This is based on the sound principle that attack is invited by weakness, not brought on by strength. It is a grim strategy, but it works. It takes guts to provide a credible deterrent to a militant, totalitarian regime, but we have done it. Responsible analysts and knowledgeable strategists agree that an all-out nuclear exchange, of the sort depicted in *The Day After*, is highly improbable—the least likely form of conflict in the world today. And we *must* keep it that way.

To an ever-increasing degree, however, we see direct and indirect conflict occurring in the nuclear shadow. Over the past decade, as the nuclear balance has shifted toward the Soviets, they have assessed less risk in their adventurism—both direct and by proxy. They have become increasingly bold in their actions in the world's trouble spots and power vacuums. They have been particularly active in areas that affect the sources and supply lines for the Western world's critical imports. The Soviets have exploited relentlessly the fear their nuclear might generates in the mind of the West. Surely they

are encouraged to see so many in the Western world clutching at false hopes that, somehow, unilateral "freeze" initiatives, nuclear-free zones, and outright appeasement *just might work this time*—that the threat of war or domination can be reduced if we just do not stand up to, aggravate, or anger the Soviet Union.

There is a widespread notion that both sides share equally in an "arms race." This is not so. Over the past two decades, the United States has regularly retired strategic assets—dramatically reducing megatonnage and warheads. Today the US has far fewer nuclear weapons than it did twenty years ago, and has indicated that reductions will continue, but the Soviet have added steadily to their strategic arsenal. They have succeeded in achieving a posture that encourages Soviet strategists to think that, after all, a nuclear war may be winnable—and to plan on that basis.

The Day After was shown just before the December 1983 deployment of US intermediate-range missiles to Western Europe was scheduled to begin, and just as the Bundestag of the Federal Republic of Germany was involved in the final debate confirming agreement to receive the Pershing IIs and ground-launched cruise missiles. Given the critical timing, it is doubtful that the showing of this major network drama of *The Day After* was happenstance.

Much of the world has forgotten—or chooses to ignore—the diplomatic and military history of this deployment. In the 1970s, the Soviets began deploying operational, multiple-warhead SS-20 missiles, ballistic missiles with ranges of some 3,000 kilometers, posing a new and devastating threat to every spot in all the European nations of NATO. The European allies felt severely threatened, and propounded a "dual-track" proposal: Unless the Soviets stopped deploying SS-20s and negotiated in good faith to reduce this new, awesome nuclear threat, NATO would field Pershing IIs and ground-launched cruise missiles in Europe and pose a similar, albeit lesser threat to the Soviet Union. NATO's preference was for mutual restraint and negotiations to eliminate these threats, but the Soviets rejected the bargain—refused bona fide negotiations. They continued the deployment of SS-20s and modernization of their other theater nuclear missiles.

Faced with an intransigent Soviet Union, the US had a obligation to fulfill its commitment to NATO and deploy countervailing power in Europe. Germany and other allied countries receiving US missiles voted boldly and responsibly to accept such weapons. This was no spurt in an "arms race," but a thoughtful, deliberate adherence by responsible governments to the successful strategy of deterrence.

Fortunately, our strategic decisions in NATO are still being made responsibly, by its statesmen, and in its legislative chambers—not on its TV screens or by mobs in its streets.



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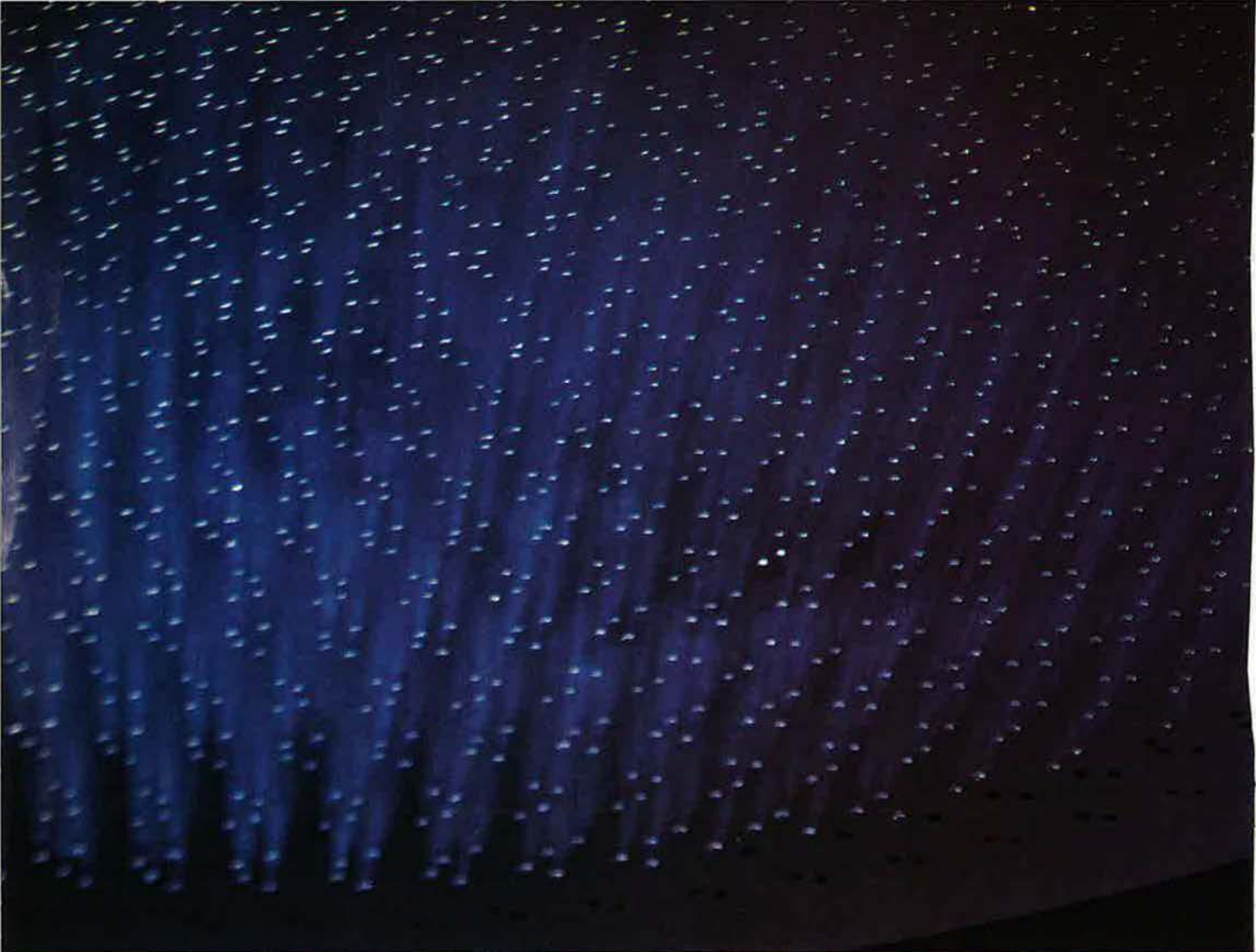
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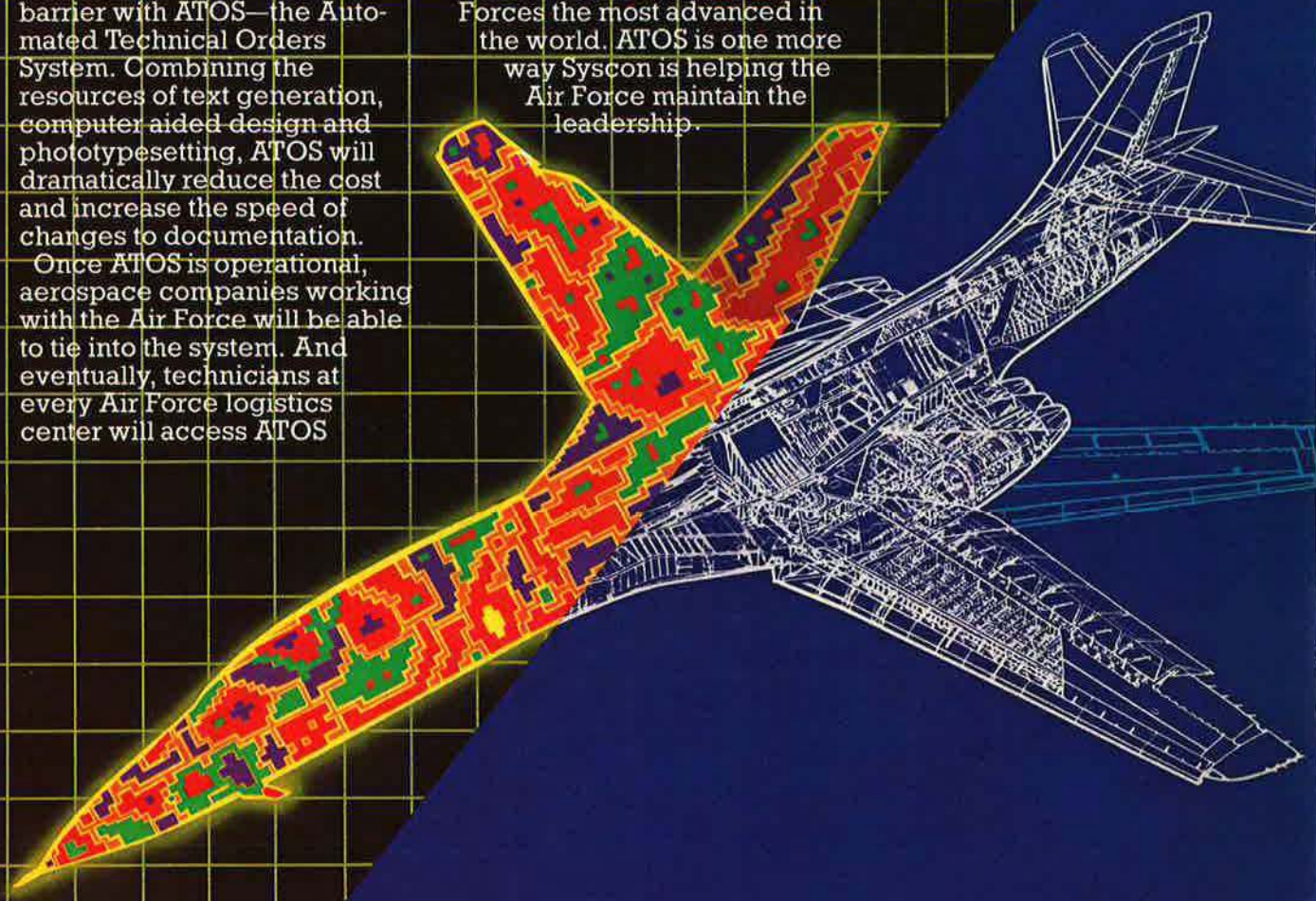
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Poor Policy?

As a Patron of the Air Force Association, I have found *Air Force Magazine's* articles about the military capabilities of the US and USSR educational and enlightening. Your articles exposing the unprecedented buildup of Soviet military might and the need for American military strength are well researched and persuasive.

In comparison to the cogent articles I am accustomed to finding in your magazine, I find the AFA Statement of Policy presented in your November '83 issue, "Statecraft and Strategy in the Nuclear Shadow," to be inconsistent and directionless.

The Statement of Policy makes the assertion, "Arms-control objectives and strategic capabilities must be shaped for mutual support and serve the common goal of a stable military balance and, hence, peace." I believe that this assertion has dangerous implications when examined closely. To design our strategic forces with the goal of being in balance with the strategic forces of the Soviets is to place American freedom at the mercy of Soviet forbearance.

Reliance on Soviet fears of American retaliation is ridiculous unless American war-winning capabilities clearly exist. The Soviet leadership has shown many times that they are willing to sacrifice millions of Soviet lives to achieve their goals of enslavement. Only clear-cut superiority of American strategic forces will assure the Soviets that fighting a war with America is senseless—that fighting a war with America is certain to end in Soviet defeat and American victory.

The Statement of Policy, in its discussion of the importance of technology, does recognize the need for winning wars in the failure of deterrence. Yet by some perverted logic it also supports the current arms negotiations whose goal is to make the Soviets just as likely to win a war as is the United States.

I agree with the Statement of Policy's assertions that "the Soviet Union regards arms control as a competitive process which serves both political and military objectives," and that

"arms-control agreements that cannot be verified and enforced effectively are worse than no accords at all." The Association's support of current arms-control negotiations seems irrational to me in light of these considerations. The Soviet Union has used détente and arms-control negotiations to change vast American strategic superiority into Soviet strategic superiority. The Soviets have consistently rejected the only effective means of verification: on-site verification.

The fact that such a faulty Statement of Policy was unanimously adopted by the AFA National Convention is especially troubling. I believe that AFA delegates should reexamine their Statement of Policy and issue a revised statement at the 1984-85 National Convention that condemns current arms negotiations as damaging to American freedom and national security.

I would appreciate hearing from other *Air Force Magazine* readers who agree that current arms-control negotiations pose a threat to freedom.

Martin S. Macher
East Granby, Conn.

Reducing Drag

It's especially gratifying to see that "tangential carriage" is being implemented for US tactical double-duty fighter aircraft (*"An Eagle for All Arenas," November '83 issue, p. 43*).

Back in 1962-63 when I was Program Manager for the FX (eventually to become the F-15 Eagle) at Fairchild Republic, we put a lot of effort on reduction of the drag caused by external stores. Working closely with aerodynamicist Ellie Kazan and designer Jean McComas, two of the best in their respective disciplines, we evolved a concept that distributed these stores lengthwise along the fuselage instead of spread laterally out along the wing as had been the practice in the past. We went a step further and designed a long quarter-round concavity on each side of the fuselage bottom half, providing additional protection for the stores from the slip-

stream behind the nose of the aircraft.

Intuition told us that we should get substantial reduction in drag from this method of stores distribution as compared to that from the then-conventional wing racks. Our boss, John Stack, concurred and gave us a budget for wind-tunnel models and won us early admittance to the Langley test facilities—one of his many special talents. The results surpassed even our most optimistic estimates. Drag from the stores was reduced by more than a factor of two.

When McDonnell eventually won the competition for the FX several years later, Ed Uhl, President of Fairchild, called McDonnell and offered to share, gratis, all of the technology that the Fairchild team had developed as a consequence of its long years of effort on the program. Detailed briefings for McDonnell engineers were held for this purpose at the Fairchild plant.

It's heartwarming to think that perhaps this intercorporate cooperation served to salvage some of the useful technology so painstakingly nurtured by the losers. In another twenty years, someone may even grab the whole enchilada.

Albert W. Blackburn
McLean, Va.

Confused

Your November articles on the F-15E (*"An Eagle for All Arenas" by Steve Ritchie*) and F-16XL (*"The Revolutionary Evolution of the F-16XL" by F. Clifton Berry, Jr.*) were fascinating, but raised more questions than they answered.

For example, Steve Ritchie correctly points out that F-4s and even modified F-105s could not adequately handle the night, all-weather mission because the machines were not designed to do that, and that the F-111, although originally envisioned by our nonflying leadership as a multimission aircraft, "eventually evolved into filling the low-level, all-weather attack mission." It is the *only* mission it does well.

He also notes that, during development, the "Air Force leadership ...

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wisely directed that the F-15 be dedicated to the air-superiority role." I was at Wright-Patterson during the development of the F-15 and recall walking around the SPO and seeing signs everywhere stating: "Not a pound for air-to-ground." While the SPO did not meet that goal entirely, it is this philosophy of designing an aircraft to meet its primary mission that has led to our most successful systems.

Now we are engaged in designing another "do everything" fighter. What have we learned from this?

Why was there no mention in either article of the capability that gives the F-111 its primary advantage, automatic terrain-following radar, and that allows the low-level, all-weather crew to divert some attention from their primary enemy—the ground—to concentrate on putting bombs on target?

Why is there that disconnect between the two articles when Ritchie says the F-15E low-level ride is mighty fine because it is "similar to that of an F-4," and Berry says the F-16XL low-level ride is mighty fine because it is so much better than an F-4?

Much as I admire Steve Ritchie's accomplishments in the air-to-air arena, would you ask a brain specialist to comment on new equipment for heart surgery? The primary gap these aircraft are to fill is in night, all-weather, low-level bombing. We have thousands of hours of expertise in just that subject conveniently clustered at Mountain Home, Cannon, RAF Upper Heyford, and RAF Lakenheath. Why not ask the experts?

Finally, it should come as no surprise to most of your readers that the sky over any potential battlefield on this planet will be dark about fifty percent of the time, and cloudy some additional percentage of the time. We have eight percent of the fighter force that can effectively strike an enemy during these times. Was your cover picture showing these two aircraft against a sky-blue background merely artistic, or was it representative of the kind of blue-sky thinking going into their designs?

Maj. Thomas N. Thompson,
USAF
Mountain Home, Idaho

• In addition to downing five MiG-21s and flying many air-to-air missions in Vietnam, Steve Ritchie logged well

over 200 air-to-ground combat missions. These included interdiction, close support, and night missions. Later, Ritchie was an instructor in both air-to-air and air-to-ground at the Fighter Weapons School. The concept for the dual role fighter is a combination of air-superiority and deep interdiction work.—THE EDITORS

Milton on El Salvador

General Milton's Central America essay, "Myth and Reality in El Salvador" (November '83 issue, p. 63), deserves comment.

Unfortunately, the General's doctrinaire point of view only serves to muddy the water further, if that's possible. El Salvador may not be Vietnam, as he points out, but a military solution will be just as hard to achieve without dramatic, far-reaching social change. Waiting for the "clear military advantage" sounds like Vietnam strategy to me. Salvadoran General Casanova's "national campaign" won't amount to anything until the Salvadoran battalions start fighting as a national army instead of like warlords scrapping over turf. Can we really expect an effective army to be based on soldiers enlisting simply to escape a poverty most Americans can't imagine? Is there any general sense of patriotic duty in the rank and file? Instead of interviewing high-ranking military officers and university professors, maybe General Milton should have talked to the foot soldiers or the villagers.

No insurgency, whether in Southeast Asia or Central America, can succeed without at least tacit acquiescence from the population, especially if the people feel there's nothing worth fighting for. Forging an effective national army can and will be done after the people believe there's going to be meaningful reform, and not just the substitution of one oppressor for another.

The Salvadorans want democracy, if last year's election is any indication. But the road to attaining that goal is far more complex than General Milton would have us believe.

Harry Wilkins
Anchorage, Alaska

Re: General Milton's November '83 article "Myth and Reality in El Salvador":

Finally, someone who makes sense and tells it as it is, and not like TV and other reporters whose reports make me sick with their exaggerations and blatant misrepresentations.

A lot of business people fly back and forth between the USA and El Salvador, Guatemala, and Honduras con-

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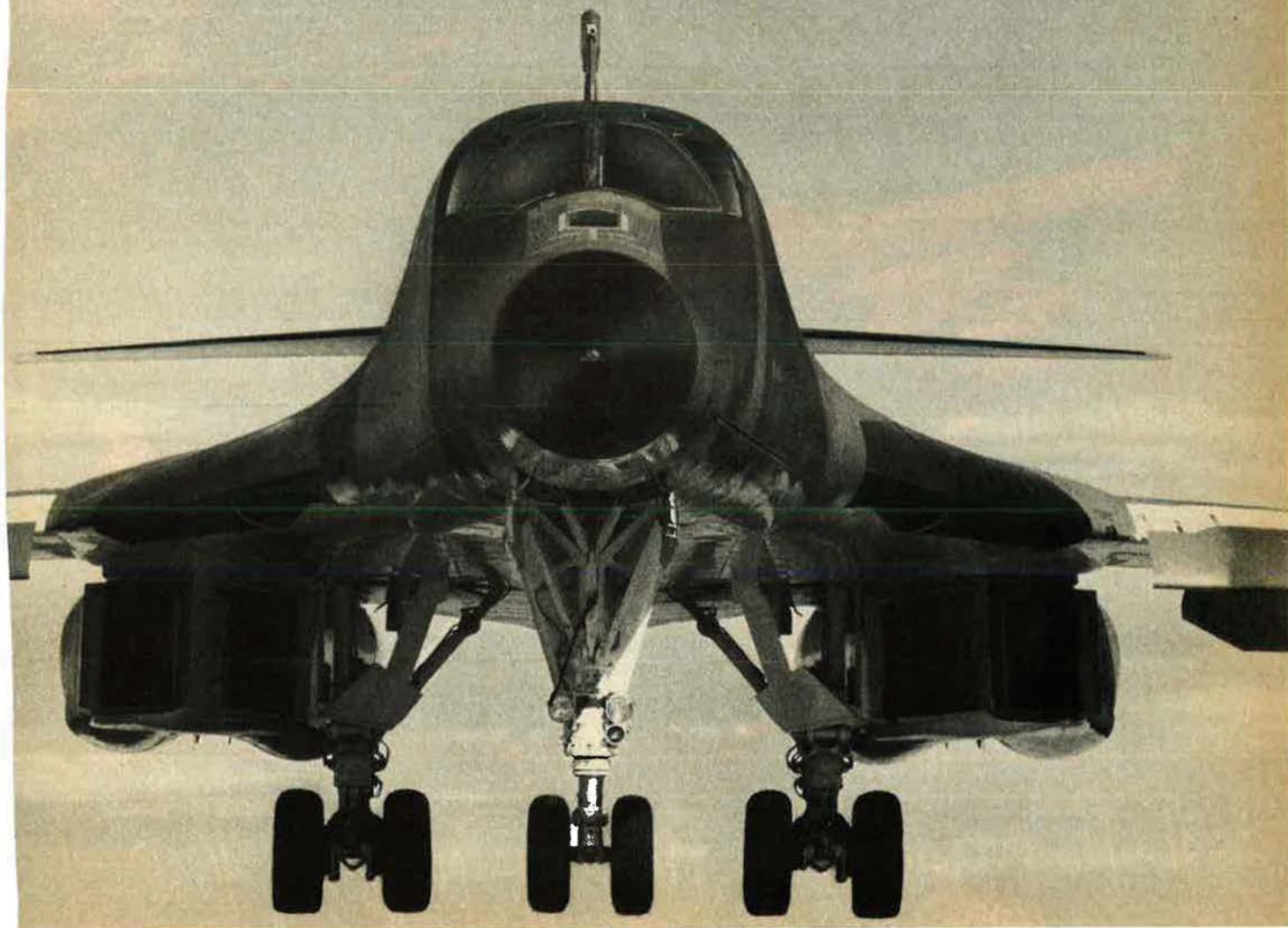


This kind of capability comes from being a major supplier of masks, regulators, oxygen storage equipment, as well as complete aircraft environmental systems. And from being part of the Garrett family.

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stantly (I do) without worrying for our lives as long as we do not stick our noses into their affairs or run to see who is firing at whom. . . .

General Milton's appreciation is completely accurate. Central America must be kept clean of Russian and Cuban influence at all cost. The situation in Central America is being used by the Communists for their own ends without trying to better conditions in that region.

The USA's fault is not having recognized that this situation was coming up, to the extent that it has, or having done something about it twenty years ago. USA AID was one drop of water on a hot stone when there should have been a whole bucket of water—at once!

It is absolutely ridiculous to compare Central America with Vietnam.
Werner C. Petzold
Cockeysville, Md.

One-Man Air Force

Re: Your "Valor" article, "One-Man Air Force," in the November '83 issue:

I remember that mission well: We were part of the 94th, of which the 401st was lead. And we of the 1st Division really got clobbered that day. As your article on General Howard indicated, the 2d and 3d Divisions were recalled, but 1st Division was already over Europe and continued in. If memory serves me right, the Eighth Air Force lost about sixty planes that day—and more than three-quarters were from 1st Division alone. (Incidentally, 1st Division got a Unit Citation for that mission.)

General Howard (then a major) was reported on by us (as well as by the 401st and other 1st Division units) to our intelligence people upon returning to England. He was truly a "hero" to us of the Bomber Command! It did take some time before Eighth Air Force could locate and duly note Howard's accomplishments.

January 11, 1944, was truly a memorable day in my diary!

Lt. Col. David W. Litsinger,
USAF (Ret.)
Lynwood, Calif.

I was fascinated by "One-Man Air Force" in the November '83 issue.

As copilot of the B-17G *Betty J*, 13th Bomb Squadron, 401st Bomb Group, I can attest to the magnificent scort job done by the long-range P-51 Mustangs. The January 11, 1944, raid on Oschersleben was a deep penetration, and we had continuous P-51 and P-38 fighter cover all the way into and back from the target.

In certain aspects the P-51 resembled the Luftwaffe's Bf 109; it is

AIRMAIL

conceivable that Major Howard's Mustang was mistakenly fired on by a B-17 gunner who, in the heat of an attack by thirty-one swarming fighters, couldn't possibly imagine that one of them was a friendly P-51!

My personal thanks and kudos to General Howard.

William P. Maher
Lexington, Mass.

Selective Service

Thanks for the fine "Bulletin Board" article on Selective Service registration in your November '83 issue of *AIR FORCE Magazine*. It will be very helpful to our registration awareness program. We constantly have a new audience to reach, since about 5,000 men turn eighteen every day.

I sense a surge of patriotism among young Americans. We now have more than 11,000,000 registered, and that represents a compliance rate of 96.4 percent. We believe that those who have not yet registered are either uninformed or misinformed about the registration requirement. That is why we are so appreciative of your publicizing the requirement.

Again, thanks for your continued support.

Thomas K. Turnage
Director of Selective
Service
Washington, D. C.

Westmoreland Suit

Gen. William C. Westmoreland's libel suit against CBS will be tried on March 1, 1984, despite efforts by CBS to delay it. Almost every one of us will remember the CBS documentary last January that gave rise to General Westmoreland's suit for damages. He alleged that CBS distorted the testimony and selectively edited the film tapes, and wound up with an accusation against General Westmoreland for knowingly conspiring to provide false information on enemy troop strengths in Southeast Asia in order to deceive President Johnson and the American people.

The early reaction to the program forced an internal investigation by CBS with the conclusion (by Burton Benjamin, a senior CBS executive producer) that there were imbalances in presenting the two sides of the issue, that CBS coddled sympathetic witnesses and relied on testimony of a

paid consultant without identifying him as such, and that CBS failed to prove conspiracy. Columnist James J. Kilpatrick concluded that "the Benjamin report provides a verdict against CBS News that is loud and clear: guilty as charged."

General Westmoreland has stated that if he wins he will donate all the proceeds from his victory over CBS to the American Red Cross and to various charities serving Vietnam war veterans and US military personnel. The Capital Legal Foundation (a not-for-profit public policy law firm) is representing General Westmoreland on a *pro bono* basis.

I understand that funds for the actual expenses involved in preparing the case for trial are running dangerously low. I think there are thousands of us throughout the Air Force Association who share General Westmoreland's plight at being impugned publicly by imbalanced reporting and biased portrayals. We cheer him on in his public effort to clear his name and to bring those in the public media to heel for their careless and reckless abuse of public trust.

I wanted readers to know about this so that those of you who want to help will know to send tax-deductible contributions to the Capital Legal Foundation, 700 E St., S. E., Washington, D. C. 20003.

Brig. Gen. William W. Spruance,
USAF (Ret.)
Marathon, Fla.

Eighth Air Force

Dennis R. Scanlan, Jr., President of the 8th Air Force Memorial Museum Foundation, has announced that the 8th AFMMF, in conjunction with the *8th AF News*, is beginning a collection of Eighth Air Force color slides. These slides will be used to build up a full-length color slide show with synchronized sound. The project officer, Lt. Col. John H. Woolnough, USAF (Ret.), is looking for enough slides to make an interesting sixty-minute show. Though plans call for the show to be built around the beginnings of Eighth Air Force in World War II, it will conclude with a brief overview of life in the Eighth Air Force after WW II and up to the present time.

In addition to screenings at Eighth Air Force reunions, the show will be designed to be a traveling exhibit for showing at unit reunions, air shows, air museums, and other suitable events. The show should also be of use in the Air Force Heritage Program for showing to members of the present-day Eighth Air Force.

The success of the project rests on the response of former 8th AFers. All

8th AFers are asked to dig through old slide collections and to send duplicate copies of anything remotely related to the Eighth Air Force. If the donor finds it impossible to duplicate slides, the 8th AFMMF asks that the original be sent. They will make the duplicates and return the original.

Please send any slides to the address below.

8th AF News
P. O. Box 4738
Hollywood, Fla. 33083

57th FIS

As part of Project Warrior, I have been assigned to compile a pictorial and written history of the 57th Fighter Interceptor Squadron. I need pictures or bits of history relating to 57th FIS personnel, components, aircraft, etc., from its beginning to the present time.

Anyone who may be able to assist me is asked to contact the address below.

1st Lt. Alan G. Miller, USAF
Public Affairs Officer
57th FIS/DO
FPO New York 09571

X Planes and F-4s

For several years I have been an avid reader of AIR FORCE Magazine.

I am researching the history of the NAA X-15 and XB-70 for publication in the American Aviation Historical Society's *AAHS Journal*. Photos and slides are required of these aircraft and of the associated support aircraft, such as the NB-52 (X-15 mother-ship), NB-58 (GE YJ93 engine test-bed for XB-70), and the chase aircraft.

I would also like to hear from personnel assigned to these programs who can also help in the preparation of flight logs and provide info on the various paint schemes employed.

I am also preparing a monograph and *AAHS Journal* article on the F-4K/M Phantom in British service (Rolls-Royce Spey engine). I would like to hear from personnel assigned to the test program at Edwards AFB, Calif., and Patuxent River NAS, Md., and from USAF/USN/USMC F-4 crews that flew F-4K/Ms with the RAF and Royal Navy.

Terry Panopalis
6 Place Grieg
Candiac, Quebec
J5R 3X4 Canada

22d Bomb Group

I am trying to organize a personal record surrounding the events leading to the loss of my uncle, Lt. Thomas C. Domville of the 22d Bomb Group, on May 10, 1942, at or near New Guinea.

AIRMAIL

Specifically, I am trying to reconstruct the events of May 10, 1942, at the field at Port Moresby, New Guinea, where he was last seen alive. I know, for instance, that his B-26 left after it had flown a raid on Rabaul, and that it had stopped at Port Moresby (but at which airstrip?) for refueling.

In general, I am looking for any information about my uncle's unit—22d Bomb Group, 2d Bomb Squadron—during its early Pacific theater days.

Anyone having any information on these topics is asked to write to the address below.

Patti Domville Hall
3561 Iris Circle
Seal Beach, Calif. 90740

Skyblazers

I am an aircraft modeler and a member of the International Plastic Modelers Society. I am trying to research the history of the Skyblazers, a USAF aerobatic team in Europe during the 1950s. I would appreciate any information from former pilots and ground crews associated with the team. I am looking for photographs and slides from when the Skyblazers flew the F-86E and F-100C.

My goal is to do a history of this team for publication. I can be reached at the following address.

Stephen W. Daniels
3776 Counselor Lane
Virginia Beach, Va. 23452

Where Are You?

I am trying to contact the following three men.

The first is Peter S. Panos of Flint, Mich., who was in Class 43-F with me at AAF preflight pilot school at Maxwell Field, Ala., primary training at Americus, Ga., and basic training at Jackson, Miss.

I am also trying to contact the substitute navigator for our crew, whose name I recall was either Everett or Elliot. I have a picture I took of him at Gracie Field's home on the Isle of Capri. Everett flew with us in the 775th Squadron, 463d Group (a B-17 outfit), on August 19, 1944, to Ploesti, Romania. Perhaps he'll remember that I had to strip the plane of everything—including the ball turret—to keep it from crashing into the Alps. The plane, which was borrowed, was named *Excalibur*.

The last man I'm looking for is a pilot whose name was Johnson. We

flew together on what was my last and fifty-first mission, and I believe Johnson's fifth mission, on September 22, 1944, to Munich, Germany. We were eventually the lone plane of our group coming out of Munich that day. I would also appreciate it if any crew members on that mission would contact me, as this was not my regular crew. I had never flown with this crew before.

I would greatly appreciate it if these three men, or anyone who knows these men, would please contact me at the address below.

Alfred D. Richards
Brook Hollow Dr.
Gladstone, N. J. 07931

Phone: (201) 234-2694

The 62d Tactical Fighter Training Squadron is making plans to pay tribute to the pilots who attained the status of ace.

To that end, we would like to hear from or otherwise establish contact with the following individuals: 1st Lt. Stanley B. Morrill, Maj. Leroy A. Schreiber, Capt. Felix D. Williams, Capt. Fred J. Christensen, and Maj. George E. Bostwick.

Please contact the address below.

Squadron Admin.
62d TFTS/DA
MacDill AFB, Fla. 33601

Phone: (813) 830-3550
AUTOVON: 968-3550

After all these years our crew has gotten together for three reunions. We are trying to locate our navigator whose services were lost to us when he was wounded during a raid on Friedrichshafen on April 24, 1944. At that time his home address was in Chicago.

Can anyone help us locate Mahlon "Lynn" Steiner?

William J. Brunk
112 Westhaven Dr.
Kettering, Ohio 45421

I am trying to contact an Air Force major general, Pete DeLonga, who I knew as a colonel in 1967 and 1968.

Pete: If you're out there, I'd like to hear from you.

Rear Adm. Fred Palmer,
USN (Ret.)
849 Five Point Rd.
Virginia Beach, Va. 23461

I am trying to locate pilots from Class 44-D during World War II.

Any pilots from that class should contact the address below.

Lt. Col. Douglas D. Steward
USAF (Ret.)
409 W. River Rd.
Oscoda, Mich. 48750

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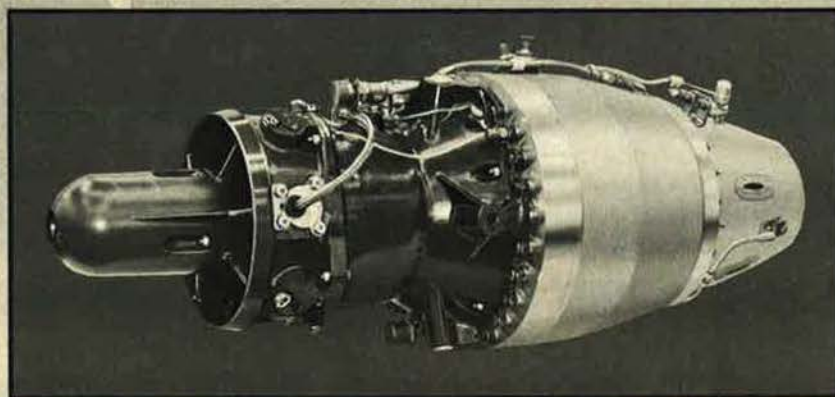
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The Soviets Test a New ICBM

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

Moscow hopes time and doubletalk will take care of complaints about cheating on accords.

Washington, D. C., Dec. 7



On November 22, 1983, the Soviet Union carried out the second successful test flight—out of a total of either six or seven launches—of its new SS-X-24 ICBM.

The missile deployed eight reentry vehicles during this flight.

One of two new Soviet solid-propellant ICBMs, the SS-X-24 is about the same size as the MX. Its development and test—occurring at the same time as the introduction of a smaller new Soviet ICBM—probably constitute a violation of the SALT II accord, which permits the development, test, and deployment of only one new ICBM by each of the signatory powers. The other new Soviet ICBM, the SS-X-25, is a smaller missile presumably designed for deployment on mobile launchers similar to those used for the SS-20 intermediate-range ballistic missile.

According to claims by Sen. Steven D. Symms (R-Idaho) on the floor of the Senate, close to 100 percent of all the telemetry data of the SS-X-24 and SS-X-25 flight tests is encrypted. This, too, might constitute a violation of SALT II and has led to series of ludicrously circular arguments with the Soviets in the SALT Standing Consultative Commission (SCC), the body designated to arbitrate real or resumed violations of the accord.

SALT II states in part that the parties will abstain from "deliberate concealment measures which impede verification by national technical means, [and] neither party shall engage in deliberate denial of telemetric information, such as through use

of telemetric encryption, whenever such denial impedes verification of compliance with the provisions of the Treaty."

The Director of the US Arms Control and Disarmament Agency, Kenneth L. Adelman, recently described the *reductio ad absurdum* technique trundled out routinely by the Soviets in the SCC. Because of this high level of encryption associated with Soviet ballistic missile tests, the US complains regularly that these Soviet actions impede this country's ability to verify Soviet compliance with the provisions of SALT II, according to Ambassador Adelman. The Soviets retort, "What is it that we encrypt that impedes verification? Would you please specify?" The US then counters that "we can't specify because you are encrypting and hiding the information," and points out that if the encrypted data were not useful, why are the Soviets hiding it? Invariably, this type of Soviet stonewalling causes the matter to be dropped after a while, he said.

The humor of the situation is seemingly lost on the US Senate, ninety-three of whose members recently urged the President to report to Congress as soon as possible about these and other putative Soviet violations of arms-control accords signed by Moscow. In addition to encryption, the Soviets reportedly also confine flight-testing of the SS-X-25 to night operations to prevent the US from detecting what kind of mobile launcher is used for this weapon.

Yet another new Soviet ballistic missile that is getting increasing congressional attention is the SS-NX-23. First tested in June 1983, this weapon is the world's largest submarine-launched ballistic missile (SLBM), rivaling in size the SS-19 and the MX. US intelligence experts believe that the gigantic SS-NX-23, a solid-fueled weapon, may be intended to replace the liquid-fueled SS-N-18, which varies in range from 6,500 to 8,000 kilometers and in the number of reentry vehicles from one to seven.

In the cruise missile area, evidence is building up that the Soviets will de-

ploy large numbers of SS-NX-21 and possibly other advanced submarine-launched cruise missiles during 1984. These weapons, with a range of up to 3,000 kilometers, will, US intelligence experts predict, be deployed within a few months on *Victor*-class and possibly other types of submarines.

Standing off just beyond the 100-fathom line along the US coastline, Soviet subs would be able to launch these long-range, hard-to-detect nuclear-armed cruise missiles in a surprise attack against vital US strategic command and control centers. The absence of US air defense and Federal Aviation Administration radars capable of detecting low-flying cruise missiles virtually grants the Soviets a free ride if they were to launch such a "precursor attack" to decapitate this country's command and control centers and key communications nodes.

Defense Department officials have warned Congress repeatedly that, because of the extremely limited US air defense capabilities, Soviet air-breathing systems—be they bombers or cruise missiles—can carry out strikes against this country without warning or conduct unchallenged reconnaissance and postattack strikes following a missile exchange. Air Force witnesses have pointed out that the growing Soviet atmospheric threat and "the major gaps in our low-altitude and coastal surveillance coverage mean that existing North American surveillance systems cannot provide the required tactical warning to enable our National Command Authorities and strategic retaliatory forces to take appropriate action."

Worse yet, at low altitudes there are miles of coastline where air-breathing systems "can penetrate our airspace and, once inside, roam freely, since we have no interior radars." The long-term remedy would be the development of space-based radars. But a protracted tug of war within the Pentagon, the intelligence community, and Congress over specific design approaches has brought this effort to a standstill.

The Soviet Union's leaders have already outlined in general terms their

plans for the pending deployment of new cruise missiles on submarines stationed near the US coasts. This announcement followed Moscow's walkout at the Intermediate-range Nuclear Forces (INF) reduction talks in Geneva. The Soviets have portrayed this action as retaliation for US deployment of Pershing II and ground-launched cruise missiles in Europe.

Ambassador Adelman dismissed the latter Soviet contention as a case of "putting a new label on old wine." Portraying these actions as "counter-deployments" simply won't wash, he suggested, because evidence built up over "years and years" shows clearly that the Soviets planned to do so all along.

Soviet infractions of arms accords are not confined to ballistic missiles (see *"The Soviets Are Violating Arms-Control Accords,"* October '83 issue). Among the latest evidence that suggests noncompliance are reports by Defense Department officials that the Soviets are building between thirty-six and forty Backfire bombers per year. On June 16, 1979, President Leonid Brezhnev informed the US SALT II negotiators—headed by President Jimmy Carter—that the production rate of the Soviet Tu-22M aircraft, known in the US as the Backfire bomber, would not exceed thirty aircraft per year. The US accepted this pledge with the proviso that "the United States enters into the SALT II Agreement on the basis of the commitments contained in the Soviet statement [concerning Backfire] and that it considers the carrying out of these commitments to be essential to the obligations assumed under the Treaty." A production rate in excess of thirty aircraft a year obviously violates this stipulation.

In another recent development that raises questions about Soviet compliance, US intelligence found that two squadrons of Backfire bombers have been assigned to a Long-Range Aviation (the equivalent of SAC's bomber element) base in the upper part of the Kola peninsula north of the Arctic Circle. Brezhnev's written statement on Backfire appended to SALT II asserts that the Soviets "will not increase the radius of action of this airplane in such a way as to enable it to strike targets on the territory of the USA." Forward-basing a number of these aircraft in the Kola peninsula does exactly that, however.

Soviet Defense Spending Grows Substantially

A number of US news media reports saw fit to interpret a recent report by

IN FOCUS...

the Central Intelligence Agency's Office of Soviet Analysis as suggesting that Soviet defense spending was declining. The CIA report, released by the Subcommittee on International Trade, Finance, and Security Economics of the Congressional Joint Economic Committee, does not support such a conclusion. Instead, there is the straightforward assertion that "Soviet military capabilities will still increase substantially over the next several years, even if the rate of growth of procurement of military hardware does not increase. The USSR is already investing so much in military hardware that merely continuing procurement at the existing level would provide very large annual increments in holdings of military equipment."

The CIA analysis finds that the new regime headed by President Yuri Andropov, who "apparently came to power with the support of the military, may well be under pressure to speed up defense spending. For example, in the first three years of this decade we believe the Soviets have already had as many systems under development as in each of the previous two decades."

Pointing out that the steady expansion of Soviet production facilities provides an increasing potential for fielding an ever-increasing volume of weapon systems, the CIA study then juxtaposes the fact that "any major effort to sharply accelerate the level of military procurement, however, could make it even more difficult to solve the fundamental economic problems facing the Soviets." The consequence of drastic procurement boosts, the CIA argued, would be lower civilian investment and slower growth or even a falling per capita consumption rate and "could, over the long run, erode the economic base of the military-industrial complex itself."

The CIA reports that the Soviet Union's economy is lagging behind the goals set for it in the current Five-Year Plan (1981-85), with the slowdown evident "in practically every industrial branch" and industrial productivity "down dramatically." In the important area of machine building, which affects both military hardware as well as the civilian sector in a pace-setting fashion, growth has fallen off to about half the planned level, the

"lowest since World War II," the intelligence report disclosed.

Per capita consumption was on a roller coaster, increasing by about one percent in 1981 and decreasing by the same rate in 1982. The availability of quality foods, the CIA analysis finds, has generally declined, with per capita meat consumption in 1982 down from the peak level in 1979.

Some signs of unrest—such as "short-lived work stoppages"—occurred in 1981 and 1982, according to the CIA, but "expressions of discontent generally were contained or averted. Faced with long lines at state outlets, consumers dealt with the shortages in ways that did not threaten the regime—by buying higher-priced foods in the officially sanctioned free markets, for example, and through barter and black-market activity."

In the defense sector, the CIA analysis finds that while spending measured in constant 1970 ruble prices continues to increase, the procurement of military hardware has leveled off since 1976. Overall defense spending, in step with overall economic growth, has slowed since then to an annual growth of two percent because of the lower procurement trends, according to the report. This relatively flat growth level of the procurement account is in contrast with annual increases in military operations and maintenance costs in the three to four percent range and boosts in military personnel costs by slightly less than two percent a year.

Stressing that trends in Soviet military spending are not a sufficient basis to form judgments about Soviet military capabilities, the CIA analysis warns that these derive from a combination of weapons stocks, doctrine, training, leadership, and other factors. Moreover, spending estimates don't allow for the "large stocks of strategic and conventional weapon systems already deployed. Indeed, current levels of spending are so high that, despite the procurement plateau noted, the Soviet forces have received since 1975 about 2,000 ICBMs and SLBMs, more than 5,000 tactical combat and interceptor aircraft, 15,000 tanks, and substantial numbers of major surface combatants SSBNs, and attack submarines," the CIA reported.

Despite the somewhat slow growth in Soviet defense spending the USSR continues to outspend the US "by a large margin. In 1981 the dollar costs of Soviet defense activities were forty-five percent greater than US outlays; procurement cost alone were also forty-five percent

SCIENCE/SCOPE

A new air defense system is monitoring skies over North America and 200 miles beyond its borders. The Joint Surveillance System (JSS) links U.S. Air Force radars, many commercial air traffic control radars, and Canadian radars into a shared system. It consists of seven regional control centers in North America and an eighth center in Hawaii. JSS, designed and developed by Hughes Aircraft Company, will cut operating and maintenance costs by about \$100 million a year because it replaces old semi-automatic equipment with fully automated hardware.

Tests of a prototype ducted rocket engine hold promise of increased range and velocity for future tactical missiles. In milestone demonstrations for the U.S. Air Force, Hughes solid-propellant ducted rocket engines were fired successfully in a wind tunnel simulating supersonic missile speeds at a variety of altitudes. Whereas conventional air-launched motors contain all the fuel and oxidizer they need for combustion, the ducted rocket obtains a large portion of its oxygen from the atmosphere. An important benefit is that the ducted rocket motor can contain more fuel for a given weight.

Efficient ways to assemble and test the AMRAAM missile have arisen from having manufacturing test engineers work closely with design engineers ever since the early stages of the missile development. The two groups teamed to develop common test specifications, test equipment, and testing techniques. Their efforts are expected to drastically reduce test correlation problems and to allow the missile to be produced immediately at a high rate. Hughes designed and developed the Advanced Medium-Range Air-to-Air Missile for the U.S. Air Force and Navy.

The 1,000th Maverick missile to be launched in training exercises destroyed a truck during military maneuvers at Nellis Air Force Base in Nevada. The TV-guided air-to-ground weapon was launched from an A-10 at an altitude of 500 feet and a range of over one mile. It scored a direct hit on the designated target amid a convoy of vehicles. The pilot, launching his first Maverick ever, said he locked the missile on target within two seconds. Maverick scored direct hits in 41 of 43 launches during exercises last year. Of the 1,000 launched in training, 85% have been direct hits. Since first being built in 1972, the Hughes TV Maverick has scored 85% hits in 1,500 total launches.

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TRW Space & Technology
Group

larger." The current plateau in procurement spending appears to be related to a combination of complex factors, including technological problems, industrial bottlenecks, and policy decisions. Some funds originally budgeted for procurement, the Agency suggests, may have been directed instead to research, development, test, and evaluation (RDT&E) "because of the increasing complexity of weapon systems being researched."

Defense Against Ballistic Missiles

On April 18, 1983, the White House directed relevant elements of the executive branch to undertake two complementary studies of the feasibility of a comprehensive defense against ballistic missiles. The findings of these studies—one dealing with the technological and the other with the strategic doctrinal aspects of such an undertaking—were turned over to the President, and at this writing he is reportedly close to making a decision on a DABM (Defense Against Ballistic Missile) program.

The Subcommittees on Investigations and Research and Development of the House Committee on Armed Services recently held intensive hearings on DABM approaches, with the Defense Department's Under Secretary for Research and Engineering, Dr. Richard DeLauer, acting as the principal government witness. Asserting that an effective multiple-layered defense may become feasible by about the year 2000, he warned, however, that the "most fragile part" of such a concept is its ability to survive "counteractions that might be taken against it."

Dr. DeLauer predicted that a comprehensive defense against ballistic missiles will have to cover four distinct phases of a ballistic missile's trajectory—the boost, post-boost, mid-course, and terminal regimes—because defense in one phase alone probably would miss too many "leakers." Interception in the boost phase is both the most effective and difficult element of DABM, he told the panel, because detection, discrimination, targeting, and interception would have to be accomplished almost instantaneously. Further, the attacker might try to confuse the defender with large numbers of decoys.

In the post-boost phase, the defense still has a chance to destroy several warheads at once, before they have been directed against individual targets. Pointing and tracking as well as discrimination of decoys as opposed to legitimate targets during

IN FOCUS...

this phase are probably easier to accomplish than at other times, he suggested.

Mid-course defense, Dr. DeLauer predicted, will turn out to be more difficult because it becomes necessary to discriminate between debris, decoys, and the individual reentry vehicles, which by now have separated from the boost-post vehicle, or "bus."

In the terminal phase, discrimination is somewhat easier because the atmosphere sorts out lightweight decoys from the heavy, shielded reentering warheads, but there is only a short period during which interception can be accomplished.

The Defense Department's ranking technologist dismissed as "loose talk" the notion that the US could attain an effective DABM capability with a level of effort comparable to the World War II Manhattan Project that produced the A-bomb or to NASA's Apollo program that landed man on the moon. The difficulties associated with fielding a workable DABM, he told the congressional panel, are equal to or exceed those of the Manhattan Project in each of such individual component areas as battle management, pointing and tracking, and interception and destruction.

Singling out battle management as the "most awesome" task associated with DABM, he said some of the associated functions "we can't do yet." He added that neither the computers nor the hardening against countermeasures needed to perform this kind of battle management exist.

Kill mechanisms that are candidates for various phases of DABM include pulsed and continuous-wave laser designs. He singled out pulsed shortwave lasers of either the X-ray or excimer (rare gases) type because of their potential capability to deliver a high impulse or shock to a missile to break or blow a hole in it and cause structural collapse of the booster.

Free-electron, excimer, and hydrogen fluoride/deuterium fluoride lasers emitting energy in a continuous wave could be used to dwell on a target until a hole is burned through it. Continuous beams of neutral particles, Dr. DeLauer said, are potentially capable of destroying internal components of reentry vehicles and, therefore, will be worked on further under the DABM program.

Kinetic energy rail guns and miniature homing vehicles will similarly be explored because of their "hit-to-kill" potential.

The cost of an operational DABM system, according to Dr. DeLauer, would be "staggering," with the R&D phase over the next five years alone ranging between \$18 billion and \$27 billion.

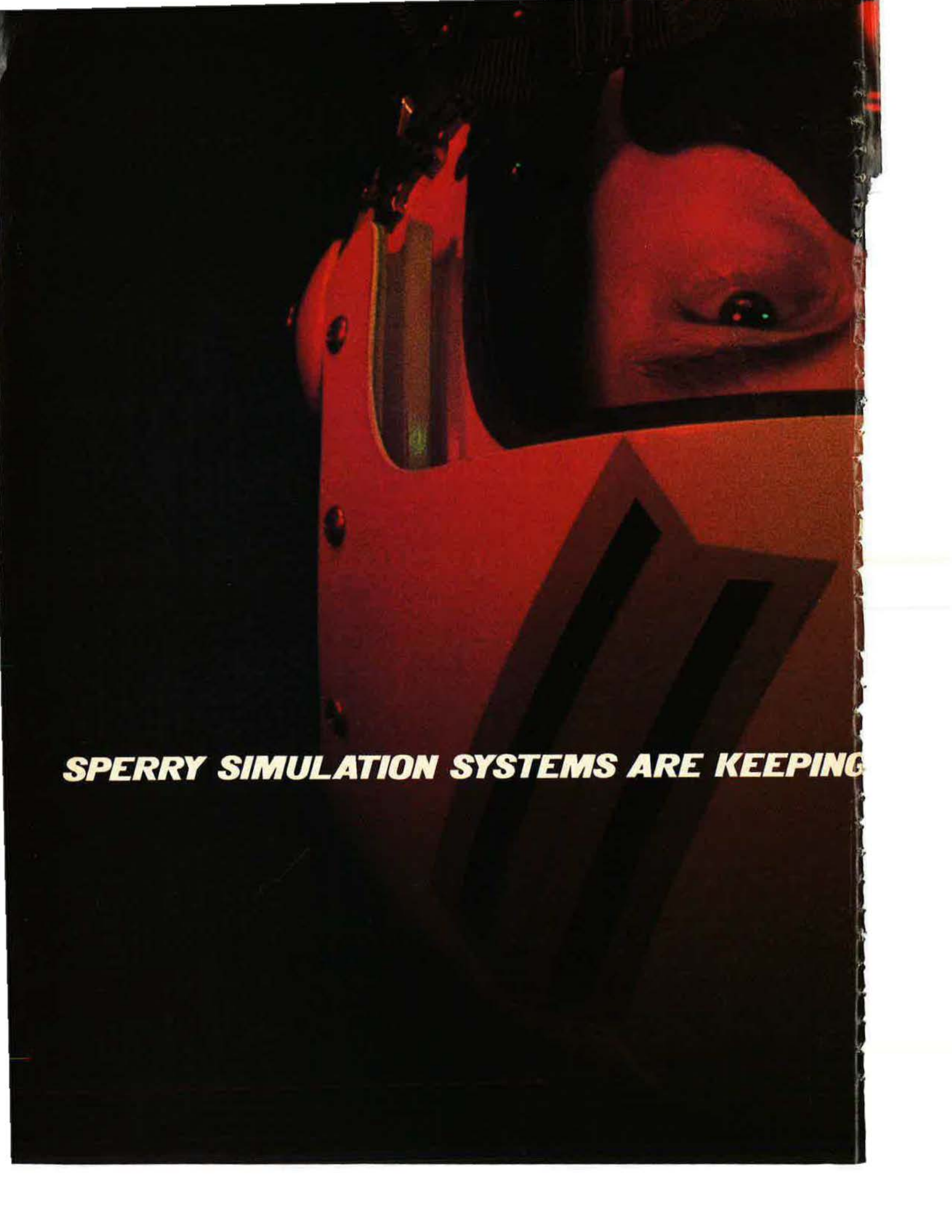
Washington Observations

★ Dr. William Perry, former Under Secretary of Defense for Research and Engineering, recently predicted at a symposium sponsored by the MITRE Corp. that the "cost performance" of computers will go up a thousandfold over the next ten years. The payoff in the defense sector from such a staggering advance might well be the capability to deter conventional warfare with conventional, nonnuclear weapons. Embedded computers, he suggested, might be imbued cost-effectively with a level of artificial intelligence that approaches human intelligence.

★ Air Force Chief of Staff Gen. Charles Gabriel recently told an AFA meeting that some 800 Air Force people were involved in the Grenadian rescue operation. MAC, TAC, SAC, and Communications Command provided the bulk of the personnel. Between 300 and 500 USAF personnel "were on the ground" at one time or another, mainly to perform security tasks, he said. SAC's role was intelligence collection and aerial refueling. TAC provided F-15 and E-3A AWACS aircraft, he said, adding that some of the command's A-10s "were deployed but not used." Some of MAC's C-130s had "some holes in them but made it, [and] the AC-130s were most useful" in shutting down hostile gun positions.

(For more on the Grenada operation, see "Blue Christmas Coming Up," p. 78.)

★ With a Unified Space Command apparently slated to come into being in 1985, concern is mounting about inadequate physical security at the Space Command's Headquarters located in downtown Colorado Springs, Colo., in a commercial building rented by the General Services Administration. Heavy civilian truck traffic in the neighborhood of the building and the known existence of a Marxist cell in Colorado Springs create a security nightmare for what is, in effect, America's first line of strategic warning. Plans for a new building have been slipped to FY '87 because of budgetary pressures. ■



SPERRY SIMULATION SYSTEMS ARE KEEPING



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The U.S. military services rely on Sperry for a wide spectrum of aircraft simulation systems. So do other military forces around the world.

For Navy ECM crews, Sperry built the team trainer for the EA6-B Prowler. And Sperry is participating in the development of a simulation system to train Air Force EF-111 air crews.

Under a U.S. Coast Guard contract, Sperry will design, test, and deliver flight training systems for the Falcon aircraft and the Dauphine Helicopter.

For the U.S. Navy and the Royal Australian Air Force, Sperry designed, and is producing, advanced flight simulators for the highly computerized F/A-18 air-

craft. Sperry simulators train U.S. Marine A-4 Skyhawk pilots and A-4 pilots of a growing number of nations.

And Sperry was selected to provide a full range of simulators for the Navy's new undergraduate flight training system.

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AEROSPACE WORLD

News, Views & Comments

By William P. Schlitz, SENIOR EDITOR

Washington, D. C., Dec. 6

★ The US and UK have signed a memorandum of understanding that formalizes British participation in DoD's Joint Tactical Information Distribution System (JTIDS) acquisition program.

JTIDS is a joint-service effort to provide high-capacity, secure, jam-resistant, digital data exchange among tactical forces. The system is to be capable of voice as well as digital communications, location and navigation data, and identification of users.

The transmission and reception of digital information among many joint participants is possible through Time Division Multiple Access (TDMA) technology, developed jointly by USAF and the US Army.

While the US Navy has developed a variation of TDMA technology, all the services are currently pursuing related activities involving full-scale development and system introduction as follows:

- USAF Class 1 command terminals entered production in July 1980 and are currently providing JTIDS capability to a number of US and NATO Airborne Warning and Control System (AWACS) aircraft, their "identified" aircraft, and their "identified" ground command and control interface facilities.

- The Air Force/Army Class 2 tactical terminal program, which entered full-scale development in January 1981, will provide JTIDS terminals and associated displays for such platforms as the F-15, the Army Data Distribution System, and UK's Tornado interceptor.

- The Navy/Marine Corps JTIDS program entered full-scale production in January 1982 and is developing three sizes of terminals. The Navy is to provide JTIDS command/control and tactical terminals for ships, aircraft, and USMC ground command and control facilities.

Initial Army/Air Force Class 2 and Navy/USMC terminals are to begin operations in the late 1980s.

Since the US's first offer of JTIDS to NATO in 1976 as part of the NATO AWACS program, the UK has led the way as the strongest supporter of the system for the Alliance, according to DoD officials.

In the past four years, the UK has increased this participation by acquiring Air Force Class 1 and 2 developmental terminals for electromagnetic compatibility testing. It recently announced it has approved acquisition of USAF/USA Class 2 TDMA terminals for use in the Tornado aircraft.

The UK is continuing to examine the use of JTIDS terminals for applications in other platforms.

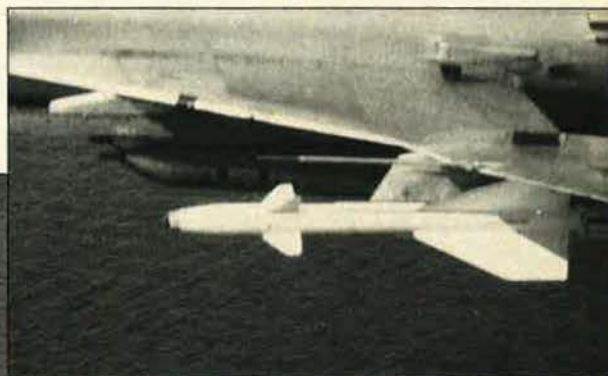
Continued cooperation between the US and UK on JTIDS conforms with long-established DoD policy supporting improved intercommunications systems within NATO.

★ The Navy has successfully flown an F/A-18 Hornet fighter off a "ski jump" elevated ramp at the Naval Air Test Center, Patuxent River, Md.

Presumably, the idea has been borrowed from the British, who have for some time been launching Harrier jump jets on abbreviated takeoffs from ships equipped with "ski-jump" devices.

The test flights are part of the S Jump Launch Assist program, an attempt to determine the feasibility of using elevated ramps to shorten takeoff distances for conventional aircraft. Previous tests were conducted with T-2C and F-14A aircraft.

The tests were initiated using a takeoff distance of 1,600 feet with this being narrowed in stages to 750 feet using combat-rated thrust. By con-



These striking, close-up photos (courtesy of the Swedish Coast Guard) show for the first time a Sukhoi Su-15 Flagon-F of the Soviet Air Forces armed with underbelly gun pods as well as the familiar AA-3 Anab missiles. This is the type of aircraft flown by Soviet Maj. Vasily Kazmin on September 1, 1983, when he shot down the Korean Air Lines 747, Flight No. 007, that had strayed over Soviet territory.



Bell Helicopter has test-flown its AH-1J Sea Cobra for airworthiness, including airframe compatibility with Rockwell International Missile Systems Division's Hellfire antiarmor missile. Flight load and vibration tests, covering the complete performance envelope, have been completed. Missile firings are planned for early 1984. The AH-1J and Hellfire are part of a US Marine Corps program.

trast, a normal field takeoff for the F/A-18 takes almost 1,900 feet at the weights being tested.

The aircraft was piloted by Cmdr. Jon Eastman, USN, and Maj. Tom Wagner, USMC. The ramp is sixty feet wide by 122 feet long and was elevated to nine degrees in the most recent tests.

★ The Air Force Instrument Flight Center that recently went into operation at Randolph AFB, Tex., is designed as the focal point for USAF instrument flight matters.

Such concerns were previously shared among ATC, AFCC, and Hq. USAF, according to Col. Jay Baker, Commander of the Center.

The Center is responsible for the development, review, and update of instrument flight procedures, manuals, training programs, and publications. Center personnel are to develop procedures and techniques for use with advanced cockpit displays, such as the head-up display in the F-16 Fighting Falcon.

The new Center was created based on an Air Force study indicating that new technology in weapon system and instrument displays demanded a central point of contact. The study also concluded that publications and training programs for instrument flight functions needed special handling to keep pace with developments.

★ MAC intends to modify its fleet of C-141s and C-130s with cockpit recorders by 1985.

The "off-the-shelf" commercial recorders should be crash-survivable and are to record communications between the aircraft and the ground, interphone conversations at selected crew stations, and all talk in the cockpit area.

"This system will give an investigation board an opportunity to hear a crew's verbal reaction to a situation as it unfolds," explained MSgt. Kenneth L. Erwin, a MAC communications

specialist. As with such civil airliner devices, the recorders will make available the verbal chronology of an accident as it happened.

A C-130 depot-level modification is under way, with completion expected in 1985. Final modification of the C-141s is expected early in 1985. The C-141s are also being modified with new digital flight data recorders.

★ Recently completed was the first phase of a two-part program to improve command control and communication of SAC's ICBM force.

The work included installation of satellite terminals and the upgrade of the existing communications system in each of the 100 Minuteman launch control centers. These each monitor ten missiles.

Expected to be initiated in mid-1985, Phase II is to equip the ICBM force with a highly sophisticated digital data network.

The new satellite terminals provide direct UHF communication between each launch control center and the National Command Authorities. In addition, SAC's survivable low-frequency ground-wave communications system has been modified to improve antijam capabilities.

According to officials, Phase I is a milestone in SAC's modernization program and is a key item in President Reagan's six-point strategic modernization plan.

★ "Sands of Time" Kitty Hawk Award

Flight Test Museum Planned for Edwards AFB

Plans are afoot for the establishment of an outdoor aircraft museum at Edwards AFB in California. Appropriately, the theme is to be the history and heritage of flight testing at Edwards.

In the past forty years, Edwards has emerged as the largest aircraft flight test facility in the free world.

A group of citizens—the nonprofit Flight Test Historical Foundation—has been incorporated in California to plan and then operate the museum at Edwards. President of the group's twenty-four-member Board of Directors is Col. William "Pete" Knight, USAF (Ret.), a former test pilot who served as Vice Commander of the Air Force Flight Test Center before his retirement in 1982.

The board has begun scheduled meetings to develop plans for various categories of public membership, fund raising, location and collection of aircraft and artifacts, site preparation, and eventual construction of a visitors center. Membership in the foundation is to be open to all citizens and businesses.

Aircraft on display are to be in a walk-through park near the main Edwards complex within sight of the flight line, with the visitor center to house historical exhibits and artifacts.

Construction and development costs are to be raised entirely through individual and corporate donations, public memberships, and fund-raising activities. No government funds are to be expended, officials noted.

The Air Force Museum at Wright-Patterson AFB, Ohio, is the custodian of all Air Force aircraft on public display throughout the US, and those to be exhibited at Edwards will be on loan from the Air Force Museum.

The foundation's Board of Trustees is made up of a cross section of top figures in American aerospace including two former AFTC commanders, several former astronauts, corporate leaders, and aviation historians.

winners were to be honored December 9 at the twenty-first annual Wright Brothers Banquet in Beverly Hills, Calif.

The recipients include two well-known figures in the world of aerospace and a newcomer who seems to have a splendid future shaping up:

- **Gen. Charles A. Gabriel**, Air Force Chief of Staff since July 1982.

- **Dr. Allen E. Puckett**, head of Hughes Aircraft Co., who has held key posts with the company for more than three decades and who has served on numerous industry and government committees.

- **Wendy Allison Wood** is the Kitty Hawk Youth Award winner. She was sweepstakes winner in the California State Science and Engineering Fair in 1981 and 1982 for her work in mathematics. In her studies and research, she has also been involved in the design of more efficient hydraulic and pneumatic systems.

Ms. Wood has also discovered a whole new group of continued fractions "never before presented in literature," according to the Los Angeles area Chamber of Commerce, which sponsors the annual awards. An hon-

AEROSPACE WORLD

ors group member of the Westinghouse Talent Search and a scholarship winner in the Thomas Alva Edison/Max McGraw Scholarship program, she plans to pursue a career in aeronautical engineering. Ms. Wood is currently in the twelfth grade.

- ★ The Air Force is planning an unmanned radio network designed to transmit emergency and wartime messages throughout the country.

The Ground Wave Emergency Network (GWEN) will rely on a mix of shared commercial radio and television towers as well as its own 300-foot-tall antennas.

The towers are to transmit low-frequency signals (150 to 175 kHz) that tend to hug the earth's surface and that are less susceptible to disruption than radio signals reflected off the atmosphere.

Another security factor will be the relay stations' shielded and secure enclosures, officials noted. They will house radios, air conditioners, heaters, and power equipment for use should commercial electricity be interrupted. Each station will be designed to resist the heavy power surges produced from nuclear detonations that would short-circuit most systems.

If any single relay or group of stations were to fail or be destroyed, messages in the system would automatically be routed along alternate paths.

Airborne crews in Air Force E-4Bs and EC-135s (flying command posts) and land-based forces throughout the country will receive messages via GWEN. The full system, with hundreds of unmanned stations, is expected to be operational by the late 1980s.

AFSC's Electronic Systems Division has awarded \$97.6 million to RCA Corp.'s Government Communications Systems Division, Camden, N. J., as prime contractor. About sixty stations are to be built and tested during the initial phase of the program to

Enlisted R&D Program Managers

The shortage of engineering officers that became apparent in the late 1970s could have had a severe impact on current and future Air Force programs and technologies.

Instead, today more than 200 Air Force NCOs and airmen are performing as engineering and scientific technicians in support of research efforts.

Gen. Alton D. Slay, former AFSC Commander, was instrumental in initiating the concept of assigning program management jobs to senior NCOs capable of managing acquisition projects within Aeronautical Systems Division's Deputate for Aeronautical Equipment.

According to Col. William E. Craven, assistant deputy for Aeronautical Equipment programs, "The research and development technicians assigned here complement my officer corps. They often accompany engineering officers on field evaluations to point out the pitfalls of a particular support system," he added.

"What better way to field better equipment than to learn from someone who has personally confronted problems associated with a particular system on the job? We want to draw on their years of experience with hands-on use of support equipment and knowledge of the frustrations in different situations. They've experienced starting a cold engine, equipment failures during specific or critical tasks, and the day-to-day burdens of maintenance," Colonel Craven explained.

Senior NCOs at ASD were the first to become involved based on availability and recommendations of their commanders. Of the forty-six senior and chief master sergeant candidates interviewed during the initial phase of the program, three were selected for the Air Force Institute of Technology Program Management Course (the same course offered to cross-flow officers).

A number of problems with assigning enlisted members to officer slots had to be resolved at Air Force level prior to implementation of the new concept.

An appropriate Air Force Specialty Code had to be estab-

lished for NCO program managers as well as screening regulations, manuals, policy letters, etc., to identify revisions needed to remove grade restrictions on academic and training courses. It was also imperative that the NCO program managers remain in place long enough to provide an opportunity to evaluate the concept and to provide stability so USAF could recover the investment made in training.

The Special Duty Identifier selected was 99501: Research and Development Technician. In summary, duties entail performing engineer, scientist, or engineering scientific technician tasks in support of research applications functions involving observations, study, and experimentation with Air Force agencies and activities.

Academic background for NCO program managers must include either chemistry, computer technology, electronic systems, aeronautical or electrical engineering, physics, and aerospace or mechanical engineering. Hands-on experience is also recommended in aircraft maintenance, electrical systems, missile maintenance, computer electronics, avionics systems, or munitions and weapons maintenance.

According to SMSgt. Bob Mengel, program manager for a mobile aircraft arresting system, "As a program manager you must be able to handle all functions related to the effort you head. This includes initiating contracts, planning the funding, procuring what you need, writing test plans, and briefing and coordinating with other agencies and services," he added.

The twenty-three-year Air Force veteran began his career in medical research and then switched to aeronautical equipment in 1981. "My first program was an airfield lighting system. When I complete my current \$120 million program, I will be managing a new boroscope system that will be used to look into aircraft engines," Sergeant Mengel noted.

Added Colonel Craven: "This concept will remain viable even if more officers become available, as long as we continue to employ enlisted help based on skill, talent, and experience."

—SSGT. ROBERT L. MATHEWS

FORWARD INTO THE FUTURE OF FLIGHT.

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

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provide a "thin-line" communications network throughout the US by 1985, officials noted.

★ Following an interim of eleven years, the 4th Weather Wing has been reactivated at Peterson AFB, Colo., to fulfill the requirements of recently created Space Command.

The 4th Weather Wing is to provide or arrange weather services in support of missile warning, space surveillance, and air defense activities, officials said. This will include support of the North American Aerospace Defense Command as well as atmospheric and space environmental services for AFSC's research and development projects. In addition, the wing will manage a worldwide network of Air Force solar observatories.

Other wing responsibilities will include launch and recovery weather forecasts for Space Shuttle and other space-related activities at Kennedy Space Center in Florida and Vandenberg AFB in California. The wing is to have more than 300 people assigned to twenty-two installations around the world.

With the reactivation of the 4th Weather Wing has also come the consolidation of the management of Air Weather Service worldwide space environmental observing sites.

★ Members of the 50th Tactical Fighter Wing team from Hahn AB, Germany, were the overall winners of the two-week Gunsmoke '83 competition. The 50th is equipped with F-16 Fighting Falcons.

The tactical gunnery and bombing event took place recently at Nellis AFB, Nev.

"Top Gun" this time was Lt. Col. Roy Neisz, an F-16 pilot with the 388th Tactical Fighter Wing at Hill AFB, Utah.

In award ceremonies, Gen. Charles Gabriel, Air Force Chief of Staff, noted that "tactics, training, and technology" would be the key factors in counteracting Soviet superior numbers in any confrontation.

About 800 blue-suiters accompanied eighty tactical fighters from sixteen Air Force units around the world. Other aircraft included A-7 Corsair IIs, A-10 Thunderbolt IIs, and F-4 Phantom IIs.

Aircrews were judged in basic weapons delivery, tactical bomb delivery, and navigation/attack. Maintenance crews were put through their paces and munitions crews participated in "loaders."

★ FAA has reconsidered its decision and will now allow two-place ultralight aircraft for flying training.

AEROSPACE WORLD

The exemption permits authorized persons to give flight instruction in powered ultralights not more than 350 pounds empty weight that have a power-off stall speed of not more than twenty-nine knots calibrated airspeed.

Furthermore, the two-place ultralights are to be placarded: "To be used for instruction only."

Single-occupant flights of two-place ultralights are restricted to

flights associated with instruction, such as ferrying the aircraft between locations, and must be flown by an authorized instructor.

★ American record-setting pilots were recognized in ceremonies during the recent National Aeronautic Association annual meeting.

Among them:

● Joanne Anderson of Denver, Colo., made the first ultralight transcontinental flight in her Eipper MX from San Diego to Kitty Hawk in seventeen days.

● Elvis Cruz of Miami, Fla., flew an ultralight seaplane from the Bahamas to Miami to set class speed and distance records.

● Dean Edmonds of Boston, Mass.,



Seated in a student cockpit trainer, MSgt. David Geer performs "hands-on" maintenance training procedures for the F-15's electrical power, lighting, and engine operative systems. Honeywell Training and Control Systems Operations, under contract to McDonnell Aircraft Co., St. Louis, Mo., delivered the first of two Simulated Aircraft Maintenance Trainers for the F-15 Eagle to Luke AFB, Ariz., late in 1983. In addition to the cockpit, the trainer includes a master simulation control console.



The 50th Tactical Fighter Wing, Hahn AB, Germany, came out on top in overall standings in Gunsmoke '83. The F-16 team scored a total of 9,378 points in the bombing, strafing, and navigation competition. See item. (USAF photo)

Blue-Suiters in Top DoD Public Affairs Posts

USAF career officers took over two top leadership posts in the Defense Department's public affairs shop late last year.

Lt. Col. Michael I. Burch, who retired from the Air Force in August after twenty years of active duty, was sworn in November 30 as Assistant Secretary of Defense for Public Affairs, succeeding Henry E. Catto, Jr.

At the same time, Col. Robert E. O'Brien, Jr., who had been Director of Defense Information, was promoted to Deputy Assistant Secretary of Defense for Public Affairs.

Colonel Burch was commissioned through AFROTC at the University of Missouri in 1963. From 1972 to 1983, he was stationed at the Pentagon in the Office of the Secretary of the Air Force and then in the Office of the Secretary of Defense, including four years as Military Assistant to the Assistant Secretary of Defense for Public Affairs.

After retiring from the Air Force, Burch became president of Washington Communications Corp., publisher of *Washington Journalism Review*. He returned to the Pentagon at the request of Defense Secretary Caspar W. Weinberger.

Colonel O'Brien entered active duty in 1957, having been commissioned through AFROTC at Northwestern University. Subsequently he served in Southeast Asia and at the Pentagon and later became director of public affairs, Hq. AFSC, Andrews AFB, Md. He returned to the Pentagon in August 1982.

—J. W. C.

and his crew set a speed record in a Beech Baron from Miami to Boston.

• Charles Hall of Cedar Rapids, Iowa, flew a Sabreliner business jet from Cedar Rapids to the Paris Air Show, navigating solely by Collins Radio satellite equipment. Using only Navstar signals to taxi and park also demonstrated the aviation potential for such equipment.

• Paul Musso of Mt. Laurel, N. J., set a 15-km straightaway speed record in his original-design "Real Sporty" Formula One racer.

★ The master control station for the Navstar Global Positioning System will be at the Consolidated Space Operations Center under construction at a site nine miles east of Peterson AFB, Colo.

When the system becomes fully operational in the late 1980s, it will be run by about 240 military and civilian personnel. The station will control

AEROSPACE WORLD

eighteen satellites, of which seven have been launched successfully.

The orbiting satellites are currently controlled through test facilities at Vandenberg AFB and Sunnyvale AFS, Calif. Vandenberg provides navigation data while Sunnyvale provides tracking, telemetry, and command data.

Navstar will be a multiservice, all-weather system that will provide US and allied land, sea, and air forces with accurate position, velocity, and timing information anywhere in the world.

Ten NATO countries are to participate in developing and deploying the system: Belgium, Canada, Denmark, France, West Germany, Italy, the

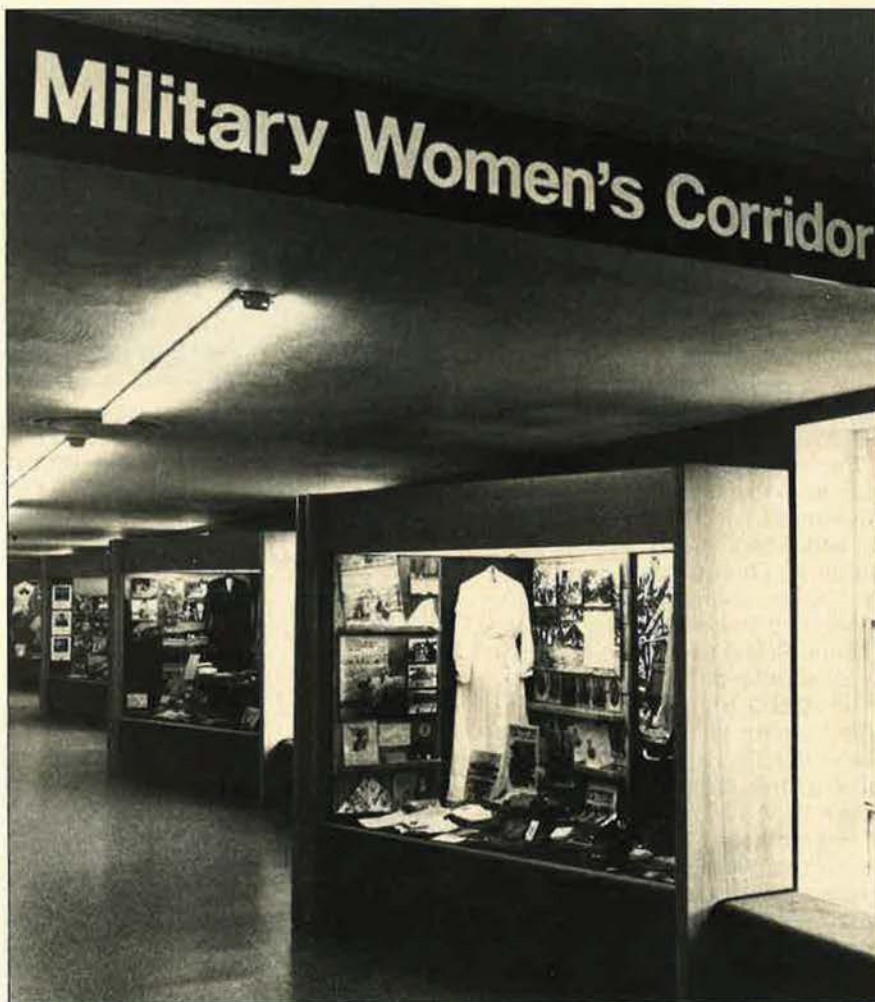
Netherlands, Norway, England, and the US.

★ NASA has agreed to fund a second step in the design of the Solar High-Altitude Powered Platform (Solar HAPP).

David W. Hall, program manager and designer at Lockheed Missiles & Space Co., Sunnyvale, Calif., said that earlier work funded by NASA's Langley Research Center demonstrated the feasibility of using photovoltaic cells to power high-altitude vehicles. The follow-on effort is to undertake conceptual designs, including a representative HAPP configuration.

Mr. Hall said that subsequent steps might include building part of the structure and mounting cells by 1984, designing and building a power train by 1986, completing the airframe in 1987-88, and flight tests by 1990.

The Solar HAPP would look like a flying wing and could loiter up to a year between 60,000 and 80,000 feet, its large pusher propeller powered by



In recognition of past, present, and future contributions, the Military Women's Corridor was recently dedicated in the Pentagon. In display cases are several thousand artifacts, dating from colonial times to the present, donated by individuals and the services. See item on p. 31.

the solar cells. The solar cells would cover two vertical stabilizers and the tops and bottoms of the wingtips, which would hinge upward to the vertical during the day to catch maximum sunlight. At night, they would return to the horizontal to improve aerodynamic efficiency while the HAPP would use power from fuel cells charged during daylight.

The Solar HAPP might have a wingspan between 100 and 300 feet, weigh between 1,000 and 3,000 pounds, and be capable of seventy-five knots at altitude. Light, strong graphite epoxy would comprise the main structure, with Mylar and Tedlar coating the wings.

The Department of Agriculture and NASA are jointly studying potential applications, such as crop management.

★ In November, the Military Women's Corridor was dedicated at the Pentagon.

The tribute to military women is located on the second floor "A" Ring between the seventh and eighth corridors. It has been "designed to acknowledge the contributions being made by today's military women, to pay tribute to their dedicated predecessors, and to provide incentive for the women of tomorrow as they meet

the challenges of the future," officials said.

The corridor opens with the forerunners of American servicewomen dating back to colonial times, picks up by tracing the history of military women from World War I to the present, and concludes with an audiovisual display that highlights the importance of women in the military today and in the future.

The numerous artifacts and memorabilia filling the corridor's display cases were contributed by the museum systems of all the services and many individuals and organizations.

Women have been a formal part of the military services since 1901. Today, some 200,000 women are in uniform.

Died in October in San Antonio: **Lt. Gen. Patrick W. Timberlake**, USAF (Ret.), Commander of IX Bomber Command in North Africa in 1942. The next year he became British Air Chief Marshal Tedder's Director of Operations and Plans and later was Tedder's Chief of Staff. Later in World War II he returned to Hq. AAF as Deputy Chief of the Air Staff. Before his retirement in 1957 he served as Commander, Allied Air Forces Southern Europe. The 1923 West Point graduate was eighty-one. ■

INDEX TO ADVERTISERS

Aerojet-General Corp.	6 and 7
Aerospace Historian	31
AIResearch Mfg. Co., Garrett Corp.	11
Allstate Insurance	91
American Airlines Training Corp.	33
Aviation Week 1984 Calendar	98
Bendix Corp., Test Systems Div.	Cover III
Boeing Military Airplane Co.	85, 86, and 87
EDO Corp., Government Systems Div.	28
Ferde Grofe Films—Aviation A. V. Library	31
Ford Aerospace & Communications Corp.	52 and 53
Games Publishing	101
General Electric, Aircraft Engine Div.	Cover II
Grumman Aerospace Corp.	27
GTE Communications Products Corp.	50
Hughes Aircraft Co.	19
IBM Corp., Federal Systems Div.	2 and 3
McDonnell Douglas Corp.	Cover IV
Northrop Corp.	15
Rockwell International, Collins Government Avionics Div.	5
Singer Co., Kearfott Products Div.	49
Sperry	22, 23, and 92
Syscon Corp.	8
Teledyne CAE	16
TRW Systems Group	20
Turbomach Div. of Solar Turbines Inc.	12
AFA Insurance	102 and 103
AFA Member Supplies	101



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CAPITOL HILL

By Kathleen G. McAuliffe, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Nov. 26

DoD Funds for FY '85

Defense Secretary Caspar Weinberger is considering a \$330 billion budget for the Pentagon in FY '85. According to key defense officials, the Secretary first informed Congress of the tentative budget figure in a meeting with Senate Budget Committee Chairman Sen. Pete Domenici (R-N. M.) and Armed Services Chairman Sen. John Tower (R-Tex.).

A \$330 billion request would represent about a twenty-two percent real increase in defense over the FY '84 budget. The growth rate presumably would make up, in part, for congressional budget cuts over the last two years. According to some figures, \$42 billion in budget authority was cut from the President's request over the three-year period FY '82-84.

The meeting with the key Senate chairmen focused on the political realities of twenty-two percent real growth for the Pentagon amid mounting deficits. Growing concern about the deficit makes it a prime campaign issue in next year's election when GOP control of the Senate may be at stake. Hence, DoD sources anticipate the defense budget will be lowered by the White House before it is formally submitted to Congress in January.

FY '84 Appropriations

Congress passed a \$249.8 billion FY '84 defense appropriations bill—the largest appropriations measure ever approved by Congress—only hours before adjourning for the year. The bill provides 3.5 percent real growth over FY '83 defense spending, well below the five percent increase provided by the congressional budget resolution. It is also \$11 billion below the President's amended request. With about \$7 billion in previously approved military construction funds, the Pentagon has a total of \$257 billion to spend in FY '84.

The measure provides for almost all the President's plans to modernize and increase the readiness of US forces—with the notable exception of funds deleted for production of binary chemical weapons. However, the

bill was criticized by some as barely living up to US insistence that NATO countries fund their national defense at a real growth rate of three percent each year.

Senator Tower told Congress that it was sizing the "military budget to budgetary considerations rather than requirements . . . in reducing the amount we spend, what we do is stretch out programs, reduce production rates . . . in fact, build in cost overruns." The Senator wants Congress to examine putting more money up front in procurement in order to save money in the outyears.

DABM Costs

Costs for implementing a Defense Against Ballistic Missiles (DABM) program, as envisioned by the President earlier this year, could be "staggering." Dr. Richard DeLauer, the Pentagon's chief of research and engineering, told the House that "you will be staggered at the cost of any one of the [candidate] technologies when the time comes to deploy." Any one of the technology efforts needed to implement such a defensive system exceeds the magnitude of the World War II Manhattan Project, he said.

The comments came as the House began an in-depth look at DABM feasibility, specifically at legislation sponsored by Rep. Ken Kramer (R-Colo.) and Sen. William Armstrong (R-Colo.) that would provide the organizational support structure for carrying out the President's defense program. Their proposal would make Space Command a unified command with full responsibility for deploying and operating all space- and ground-based strategic defenses, and would create a new agency to coordinate all directed-energy technology programs.

The President's defense initiative is fully compatible with all existing treaties because it calls for broad R&D efforts only, according to Assistant Defense Secretary Richard Perle.

DoD, which is currently spending about \$500 million a year on directed-energy programs, planned to ask Congress for \$1.8 billion in FY '85 and

\$18 billion for FY '85-89 for all defense programs, including those in the field of directed energy. Those figures are expected to increase twenty-five to fifty percent as a result of recommendations submitted to DoD by a panel of scientists specially appointed to study the missile defense concept. The President is to decide on the funding increase next month.

DoD is calling now only for a technology exploitation program with development in the late 1990s and possible deployment after the year 2000. Costs for full deployment could be the equivalent of the strategic forces budget—some fourteen percent of the total defense budget.

Warranties on Future Systems

The House and Senate approved an amendment, initiated by Sen. Mark Andrews (R-N. D.), that requires the prime contractor of a system to provide the government with a written guarantee for the service life of that system. A Senate report accompanying the FY '84 defense appropriations bill stated that "tax dollars should no longer be expended for the purpose of producing military weapons that are operationally unreliable, do not meet the military mission, task, and threat, and may imperil the lives of our troops. . . ."

The only loophole is that the Secretary of Defense may waive the requirement if it is deemed not to be in the national interest or not cost-effective. A written explanation to Congress, however, would be required.

Congress plans to look at the issue in greater depth during the FY '85 budget cycle. There is concern in DoD and in some congressional circles that warranties should apply to subsystems only. According to Deputy Secretary of Defense Paul Thayer, blanket provisions would reduce the opportunities for competition in spare parts in systems as Congress wants, inhibit contractors from pursuing innovative but risky technology, and increase costs significantly. The warranty issue was popular and not challenged, in part because of potential political fallout for opponents. ■

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Mature technologies are at hand for engines, airframes, and avionics. The tough part is how best to put them all together in the most integrated aeronautical systems ever built.



Toward the Totally Integrated Airplane

BY JAMES W. CANAN
SENIOR EDITOR

FIGHTER pilots are here to stay. USAF is dispelling any doubt about that, and not just with traditionalist rhetoric. It is in the process of automating aircraft to a very high degree. But it is also demonstrating that such automation will enhance—not diminish—the pilot's responsibilities and roles.

The evidence lies within Air

Force Systems Command's Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio. There, the Air Force Wright Aeronautical Laboratories (AFWAL) are marshaling a mind-bending array of newly mature or fast-ripening technologies for convergence in future high-performance aircraft. And the spotlight is on USAF's Advanced Tactical Fighter program, which is now, finally, a going concern.

As presently conceived, the ATF

will be far more capable than any fighter yet built. But it will not overtax its pilot. On the contrary, its technologies will mesh to make the pilot's many tasks more manageable, his cockpit less cluttered and disconcerting, his presence more meaningful. The ATF will be a highly automated airplane, but its pilot will be anything but an automaton.

The promise of unprecedented compatibility between the ATF and its pilot springs partly from developments in the Advanced Fighter Technology Integration (AFTI) program, being managed by ASD for USAF, NASA, and the Navy. Capitalizing on rapid advances in avionics, propulsion, aerodynamics, computational capability, materials, and other high technologies, AFTI and an assortment of related programs are giving new meaning to the term "weapon system."

In short, the programs are showing that men, missiles, and flying machines will make an ever-better team, and that their future roles in air warfare should be examined in orchestration with—not in isolation from—one another.

Over the past several years, the US defense establishment's most fervent adherents of autonomous missiles have predicted that such weapons will render air-superiority aircraft and fighter pilots passé. They claim that, in air warfare of the future, aircraft will be employed merely as trucks to take the omniscient missiles aloft and cut them loose from afar. Moreover, the mis-



Advances in aerothermal-effects techniques permit testing of aircraft model (left) under varied combinations of heat and aerodynamic stress. This will pay off in the development of USAF's Advanced Tactical Fighter (ATF), perhaps resembling artist's futuristic concept (right).

sile buffs argue that high-performance fighters already strain their pilots' physiologies and powers of concentration, and thus have reached their limit of utility.

This problem was addressed in a 1982 report for AFSC by the Air Force Studies Board of the National Research Council. Called "Automation in Combat Aircraft," it said that "the intelligent allocation of tasks between pilots and automated systems has long been recognized as a key problem in the development of aerospace technology." That problem must be overcome, said the report, because "the human operator is a crucial component of the combat aircraft system." Moreover: "Any attempt to automate combat aircraft . . . must be done in the context of human capabilities and limitations."

The report recommended, among other things, that cockpit technologies be automated and integrated in concert with those of the rest of the aircraft and its weapons, lest the pilot be left behind.

Integrating Man and Machine

This is exactly what is happening at ASD. "What we're aiming for in the Advanced Tactical Fighter," explains Col. Albert C. Piccirillo, ATF Program Manager in the office of ASD's Deputy for Development Planning, "is to integrate the man and the machine to an unprecedented extent, to where everything—pilot, airframe, engines, weapons, fire controls, flight controls, and sensors—is interfaced and working as a total system."

The cockpit is the cynosure. "Cockpit integration and simplification are what we need," declares Brig. Gen. Ronald W. Yates, ASD's F-16 Program Manager. "We have got to the point where we provide the pilot with tremendous amounts of information, highly compressed, from many sources, all in real time. Often, he doesn't know what to do first. He doesn't need any more sensors or switches. He needs something to tell him, 'Here are your tar-



gets and your threats, and this guy is going to kill you unless you deal with him now.' "

This is being done. In the name of cockpit automation technology, ASD's laboratories and other USAF experts are studying the configuration and content of fighter cockpits. With an eye to the future, they are exploring such questions as how much should be done automatically vs. intervention by the pilot, how best to cohere and convey information on his panels, and what his optimum seat angles should be for certain tasks under certain conditions. Such research is relying heavily on simulators, an expanding arena at ASD.

Making the pilot a better manager of his work load will avail him nothing, however, if his fighter is too hot to handle, too easy to detect, lacking in combat radius for all its speed, or precluded from using airstrips torn up by enemy bombs.

This is why ASD is also concentrating on developing engine, airframe, and flight-control technologies that will restrain G loadings, provide short-takeoff-and-landing (STOL) capability while upgrading performance, and permit sustained supersonic speeds without using fuel-gobbling afterburners.

The many disparate technologies for accomplishing all this—at system, subsystem, and component levels—should be at hand by the time the ATF goes into full-scale development. But the tough part will lie in sorting out the technologies, and in forming the right combination at the right time for incorporation in the ATF. This, says Lt. Gen. Robert D. Russ, USAF's Dep-

uty Chief of Staff for Research and Development, will entail "a fantastic effort—but it's doable."

Lt. Gen. Thomas H. McMullen, Commander of ASD, agrees on both counts. General McMullen makes the additional point, a salient one, that "the integration of technologies has become a technology of its own." (See also p. 42.)

This is nowhere truer than in the ATF program, which Colonel Piccirillo confidently predicts will produce "the most integrated weapon system ever built." Such a prospect suggests a need for exquisite coordination among the already tightly knit AFWAL laboratories and ATF-related program offices. Thus, the sense of teamwork at Wright-Patterson is especially palpable now that the ATF is on its way.

After several years of discussions about the need for and timing of the ATF program, it came alive only last September. USAF awarded contracts to seven aerospace companies—Boeing, General Dynamics, Grumman, Lockheed, McDonnell Douglas, Northrop, and Rockwell International—for conceptual designs to be delivered next spring.

"The concept definition phase will do a great deal to converge our ATF technology options," explains Dr. Keith Richey, Chief Scientist at ASD's Flight Dynamics Laboratory. "We probably have five to six years to bring the technologies to the point of readiness. That's adequate time to do some technology demonstrations that need to be done, assuming the funding holds up."

The companies involved in the ATF program are guarding their

design concepts closely. For one thing, explains a high-ranking industry official, "eighty-five percent of what each of us [the companies] is doing is pretty well known to all the others. But the other fifteen percent is highly proprietary, and a lot of it has to do with how we plan to put all the technologies together."

Eluding Enemy Detection

There is another reason for silence. The fighter will be designed to embody a variety of advanced low-observables technologies. The threat makes this imperative.

As a result, ASD and its design contractors are up against the problem of keeping the ATF's radar, infrared, and optical signatures at very low levels, while retaining the classic capabilities of a fighter. Among other things, this means attaining transonic and supersonic speeds with minimum use of heat-spewing afterburners, a capability that is coveted for its fuel efficiency and fighting range as well.

It also means engine-inlet designs—a la the B-1B bomber and presumably the Advanced Technology Bomber (ATB)—that prevent enemy radar signals from echoing off of engine fan blades, and nozzle innovations, such as the "Venetian blind effect," for veiling exhaust emissions and thwarting IR seekers.

Eluding enemy detection will become exponentially more difficult for US aircraft in the years ahead. The Soviets continue to develop new generations of fighters and interceptors now rivaling, in their target-acquisition and fire-control capabilities, top-line US fighters and attack aircraft. Soviet radars operating with SAM batteries are also demonstrably more formidable. All such systems strongly suggest an increasing Soviet mastery of digital electronics, a technology in which the US has begun to lose its longtime lead.

The urgent need to outdistance the Soviets once again in microelectronics is the *raison d'être* of the

Pentagon's high-priority, triservice Very-High-Speed Integrated Circuits (VHSIC) program. A resounding success so far in development, the program is beginning to turn out semiconductor chips for military computers that should make them capable of processing signals and data at least a hundred times faster than is presently possible.

USAF can hardly wait for the VHSIC microprocessors. "The total integration of the avionics systems on each of our airplanes is number one among all our VHSIC program priorities," asserts one USAF official. And the ATF will be designed for VHSIC data and signal processing right from the start.

Given the Soviet threat, there is no longer much doubt among US defense policymakers—as once there was—of the need for the ATF. "Do we need it? We sure do," declares Deputy Defense Secretary Paul Thayer, a onetime fighter pilot. "I doubt that the Russians will come up with anything equal or superior to the ATF between now and sometime in the 1990s," Thayer adds, "but they'll certainly forge ahead in new fighters."

Even at that, such timing would make for a very close call. The ATF's first flight is not scheduled until 1991, which suggests operational status approaching the mid-1990s.

Cautioning against slippage in that schedule, General McMullen makes the point that "the ATF is already farther behind the F-15 than

the F-15 was behind the F-4." Moreover, USAF officials claim that in the context of fighter technology advancement, the leap from the F-4 to the F-15—even though both are jets—was longer than the one from the propeller-driven P-51 to the F-86 Sabre.

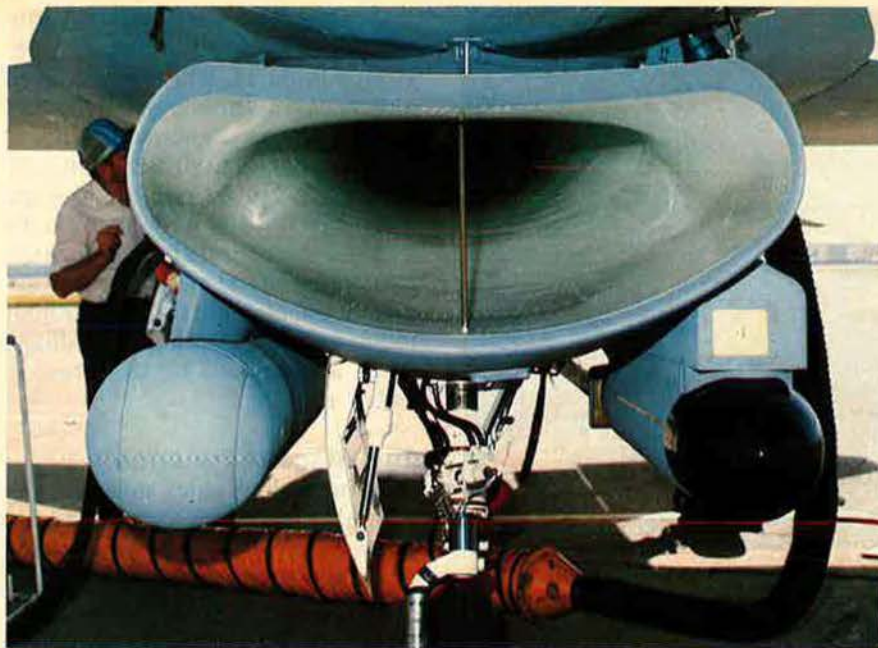
There is, however, a plus side to the ATF program pacing. In its current programs for upgrading or variegating the capabilities of its F-15s and F-16s, ASD is getting a more certain feel for technologies—and their integration—that are apropos of the ATF. Among them are improved radars, cockpit displays, flight controls, engines, and aerodynamic shapes, such as the cranked-arrow wing and the tangential weapons carriage features of the F-16 and F-15 Dual Role Fighter (DRF) candidates respectively.

ASD's F-16C and D development program provides insight into the problems of upgrading fighter technologies and integrating them as they go. The newer F-16s are being readied to accommodate, at various stages, the Advanced Medium-Range Air-to-Air Missile (AMRAAM), the Advanced Self-Protection Jammer (ASPJ), the Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) pods, and receivers and data links for the Navstar Global Positioning System (GPS) navigation satellites.

In addition, the F-16C and D variants will also contain new-generation radar altimeters, radar warning receivers, and perhaps—later on—

USAF Capt. Keith Beachy operates the Microprocessor Application of Graphics with Interactive Communications (MAGIC) simulator at ASD's Flight Dynamics Laboratory. MAGIC integrates voice-control and pictorial-display cockpit technologies.





F-16 test-bed aircraft is prepared for takeoff at Edwards AFB, Calif., carrying Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) pods on its air inlet. The LANTIRN system is expected to give USAF strike aircraft a much-desired capability for night-in-weather attack around the clock.

navigation systems employing ring laser gyroscopes.

All of the above, says General Yates, the program manager, "are fantastic challenges in advanced technologies in and of themselves. And they are all interactive. They have to play together as an integrated weapon. That's the biggest challenge of all."

A Dual Role ATF?

Facing up to that challenge from the outset of the design process is what the ATF program is all about. The challenge will become more and more complicated as ASD and its ATF contractors continue to cope with the very big question of how much air-to-surface capability the fighter should ultimately have.

The ATF will be designed, first and foremost, as an air-superiority aircraft. But, secondarily, it will also have to have air-to-surface capability.

At the moment, USAF is planning on a fleet of ATFs that could be at least as large in numbers as the planned fleet of F-15s. Justifying such numbers may be difficult in light of defense-budget stringencies and operational goals unless USAF promotes the ATF to the Defense Department and Congress as a highly flexible combat aircraft, no fudging about it.

Such duplication of missions in one aircraft may be possible with the ATF as never before. Given the swift pace at which aeronautics technologies are progressing and are being integrated, the best air-to-air and air-to-ground capabilities may indeed be attainable in the ATF. The reason: Historical trade-offs between those capabilities are no longer so severe as in the past, and may indeed be disappearing. This is being demonstrated by ASD's work on the Dual Role Fighter (DRF) program, and in its farther-out programs as well.

The ATF's potential for air-to-surface capability as a fully integrated weapon system is showing through in the ASD Avionics Laboratory's "night-in-weather-attack" program. That program is exploring new technologies to enable attack aircraft to fly and strike targets around the clock and in the nastiest weather imaginable.

A major program goal is to develop microelectronic target-acquisition and navigation systems that are not only more effective and reliable but also so small and compact that they will not encumber the aircraft in its air-superiority mode.

USAF has long believed that radars—of the synthetic-aperture or millimeter-wave variety—may be the key to this. But synthetic aper-

ture radar is apparently farther away from application than its adherents had hoped. And millimeter-wave radar turns out to have a lot of problems with raindrops and other forms of precipitation.

As a result, ASD's Advanced Target Acquisition Sensor (ATAS) experimentation takes on special significance. Looking beyond the LANTIRN system now in development, with its two outboard pods for navigation and targeting, ATAS—employing highly advanced Forward-Looking Infrared (FLIR) technology—shows great promise.

ATAS technology is expected to double the range of existing FLIR systems and to be much more difficult to spoof with countermeasures, such as flares. Moreover, ATAS will be sufficiently sharp-eyed, officials claim, to tell the difference between, say, a tank and a tank-mockup decoy.

ASD is also developing ultra-sophisticated software for fire-control avionics in strike aircraft. This comes under the MULTACK, for Multiple Target Attack, program. Its essence is software, and its goal is this:

When fire-control processors receive data from aircraft sensors showing multiple targets, the micro-processors themselves will work out the complex algorithms needed to deliver the aircraft's weapons onto those targets, in a discriminating manner, in just one pass.

ASD is also nurturing terrain-avoidance (as distinguished from terrain-following) technologies that will enable attack aircraft to approach densely defended ground targets on preprogrammed paths that approximate broken-field running in order to elude ground fire, and at altitudes as low as 100 feet. To this end, ASD is developing a carbon-dioxide laser detection system for the strike aircraft that should be capable of discerning attack-approach impediments as tiny as wires strung across canyons or gorges.

New Ways to Fly

While current fighter-enhancement programs teach ASD how to cope with technology insertion on the run, they are probably transcended—in their technological significance for the ATF and for other future aircraft—by the AFTI effort.



Grumman Corp.'s X-29 forward-sweptwing demonstrator aircraft takes shape at Grumman's Bethpage, N. Y., facility. Under Defense Advanced Research Projects Agency (DARPA) auspices, the X-29 will test the use of forward canards as the main control surfaces.

Accurately billed as a demonstration of "new ways to fly," AFTI is managed by ASD's Flight Dynamics Laboratory for USAF, NASA, and the Navy. One of AFTI's main test-bed aircraft, operating out of Edwards AFB, Calif., is an F-16 featuring a Digital Flight Control System (DFCS).

At the core of that system are three digital computers (natural for future VHSIC implantation) and copious multiplex data transmission buses that add startling dimension to the Fly-by-Wire (FBW) technology pioneered by FDL two decades ago. Now AFWAL is edging even farther out in such technology. It is testing "fly-by-light" controls in which a fiber-optic cable supplants electrical circuitry as the data link between computers and flight controls. Such links are lighter, faster (they can transmit more data, more swiftly, through smaller connections), and—very importantly—may be virtually impervious to electromagnetic interference.

If mature when needed, fiber optics technology could well find a home in the ATF. For now, however, FBW technology at the DFCS state of the art does quite nicely. DFCS's ultra-fine-tuning of control surface innovations such as the AFTI/F-16's twin vertical canards makes it possible for the pilot to fly the aircraft in several bizarre modes. Among these are sideways without banking and up and down with the aircraft at the horizontal—all the time with

weapons firmly on target or firing.

The weapons connection is a key one. It signifies one of the highest-priority goals of all future aircraft technology integration: the blending of fire and flight controls.

Now, ASD is moving to factor STOL nozzle technology into the high-maneuverability equation. Late last September, it issued an industry Request for Proposal (RFP) for a "STOL and Maneuver Technology Demonstrator" aircraft. The aim is to fly, by 1987, a test-bed aircraft with a two-dimensional exhaust nozzle for thrust vectoring and thrust reversing, all integrated by means of digital flight controls.

This program also comes under the heading of "sortie generation," one of AFWAL's four "major thrusts"—along with night-in-weather attack, supersonic persistence, and space applications. The sortie-generation endeavor is oriented to making future fighter and attack aircraft capable of taking off from and landing on damaged runways within 1,500 feet, maybe even slantwise, to avoid bomb craters.

Given the proliferation of Soviet long-range missiles and forward-based attack aircraft, this is an urgent matter. But the STOL program's payoff for in-flight fighter maneuverability, too, could be very big. Vectored-thrust nozzles, perhaps even blowing against the aircraft's surface, hold promise for some pretty fancy flying.

General Russ describes it: "With the flight controls being demonstrated in AFTI, and with vectored and reverse thrust, we'll be approaching the maneuverability of helicopters in high-performance fighters." For example, says the General, pilots will be able to "skid" their aircraft into turns—combining lateral movement and acceleration at high thrust—without inducing overpowering G loadings. Such a prospect, he declares, is "very exciting."

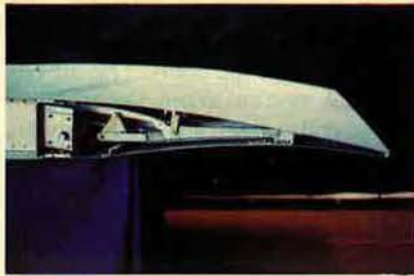
The Wings of Tomorrow

Wing technologies now bearing fruit also bode well for aircraft maneuverability. Over the years, wing designers have come up with an assortment of wings oddly shaped or meant to move in flight. Many have been wildly impractical. Some of the promising ones were far in advance of structures and controls technologies needed to make them worthy of application. Now such technologies have caught up, and new wing concepts are attracting greater attention.

One such concept is the forward-sweptwing that the Defense Advanced Research Projects Agency plans to test on Grumman's X-29 Advanced Technology Demonstrator aircraft. The wing skin is built of epoxy composites reinforced with boron and graphite fibers. This gives it stiffness to resist bending and torsion. Its champions are confident that the forward-sweptwing, working in conjunction with automated canards, will demonstrate eye-catching maneuverability.

Some high-ranking USAF officials appear to be interested in the DARPA program more for what it may tell them about canards, automation of controls, and the advantages and disadvantages of flying an intrinsically very unstable aircraft. But they are perking up to the potential of another design—the mission-adaptive wing.

Late next summer, the AFTI/F-111 aircraft is scheduled for first flight with a mission-adaptive wing. Now being attached to the F-111 by Boeing, its builder, and NASA, the wing has no conventional flaps, slats, ailerons, or spoilers. It changes camber (shape) in flight. Controlled by a digital FBW system, its advanced-composite lead-

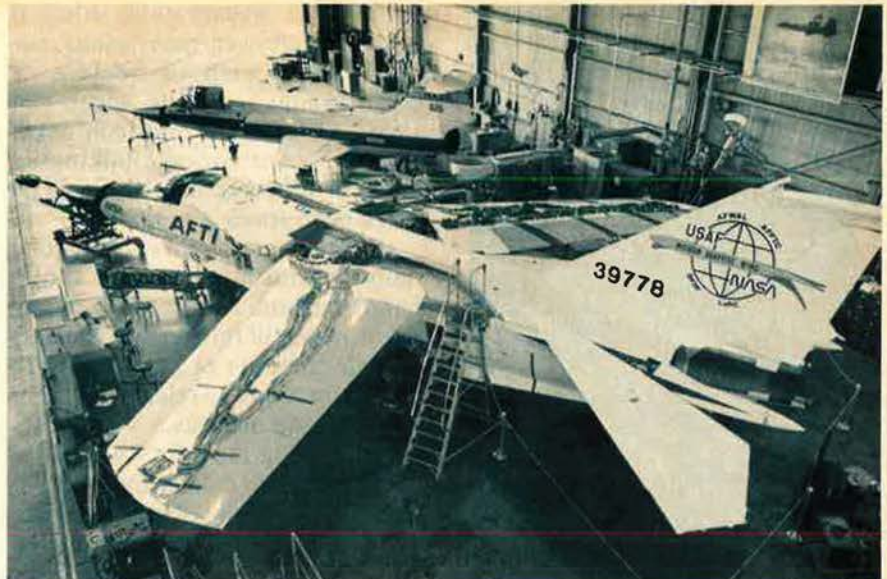


ing and trailing edges flex continually in accordance with varying flight conditions. Thus, the completely smooth wing is always at its optimum shape for cruise or climb, in clear air or turbulence—you name it.

For the combat pilot, says Ronald W. DeCamp, ASD's manager of the mission-adaptive wing program, this means "tighter maneuver radius for evasive action and survivability, a more stable aircraft for weapons delivery, increased confidence, and a more comfortable ride."

Indeed, a great many of today's developments or new applications of aerodynamics, engines, and avionics, singly or in integration, are creating a more orderly and comprehensible environment for the pilot. Prominent among them is the integration of avionics, centered in the Advanced Systems Integration Demonstrations (Pave Pillar) program under the direction of ASD's Avionics Laboratory.

Beckoning to VHSIC technology, Pave Pillar contractors aspire to nothing less than consummate interaction—amid an avionics architecture featuring high-speed multiplex data—of the aircraft functions of



Mission-adaptive wing, using electronically controlled internal mechanisms to change its always-smooth shape (left) in flight, should greatly enhance the performance of future aircraft. The first of these variable-camber wings, built by Boeing, were recently installed (above) on an Advanced Fighter Technology Integration (AFTI) F-111 at NASA's Dryden Flight Research Facility, Edwards AFB, Calif., for testing beginning late next summer.

navigation, guidance, target acquisition and tracking, weapons management and delivery, terrain following and avoidance, and electronic countermeasures.

The implications of this for the pilot are enormous. It means that instead of data from such subsystems showing up willy-nilly on cockpit-crammed individual displays and dials, the data will be collated by information-integrating microprocessors and then fed to a relatively few head-up or cathode-ray tube (CRT) displays.

In coming years, CRTs will almost certainly be replaced by Light-Emitting Diode (LED) displays in showing the pilots cartoon-like pictures or maps of what is going on around them and what needs to be done. Now being developed by FDL, the LED displays are smaller and more reliable than CRTs. CRTs tend to go blank all at once upon malfunctioning. In contrast, LED displays fade out gradually, giving ample warning of their need for repair or replacement.

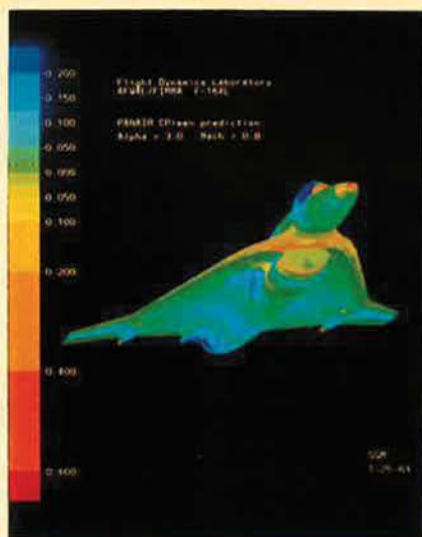
Sensors and Computers

When the fully integrated sensors and computers show the pilot that he had better concentrate for the moment on dodging a hill, or on turning away from and outrunning an oncoming missile, other micro-electronic devices will automatical-

ly tend to weapon-system duties less demanding of his attention, such as fuel management. Moreover, the pilot may well be able to command the aircraft to take action, in attack, avoidance, or whatever, simply by telling the computers what he wants done.

The ability of computers to respond to voice commands, or indeed to issue them, is nothing all that new. Some automobiles have computers that speak. An F-15 computer emits an "Over-G, Over-G" warning, in female tones, when the pilot is overextending his fighter. F-16 computers sound off amid a score of emergency situations with the words "Caution" and "Warning." But all this is trifling technology as compared to the intricacies of a computer that will be able to handle an extensive vocabulary and to recognize and react to the pilot's voice as it varies in timbre and pitch under combat stress.

Such computers require a relatively high level of artificial intelligence programming, or complex algorithms (mathematical expressions), in their software. This, again, is why very-high-speed integrated circuits and very-large-scale integrated circuits will be in heavy demand once they emerge from development and testing. As microprocessors, their commodious, quicksilver-fast circuitry will be



ASD's Flight Dynamics Laboratory tests a computer-drawn F-16XL in a "numerical wind tunnel." This unique, revolutionary technique was made possible by programming a supercomputer to solve fluid-dynamics equations.

highly conducive to artificial intelligence programming.

Even without such circuits, however, USAF's current voice-reactive computers are doing fine. The AFTI/F-16 now embodies some voice-recognition functions and shows "great promise," says one ASD official. For example, the system has demonstrated that it can set up weapons-delivery modes in the fighter's fire-control system with, he says, "a pretty reasonable degree of reliability."

The problem is that, in combat, such a system would have to be downright foolproof. Pilots do not want their weapons going off at the wrong time because the computer

thought it heard something it hadn't. Moreover, many pilots, despite their wish to be free of "switchology"—and to spend less time looking down into their cockpits—may feel strange talking instead of touching, as they have always been trained to do.

Consequently, USAF voice-command researchers believe that a happy medium may be in the offing. Pilots may still rely on switches, although far fewer of them, for such lethal functions as releasing bombs or launching missiles.

Simplifying the pilot's work load and freeing his hands for flying is also the aim of the helmet-mounted sight, which will be used in the AFTI/F-16. This system permits the pilot (the aircraft weapon system's optical supercomputer) to lock on the target just by looking at it.

As of now, in single-seat fighters, pilots locate and track a target by tuning their radar. On the new helmet-mounted sight, cross hairs are on the helmet visor. All the pilot has to do in order to lock on a target—once it is within visual range—is keep his eye on it. His line-of-sight angle to the target is translated into digital data by an electromagnetic receiver on his helmet visor and is passed on to the aircraft's fire-control system via a transmitter on the canopy behind his head.

Harking to the worsening threat of chemical warfare, ASD is developing a pair of potential lifesaving cockpit systems. Called the On-Board Oxygen-Generation System (OBOGS) and the On-Board Inert

Gas-Generation System (OBIGGS), they are systems that generate air suitable for respiration. The air enters the system from the engine, where it has been purified by heat, is cooled for breathing, and then passed back. USAF plans to install such systems on some developmental aircraft in the near future.

Electronics Is the Key

Interdependence of pilot and aircraft is strikingly evident, too, with regard to engines. And once more electronics is the key.

In ASD's current fighter engine programs, for example, Pratt & Whitney and General Electric have already introduced Engine Electronic Control (EEC) systems. Those systems do not actually run the engines; rather, they act, in effect, as supervisors—and optimizers—of the conventional hydro-mechanical controls. The EEC system is based on analog computation. Now, however, ASD and its engine contractors are advancing to Digital Engine Electronic Control (DEEC) systems.

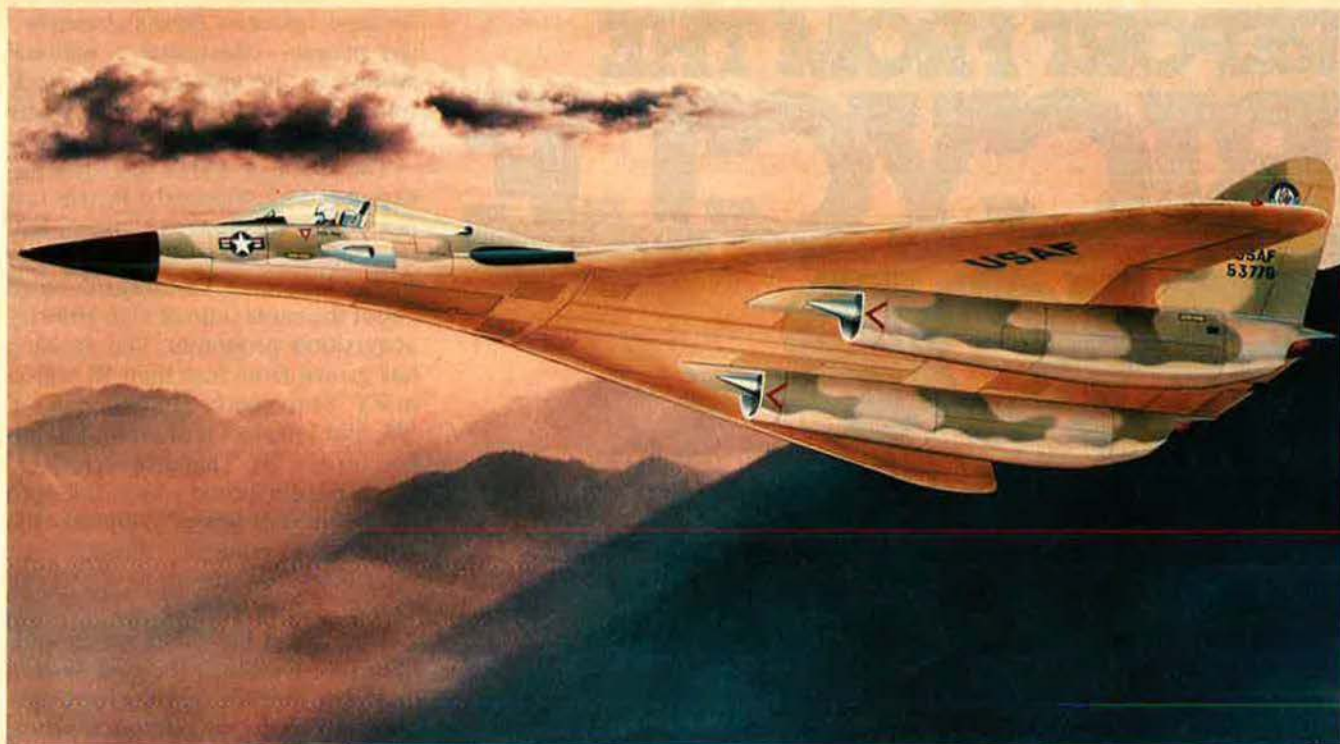
These DEECs will literally operate the engines, fine-tuning the various stages at all times in keeping with what the pilot—through his throttle settings—tells them what he needs them to do. And during hands-off, steady-state flight operations, the DEECs can be totally in charge, prescribing optimum engine adjustments for most efficient "surge" operations.

"Digital electronics will give us tremendous improvements," declares Col. James Nelson, ASD's Deputy for Propulsion. "Analog control is good. But it's relatively fixed in what it can do for you. Digital control is much more flexible. It opens up that whole new arena of programming, just as it does for radar, electronic countermeasures, sensors, or whatever."

The engine companies are making the transition to DEECs in their improvements of existing engines for current fighters and bombers. What they are learning will be applied and refined in developing en-



The AFTI/F-16 cockpit exemplifies USAF's emphasis on making pilots more productive and comfortable. Among major changes are two multipurpose displays and a wide field of view head-up display.



Powerplants catch the eye in this artist's rendition of a future air superiority fighter. Engines now being designed for USAF's ATF will have unusually high thrust-to-weight ratios through their incorporation of advanced materials and sophisticated cooling techniques.

gines for the Advanced Tactical Fighter.

P&W and GE are assimilating technologies for ATF engines (the fighter is expected to have two powerplants) in the 9:1 or 10:1 thrust-to-weight ratio class. In comparison, P&W's F100 engine is 8:1 thrust to weight; GE's F110, in the 7.5:1 class.

The ATF demonstrator engines being designed by both companies are not expected to exceed, by much, the absolute thrust of the F100 or the F110. But they will be much lighter than either, thus allowing for much greater relative thrust. They will also be capable of running hotter and a great deal more reliably. The companies will bring off this seeming anomaly, USAF officials predict, by means of their extensive incorporation of heat-resistant alloys and, even more importantly, of sophisticated cooling techniques.

Engines: The Pacing Item

As in all aircraft development programs, the engine development will determine the pace of the ATF

development program. Long engine-hardware lead times make it imperative that the ATF engines get an early start. But from the word go, ASD is paying special attention to keeping ATF's airframe, avionics, and engine designs and developments on closely spaced parallel tracks, ready for smooth confluence at the proper milestones.

A major goal of such monitoring is to ensure that the ATF engine inlet design will be synergistic with the airframe design. This may be a tricky proposition, given all possible airframe configurations and the need, for instance, to design the inlets with signature reduction high in mind.

Once ASD narrows down its field of ATF airframe designers, the engine developers will undertake computer-model testing of inlet designs appropriate to the designs of the two or three airframe finalists. This approach is a far cry from that of the old days (pre-F-15), when engine and airframe designs all too often proceeded in isolation, and were found to be workable or unworkable only when flown.

Stunning advances in computational capability now make it possible to presage optimal inlet-airframe matchups before hardware is ever cut, or to determine, for example, the heat-resisting and other durability properties of a structure

such as a turbine disc. As part and parcel of the computer-aided design (CAD) process that is becoming pervasive in the aeronautical world, computerized analytical models derived from mathematical expressions can tell as much about the behavior of a system or a structure as can, for example, a wind tunnel.

Such computational wizardry is not an end-all, however. As one USAF official puts it: "We'll always have to sit in airplanes and feel them out in flight before we're totally confident of what they'll do." And that means pilots.

Over the years, as automation-cum-artificial intelligence proceeds apace, it is more than likely that unmanned aircraft will play a larger role in such missions as reconnaissance, targeting, and ground attack. The Boeing Pave Tiger Remotely Piloted Vehicle (RPV), being developed for USAF, is a promising example. But when it comes to air superiority, says Stan Tremaine, ASD's Deputy for Development Planning: "That's where you have the need for split-second decisions best made by humans."

"What the computer people are doing is wonderful," Tremaine declares, "but computers will never replace that mass of neurons we call a brain. And if they do, we won't need man anymore—and not just in airplanes."

REPORT FROM THE BICYCLE SHOP

The Aeronautical Systems Division carries on the tradition in the Wright brothers' old neighborhood.

BY LT. GEN. THOMAS H. McMULLEN, USAF
COMMANDER, AERONAUTICAL SYSTEMS DIVISION

Too late . . . too late in recognizing the threat and too late in preparing to do something about it. That is how General Douglas MacArthur characterized the element common to all military failure. At Aeronautical Systems Division, we are running hard to provide the hardware for the flying Air Force of tomorrow—as well as today—so the Air Force won't ever be termed too late. It's a job that gets harder every day as we see the growing technological threat around the world. Gone forever are the days when we could count on dealing with an enemy who, though he would doubtless outnumber us, would be flying aircraft of modest technical capability. Now the Soviets—and their surrogates all about this globe—are pressing us hard in weapon system effectiveness.

The US military bought its first aircraft back in 1909; the first contractors were the Wright brothers. But our requirements then were not quite the stuff of today's needs. We asked for an aircraft that could carry two people on a ten-mile test at an average speed of forty mph; it also had to carry sufficient fuel for a flight of 125 miles. Orville and Wilbur won the first aeronautical contract incentive by exceeding the speed requirement by just over two mph!

We take pride that the heritage of

Aeronautical Systems Division stems directly from that same bicycle shop on Third Street in Dayton, Ohio, where the Wright brothers developed the technology for their first aircraft. It is just a mile from my office to the field where the Wrights made their first successful glider flights and then established the practicality of powered flight with extensive powered flying after that first flight at Kitty Hawk. So it's easy to see how we came on our nickname, "The Bicycle Shop."

Our job at ASD is both aeronautical technology and acquisition of aeronautical systems and related equipment to meet Air Force requirements—now and for the future. We look on ourselves as the "high tech" company of the flying Air Force. Indeed, the same kind of enthusiasm, dedication, and spirit of accomplishment shown by the Wright brothers still prevails in our modern aeronautical version of the Bicycle Shop.

At ASD we have a uniquely capable team of more than 10,000 people—scientists, engineers, logisticians, business managers, program managers, and many others—dedicated to satisfying Air Force aeronautical requirements. They are engaged in several hundred programs and projects ranging from applied research and exploratory development to production of operational

weapon systems. ASD's strength—our people—constitutes a national resource, the greatest concentration of aeronautical expertise at any single place in the free world.

The scope of ASD's activities has expanded significantly in the last few years. We manage just over half the defense dollars coming to Air Force Systems Command—and about the same ratio of high-priority acquisition programs. Our funding has grown from less than \$8 billion in FY '81 to nearly \$16 billion in FY '83, and I project more than \$20 billion for FY '84. That growth reflects the needed national commitment to modernize our forces to counter the current and emerging threat.

The Growing Threat

That threat has taken on an ominous new look over the past decade or so because the Soviets have dramatically reduced our once seemingly insurmountable technological lead. Now, not only is their force structure bigger than ours, but they have clearly added new sophistication in the combat capability built into their weapon systems.

As a result of their well-coordinated research, development, and production efforts, the Soviets now not only produce a first-line fighter every eight hours—about seven times our current inventory production rate—but they are first-rate, sophisticated machines. I've seen them—up close—and don't ever think they are simplistic aircraft of a peasant-level work force. They're not. They've changed from small, low-payload, defense-oriented fighters to an array of combat aircraft with good range-payload characteristics capable of projecting Soviet power far beyond the borders of the Soviet Union. And they have more new ones on the way.

The Soviets have started development of their new bomber, the Blackjack. It is larger than the B-1B and has intercontinental-range capability. It's expected to be operational in the mid-1980s. When you add the new long-range air-launched cruise missile they are currently developing for this aircraft, you get an addition to one side of the strategic balance that we simply cannot ignore.

And the tactical story is similar—the Foxhound and Frogfoot are now



ABOVE: B-1 bomber prototype reconfigured for B-1B testing at Edwards AFB, Calif. (USAF photo by TSgt. Wayne Specht) **LEFT:** Lt. Gen. Thomas H. McMullen, ASD Commander, calls up a CRT display of B-1B structural characteristics.



being deployed and the Fulcrum and Flanker are on the way. All four open up areas of combat capability heretofore strictly the province of the West—the Frogfoot in close air support, and the other three in all-weather, look-down/shoot-down capability with air-to-air missiles that can reach out beyond visual range.

But these capability growths should come as no surprise. Soviet investment in military R&D—some \$150 billion greater than the US over the decade just past—and an influx of engineers and scientists—four to five times greater than the

US between 1966 and 1981—are having their payoff.

So, it's with one eye on this formidable and growing opposition that the men and women, military and civilian, of ASD go about their work of providing the very best aeronautical equipment they can to the combat elements of our Air Force. Perhaps the best way to get a feel for the beat of this work is to look at some of our activities on current weapon systems, grouped into mission areas, and then at what we're doing to lay the foundations for tomorrow's Air Force.

Strategic Systems

Modernization of US strategic forces goes well beyond the issues of the new Peacekeeper and small ICBM. ASD's role includes development of the new B-1B bomber and adding to the capability of the venerable B-52. The manned bomber leg of our strategic triad remains necessary because it significantly lowers the prospects for success of any Soviet preemptive strike through launch on warning while

retaining its offensive capability through both penetrating to the target and standing off with missiles. It's a reusable weapon system and, what's more, can be a conventional weapons platform.

The B-1B will give us penetration capability well into the 1990s through a combination of reduced radar observability and highly effective, reprogrammable electronic countermeasures. It will be able to perform as a very effective cruise missile carrier, a conventional bomber, a force-projection weapon system, and a maritime support aircraft.

Highly concurrent, the B-1B program continues to track just ahead of cost and schedule constraints that are very tight; but we intend to realize them—and we're on record to both the President and Congress to that effect. These commitments draw interest in B-1B progress from the highest levels. The program director reviews the program at frequent intervals with the Secretary of Defense, communicating with him in what we call "Red Streak" reporting when necessary.

Due to the extensive experience gained during the original program, production problems have been minimal. Few changes to the airframe design have been necessary. Perhaps the best indicator of the

A B-52G bomber carrying its complement of twelve air-launched cruise missiles (ALCMs) on wing pylons is refueled in flight by a KC-135 tanker. Both aircraft are from Griffiss AFB, N. Y., home of USAF's first operational B-52/ALCM wing.

health of the program is the way the B-1B associate contractors and the subcontractors and suppliers are working together. With material and parts flowing in from more than 5,000 firms in forty-eight states, the potential for problems is high. A supportive, "can-do" attitude is keeping those problems from happening. That's why we call the B-1B "America's Airplane."

But it is still some time before we will have a substantial number of B-1Bs in service, so we continue to rely on the B-52 for manned strategic operations. ASD has developed, and put into production, major avionics modifications to improve the B-52's ability to get to the target—coping with more potent enemy defensive systems—as well as to upgrade the aircraft's overall operational reliability. What's more, the B-52 force utility has been expanded by adding the capability to carry and launch the AGM-86B Air-Launched Cruise Missile (ALCM) that we are procuring.

The ALCM provides Strategic Air Command the flexibility to choose a standoff attack option as well as penetration. ALCM became operational, on schedule, in December 1982. We'll procure something over 1,700 ALCMs—in fact, more than a third of those have already been delivered, on time and within budgeted cost. And in addition to acquiring ALCM, we're breaking ground on a second-generation strategic air-launched cruise missile—the Advanced Cruise Missile (ACM)—that promises improvements in range and survivability.

A closely related program we've begun to develop recently is the Common Strategic Rotary Launcher (CSRL), a single launcher designed to fit both the B-52 and B-1B—as well as being a candidate for future strategic aircraft, such as the Advanced Technology Bomber. It will be capable of carrying gravity weapons, the AGM-69A Short-Range Attack Missile (SRAM), ALCM, ACM, and any follow-on



missiles like the SRAM-replacing Advanced Air-to-Surface Missile. We expect CSRL to help streamline SAC's loading and logistics operations.

Tactical Systems

While modernization of the manned strategic force has been accelerating only in recent years, ASD has been deeply involved in modernization of the tactical forces for more than ten years. The current stars of this effort are our two great front-line fighters, the F-15 and F-16.

With more than 700 delivered, we're roughly at the halfway point in production of planned F-15s. We believe the F-15 Eagle is the world's best air-combat aircraft, and has been since the day it was introduced, but we think we have to work hard to keep it that way. Through a Multi-Staged Improvement Program (MSIP) for the F-15, we plan to add programmable armament control, to improve the central computer and radar, and to integrate the

AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM).

Our multirole F-16 fighter continues to gain increasing acceptance worldwide—now in or committed to eleven air forces around the world. At \$51 billion, it is the largest dollar value program in the Department of Defense, with projected growth to 2,651 aircraft for USAF through 1992—and with ongoing and potential foreign sales of an additional \$26 billion.

Originally designed as an air combat technology demonstrator, the F-16 has proven itself in air-to-ground missions, too—a fact well demonstrated by being the overall winner at Tactical Air Command's worldwide Gunsmoke '83 fighter gunnery competition on the Nellis air-ground ranges.

This past July we delivered the 1,000th F-16 Fighting Falcon. We are currently producing about twenty aircraft each month worldwide and elements are coproduced by companies in Belgium, Denmark,

Lt. Gen. Thomas H. McMullen has been Commander of Aeronautical Systems Division, Wright-Patterson AFB, Ohio, since August 1982. A West Point graduate, General McMullen flew seventy-eight combat missions in F-86s in Korea and served as an air liaison officer during the conflict in Vietnam. He worked for NASA as assistant mission director of the Apollo program, and has commanded the Tactical Air Warfare Center at Eglin AFB, Fla., and served as TAC Vice Commander, among other assignments. General McMullen holds a bachelor's degree in military engineering as well as master's degrees in astronautical engineering and administration.

the Netherlands, and Norway, as well as in the United States. As with the F-15, we have an ongoing improvement program for the F-16. The F-16 Multinational Staged Improvement Program (MSIP) will introduce improvements in the fire control computer and radar, incorporate the joint USAF-Navy Airborne Self-Protection Jammer, as well as add AMRAAM and LANTIRN capability to selected parts of the F-16 fleet.

LANTIRN is the acronym for Low-Altitude Navigation and Targeting Infrared for Night system. It consists of a navigation pod to get to the target area at terrain-hugging altitude around the clock and a targeting pod for precise attack of any size target. The nav pod presents a day/night picture of the outside world to the pilot on a wide-field-of-view head-up display (HUD). It also has a terrain-avoidance radar so that the pilot can fly at altitudes low enough to avoid threats even at night.

The targeting pod provides a magnified view of the targets, and then launches weapons automatically at targets selected by the pilot. LANTIRN will provide the F-16 a night/adverse weather attack capability that will significantly increase our ability to fight, even when outnumbered on the ground. For example, it provides the basis for more than doubling our sortie rate during the Central European winter.

ASD has two relatively new activities that may affect both the F-15 and F-16 programs—the Alternate Fighter Engine and the Dual Role Fighter programs.

Both the F-15 and F-16 are powered by the F100 engine that, when introduced in the early 1970s, demonstrated dramatic improvement in thrust-to-weight but at the cost of some operability and durability. For some time, ASD has been developing improvements to this aspect of the F100 while at the same time developing a fighter derivative of the B-1's F101 engine, which has had reliability as a priority from the outset.

We are now conducting a competition between these two engines, and will decide early in 1984 which one—or perhaps what mixture of both—we'll procure for the F-15s and F-16s we buy beginning in FY '85. As in so much of our business,

we're seeing great results from this competition, early as it is. It represents a continuation of the commitment on the part of the Air Force to acquire major systems and subsystems competitively whenever and wherever the conditions can be established for competitive advantages.

Our second initiative involving both the F-15 and F-16—and, incidentally, also a competition—is the Dual Role Fighter (DRF) program. Our interdiction capability now rests on aging F-4s and too few F-111s. To correct this tactical shortfall, we have been evaluating derivatives of the Eagle and the Falcon—the F-15E and F-16E—to carry large payloads over long distances at night and through adverse weather conditions (*see November '83 AIR FORCE Magazine*).

Both competitors for DRF are de-

buy of the basic aircraft. We are now in the process of evaluating flight-test results of each candidate, as well as development and production proposals by the contractors. This will also provide the basis for a program decision early in 1984.

Another new system to help our tactical air forces expand their operations into the night is infrared (IR) Maverick. IR Maverick combines the existing time-tested Maverick point-target air-to-surface missile with a new IR seeker for attacking targets at night as well as during the day. IR Maverick has suffered from much controversy—but I'm confident that results of the Air Force Follow-On Test and Evaluation (FOT&E) beginning in June will set those concerns to rest. Moreover, IR Maverick has the potential to be a strong production program with the prime contractor



An F-16 over Edwards AFB carries Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system flight-weight dummy pods in a test of aerodynamics. Active pods will be tested throughout 1984 as USAF prepares to install LANTIRN on its F-16s.

rived from the respective aircraft's avionics suites and improvement programs. The F-15E is an evolution of the MSIP two-place F-15D configuration with conformal fuel tanks and further enhanced in air-to-surface capability by addition of LANTIRN and a missionized rear cockpit. The F-16E combines the basic F-16D MSIP avionics, including LANTIRN, with the longer fuselage and cranked arrow wing demonstrated on the F-16XL prototype to provide greater range/payload capability. The DRF will be procured within the programmed

working hard to cut production costs, spurred on by the fact that we are bringing on a second contractor to participate in a head-to-head competition just as fast as we can get him qualified.

Mobility and Support Systems

One of the most basic concerns facing the Air Force today is the shortfall in our ability to project US combat forces worldwide—to get to the battle on time with enough forces to do the job.

The need for near-term improvement in intertheater airlift is being

met by procurement of fifty C-5Bs. The operational characteristics are basically the same as the C-5A currently in the inventory, with only minor configuration changes to improve reliability and maintainability. We'll receive the first C-5B in December 1985 and the fiftieth aircraft in early 1989.

On a longer term basis, we are continuing with a pre-full-scale engineering development effort for the C-17 airlift aircraft. The C-17, which grows from the technology we demonstrated in the Advanced Medium STOL Transport (AMST) program, is designed specifically to move outsize combat equipment and cargo into austere airfields in the combat theater. We are preparing to move the C-17 program into full-scale engineering development in FY '85 with production deliveries starting in the early 1990s.

Aerial refueling is an important element of our ability to project US combat forces worldwide; our tanker fleet consists of the KC-135 and the new KC-10. The KC-10 tanker/cargo aircraft provides another major increase in our airlift capability by providing aerial refueling for strategic airlift and general-purpose forces. In addition, the inherent cargo capability supports the rapid deployment of the general-purpose forces—refueling fighters deploying overseas while carrying along the support they need to hit the ground running. In December 1982, a multi-year procurement option for forty-four additional aircraft was awarded, bringing the total procurement to sixty aircraft. The first KC-10 was delivered in March 1981, and deliveries will continue through September 1987.

The KC-135 remains the workhorse of our aerial refueling fleet, supporting all strategic and general-purpose forces. The Air Force deficiency in aerial refueling capability, brought on by ever-increasing refueling needs, is receiving further attention here through modernization of the KC-135 by adding new CFM56 turbofan engines—as well as other subsystem improvements. This reengining effort improves thrust and fuel offload capabilities significantly while also reducing fuel consumption and alleviating problems associated with the use of water for thrust augmentation.

In another aspect of this mission area, we are commencing several programs to satisfy different Air Force airlift needs by procuring or leasing small turbine-powered aircraft that are already operating in business or commercial aviation—making only the minimum changes to meet specific military requirements, such as more robust communication. For example, in 1983, we awarded contracts for military versions of three different off-the-shelf business aircraft under two separate special airlift programs. Under the first, three Gulfstream III aircraft, designated C-20As, are being leased to provide worldwide air transportation for senior US government officials and foreign dignitaries. We'll purchase these three aircraft in FY '85 and an additional eight in FY '86-88 to replace the aging C-140s currently being operated by Military Airlift Command (MAC) for this high-priority transportation requirement.

In September 1983, we awarded lease contracts for military versions of the Learjet 35A, designated the C-21A, and the Beech B200C, designated the C-12F. The total program includes the lease of eighty C-21As and forty C-12Fs, including supply and maintenance support, to replace the current fuel-inefficient CT-39 fleet. First deliveries are scheduled for March 1984.

The final example of this new airlift process is the program we have to procure eighteen off-the-shelf small cargo aircraft as a part of the

European Distribution System (EDS). EDS will be designed to facilitate movement of needed supplies and support within the European theater. We think this will help to stretch the Air Force store of spares to produce the high fighter sortie rates we'll need to win there.

Air rescue and special operations are another set of requirements addressed in this mission area. After many years at a rather low level of modernization activity, the Air Force is moving out to develop and procure the HH-60D Night Hawk. The basic airframe is a derivative of the Army's UH-60 Black Hawk, with modifications to provide the specialized equipment and integrated avionics required for combat rescue and special operations. Planned Initial Operational Capability (IOC) for the first lot of three aircraft is in FY '88, with approximately 150 aircraft to be delivered through FY '92.

Common to all these aircraft programs, whether they're in the strategic, tactical, or airlift mission areas, is the need for well-trained pilots to fly these new and improved aircraft systems. The T-46A, currently in development, will replace the aging T-37 fleet and ensure that the Air Force can sustain required pilot training well into the future. Essential design characteristics of the T-46A include twin engines, side-by-side seating, and cockpit pressurization, and it will feature significant improvements in performance, maintainability, and noise



pollution compared to the T-37. A total buy of 650 aircraft is planned, with IOC in September 1987.

Shaping Tomorrow's Air Force

Thus far, we've been on a brief tour of ASD programs for systems that are now, or soon will be, in the hands of our fighting forces. To some, they are new, but not to the people of ASD. The gestation period from concept to production of modern weapon systems can be from ten to fifteen to perhaps even twenty years. This fact of life means that we must keep our sights trained on the needs of our Air Force twenty and more years hence. ASD is doing that—and on two levels, focusing on the sort of weapon system capabilities the Air Force will need to meet the enemy threats of the future and the technology capabilities we'll need to build those systems.

ASD development planners have a hand in both of these areas—with the fundamental responsibility for initiating new system programs, but being a party in technology planning, too. They start with projections of future threats drawn from the judgment of experts from intelligence and technical areas as well as from members of the operational commands. They weigh the capabilities of our forces against the growing threat, determining shortfalls. They consider technological capabilities and opportunities in conceiving possible system options that can then be evaluated for feasibility,

effectiveness, and affordability. It's a complex, never-ending process involving close interaction of the technical and operational communities.

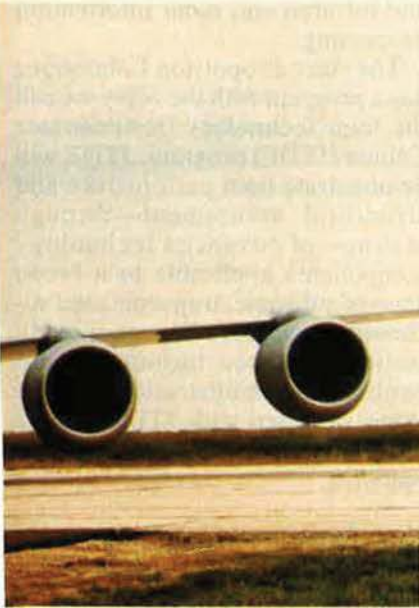
To get some feel for the scope of our planning, let's briefly consider three of our current projects: one that revolves around today's systems, one that includes an evolutionary change, and one that envisions revolutionary change.

The first is the Far Term Fighter Force Modernization Investigation. All of our force projections show that ninety percent of our tactical aircraft in the year 2000 will be aircraft currently in the inventory—like the F-15, F-16, F-111, and A-10; in fact, if our plans hold, the F-15 and F-16 will be in production into the 1990s. Yet, as I noted earlier, the Soviets are designing and developing new tactical aircraft at a hectic pace, while still producing their capable older aircraft. If a future conflict develops, we will face a numerically superior threat consisting of very good quality aircraft systems.

Mission area analyses lead us to conclude that our force, if unchanged, will be at a disadvantage in both performance and ability to generate sorties. The Far Term Fighter Force Modernization Investigation will assess the availability and capabilities of emerging technologies that, when applied to the F-16, F-15, or A-10, will improve and extend their useful life. The study includes a broad spectrum of technologies involving avionics, propulsion, airframe, flight controls, biotechnology, and weapon integration.

Another key to upgrading the performance of our current fighters is to improve the man-machine interface and to decrease the pilot work load. The Far Term Fighter Force Modernization Investigation, and the improvements it defines making use of advanced technologies, will play a key role in enhancing the availability, the performance, and the survivability of our current tactical aircraft.

Reengined KC-135 tanker turns for takeoff. The addition of new CFM56 turbofan engines to USAF KC-135s "improves thrust and fuel offload capabilities significantly," General McMullen declares, at a time of "ever-increasing refueling needs."



Advanced Tactical Fighter

There is a point, however, where the advancing technology of our adversaries will demand that we deploy a new airframe. We are looking toward that point with our program for an Advanced Tactical Fighter (ATF), the next-generation evolution of our tactical force structure. The ATF is envisioned to be an air-superiority fighter with good surface-attack capability. We are looking hard at technologies that allow supersonic persistence, increased maneuverability, short takeoff and landing, low observables, and increased supportability.

The current program consists of a Concept Development Investigation (CDI) and a Joint Advanced Fighter Engine (JAFE) program. The CDI includes contracts with seven aircraft companies providing the analyses needed to select design options for the ATF. These investigations will be completed in the spring of 1984. They will be the basis for zeroing in on the right elements of the technologies I listed—or others—and will form a basis for subsequent demonstration/validation and full-scale development programs. Modern, high-performance engines take even longer to develop than airframes. For that reason we have begun an aggressive effort to bring along engine technology advancement as a forerunner to system development. The JAFE program has awarded contracts to two engine manufacturers to develop and test demonstrator engines as a foundation for ATF propulsion engineering development in the 1980s.

Looking even beyond the era in which evolutionary systems like ATF make sense, we can foresee the need for radically new kinds of systems. For example, we—and others—are now considering one that could provide quick-reaction global strike and reconnaissance, be space-capable, and yet operate from military airfields. We call this concept the Transatmospheric Vehicle (TAV)—an aerodynamically configured, manned system whose characteristics include the ability to launch with short warning from current military airfields and to operate in all kinds of weather. The TAV would allow the Air Force to operate regularly in the region from the upper reaches of the atmosphere



USAF is developing the HH-60D Night Hawk helicopter for air rescue and special operations. It will be a derivative of the USAF/Sikorsky UH-60A shown at the left.

to low earth orbit. It could respond quickly from the United States to any hot spot in the world to perform multiple missions.

Planning now being done by ASD will provide the basis for an Air Force decision in 1988 on whether or not to proceed with TAV prototype development. We're working now on mission/effectiveness analyses and proposed conceptual designs. Results of these concept exploration and definition efforts will define the basic validation program for prototype development and flight tests.

Concurrent with these initial studies will be accelerated investigations of key technologies. The major technology driver is the need for rapid turnaround operations that require multiple reuse and minimum inspection/maintenance of the primary elements of the TAV system. Obviously, the key areas that will require technological advancement for TAV are materials, propulsion, aerothermal dynamics, flight controls, and avionics.

Building Tomorrow's Technology

Achievement of all these system capabilities depends on the necessary advances in technology to underwrite them. That responsibility here is the province of ASD's Air Force Wright Aeronautical Laboratories (AFWAL): the Avionics, Flight Dynamics, Aero Propulsion, and Materials Laboratories. Separated from ASD in 1962, these four laboratories were again made a part of this institution in November 1982 to facilitate transition of new technology into systems by bringing systems and technology planning closer together. The benefit of this

realignment is obvious to us, but nowhere better than in the focus now given to the extensive laboratory efforts to provide the necessary technologies—in time—for ATF development. It's a tie that has made some fundamental changes to technology programs and how the capabilities they promise will be incorporated into aeronautical systems.

AFWAL's activities include a multitude of programs over the entire spectrum from research and exploratory development to system support. To assure coherence in this diversity we use a management approach we call the "major thrust" process—a process through which programs from the four constituent laboratories are focused on high-priority Air Force needs. Major thrusts are developed to provide cross-laboratory direction to their efforts to support clearly defined capability applications. There are presently four major thrusts; each thrust involves several labs but each also has a lead laboratory. The Night/In-Weather Attack lead thrust is handled by Avionics Laboratory; Supersonic Persistence is the responsibility of Aero Propulsion Laboratory; Sortie Generation falls in the domain of Flight Dynamics Laboratory; and Space Applications comes under Materials Laboratory.

The Night/In-Weather Attack thrust oversees the technology programs necessary to develop twenty-four-hour-a-day strike capability. The thrust into Supersonic Persistence is aimed at the propulsion, materials, and structures technology and aerodynamic technologies to permit flight at supersonic speeds for durations greater than current dash capabilities. Sortie Generation

is concerned with providing a means of producing sorties at high rates under wartime conditions, such as from heavily damaged airfields. Space Applications is primarily directed to support systems whose missions are strategic offense and defense.

Beyond these specific programs a host of efforts is under way in our labs today that will change how America's designers provide solutions to requirements for aeronautical systems. Many of these show promise across a broad spectrum of applications—not necessarily bounded by the interest in military capability that spawns them. While the breadth of the labs' undertakings go well beyond what we can cover here, some examples will provide a feel for their scope.

One of the most promising programs at ASD—one that could revolutionize information-processing capabilities—is our Avionics Laboratory work on Very-High-Speed Integrated Circuits (VHSIC). VHSIC chips will demonstrate processing speeds fifty to a hundred times greater than present integrated circuits. The reduced size of these chips, and the great speed increase that results, will enhance all information-handling capabilities of the future—and has direct application to such areas as navigation computers, data bus management, and infrared and radar information processing.

The Aero Propulsion Laboratory has a program with the Navy we call the Joint Technology Demonstrator Engine (JTDE) program. JTDE will demonstrate both performance and structural assessment—through testing—of advanced technology components applicable to a broad class of subsonic, transonic, and supersonic systems. We are already testing advanced turbine components in a demonstration engine. What we learn with JTDE will be used in all our future engine developments.

New Fuels and Materials

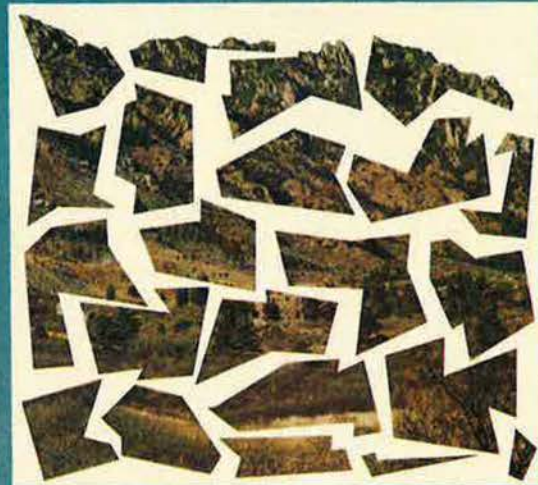
In other propulsion developments we are seeking aviation fuel

A photograph of a laptop's internal components, showing the motherboard, RAM modules, and other hardware. A red laser line is visible across the image.

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alternatives, such as jet fuel produced from shale oil, to avoid future fuel shortages—and, more directly, to reduce our dependence on foreign suppliers. We already have an effort going to modify engine components to accept new fuel. To go along with that we are developing new fuel specifications to take into account both needed engine changes and new fuel properties; the effects of the variation of fuel properties on the performance, durability, and emissions of turbine engines are being evaluated. Right now we are estimating that by mid-1984 two Air Force bases will be operating on shale oil-derived jet fuel to demonstrate the ability of the fuel to serve our needs.

Our Flight Dynamics Laboratory is working the complex area of battle damage in the Aircraft Battle Damage Repair program (ABDR). As aircraft join the fleet with new composite structures and fly-by-wire and other advances, our repair capability also needs modernization. We have established an advanced development program, using results from efforts in related fields, such as computer technology, diagnostic capabilities, self-repairing techniques, damage-tolerant materials, and "super glues," to provide the needed new rapid assessment and repair techniques.

One of our most interesting new flight demonstration programs is the STOL and Maneuver Technology Program to evaluate coupled flight and propulsion controls with a thrust vectoring, two-dimensional nozzle. Thrust reversing, rough and soft field landing gear, and advanced landing aids will also be demonstrated. These technologies will allow night and all-weather operations from damaged or austere airfields or from short, wet runways, and improved "up-and-away" maneuver capability and cruise efficiency.

As we add to the system capability of our aircraft, we must also make them stronger and lighter. The ordered polymers program being worked today at our Materials Laboratory is aimed at providing super-strong, lightweight material for aircraft structures. Polymer fibers have already been produced that have strength properties exceeding steel and titanium; we have also demonstrated that these fibers can

be formed into useful structures using epoxy binders while still retaining the high-strength/low-weight characteristics we are searching for. The promise these polymers hold for making useful aircraft structures is great—and, as an added plus, these materials are transparent to radar frequencies.

In other materials advances, we are making excellent progress in a rapid solidification technology that produces alloys that cannot be turned out by standard processes. In aluminum powder metallurgy, alloys are mixed with constituents in powdered form. Subsequent rapid solidification processing can provide alloys with high strength and corrosion resistance, low density, and high temperature capabilities. In a notable example, the original titanium castings for the B-1B engine nacelles were replaced with rapid solidification aluminum castings that were lighter and produced at a lower cost. The weight saving was 470 pounds (nineteen percent), and the cost savings for 100 aircraft, including life-cycle savings, is \$56 million.

What Lies Ahead

This glimpse through ASD's open door has only given a partial view of our activities—and thereby has raised the risk of distorting the focus we are placing on trying to do our job better. I've concentrated on our major programs, the systems that tend to make the headlines; behind these, however, there are hundreds of programs and projects that support the systems, enhance their components, make them more reliable and maintainable, decrease their costs, and improve the business practices by which we acquire them. And there is our 4950th Test Wing, with not only the expected aptitude for conducting tests, but with the ability to design and manufacture complex test modifications.

What I have not done is address the fundamental improvements we're making in our version of the acquisition process from both business and support perspectives; while I can't expound upon them here in any detail, I want at least to get them on record—and perhaps address them at some future time.

We are stepping up the priority of

acquisition logistics—with the objective of assuring that the inherent performance capabilities we have designed into our systems are really available to the operational commands when they need them. We are pressing technology, planning better, and making larger resource application to improve readiness and cut the costs of ownership. We are pushing standardization hard for both its economic and its logistic benefits.

Likewise, we are attacking how much things cost. We have responsibility for the Air Force Manufacturing Technology Program to develop methods and materials to reduce the cost of making the things we need. We are working hard to modernize the industry that provides us aeronautical systems—and here the challenge is more one of structuring smart business deals that encourage our contractors to make long-needed capital investments than it is of advancing the state of the manufacturing art.

We're working just as hard at improving our ability to estimate what a program will really cost—and then to bring the program home within that cost estimate. This is an important element of maintaining the credibility we need to stay in business, and involves a broad range of factors not all subject to our jurisdiction. We are continuing to expand the application of competition where it makes sense as one of the processes to get more value from each defense dollar. We're pressing such improved contractual approaches as multiyear procurement where it makes good business sense—although we find that we're sometimes out ahead of the system in that area. I'd like to spend more time covering these fundamental issues—but that's another story.

ASD is a great Air Force institution of people dedicated to keeping our country at peace through providing the best aeronautical systems we can. We have our eye firmly fixed on molding the Air Force of tomorrow—yet we're keenly aware of the heritage that has shaped us. It's fortunate that we share this ground with the great Air Force Museum. It inspires all of us in our efforts, encouraging us to turn out aeronautical systems worthy of eventual enshrinement there. ■

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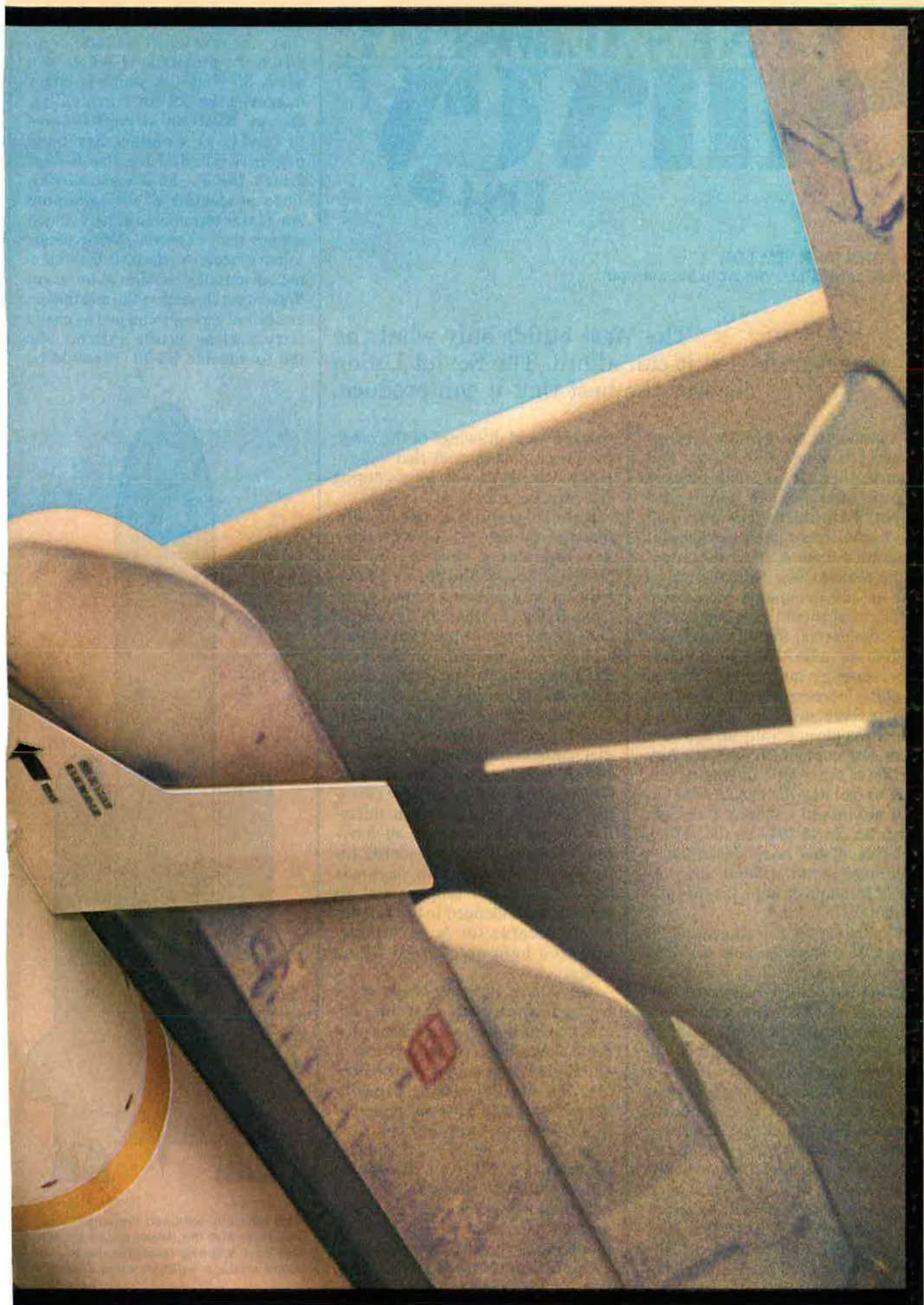
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JANE'S AEROSPACE Survey 1984

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

The West builds only what the monetarists say it can afford. The Soviet Union chooses the best that it can produce.

IF *Jane's All the World's Aircraft* were concerned with politics and finance, this survey would consist of page after page of unmitigated gloom. With thirty-four wars and major conflicts raging worldwide, apparent sweeping under the carpet of the remains of a Korean airliner and its 269 occupants shot down during what should have been a routine commercial flight, a total lack of progress in East/West talks aimed at preventing a nuclear holocaust, a resulting increase in the deployment of strategic missiles in nations whose people generally do not want them, and economic chaos in every section of the aviation industry, it is easy to feel that the late George Orwell possessed uncanny foresight when he chose 1984 as the setting and title of his book describing a nightmare world without any vestige of freedom or hope for the individual.

Against such a background, it would be understandable if everyone designing, building, and operating aircraft decided to hibernate until January 1, 1985. And yet, from a technological viewpoint, aviation has never faced more exciting and challenging prospects in the four score years since Orville and Wilbur Wright made their first tentative powered flights at Kitty Hawk.

Most regular readers of *Jane's* turn first to the Soviet pages to discover what is new, without expecting to read of any dramatic engineering breakthroughs. This year they would be well advised to read all the small print, as well as to study pho-

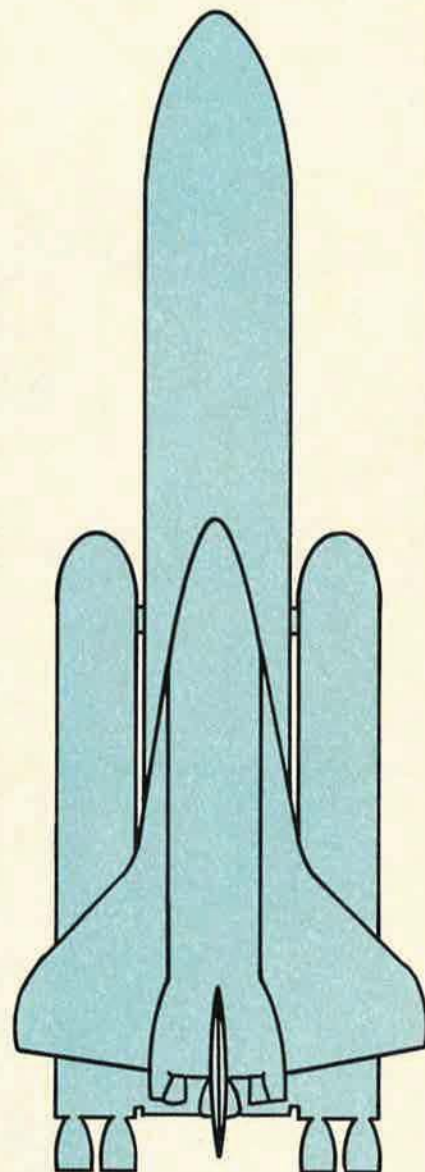
tographs and drawings of the range of new combat aircraft that will re-equip Warsaw Pact air forces during the next decade.

It should surprise no one to learn that the Soviets now have under development a spacecraft like NASA's Space Shuttle and have built the largest conventional aeroplane flying anywhere in the world. Outsize aeroplanes have held a particular fascination for Russian designers since the young Igor Sikorsky built and flew the first four-engined aircraft at St. Petersburg in 1913. Its present-day Soviet counterparts hold all twenty-seven international speed and height records for jet aircraft carrying payloads of more than thirty-five metric tons (tonnes), all sixty-four speed and height records for turboprop aircraft with payloads from one to 100 tonnes, and an equally unchallenged list of weight-lifting records for large turbine-powered helicopters and flying boats.

Yet, Soviet designers have never had at their disposal powerful fuel-efficient turbofans of the kind that Pratt & Whitney, General Electric, and Rolls-Royce supply for the Boeing 747 and other large-capacity Western aircraft. This was apparent in 1976, when the prototype Il-86 airbus had to make its first take-off from a 5,970-foot runway in Moscow using turbofans that were only marginally capable of doing the job and have since delayed full exploitation of the airliner's potential.

Soviet industry must, at last,

have produced such an engine or Oleg Antonov could not have completed the prototype of his An-400 heavy-lift freighter, which is larger than even the US Air Force's C-5A Galaxy. Such an aircraft (known to NATO as Condor) has been urgently needed by the Soviet armed forces, as a tank carrier, since production of the turboprop An-22 was terminated in 1974, much sooner than expected. What seems to have been overlooked by statesmen discussing missiles at the East/West arms-limitation talks is that an aircraft of this size can just as easily ferry nuclear missile systems like the formidable SS-20. It would be



This officially released drawing suggests that the Soviet space shuttle will bear a strong resemblance to NASA's Space Transportation System.

stupid to regard withdrawal of such weapons from forward launch areas in East Germany and Czechoslovakia as a major concession when they could be reinstated at a moment's notice by Condor freighters.

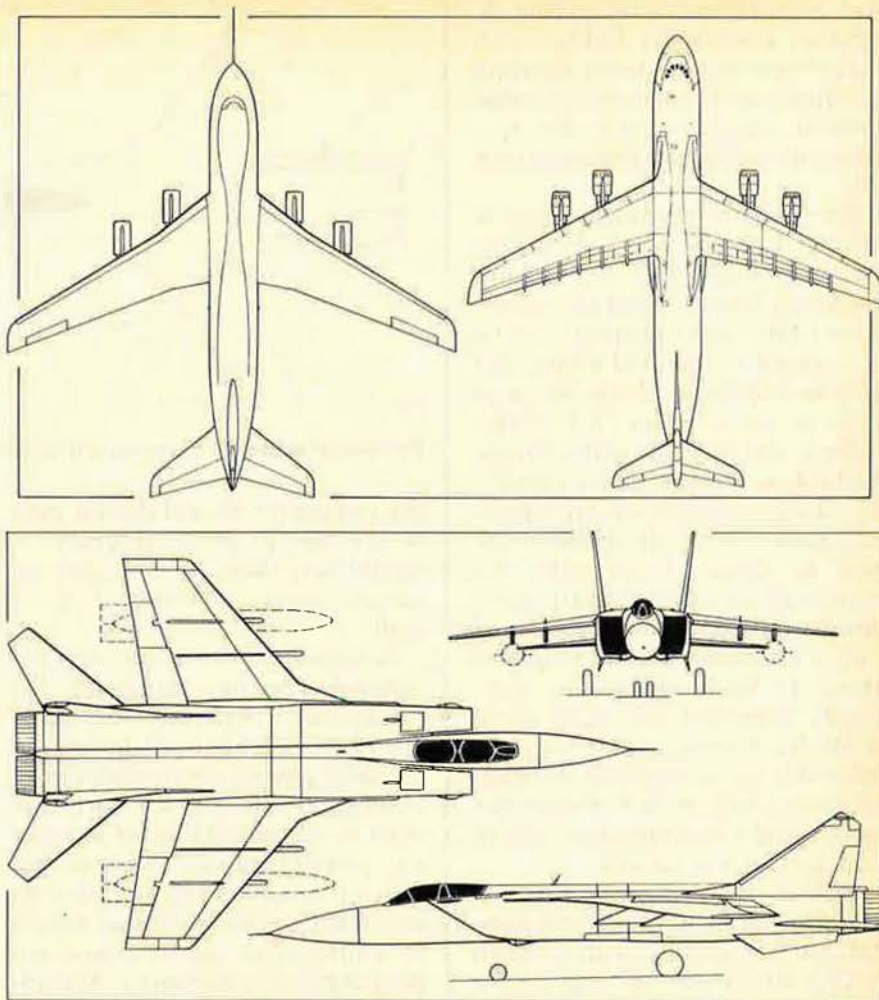
Also, setting aside all political and humanitarian factors in recent events, the availability of aircraft with such capability makes it doubly important to monitor the construction of massive new runways in strategic areas like Grenada, where they are not justified by commercial air traffic.

New Soviet Combat Aircraft

Since the potential of two small atomic bombs was demonstrated at Hiroshima and Nagasaki in 1945, it has been affirmed often that a full-scale nuclear war is unthinkable. While mass-producing weapons for the unthinkable, NATO and the Warsaw Pact nations have maintained a semblance of realism by claiming to balance their conventional forces stationed in Europe. There never was a genuine balance, and NATO air forces, for example, continue to be outnumbered at least two to one in terms of front-line tactical aircraft. It has usually been assumed that the imbalance is offset by NATO superiority in weapon system quality and personnel training standards, so that any confrontation, intended or accidental, could be contained by fighting at a non-nuclear level for long enough to enable a cease-fire to be arranged.

Unfortunately, the Soviet Union has never disguised the fact that it regards both tactical nuclear weapons and chemical warfare as normal elements of any military action in Europe, while the provision of shelters for selected leaders and bureaucrats in places like the UK indicates how little such people believe that a nuclear exchange could be limited to the immediate battle area.

Nor does the former disparity in the quality of East/West weapon systems persist. While the West builds only what the monetarists say it can afford, the Soviet Union always chooses the best that its designers and engineers are capable of producing. Six new types and variants of fighter and attack aircraft introduced into Warsaw Pact air forces since 1970 have increased the overall payload/range capability to



TOP: The world's largest aeroplanes: Antonov An-400 (left) and Lockheed C-5A Galaxy to same scale (Michael A. Badrocke). **ABOVE:** MiG-31 (NATO Foxhound), based on official USAF original drawing (Pilot Press).

such an extent that more bombs could be dropped on London in 1984 than could be put on Frankfurt in 1970. The massive growth in Warsaw Pact helicopter strength would add immensely to the difficulty of halting an offensive against NATO in Europe. Photographs of camouflaged Mil Mi-26 Halo helicopters in operational service, reproduced in the October 1983 issue of the Soviet magazine *Aviation and Cosmonautics*, show that the armies of the East can already call for support from rotary-wing V/STOL aircraft with a payload and cargo hold very similar in size to those of a Lockheed C-130 Hercules. Nobody doubts that designer Marat Tishchenko, Mikhail Mil's highly competent successor, will soon plug another gap in the inventory by producing a small and agile helicopter fighter designed to remove all low and slow NATO aircraft from

the sky in front of a Warsaw Pact assault force.

The MiG-31 Foxhound is operational with several units as the first of a new generation of Soviet fighters. It inherited its cropped delta wings and general configuration from the MiG-25 Foxbat and is believed to have two of the same 30,865-pound-thrust Tumansky R-31 afterburning turbojets as Foxbat-E. But it is a tandem two-seater, with a reduced maximum speed of Mach 2.4. Enhanced capability stems from its new look-down/shoot-down pulse Doppler radar, allied to an armament of eight air-to-air missiles, including the latest radar homing AA-9, and a heavy caliber gun.

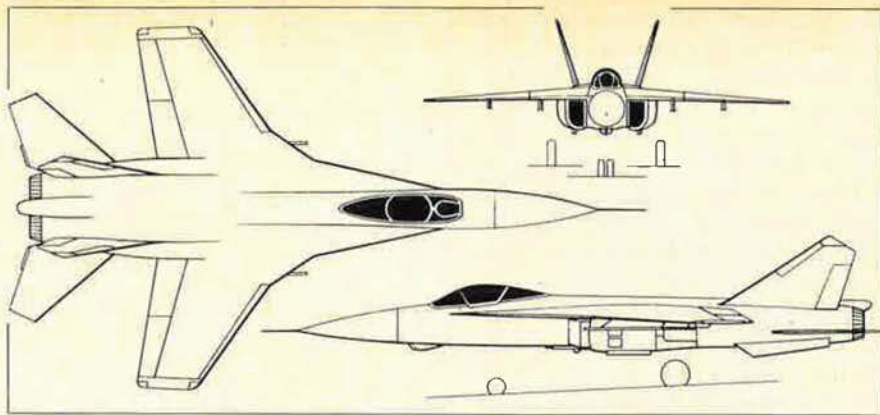
Close behind, with a likely initial operational capability this year, is Sukhoi's single-seat twin-jet Su-27 Flanker. In the same category as the F-15 Eagle, it is described by official

Western sources as a supersonic all-weather counterair fighter with look-down/shoot-down weapon systems and beyond-visual-range air-to-air missiles, and as having a possible secondary ground attack role.

An estimated maximum speed of Mach 2.3 makes the Su-27 a little slower than the MiG-29 Fulcrum, the Soviet Union's third new-generation fighter that is expected to be operational by the mid-1980s. The MiG is smaller, in about the same class as the US Navy's F/A-18A Hornet, and probably with a similar dual-role air combat/attack capability. At least two versions are reportedly under test, with different engine air ducts. Even with two engines giving a total 38,000 pounds thrust with afterburning, compared with a maximum takeoff weight of about 37,500 pounds, the unofficially suggested maximum speed of Mach 2.8 seems excessive; more believable are a reported instantaneous turn rate of 16.8 degrees per second and a sustained turn rate of 8.26 degrees per second.

Fighters as good as the MiG-31, MiG-29, and Su-27 would still have difficulty in coping with modern NATO attack aircraft and cruise missiles if they had to rely on the traditional techniques of ground-controlled interception supplemented by the wholly inadequate Tu-126 Moss AWACS aircraft. Mid-1983 reports that the second-generation Mainstay AWACS, based on the Il-76 transport, had proved a disappointment and was to be superseded by an early warning and fighter control version of the wide-body Il-86 seem to have been misleading. The West German defense ministry insists that Mainstay will begin supporting the Voyska PVO Soviet home defense interceptor force this year. Could it be possible that the reported military Il-86 is an airborne command post counterpart of USAF's E-4B derivative of the Boeing 747?

An efficient partnership of a fighter like Foxhound and an AWACS like Mainstay might have prevented the September 1, 1983, disaster that befell Korean Air Lines Flight 007. More than two months afterward, as this survey is being written, the only unarguable facts are that the Korean Boeing 747 should not have



Provisional drawing of one variant of the MiG-29 Fulcrum (Pilot Press).

been where it was, and that the pilot of the Soviet Su-15 interceptor should never have fired his gun and missiles against an unidentified aircraft.

Responsible sections of the international press have suggested that the mistake occurred because a USAF RC-135 had been detected in the same general area on that fateful evening. If this is true, more care must be taken in the future to avoid any possibility of confusion between the commercial and the covert. There appears to be no danger to airliners that stay on course under normal circumstances. According to ICAO, the international west-bound air route that Flight 007 was supposed to follow had been used in complete safety by an estimated 100,000 or more civilian commercial flights before the incident of September 1.

Only rarely does the public catch a faint whisper of entirely legitimate operations by the elint, comint, and other intelligence-gathering aircraft of both sides; but a recent TV program, transmitted widely throughout Europe, focused attention on alleged wanderings of Aeroflot aircraft during regular scheduled operations. Radar in Bremen tower showed one Paris-bound flight deviating five miles off its designated air route toward a major NATO military base and giving an inaccurate position report before being directed back to its correct heading. A Swiss official claimed that two Air-India transports, chartered and flown by Aeroflot, passed without permission over military bases in his country before being made to land. A German military spokesman implied that such overflights,

presumably with cameras in use, were documented but not made the subject of official protest in the interests of peaceful coexistence.

Wrong Weapons in the West?

For anyone old enough to remember the late 1930s, such reports, and the growing pace of weapon deployment by East and West, have a familiar and ominous ring. The old-fashioned deterrent, based on tens of thousands of nuclear weapons, is no longer capable of preventing war and has become a threat to the survival of life on earth. This is not the weak cry of a pacifist, or a plea for the suicidal path of unilateral disarmament; but if the people charged now with negotiating a sensible, balanced reduction of nuclear weapons prove incapable of progress, then they must be replaced with people who can do so.

Total nuclear disarmament would simply take us all back to the bloody centuries of big legions, which reached their zenith in the trenches of France in 1914-18. It would also place the world at the mercy of any ambitious head of state who manufactured a few such weapons in secret. However, one need look no further than the UK for a supreme example of current muddled thinking. Its government has decided to spend around £11,000 million that it can ill afford on submarine-launched Trident missiles; yet there is no circumstance in which Britain could ever consider firing Trident except as an utterly pointless sequel to the earlier devastation of the UK.

If NATO is unable to guarantee continued deterrent defense of a European member like the UK on the enormous overkill basis of US

strategic missiles, who would pretend that UK Trident is more likely to cause an aggressor to hesitate than would a few squadrons of Rockwell B-1B bombers? The B-1Bs would cost much less, would be sufficiently versatile to play a part in incidents outside the European theater (which are far more likely), could just as easily be acquired from the US, and would bring one step nearer the elusive commonality of equipment so desirable among NATO forces.

Another weak link in current NATO strategy continues to be the cruise missile, which, in different forms, constitutes primary armament for the B-1B and a spearhead of NATO's new theater nuclear force in Europe. At the last count, it was admitted that the crash of an AGM-86B air-launched cruise missile on the Utah Test and Training Range on October 18 was the third failure in twelve flights in the current series of test and evaluation missions. One can sympathize with Canadians who feel uneasy at the prospect of unarmed ALCMs being tested over a 1,400-mile route down the Mackenzie River valley, through the Yukon, and across the northeastern tip of British Columbia before turning to fly over northern Alberta and ending up in Saskatchewan.

Nor do Tomahawk ship-launched and ground-launched cruise missiles and the Pershing II ballistic rocket have an impressive record of success in test firings to date. Destruction during the summer of 1983 of a disintegrating Pershing II launched from Cape Canaveral was the fourth failure in sixteen tests,



F-15 Eagles of the 48th Fighter Interceptor Squadron, first F-15 unit to fly air defense missions, are now on full-time alert status at Langley AFB, Va.

and the third in the last four on that date. One wonders if the new generation of NATO European-based theater missiles poses as great a threat to the Warsaw Pact nations as to those whose homes lie around their bases, or between the bases and the East/West border.

The Better and the Best

It was suggested earlier that the Soviet Su-27 is in the same category as USAF's F-15 Eagle, and that the MiG-29 might have capability similar to that of the US Navy's F/A-18A Hornet. In the same way, it can be said that Tupolev's new strategic heavy bomber, known to NATO as Blackjack, is both larger and faster than the forthcoming B-1B. But what do we mean by "in the same category" and "similar to"? How do Blackjack's all-important Stealth features and weapon systems com-

pare with those of the high-technology B-1B? And does it matter that Soviet fighters continue to roll off the assembly lines at the rate of three a day, far surpassing NATO production?

At times the superior, but complex, equipment of Western aircraft has been a disadvantage. For example, the Foreword to the 1980-81 *Jane's* quoted US Defense Department official statistics showing that an average forty-two percent of USAF tactical aircraft were not mission capable at any particular time during FY '79. Compare now the record of twenty-four F-15s from the 18th TFW at Kadena AB, Okinawa, Japan, which flew to Korea for a combat training exercise. They logged a total of 418 missions in nine days without missing a single scheduled flight due to maintenance problems. On every occasion, the F-15s took off with all systems operating, equivalent to a 100 percent mission readiness rate. During a three-day surge, the twenty-four aircraft completed 223 sorties, one aircraft flying eight times in a day. Time on the ground between sorties was reduced to under eight minutes, with the pilots remaining in their cockpits.

Bearing in mind the complex systems of the F-15, this is a fine record, even in the untroubled environment of a peacetime exercise. Similarly, the F/A-18A Hornet has emerged from a development period threatened by congressional budget cutbacks to become the dual-role



F/A-18A Hornet—the US Navy/Marine Corps force multiplier, now operational after a stormy development period.

force multiplier that the US Navy and Marine Corps wanted. It has shown itself able to perform deep air support missions comfortably beyond 575 miles' range, with a hi-lo-lo-hi profile and adequate combat reserves. Its capability to self-escort and to navigate precisely, to find its target at night using FLIR, and to use its laser spot tracker when supporting designator-equipped ground forces has enabled the first F/A-18 squadron to achieve an average CEP (circular error probable) of thirty-five feet in practice, compared with an average CEP of 120 feet for a highly experienced Marine F-4 squadron.

Unfortunately, those who control Western defense budgets often prevent the good from becoming better. This can be self-defeating. Congress refused funding that might have converted the A-10 Thunderbolt II into a true all-weather combat type with a second seat, search radar, and other equipment for night operation. Instead, members decided to support development of LANTIRN, the Low-Altitude Navigation Targeting Infrared for Night fire control pod that was supposed to give the single-seat A-10, F-15, and F-16 night attack capability.

During the summer of 1983 a committee of the Defense Science Board reported that LANTIRN was unreliable as a means of locating targets at night and was vulnerable to enemy countermeasures. It foresaw "monumental false alarm rates," with missiles chasing automobiles instead of tanks or failing to find any target on which the hot spots were covered with canvas or branches. Yet the estimated program cost had increased from \$1,000 million to \$1,800 million in one year.

LANTIRN was still alive at the

time this survey was written, and one hopes that its deficiencies will be overcome, as there is no obvious alternative within an acceptable time scale.

The highly important Sikorsky HH-60D Night Hawk combat rescue helicopter program is under more immediate threat because USAF was said by its critics to have taken the basic \$5 million UH-60 and converted it into a \$20 million aircraft by design changes and added equipment. The original plan to acquire 243 HH-60Ds has been amended to only sixty-nine HH-60Ds, plus eighty-six HH-60Es with diminished equipment and capability.

US partnership in the British JP233 weapon system promised to give USAF the runway destructor that it lacks. Ax grinding by US industry led to withdrawal from the program and transfer of funding to the MRASM runway attack variant of the Tomahawk cruise missile. MRASM was itself canceled in the summer of 1983, leaving US tactical air forces to continue training for hazardous overflights with ineffective weapons, or to purchase an older foreign weapon like the French Durandal.

At the AFA Convention briefings last September, delegates were told that a House Armed Services Committee vote to cut back to thirty the FY '84 request for forty-eight F-15s, with thirty more each year thereafter, resulted from a decision to fit AMRAAM medium-range air-to-air missiles to the lower-cost F-16. The originally projected cost of \$26,000 million for 696 more F-15s was considered unaffordable, especially as the F-16 will also have a longer-range radar from FY '84. Each F-15, it was said, would have

cost twice as much as an F-16 for only a marginal increase in capability, mostly in range.

One wonders how much Argentine pilots would have paid for extra range/endurance during the Falklands campaign, and how much difference it would have made if the Luftwaffe's Bf 109s could have stayed longer over southern England during the 1940 Battle of Britain. There are times when a little extra performance makes all the difference.

Good news is that the US Army regards its LHX project to design and produce a multipurpose light helicopter family for the twenty-first century as potentially the largest-ever peacetime helicopter program. The plan calls for several thousand aircraft, costing more than SAC's 100 B-1B bombers, to replace all the Army's assorted UH-1 Iroquois, AH-1 HueyCobras, OH-6A Cayuses, and OH-58 Kiowas. A family of related body shells of composite construction will use common engines, rotors, transmissions, and other dynamic components. Other features are expected to include digital avionics, advanced digital flight controls, conformal weapons carriage, Stealth characteristics, and a simplified cockpit to reduce pilot work load for single-crew operation whenever practicable.

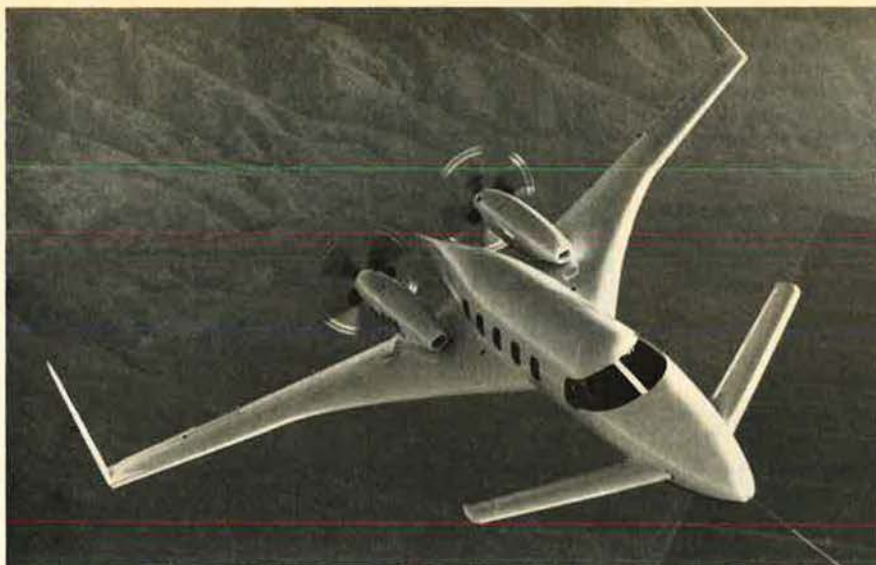
One version of the LHX, depicted in an artist's impression from Hughes, would be a highly advanced single-seat combat helicopter with short sweptwings and the company's NOTAR system, as tested on an OH-6, instead of the normal tail rotor. It looks like nothing yet flown, and could be precisely what is needed to match the latest ideas of Mr. Tishchenko of the Mil Bureau.



Hughes concept for a single-seat combat version of the US Army LHX.

Learning from the Homebuilders

There was a period soon after World War II when designers in the aviation industry let their imagination run riot to such an extent that aircraft of every conceivable shape appeared on the drawingboards of even the most respectable companies. A number of the more extreme designs were built and left the ground, briefly, especially in France, confirming the old adage



Burt Rutan's eighty-five percent scale flying prototype of the 8/10-passenger Beechcraft Starship I business transport.

that even a brick will fly, given enough thrust. Today's projects tend to be more traditional; some of the exceptions, like the LHX fighter helicopter, are highly significant.

Best known pacesetter of new thinking in fixed-wing design has been Elbert "Burt" Rutan of California. Sixteen years ago he started work on a small two-seat canard delta named the VariViggen, with a pusher propeller at the tail. A family of sweptwing canards followed, of which the VariEze was soon being built in thousands by amateur constructor/pilots.

The fuselage is made of large sheets of rigid urethane foam, carved to shape and covered with glassfiber. The wings are of unidirectional glassfiber with a rigid foam core, and sport NASA winglets. Futuristic lines are enhanced by a one-piece arched cantilever strut carrying the main wheels, and a nosewheel that retracts in flight to reduce drag and on the ground to facilitate entry to the tandem cockpits.

In 1979, an uprated version, known as the Long-EZ, beat by nearly 1,845 miles a distance record set by a "real aeroplane" which had remained impregnable for twenty years. In doing so it covered 4,800 miles around a closed circuit in a nonstop flight lasting thirty-three hours, thirty-three minutes, and forty-one seconds.

By then it was impossible to ignore Rutan's capability. When

USAF requested proposals for a Next-Generation Trainer (NGT) to replace the Cessna T-37, he built for Fairchild a sixty-two percent scale flying representation of the company's design, using the speedy low-cost construction techniques developed for his homebuilts. Fairchild won the design competition and now has a contract to produce prototypes of an expected production run of 650 T-46A trainers (full-scale and with conventional metal structure).

Rutan has formed a company named Scaled Composites Inc. to offer similar prototype services to other manufacturers. Much of what leaves his factory in the future will be cloaked in military or industrial secrecy, but one SCI product that created a sensation in 1983 was an eighty-five percent scale prototype of Beech's new eight- to ten-passenger Starship I twin-turboprop business transport. The sweptwing canard configuration, with pusher propellers, suggests some Rutan influence, although Beech engineers describe the concept as "mainly ours."

It is too early to predict what impact such a revolutionary design will have on a traditionally conservative business market; but the almost simultaneous arrival, at the recent National Business Aircraft Association convention in Dallas, of a mockup of a twin-turboprop canard pusher under joint development by Piaggio of Italy and Gates Learjet of the USA suggests that a change of attitude may be detected as the young postwar sports-car fraternity attains executive status.

Whether or not they will be able to afford what have been called the "Star Wars business jets" depends on a sustained industrial recovery from the recession of the past decade. One of the first hopeful signs was evident when Cessna recalled ninety-eight percent of the workers it had laid off on August 12, 1983. At that time it had caused a tremor through the general aviation industry by suspending all aircraft manufacture for at least five weeks. It was felt that there could be little hope for lesser companies when the world's largest producer of aeroplanes, in terms of numbers delivered, could find no market. No more was heard about the plans for a new company to take over production of the Gulfstream Aerospace Commander 112 and 114 light-planes; types like Adams Industries' Thorp T211 seemed to disappear without trace.

Even now, Cessna has restored to production only its middle-line singles, the 172, 182, U206, 208 and 210, the 303 light twin, and its top-of-the-line turboprop Conquest I and turboprop Citations. The larger piston-engine twins will start up "sometime after the first of this year," the 152, 185, and 188 agricultural aircraft hopefully in March.

The Year of the Commuter

What had seemed likely to be remembered as the year of the commuter transport ended with predic-

John W. R. Taylor, the world's top aviation authority, has been editor of Jane's All the World's Aircraft since 1959. His bimonthly "Jane's Supplement" is a valued regular feature of this magazine, and he also compiles or edits the galleries of aerospace weapons for both the USAF Almanac and Soviet Aerospace Almanac issues. Trained as an architect, he fulfilled his ambition of becoming an aircraft designer by working under the famed Sydney Camm at Hawker during World War II. He has written more than 200 books and thousands of articles on aviation subjects. Mr. Taylor is a Fellow of the Royal Aeronautical Society, the Royal Historical Society, and the Society of Licensed Aircraft Engineers and Technologists.

tions from well-informed market analysts that three of the six manufacturers of new twin-turboprop thirty- to fifty-passenger aircraft would decide to cut their losses and drop out of the contest. This might have happened in normal times. Now, with little possibility of finding programs to replace anything that is abandoned, all six must keep their assembly lines open for as long as someone will buy what trickles off the end.

Shorts of Belfast was clever enough to get in first. By building its thirty-six-seat model 360 on the basis of the already popular 330, and by rejecting unessential refinements like pressurization for an aircraft that would spend its life on busy, short-haul, low-cost services, it was able to offer passengers the attraction of a big cabin with stand-up headroom. Operators discovered that they could make money with the 360 from day one. Shorts also continued to show an operating profit, with sales passing sixty by summer 1983, mainly for US customers.

EMBRAER of Brazil had also penetrated the US market successfully with its twenty-one-passenger Bandeirante. On July 27, 1983, it flew the prototype of the thirty-seat Brasília, with two of Pratt & Whitney's new 1,500-shp PW115 turboprops, which help to make it the fastest of the current crop of commuters. A high-speed cruise of 288 knots is allied to an airframe weight lower than most competitors considered possible, achieved by the use of special lightweight aluminum alloys and composites. Firm orders will not be accepted until performance estimates have been verified, but a large domestic market in Brazil swelled options to 107 by the time of the first flight, with the future potential of maritime patrol, ECM, corporate, and cargo versions still untapped.

The same factor of a huge home market virtually guarantees the success of the joint Indonesian/Spanish CN-235. A pair of 1,700-shp General Electric CT7s, rough field landing gear, and a rear loading ramp/door should enable it to operate from 2,640-foot strips with thirty-nine passengers or 8,800 pounds of freight, which none of its competitors can match. Orders totaled 106,

RIGHT: First two production Shorts 360 commuter airliners in the insignia of Suburban Airlines of Pennsylvania and Simmons Air of Michigan.
BELOW: EMBRAER's Brasília commuter transport, big brother of the popular Bandeirante.



RIGHT: The Saab-Fairchild 340, first Swedish-American joint design.



with twenty-three options, before the prototypes had left the ground.

Another two-nation type with CT7s is the Swedish-American Saab-Fairchild 340, which can carry thirty-four commuter passengers but is also making a strong bid for corporate sales from the start. Orders and options were said to total around 100 by summer 1983, of which twenty percent were for the executive model. With three aircraft clocking up flying hours toward certification, deliveries are expected to begin in the coming spring. Manufacturing plans envisage completion of twenty-four SF 340s by the end of this year and fifty in 1985, building up to seventy-two per year by 1987.

For the sake of the teams responsible for the two remaining commuter newcomers, one can only hope that the market will be as buoyant as such delivery targets suggest. Aeritalia of Italy and Aérospatiale

of France were late in pooling their immense capability and experience in the ATR 42 project, and the first flight of a prototype is still at least nine months away. Unit cost of production aircraft is likely to be \$1 million higher than for aircraft already discussed. However, the initials ATR stand for "regional transport aircraft" in the languages of the two partners, and the 42 indicates that seating plans accommodate from forty-two to forty-nine passengers, putting the aircraft in a different category from the thirty-seaters. By summer 1983, orders totaled forty-six, with eleven options. Deliveries will start with five aircraft in 1985, building up to fifty-two in 1987.

Meanwhile, de Havilland Canada appears to be in the least enviable situation of all, despite the qualities of its thirty- to forty-seat Dash 8. Its knowledge of market requirements is unequaled. As a start, it has sold

more than 800 of its DHC-6 Twin Otters alone since 1966. These twenty-seaters have logged more than 7,000,000 flying hours and are used on more daily scheduled flights than any other propeller-driven aircraft, with only the Boeing 727, 737, and McDonnell Douglas DC-9 performing more daily services.

In the Dash 8, DHC decided that quiet, fuel-efficient operation and unequaled comfort were likely to be more important to its short-haul and corporate customers than the STOL capability that had been considered number-one priority for most of the company's previous designs. The resulting aircraft is still above average in this respect, with a design FAR Pt 25 takeoff field length of 2,710 feet at maximum takeoff weight, and landing field length of 2,980 feet. Combined with an eight-foot, two-inch cabin width and headroom of six feet two inches, it offers passengers that little extra that could be important.

Unfortunately, the Dash 8 has arrived at a bad time. Quite apart from the general recession and excessive competition, the Canadian government is reported to have lost nearly \$Canadian 1,246 million on aerospace programs, of which \$265 million were lost by DHC in the last seven months of 1982, mainly through development write-offs on the Dash 7 and Dash 8.

This is the kind of problem to which governments and economists must apply their minds worldwide if our industry is to survive. That they are capable of doing so is shown by the blowing of public-relations trumpets and Conservative Party

applause that greeted the announcement that British Airways had progressed from years of heavy losses, and a modest operating profit of £13 million in 1981, to a profit of £190 million in 1982 before deduction of interest charges. With debts totaling more than £1,000 million, the balance sheet as a whole was certain to appeal more to financial wheeler-and-dealers than to UK taxpayers, who are likely to settle the £1,000 million overdraft before Mrs. Thatcher's government sells British Airways under its privatization policy.

Private Profit or Public Service?

Private ownership of British Airways may ease the state's financial burden, but will it ensure continued high standards of safe, efficient service for the airline's passengers? Those who expect annual profits from a planned purchase of shares would do well to study first the everyday costs of running a major international airline, and of buying the appropriate proportion of the 5,000 new aircraft with which the world's commercial air fleets must be reequipped between now and 1995.

They would not be encouraged by the 1982 results of the eleven major, privately owned US operators. Of the entire group, only US Air, Northwest Orient, and United recorded net profits. The eleven airlines suffered a cumulative net loss of \$742 million, compared with a \$620 million loss in 1981. Total operating loss was \$600 million. Statistics in hundreds of millions are beyond the comprehension of most people. Easier to understand is that

it would cost every man, woman, and child in the UK about £18 to wipe off British Airways' debts so that its new owners could start with a clean balance sheet. Such a proposal would generate howls of protest from many quarters; but how much is a good airline worth as a national asset, whoever owns it?

The Concorde has always presented a good case in favor of public support for aviation. It was designed to carry 100 passengers across the Atlantic at twice the speed of sound. This it has done with remarkable standards of regularity and safety, making supersonic transportation routine in the process. It was not designed to be quiet, because noise regulations did not exist at the time of its development. It was not designed to make a fortune or recoup its development cost in an unimagined future period when fuel costs would suddenly treble. Yet, in the last financial year, British Airways' small Concorde fleet achieved an operating profit of around £7 million, and the aircraft remain in such demand that the airline has applied for permission to extend its London-Washington service to Miami.

Like nuclear weapons, supersonic transportation cannot be un-invented, so what follows Concorde one day? The West seems reluctant to indulge in such extravagant thoughts. It is, therefore, interesting to note that the Soviet Union received FAI confirmation of four speed with payload records set on July 13, 1983, by something identified only as "Aircraft 101," powered by four 44,100-pound-thrust "Type 57" engines, and which carried a thirty-tonne load around a 1,000-kilometer circuit at Mach 1.91 (1,097 knots).

Aircraft 101 is a Tupolev Tu-144 supersonic transport—a type withdrawn by Aeroflot from passenger operations. It is probably being used as a development test-bed for engines installed in Tupolev's new Blackjack supersonic strategic bomber. The fact that it is flying with new engines also suggests the possibility that, in a post-Concorde era, the USSR might one day see advantages in having the world's only supersonic airliners to operate alongside the world's largest subsonic transports.



Good aircraft, bad time—the de Havilland Canada Dash 8.



ABOVE: Boeing 757s of Monarch achieved 100 percent dispatch reliability in one weekly period recently. **LEFT:** Airbus A310, setting reliability records in its first six months of airline service.

If the West is to maintain its present leadership in the manufacture of airliners, it must eventually accept a completely new basis for financing both manufacturers and operators. This may not sound attractive, but would anyone ever have built a great bridge or a magnificent cathedral if the end product had, first and foremost, to show an operating profit? It was sufficient for earlier generations that such projects gave work and livelihood to those who built them, and would improve the quality of life for those who used them far into the future.

If this sounds naïve in a materialist age, it is worth remembering that the US already has, in its National Aeronautics and Space Administration, an outstanding example of right thinking. In its first twenty-five years of life, NASA has enabled twelve astronauts to walk on the moon and dozens of astronauts and scientists to work in earth orbit. It has explored the planets Mercury, Venus, Mars, Jupiter, and Saturn, and launched communications satellites that allow us to see events anywhere on earth as they happen. It has added immeasurably more to man's knowledge of the universe than all previous achievements by all the men of history. The direct cost of all this has been as astronomical as its triumphs. Indirectly, applications of its work have built in-

dustries, created jobs, and enriched life in hundreds of ways.

That last sentence could be applied just as truly to powered flight. Should we not, therefore, regard as warning signs the premature withdrawal from production of the Lockheed TriStar, abandonment of aircraft as promising as the McDonnell Douglas MD-90 and MD-100; use of the Concorde as a PR gimmick on such mundane operations as a 300-mile commuter shuttle between London and Glasgow; and lack of enthusiasm by the governments of Western Europe to finance the 147/179-passenger Airbus A320, despite the enormous success of the larger A300 and A310, and promise of a launch order for the A320 from British Caledonian Airways?

The current generation of commercial transports is recording standards of reliability that are almost beyond belief. Based on the World Airlines Technical Operations Glossary, the first twelve A310s, operated by three airlines, achieved a fleetwide technical dispatch reliability of ninety-eight percent in September 1983, and 97.4 percent for the total first six months of operational life. Figures for the Boeing 757 are equally impressive, with a cumulative record of ninety-seven percent for twenty-two aircraft since January 1, 1983. Leading operator was Monarch Airlines of the

UK, with 98.6 percent dispatch reliability, and 100 percent for the last weekly reporting period before the October 25 statement.

Data issued by Boeing show how the manufacturers of the big turbofans fitted to its current aircraft are making such statistics possible. Rolls-Royce's 53,000-pound-thrust RB211-524D4 has the best overhaul shop visit rate of any engine fitted in the big 747s—only 0.18 per thousand hours when measured over three-month or twelve-month periods. Some RB211s have been installed in TriStars for more than three years without removal for overhaul. The longest-life engine, in a Pan American TriStar, had run for nearly 9,000 hours at the time of the report, with others of Delta, Pan Am, and LTU not far behind. A test run of an LTU engine, removed for conversion to a higher standard, showed that specific fuel consumption had deteriorated by only one percent after more than 1,400 flights totaling 8,000 hours.

A New Pioneering Age

It might be imagined that the aerospace industry would be satisfied with its present standards of performance and reliability. In fact, we are at the brink of a new age of pioneering in the air. This is evident at every level of technology, from the new generation of highly practical air recreation vehicles (ARVs) that is following the first primitive microlights, to sophisticated supersonic types like Grumman's forward-sweptwing X-29A, and composite construction, canard, delta-wing fighters such as Sweden's JAS 39 Gripen and Israel's Lavi.

The ARVs are intended as low-cost sporting aircraft for one or two people but, like the X-29A, they have become possible only through the development of lightweight composite structural materials. Their tiny engines represent a major progression beyond the chainsaw and golfcart engines that were adapted for the early microlights. If such a remark inspires little confidence in those who have learned to trust the well-established flat-fours and flat-sixes installed in Beech, Cessna, and Piper lightplanes, they should bear in mind that Porsche of Germany and Robin of France will soon be selling aviation engines

based on engines developed originally for Porsche, Peugeot, Renault, and Volvo automobiles and claimed to be superior in every respect to the horizontally opposed aero engines that have changed little in decades.

Nothing positive may yet be published concerning the Stealth technology that is being built into the next-but-one generation of military aircraft. The word "Stealth" has been superseded in official circles by "low observability," and there are rumors of strange configurations, with few straight lines or flat reflective areas; engine air intakes and jetpipes located on top of fuselages that are formed from radar-transparent composites; engine components made of plastics; new ECM to jam and confuse enemy search radars; radar-absorbent surface finish; and much more. The B-1B has a radar signature only one-hundredth that of a B-52 as it approaches; as for the Lockheed F-19 . . . but that, of course, stays secret.

Technology is working in other ways to improve aircraft survivability and serviceability. Using micro-electronic technology, British Aerospace has demonstrated that it is possible to replace the miles of electric cable in a fighter by a few pairs of small wires that can pass a million bits of information each second, in digital form, to operate every aircraft system. The data-base system planned for BAe's Agile Combat Aircraft of the mid-1980s will have the ability to "heal itself" after sustaining battle damage by reconfiguring in the event of failure of part of the system. Other companies are looking beyond fly-by-wire to fly-by-light fiber optics.



Holder of the world speed record in its class, the CFM Shadow is typical of the thoroughly practical designs now superseding earlier, primitive microlights (East Anglian Daily Times).



With a wingspan of 267 feet and takeoff weight of 40,000 pounds, Lockheed's proposed high-altitude drone is intended for elint and other military missions. Dual-cycle turbojet/turboshaft engines, burning liquid hydrogen fuel, would provide twenty-four-hour endurance.

Fears of imminent exhaustion of conventionally produced hydrocarbon fuels have lessened, following the discovery of vast new reserves, but the search for alternatives has continued. USAF jet aircraft at Hill AFB, Utah, and Mountain Home AFB, Idaho, are beginning a two-year program of operation on JP-4 derived from shale oil, of which eighty percent of the world's known recoverable reserves are concentrated in the USA.

Nor has a series of disappointments dimmed Lockheed's interest in liquid hydrogen. Its first opportunity to turn interest into reality came in 1956. After two years of preliminary design studies in the famous Skunk Works at Burbank, the team that gave USAF the U-2 received a contract for two prototypes of a liquid hydrogen-fueled reconnaissance aircraft known as the CL-400, about which little has ever been published.

It was intended to fly at Mach 2.5 at 100,000 feet, and the first flight was scheduled to take place only eighteen months from go-ahead. To save time, the chosen configuration was similar to that of Lockheed's F-104 Starfighter. To contain the required 21,404 pounds of liquid hydrogen, crew of two, and 1,500-pound payload, the fuselage had to be scaled up to a length of 160 feet, with a diameter that foreshadowed modern wide-body transports. The straight wings had a 3.38 percent biconvex section, and an area of 2,400 square feet. Landing gear was bicycle type, with outriggers, and a retractable ventral fin ensured di-

rectional stability in supersonic flight.

The two Pratt & Whitney 304 hydrogen expansion engines were to be mounted in wingtip pods, with fixed double-cone inlets and simple convergent-divergent nozzles. Each delivered 9,500 pounds of thrust at sea level, and 6,100 pounds at Mach 2.5 at 95,000 feet. Range was estimated at 2,530 miles, but there was a snag. To produce sufficient fuel to keep the planned fleet of sixteen CL-400s in the air would have used up one-quarter of all the natural gas coming into Los Angeles; and where would the aircraft refuel if deployed overseas?

The CL-400 was canceled in 1957, but all was not lost. Today, Lockheed is looking seriously at the possibilities of a very-high-altitude, long-endurance pilotless aircraft fueled with liquid hydrogen that could perform a variety of missions such as communications relay, early warning, surveillance, and meteorological reconnaissance.

Of more immediate importance, Skunk Works research suggested back in the 1950s that the speed and height planned for the CL-400 could be combined with doubled range by switching to hydrocarbon fuel. Such thinking produced USAF's SR-71A, which continues to perform vital strategic reconnaissance tasks and has held the world's absolute speed record, unchallenged, for more than seven years. It would take a brave man to predict the shape of the aircraft, and the type of powerplant, that will one day exceed that record. ■

GAS turbine engines are one of the most visible and expensive commodities owned by the United States Air Force. The current inventory of installed and spare gas turbine engines includes more than 64,000 jets and auxiliary airborne and ground power engines worth more than \$12 billion. Add to that the billions of dollars' worth of engines being procured for new weapon systems, and you can appreciate the magnitude of the business. There are literally thousands of people in the Air Force involved in the care and feeding of gas turbine engines. This article reviews gas turbine engines from three viewpoints.

The first is that of the operating commands. They must meet mission sortie requirements in such terms as readiness (Are the aircraft systems performing sufficiently to allow accomplishment of the mission?), availability (Are the aircraft ready when needed?), and capability (Do the aircraft have the necessary performance, thrust, fire-power, accuracy, and endurance?).

The second viewpoint comes

from the program managers at the Aeronautical Systems Division (ASD) of Air Force Systems Command, where the Air Force initiates the development and production process. ASD is involved in translating the operators' needs into specifications and contracts that ensure the timely delivery of engines that perform as required. ASD's job also includes ensuring that integrated logistics support requirements are satisfied. Of course, all aspects must be controlled tightly within established cost and schedule restraints.

The third viewpoint is from Air Force Logistics Command (AFLC), where the mission is to provide the operator with the support needed to meet wartime requirements and cost-effective peacetime operations. This support requires implementation of the total integrated logistics support plan, including such elements as repair capability, spares, training, transportation, redesigning, and upgrading to maintain system capabilities.

Finally, this article will examine

some other areas of more general interest and take a look at where engines and engine management are headed in the future.

In the Cockpit

The operator in the cockpit wants an engine that will respond to the throttle. He wants one that will go from idle to maximum afterburner as rapidly as he can move the throttle. He wants one that is as smooth in a high-energy condition as it is during cruise condition—no compressor stalls, rumbles, or overtemp/fire warning lights when it's loaded. When he takes the active runway, he wants an engine in which he has confidence, one that will get him off, through the mission, and back to homeplate. In short, he wants "a hummer, not a bummer."

The engine should be one that the maintainers can troubleshoot and repair without complicated equipment and procedures. The reliability must be such that premature failures and unscheduled removals are at an absolute minimum, allowing spares on the ready line to be

THE CARE AND FEEDING OF GAS TURBINES

A jet engine must respond to the throttle, of course, but that's only one consideration when thinking about powerplants.

BY BRIG. GEN. THOMAS A. LA PLANTE, USAF
COMMANDER, AFLC LOGISTICS OPERATIONS CENTER

*An F101 derivative fighter engine
undergoes tests at the Engine Test
Facility at Arnold AFS, Tenn.*



maintained at maximum numbers. Also, spare parts must be readily available so that cannibalization is rarely, if ever, required. The operating commands are where the buck stops.

ASD's Goals

Providing high-performance, fuel-efficient, lightweight engines that are supportable is one of the goals of today's engine program managers at AFSC's Aeronautical Systems Division. Since 1977, ASD's Deputate for Propulsion has existed for the express purpose of refining the acquisition process for engines to assure that the Air Force has the latest technology powerplants for new weapon systems. Not only does ASD strive to incorporate state-of-the-art technology (for example, active cooling circuits for turbine hardware, electronic control systems, or single-crystal and directionally solidified materials), but, perhaps even more important, it also incorporates new, more efficient acquisition and management techniques to acquire and manage

in-service engines. Multiyear procurements and extended warranties are only two recent innovations.

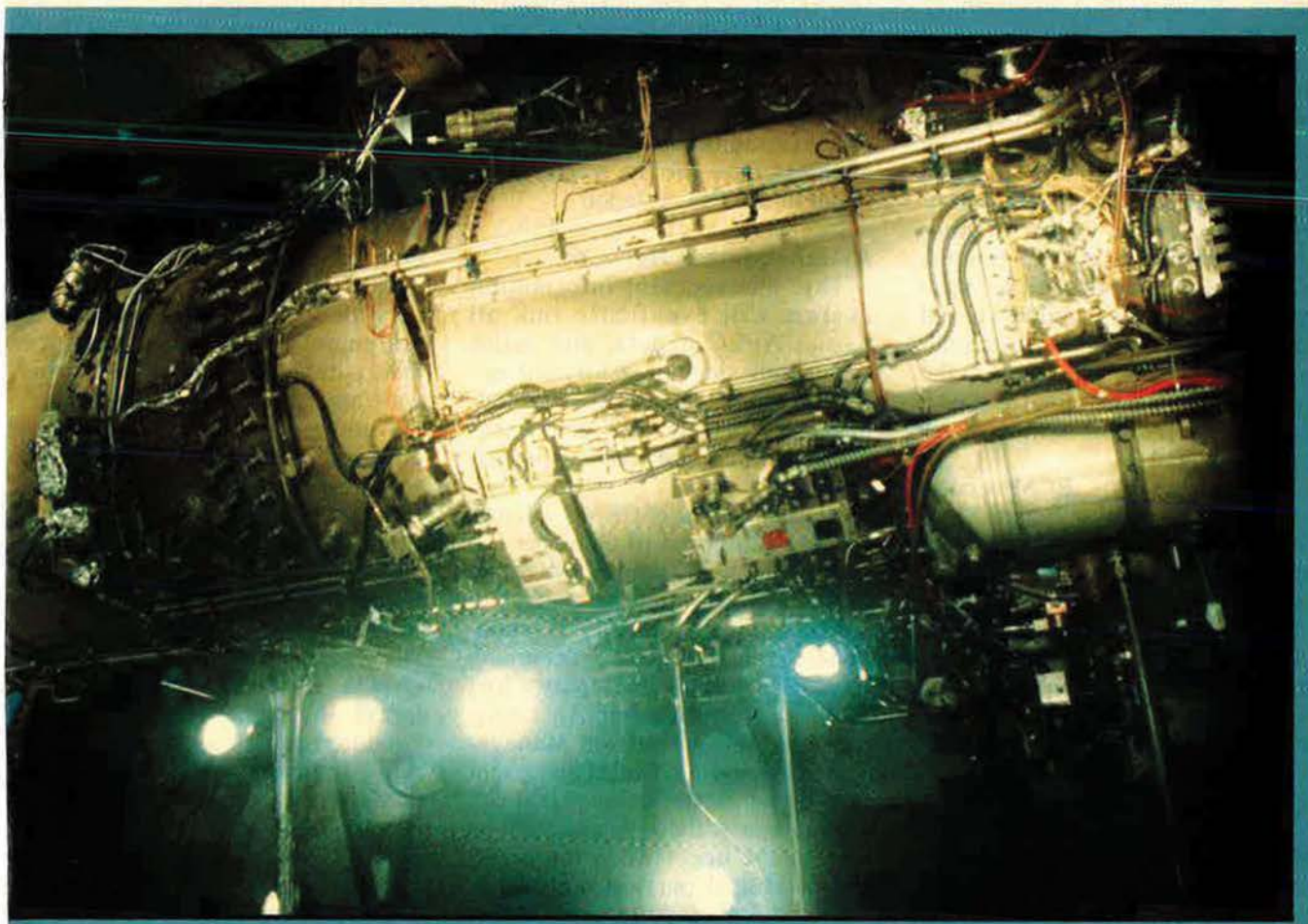
W. J. Meyer, the first civilian to direct the Logistics Directorate of ASD's Deputate for Propulsion and current Chief of the Propulsion Management Division in AFLC's newly formed Logistics Operation Center, said, "To help assure engines are designed for supportability, the Air Force Acquisition Logistics Center has collocated more than fifty senior logisticians, analysts, and engineers in ASD's Deputate for Propulsion. This management concept allows optimum interchange between the designer and the supporter and permits early evaluation of the mission support impacts of design, thus prompting configuration changes where needed." The removal of the F100-PW-100 augmentor's external nozzle segments—affectionately called "turkey feathers"—saved more than half a billion dollars in lifetime support and acquisition costs for the Air Force. "This is one of the best examples of the value of

combining design and support personnel in one program office," said Mr. Meyer.

The View from AFLC

AFLC's goal for engines is to provide the required support to the operational units and, at the same time, reduce the cost of ownership. Three areas of emphasis are maintaining required inventory, maintaining specified performance, and optimizing reliability and maintainability. AFLC approaches these objectives in a variety of ways by using supportability, availability, maintainability, and management concepts.

For supportability, we have developed analytical modeling tools that simulate various peacetime and wartime scenarios to predict required spares, manpower, transportation, and so on. These estimates are used to justify the procurement of spares, allotment of manpower, etc. Training plans are then formulated along with necessary technical data and support equipment. All elements of integrated logistics sup-





Last year, the Air Force took delivery of the 3,000th Pratt & Whitney F100 fighter engine. Those present at the acceptance ceremony included, from left, Col. Joseph Syslo, Commander of USAF's Plant Representative Office at P&W's Hartford facility; Col. James Peterka, Chief of the Propulsion Management Division at the San Antonio ALC; Col. James Nelson, ASD's Deputy for Propulsion; Brig. Gen. Ronald Yates, Director of ASD's F-16 System Program Office; ASD Commander Lt. Gen. Thomas McMullen; and Pratt & Whitney employees Harry Durant, Roland Forgues, and Marilyn Spadaccini.

port are developed thoroughly to ensure an optimum supportability posture.

The availability of the system is also a critical concern to AFLC. In this area, we are implementing the Reliability Centered Maintenance (RCM) concept, similar to that used by civil airlines. RCM focuses attention on critical engine components affecting safety, operations, or cost. Maintenance actions, such as inspections, are scheduled based on a failure-modes-and-effects analysis. The goal of RCM is to keep the engine on the wing as long as possible and to eliminate unnecessary maintenance.

For some engines, RCM is combined with the Turbine Engine Monitoring System (TEMS) and the newly developed Comprehensive Engine Management System (CEMS). The TEMS is an on-board engine monitoring system that tracks engine health continuously by recording sensor data at predetermined flight phases and upon exceeding established limits.

The TEMS also tracks engine usage data, such as starts and engine cycles. When the aircraft returns to base, the TEMS gives an immediate go/no-go indication for rapid aircraft turnaround. Data can

be gathered electronically by a small collection unit and transferred to the CEMS management information network, which converts the data to formats usable in flight line, intermediate, and depot maintenance in addition to providing management data for the major command and AFLC's depot.

A Management Network

This management information system will eventually link all bases, AFLC depots, and major commands, including forward operating areas. The network will allow rapid data transfer and expedited maintenance and supply actions.

"The existence of CEMS will permit the Air Force to eliminate the maximum overhaul times (MOT) on engines by tracking the useful life consumption on life-limited components within the engine," according to A. Bruce Richter, Deputy Chief of AFLC's San Antonio Air Logistics Center's Propulsion Management Division. Instead of being sent into depot repair every 1,000 operating hours, these engines will be sent to the depot when the useful life of critical parts is consumed. This requires daily tracking of engine operating times and maintain-

ing a computer data bank on all serialized critical parts.

"As an example of the magnitude of the effort," Mr. Richter said, "consider that the F100 engine [F-15/F-16 aircraft] has ninety-two life-limited parts, each with its own individual serial number. Therefore, with a current inventory of some 3,000 F100 engines, each day the hours or low-cycle fatigue counts on 276,000 engine components must be recorded. This management requirement has forced us into the data automation business in a big way, and CEMS is our answer."

Another aspect of availability is improved systems reliability. AFLC tracks reliability trends and identifies areas where engine modification improvements are required. One key source of information that permits early identification and resolution of impending problems is Accelerated Mission Testing (AMT). AMT is the nonflying testing of an engine under controlled conditions on an accelerated basis. AMT indicates potential problem areas in the operational inventory. Results from AMT, as well as from actual fleet experience, generate modifications that can resolve pending deficiencies. By combining AMT and field experience, great

strides are being made toward increasing systems availability.

Maintainability Decided Early

Once design basics are set, maintainability considerations are largely locked in. For this reason, maintainability is primarily addressed during the conceptual and design phases. AFLC Deputy Program Managers for Logistics (DPMLs) are located with ASD System Program Offices to ensure that integrated logistics is covered adequately during acquisition and that new engine concepts, such as RCM, are considered. "Designing for Supportability" is the watchword of all DPMLs.

To make sure engines are effectively managed, engine managers are assigned to both major command and base levels. Specific engine item managers are also assigned to AFLC's Air Logistics Centers. Twice a year, the entire engine community meets under the auspices of the Air Force Engine Logistics Planning Board. They meet to set up the guidelines for developing policies and logistics plans governing all Air Force aircraft engines.

At the other end of the spectrum, Hq. AFLC assesses the impacts of various engine management system elements on total mission capability. By tracking the key engine factors and their contributions to system degradation, an effective method is established for identifying potential engine-related problems and applying resources to remedy them.

At all levels, AFLC is striving for efficient and effective management of the valuable Air Force engine inventory. To help reduce the cost of ownership, AFLC has a major program under way to improve the way we buy spare parts. George A. Davis, Deputy Chief of the Oklahoma City Air Logistics Center's Propulsion Management Division, said, "Buying from the original manufacturing source is a business

Lifeline for Critical Materials

MATERIAL	SOURCE	US IMPORT DEPENDENCY
Cobalt	Zaire/Zambia	97%
Tantalum	Indonesia/Zaire/Canada	97%
Nickel	Canada/USSR/Australia	77%
Chromium	S. Africa/Zimbabwe/USSR	92%
Titanium	Australia/Africa	96%
Aluminum	Australia/Guinea/Jamaica	93%
Columbium	Brazil/Canada	100%

While the Air Force does what it can to recover and recycle key materials, its dependence is great on foreign sources for elements needed for superalloys used in engine manufacture.

strategy the Air Force is now emphasizing. Review of proprietary data is under way to determine which items can be fully competed. In many cases, complete reprocurment data packages don't exist, thus inhibiting competition. Building these packages is very labor intensive and will take some time to accomplish."

Materials Dependence

The worldwide commitment of the USAF engine business requires international support for its complex technology. While our aerospace manufacturing capability is unsurpassed in the world, our dependency for superalloy materials is equally as great. Examples of US dependency for such materials are shown in the accompanying chart.

Four years ago when Zaire temporarily shut off its supply of cobalt ore to the world, the price rose from \$12 a ton to \$70 a ton (on the "spot market"). The increase affected both the price and lead times of spare parts drastically. The aerospace industry remains vulnerable to critical materials supply and has initiatives under way to reduce the scrap (chip) rate of these materials during the manufacturing process and to recover what scrapage does occur. The Air Force also has a precious metals program to recover condemned engine components and assess them for reconstitution. Metals recovery and recycling programs show promise for the future.

Finally, there is the issue of international distributions of high-technology aircraft engines and the support and maintenance commitments that accompany these international distributions. The F100 engine is now being sold or operated in about two dozen countries. International customers include Israel, Saudi Arabia, Egypt, Pakistan, Venezuela, Japan, and Korea. Major depot manufacturing/repair capabilities are present or planned for key overseas locations to support this diverse inventory.

After the initial resolution of technology transfer issues, these international facilities will be seeking international customers. USAF currently has F100 engine accessories and components repaired in Europe. In 1984, F100 engine and module depot repair contracts will be issued in Europe. Within two years, F100 engine, module, accessory, and component repair for USAF will exist in the Far East. These worldwide depot repair capabilities, together with our facilities in the States, augment existing base-level repair efforts and improve surge capability significantly.

The Engine Resource

The \$12 billion Air Force inventory of engines is a substantial national resource. Effective use of this resource requires exceptional management and coordination among operators, acquisition managers, and supporting logisticians.

The Air Force is committed to providing the maximum mission capability possible for the engine dollars available. The goal remains an ever-improving management system to translate user needs into capable, reliable, available, and maintainable gas turbine engines. ■

Brig. Gen. Thomas A. LaPlante is Commander of AFLC's Logistics Operations Center, Wright-Patterson AFB, Ohio. Following graduation from the Air Force Academy in 1961, he began his Air Force career as a navigator and subsequently earned pilot's wings in 1964. A veteran of 167 combat missions in Southeast Asia, General LaPlante is also a graduate of the Armed Forces Staff College and the Industrial College of the Armed Forces. He assumed his present duties in July 1983.

AFROTC Bounces Back

The scholarships are a big attraction,
but changing attitudes toward the
military have helped, too.

BY WILLIAM P. SCHLITZ
SENIOR EDITOR

SOARING tuition costs, a more favorable attitude toward the military, and career opportunities are major reasons for the resurgence of the Air Force Reserve Officer Training Corps at college campuses around the nation.

Cadet enrollments in AFROTC have risen steadily from 1976's low of 16,579 to more than 26,000 today. AFROTC has been tasked to commission some 3,300 new officers annually over the next several years.

With memories of the Vietnam War fading and service to country once again in favor, a uniform on campus is no longer a magnet for angry confrontation. Moreover, current films and television productions are depicting military service with less hostility. Even the return by the nation's youth to shorter hairstyles and more conservative dress may be a factor.

In any event, joining an AFROTC unit can be financially rewarding. Nonscholarship cadets are paid \$100 a month during their junior and senior years; those with AFROTC scholarships are provided tuition, fees, books, and \$100 a month.

"Such inducements are helping us to attain our major goal of attracting quality people," noted Brig. Gen. William J. Grove, Jr., AFROTC Commandant, at his headquarters at Maxwell AFB in Alabama.

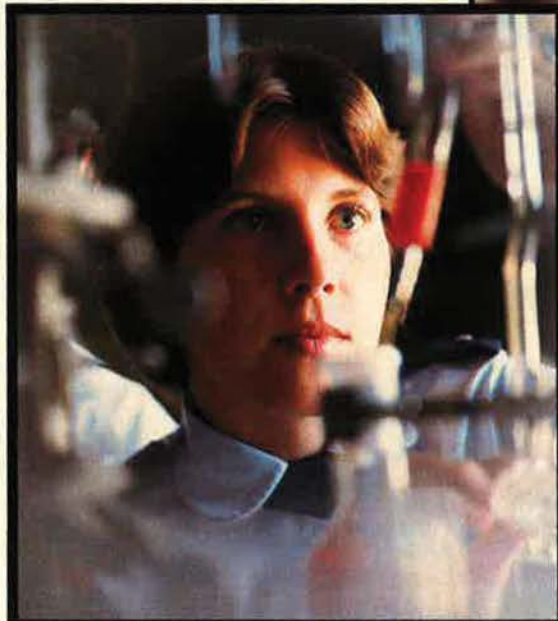
"We're demanding higher grade point averages and SAT scores, and with campus leaders once again in the ranks, other top performers tend to follow," General Grove noted.

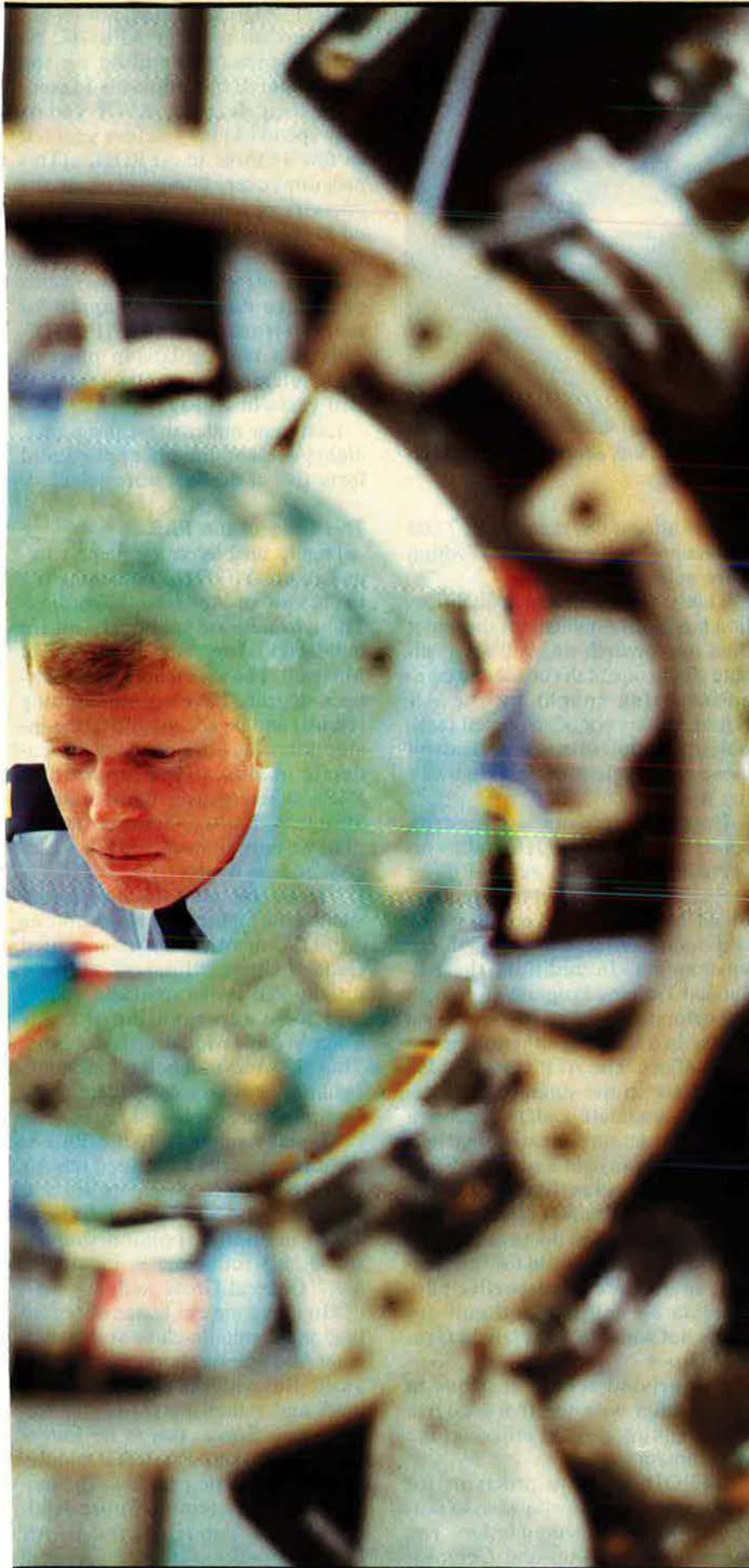
Money isn't the only attraction,

though. Young people still dream of flying airplanes. Cadet Col. Mike Mitchell, an Air Force brat, has wanted to be a fighter pilot since childhood. This prompted him to sign up with AFROTC's Detachment 5 at Alabama's Auburn University. Following graduation, he's scheduled for Undergraduate Pilot Training.

"If all goes as planned, Mike will have double skills," commented Col. Neal Winters, his Professor of Aerospace Studies (PAS) at Auburn. "He'll fly airplanes for a number of years and then take his flight-line experience into the engineering workplace."

Another Auburn student, Cadet 2d Lt. Steve Henning, isn't interested in a flying slot. He wants an Air Force career in engineering.





"While the economy might be improving, engineering firms continue to skim off the top graduates for employment, leaving the others to scramble in the job market for what they can get," he said. "And those finding jobs might spend four or five years in design work before they are given significant responsibilities."

"On the other hand, junior officers going on active duty for the first time in the Air Force are now routinely given major responsibilities unheard of ten years ago. This translates into management experience with program offices, people, and budgets," the engineering student added.

According to Lt. Col. Joseph H. Holt, Jr., Professor of Aerospace Studies at Alabama State University in Montgomery, management experience accrues to cadets even before they are commissioned and go on active duty "since a wide range of events conducted at the AFROTC detachments is pretty much run by the cadets."

Programs Available

Two AFROTC programs are available. One is a four-year program students can enroll in as freshmen. The second is a two-year course for the juniors and seniors. "The two-year course, then, provides an option further along in a student's college career rather than at the outset," noted General Grove.

The four-year program is structured so that the General Military Course is presented during the first two years and the Professional Officer Course during the junior and senior years. (Of the total AFROTC enrollments in any given year, the largest percentages are in the freshman and sophomore years. It is those classes that experience the highest dropout rates.)

Between the two courses a four-week field training course is mandatory for the cadets enrolled in the four-year program. The summer encampments are conducted at thir-

AFROTC produces 41.4 percent of all the new officers coming into the Air Force. With cadet enrollments up, USAF can afford to be selective.



A key AFROTC objective is the recruitment of minorities, with particular emphasis on recruits in the fields of science and engineering.

teen air bases across the country.

"While the cadets operate in a group situation, the encampments give us the opportunity to evaluate them on an individual basis as to attitudes and aptitudes before accepting them into the Professional Officer Course," explained General Grove. "It's a watershed, because at the same time this will usually be a cadet's first experience with the real Air Force. It is at this point that some decide that the way of life is not for them," he added.

The cadets are paid a salary during the encampment and are reimbursed for travel expenses.

For students in the Professional Officer Course (POC) offered in the junior and senior college years, the mandatory encampment lasts six weeks. "It's sort of a catch-up session with the additional two weeks devoted to academics that the four-year cadets have already been exposed to," General Grove pointed out.

Just prior to beginning the POC, the cadets sign an enlistment contract—usually on the first day of class—that initiates their military obligation. (AFROTC scholarship recipients make this decision at the beginning of their sophomore year.)

But that's not all. Prior to admission to the POC, a cadet must qualify under a combination of a number of test criteria, such as college grade point average. This weeding-out process comes under the general heading of Weighted Professional Officer Course Selection System. For example, for the

FY '85 allocation, there were 7,000 applicants, sixty percent of whom were selected.

That's still not all. Once qualification has been established, the cadet then must match up with an available slot in one of the academic categories being sought by the Air Force. In this era of advanced technology, about seventy percent of these are in scientific and engineering majors.

Besides purely military academics on campus, AFROTC cadets receive instruction in several other ways. They make field trips to nearby air bases to observe both junior and senior officers in their job environments. In addition, the Advanced Training Program affords an opportunity to spend two weeks on a base in a working situation with a host officer. The ATP sessions also take place in the summer.

Pilot candidate cadets receive a flight instruction course during their senior years in light aircraft at FAA-approved civilian flying schools. This usually consists of twelve and a half dual hours and thirty minutes of solo time. "One reason for this is so we can evaluate a prospective pilot candidate's aptitude and cull out those not suitable," explained General Grove.

The ground school sessions in conjunction with the flying course are taught by a rated officer at the detachment.

AFROTC has two programs for enlisted personnel who wish to pursue an Air Force commission. The Airman Scholarship and Commis-

sioning Program (ASCP) allows eligible airmen to enter AFROTC on scholarships. Depending on the time required by applicants to complete their degrees, ASCP cadets may spend as many as four years or as few as three in AFROTC. (This program is very competitive and the majority of scholarships are awarded in technical areas.) The Airman Early Release Commissioning Program allows airmen with two years of college remaining to apply for early release to enter AFROTC. This is a nonscholarship program with selectees normally spending two years in AFROTC.

Last year under these programs, eighty-six candidates applied and forty-five of the best were selected.

The Role of the PAS

Highly visible on a college campus is an AFROTC detachment's Professor of Aerospace Studies. Though many are volunteers, all are hand-picked by Hq. AFROTC at Maxwell. The PAS must have a master's degree, have an outstanding record, and be acceptable to the institution where assigned. "The academic qualifications required of PASs in some cases are extremely stringent," noted General Grove, "but we have first-rate people to accommodate them."

"There are good reasons for assigning the highest-caliber people as AFROTC instructors," commented General Grove. "First off, they are usually the initial contacts cadets will have representing the Air Force's professional officer corps. Thus, it is inevitable that the cadets assume them as role models," the Commandant explained.

"Equally important, the PAS is the direct interface between the Air Force and the college, its student body, faculty, and administration. Thus, in another opinion-shaping sense, his influence is incalculable," General Grove added.

"In a bygone era it was accepted that most middle-class youngsters went into one or another of the services. But with the cessation of the draft and establishment of the All-Volunteer Force, this is no longer true. It is essential then that middle-class students on campus—the majority of the nation's future leaders—have a high regard for the Air Force representative," General

Grove explained. "It also must be remembered that much of the thought that will shape the nation's future emanates from academia. This could have a critical influence on the Air Force in particular and national defense in general," the Commandant noted.

"Finally, if our objective is to produce highest-quality officers, we must have the highest-caliber people training them." Because of their close association with the cadets, the PASs are in the best position to evaluate them as prospective officers. "For example, the PAS would be aware that a cadet's less-than-top grades are a reflection of the part-time job he is holding down to support his family," noted Colonel Holt of Alabama State University. Counseling sessions are geared to determine cadet motivations toward AFROTC, to a particular career field, and to the Air Force.

Besides the job satisfaction of working with bright young minds in an academic environment, the PAS receives tangible benefits as well. "The PAS takes what is essentially three or more years of training experience on to more conventional Air Force assignments," General Grove added.

Scholarships: A Key Element

Leaders at Maxwell are the first to concede that a crucial factor in their success is the AFROTC scholarships offered. Two, two and a half, three, three and a half, and four-year scholarships are available.

The scholarships are designed to produce sufficient numbers of officers qualified to meet selected Air Force requirements. "We have an abundance of qualified applicants competing for pilot slots so we don't need additional incentives there," noted Lt. Col. Vernon F. Steele,

AFROTC Chief of Recruiting at Maxwell.

"We offer scholarships to qualified candidates who will fill Air Force officer needs, particularly in science and engineering career fields. Only a few scholarships are offered to candidates to meet other officer requirements, such as pilot and navigator, missile and non-technical, and health professional. Of course, the other commissioning sources of new line officers—OTS and the Air Force Academy—also have their fair share of available slots in the commissioning pipeline," Colonel Steele remarked.

The four-year scholarship program attracts about 15,000 applicants each year, with about twenty percent being awarded a scholarship by a central selection board. Scholarship recipients make up about twenty-nine percent of the total cadet enrollment.

AFA, JROTC, and the Air Force's Auxiliaries

The Air Force Association has deep appreciation of and a long association with the high school Junior ROTC program and the Air Force's auxiliary organizations.

Currently, there are more than 40,000 students enrolled in the JROTC program in 286 detachments in the US and several overseas. About one-third of the JROTC cadets are women.

Unit instructors are qualified retired officers and NCOs who continue to wear the uniform but are full-time members of the high school faculty. Nominated by AFROTC, they are hired and paid by the high school. The Air Force reimburses a portion of the instructor salaries. The officer usually teaches the academics and the NCO administers the program and is responsible for the leadership segment of the curriculum.

"Junior ROTC was designed to stress academic excellence and leadership, and to assist the student in becoming a better-informed citizen on matters of national defense and challenges of the aerospace age" is how USAF describes the mission.

Subject matter ranges from the mechanics of flight to astronomy. A glance at the curriculum should dispel any notion that the intent of JROTC is to mold children into militarists. The cadets do wear uniforms one day a week. The uniforms are provided by the Air Force, which also supplies classroom audiovisual and other teaching aids.

Cadets drill under the leadership of upperclassmen, undertake fund-raising projects, and venture out on field trips to aerospace facilities and industries.

Each year, about 4,000 students actually complete the three-year JROTC program, which doesn't entail any sort of service obligation or financial assistance by the Air Force, as does AFROTC. The entire junior program costs USAF about \$8.2 million a year.

Close to eighty percent of those completing the three-year JROTC program go on to further experience with the

military. Those enlisting are eligible for higher rank and pay. Cadets entering the active-duty Air Force with three years of JROTC come in as airmen first class instead of airmen basic. Those with two years enter as airmen. Each JROTC unit can nominate five cadets to the Air Force Academy. (Of the Academy class that entered in 1983, 161 cadets were selected from JROTC units.)

Each designated JROTC "honor unit" can also nominate three cadets to the Naval Academy and three to West Point. And there are those cadets who join AFROTC with or without a scholarship or sign up with AFRES or ANG.

Because JROTC is an excellent source of future Air Force and aerospace leadership, AFA considers it of prime importance and supports it fully, as it does the Civil Air Patrol and AFROTC, including the Arnold Air Society and Angel Flight.

AFA furnishes this support in a variety of ways at the local, state, and national levels. Association members and chapters host meetings and dinings-in, and a number of AFA awards and scholarships have been specifically tailored for presentation to these groups. AFA also donates equipment and provides logistical support as required.

In cooperation with Air University, AFA also sponsors an annual Aerospace Education workshop for JROTC instructors during AFA's National Convention in Washington, D. C. The workshop serves to revalidate the credentials of the instructors.

In addition, AFA sponsors, through its Aerospace Education Foundation, an annual contest for JROTC units. Entries range from video presentations to written essays. The overall winner receives \$1,500 and a plaque. The high school principal, the JROTC instructor, and two cadets are guests of AFA during the National Convention. Each of the contest's five category winners receives \$500 and a plaque. Twenty contestants receive honorable mention and certificates of merit.

Subjects have ranged from "Why America Needs the B-1" for the initial contest in 1973 to "The Imperatives of National Readiness" in 1977. The 1984 topic is "Military Space Ventures."

The future personnel needs of the Air Force are defined by the Air Staff, Hq. ATC, and the Manpower and Personnel Center.

In all, AFROTC supplies a hefty 41.4 percent of all new officers. In FY '82, for example, 3,542 graduates donned the blue suit from 151 detachments around the country.

"We are really into science and technical degrees. Of the 1,000 pilot candidates we are tasked to produce this year, fifty percent are required to have technical backgrounds," General Grove said. "Our engineering and science goals are equally demanding, being broken down to specific academic majors required to fill Air Force needs."

AFROTC also has the task of recruiting thirteen percent minorities as an annual commissioning objective. "We have a challenge in this area in finding and recruiting sufficient numbers of high-quality minority prospects who meet the prerequisite education and other AFROTC enrollment standards to pursue an Air Force officer commission through the college program," explained Colonel Steele. "To meet our minority recruiting goals—and we fully intend to do so—means that we must have a smart plan and a directed recruiting effort focused on our minority market using all available recruiting resources," the Colonel added.

"One invaluable recruiting resource going for us is the cadet corps itself. Some of our best recruiters are cadets. Qualified blacks, for example, will go out and get us other qualified blacks. The effort continues to pay off. This year, we plan to commission 374 black officers and seventy-eight other minorities. Our philosophy—and that of the Air Staff—is that minorities should have full representation in all leadership areas," Colonel Steele noted.

AFROTC has met its minority objectives for the past three years.

Exacerbating the problem of recruiting highly qualified minorities is that the competition for them is fierce throughout all segments of society. In this, AFROTC will utilize every resource it has at hand; for example, Lt. Col. Guion Bluford, the first black Air Force officer in space, has been featured at events targeted toward luring qualified

black prospects who are pursuing scientific and engineering degrees.

The recruitment of women has also not been neglected. "The 592 currently enrolled in the junior class throughout AFROTC have higher academic qualifications than any other group except doctors," General Grove declared. "And the twenty-five women pilot applicants as a group top everybody else," General Grove added.

In FY '82, 519 women were commissioned through AFROTC, up from a grand total of two ten years earlier.

Approaches to Recruiting

Despite the current resurgence of popularity on college campuses around the nation, AFROTC is not resting on its successes.

The recruiting instruments at its disposal are both conventional and unique. First, Air Force Recruiting Service and even Civil Air Patrol may steer likely prospects to local detachments. Professors of Aerospace Studies and their assistants make recruiting visits to high schools and junior colleges.

Detachments also accept students from other colleges under "crosstown" consortia agreements with the schools involved. Students from some 570 additional colleges take advantage of these agreements.

Furthermore, some 2,017 Air Force Reserve officers—known as Admissions Liaison Officers—actively support and recruit for the Air Force Academy and the AFROTC programs. Interested candidates are encouraged to apply for admission to the Academy as well as for AFROTC scholarships.

"AFROTC's recruiting budget is spent primarily on a variety of advertising, brochures, targeted mass mail-outs, high school and college recruiting visits, and specific minority recruiting initiatives," noted Colonel Steele. "We'll send headquarters people to regional recruiting conferences to discuss current recruiting initiatives and specific kinds of recruiting requirements. There are thirty-nine AFROTC regional admissions counselors (ADCs) who work with assigned detachments and the reserve Liaison Admissions Officers in conducting regional recruiting programs.

ADCs not only recruit but orchestrate and direct a planned regional effort to meet detachment enrollment requirements," he added.

Some 1,100 officers, airmen, and civilians are assigned to AFROTC detachments and other facilities around the country. Five regional commandants—senior colonels—report directly to Hq. AFROTC, which has a staff of 155 blue-suiters and civilians.

"In our bid for candidates, we tell it like it is. We have no need to enhance or omit information to induce people to join. We have a solid marketing product—the US Air Force," noted Colonel Steele. "Therefore, our motto of 'Quality Recruiting With Integrity' is entirely appropriate."

For the Future

AFROTC recently received some good news from Capitol Hill. Congress approved the FY '84 appropriations bill that provides payment of tuition assistance and allowances to ROTC scholarship cadets in selected majors beyond the fourth year of schooling if necessary to earn baccalaureate degrees. The scholarship extension entails an additional active-duty obligation.

"A future goal to be sought from Congress might be an increase in the subsistence stipend," noted General Grove. "The last increase was in 1971 to \$100 a month. If this had kept pace with inflation the rate would now be \$250," he added.

"In considering a future increase, Congress would certainly ask us how it would enhance recruitment and retention. The short answer is that today it wouldn't help much since we're doing well in those areas. But in a year or two the climate might change and it would be mighty nice to have that on the shelf," the General declared.

"While the economy may change for the better and make competition for qualified people even stiffer, we don't anticipate any letdown in the high tuition rates," noted Colonel Steele. "But we know that in the near term we'll have to contend with a sharply reduced youth population and keen competition from the civilian business and industrial sector, making the recruitment job that much more of a challenge," he concluded. ■

Crisis in the Cockpit

The copilot, John Morgan, had two alternatives: pull the plug on a wounded friend or fight him for control of the stricken B-17.

BY JOHN L. FRISBEE

AT mid-1940, with war raging in Europe and the United States sure to become involved, it looked as though John Morgan was never going to be an Army flyer. The six-foot-two-inch, 210-pound Texan had been classified 4-F by his draft board as a result of an earlier accident in which he had broken his neck. But the Royal Canadian Air Force, more interested in willing warriors than in medical history, welcomed Morgan into its pilot-training program. A year later, he was in England, wearing the RCAF uniform but flying bombers for the Royal Air Force.

In May 1943, John Morgan transferred to the US Army Air Forces as a flight officer and was assigned to the 92d Bomb Group's 326th Squadron, based at Alconbury. Sixty days later, on July 18, Morgan sat in the right seat of a B-17 as copilot for 1st Lt. Robert Campbell, a huge, muscular Mississippian, as they climbed out over the North Sea, and headed for Hanover and one of the most remarkable bomber sorties of the war.

Before the bomber stream reached the Dutch coast, it came under heavy attack by Luftwaffe fighters. The intercom of Morgan's plane was shot out, the tail, waist, and ball-turret guns ceased firing, a cannon shell shattered the windshield on the copilot's side, and a machine-gun bullet struck pilot Campbell in the head, splitting open his skull. Campbell, semiconscious and in a crazed condition, fell forward, locking his arms around the control column.

Morgan knew that if the B-17

dropped out of formation it would be easy prey to German fighters. Flying with his right hand, he dragged Campbell off the controls, holding him back in the pilot's seat with his left arm. The wounded pilot continued to fight instinctively for the controls as Morgan maneuvered back into formation. He now had two alternatives: pull Campbell's oxygen mask off, which, at 26,000 feet, would have been fatal to the wounded man, or fight the crazed pilot for control of the B-17 as long as his strength lasted, hoping that another crew member might come up to the cockpit and help. He chose the latter alternative.

Once again enemy fighters came in. As they pulled up over the riddled B-17, the top turret gunner fell to the floor, one arm shot off at the shoulder. Morgan's navigator, Keith Koske, unable to apply a tourniquet, got the gunner into a chute and pushed him out the lower hatch, believing correctly that the -50° F. cold would stop the bleeding. The gunner survived, was cared for by German surgeons, and was repatriated in late 1944.



Lucky to be alive to tell about it, Lt. John C. Morgan recounts the events of July 18, 1943.

The navigator, bombardier, and engineer were aware from the B-17's erratic flight that something was wrong in the cockpit, but all were too busy fighting off attackers to leave their stations. For two hours, John Morgan held formation, all the time fighting to keep the irrational Campbell off the controls. Finally, after bombs-away, navigator Koske came up to the cockpit and, shocked by the grisly scene, helped Morgan get Campbell out of the pilot's seat.

As the formation let down over the North Sea, the gunners Morgan had believed to be dead appeared on the flight deck. Their oxygen system had been knocked out in the first fighter attack and they had been unconscious until the bombers descended to lower altitude. Bob Campbell died minutes after Morgan landed the battered bomber at an RAF base near the English coast.

On December 17, 1943, Lt. Gen. Ira Eaker, Commander of the Eighth Air Force, presented 1st Lt. John C. Morgan the Medal of Honor in recognition of his heroic acts over Germany that July day. General Eaker directed Morgan to fly no more combat. But Morgan decided that if the war was not over for the Allies, it wasn't over for him. He volunteered for several more missions, including the first Berlin raid of March 6, 1944. On that day, John Morgan's war against Nazi Germany came to an end. His B-17 was shot down and he remained an unwilling guest of the Luftwaffe until V-E Day.

John Morgan must surely be the only draft-classified 4-F to serve with the air forces of three nations, fly twenty-six combat missions (he says it really was only twenty-five and a half) with the RAF and the AAF, earn this country's highest decoration for valor, and spend fourteen months as a POW. No American who survived World War II paid his dues more fully than that tough, tenacious Texan. ■

As part of the FY '84 Defense Appropriations Bill, Congress approved recently the allocation of \$105 million for work on superhard ICBM silos—one of the follow-on basing technologies for the ICBM Modernization Program. The reasoning behind this move was, as a congressional report put it, "that recent blast tests on scale-model silos have demonstrated that superhardening of ICBM silos to very high overpressures is technically feasible."

Behind this prosaic assertion may lurk the potential for technological advance of great importance to the future effectiveness and survivability of silo-based ICBMs and, hence, our overall strategic deterrent. The recognition gestated in the mid-1970s that hardened silos housing ICBMs may not be as vulnerable as originally thought to the shockwaves—also called overpressure, which is expressed in pounds per square inch (psi)—and other effects of a nuclear detonation. Assessments by the Air Force's Foreign Technology Division (FTD) at Wright-Patterson AFB, Ohio, of intensifying elaborate Soviet silo hardening produced tangible evidence that tended to contradict the then-prevalent view that there were insuperable limits beyond which silos could not be hardened. For years the upper limits of overpressure resistance for hard structures of this type were thought to be in the 2,000-psi range.

Key elements of this country's technical community doggedly continued to hold this view as late as 1981 when the research that started with FTD's probing of Soviet hardness levels finally produced incontrovertible evidence to the contrary. The consensus now—based on structural model tests carried out jointly by the Defense Nuclear Agency (DNA) and the Air Force—is that structural survivability has been demonstrated to about twenty-five times the hardness level of the hardest Minuteman silos.

There are basically four types of nuclear effects that determine the survivability of silo-based ballistic missiles. In a chronological sense, prompt radiation is the first product of a nuclear burst. This phenomenon lasts from a few microseconds to a few tenths of a second and involves mainly gamma and neutron radiation. The airblast that occurs in the form of a rapidly rising spike follows, lasting from a few tenths of a second to several seconds.

Immediately following is the fireball that lasts from tenths of a second to many seconds after the detonation. The fireball is the product of the radiation and energy of the detonation being absorbed by the atmosphere nearby. The interior of the fireball is a near-vacuum. Finally, a dust and debris cloud forms a few seconds after the burst, leaving a large crater that, depending on the yield and height of the detonation, can be several hundred feet in diameter and tens of feet deep. While this dust cloud may last for an hour or more, the larger debris settles back to earth and can, if no precautions are taken, literally bury a silo and keep the ICBM inside from reaching the surface.

In terms of ICBM survivability, the most critical component of a nuclear detonation is generally the airblast. In the case of a one-megaton detonation, bunkers hardened to a level of about 100 psi would be destroyed out to a distance of one mile from the burst. Unhardened vehicles, ships, and submarines would be vulnerable over a

distance of more than four miles. Aircraft within a radius of about eight miles, and dirigibles up to twelve miles away, would be similarly vulnerable. Put another way, targets vulnerable to an overpressure of as low as one psi would be demolished by a one-megaton blast over an area of 441 square miles.

On the other hand, targets hardened to 1,000 psi overpressures—the level of older ICBM silos—are vulnerable to such a blast only over an area of three-tenths of a

The Soviets have given their ICBM sites structural survivability beyond the limits once thought possible. Meanwhile, USAF's superhardening program is in search of funds.

The Prospect For Superhard Silos

BY EDGAR ULSAMER
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A one-eighth-scale model of a superhard silo is lowered into a pit at Fort Polk, La., in preparation for an explosive test. The silo, made of steel and concrete, is more than ten times harder than previous US silo designs tested in the past decade.

square mile. By the way of a benchmark, USAF's upgraded silo (UGS) program launched in the early 1970s that involved only modest improvements nevertheless succeeded in cutting in half the radius of lethality that extends outward from the impact point of a nuclear weapon compared to that of older Minuteman silos. In other words, an attacker would have to cut the CEP (circular error probable, a statistical measure of ballistic missile accuracy) in half, just to stay even in terms of probability of kill against the newer US silos.

The Promise of Superhard Silos

The President's Commission on Strategic Forces (Scowcroft Commission) in April 1983 recommended "vigorous research on new techniques for hardening silos." This recommendation was based upon the belief that superhardening technology accomplished for the Closely Spaced Basing (CSB) mode was most impressive and involved dramatic improvements in ICBM silo hardening. The Commission believed that, should such R&D on silo hardening prove effective and affordable, it could later be applied usefully to some or all of the silos containing MX. Additionally, such hardening techniques could prove useful for small ICBM (SICBM) deployments in the 1990s.

As the Commission, chaired by Lt. Gen. Brent Scowcroft, USAF (Ret.), pointed out, "New concepts and developments in hardening are quite promising. They could lead to the capability to harden such targets as ICBM silos far in excess of what was thought possible only a short time ago." While cautioning that accuracy improvements might eventually put at risk even the hardest structures imaginable, the Commission pointed out that "nonetheless, increased hardness would raise the weapons requirements and the risk of attack for some years. Hardening will also be able to postpone vulnerability to, and therefore the probability of, attack by submarine-launched ballistic missiles."

The Commission, comprised of some of the nation's most respected defense experts, urged that special programs keyed to demonstrating silo hardness in an unambiguous way be undertaken to support subsequently the deployment of MX or the SICBM in superhard silos or shelters. Basing the US ICBM force in more than one manner, the Commission reasoned, "would require different types of planned Soviet attacks. Deployment in hardened silos would require the Soviets to plan to use warheads that are large, accurate, or both. Moreover, for those silos or shelters holding a missile with only one warhead, each would represent a far less attractive target than would be the case for a silo containing a large missile with many MIRVs."

The Small Missile Independent Advisory Group—convened by the Air Force—subsequently seconded the findings of the Scowcroft Commission by stressing that the option should be kept open to dual-base the SICBM in hardened mobile launchers as well as in superhard fixed silos.

Fostering the scientific community's enthusiasm for deploying some ICBMs in superhard (able to resist overpressures in excess of 15,000 psi) fixed silos is the fact that during the past year intense research and development efforts produced significantly advanced hardening concepts. Specifically, a growing body of evidence from

subscale testing and theoretical modeling suggests that the craters and overburden caused by nuclear detonations in some geologies are much smaller than previously assumed.

The smaller the area of the crater, the less likelihood that a silo will be inside the crater, and silos even barely outside the "lip" of the crater will remain operational. A silo that is within the crater of a detonating weapon will be tilted so that the ICBM inside can't be launched. New design techniques, however, make it probable that up to about forty degrees of tilt will not necessarily preclude a successful launch. A superhard system must obviously be able to withstand numerous severe conditions, including a piling up of debris that could prevent or delay launch, lateral and vertical shocks to the missile system, and forces that tend to crush and distort the silo itself.

"Cold Launching"

Most new ICBM designs gain from the fact that the missile is encapsulated in its own special canister and, when deployed in a silo, will be "cold-launched." The superhard ICBM silo would have an inside diameter similar to the size of Minuteman, but its concrete walls would be much heavier and use seven to eight percent steel in reinforcement, compared to 1.5 percent, and would also have a thicker steel interior liner.

The missile is to be protected from the severe shocks associated with a nuclear environment in a number of ways. First, the missile itself can tolerate higher shock loads because it incorporates special design features, such as high-strength motor cases and interstage structures. Secondly, the ICBM's cold-launch canister buffers shock loads. Lastly, advanced methods of suspension could cushion the missile-canister assembly. Recent developments in the field of shock isolation techniques that capitalize on "superfoam" and liquid springs could more than halve the "rattlespace" requirement, meaning the area between the missile and the silo walls, allowing hardened silos to be smaller and more affordable.

Getting an ICBM out through the accumulated debris atop its silo may also turn out to be somewhat easier than originally assumed. If the craters are smaller than previously estimated, that means less dirt and debris will be thrown into the air to settle back on top of the silo. Under severe conditions, a debris blanket twenty feet thick might pile up on the silo closure. Recent tests indicate that by using a two-stage actuator, the canisterized missile and the silo closure can dig through such a debris accumulation. The closure and the upper section of the canister are then discarded to let the missile eject and ignite its rocket motor.

Scale Testing

Recent static and dynamic tests by the Defense Nuclear Agency and the Air Force Systems Command's Ballistic Missile Office (BMO) involving the simulation of nuclear weapon effects by means of high-explosive charges underscored the potential for enhanced survivability of advanced silo designs. Both simulated airblast and airblast-induced ground-motion effects were brought to bear on model silos.

As the Deputy Director of the Defense Nuclear Agency, Dr. Marvin C. Atkins, explained, "The silo test

models varied in size from about three to six feet in diameter and up to thirty feet in depth. Models of different sizes were tested to validate scaling laws, at least over a limited range of sizes, which can now be used in analytical design codes. The effects of geological siting were also investigated by testing in several different sites. Silo components—the door, headworks, and launch tube—were tested both separately and in complete silo configurations. This test program was the first ever to investigate a range of damage levels—from no damage to nearly total collapse.”

He added that other by-products of a nuclear detonation—such as ground motion, cratering, radiation, electromagnetic pulse (EMP), and thermal effects—were also investigated.

As a result, a number of design approaches are now thought to hold considerable promise. At the same time, these tests taught another important lesson, according to Dr. Atkins: The impulse delivered by these high-overpressure, short-duration blast loads may be at least as critical to determining structural hardness as the overpressure itself. With this knowledge, the silo design can be optimized for both effects.

Important new information was gleaned from a series of dynamic tests that first exposed a one-quarter-scale silo incorporating advanced design approaches to overpressures in the 25,000 psi range, and then in the 50,000 psi range. The result was “moderate” damage at the 50,000-psi level that would not have degraded the missile’s basic performance. There appears to be room for considerable improvement.

Other tests pointed at potential gains in shock isolation as a result of the use of foams and high-efficiency dampers for fluid isolators. Even more advanced fluid isolator dampers are under development and will undergo vigorous testing over the next two years. Lastly, the findings from recent tests of special devices known as “egress actuators” point the way toward ICBMs that can push through extremely heavy accumulations of debris atop their silos.

Air Force and DNA experts point with pride to recent palpable advances in the field of silo hardening. In the structural area, various new silo closure designs have withstood overpressures of almost 45,000 psi without failure. Headworks and silo walls using novel steel liners have tested out without failure at close to 55,000 psi. Integrated into a quarter-scale silo, these structural components have withstood overpressure loads of around 55,000 psi. Similarly, lateral shock isolators, hydropneumatic spring dampers, and multistage actuators have been boosted to significantly advanced performance levels.

The purpose of this work is to provide sufficient understanding of the various hardness criteria to support a 1986 full-scale engineering option for an integrated superhard silo system. In turn, this entails validating system concepts that can withstand overpressure impulses of up to 100,000 psi. Funding for the superhard silo development program came from the MX Peacekeeper program in FY '83, but in FY '84 switched to a new line item, the small missile follow-on technology effort.

Congress saw fit to cut in half the FY '84 Defense Department request of \$210 million. The implied reason for this reduction was congressional concern that ad-

vances in silo hardness technologies might keep the Defense Department from pursuing mobile launcher research and development at the high level mandated by Congress. This supposition seems at odds with the Air Force’s strong and vigorous commitment to a mobile SICBM, in concert with protecting the option of basing a portion of the force in hardened silos.

A Breakthrough in Understanding

While superhard silo technologies hardly hold the same attraction as new bombers or missiles, their importance to the deterrent capabilities of the nation, nevertheless, could be vast. As Gen. Robert T. Marsh, Commander of Air Force Systems Command, told this writer, hardness levels now thought feasible for modern silos would “impose significant burdens” on would-be attackers, especially as a complement to new mobile SICBMs. The work by DNA and BMO over the past year or so, he said, “has really opened our eyes about hardness levels” that can be attained by a better understanding of primary nuclear effects, on the one hand, and design features that take full advantage of this newfound understanding, on the other.

This breakthrough in understanding, he suggested, could lead to a breakthrough in an operational sense. General Marsh mentioned specifically that the overpressure impulse may well be shorter and sharper than previously assumed, with the result that building structural flexibility into the silo structure could lead to significant gains in survivability.

The Commander of AFSC’s Ballistic Missile Office, Brig. Gen. (Maj. Gen. selectee) Aloysius G. Casey, told this writer that one of the potentially significant conclusions of BMO’s and DNA’s “total re-look” at nuclear weapon effects—and the technical community’s understanding thereof—is that past assumptions about the size of craters dug by nuclear ground bursts were probably overstated.

The technical community now tends to believe that the diameter of craters caused by nuclear detonations may be up to sixty percent smaller than originally estimated. Correctly estimating the crater size is of grave importance since silos within the lip of the crater can be expected to experience a degree of damage in terms of tilting and crushing that militates against a successful missile launch. On the other hand, the recent and continuing advances in silo hardening suggest that silos even barely outside of the crater will remain operational.

The other key factor causing growing confidence in the survivability of modern silo-based ICBM systems involves radically advanced design approaches. As General Casey put it, the current generation of cement silos is held together by steel “rebars,” or risers. The new approach, in fact, amounts to a “steel structure that has some concrete for spacing” purposes, he stressed. The concrete is sandwiched inside and outside by steel plate liners. These advanced designs incorporate so much steel that they “can take an excursion into the elastic area and actually [tolerate] inelastic change,” meaning permanent shifts in their vertical and horizontal dimensions, without impairing missile launch.

Augmenting the survivability of canister/ICBM systems in terms of overpressure and ground motion is corresponding progress in protection against other nu-

clear effects. Both BMO and DNA are confident that the system's exposed surface components can be protected by layers of ablative materials against the searing heat of the nuclear fireball. The parts of the system that are underground are not likely to be damaged by the fireball.

How the system will fare in relation to the electromagnetic pulse (EMP, a lightning-like phenomenon induced by nuclear detonations over a broad frequency range) may be harder to ascertain, according to the BMO Commander. The silo would be in the so-called source region of the phenomenon, the least predictable and hardest-to-simulate area of EMP propagation. Nevertheless, there is reasonable confidence that the canister enshrouding the MX and SICBM constitutes an effective shield against EMP and other radiation effects.

The next steps in this comprehensive program involve tests of a full-size (twelve-foot-diameter) silo to overpressure levels of up to 50,000 psi in 1984; demonstrations of breaking through heavy layers of debris in 1985 and 1986; and test of a full-scale integrated silo, including suspension and egress systems, at levels from 50,000 to 100,000 psi late in 1986. In support of these activities, the Defense Nuclear Agency will develop test techniques and identify the environmental factors induced by overpressures up to and exceeding 100,000 psi. DNA also is formulating its Advanced Silo Hardening program. The purpose of this effort in the structures area is to "establish the upper limit of silo hardening and to

develop cost-effective silo designs over a range of hardness levels," according to Dr. Atkins.

The Operational Payoff

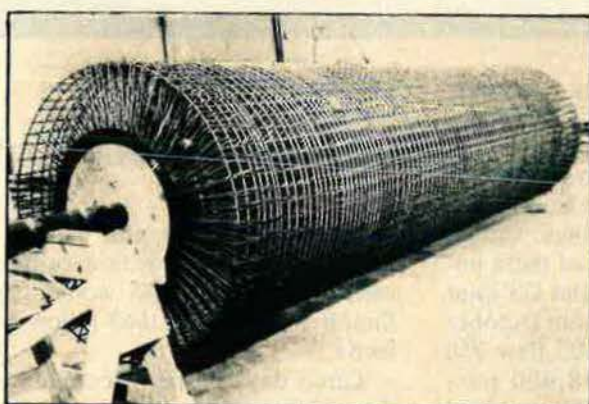
The consequence of such superhardened silos, in concert with hard mobile deployments of SICBMs, would be staggering for a potential attacker. As Gen. Bennie Davis, Commander in Chief of Strategic Air Command, told this writer, "Anytime you can get superhardening values well above 6,000 psi, you automatically complicate the targeting problem" of the attacker. Declaring himself a staunch supporter of mobile basing, he nevertheless pointed out that "prudence might dictate a mix" of small ICBMs deployed in hard mobile launchers and either MX or SICBM in superhard silos because of the attendant "clear-cut advantages."

Such a combination of forces would exact an exchange ratio—meaning the number of warheads expended by the attacker vs. what he can expect to kill on the other side—that is "extremely bad" for the former. Dr. Atkins estimated that to ensure an adequate P_k (probability of kill) against superhard US silos, the Soviets would for the foreseeable future probably have to resort to warheads with a yield in the twenty-megaton range or develop "earth-penetrators," meaning extremely heavy and complex warheads that dig deep into the ground before they detonate. Earth-penetrators maximize ground-motion and, hence, are extremely effective hard-target killers, but their heavy weight decimates the attacker's missile throw-weight.

While noting that superhardening could have future applicability to MX, General Casey also suggested that US SICBMs deployed in superhard silos could have merit. He stated it would force the Soviets to assign "two or more RVs [reentry vehicles] against each US missile" to maintain a high P_k . The resultant drawdown of forces clearly favors the defender and, therefore, creates stable strategic conditions that militate against a Soviet first strike, he argued.

General Davis strongly advocated vigorous pursuit of superhardening because it promises to retain indefinitely the unique traits of the currently deployed ICBM force, such as "high availability, redundant communications links, and rapid responsiveness." In addition, such a deployment mode would also complement mobile systems that could be somewhat limited operationally because—under certain conditions—their guidance systems require spin-up, meaning a warm-up period to attain design accuracy. A fixed silo system, on the other hand, can be kept in a fully operational condition with all instruments running on normal power, allowing it to be virtually 100 percent available.

It is clear that much has been learned in the last two years about how to achieve significant levels of silo hardness and the advantages that could accrue to ICBM effectiveness in this basing mode, particularly as a complement to mobile SICBM deployments. The US should capitalize on this newly acquired knowledge and continue research and development efforts to preserve this option for future ICBM modernization decisions. While congressional action in reducing funds for silo-hardening research and development will slow progress to this end, it is clear that its potential to enhance deterrence further must be fully explored. ■



ABOVE: This reinforcing steel-bar skeleton was used in the Peacekeeper silo model test at Fort Polk, La. **RIGHT:** During a 1982 test, the Peacekeeper silo model suffered only negligible damage when exposed to the TNT equivalents of the largest Soviet nuclear weapons.





BLUE CHRISTMAS COMING UP

BY JAMES W. CANAN, SENIOR EDITOR

Airlifters put the paratroopers down. Gunships pounded the enemy so ground forces could advance. And that's only part of what the Air Force did in the Grenada rescue.

WE'RE highly trained and extremely capable troops. That's why we were in the forefront of the Grenada operation. The idea was not to destroy half the country, but to go in and surgically take out enemy targets. . . . This was a rescue mission, and the AC-130H gunship was the perfect vehicle for it."

In those words, Col. Hugh L. Hunter, Commander of the 1st Special Operations Wing (SOW) of the Military Airlift Command (MAC) at Hurlburt Field, Fla., described his unit's crucial role in the successful US combined-arms and multinational strike against Cuban and Grenadan Marxist troops in Grenada last October 25–November 2.

That operation rescued 622 American medical students and eighty-seven foreign students who

had been threatened by a bloody, militant-Marxist coup in Grenada. It also prevented the Soviet Union and Cuba from establishing another military foothold in the Caribbean.

Twenty-six USAF wings, squadrons, and groups, most of them under MAC, took part in the US joint task force operation. From October 25 to November 6, MAC flew 750 missions involving 18,000 passengers, 8,800 tons of cargo, and 500 aircrew. USAF personnel on Grenada numbered 300.

Outstanding Achievements

In the aftermath, ten USAF officers and noncommissioned officers were cited for outstanding achievements, such as skillful and courageous flying of airlifters and gunships under fire. Seven of them represented MAC at a November 7 White House ceremony in honor of distinguished Grenada veterans from all the services and the students they had rescued.

On that occasion, President Reagan thanked the Grenada veterans for a "heroic rescue mission." The President also said: "A few years ago, it seemed that America forgot

Carrying US paratroopers who had fought in Grenada, a Military Airlift Command (MAC) C-141 takes off for home from the Point Salines airfield.

what an admirable and essential need there is for a nation to have men and women who would give their lives to protect their fellow citizens."

Three days earlier, Secretary of the Air Force Verne Orr and Secretary of the Army John O. Marsh were on hand at Pope AFB, N. C., as MAC brought home the first contingent of 82d Airborne Division paratroopers who had fought in Grenada. Pope's 317th Tactical Airlift Wing had delivered them to the island in its C-130s, flying the paratroopers around the clock from Bridgetown, Barbados, to their point of assault—aided by MAC gunships from Hurlburt—against Cuban and Grenadan troops at the island's heavily defended Point Salines airfield.

At the Pope AFB ceremonies, Secretary Marsh had high praise for the paratroopers. Moreover, Secretary Marsh declared: "Secretary Orr's presence here today is testi-

mony to the Army's gratitude to the greatest Air Force in the world, who helped us, and whom we thank today."

MAC's top commanders eschewed self-congratulation, but were pleased. "We found," said Maj. Gen. Donald D. Brown, MAC's Deputy Chief of Staff for Operations, "that our organizational concepts were solid and our procedures were sound. They enabled us to respond to the quick tasking [for the short-notice Grenada operation]. But the most rewarding development was the attitude of our people. They were anxious to get involved."

General Brown credited the units of the 1st SOW at Hurlburt with "an outstanding job" of supporting Army ground operations with fire from AC-130 gunships. The rapid-fire guns of those aircraft proved to be "the most effective air-to-ground weapons" in the engagement, the General said, because their fire was "extremely precise." This was highly important in view of the combat's close proximity to civilians

and civilian installations on Grenada.

The 1st SOW and other USAF special operations forces (SOF) units worldwide are relative newcomers to MAC. Formerly under the Tactical Air Command (TAC), they were transferred to MAC last March 1, following discussions between Gen. W. L. Creech, TAC Commander, and Gen. James Allen, MAC Commander in Chief. General Allen subsequently retired from active duty, and was replaced as MAC Commander in Chief by Gen. Thomas M. Ryan, Jr.

The idea behind the transfer was to consolidate the SOF units with MAC's Aerospace Rescue and Recovery Service (ARRS) units, thus "enabling us to swap logistics," said General Brown, in support of the units' comparable aircraft and helicopters, such as C-130s and HH-53s. In order to centralize the management of SOF and ARRS missions, USAF created the Twenty-third Air Force at MAC headquarters, Scott AFB, Ill.

The First Real Test

As General Brown expressed it, Grenada was "the first real test of the consolidation, and it went very

well." But, more broadly, he said Grenada also tested MAC's philosophy of "doing in peacetime the same things we would have to do in wartime—so even when we increase the tempo and amplitude in wartime, we are able to put our forces into the right areas of operation." On that count, too, MAC came through.

At the outset of the Grenada operation, US commandos (their unit identification was classified) were assigned three missions: rescuing the Grenadan governor-general, Sir Paul Scoon, from his residence; releasing political prisoners from the island's only jail; and silencing the government-run radio station. But at the house and the jail, the commandos encountered heavy opposition, and required air support.

In providing it, two US Marine Cobra helicopters were shot down. Meanwhile, by all accounts, three Soviet-built armored personnel carriers were advancing against US commandos in the governor-general's house.

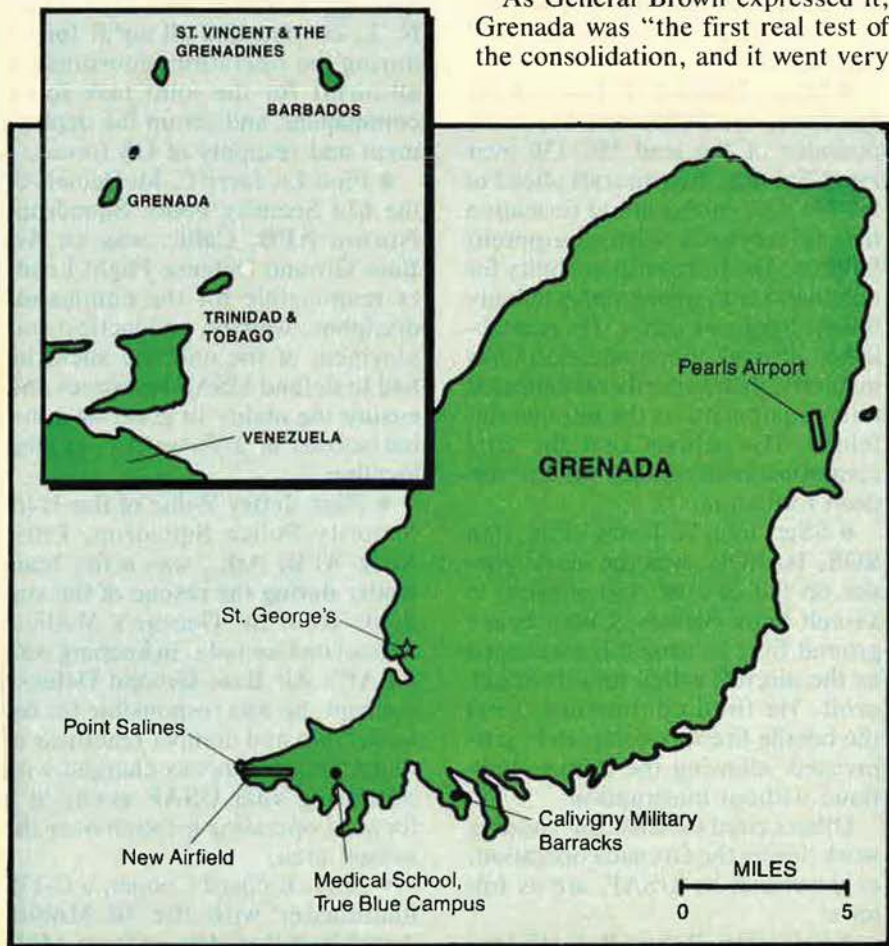
At that point, a MAC AC-130H Spectre gunship showed up. Its fire stopped all three armored vehicles, thus providing the commandos with a breathing spell during which the Marines arrived and the missions were accomplished.

Initiating separate action at Point Salines airfield, the 1st SOW's 8th Special Operations Squadron dropped the first wave of airborne troops. Then the gunships of the 1st SOW's 16th Special Operations Squadron riddled enemy positions athwart the paratroopers' advance.

But even before all this took place, a twelve-man combat control team of the 317th Tactical Airlift Wing at Pope AFB had gone into Grenada to establish landing and drop zones for the spearhead US assault forces. Under sniper fire, the team removed explosives from the Point Salines airfield control tower and, also, according to some reports, secured a smaller airstrip at Pearls, where the Marines landed.

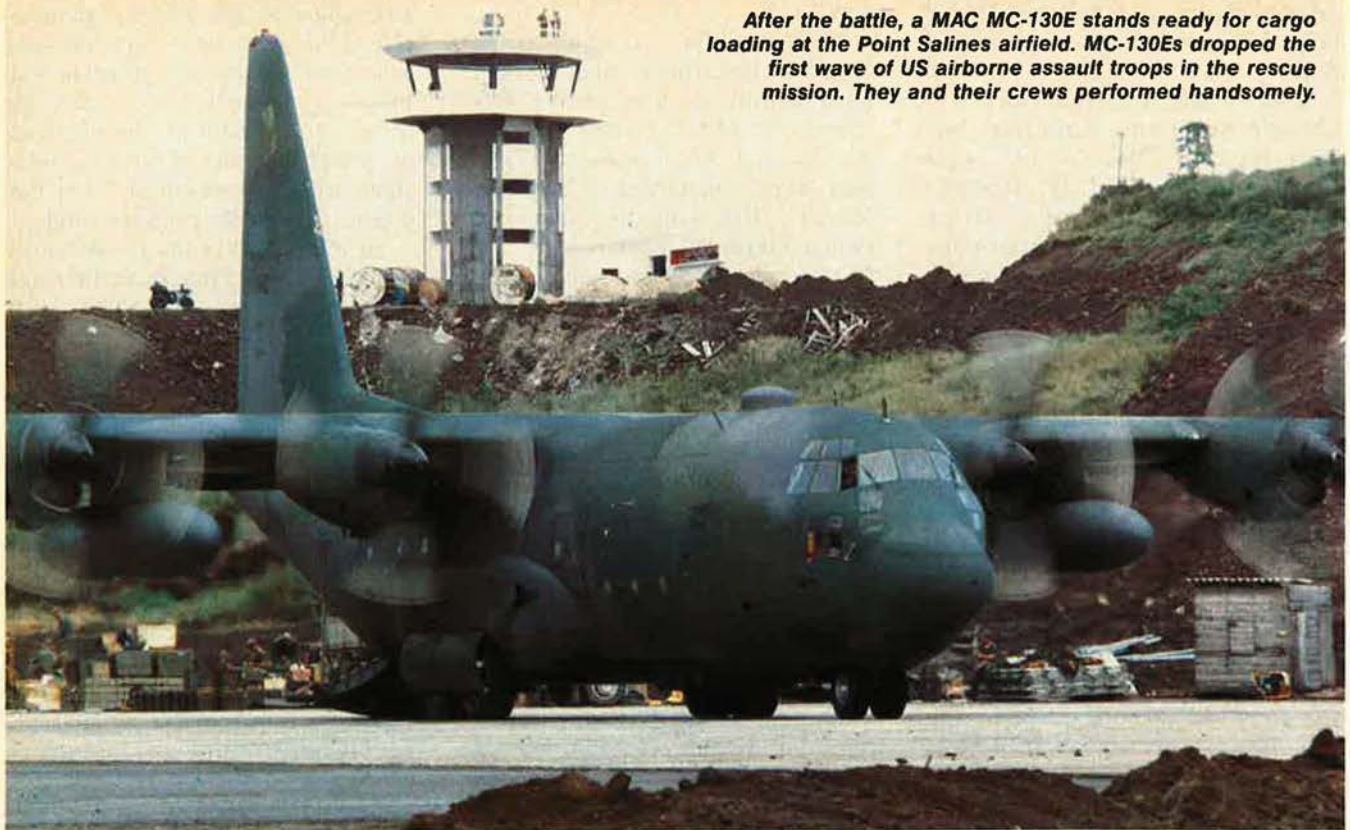
Superior Achievement

For his leadership of that team, Capt. Steven R. Scott was among



Map shows Grenada in the context of Venezuela and Barbados, from where MAC airlifted US assault troops to drop zones near key combat destinations.

After the battle, a MAC MC-130E stands ready for cargo loading at the Point Salines airfield. MC-130Es dropped the first wave of US airborne assault troops in the rescue mission. They and their crews performed handsomely.



the ten USAF Grenada combat veterans cited for superior achievement. Four of the others commanded or were crewmen of 1st SOW aircraft in the Point Salines engagement. Following are USAF accounts of what they did:

- Lt. Col. James L. Hobson, Jr., of the 8th SOS, 1st SOW, was the command pilot of the lead MC-130 aircraft in the first element of the parachute assault at Point Salines. Just prior to the parachute drop, a searchlight suddenly locked onto the aircraft. The paratroopers jumped, but drew intense ground fire. Colonel Hobson held the aircraft steady until the jump was completed, then put his aircraft through rigorous evasive maneuvers back over the sea and to safety. His courage and skill under fire made it possible to place the first wave of troops on target.

- Maj. Michael J. Couvillon of the 16th SOS, 1st SOW, was the command pilot of an AC-130 gunship during the assault on Point Salines. When the initial parachute drop was disrupted by searchlights and heavy ground fire, his gunship was called in. He established an attack orbit, aligned the aircraft's guns, and within minutes silenced the hostile posi-

tions. The airdrop continued and was successful due to the quick actions of Major Couvillon and his gunship crew.

- MSgt. Howard W. Davis of the 8th SOS, 1st SOW, was the radio operator of the lead MC-130 over Point Salines. Two aircraft ahead of his MC-130 in the initial formation had fallen back with equipment failures. Thus, the responsibility for command communication suddenly fell on Sergeant Davis. He reestablished critical communication links instantly, then expertly rechanneled radio equipment as the mission unfolded. His actions kept the vital communications intact for the airdrop formation.

- SSgt. John W. Eutzy of the 16th SOS, 1st SOW, was the aerial gunner on the first AC-130 gunship to assault Point Salines. Under heavy ground fire, he armed his weapons as the aircraft rolled into its attack orbit. He fired continuously, and the hostile fire was completely suppressed, allowing the drop to continue without interruption.

Others cited for their outstanding work during the Grenada operation, as described by USAF, are as follows:

- Brig. Gen. Robert B. Patterson,

Vice Commander of the Twenty-first Air Force at McGuire AFB, N. J., commanded all airlift forces during the operation, coordinated all airlift for the joint task force commander, and set up the deployment and resupply of US forces.

- First Lt. Jerry C. McDaniels of the 63d Security Police Squadron, Norton AFB, Calif., was an Air Base Ground Defense Flight Leader responsible for the command, discipline, welfare, and tactical employment of the unit. As such, he had to defend USAF resources and ensure the ability to generate combat sorties at a forward operating location.

- SSgt. Jeffry Willie of the 314th Security Police Squadron, Little Rock AFB, Ark., was a fire team leader during the rescue of the students from St. George's Medical School on Grenada. In keeping with USAF's Air Base Ground Defense concept, he was responsible for the leadership and combat readiness of that team, which was charged with protecting vital USAF assets at a forward operating location near the assault area.

- SSgt. Richard Cooper, a C-130 loadmaster with the 3d Mobile Aerial Port Squadron at Pope AFB,

supervised and directed the on-off loading operations of his aircraft and was in charge of evacuating the medical students from Grenada.

● SSgt. Dennis H. Delk, a C-141 loadmaster with the 300th Military Airlift Squadron of the 315th Military Airlift Wing at Charleston AFB, S. C., an Air Force Reserve (Associate) wing, was the loadmaster of the first C-141 that brought the students home.

Magnificent Performance

Two other AFRES Associate wings—the 514th MAW at McGuire and the 512th MAW at Dover AFB, Del.—also participated in the airlift. All Reserve units performed “magnificently,” said MAC’s General Brown. In fact, the General emphasized “the willingness and readiness” not only of MAC’s Reservists but also of “all our support elements in the operation,” such as security police and communications units.

For example, communications specialists from several units in Air Force Communications Command were involved early and heavily. Among the first to deploy were members of AFCC’s Hammer Ace team, a special-purpose unit at Scott. It set up some of the first long-distance satellite communications from Grenada to Scott AFB and, via Scott, to London.

TAC, too, played a major role. In fact, two USAF officers—Capts. Robert M. Awtrey and Jimmy E. Alexander—of Detachment I of the 507th Tactical Air Control Wing were among the ninety-three US servicemen wounded in Grenada. Their detachment is situated at Pope, but the 507th TACW is headquartered at Shaw AFB, S. C. The wing’s far-flung detachments serve as TAC’s liaison with infantry and airborne units in coordinating close air support.

In the weeks following the operation, several other USAF participants in the Grenada mission, besides those initially honored, were expected to be cited for skill and coolness under fire. One such was

TSgt. Charles H. Tisby, a loadmaster with the 39th TAS at Pope. Tisby was credited with saving the life of an unidentified paratrooper.

It happened when Tisby’s aircraft took “Blue Christmas” (anti-aircraft) fire over Point Salines airfield. According to a USAF report, Tisby described it as follows:

“I was watching the troops jump when the aircraft entered a hard right bank to avoid the fire. The trooper had jumped, and I heard a large bang. I figured he’d been hit, but I looked out the door, and five feet below was a stray static line.”

But it wasn’t a stray. It was still connected to the trooper.

“I began to drag him in,” said the Sergeant. With the help of paratroopers still on board, he got the job done.

There were many such extraordinary feats. They occurred in the context of a great many USAF men and women carrying out vital jobs in the less heroic—but no less important—manner for which they had been trained. For example, USAF’s 7th Weather Wing at Scott, 4th Weather Wing at Peterson AFB, Colo., and 5th Weather Wing at Langley AFB, Va., worked with Air Force Global Weather Central at Offutt AFB, Neb., in making sure that aircrews knew what was coming in Caribbean skies.

The importance of air-to-air re-

fueling was amply demonstrated as well. According to an Air Force account:

“Flexibility in airborne operations played a key role in supporting the United States ground action in Grenada. Two Strategic Air Command (SAC) KC-10 Extenders operated by 2d Bombardment Wing aircrews from Barksdale AFB, La., proved it in one operation that logged seventeen and a half hours in the air.

“While returning to Barksdale from one tasking, the crews were alerted for another refueling, which required the maximum transferable fuel.

“Still airborne, one KC-10 passed its fuel to the other before landing at Barksdale. The remaining KC-10, now carrying its full fuel load, rapidly headed for the rendezvous point in the Caribbean and transferred 110,000 pounds of fuel, enabling three other Air Force aircraft to continue their operations.”

Withal, everything meshed well for USAF in the Grenada operation. In larger context, however, MAC’s General Brown raised a qualifier.

“We are glad,” the General said, “that the magnitude of the operation was such that we were able to task it efficiently. But we still have shortfalls of equipment that we badly need to overcome in order to fulfill our worldwide responsibilities.” ■

Grateful American medical students board a homeward-bound MAC C-141 at Point Salines. The US-multinational operation rescued 622 American students and eighty-seven from foreign nations in Grenada.



SCOPING THE SPARES PROBLEM

A special task force says the Air Force is vulnerable to overpricing on six percent of its spare parts budget.

BESET by horror tales of \$916 stool caps and \$58 screwdrivers, the Air Force has committed itself to screening every item on its spare parts list, down to the lowliest nut and bolt, to see if a reasonable price is being paid for them.

Until that ambitious effort is completed, nobody will know exactly how bad the overpricing problem is. Initially, the Air Force will screen the 88,000 different items it plans to buy in FY '84, and then begin expanding the work to cover the 834,000 kinds of spares the Air Force manages.

A special task force called the Air Force Management Analysis Group (AFMAG), however, has now estimated the outer boundaries of the problem and has made comprehensive recommendations for dealing with it.

The AFMAG study, released to the public in November, says the Air Force is vulnerable to overpricing on thirty-one percent of the spare parts it buys. That vulnerability centers on low-value expendable parts. It amounts to a danger zone of some \$300 million a year, about six percent of the total spare parts budget.

It will require the efforts of a thousand additional people over several years to find the extent of actual overpricing within those vulnerability percentages and to establish a fair price for each part, AFMAG says.

Deciding What's Reasonable

Full-blown value engineering work will have to be run on the more complex parts. For simpler ones, the screening may amount to no more than looking at a sample of the part or a picture of it. Up to now, orders for low-cost items have been filled by the numbers, with order

BY JOHN T. CORRELL
EXECUTIVE EDITOR

fillers seldom having any idea what they were buying.

In fact, the main fuze to the spare parts controversy was lit when the Air Force's Zero Overprice program finally put the price tag for spare parts into the hands of people who knew what the parts were. (See "Beyond the \$916 Stool Cap," September '83 issue.) Since that program was begun, sharp-eyed watchers on flight lines and in mainte-

The worst of the problem can be traced to a lack of adequate data.

nance shops have reported 18,000 instances where they thought overcharges might have occurred. Excessive costs have been verified in four percent of those cases.

Discovery of overpricing, then, is hardly the rare or random event it is sometimes depicted to be. On the other hand, the Air Force acknowledges that its grasp on the problem is less than total, in large part because of a spare parts data system that one AFMAG spokesman characterizes as "out of the Stone Age."

Competition and Quantity

"Two major forces contribute to the attainment of economical prices," the AFMAG said. "They are competition and buying economical quantities."

The Air Force is least vulnerable to overpricing when it has more than one supplier competing to sell a product. That happy situation exists for only thirty-four percent of the parts bought, representing twenty-two percent of the money spent on spares. (See accompanying chart.) A decade ago, 37.5 percent of all spares were bought on a competitive basis, but since then, a variety of factors has greased the slide to sole sources.

The best substitute for competition is to negotiate a spares buy with audited, certified cost and pricing data. This procedure is followed for about half of the spare parts spending, but is employed mostly for high-value parts.

Barring competition or negotiation with good data, the next best thing is to avoid buying in dribs and drabs. Over the past few years, the Air Force has bought about half of its reparable spare parts in batches of five or fewer, and thirty-nine percent of its nonreparables in quantities of twenty or less. AFMAG figures that the minimum order to get a decent price should be ten reparable items or fifty nonreparable ones.

Repetitive small quantity purchases were frequently made because the spare parts account was underfunded. In addition to driving up the cost of the parts themselves, the succession of small orders added to administrative expense.

Whenever none of these approaches—competition, use of cost and pricing data, or reasonable quantity buys—is taken, the Air Force is wide open to overpricing. That is the zone of vulnerability that AFMAG identified.

Taking Shortcuts

The basic story the AFMAG report tells is one of too few people

with too little data taking shortcuts in the face of a rising work load. Between 1973 and 1979, Air Force Logistics Command lost more than 22,000 personnel authorizations, and experience levels dropped across the board. This came just as the Air Force was modernizing its tactical fleet and as the amount of spares work to be done was increasing. Big items had to be given priority, so little items were often left to shift for themselves. Any spare part with an annual buy value of less than \$7,500 was not even screened as a candidate for competitive procurement when a reorder came in.

Several stopgap pricing methodologies emerged. One called "statistical pricing" was used for parts in the \$1,000 to \$5,000 cost range. A sample of ten percent of these items was selected out for individual pricing attention; price proposals for the remaining ninety percent were accepted automatically.

Another approach was "formula pricing," in which prenegotiated factors and standards were applied to a buy lot of considerable size. The price of some items in the big lot might be high, others low, but as a total package, it ought to work out about right.

These techniques allowed a limited number of people to cope with a

great volume of business, but the potential for overpricing was omnipresent. Until the analysis of all 834,000 parts in the inventory is completed, however, it is impossible to say for sure if these methodologies were as faulty as the horror stories suggest.

Still another technique was to rely on price history. If, after factoring out inflation and differences attributable to the size of the buy, the new price was about the same as before, no further checking was done. The weak point here is the assumption that the last price paid was reasonable.

Inside the Horror Stories

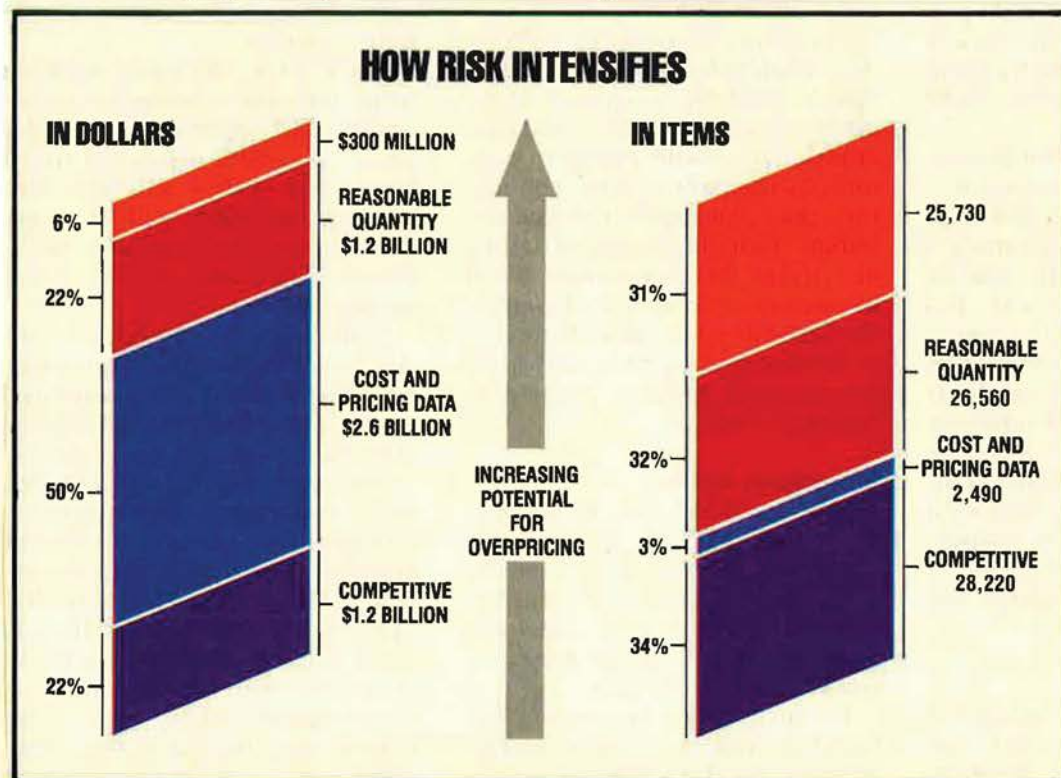
The outrageous-sounding prices that made the headlines came about in a variety of ways. With the \$916 stool cap, for instance, it was a matter of an order processor being totally ignorant of what the item was. Boeing was being asked to tool up from scratch to produce two or three little plastic parts. There was no way that Boeing could have produced the item in that quantity at a reasonable price. The solution, now painfully clear, is that such parts should be bought from manufacturers who are in business to produce them—and not bought two or three at a time.

Other spare parts stories have

sounded more outrageous than they really were. The AFMAG study describes how the famous Navy diode appeared to leap from four cents to \$110.34 because of a quirk in cost allocation. The diode's misfortune was to be bought as a line item on a spare parts order that also included six power supply units. Following usual procedure, the supplier prorated material-handling costs and overhead equally to each line item on the order, then added profit margins based on the individual totals.

The overall bill to the government was the same as if costs had been allocated to each item according to its intrinsic value. The appearance, however, was that a cosmic price had been paid for the diode. Nobody noticed the great deal on the power supply units.

This isn't to say that every high-priced spare part can be written off to administrative peculiarities. Prime contractors acquire many parts from subcontractors for resale to the government, usually at an appreciable profit. Sometimes the prime gets the part in a semifinished condition and must do further work on it. In other instances, the prime may only inspect or repackage the part—or do nothing at all. One Air Logistics Center compared the markup rate on parts by prime contractors and found that it ranged



The Air Force is least vulnerable to overpricing on spare parts when it buys them competitively. Next lowest risk comes when cost and pricing data are available. Barring that, likelihood of overpricing can be reduced to some degree by purchase in economic order quantities. When all of these safeguards are absent, the Air Force is most vulnerable to overpricing. Figures shown are FY '82 dollars spent and items bought.

from twenty-eight percent to 250 percent.

The image of bumbling and malfeasance was inflamed last summer when a wildly inaccurate draft report on aircraft engine spares by the Defense Department Inspector General was leaked all over Washington. That draft overlooked 957 instances in which spare parts had decreased in price and grossly overstated the cost increase on others. DoD acknowledged the document was fatally flawed and sent it back to the auditors for reworking, but official debunking of the leaked version has been extraordinarily mild.

Voids in the Data

The heart of the spare parts problem is data, not only to tell the buyers what they're buying, but also to foster competition among spare parts vendors. Unless the Air Force can give valid engineering data to a potential second-source supplier, it is stuck with a single source for a part.

At present, the Air Force does not even know the *status* of data on thirty-nine percent of the parts it has coded with a procurement source code. This is because the value of those items is below the dollar threshold set for screening. Data is either missing or inadequate for another sixteen percent of the parts. And in the case of eight percent, producers claim the data is proprietary—developed by them and the exclusive right to use it held by them.

AFMAG sources say that as early work on a system progresses, it is not unusual for 1,000 to 2,000 engineering data changes to be made a month. More changes will come later, although at a slower rate. Too often, the Air Force has taken a square-filling approach to getting data from its contractors. Emphasis has been on format and reporting schedules rather than on collecting accurate data and keeping it current. Based on what they have seen so far, AFMAG analysts suspect that much of the thirty-nine percent now categorized as "unknown" will turn out to be junk.

More Competition

Inadequacy and unavailability of spare parts information, the AFMAG report says, is "the great-

est inhibitor to the Air Force's ability to increase competition." Consequently, a major thrust of the Air Force's response to the problem will be development of good data systems for buying spare parts.

Eventually, it will incorporate the pricing information that the 1,000 new workers come up with. An AFMAG spokesman also envisions the data systems as allowing the call-up of a picture of each part on a desktop computer screen.

The goal is not competition on every spare part. In hot sections of engines, for example, tolerances are so close and traceability of mate-

There were too few people with too little data, taking shortcuts in the face of a rising work load.

rials is so important that it would be hazardous to try putting vital components together with parts from here and there.

Moreover, the defense industrial base has shrunk from 6,000 suppliers twenty years ago to 3,500 today. That reduces the number of sources available to compete. Many of the remaining suppliers and subcontractors would prefer to continue to deal through prime contractors, thus avoiding the red tape and bureaucratic headaches of selling directly to the government. Small businesses are often scared away by the instability and unpredictability of defense procurements driven by year-to-year budgets instead of multiyear funding.

Immediate Action

The AFMAG task force was headed by Maj. Gen. Dewey K. K. Lowe, Commander of Sacramento Air Logistics Center. The group began last June, working under the auspices of the Air Force Inspector General in the Pentagon.

Because of the urgency of the problem and the public uproar about it, AFMAG briefed its find-

ings to top decision-makers as it went along. Some of its recommendations were put into effect immediately.

Each of the five Air Logistics Centers, for example, has already established an office to increase competition in parts purchases and to conduct value analysis of spares prices. Work has already started toward improvement of the spare parts data-processing system.

The group made a long list of specific recommendations. It said the Air Force must buy its parts in economic quantities, and, where it can, use multiyear procurements. As rapidly as possible, shortcut pricing methods should be dropped in favor of individual parts pricing. Cost allocation procedures should be revised to reflect the intrinsic value of parts, thus avoiding the perception of overpriced parts because of administrative distortion.

With the AFMAG study and other actions taken over recent months, the Air Force has served notice that it will be a very tough, very critical customer when it buys spare parts. The aerospace industry, as embarrassed by the horror stories as the Air Force was, is cooperating fully.

The Air Force has announced that it will eliminate the practice of parts pricing based on statistical-sampling techniques. Greater effort will be made to buy spares directly from suppliers.

In FY '84, USAF's goal will be to break out spares purchases representing thirty percent of the dollar value of vendor-produced items from prime system contracts. Proprietary data rights will be recognized for only five years after delivery of the first item employing that proprietary data.

With the creation of the new Joint Air Force Acquisition Logistics Center, spare parts and supportability of systems will get more priority in the early stages of future systems.

The great value of the AFMAG report is that it examines the spare parts problem comprehensively and proposes a workable plan for attacking the problem systematically. That, finally, should enable the Air Force to get out of the no-win mode of responding to horror stories one by one and to start dealing with the basic malady instead of the symptoms. ■

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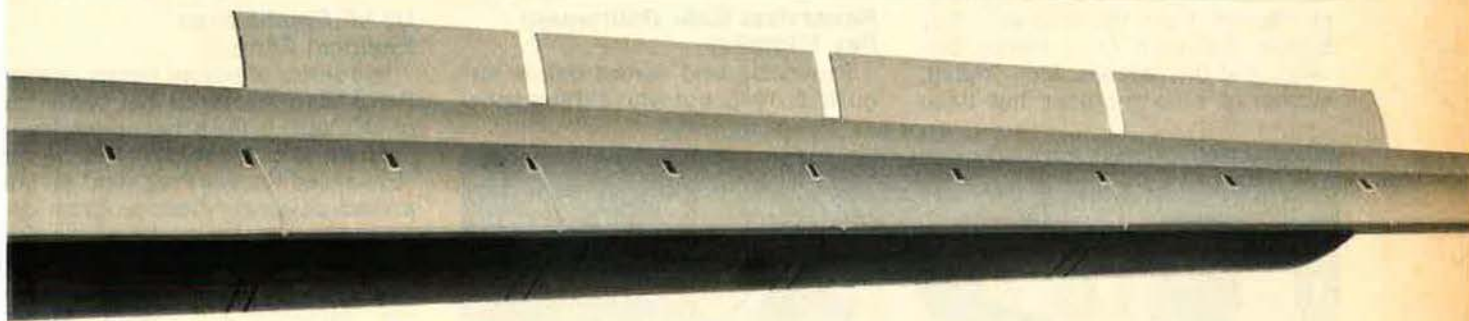


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THE BULLETIN BOARD

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

Outstanding People

Mrs. Ann E. Triplett of Randolph AFB, Tex., was recently named one of 1983's Ten Outstanding Young Women of America. Mrs. Triplett, wife of Maj. Henry H. Triplett, Jr., of the Air Force Manpower and Personnel Center, is a nurse at the Northeast Minor Emergency Center in Live Oak, Tex.

The honor goes each year to ten women selected for service to family, community, and profession by the Outstanding Young Women of America organization. Ann Triplett was chosen for her work as a registered nurse, volunteer, homemaker, and also for her demonstrated superior personal qualities.

After hours, Mrs. Triplett serves as a volunteer Red Cross nurse, and has done so for the last ten years. Her other volunteer efforts currently include the base chapel, wives' club, base PTA, and the Greater Randolph Youth Soccer Association. Among her previous volunteer stints have been Special Olympics, NFL Alumni Players Golf Tournament, Boy Scouts, Salvation Army, Family Services, and the Jaycees. Mrs. Triplett, mother of a sixth-grader, has been

named Wife or Woman of the Year by at least five other organizations over the years.

Meanwhile, Maj. Felix Sanchez, an instructor at the USAF Academy, has been named one of the Ten Outstanding Young People of the World for 1983. Major Sanchez is honored for significant career contributions to the Air Force and for active participation in religious activities.

The award is sponsored by Jaycees International and follows recognition of Major Sanchez as one of the 1983 Ten Outstanding Young Men of America, an award sponsored by the US Jaycees. (See March '83 "Bulletin Board.") This is the first year of the international award.

The Major was recognized for his accomplishments while assigned to Hill AFB, Utah, as flight test director of the ground-launched cruise missile test program. He is one of three Americans to be so cited. People from seventy-four nations competed.

Reservists Gain Retirement Pay Eligibility

Reservists who served before August 16, 1945, but who did not serve

on active duty in either World War I, World War II, or later in Korea, have been ineligible to receive retired pay because the law required them to serve on active duty during a period of these hostilities.

This has now been changed. Public Law 98-94 has added the Berlin and Cuban crises, as well as Vietnam, to the list of hostilities that make such Reservists eligible for retirement pay. Now, any extended active duty served from August 13, 1961, to May 31, 1963, or from August 4, 1964, to March 27, 1973 (other than for training), will count for pay eligibility.

Air Reserve Personnel Center officials emphasize that this recent change applies only to Reservists who were in the program before the end of World War II. Thus, those affected will normally be fifty-six years of age or older. If you think you might be eligible, write ARPC/DPAAR, Denver, Colo. 80280, or call toll-free: 1-800-525-0102, ext. 402.

USAF Emphasizes Physical Fitness

In a series of related moves, the Air Force has given notice that "shape up or ship out" is the order of the day.

Phase II of a two-part test of the "Enhanced Fitness Program," an improved physical-fitness program designed to increase readiness, begins this month at Grand Forks AFB, N. D.; RAF Lakenheath, UK; Laughlin AFB, Tex.; McChord AFB, Wash.; Myrtle Beach AFB, S. C.; and Osan AB and Pil-Sung, South Korea.

The program encourages a lifestyle that includes regular exercise. Results of the test will be used to refine the program before its Air Force wide implementation, scheduled for late this year. Phase II will evaluate all the proposed program elements such as the personal exercise program, fitness evaluation (which includes sit-ups and running), and fitness improvement training. Phase I completed in September, involved random testing of nearly 2,500 Air Force members worldwide to determine a general fitness pattern among blue-suiters.



Japanese 1st Lt. Takao Sawai (left) and 2d Lt. Masafumi Miyake of the 2d Air Wing at Chitose AB, Japan, talk to Sylvia Chase, reporter for the ABC News program "20/20", after her first flight in an F-15. Ms. Chase, flown by Lt. Col. Jere T. Wallace, 67th Tactical Fighter Squadron Commander from Kadena AB, Japan, flew a mission with Japanese and US pilots during the filming of an upcoming program on Japanese/US defense cooperation. Colonel Wallace was awarded AFA's 1983 Lt. Gen. Claire Lee Chennault Award designating him as the year's outstanding aerial warfare tactician. (Photo by Capt. Kevin Krejcarek, USAF)

The personal exercise portion of the program is at the discretion of each member, but such aerobic activities as cycling, jogging, swimming, or racquet sports are encouraged. The elimination of smoking and the use of stress management techniques are also emphasized.

The fitness evaluation segment is currently planned as a 1.5-mile run and sit-ups. A twelve-minute swim may be substituted for those with medical excuses.

In addition, the Air Force has moved to make physical conditioning mandatory at all Air Training Command technical schools. Aerobics training exercises are featured. Two periods each week will be required.

Finally, Headquarters has spelled out for the field what to do with members participating in the Air Force Weight Management Program who are not reducing satisfactorily.

In essence, commanders have been told to weigh members more often and to take administrative action against members who haven't lost at least six pounds during each sixty-day weigh-in period. Members were previously allowed to "average" the six-pound loss each two months.

Further, administrative action is now authorized anytime during a one-year observation period after the blue-suiter meets the weight standard—if the obesity returns. Action can include administrative separation.

Veterans Distribution Studied

The VA has published its latest estimate of the geographic distribution of the some 28,000,000 veterans in the US. This study, based on the 1980 census findings, spotlights veteran totals in the fifty states and the District of Columbia and in each of the 3,147 US counties and in forty-four cities. The figures, in addition to serving VA planning and administrative purposes, are used by Congress and other federal agencies, state and local governments, and public and private citizens interested in veterans problems.

Some interesting facts emerge from the estimates—which, while actuarially sound, are, the VA reminds users, only estimates. Figures are rounded off to the nearest ten.

War veterans—defined in the study as having served during specific periods of time—make up eighty-two percent of the total number. World War II vets make up the largest single sector of the population, accounting for nearly two of every five veterans. Vietnam veterans constitute almost thirty percent of the total group.

There are roughly 123 veterans for each 1,000 persons in the civilian population. The median age of the veterans is 51.4 years, and veterans over sixty-five make up about fifteen percent of the total. Both of these figures, of course, are expected to increase during the next decade.

The ten counties in the United States with the largest estimated veteran populations are:

Los Angeles Co., Calif.	848,190
Cook Co., Ill.	581,280
Harris Co., Tex.	297,000
Wayne Co., Mich.	279,940
San Diego Co., Calif.	261,300
Orange Co., Calif.	257,530
Maricopa Co., Ariz.	218,160
Allegheny Co., Pa.	210,170
Dallas Co., Tex.	199,870
Philadelphia Co., Pa.	199,400

The states with the largest absolute number of veterans are California—far and away the leader with just over 3,003,000—and New York, with just under 2,000,000. Alaska is the state with the fewest veterans, with but 50,000 calling the far north state home. Generally, the veteran population is shifting towards the south and the west.

CHAMPUS Funding Brightens

DoD leaders have, for some time, been citing gloomy projections for CHAMPUS funding. Now, in somewhat of a reversal, they are lauding cost-cutting steps taken by CHAMPUS and the military that have cut projected losses from some \$160 million to perhaps \$12 million.

What's happened? Several attacks on the problem have yielded results, according to CHAMPUS officials.

- The military medical depart-

ments have improved services at military hospitals to the point that families are seeking care there first. As a result—and also due to tightening of nonavailability statement issuance—CHAMPUS civilian hospital admissions are down by almost five percent this past year.

- An aggressive campaign against fraud and abuse has avoided an estimated payout of several millions of CHAMPUS dollars. Final tying of CHAMPUS to the Defense Enrollment Eligibility Reporting System (DEERS) should save several million more.

- Congress has passed legislation making CHAMPUS "second-pay" to all other health insurance. This action also avoided millions.

All in all, and while CHAMPUS still has a long way to go to be out of the woods fiscally, things are improving.

Bus Donated to Air Force Village

Thanks to Tactical Air Command officers' wives clubs, the Air Force Village in San Antonio, Tex., now has a new twenty-one-passenger bus.

The shiny blue-and-white vehicle was turned over to Village residents by representatives from fifteen TAC OWCs who were accompanied by TAC Commander Gen. W. L. Creech and Mrs. Creech (see photo). The clubs raised the money to buy the bus, continuing a tradition begun in 1974 when the TAC OWCs gave their first bus to the Home.

Village residents expressed excitement and appreciation to the group. General Creech added praise from himself and Mrs. Creech, noting that "it proves that we in the Air Force care, and we in the Air Force take care of our own."



Gen. W. L. Creech, Tactical Air Command Commander, his wife Carol (at the General's left), and representatives from TAC's Officers' Wives Clubs stand beside the bus they donated to Air Force Village. (USAF photo)



Brig. Gen. Frances I. Mossman (see item below).

First Woman Reservist To Star Rank

The year 1983 saw the first woman advance to star or flag rank in an armed forces Reserve component. She is Brig. Gen. Frances I. Mossman, Mobilization Assistant to the Director of Programs and Evaluation, DCS/Programs and Resources, Hq. USAF, Washington, D. C.

General Mossman, a native of Hawaii, currently lives in southern California, where she is a planning consultant and an instructor in the

THE BULLETIN BOARD

arts at UCLA. Holder of a juris doctor degree from George Washington University, she first entered the Air Force in September 1953 and graduated from OCS in March 1954.

She has served as an air traffic control officer and intelligence officer.

Short Bursts

In what is billed as one of the "largest single acquisitions of data-processing equipment ever undertaken in the health-care field," the VA has obligated \$62 million over the next two years to buy more than 300 computers, 12,000 terminals, 6,000 printers, and about 800 communication linking devices. The VA is the nation's largest health-care system.

About **sixty percent of all military women are single**, according to a DoD study. The Navy, with about thirty percent married females, and the Air Force, with about a fifty-fifty break-out, are at the extremes of the DoD average.

The Air Force now offers **ID card privileges** to twenty-one- and twenty-

two-year-old dependents attending any accredited post-secondary school offering associate or higher degrees. Previously the institution had to be listed in the Department of Education's directory. Main thrust of the change will be to authorize cards for attendees at hospital-sponsored post-secondary courses or for those in foreign countries attending a school recognized by the equivalent of that country's DoE. Students in nondegree programs, even in recognized schools, still aren't eligible.

Named **best Accounting and Finance Office** in the Air Force for 1983 is the **Warner Robins ALC facility**, Robins AFB, Ga. Nine areas were judged, including customer service. The unit handled its military pay transactions with 99.5 percent accuracy.

A rider to the 1984 Defense Authorization Act allows the military to "accept from any person voluntary services to be provided for a museum or a family-support program operated by that military department." What this does is provide **protection to the volunteer** in the event of accident or injury. The services would still like to get authority to **reimburse volunteers for mileage and expenses**. Rep. G. William Whitehurst (R-Va.) is spearheading this effort.

Speaking of volunteers, **Mrs. Sandi Dempsey**, Eglin AFB, Fla., has been named **Air Force Morale, Welfare, and Recreation Volunteer of 1983**. The wife of MSgt. Haven Dempsey and mother of three teenagers, she is active in youth center work cheerleading clinics, chaperoning and secretarial efforts, and is "Squac Mom" for two football and baseball teams. Whew!

The **VA Medical Center at New Orleans** has established an **open-hear surgery program**, making this procedure available in that area for the first time. Last year sixty-five patients had to be sent out of state for the treatment.

The **number-one Air Force Recruiter for 1983** is **SSgt. David V. Stevens** a former dental lab specialist. Sergeant Stevens, who works out of Arlington, Tex., says that he really believes in the Air Force and that his success stems from "selling it honestly."

The **USAF Academy** has captured the **Commander in Chief's Trophy** for the second straight year. The three military academies compete for this in interservice football competition. Decisive victories over both Army and Navy—40-20, beating Army; 44-17 over Annapolis—earned the Falcon service bragging rights.

SENIOR STAFF CHANGES

PROMOTIONS: To be **Major General:** Donald O. Aldridge; Carl D. Black, KyANG; Thomas C. Brandt; Aloysius G. Casey; Lewis G. Curtis; John J. Doran, Jr.; William L. Doyle, Jr.; Michael J. Dugan; Archer L. Durham; Eugene H. Fischer; Charles R. Hamm.

Elbert E. Harbour; Winfield S. Harpe; Harold G. Holesinger, IIIANG; Jerry D. Holmes; Bradley C. Hosmer; John P. Hyde; Hansford T. Johnson; Buford D. Lary; Michael A. Nelson; Robert W. Norris; Robert B. Patterson.

Randall D. Peat; Leonard H. Perroots; Clifford H. Rees, Jr.; Arthur J. Sachsels; Charles A. Sams, OreANG; James D. Shepherd, AlaANG; Ellie G. Shuler, Jr.; Charles P. Skipton; Larry N. Tibbetts; Claudius E. Watts III; Gordon E. Williams.

To be **Brigadier General:** Thornton E. Becklund, NDANG; Boyce O. Cranford, ArkANG; Donald J. David, ColoANG; Frank E. Dougherty, Jr., MdANG; Harold C. Earnhardt, NCANG; Dale F. Egide, WisANG.

Cecil W. Greene, AlaANG; James J. Hourin, LaANG; Hoyal B. Kye, TexANG; John N. Olson, SDANG; Robert E. Preston, OhioANG; James R. Roberts, TennANG; William G. Work, MoANG.

RETIREMENTS: M/G James L. Gardner, Jr.; B/G Philip S. Prince.

CHANGES: B/G (M/G selectee) Robert W. Norris, from Staff Judge Advocate, Hq. SAC, Offutt AFB, Neb., to Dep. JAG, Hq. USAF, Washington, D. C., replacing retired M/G James Taylor, Jr. . . . B/G Jack W. Sheppard, from DCS/Personnel, Hq. MAC, Scott AFB, Ill., to C/S, Hq. MAC, Scott AFB, Ill., replacing retired M/G James L. Gardner, Jr. . . . B/G C. Norman Wood, from Exec. Dir., President's Foreign Intel. Advisory Board, Washington, D. C., to Dep. Dir., Nat'l Strategic Target List, JSTPS, Offutt AFB, Neb., replacing retired B/G Allen K. Rachel. ■

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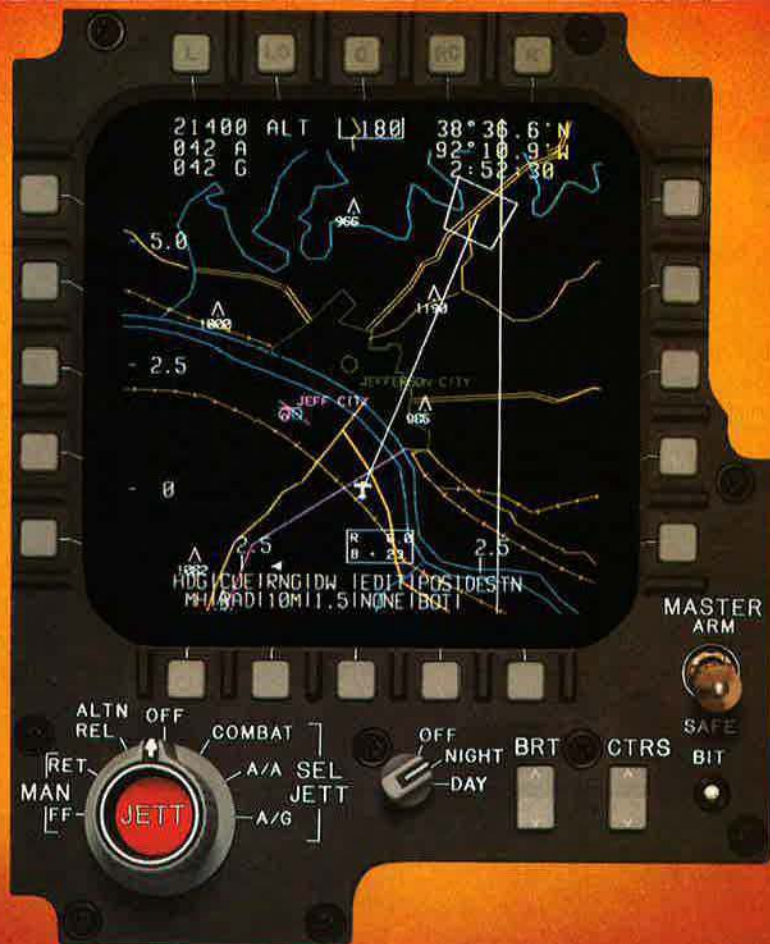
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Intercom

AFA's Achievements in 1983

Message from the President

Continuing an initiative begun last January, we devote this month's "Intercom" section to a forward-looking year-end report, summing up AFA's situation as 1983 came to a close and taking note of achievements during the past twelve months. The facts and numbers presented here tell of progress, but they give only a glimmer of the vitality and the effectiveness of AFA.

This report was compiled by the national staff, but AFA's real record in 1983 was written by you, the members, now 200,000 strong. Other organizations look often to AFA with envy, seeing it as a model of what they aspire to be. The magic of AFA, however, is in the number of superbly competent men and women in its chapters, willing to devote great amounts of their time to the furtherance of airpower and national defense.

In 1983, our Association was led by a distinguished Board of Directors. I am privileged to serve as your President for a second term. My predecessor, Judge John G. Brosky, was also reelected as your Chairman of the Board. The Association has been fortunate in the quality of its national officers and has been blessed by strong leadership at the state and local levels. Above all, AFA is an organization of dedicated, determined, strong-minded members.

Because of that, the Air Force Association speaks with a voice that is heard and respected, and is carrying out effectively the mission for which it was chartered thirty-seven years ago.

—David L. Blankenship,
President.

Membership. In 1983 AFA experienced the largest single-year increase in membership in the Association's thirty-seven-year history. At year's end total membership exceeded 200,000, a net gain during the year

of some 20,000 members. Equally impressive was the increase in the number of AFA Life Members. Participation in this select category of membership has nearly doubled in each of the past three years and now exceeds 14,000.

An analysis of the membership rolls shows substantial representation from all segments of the aerospace community, but the largest single category continues to be active-duty Air Force people, who account for thirty-five percent of total membership.

Geographically, the largest concentrations of members are in California and Texas, which together account for twenty-five percent of total membership. Aside from these two states and Florida and Virginia, no other single state accounts for more than four percent of AFA's total membership. The remaining seventy-five

percent of the membership is spread evenly throughout the country.

Headquarters Building. For the Air Force Association, Christmas arrived a few days early in 1983. AFA's new headquarters building was "topped out" in mid-December. At that time, and in accordance with long-standing tradition, a pine Christmas tree was mounted atop the building's superstructure in Arlington, Va., just across the Potomac River from Washington, D. C.

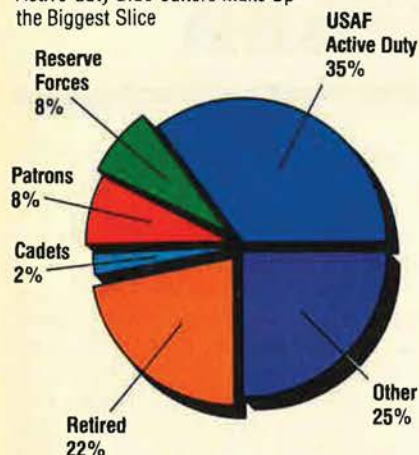
The "topping out" signaled the completion of the excavation and the building construction that began last spring after the public groundbreaking.

When completed in late June of this year, the building will have some 63,000 square feet of available office space, with 234 underground parking spaces. A little more than 30,000 square feet of this total will be oc-



The AFA Membership Pie

Active-duty Blue-suiters Make Up the Biggest Slice



cupied by AFA. The remainder is now being offered to a number of tenants.

As of this writing, work on the building is progressing well and is on schedule. Plans are still firm for a "move in" sometime in July of this year, with formal dedication planned to coincide with the Association's National Convention in Washington, D. C., in mid-September.

Once the building has been completed, "with all systems go," and again in accordance with tradition, another milestone will be commemorated with the hanging of a broom from the roof—indicating a "clean sweep."

Field Organizations. While AFA membership is increasing, growth of chartered AFA units runs apace. In 1983 the number of state organizations remained at forty-one, but three new organizations were in the formative stage: Minnesota, Hawaii, and Kentucky. A majority of those forty-one state organizations held conventions during 1983.

The number of chapters grew by ten. There are now 316. New overseas chapters have formed at RAF Greenham Common in the UK and at the San Miguel Spacetrack facility in the Philippines.

More AFA members than ever before, approximately 146,000, are affiliated with chapters. Chapters have stepped up their efforts in a variety of endeavors, including better programs, awards, community-level activities, and relationships with Air Force bases, units, recruiters, ROTC

and Junior ROTC units, and Civil Air Patrol squadrons. Communications outreach is expanding, with more and better newsletters being published.

A record 375 delegates, representing forty-three states, Guam, and Puerto Rico, were registered at the AFA National Convention in September.

The annual Orientation for State Presidents and new Board members in October was also attended by a record number. Seventeen of those who came purchased Life Memberships on the spot. At the orientation, senior field leaders acquainted themselves with AFA staff members and also exchanged concerns, ideas, and future plans.

AFA's National Vice Presidents have steadily increased their involvement in Association affairs.

Members and units are taking greater advantage of the availability of

AFA products, including gifts, awards, and personal items. Foot-Joy golf and street shoes can be obtained at competitive prices through the expanded Field Organizations member service. Distinctive leisure wear for men and women—shirts, sweaters, and windbreakers—are among other items in stock.

On Capitol Hill. AFA's efforts included providing liaison with Congress, the Department of Defense, the White House, and other elements of the executive branch in consonance with and in support of the Association's policy positions on R&D, procurement, defense manpower, and arms control unanimously adopted by National Convention delegates.

All year long while Congress was in session AFA chapters and elected leaders were kept apprised of the status of the numerous programs of vital

AFA . . . The Right Stuff

AFA's Communications Department has produced two public service announcements in support of USAF and AFA that feature Brig. Gen. Charles "Chuck" Yeager, USAF (Ret.). The two thirty-second spots accompany a one-hour program of Air Force Academy football highlights that was shown on the Military Cable Channel to twenty-eight base communities. Further, the spots were distributed to television stations in sixteen cities near Air Force bases in AFA's twelve regions for broadcast on Veterans Day.

The spots were filmed at National Airport in Washington, D. C., during ceremonies marking the premiere of the movie *The Right Stuff*. At the end of each spot, General Yeager, seated in the cockpit of his P-51 *Ain't Misbehavin'*, gives the "thumbs up" and says: "The Air Force Association . . . now *that's* the right stuff!"

During the filming, with the media closing in on his aircraft, it looked as if the chance to videotape General Yeager would be lost. Climbing out of the cockpit he put his hands up to the national press and said, "Wait a minute. First I've got to do something for AFA." With that, he did the spot six times to make sure AFA got the right stuff.



General Yeager stands atop the wing of his P-51 *Ain't Misbehavin'*.

Here's what AFA's new headquarters building looked like on December 7 as this issue was being prepared. AFA's staff will move into their new home next summer. (Photo by William A. Ford, Art Director)

interest to the Air Force, from the initial budget request submitted to Congress by the Administration to the final funding level in the regular appropriations bill.

During considerations of the DoD appropriations bill and the DoD authorization bill, AFA staff members audited more than seventy-five personnel-related hearings over a period of 142 legislative days on Capitol Hill. We participated actively in the realization of fifteen long-held AFA personnel policy goals and were invited by the Air Force Surgeon General's office to participate in the development of health-care legislation and programs that did not adversely affect Air Force personnel—active-duty or retired.

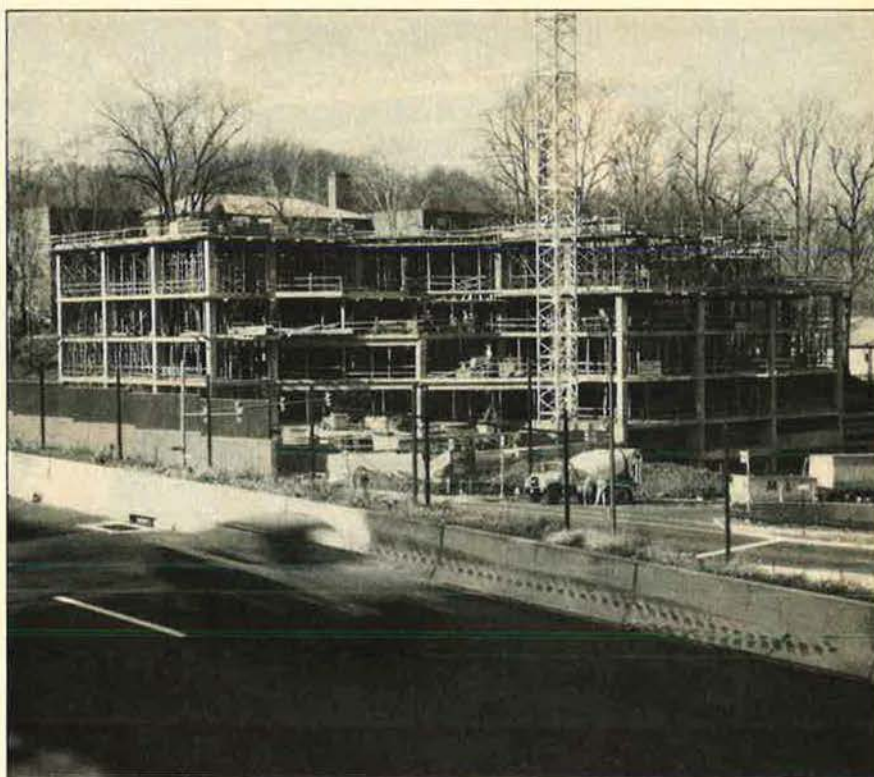
After the findings of the President's Private Sector Survey on Cost Control were released in June, an Executive Analysis was prepared for AFA chapters on both the OSD and the Air Force Task Force reports.

The 1983 AFA Salute to Congress was a success, with 124 congressmen and 120 staff members as well as many senior Air Force officials in attendance.

National Symposia. In 1983 AFA conducted five national symposia. The objective was to provide authoritative and reliable data on pressing Air Force and national security requirements to AFA members, defense leaders, industry executives, the media, and the public at large. Audience reaction and media coverage were strong and positive.

In addition to the annual symposium in Los Angeles, Calif.—held in November under the title: "The US Air Force Today and Tomorrow: The New Priorities"—AFA, for the second consecutive year, sponsored symposia on electronics and on mobility. The symposium on "Electronics and the Air Force" was held in conjunction with Air Force Systems Command's Electronic Systems Division in April in Boston, Mass. In June, AFA's symposium entitled "Mobility: Key to Global Deterrence" was held in St. Louis, Mo., in cooperation with Military Airlift Command.

New programs for 1983 included a



symposium on "Tactical Air Warfare," held in conjunction with Tactical Air Command during the 1983 AFA Convention in Washington, D. C., and a symposium entitled "Logistics: The Long Pole in the Tent," held in cooperation with Air Force Logistics Command in October in Dayton, Ohio.

Communications. New ideas and new techniques were bywords in AFA communications in 1983. An innovative approach was taken to expand the reach of AFA's Aerospace Development Briefings and Displays during the National Convention. On September 15, AFA beamed via satellite eight aerospace briefings from the convention site to ten Air Force commands and divisions throughout the nation. While some technical problems interrupted the transmission, eighty-five percent of the national audience said that they would attend another AFA video telecast.

Chapter and state communications programs were strengthened by the availability of more resources for use by AFA leaders. AFA's central library, which now includes eight films, eighty-five videotapes, six sound/slide productions, and twenty speech blocks, was used by eighty chapters, six state organizations, and eight regional organizations to augment AFA programs at the grass-roots level. The

most popular film was "Countdown for America," which was shown 185 times during the year.

AFA's Communications Committee addressed the issue of strengthening state and chapter communications programs by producing videotaped panel discussions and an audio cassette package on chapter communications that were distributed to the field.

AFA's national events received excellent coverage in the news media. The 1983 National Convention attracted 224 media representatives, the largest number to attend in more than a decade. AFA's national symposia generated extensive coverage both nationally and in the local areas where they were held.

In addition, there was an increasing awareness of the Association as a news source on a variety of key policy issues—from MX and arms control to people issues. During the year, senior staff members were frequently contacted by national and foreign media to appear on talk shows and panel discussions and to provide background information on topical defense issues.

Aerospace Education Foundation. A variety of activities, including a new thrust to improve the scientific and technological literacy of America's



AFA Deputy Executive Director Andrew B. Anderson, left, who has directed AFA's new headquarters building project since its inception, reviews a blueprint with construction superintendent Ernie Blankenship. (Photo by Ken Goss)

youth, has kept the Foundation busy in the past year.

During the 1983 AFA Convention the Foundation sponsored the Third National Laboratory for the Advancement of Education. Its theme was "Improving the Scientific and Technological Literacy of America's Youth." The Foundation is now working on plans to hold follow-up regional symposia on this topic.

In concert with the Air Force Historical Foundation, AEF will produce two books in the near future: a biography of Gen. Carl A. "Tooey" Spaatz and an anthology on the contributions of twelve aerospace leaders. In addition, complimentary copies of three books (*Forged in Fire*, *A Few Great Captains*, and AFA's own *Crusade for Airpower*) were sent to Air Force Junior and Senior ROTC units, NCO Academies, Civil Air Patrol regions, and the Officer Training School—all sources of future Air Force and aerospace leaders.

Dissemination of Air Force vocational/technical courses to civilian schools is continuing, along with an investigation of Air Force high-technology courses that may be available for distribution. In a related matter, the Air Force has assigned an active-



Dr. Don C. Garrison, right, AEF President and President of the Tri-County Technical College of Pendleton, S. C., accepts the Association of Community College Trustees' Marie Y. Martin Award. The award is presented annually to the nation's top community college administrator. Making the presentation is Tri-County's Board Chairman, J. B. Ouzts. The occasion was the ACCT's Convention in Phoenix in October.

duty officer to a one-year tour as a "Research Associate" to study, observe, and participate in AEF's efforts to improve scientific and technological literacy among the nation's youth.

The Foundation currently has 326 individual and twenty-four corporate fellows in its General Jimmy Doolittle Educational Fellowship program and fifty-four individual and two corporate fellows in its General Ira C. Eaker Historical Fellowship program. Both programs provide resources for various Foundation projects. Additional support is provided by AFA, the Los Angeles Air Force Ball, the Iron Gate Chapter's National Air Force Salute, and other individual and chapter contributors.

For the past twelve years the Foundation has sponsored a contest for all Air Force Junior ROTC units. The topic for 1984 will be "Military Space Ventures."

Councils. AFA's Enlisted and Junior Officer Advisory Councils continue to be among the most effective and productive advisory groups of AFA. The councils represent input from every Air Force Major Command, Separate Operating Agency, and Direct Reporting Unit.

This year the Councils met three times and presented significant recommendations to the Air Force on implementation of Project Technology 2000, an Air Force initiative to encourage the study of science and mathematics in the nation's schools. Additionally, the Councils played a key role in furnishing suggestions and recommendations that eventually were reflected in AFA's Defense Manpower Issues policy paper.

During last year's AFA Convention, Senior Enlisted Advisors from throughout the Air Force again met in a worldwide conference to address issues of importance to USAF and AFA.

Insurance. AFA's insurance programs experienced continued growth throughout 1983. At the close of the year nearly 48,000 policies were in force.

During the year particular interest was shown in AFA's ChamPLUS® and Medicare Supplement plans because of the increasing need to minimize out-of-pocket medical expenses. Claims payments under the two programs more than doubled during the year (necessitating an additional claims analyst on AFA's staff), and the number of AFA families covered un-

der these new programs increased to more than 6,500.

During the past twenty-five years, total claims payments made under AFA's several group insurance programs have grown rapidly and now exceed more than \$50 million. Nearly seventy-five percent of this total amount has been paid to beneficiaries of members covered under

AFA's life and accident insurance plans, while the balance—approximately \$13 million—has been paid to members for losses resulting from injury and/or illness.

The group life insurance plan, covering more than 31,000 AFA members and with more than \$1.4 billion of insurance in force, again provided participants with a substantial year-end

dividend. This dividend, amounting to twenty percent of the premium paid for coverage during the previous year, was paid to all participants in June 1983. This marked the tenth consecutive year in which a sizable dividend has been paid. New, higher amounts of coverage were also introduced for all persons under age thirty as of June 1983.

AFA STAFF PROFILES

The Friendly Folks In Field Organizations

By Capt. Patricia R. Rogers, USAF
CONTRIBUTING EDITOR

Donna Coffey just took a telephone order for mailing labels from an AFA chapter in Texas. Now she's talking with the finance department at AFA's national headquarters about a chapter's rebate check.

"I've spent the last three years of my life on that telephone," said the North Carolina native with a grin. As Director of Field Services, she is unabashedly proud of her twelve-year career in Field Organizations, pointing out that she has held almost every job in the six-person office.

Field Organizations is headed by Dave Noerr, a former California chapter president and state vice president. He and his staff work directly with the 316 AFA chapters, forty-one state organizations, and twelve regional organizations nationwide, assisting AFA volunteers with all the challenges of running a chapter and interfacing between the chapter and functional areas at AFA National Headquarters. Field Organizations is a one-stop shopping center or, if you will, a one-call service organization for AFA chapters. Seventy percent of AFA membership is affiliated with a chapter.

"We are here to help them," said Mrs. Coffey.

Help comes in a variety of forms. A telephone caller to Field Organizations can get administrative assistance in acquiring such items as certificates, mailing labels, back issues of *Air Force Magazine*, special supplies, and the like.

Field Organizations also sends out chapter rebate checks that are directly related to membership size and to the number of new members obtained quarterly. To keep membership rolls current, complete chapter membership rosters are mailed twice a year, with interim rosters and rosters of expired memberships going out monthly. The department also monitors the Community Partner program, in which a business sponsors one or more of its employees as members or patrons of AFA as part of a community service to bolster national defense awareness.

Chapters send their activity and financial reports to Field Organizations.

"Someone actually reads all those reports they send in," said Karen McReynolds, who accounts for all requests from the field that are sent to the Field Organizations office. "I read them and pass them along to Dave [Noerr], pointing out any special activities or events."

Advice and guidance are also freely dispensed. A new state president wants to run a super state convention and needs pointers. A new chapter president finds out he or she has bitten

off a huge chunk of responsibility and wants someone to help chew it.

It's all in a day's work at Field Organizations. In fact, certain types of minor crises are so "typical" that the staff has written a book explaining such things as the role of National AFA, how to form a chapter, and the correct protocol for various social functions. The book, which is updated periodically, is distributed to AFA field leaders and is also available from the Field Organizations office.

Fortunately, advice is not limited to telephone connections. Mr. Noerr spends every weekend from April to August traveling to state conventions, during which he holds workshops to share ideas on running an AFA chapter.

"We exist to provide them [state and chapter organizations] with all the tools to work smart," he said. In October, Field Organizations sponsored a three-day program in Washington, D. C., to brief all the AFA state presidents.

Of course, Field Organizations gets another chance to interact with members at the chapter, state, and national levels at the annual AFA National Convention. Field Organizations plans, organizes, and helps conduct all the business meetings and the opening ceremonies. And it takes the work of all the office members—including Kathy White, who handles membership and rosters, TK Hyatt, who services both units and individuals for ordering supplies, and Jeanne Buffalino, Mr. Noerr's secretary—to get the job done.

Dave Noerr is proud of his staff. He's proud of his work, too.

"It's a fun thing to do," he said. "They [the chapter members] represent what is best about America. Without volunteerism, it just wouldn't go. Without volunteerism America wouldn't go."



The Field Organizations staff (from left): Dave Noerr, Karen McReynolds, Kathy White, Jeanne Buffalino, TK Hyatt, and Donna Coffey (seated). Field Organizations is a one-call service center for AFA chapters.

Announcing the 1984 Aviation Week Calendar

The Roaring Twenties and Thirties



The Birth of Air Transport

1 Barnstorming, trans-Atlantic flight, instrument navigation, polar exploration and the birth of air transportation; Lindbergh, Fokker, Byrd, Balbo, Sikorsky, Earhart and Douglas "Wrong-Way" Corrigan. What an era!

2 It's all captured in *The Roaring Twenties and Thirties*, Aviation Week's 1984 calendar, our fifth annual salute to "Memorable Eras in Aviation." Twelve magnificent paintings, created exclusively for Aviation Week by the noted French aviation artist Paul Lengelle, recreate the excitement of that historic time—and they can be yours to enjoy all through next year, and to keep forever.

3 Suitable for framing, these 14½ by 11½-inch prints are a handsome addition to any collection of aviation history and memorabilia, and make a perfect gift for all your aviation-minded friends this holiday season.

4 SPECIAL OFFER: Limited quantities of our last three calendars are also available: *The Contributions of Some Nearly Forgotten Pioneers* (1981); *World War I—The End of the Beginning* (1982), and *Famous Fighters of World War II* (1983). You may use the handy coupon below to order any of these, as well as your 1984 calendar.

5 BULK RATE OFFER: The 1984 Aviation Week calendar is a great gift idea for so many friends on your personal or business holiday gift list! Call Calendar Sales at 212/512-2123 for bulk rate (25 or more) prices and information.

PLEASE SEND ME _____ copies of the full-color 1984 AW&ST Calendar: *The Roaring Twenties and Thirties*, at \$10.95 each (postage and handling included).

Please also include the indicated number of copies of previous calendars at \$4.50 each.

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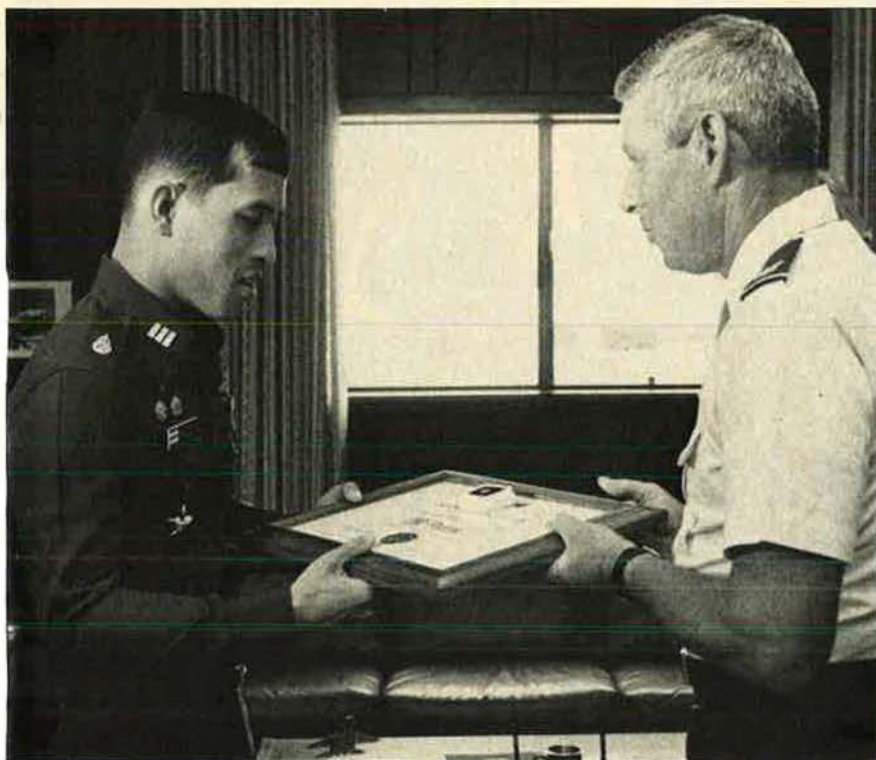
CITY _____

STATE _____

ZIP _____

COUNTRY _____





His Royal Highness, Crown Prince Maha Vajiralongkorn of Thailand, left, recently became an AFA Life Patron while in F-5 training in Williams AFB, Ariz. Presenting the certificate and pin is Col. William L. Hiner, Commander of the 82d FTW at Williams.

Briefings and Displays. This year's program of aerospace briefings and displays during the AFA National Convention was one of the most success-

ful ever. More than 7,700 people attended, making for the largest crowd in the more than twenty years that AFA has been staging this event.



Brig. Gen. William M. Constantine, USAF, left, Commander of SAC's 40th Air Division, Wurtsmith AFB, Mich., was the guest speaker at the annual North Dakota State AFA "Fish Fry," held recently in conjunction with AFA's Red River Valley Chapter's annual awards presentation. Presenting General Constantine with a stained-glass plaque of a B-52 and a Minuteman II missile are Maury Rothkopf, right, then North Dakota State AFA President; and Al Bartolomei, Chapter President.



At a recent meeting of AFA's H. H. Arnold Chapter in New York, AFSC Commander Gen. Robert T. Marsh, right, was presented an Aerospace Education Foundation Jimmy Doolittle Fellowship by Frank X. Battersby, Chairman of the Chapter's Executive Council. The Fellowship was sponsored by the Arnold Chapter.

The exhibit hall at the Sheraton Washington Hotel was packed. More than 100 companies or divisions of companies participated, with fifty-nine conducting formal briefings on the latest developments in USAF systems and equipment.

AFA provided bus service from the Pentagon, Andrews AFB, Md., and Bolling AFB, D. C., to facilitate Air Force attendance.

Advertising. Total advertising in AIR FORCE Magazine for 1983 was 532 pages, which included 107 pages in September, the largest single-issue total in recent history. The 1983 total is an increase of two percent over 1982 and marks the tenth year in a row that advertising sales exceeded those of the previous year.

Industrial Associates. As of this writing, 228 companies are affiliated with AFA's Industrial Associate program. Through this affiliation these companies support the objectives of AFA as they relate to the responsible use of aerospace technology for the betterment of society and the maintenance of adequate aerospace power as a requisite of national security and international amity. At this time last



During ceremonies at which he was presented the Thomas D. White National Defense Award, AFA Executive Director Russell E. Dougherty stands before the Air Force Academy color guard for the national anthem. See item. (Photo by Bob Jackson)

year, 204 companies were affiliated with the program.

AFA Executive Director Receives Thomas D. White Defense Award

During ceremonies held in October at the Air Force Academy in Colorado Springs, Colo., AFA Executive Director Russell E. Dougherty was presented the 1983 Thomas D. White National Defense Award. Named in honor of Gen. Thomas Dresser White, USAF (Ret.), Air Force Chief of Staff from 1957 to 1961, the award was established by the Air Force Academy in 1962 and is conferred each year on "the United States citizen who is judged to have contributed most significantly to the national defense and security of the United States during the years preceding the award."

Previous recipients of the prestigious award include Gen. Curtis E. LeMay, USAF (Ret.), Clarence L. "Kelly" Johnson, Gen. Lauris Norstad, USAF (Ret.), Bob Hope, and Sen. Barry M. Goldwater (R-Ariz.). Melvin R. Laird, former Secretary of Defense, was last year's winner.

Unit Reunions

Valiant Air Command

The Valiant Air Command annual air show will be held on March 10-11, 1984, at Tico Airport, Fla. (west of Cape Canaveral). **Contact:** Col. Bob Reid, VAC, 8970 Mahogany Way, Plantation, Fla. 33324. Phone: (305) 472-2356.

73d Bomb Wing Ass'n

A reunion will be held on May 17-20, 1984, at the Marriott Airport Hotel in Atlanta, Ga., for former members of the 73d Bomb Wing, including personnel from the 497th, 498th, 499th, and 500th Bomb Groups; the 65th, 91st, 303d, and 330th Service Groups; and attached and assigned units on Saipan during World War II. **Contact:** 73d Bomb Wing Association, 105 Circle Dr., Universal City, Tex. 78148.

99th Bomb Group

Members of the 99th Bomb Group will hold their reunion on May 4-6, 1984, in Houston, Tex. **Contact:** James Flex, P. O. Box 1185, Dickinson, Tex. 77539. Phone: (713) 337-2240.

307th Air Refueling Squadron

The 307th Air Refueling Squadron will

hold its reunion on March 2-4, 1984, in Tucson, Ariz. **Contact:** Bill Davern, 8820 E. Bluefield, Tucson, Ariz. 85710.

307th Bomb Group

Members of 307th Bomb Group "Long Rangers" will meet for their fifth reunion on May 4-6, 1984, at the Hilton Inn, Florida Center, Orlando, Fla. **Contact:** Mrs. Cena Marsh, 1923 Atkin Ave., Salt Lake City, Utah 84106. Phone: (801) 466-5805 or (801) 539-6300. George Jaffe, 1226 Humboldt St., Reno, Nev. 89509. Phone: (702) 329-5788 or (702) 322-4222.

475th Fighter Group

Members of the 475th Fighter Group, Fifth Air Force, will hold their reunion on May 17-20, 1984, at the Doubletree Inn, Scottsdale Mall, Scottsdale, Ariz. **Contact:** H. N. "Pete" Madison, 150 N. Myers St., Los Angeles, Calif. 90033. Phone: (213) 261-7171.

Kelly and Randolph Fields

I am trying to organize a reunion for personnel who attended or served in the Central Flight Instructor Schools at Kelly

CORRECTION

Last month, in a photo caption on p. 161 (with a photo of the Wright Memorial Chapter's annual Air Force Birthday Ball), we identified Gen. James P. Mullins, Commander of the Air Force Logistics Command, as "recently retired." This was in error. General Mullins is still very much on active duty and still very much in charge at AFLC. Our apologies.

—THE EDITORS

or Randolph Fields, Tex., during World War II.

Please contact me for more information at the address below.

Dempsey W. Welch
913 N. 66th St.
Waco, Tex. 76710

Phone: (817) 772-4552

Patriots Reunion

I am trying to locate former students and/or parents of students who attended Douglas High School (Ellsworth AFB, S. D.) between 1963-65 for the purpose of planning a reunion.

Please contact the address below for more information.

Ed Miles
6916 Betsy Ross
Watauga, Tex. 76148

Phone: (817) 498-5195

10th Combat Cargo Squadron

I am trying to update the membership roster for the 10th Combat Cargo Squadron, 3d Combat Cargo Group.

Please contact the address below.

Thornton Rose
2014 Mirror Lake Dr.
Fayetteville, N. C. 28303

Class 43-E

I would like to hear from members of Class 43-E (Gardner Field, Taft, Calif.) for the purpose of sharing information about reunions held in Taft, Calif., for personnel who served at the field.

Please contact the address below.

C. M. Trinkle, Jr.
P. O. Box 516
Lost Hills, Calif. 93249

Class 44-J

I would like to hear from pilots and members of Class 44-J who attended flying school at Cuero, Waco, or Victoria, Tex., for the purpose of planning a reunion.

For further details, please contact the address below.

Carlos B. Esteva
P. O. Box 968
Arecibo, P. R. 00613

Class 49-A

I am interested in locating members of Pilot Training Class 49-A who would be interested in a thirty-fifth-year reunion.

Please contact the address below.
Brig. Gen. Claude F. Heath,
USAF
4007 Ivydale Lane
Sandston, Va. 23150
Phone: (804) 737-8211

96th Bomb Squadron

Reunion plans are under way for former members of the 96th Bomb Squadron, 2d Bomb Wing (Chatham/Hunter AFB, Ga.).

For further details, please contact the address below.

Lee Herridge
16975 Encino Hills Dr.
Encino, Calif. 91436

Phone: (213) 986-4071

1708th Ferrying Group

We are trying to form an organization for the purpose of holding a reunion for former members of the 1708th Ferrying Group, including the 1737th, 1738th, and 1739th Ferrying Squadrons.

Please contact one of the addresses below.

Ernie Davis
17881 S. W. 113th Ct.
Miami, Fla. 33157

or

Ted Timbers
4150 Flamingo Crest, Apt. 2
Las Vegas, Nev. 89121

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- C. Member Tie Tac \$10 each _____
- D. Lapel Pin \$15 each (Please specify: President, Past President or Life Member) _____
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Enclose your check or money order made payable to Air Force Association, 1750 Pennsylvania Avenue, N.W., Suite 410, Washington, D.C. 20006. (D.C. residents please add 6% sales tax.)

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- 2) All eligible dependents of AFA members on active duty. Eligible dependents are spouses under age 65 and unmarried dependent children under age 21 (or age 23 if in college).

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(See chart at right)

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CHAMPUS-approved Residential Treatment Center.

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AFA CHAMPLUS® insurance is administered by trained insurance professionals on your Association staff. You get professional, courteous service from people who know your needs and know the detail of your coverage. Your insurance is underwritten by Mutual of Omaha, largest individual and family health insurance company in the world.

AFA OFFERS YOU HOSPITAL BENEFITS AFTER AGE 65

Once you reach Age 65 and are covered under Medicare, AFA offers you protection against hospital expenses not covered by Medicare through the *Senior Benefit Plan* of AFA Hospital Indemnity Insurance. Members enrolled in CHAMPLUS® will automatically receive full information about AFA's Medicare supplement program upon attainment of age 65 so there will be no lapse in coverage.

AFA CHAMPLUS® BENEFIT SCHEDULE

Care	CHAMPUS Pays	AFA CHAMPLUS® Pays
<i>For Military Retirees Under Age 65 and Their Dependents</i>		
Inpatient civilian hospital care	CHAMPUS pays 75% of allowable charges.	CHAMPLUS® pays the 25% of allowable charges not covered by CHAMPUS.
Inpatient military hospital care	The only charge normally made is a \$6.55 per day subsistence fee, not covered by CHAMPUS.	CHAMPLUS® pays the \$6.55 per day subsistence fee.
Outpatient care	CHAMPUS COVERS 75% of outpatient care fees after an annual deductible of \$50 per person (\$100 maximum per family) is satisfied.	CHAMPLUS® pays the 25% of allowable charges not covered by CHAMPUS after the deductible has been satisfied.
<i>For Dependents of Active-Duty Military Personnel</i>		
Inpatient civilian hospital care	CHAMPUS pays all covered services and supplies furnished by a hospital less \$25 or \$6.55 per day, whichever is greater.	CHAMPLUS® pays the greater of \$6.55 per day or \$25 of the reasonable hospital charges not covered by CHAMPUS.
Inpatient military hospital care	The only charge normally made is a \$6.55 per day fee, not covered by CHAMPUS.	CHAMPLUS® pays the \$6.55 per day subsistence fee.
Outpatient care	CHAMPUS covers 80% of outpatient care fees after an annual deductible of \$50 per person (\$100 maximum per family) is satisfied.	CHAMPLUS® pays the 20% of allowable charges not covered by CHAMPUS after the deductible has been satisfied.

NOTE: Outpatient benefits cover emergency room treatment, doctor bills, pharmaceutical and other professional services.

There are some reasonable limitations and exclusions for both inpatient and outpatient coverage. Please note these elsewhere in the plan description.

APPLY TODAY!

ST FOLLOW THESE STEPS

Choose either AFA CHAMPUS® Inpatient coverage or combined Inpatient and Outpatient coverage for yourself. Determine the coverage you want for dependent members of your family. Complete the enclosed application form in full. Total the premium for the coverage you select from the premium tables on this page. Mail the application with your check or money order for your initial premium payment, payable to AFA.



MITATIONS

Coverage will not be provided for conditions for which treatment has been received during the 12-month period prior to the effective date of insurance until the expiration of 12 consecutive months of insurance coverage without further treatment. After coverage has been in force for consecutive months, pre-existing conditions will be covered regardless of prior treatment.

EXCLUSIONS

This plan does not cover and no payment will be made for:

Routine physical examinations or immunizations

Domiciliary or custodial care

Dental care (except as required as a necessary adjunct to medical or surgical treatment)

Routine care of the newborn or well-baby care

Injuries or sickness resulting from declared or undeclared war or any act of war

Injuries or sickness due to acts of intentional self-destruction or attempted suicide, while sane or insane

Treatment for prevention or cure of alcoholism or drug addiction

Eye refraction examinations

Prosthetic devices (other than artificial limbs and artificial eyes), hearing aids, orthopedic footwear, eyeglasses and contact lenses

Expenses for which benefits are or may be payable under Public Law 89-614 (CHAMPUS)

PREMIUM SCHEDULE

Plan 1—For military retirees and dependents (Quarterly Premiums)

Inpatient Benefits

Member's Attained Age	Member	Spouse	Each Child
Under 50	\$19.03	\$23.30	\$14.85
50-54	\$26.16	\$32.01	\$14.85
55-59	\$36.16	\$44.28	\$14.85
60-64	\$43.62	\$53.41	\$14.85

Inpatient and Outpatient Benefits

Under 50	\$26.80	\$31.05	\$37.13
50-54	\$36.83	\$42.68	\$37.13
55-59	\$50.92	\$59.02	\$37.13
60-64	\$61.41	\$71.20	\$37.13

Plan 2—For dependents of active-duty personnel (Annual Premiums)

Inpatient Only	None	\$ 9.68	\$ 5.94
Inpatient and Outpatient	None	\$38.72	\$29.70

APPLICATION FOR AFA CHAMPUS*

Group Policy GMG-FC70
Mutual of Omaha Insurance Company
Home Office: Omaha, Nebraska

Full name of Member _____
Rank _____ Last _____ First _____ Middle _____

Address _____
Number and Street _____ City _____ State _____ ZIP Code _____

Date of Birth _____ Current Age _____ Height _____ Weight _____ Soc. Sec. No. _____
Month/Day/Year

This insurance coverage may only be issued to AFA members. Please check the appropriate box below:

☐ I am currently an AFA Member. ☐ I enclose \$15 for annual AFA membership dues (includes subscription (\$14) to AIR FORCE Magazine).

PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (Check One) ☐ AFA CHAMPUS* PLAN I (for military retirees & dependents) ☐ AFA CHAMPUS* PLAN II (for dependents of active-duty personnel)

Coverage Requested (Check One) ☐ Inpatient Benefits Only ☐ Inpatient and Outpatient Benefits

Person(s) to be insured (Check One) ☐ Member Only ☐ Member & Children ☐ Spouse Only ☐ Spouse & Children ☐ Member & Spouse ☐ Member, Spouse & Children

PREMIUM CALCULATION

All premiums are based on the attained age of the AFA member applying for this coverage. Plan I premium payments are normally paid on a quarterly basis but, if desired, they may be made on either a semi-annual (multiply by 2), or annual (multiply by 4) basis.

Quarterly (annual) premium for member (age _____) \$ _____

Quarterly (annual) premium for spouse (based on member's age) \$ _____

Quarterly (annual) premium for _____ children @ \$ _____ \$ _____

Total premium enclosed \$ _____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Dependents to be Insured Relationship to Member Date of Birth (Month/Day/Year)

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such pre-existing conditions will be covered after this insurance has been in effect for 24 consecutive months.

Date _____, 19 _____

Member's Signature

1/84

NOTE: Application must be accompanied by check or money order.

Form 6173GH App.

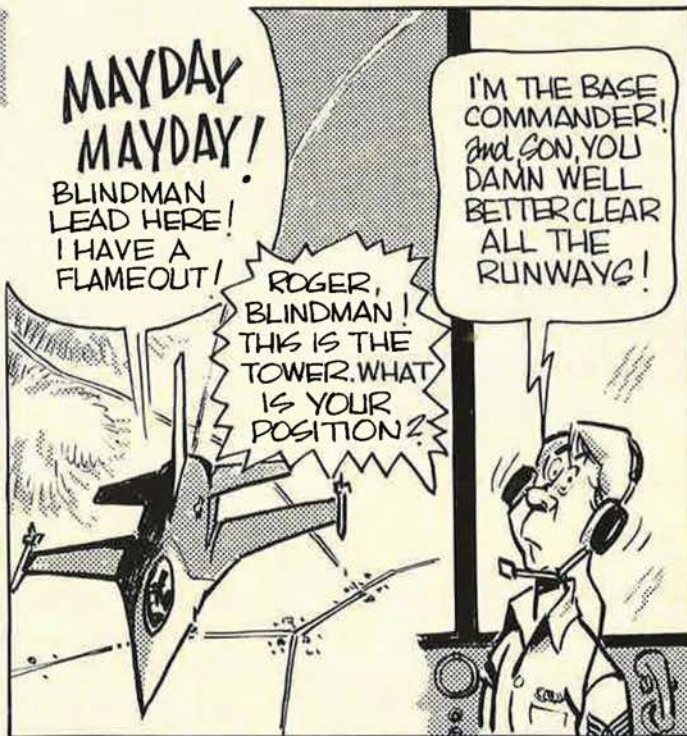
Send remittance to:

Insurance Division, AFA, 1750 Pennsylvania Ave., NW, Washington, D.C. 20006.

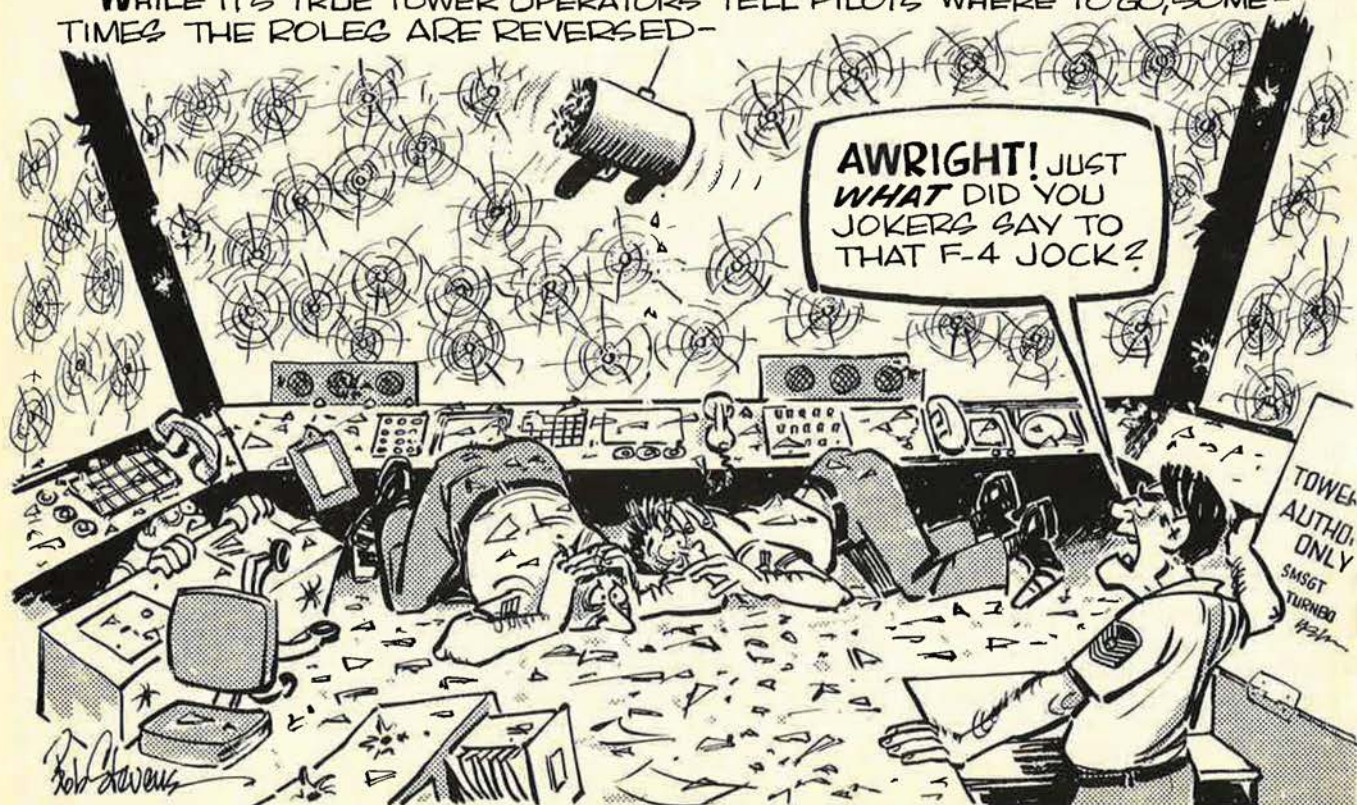
"There I Was..."



SENIOR AIR TRAFFIC CONTROLLER'S "WINGS"



WHILE IT'S TRUE TOWER OPERATORS TELL PILOTS WHERE TO GO, SOMETIMES THE ROLES ARE REVERSED—



The evolution of an automatic test system...

the Bendix way.

Why Bendix was ready for MATE.

The objective of the Modular Automatic Test Equipment (MATE) concept developed by the Air Force is to put an end to the practice of designing new ATE for every new requirement by making maximum use of existing equipment.

It's more than a theory. With Bendix Test Systems Division the systems integrator, the first practical application of the MATE concept was delivered in January, 1983: the Intermediate Automatic Test System (IATS) for the inertial navigation system of the A-10 close support attack aircraft.

Bendix was ready for this first MATE application because we had anticipated the practicality of modular ATE and developed the Bendix Series 320 as an in-house project. The Series 320 replaces obsolete ATE, while retaining existing test program sets, programs

and interface adapters...which represent the bulk of the cost of ATE. In its first application, the Series 320 made possible the updating of an obsolete system saving millions of dollars invested in programming and test adapters.

Now we've gone a step further. The Bendix ATLAS Composing Terminal (ACT) makes it possible for operators to generate ATLAS test programs. In its first application, ACT reduced the cost of programming by 35%.

That's the Bendix way. Evolution, as contrasted to re-inventing the wheel. TSD creates solutions to specific requirements and builds in the capabilities for solving future problems. They might be yours.

Other examples of the Bendix way are described in our brochure "Automatic Test Systems the Bendix way." Please ask for your copy.



Patent Applied For.

The Bendix Corporation
Test Systems Division
Attn: Marketing Department
Teterboro, New Jersey 07608
(201) 393-2521



The power of ingenuity

F-15 EAGLE

THE DUAL ROLE FIGHTER.



**SOMETIMES YOU
HAVE TO GO A LONG WAY
TO REACH VICTORY.**

Battles aren't always decided at the front. Often the deciding factors lie far away and can be reached only by air.

Then a mission called *Deep Interdiction* is necessary. Deny an enemy the means and the will to continue an attack. Defeat enemy efforts at reinforcement and resupply on land and at sea. It's a military response that wins battles and saves lives.

The difficult mission.

Deep interdiction is a global mission that needs a fighter weapons system with flexibility, survivability and endurance—and all at reasonable cost. It must have countermeasures and weapons to fight through hostile skies going to and from the target. The crew needs low altitude navigation targeting infrared for night (LANTIRN) sensors to guide the way, to see the target clearly, and to pinpoint adversaries under weather, day or night. And they must have the fire control systems to strike precisely.

The dual role fighter: The F-15 Eagle.

The Eagle has superior maneuverability and speed. Photo-quality sensors are matched with computer navigation to pinpoint targets and to guide the Eagle to them behind the cover of terrain, night, and bad weather. Long, long range—the Eagle has flown unrefueled across the Atlantic—is combined with advanced countermeasures and an ability to carry more than eight tons of armament of every type.

Victory need never be far away if you have the F-15 to fly far enough, fast enough, day or night in any weather, with the payload to achieve it.

Nothing else will do.

**MCDONNELL
DOUGLAS**

