FEBRUARY 1989/$2

AIR FORCE

PUBLISHED BY THE AIR FORCE ASSOCIATION

MAGAZINE

On the Threshold of the 1990s

A GOOD PLANE I

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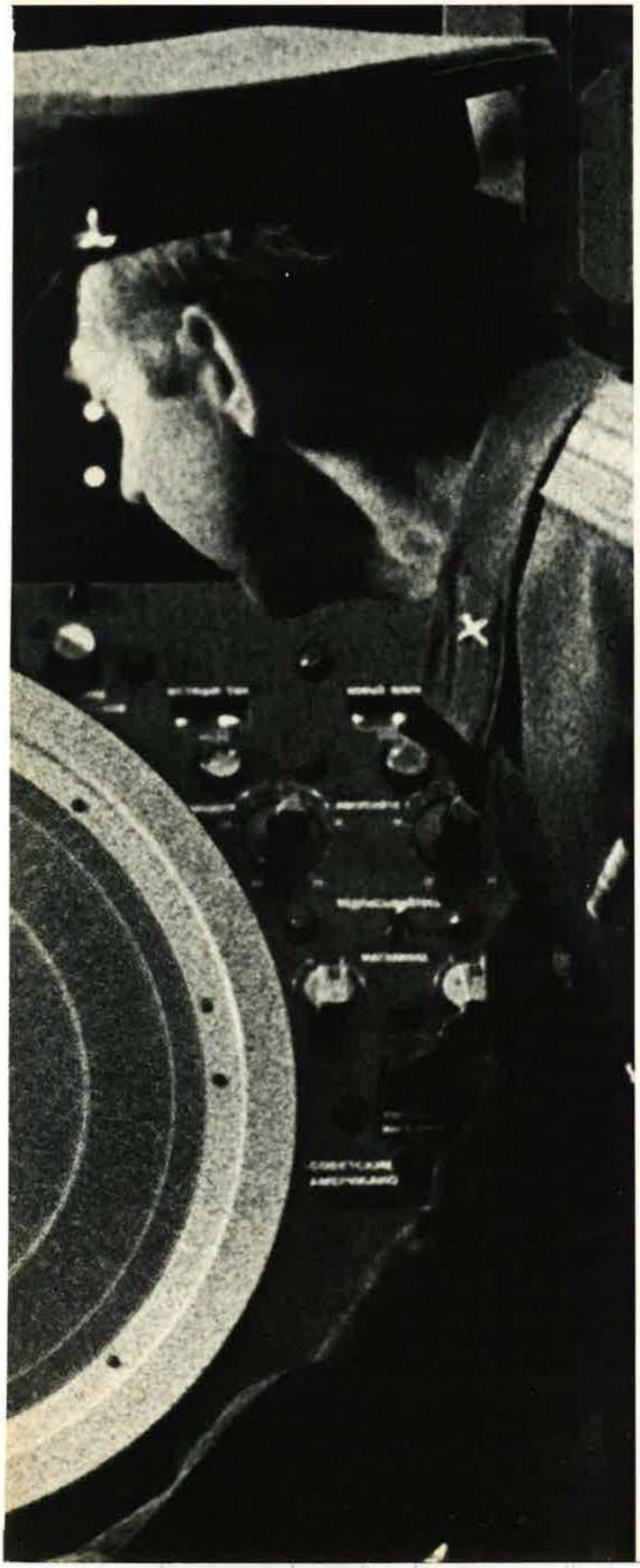

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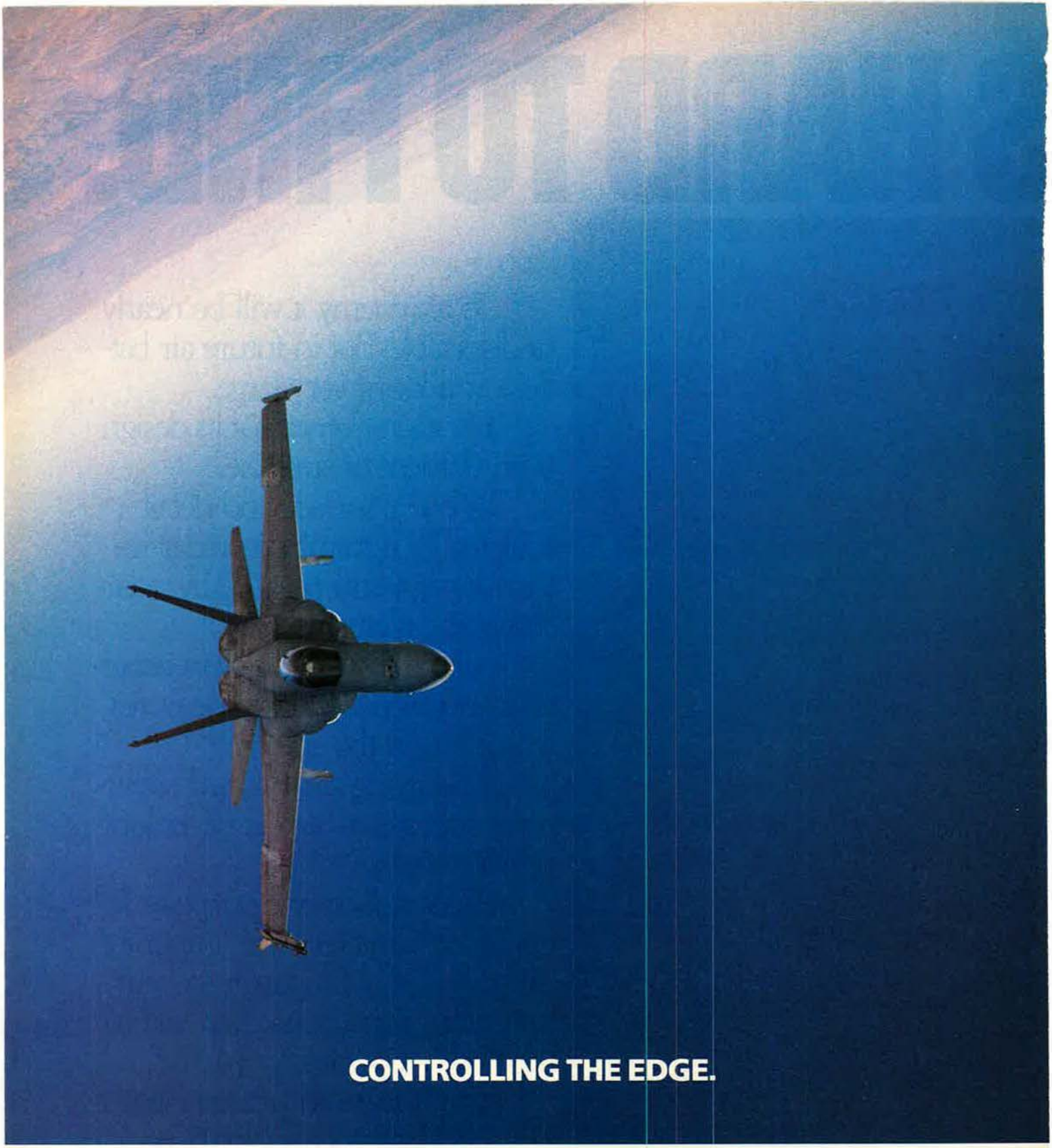

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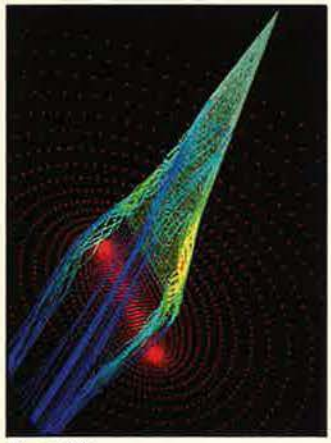

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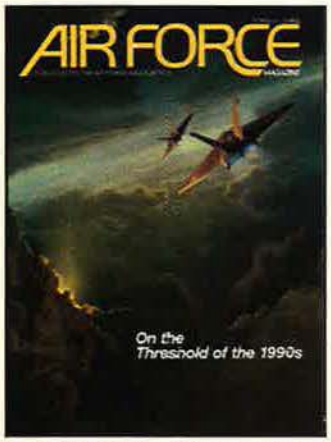

About the cover: Off to counter the future threat these lethal fighters, from Lockheed Corp.'s film "F-22—A Look Forward in Time," herald our forecast of the next decade. The special section, "Threshold of the 1990s," begins on p. 32.

Special Section: Threshold of the 1990s

Features

Departments

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An Editorial

The Doctrine of Tranquility

By John T. Correll, EDITOR IN CHIEF

In 1910, Norman Angell of Great Britain proved on paper that war in Europe was impossible. The major powers had not been at war with each other for forty years. They had nothing to gain—and everything to lose—from a war on the continent, which would be ruinous to their interdependent economies. Modern weapons would reap a human carnage too terrible to contemplate.

No great issue impelled Europe toward war. Furthermore, the period was something of a heyday for diplomacy. There was logical reason to believe that the nations would work out their differences and preserve the long peace.

History, however, does not always follow logic. The circumstances that led to World War I defy simple or sensible explanation. Yet the war that couldn't happen did happen. It began spectacularly in August 1914, and when it finally ended four years later, the combatant forces had suffered more than 8,000,000 fatalities.

A new doctrine of tranquility is emerging in the 1980s. In many ways, it is reminiscent of the theories of 1910. Europe again has been at peace for more than forty years. Peace, according to popular logic, will surely continue if we take full advantage of our opportunities for economic and political cooperation. There can be no winners in a European war. For what conceivable purpose might any nation unleash the modern powers of destruction? The military threat to Europe, we are told, is rapidly diminishing to the point of insignificance. From there, it is an easy step to the conclusion that strong military defenses have become an unnecessary burden for nations or alliances to bear.

Among those who see shadows of 1914 in the political developments of today is Henry Kissinger. He warns against a euphoria in which we are swept up by the happy picture that Soviet General Secretary Mikhail Gorbachev paints for us in his speeches. We are allowing impressions and enthusiasm to replace careful negotiation in the new world we seek to build.

"In the absence of a political dialogue, the two sides are working themselves—in the name of peace and arms control—into a classical European crisis of the kind that produced World War I," Dr. Kissinger believes.

The Doctrine of Tranquility can't be debunked completely, because it is not all wrong. Some of its points, taken independently, are valid enough. There is no sensible rationale for a war in Europe. There are new opportunities to promote peace and security by diplomatic and economic means, and the West must surely pursue them.

It would be prudent, however, to temper our optimism with caution. We still live in violent times. According to a count published by Scripps-Howard News Service, twenty-two wars around the world in 1988 left 416,000 dead. It might be worth remembering that World War I was touched off by regional turmoil that spread with consequences that no one had foreseen. How sure can we be today that peace is at hand?

Before the arrival of Mr. Gorbachev, change in the relationship of the great powers occurred with excruciating slowness—when it occurred at all. Suddenly, Mr. Gorbachev was moving among us, urging that we proceed at a gallop. His style has been to conduct international affairs through statements on television rather than through dull diplomatic channels, where people tend to ask questions, read the fine print, and weigh proposals with picky deliberation.

Mr. Gorbachev has conducted a running seminar on how to win hearts and minds abroad, but we cannot yet see how his grand program of change will turn out. At home, he is fighting economic problems that may prove impossible for him to solve. He faces widespread dissatisfaction with reforms that have brought new hardships but few discernible benefits. In the Soviet client states, he has awakened strong political passions that could turn in directions that are difficult to control. The promised reductions in Soviet military power are still in the talking stages.

This editorial is not a prediction of war. More than anything, it is a prediction of unpredictability. We should not conduct our foreign affairs with hearts aflutter, and we should not be too quick to abandon the policies and provisions that have kept the peace for forty years. Most of all, we should remember that the course of human events is not always logical and that history does not always play out as we anticipate.

The *Time* Magazine cover story for August 22, 1938, observed, "This fiscal year, the U.S. Army is costing $492,896,735, a record peace-time high. Since the U.S. is determined not to fight abroad and does not expect to have to fight at home, the public may well ask whether its half billion dollars is serving any purpose except to keep up with the Joneses of Europe and Asia. Where, how, and for what does the U.S. Army expect to fight?"

In the opinion of experts, *Time* reported, the most probable use of the Army would be in a civil disorder of some sort on the US mainland. The second likeliest employment would be a war in South America. "War in Europe or Asia for any reason" was ranked third on the list, exceeded in improbability only by a foreign invasion of the United States.

Optimism is wonderful stuff. So is logic. On the other hand, there's a lot to be said for keeping one's expectations flexible and one's powder dry. ■

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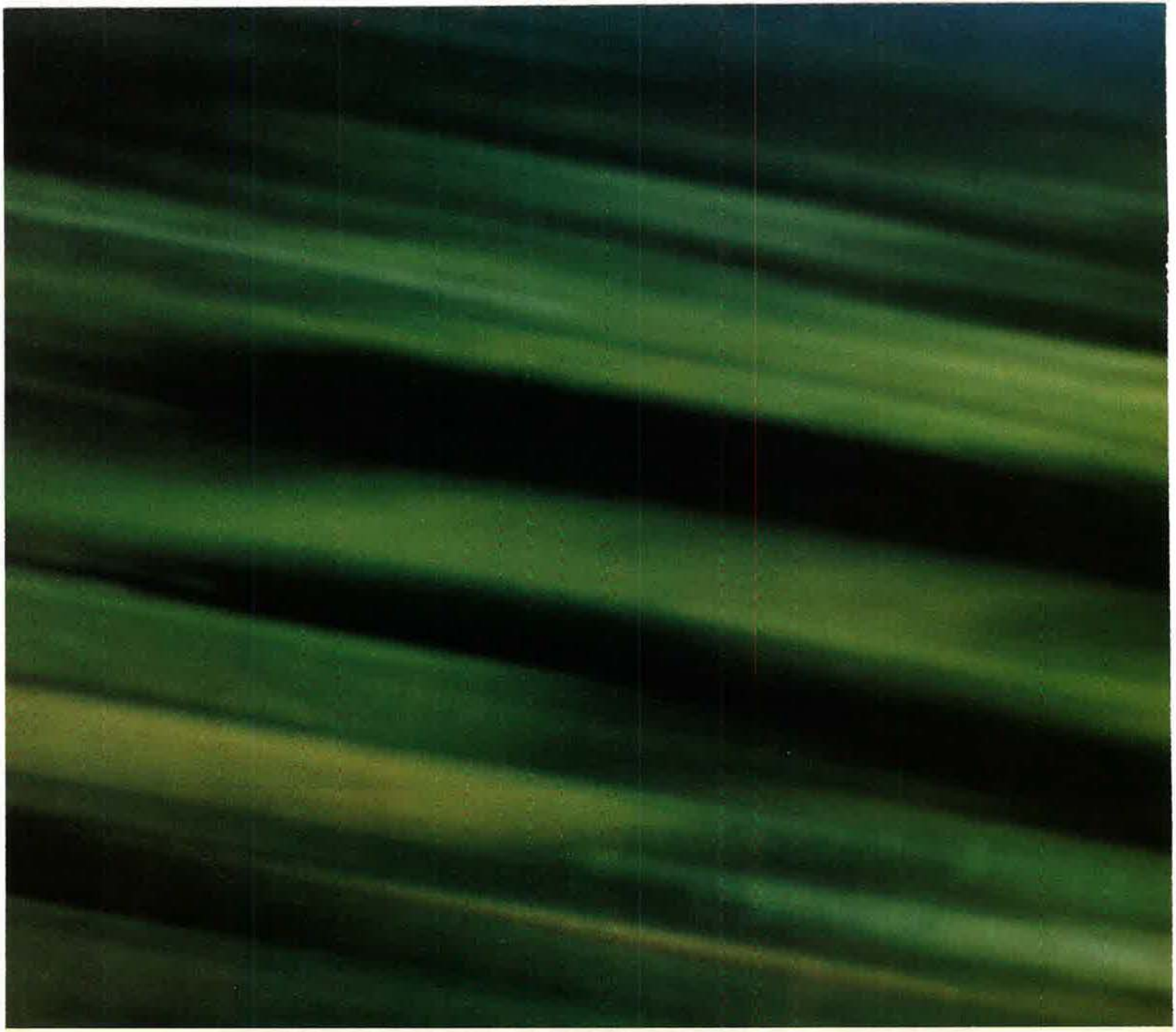

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the ALQ-184.

long experience with system fundamentals can improve an older system's capabilities.

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

Airmail

Problems with SUPT

James Canan's "Always Good—And Often Superb" in the December '88 issue highlights several truths: ATC's instructors are some of the best, the present UPT program does produce quality pilots for the amount of money invested, and the command desperately needs new aircraft.

However, he appears to have swallowed the party line that SUPT is the panacea for the Air Force's training dilemmas. In reality, SUPT is strictly a cleverly disguised budgetary maneuver (using the "trainer master plan" as a cover) to cope with ATC's last-place spot in the aircraft acquisition pecking order. The program will most likely slight the teaching of "the basics" as SUPT attempts to appease a multitude of myopic, parochial MAJCOM concerns about the quality of UPT graduates.

Operationally, the TTS students—those whom the "master plan" appears to "help" the most—will be hurt more than the fighter/bomber group. Such benign tasks as getting into the proper refueling position, managing computer information, coordinating crew assignments/work loads, and listening to more than one radio at a time (one of MAC's pervasive complaints on graduate critiques) do little to develop fundamental *flying* skills or the ability to think quickly in a dynamic flight environment.

The fighter/bomber types will also be hurt as we attempt to make seasoned tactical pilots out of fledgling aviators with the limited number of hours with which ATC is currently plagued. How quickly the command forgets that only a few years ago the syllabus had to decrease the number of advanced flying tasks in T-38s because basic skills were suffering from lack of repetition. When ATC tries to do too much with too little, the students fail to master the "basics" that Maj. Michael Thomas so wisely champions.

What service and defense officials must seek is a radical change to the current pilot training program to double or triple the amount of flying time (and, correspondingly, the program's length). Such a program would increase the time each student could spend mastering basic flying skills, in addition to introducing the more advanced skills at a much cheaper cost per flying hour. ATC could then teach some of the mission-related tasks that TAC, MAC, and SAC request without degrading the basic product.

Credible physical conditioning and GLOC [G-induced loss of consciousness] resistance programs could be incorporated, as well as a hefty increase in solo time. Additional night training, including night VFR [visual flight rules] navigation, could be molded into the syllabus to make the graduate better prepared to train operationally for that twenty-four-hour-a-day war we all hope will never come.

Emphasis could also be placed on operations outside the control of the Air Route Traffic Control System and Radar Approach Control (RAPCON) facilities, an evolution that has significantly degraded the ability of pilots everywhere—not just in UPT—to analyze their flying environment properly. An appropriately funded program incorporating some of the concepts just mentioned will go a long way toward developing future bomber, fighter, tanker, or transport pilots capable of making smart decisions on their own.

MAJCOMs must pull together, widen their parochial sights, and spend the money up front to properly train our young pilots, rather than skimp in order to buy a couple of extra planes while complaining about the quality of pilot we put in those machines. With a visionary UPT program—not one that takes us back to TB-25 days—I would be willing to bet that Congress would have to buy fewer new F-16s, A-10s, B-1s, etc., to replace those we splatter all over the globe.

Let us not forget the axiom that "a combat machine lost in peacetime is one that the enemy does not have to worry about in combat." Never has that axiom been so true as it is today.

Lt. Col. James V. Kelso III, USAF (Ret.)
Griffin, Ga.

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

Ready for War

Major General Ellis's article "More Hands for Base Defense" in the December '88 issue was right on the money and should be given serious thought. The idea of training base support personnel to handle emergency situations is not a new one but is seldom given the appropriate attention. All USAF bases have a Disaster Preparedness Team that is charged with training base personnel to handle such emergencies. Unfortunately, the only contact the majority of people have with [the team] is during the in-processing briefing they receive when reporting to a base.

At many bases, supervisors are tasked to support exercises with people to augment the Disaster Preparedness Team, but they seldom send their best people. "They are too valuable to the mission to give up" is often the excuse they use for not sending their best. We can't afford to take this kind of attitude toward these exercises, or else the real thing will be a disaster.

The program Major General Ellis described should be given a thorough review by all commanders, and efforts to implement some or all of them should be pursued. The cost of implementing the program wouldn't be excessive, and the potential return on investment could be measured in lives.

The United States long ago gave up on conducting a Civil Defense program, but the military can't afford to take the same complacent attitude or the mission won't be accomplished. We are running the risk of becoming a

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Airmail

"peacetime-only Air Force" by not training all of our people to be ready for war. History is full of examples of the result of not taking air base operability seriously—we can't afford to add our names to the list. This kind of program must be supported from the highest levels to be successful. Let's get with the program!

Capt. Benjamin H. Downing, USAF
Offutt AFB, Neb.

Demeaning Nickname

Your December '88 article entitled "The Battle Log of Birdman Silver" was very touching and informative. I hadn't realized how insensitive people can be. I too feel as though giving John Silver the nickname "Stumpy" is very demeaning. John Silver was an important part of the military. . . . He flew over the front line to deliver important information to our Allies. He completed dangerous flights through enemy fire. He flew after he had been hit in the breast by a machine-gun bullet, with his body all but ripped apart. He lost a leg in that same flight, yet he flew on to complete his mission and many lives were saved. He was near death but he continued flying high.

How many servicemen would be so devoted to their duties that their own lives did not matter? . . . John Silver was respected throughout the Army for his extraordinary feats of airmanship and devotion to his duty. I wonder what the servicemen who worked with John Silver would say about this ungrateful nickname.

I plead with the Air Force Museum director and staff, please correct the placard and remove the nickname "Stumpy" from all records and handouts. "Stumpy" was never part of his name. Please don't change history.

Daphne J. Connolly
Jacksonville, Ark.

Total Force Awareness

When I got to the September issue, I was pleased to read more about the Total Force. As a member of the Air Force Reserve, I wholeheartedly support this concept. I've seen it work. I'd like to give a couple of examples where some active-duty people haven't quite grasped the concept of reservists being part of the team.

About four years ago, a co-worker and fellow reservist was on his two-week annual tour. He was taken to a branch chief's office and introduced thusly: "Sir, this is Colonel X. He's not a real colonel; he's just a reservist."

I recently attended a meeting at another base in my civilian capacity. During a break, I overheard an active-duty lieutenant colonel explaining a base map with unit designations on it to a civilian. When he pointed out an Air National Guard fighter interceptor group, he said, "This isn't a real Air Force unit. It's just a National Guard unit." I had to chuckle to myself. This officer must have slept through the Total Force discussion during his Air Command and Staff College studies.

Keep up the good work in letting the rest of Air Force know that the Air Reserve Forces are contributing partners.

Maj. H. R. Hale, USAFR
Plain City, Utah

Base Honor Guards

Congratulations on your excellent article covering the Air Force Honor Guard in the November '88 issue. These outstanding airmen give new meaning to the word "professional."

Please allow me, however, to add another group of professionals to your tribute—the men and women of the Base Honor Guards located throughout the world. These selfless individuals sacrifice their own time, and most often off-duty time, to bring credit to USAF and America.

As Assistant Team Chief of the Scott AFB Honor Guard from June 1986 to January 1988, I was involved in countless parades, ceremonies, and funerals throughout the Midwest. All of the approximately eighty officers and airmen who were part of the Honor Guard were volunteers, as I am sure countless others are USAF-wide. Although most wouldn't meet the rigid standards of the Air Force Honor Guard, each one is as professional and as dedicated to the mission as their celebrated counterparts.

These individuals must take time from their normal duties to perform details, often leaving before dawn and not returning until well after dark, riding on cramped school buses, performing in inclement weather, and changing into the Honor Guard uniform in bathrooms, broom closets, and basements.

For most rural communities, the presence of the Honor Guard at a funeral or parade is the only chance to get a close-up view of one of the Air Force's most sacred and prestigious duties. I personally salute each and every member of the Base Honor Guards throughout the world.

Sgt. Hugh R. Lander, USAFR
Bloomington, Ind.

WAR GAMING AND OPERATIONAL READINESS

SYSCON and the Joint Staff are working together to apply state-of-the-art technology to all aspects of the war planning process.

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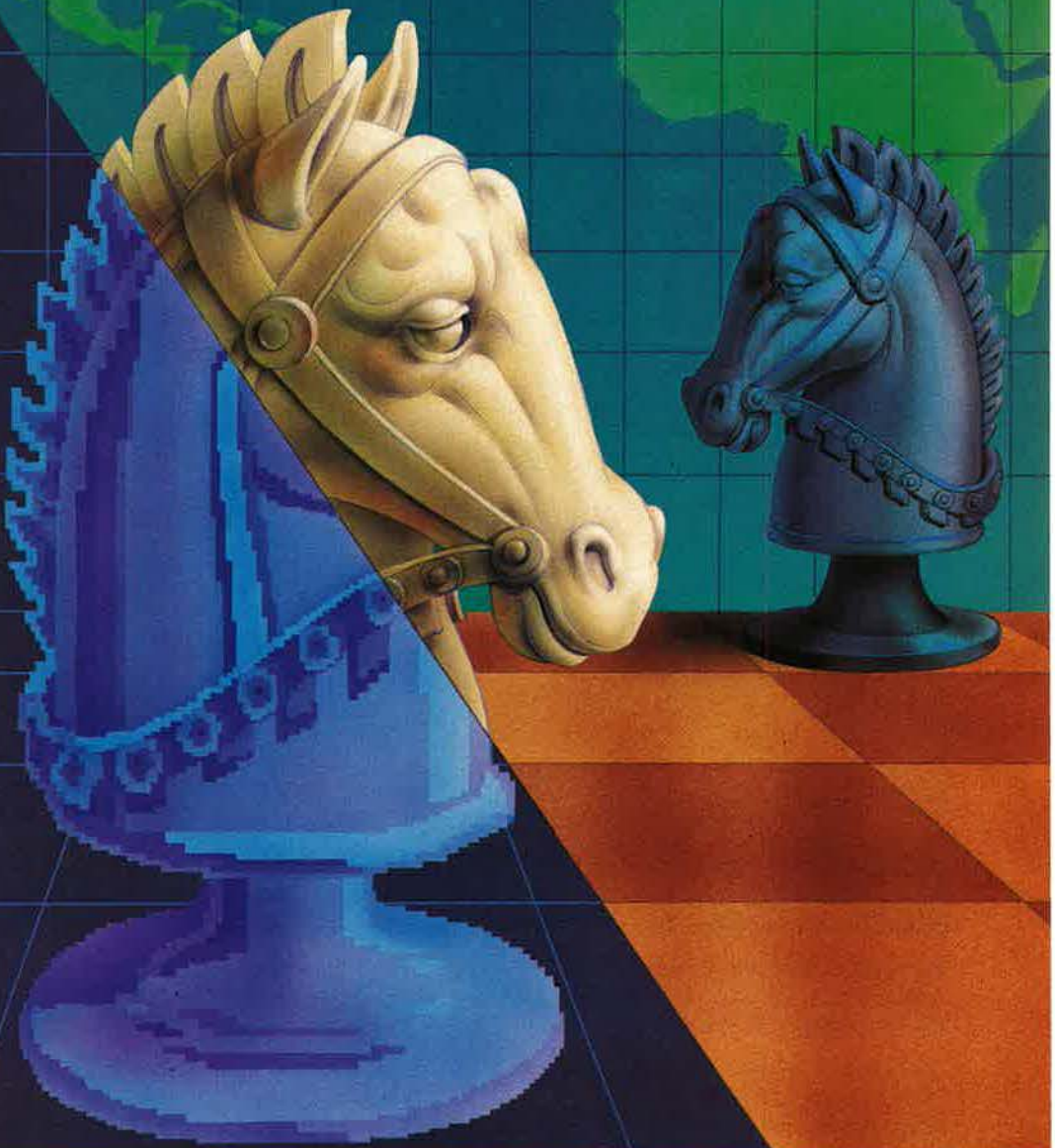
SYSCON is working with the Joint Staff developing computer based decision support tools under the Automated Force Generator Program, the prototype models for the next generation war planning information system.



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Soviet Strategy

With regard to "Defeating Red Armor," which appeared in the October '88 issue:

Do you honestly believe that a Warsaw Pact invasion will focus on the Fulda Gap? Does it not make more sense to attempt the Northern Plains route?

Coming through the Fulda Gap will have the Russians and their allies run into the best large unit in the US Army—the 11th Armored Cavalry Regiment. It would be much better to try the Northern Routes to capture vital North Sea ports and stop reinforcements from America. After all, what's up there? Conscripted Dutch and Belgian forces, the undermanned British Army of the Rhine (thirty-five percent of which is in Northern Ireland), not the best US and West German forces. . . .

The Russians know history. They'll be starting only 300 miles east of where Hitler started the Battle of the Bulge, and he came perilously close to winning.

NATO should realign units to counter this threat and place less emphasis on the geographically difficult terrain in Southern Germany.

Maj. Martin V. Smith,
USAFR (Ret.)
Sea Bright, N. J.

Pilot Error

The picture in the November 1988 issue on p. 47 is not of USAF and Thai pilots. The caption on p. 46 refers to them as such.

They are military freefall parachutists. The parachutes they have on are MT1-XS or MT1-XX, depending on whether or not they are Army or USAF. The man in the foreground has an altimeter on his left wrist. This tells the jumper how high above the ground he is.

I spent five years as a combat control operator, with Det. 4, 1722d CCS, at Dyess AFB, Tex. I have made forty jumps with that particular rig and maintained six of them on a daily basis.

SSgt. Daniel A. Tate,
USAF
Kelly AFB, Tex.

• *Sergeant Tate and several other readers have pointed out our mistake. We regret the error.*—THE EDITORS

Looking for an Answer

Re: Valor: "A Desperate Venture," November '88 issue.

Being a Brown Shoe Air Corps type and having served two years (1968–70) in the immediate area of Mehdia Beach, Kenitra, Morocco, I read the above-titled article with keen interest. However, I could not help but reflect on the difference in thinking by leaders (generals) of today vs. [those of] World War II.

Three men made the mission. One, Colonel Craw, was killed prior to its completion but received the Medal of Honor posthumously. The other two were captured and held prisoner. Major Hamilton also received the Medal of Honor. The third, a private first class, apparently was not a recipient of that or any other award. Obviously, his life threat and other efforts toward the mission were not worthy of consideration in the minds of Generals Truscott, Patton, or Eisenhower.

Thank God for the change of attitude toward the enlisted corps. Perhaps Mr. John L. Frisbee, the author, can let readers know what became of Pfc. Orris Corey. As far as the article goes, he may still be a prisoner in Morocco.

CMSgt. Hardy B. Abbott,
USAF (Ret.)
Colorado Springs, Colo.

• *We're unable to learn anything about the fate of Orris Corey. Can any readers help?*—THE EDITORS

Number One Problem

Concerning your editorial "Of MiGs and Plowshares" in the December '88 issue: I'm no fan of the Russians, but you slant your editorial when you use the Secretary of Defense's statements comparing Russian strength in Europe to US strength in Europe. You should be using statements comparing Warsaw Pact strength to NATO strength. This would present a more realistic picture of what the US is up against.

General Secretary Gorbachev's recent announcements of force reductions create the atmosphere for meaningful conventional force reduction talks between the West and East. We should use this atmosphere to obtain meaningful force reductions from the Russians that would enable the US to bring its defense spending to the level of our allies. This would help defense's number-one long-term problem—the budget deficit.

Lt. Cmdr. R. A. Stobaugh,
USN
Jacksonville, Fla.

Caption Misfire

We appreciate your printing the outstanding photograph of the F-16 Fighting Falcons in your October '88 issue. We want to compliment your photo caption writer, who for years has done a superb job of accurately describing photographs. It is a shame when a person of his caliber is supplied with inaccurate or too little information to maintain his exceptional record of accuracy.

We refer to the photo caption on p. 115 of the October issue, describing the Curtiss P-40 Warhawk with two F-16 Fighting Falcons . . . *[see also "Airpower Roots," January "Airmail," p. 10]*. This caption contains some inaccuracies, and there are serious omissions.

The P-40 Warhawk was, in fact, flying at cruise power and had been leading the formation for over thirty minutes with the F-16s, with their superior aerodynamic qualities, tucked tightly and comfortably on his wing (not passing) as they maneuvered behind the B-25 camera ship at about 220 miles per hour.

The "mission" being flown was one of many in which the CAF supports the "history and heritage" portion of USAF Project Warrior. . . .

Lloyd P. Nolen
Harlingen, Tex.

Clinton-Sherman Curiosity

As I recall, Clinton-Sherman AFB (CSM), Okla., was deactivated years ago. I am a meteorologist, and over the last several years I've noted only minimal weather observations from that location. This suggested that the field was still in use, but presumably civilian.

On November 14, 1988, I saw a pilot report of low-level wind shear from a C-141 at CSM. Is that former base still used by the Air Force?

Maj. Evert Schmidt,
USAF (Ret.)
Mundelein, Ill.

• *The base is used by SAC as a forward operating location. For those interested in what's going on these days at Clinton-Sherman, we recommend the article "SAC Extends Its Wings," by Jeffrey P. Rhodes, in the August 1988 issue.*—THE EDITORS

Malmstrom's Flying Mission

I hate to differ with you, but on p. 36 of your December '88 issue, under "Milestones," you stated that Malmstrom AFB now had its first "fixed-wing flying mission in almost twenty-five years."

I would not let too many of the folks who served with the 17DSES, flying and fixing EB-57 Canberras in the

1970s, hear you say they didn't qualify as a "fixed-wing" flying mission.

A finer unit there never was.

David P. Zajonc
North Pole, Alaska

Missileers and T-38s

Your December '88 issue was well done, and I just wanted to add my praise for the young men and women who work on our missiles up here at our SAC missile wings and for those who trained them. These young people are simply "the best." They do fantastic work under impossible conditions, sometimes on equipment that is older than they are, and are a main reason SAC missiles maintain such an impressively high "on alert" rate.

These people travel to remote sites usually more than a hundred miles away, in blazing heat and freezing cold, at all hours, day and night, and I seldom hear them complain. They are super people, and we are lucky to have them working for our country's military.

In addition, I would like to mention the line in the article "Always Good—And Often Superb" that stated, "If you can fly the T-38 you can fly anything in the Air Force." This may be true, but I don't think the reverse is true. I know there are many like myself who got through T-37 training, but washed out of T-38s, and will always wonder what it might have meant to have a dual-track program when we were going through.

While I am past the age limit to fly in the Air Force, there are still others who washed out of T-38s but might still make good pilots if given a second chance in a TTB-type trainer. It could even save the Air Force some money. It is good that the Air Force is going to a dual-track program, and it should be much more cost-effective.

Capt. Scott Mattson,
USAF
Grand Forks AFB, N. D.

Weapons Controllers

Your December '88 issue, "It All Begins With Training," was a fascinating insight into the outstanding training being conducted by Air Training Command for today's Air Force. However, you overlooked one of ATC's oldest and proudest units—the USAF Air Weapons Controller School. Our school, located at Tyndall AFB, Fla., has been providing controller undergraduate training for USAF, Air National Guard, and international officers from more than thirty nations since 1948. We're training air weapons controllers to serve the fighter pilot in combat. They will learn to use radar, communications, data links, and other real-time sensors to act as the "third" wingman in combat.

We've trained more than 20,000 air weapons controllers in our fundamental, advanced, and international courses. . . . At various times in our history we flew F-51, F-86, C-45, C-47, B-25, SH-19, and T-33 aircraft in support of air weapons controller training. . . .

Our graduates fill important operational and staff positions in support of command and control throughout the Air Force and in key joint assignments throughout the Department of Defense. . . . We're proud of the more than 100 colonels, nine general officers, and one Secretary of the Air Force who are graduates of our school, and we honor all of them through the Air Weapons Controller Hall of Fame located in our headquarters building at Tyndall AFB.

Organized under the 3625th Technical Training Squadron and reporting to the 3300th Technical Training Wing, Keesler AFB, Miss., we also provide three-level technical training to aircraft control and warning operators with assignments to Sector Operations Control Centers. Additionally, we provide three-, five-, and seven-level technical training to Sector Operations Control Center computer maintenance technicians from both the United States and Canada.

Like others in ATC, we're in the midst of updating our courses, equipment, and methodology to keep pace with the needs of the tactical air forces.

If the Air Training Command mission is ever featured in AIR FORCE Magazine again, please look us up; we've got tradition, pride, and professional training that will knock your socks off.

Lt. Col. Terence J. Swan,
USAF
Tyndall AFB, Fla.

Calendar Controversy

The educational affiliate of our Air Force Association is the Aerospace Education Foundation. Its stated goal is to "educate the public and create the necessary environment to promote a greater understanding of advanced aerospace developments vital to our national defense and economic stability."

I recently received my Aerospace Education Foundation 1989 calendar. It opens with a letter, signed by former Senator Goldwater, stating, "This calendar focuses on the most important part of the Air Force, the people who keep our country free: the pilots, the aircrews, the technicians, the astronauts—all professional men and women devoted to the service of their country and the advancement of education."

Please note that the key people who keep this country free are the SAC Missileers—those who man and maintain our ICBM resources—people who were not mentioned at all in Senator Goldwater's opening letter. Nor was their full-time alert resource, a Minuteman or Peacekeeper missile, displayed in the entire calendar.

I can assure you that our adversaries are "educated" enough to know which weapon system really keeps them at bay. It seems that it's time the people serving in the Aerospace Education Foundation educate themselves before attempting to educate the public in fulfilling their stated goal. Perhaps the 1990 calendar can properly reflect the real deterrent force in this country.

Lt. Col. William R. Hodge,
USAF
Malmstrom AFB, Mont.

Blue-Suit Teamwork

You can't beat the blue-suit teamwork of maintenance troops evidenced by the outstanding record of Randolph's 12th OMS detailed in "The Troops Behind the Trainers" *[by Susan Katz-Keating, December '88 issue, p. 92]*. It's also great to see that the Queen Bee [program] is still going strong. I remember setting it up in early 1976 while working at Hq. ATC/LG. Powerful co-workers included Mr. Thad Brannon from logistics plans and SSgt. (now CMSgt.) Bob Laymon from the 12th Maintenance complex.

The concept made sense then—and now.

Col. Thomas A. Klimas,
USAF
Cameron Station, Va.

MAC's Heritage

The Military Airlift Command's Airlift Operations School (AOS) is in the process of completing pictorial displays of various airlift operations of years gone by. Three displays are complete: on the "Hump," Berlin Airlift, and Korea. We are now starting our most ambitious and largest display project—one dealing with airlift during the Vietnam War.

We would greatly welcome any contributions of photos dealing with airlift operations in Vietnam. We are looking for photos that fall into four broad categories: strategic airlift, tactical airlift, rescue, and special opera-

THE AIRFORCE STORY

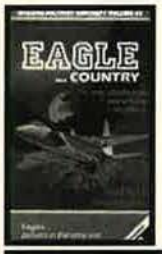
CHOPPER WARS

"To the grunts, they were a Godsend, to the enemy they were beasts from hell - the 'Choppers'." You will now experience the action of one of the most devastating weapons used in Vietnam, including the tactic known as "Recon by Fire".
#2762 60 Min. $29.95

THE SMASHING OF THE REICH

By mid-1942, the Nazis owned Europe. It was obvious to the Allies that precision bombing had to knock out Germany's manufacturing centers. The advent of the P-51 long-range fighter enabled the Allies to rule the sky of Germany. This award-winning film captures the drama, tragedy, and finally the victory over Hitler's armies.
#2429 84 Min. $29.95

EAGLE COUNTRY



Have you ever dreamed of flying in the world's hottest fighter aircraft? The F-15 Eagle's superior dogfight capabilities will keep you at the edge of your seat as the F-15s go head-to-head against F-14s, F-16s, and F/A-18s. This one is for anyone interested in aviation.
#2150 85 Min. $59.95

photo courtesy U.S. Airforce

FALCON DOMAIN

The F-16 Fighting Falcon was designed to out-fight any enemy aircraft in the sky and is armed to dominate. In this full-color panorama, you get a detailed look at the systems, weapons, and "magic" that make the F-16 a 21st century fighter plane. You'll be strapped in the cockpit during gut-wrenching dogfights as the pilots take the F-16 to the edge. From the LANTIRN infrared night attack system to the high-powered ride with the "Thunderbirds," Falcon domain is a stunning film to add to your collection.
#2178 90 Min. $59.95

THE RED BARON

This is the story of Manfred von Richthofen, WWI's premier ace who shot down 80 Allied planes! This Ace of Aces was the greatest aerial tactician of World War I. Included are interviews with the last surviving pilots who flew with and against him. Excellent WWI dogfight footage, crashes, and The Red Baron's last flight are highlighted in this compelling story of the most legendary personality in the annals of aviation.
#2569 60 Min. $29.95

HISTORY OF NAVAL AVIATION

From the first aircraft carriers, the job of naval aviation has been filled with danger and excitement. This historical look back at the proud tradition of naval aviation is brilliantly chronicled. If you want to know where naval aviation is heading, you must appreciate where it has been. GREAT FOOTAGE!
#2642 60 Minutes $29.95

JET FIGHTER

An exciting overview of America's current frontline jet fighters that puts you in the cockpit for a 9G ride you won't soon forget. This is a closeup look at the F-14, F-15, F-16, F/A-18, and the new F-20. Jet Fighter puts you in the cockpit where you can experience dogfights and weapon demonstrations that will leave you speechless. All Action!
#2272 45 Min. $39.95

AIR WAR IN VIETNAM

The most awesome display of aerial fire-power ever was unleashed in Vietnam. Air War in Vietnam uses the pick of air combat footage to tell the story from the first U.S. advisor to the massive U.S. bombings. Also included is captured North Vietnamese footage of their anti-aircraft defenses.
#2012 118 Min. $39.95

MOFFETT AIRSHOW: 1988

The largest air show in the U.S. is the setting of this thrilling 2 hour video review. You're in the cockpit with the USAF Thunderbirds, F/A-18 Hornet, the Air Force "Smoke Squadron" Team, as well as on an actual submarine chase. A lot of action!
#2763 120 Min. $39.95

THUNDERBIRDS

The magnificent Air Force Thunderbirds put on a spectacular aerial show in this specially produced thirty-minute highlight film. You'll be strapped into the cockpit and get a look at the hottest pilots and planes in the business. WOW!
#2691 30 Min. $24.95

FIGHTING SABRE JETS

When the MiG-15 jets were suddenly introduced into the Korean War, our air superiority was threatened. America's answer was the F-86 Sabre Jets. Take this gut-wrenching ride and get a ringside seat to the Korean air war.
#2184 118 Min. $39.95

TOP GUNS: THE REAL STORY

This is a thrilling look at the fighter pilots of the '80's. Set to a surging musical score and gut-wrenching cockpit footage, this film allows you to experience the excitement from the Top Gun Training School to the life or death struggle in the air. Breathtaking!
#2754 60 Mins. $29.95

ESCORT: THE P-51 MUSTANG

From the Mustang's development to her glory days as deep escort into Germany, this action-packed film is the definitive record of the legendary P-51. Made with the cooperation of the USAF, interviews with combat pilots including Ace Donald Strait (13 1/2 kills) are interwoven with superb air-to-air and in-the-cockpit footage.
#2155 60 Min. $39.95

TOP GUN AIR SHOW

Straight from Fightertown, USA, you can now see the hottest fighter planes in this in-depth 2-hour extravaganza. The F-14, F-16, F/A-18, and the Blue Angels highlight this grand film that features the world's hottest pilots.
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SCIENCE/SCOPE®

The first Advanced Medium-Range Air-to-Air Missile (AMRAAM) to be test fired with a live warhead destroyed a target drone. The AMRAAM was launched at medium range from a U.S. Air Force F-16 traveling at Mach 0.9 at 10,000 feet. The target drone was flying at Mach 0.8 at 7,000 feet. When the AMRAAM came within close range, the missile's warhead detonated and destroyed the drone. Developed by Hughes Aircraft Company, the AMRAAM is designed for use by the U.S. Air Force on F-15 and F-16 aircraft, by the U.S. Navy on F-14 and F/A-18 fighters, and on West German F-4F Phantoms, and United Kingdom's Sea Harrier and Tornado Air Defence Variant aircraft.

A liquid crystal light valve makes possible high-resolution display of full color, real-time computer graphics. The light valve, part of a new superprojector developed at Hughes, acts as an image intensifier which modulates light from high-intensity xenon arc lamps with the image from a low-intensity ultra-high resolution CRT. The red, green, and blue information is converged digitally on the projection screen. The resulting image has a resolution in excess of 1,000 TV lines. Image flicker is eliminated by the inherent properties of the light valve, and electronic raster shaping corrects for keystone effect. Applications for the projector, designated Model 1000, include air traffic control centers, status board presentations, technical presentations, trade shows and exhibits.

The capability to foil a number of different kinds of simulated jamming signals has been successfully demonstrated by a broadband, agile, radar/electronic warfare roofhouse system. The key to this success was a five-channel Simultaneous Transmission and Reception (STAR) radar, designed and built by Hughes for the U.S. Department of Defense, and a specially designed control unit allowing five different signals, one per channel, to be transmitted or received simultaneously in any desired combination. For the jamming tests, the control unit continuously monitors the five STAR radar channels, and automatically switches the transmitted power to a channel in which no jamming is present. Further, the control unit allows multiple radar signals to be transmitted, received and processed simultaneously rendering ineffective many forms of conventional jamming.

A new sodium-sulfur battery will deliver more power than any other battery built to date. The sodium-sulfur battery is being developed by Hughes for military and commercial satellites that fly in low-Earth and geosynchronous orbits. Possible applications include radar and communications systems requiring more power than is available in currently used nickel-cadmium and nickel-hydrogen batteries. The new generation of batteries will use hot, molten sodium and sulfur to store energy. Sodium-sulfur batteries provide 50-watt hours of power per pound, compared to 18-watt hours per pound available in nickel-hydrogen batteries.

A forward-looking infrared (FLIR) has been configured as a night sight for a variety of U.S. military weapons. The Hughes-built Thermal Weapon Sight (TWS) has been adapted for use with Stinger missiles, machine guns, grenade launchers, and all crew-served weapon systems. The TWS is a developmental passive infrared sensor employing a thermoelectrically cooled focal plane array that allows soldiers to locate targets and see at significant distances in battlefield conditions. It has a standard NATO weapons mount, and its telescope and reticle are easily changed to perform various duties.

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

HUGHES

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tions. In these areas we are interested in depicting all aspects of the airlift system (logistics, maintenance, cargo, and operations).

Anyone interested in contributing information or pictures on the above items, please contact the address below.

Capt. Chris J. Krisinger
Editor, *Airlift* Magazine
Airlift Operations School
Bldg. 1522
Scott AFB, Ill. 62225-5448
Phone: (618) 256-5188

Stevens Critiques

Now I realize that putting a comic strip into your magazine can add a little zest to the many pages of juicy information about new aeronautical breakthroughs and studies, but come on! "There I Was . . ." by Bob Stevens is a shameful strip that is not entertaining or in any way funny. In fact, at times it can put down and even depress those servicemen whom its plot, if any, may depict. I, though a civilian, feel that these mindless attempts to be humorous are a negative influence on the morale and self-esteem of our brave, fighting men. . . .

Christopher Summers
Tacoma, Wash.

Heartfelt thanks and every good wish to Lt. Col. Bob Stevens for the delight he has given countless readers over the past quarter century. A blessed and fruitful new year for him (and for all Air Force personnel).

Lt. Col. Earle A. Newman, CAP (Chaplain)
Baltimore, Md.

B-29 Wreckage

A newly formed Hill Walking Group, employees of Rolls-Royce in Glasgow, Scotland, recently located wreckage of a B-29 southwest of Inverary, Scotland, across Loch Fyne, between Strachur and Lochgoilhead. They think the plane crashed sometime after World War II and report that the wreckage is almost untouched and covers a large area.

The group would like to know more of the crew, their unit, and if they survived. The group thinks that, if the crew died in the crash of the plane, a marker at the site would be appropriate.

Any assistance will be greatly appreciated.

Lt. Col. Victor E. Clark, Jr., USAF (Ret.)
14262 Southern Pines Dr.
Dallas, Tex. 75234
Phone: (214) 243-0890

B-18B Restoration

The 868th Tactical Missile Training Group is getting ready to restore a B-18B aircraft as part of a group project, and I would appreciate it if anyone who has worked on or flown this type of aircraft could give us assistance with any available pictures or written information on this particular type and model aircraft.

Robert B. Lumpkin, Jr.
9366 E. Stella Rd.
Tucson, Ariz. 85730

AFCC History

I am currently engaged in writing an official AFCC history of the command's involvement in combat communications/mobile communications. The chief focus of this monographic study is on organizational and operational activities. However, other facets of this topic also will be explored. I particularly would like to get in touch with those who have specialized knowledge about or served in an AACS or AFCS combat communications/mobile communications unit. Your thoughts and memories would go far in filling in the gaps of official documentation. Moreover, any photographs you might lend us would be of great value to this study.

Timothy J. Mucklow
Hq. AFCC/HO
Scott AFB, Ill. 62225-6001

P-82B Parts

The Confederate Air Force needs help in locating propellers (hubs and blades) for the P-82B that had a gear failure at "Airsho 87." Parts needed are listed below:

Left Side: Hub—AL542F-C1 or D, blades—H20-162L-30M2 or H20A1-162L-30M2.

Right Side: Hub—A542F-C1 or D1, blades—H20-162-30M2 or H20A1-162-30M2.

Ralph S. Royce
Confederate Air Force
One Heritage Way
P. O. Box CAF
Harlingen, Tex. 78551-0151

Historic Kingman

Kingman Army Air Force Base, Ariz., was a leading gunnery school during World War II. Like many other bases, it was given to the local government. It has slowly eroded to the point that only the tower and a few buildings remain.

Several local pilots are attempting to assemble all available information concerning the base. We have initiated the paperwork to have the tower listed as a historic structure. Ultimately, we hope to assemble enough material to have a museum. We would appreciate any photographs, issues of *The Cactus* (base newspaper), yearbooks, unit insignia and number, rosters, and the like. All material sent to us will be returned, intact, to the senders if they so desire.

Gene Wolff
971 Riata Valley Rd.
Kingman, Ariz. 86401

F-102s and F-104s

I would like to hear from anyone who was associated with F-102s and F-104s in Southeast Asia while they were in operation during the war in Vietnam. The purpose is to compile a current address list and also to gather pictorial and factual coverage for a series of articles.

Warren E. Thompson
7201 Stamford Cove
Germantown, Tenn. 38138
Phone: (901) 754-1852

Helicopters in Vietnam

I am currently gathering material and conducting research for a book on helicopter camouflage and markings in Southeast Asia. The book will cover Air Force as well as Army, Navy, and Marine helicopters.

I would like to borrow photographs, color or black and white, as well as color slides of helicopters in Southeast Asia. Any material that I borrow will be handled carefully and returned as quickly as possible. Since I am presently overseas (Japan), please insure or register any packages that are sent to me. I will do the same when returning the material. All donations of material that I use will, of course, be fully credited.

Maj. Michael A. Campbell, USA
PSC Box 255
APO San Francisco 96293-0006

I am attempting to compile a history of USAF helicopter gunship operations during the Vietnam conflict. UH-1F, P, and N armed helicopters were used by the Air Force for various missions from Vietnam's II Corps area between June 1967 and 1972. Both the 14th Air Commando Squadron and the 20th Helicopter Squadron (later SOS) are known to have operated armed UH-1s. I would like to contact anyone who may have served with these squadrons or who has knowledge of their operations and would be willing to share their experiences with me.

Jim Sprinkle
920 Timber View Dr.
Bedford, Tex. 76021

26th TRW Lineage

The 26th Tactical Reconnaissance Wing, Zweibrücken AB, West Germany, is looking for information on World War II "nose art." Specifically, the wing is looking for copies of photos of aircraft from its World War II history. The wing traces its lineage from the 5th Photo Group, which served in North Africa in 1943 through the missions it flew from bases in Italy, and the 38th Reconnaissance Squadron, which served in the Pacific during 1944–45.

All information will be greatly appreciated and all photos returned. If you have any photos of aircraft of these units, please contact the address below.

Sgt. James C. Mesco, USAF
Hq. 26th TRW/HO
APO New York 09680

Sioux City AAB

We are currently compiling a history of the Sioux City Army Air Base from first opening in 1942 until the end of the war. If you have pictures, memorabilia, or information you would like to share or donate, please contact the address below.

SMSgt. Earl L. Belt
Sioux City Air Base
Historical Committee
P. O. Box 709
Sergeant Bluff, Iowa 51054-0709

36th TFW

Mid Atlantic Air Museum of Reading, Pa., is researching the history of F-86F #51-13417. We know it served with 36th TFW, Bitburg, Germany, but we would like to know to which of the three squadrons it was assigned so we may correctly mark it during restoration.

Also, I was assigned to 36th TFW (1963–66) during the F-105 era. Any ex-Bitburgers or "Thud" nuts out there? Mid Atlantic Air Museum is also attempting to acquire one of the few remaining Thunderchiefs.

Charles L. Byler
RD 2, Box 444
Boyertown, Pa. 19512

SAC Races

I am beginning preparations for a major magazine article on sports car races sanctioned by the Sports Car Club of America (SCCA) in the late 1940s and 1950s. The events were conducted on the runways and taxiways of many Strategic Air Command (SAC) bases, and Air Force personnel supplemented the SCCA officials and workers and served as flagmen, pit and paddock workers, observers, and timers. The races were usually for the benefit of the SAC Airmen's Living Improvement Fund, the Air Force Aid Society, and local charities.

I would like to make contact with anyone who participated in or observed these races who would be willing to contribute recollections and photographs. I am especially interested in photographs because there seem to be very few available from media sources. Any photographs will be credited to the sender or the photographer and returned, and any costs incurred in providing information will be reimbursed.

Jeff Allison
Vintage Motorsport
27 Tecoma Circle
Littleton, Colo. 80127

Roll Call

I am researching the military service of SSgt. Armond R. Richard, USAAF, an air gunner with 535th Squadron, 381st Bomb Group, VIII Bomber Command, who was killed in action on November 5, 1943, when his B-17 was shot down over Gelsenkirchen, Germany. Three of his crew survived: 1st Lt. Donald K. Hopp (pilot), 2d Lt. Marshall E. Tyler (navigator), and TSgt. Alexander M. Girvan (engineer). I would like to hear from these gentlemen and anyone else who served with 381st Bomb Group from June to November 1943.

Please contact me at the address below.

Alan Riches
2 Harvard Court
Honeybourne Rd.
West Hampstead
London NW6 1HJ, England

Capt. John Trevor Godfrey, serial number 0885950, flew a P-47 called "Reggie's Reply" and, later, P-51s from the 4th Fighter Group, Debden, England, against Germany in World War II. Captain Godfrey was the wingman for Capt. Don Gentile, for whom Gentile AFS, Ohio, was named.

I would appreciate hearing from anyone who has any personal recollections or stories about Captain Godfrey. If photos are available, I will have them copied and return the originals as soon as possible.

SSgt. Roger D. Richard, USAF
Air Force Recruiting Room #3
251 Main St.
Woonsocket. R. I. 02895-3123
Phone: (401) 769-8260

I'm looking for some information about the F-105D flown by 1st Lt. Karl Richter, 421st TFS, 388th TFW, on his MiG-killing mission on September 21, 1966.

I would like to know the markings of this particular Thud (serial number, squadron markings, artwork, etc.).

Please contact me at the address below.

Menelaos Skurtopulos
Kreuzberger Str. 13/258
4800 Bielefeld 1
West Germany

I have been trying to locate an old friend and wingman who flew with me for several years when we were members of the 467th Strategic Fighter Squadron, 508th Strategic Fighter Wing, based at Turner AFB, Ga. His name is John C. Upshaw, S/N 43739A. His rank was captain at time of discharge, about 1965.

Robert D. Williams
7744 W. Lilac Rd.
Bonsall, Calif. 92003

We at the University of Michigan's Detachment 390 of AFROTC are currently in the process of updating our alumni files, and would greatly appreciate it if any graduates from Detachment 390 would send their name and current address to the address below.

Alumni Office
Air Force ROTC Detachment 390
University of Michigan
North Hall
Ann Arbor, Mich. 48109-0185

I would like to locate anyone who served with my uncle, Julius K. Atkins, in the 3d AAF Liaison Training Detachment, Lamesa, Tex., in September 1943.

He was an aviation student at that time, attending the Army Air Force Contract Pilot School (Liaison-Advanced). Also, I would like to have information about this school and the training it provided.

T. R. Williams, Jr.
6400 Middle Ridge Lane
Chattanooga, Tenn. 37343
Phone: (615) 842-7285

I have been attempting to locate Airman "Joey" Odom, originally from Florida.

We were stationed at Carswell AFB, Tex. (Hospital Squadron), during 1965–66. Joe was a hospital corpsman at the time.

Stu Herrold
P. O. Box 146
Emmitsburg, Md. 21727

I am trying to locate the following crew members of the B-17 *Satan's Lady* in the 369th Bomb Squadron,

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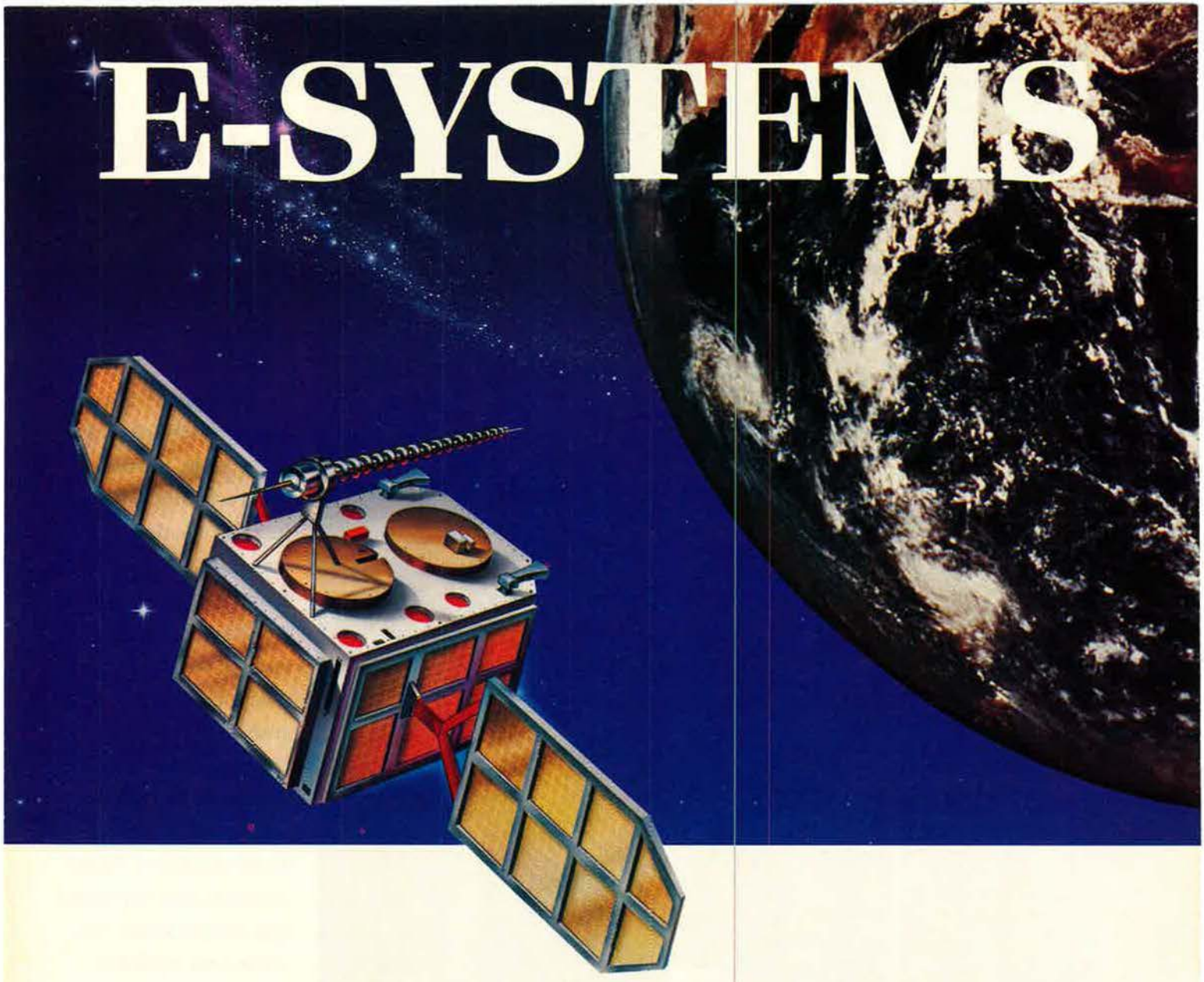

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306th Bomb Group (H), Eighth Air Force: Merlin Ernest (Mich.), Wyman Wilson (Richman, Ind.), and Cecil Cook (Miss.).

Please contact me at the address below.

William R. McKillop
621 Kristy Circle
Melbourne, Fla. 32940
Phone: (407) 242-2370

As a former pilot trainee of Class 52-A in Craig, Ala., I should like to get in touch with my classmate Bill Forsman, who later became a fighter pilot in the US Air Force.

J. M. Saget
17 Bd Aristide Briand
77000 Melun, France

We are trying to locate the following former members of our old World War II unit, the 75th Bomb Squadron: "Snuffy" Smith, Bill Jennings, Mark Childs, Forest ("Pop") Graham, Marshall King, John Janasack, Dick Pitcher, Robert Anderson, Lewis Bartlett, E. P. Cutright, Arnold Eiklund, F. E. Hoard, L. A. Tipton, Don Davis, Don Black, and Barkowsky, Bryant, and Hansen.

Anyone knowing these men, please forward their addresses to me.

Bill Thomas
1588 W. 25th Ave.
Eugene, Ore. 97405
Phone: (503) 484-9900

I am trying to locate former members of the Electronics Training Group (ETG). The ETG was composed of some 400 newly commissioned Signal Corps and Air Corps lieutenants sent to England beginning in August 1941 to attend British Air Warning schools.

Former ETG members or those with knowledge of ex-ETG personnel are asked to write to the address below.

Louis P. Goetz
1611 S. Missouri
Roswell, N. M. 88201

I am attempting to contact all members of the USAF training command who were in the Space Training Unit at Sheppard AFB in the 1960s.

Jack Schmidt
4314 Columbia Dr.
Pasadena, Tex. 77504

I am trying to locate the following former crew members of the B-24 *Mairzy Doats* who flew with me in the 579th Bomb Squadron, 392d Bomb Group, Eighth Air Force, during the period of February 1944 through May 1944: Edward R. Slagle, Richard F. Mandell, Luell E. Ward, John R. Sundo, Manuel A. Rego, and Edward J. Courtney. If anyone has any data on the whereabouts of these men, please contact the address below.

Lt. Col. Robert C. Lory,
USAF (Ret.)
6924 Marilyn Ave., NE
Albuquerque, N. M. 87109
Phone: (505) 821-0943

I am trying to locate the following former members of the Ground Observer Corps who served during the late 1950s at the White Plains Filter Center or the Trenton, N. J., Filter Center: the former commanding officer, Carmine Coppola, who was from New Jersey; former Maj. Robert Graham; and all other members of our team: Welsh, Knoll, and Nick Stone.

MSgt. Samuel B. Moody,
USAF (Ret.)
102 Bay Berry Rd.
Altamonte Springs, Fla. 32714
Phone: (407) 862-7623

Collectors' Corner

I have recently started a collection of various organizational patches associated with the F-16 Fighting Falcon. I would appreciate hearing from anyone who has any information on obtaining squadron, wing, division, Air Force, test, or other nations' patches. I am willing to trade or purchase these patches.

Jeffrey A. Riechmann
38511 Frontier Ave.
Palmdale, Calif. 93550

I seek help from readers who might consider sending duplicate, discarded, unwanted glossy photos of the following: USAF fixed-rotary aircraft World War I to 1960s; "first" USAF production-prototypes-experimental jet aircraft; rare/unique aircraft; racing aircraft—past and present; F-105 Thuds (also any Thud-River Rat-Sierra hat patches, Sierra Hat/go-to-hell Thud hats, etc.); F-102A, TF-102, F-106A/B; and World War II nightfighters.

I am also interested in autographs or autographed photos from early-past-current test and first-flight pilots; US, RAF, Canadian, Aussie, New Zealand, German, Japanese aces; military/civil aviation record holders; civil aerobatic pilots—teams from around the world; past/present racing pilots; famous women/men in aviation; famous aircraft designers; famous "Thud" pilots.

Gary Olson
1812 1st Ave. S. #306
Minneapolis, Minn. 55403

I am seeking patches from a unit that served in Vietnam, the 20th Special Operations Squadron "Green Hornets," and patches from Vietnamese supporting unit "King Bees."

Phil Rouviere
P. O. Box 1380
Krebs, Okla. 74554

I am looking for patches from all units that have flown the F-106 Delta Dart.

I am also collecting photographs of the F-106. I am looking for photos showing the development of the F-106 and the various units that it served in. Please provide as much history of the photographs as possible.

Anyone having the above, please contact me at the address below.

David F. Lahrman
5753 Farmfield Dr.
Mason, Ohio 45040
Phone: (513) 398-7633

I am quartermaster of VFW Post 1481 in Ogden, Utah. Our post has been trying to build a collection of military patches for display. I would appreciate any donations of patches and will reimburse all postage used.

R. Larry Miller
664 Chester St.
Ogden, Utah 84404-5019

I am a collector of Vietnam-era memorabilia and wish to acquire wings and patches from helicopter crews and units, especially the following helicopter crew wings: door gunner (G), crew chief (CC), recon crewman (R), medevac aidman, SAR crewman (SAR), chief engineer (CE), chief engineer (FE). Will trade or buy.

Please contact me at the address below.

Capt. Douglas Townend, CAF
1758 Harvest Crescent
Orleans, Ontario, Canada
K1C 1V4

I am willing to donate twenty-nine aircraft models—seventeen professionally built—to an organization that will use them for display and/or education. Models include F-4, F-5, T-38, F-101, T-39, and F-104 (professional) and F-86D, T-33, B-57, B-70, P-47, F-105, to mention a few. All models are in "mint" condition, in three shipping containers with models in individual cartons. Those interested must be willing to pay for shipment and provide receipt. I will *not* donate to individuals.

Col. J. R. Conti, USAF (Ret.)
1206 Pine Harbor Point C
Orlando, Fla. 32806

Capitol Hill

By Brian Green, CONGRESSIONAL EDITOR

Washington, D. C.

DoD Budget

The Defense Department announced a fiscal year 1990 DoD spending plan that provides $305.6 billion in DoD budget authority. The budget represents a two percent increase over FY '89. Other highlights:

- Multiyear procurement requests for thirty-two programs, including the B-2 Stealth bomber. If the requests are approved, DoD expects $8.5 billion in savings over the period of the acquisitions.
- No further force structure reductions.
- A 4.1 percent military pay raise.
- Maintenance of flying hours at FY '89 levels.

This budget submission is the last to be prepared by Secretary of Defense Carlucci and the Reagan Administration. The Bush Administration is expected to submit revisions.

Congress as a Problem?

A high-level study group cochaired by former Secretaries of Defense Harold Brown and James Schlesinger has concluded that while DoD has made "considerable progress" in implementing reforms recommended by the Packard Commission and mandated by the 1986 Goldwater-Nichols Defense Reorganization Act, "in one key area—the participation of Congress in defense management and decision-making—there has been very little change in fundamental practices and procedures." The report argues for a stricter division of responsibility among the budget committee, armed services committee, and appropriations committee; for biennial budgeting for the Defense Department; and for periodic budget summits between the executive branch and congressional leaders. It also calls for greater use of multiyear appropriations and funding weapons production at efficient rates.

Recognizing the practical difficulties and congressional reluctance to move to two-year budgeting, the report proposes that an Off-year Appropriations Adjustment Act be enacted. This act would be considered under the legislature's usual budget procedures, would specify the conditions under which changes to the biennial budget could be proposed, and would permit adjustment for unforeseen developments in the economy, international arena, or specific defense programs.

The study also proposes an Economic Factors Adjustment Fund, to provide a mechanism to cover price fluctuations in defense goods and services. The fund would be intended to further stabilize defense programs and mitigate the difficulty in two-year budgeting imposed by economic fluctuations beyond the government's control.

The report identifies "cautious movement" in DoD toward reform in force planning, programming, and budgeting and slow progress in improving the acquisition process. It cautions against additional legislation until the 1986 reforms have been "fully digested." A Pentagon spokesman maintained that thirty-four of the thirty-seven Packard Commission recommendations had been or were being implemented.

New Committee Members

Senate newcomer Robert Kerrey (D-Neb.) joins Ser. Brock Adams (D-Wash.) and Sen. Wyche Fowler (D-Ga.) as the new Democrats on the Senate Appropriations Committee. They fill vacancies left by retired Sens. John Stennis, Lawton Chiles, and William Proxmire. Sen. Phil Gramm (R-Tex.) moves over from the Senate Armed Services Committee (SASC) to take the Republican vacancy on the Defense Subcommittee left by the defeat of Lowell Weicker (R-Conn.).

The new SASC members include Republicans Dan Coats of Indiana (who was appointed to fill Vice President Quayle's seat), Trent Lott (Miss.), Slade Gorton (Wash.), and Malcolm Wallop (Wyo.). Senators Lott, Gorton, and Wallop fill SASC seats vacated by, respectively, Senator Gramm, Sen. Steve Symms (R-Idaho), who moved to the Finance Committee, and Sen. Gordon Humphrey (R-N. H.), who will serve on the Foreign Relations Committee. Sen. Robert Byrd (D-W. Va.) will be the new SASC Democrat, filling Senator Stennis's seat. Senator Byrd will also serve as chairman of the Senate Appropriations Committee.

New chairmen will be appointed for the House Armed Services Committee subcommittees on Investigations and Procurement and Military Nuclear Systems. Those slots were opened by the retirement of Rep. Sam Stratton (D-N. Y.) and the death of Rep. Bill Nichols (D-Ala.). Rep. Pat Schroeder (D-Colo.) and Rep. Ron Dellums (D-Calif.), both critics of many military programs, and Rep. Beverly Byron (D-Md.), who is often inclined to support Pentagon requests, are in line for consideration.

VA Criteria

Congress has changed the eligibility criteria for veterans seeking outpatient care at VA facilities. The new law authorizes some veterans to receive any required outpatient care, while others are now entitled only to pre- or post-hospital care, to obviate the need for a hospital admission, or if space and resources are available.

The new law establishes four eligibility groups. **Group I** veterans are entitled to any needed outpatient care. This includes veterans who need care for service-connected disabilities rated at fifty percent or greater. **Group II** veterans, those with low income and service-connected disabilities rated thirty or forty percent, are entitled to pre- and post-hospital outpatient care or to obviate the need for hospitalization. **Group III** includes former prisoners of war, World War I veterans, and VA pensioners receiving benefits because they need aid and attendance or are housebound. These veterans are eligible for outpatient care, if space and resources are available. **Group IV** includes all other veterans—those with a service-connected disability rated at less than thirty percent and who exceed the income threshold ($9,940, or $11,866 if married). They can receive outpatient care if space and resources are available. ■

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Aerospace World

By Jeffrey P. Rhodes, AERONAUTICS EDITOR

Washington, D. C.

★ The aerospace industry has an urgent message for the Bush Administration and the 101st Congress: "Make defense contracting attractive again."

Don Fuqua, president of the Aerospace Industries Association of America, put it that way at the annual aerospace review-and-forecast luncheon sponsored by AIA and the Aviation/Space Writers Association near the end of last year in Washington.

Among other things, the government should "repeal or modify the ill-conceived 'reforms' of recent years that collectively threaten the defense industry's financial health and the strength of the defense industrial base," Mr. Fuqua declared. He said the industrial base is "shrinking at an alarming rate" as longtime defense contractors give up or choose not to expand their business with the Pentagon.

Mr. Fuqua described the laws and regulations aimed at reforming defense procurement in recent years as including "some that directly or indirectly reduce profit levels, some that reduce industry's cash flow, some that require industry to shoulder expenses that were formerly reimbursed, and one that obligates contractors to buy into development programs by sharing the cost—in other words, paying for a chance at a production contract."

He said that all such "so-called reforms" tend to increase industry's risks while reducing its profits and "have significantly reduced the rate of return on defense business, often to less than half of what analysts consider an acceptable level."

The AIA president said that the Pentagon has done better in recent years at giving industry more say in decisions on the defense procurement process, but that it needs to go further. He recommended that the government stabilize procurement by means of multiyear contracting and biennial budgeting.

Mr. Fuqua also asserted that the industry is "outraged" by suggestions that "fraud is rampant" and by "the lynch-mob attitude" that he said surrounds current investigations of such fraud. He claimed that the industry "most definitely is not" riddled with waste, fraud, and abuse, and he added:

"DoD now has approximately 22,000 contracting specialists and an equal number of auditors and inspectors. That's a legion roughly the size of four light infantry divisions. I'm curious to know what it costs in relation to the savings it accomplishes in fraud prevented."

Mr. Fuqua declared, "The whole matter of the defense acquisition process is one that demands priority attention from the Bush Administration, the new Congress, and industry. . . . The national changing of the guard offers a fresh opportunity for creation of a more hospitable climate."

The AIA president reported that 1988 was "a very good year for the aerospace industry" in terms of its balance of trade, backlog of unfilled orders, and increased profits. Total sales were down somewhat and are becoming more difficult to bring off in an increasingly competitive foreign market, he said.

With the US defense budget in a no-growth mode, foreign sales of civil and military aerospace products are the key to "maintaining or improving our activity and employment levels," and "our chances of success hinge in part on a greater degree of support from the US government," Mr. Fuqua said.

★ America's manned spaceflight recovery effort got into high gear with the successful launch and mission of the Space Shuttle *Atlantis* in early December. This was the second Shuttle mission since the January 1986 *Challenger* disaster grounded the orbiter fleet.

Security was tight for the STS-27 mission, since the orbiter carried a classified military payload. Only the liftoff from the Kennedy Space Center in Florida and the orbiter's landing at

General Dynamics recently completed proof-of-concept tests of its blue laser system for the Navy's Submarine Laser Communications program. The program's goal is satellite-to-submarine communications in real time without interrupting the sub's normal mode of operation or revealing its location. An extremely sensitive sensor on the submarine is used to decode the laser's flash patterns underwater. The tests were conducted from a Navy P-3 Orion.

Edwards AFB, Calif., were televised, and minimal details were given about operations during the mission. The four-day, nine-hour, six-minute, and nineteen-second flight was the longest of the three dedicated DoD Shuttle missions so far.

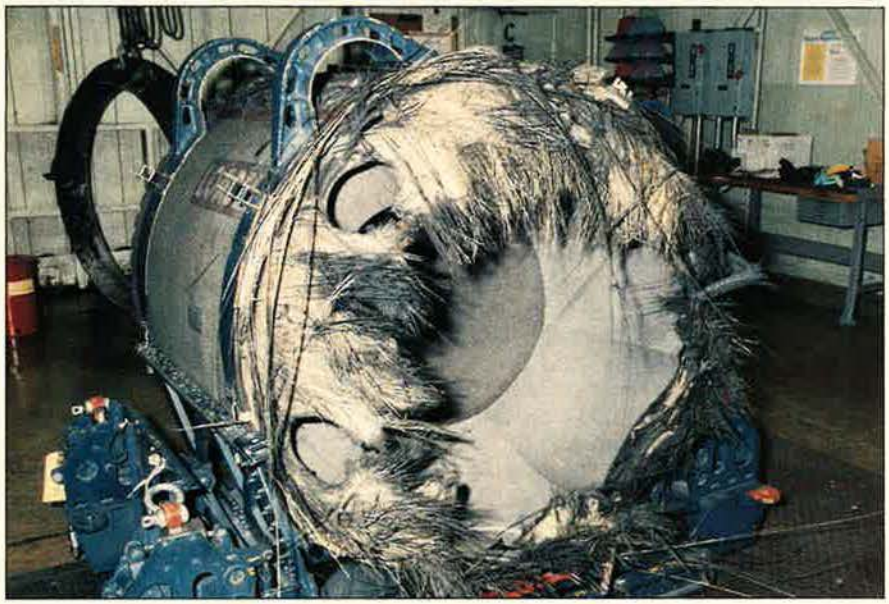
The Shuttle's launch was delayed a day because of high winds aloft, and the launch at 9:31 a.m. on December 2 came with only one minute left in the launch "window." Navy Lt. Cmdr. Robert L. "Hoot" Gibson served as mission commander, with USAF Lt. Col. Guy S. Gardner as pilot. Two Air Force officers, Col. Robert M. "Mike" Mullane and Lt. Col. Jerry L. Ross, were mission specialists, as was Navy Cmdr. William M. Shepherd. This was only the third launch of *Atlantis*, which had been flown on Mission 51-J (another DoD flight) in October 1985 and Mission 61-C a month later.

The Shuttle stack rolled 102 degrees on takeoff, putting *Atlantis* on a direct flight path over the Soviet Union. The orbiter was believed to be carrying a $500 million satellite called Indigo Lacrosse, which uses synthetic aperture radar to "see" ground targets through clouds and darkness. The satellite was launched on the first day of the mission, according to expert observers. *Atlantis* flew formation with the released satellite until the crew and ground controllers were satisfied it was functioning.

The landing at Edwards on December 6 was closed to the public, a change from most missions. The orbiter landed just after the national TV news started on the east coast, and the three major noncable networks all cut in for a live telecast of the orbiter's landing on Runway 17. *Atlantis* lost one thermal heat protection tile on a nosewheel door, and a number of other tiles were damaged during the mission. During the routine postflight inspection, it was discovered that a crack had developed in one of the orbiter's turbopumps. *Atlantis's* next flight is scheduled for April.

In other Shuttle news, Air Force Lt. Col. Frederick Gregory, who flew as pilot on Mission 51-B, will become the first black astronaut to command a space mission when *Discovery* lifts off on STS-33 this August. He will command a five-person DoD mission.

Construction of OV-105, the replacement Shuttle for *Challenger,* is well along at Rockwell's Palmdale, Calif., facility. Essentially identical to *Discovery* and *Atlantis,* OV-105 is scheduled to be delivered in April 1991, with a first flight in February 1992 on STS-54. The $1.3 billion orbiter will be named by schoolchildren. Work is going on at two Rockwell plants in California and by more than 100 subcontractors across the US. The new orbiter is scheduled to have its two orbital maneuvering system pods installed this month.



Engineers at the Arnold Engineering Development Center in Tennessee ignited a shaped charge to rupture this rocket motor midway through a test firing at a simulated altitude of 100,000 feet. The hole opened by the charge caused a sudden decompression, immediately extinguishing the solid fuel burn. The partially burned Minuteman III missile third stage will be examined by technicians at Hill AFB, Utah, as part of the Minuteman Reliability Assessment program.

★ Reengining Boeing KC-135 tankers with General Electric/CFM International F108-CF-100 engines has produced dramatic increases in fuel efficiency for the aircraft, designated KC-135R. Able to carry more fuel farther, two R models can do the work of three KC-135As.

Besides being more productive, the "new" tankers recently set some new records. Crews from four units that fly KC-135Rs converged at Robins AFB, Ga., on November 19 and set sixteen class time-to-climb records. A single KC-135R (serial number 62-3554), nicknamed *Cherokee Rose,* was used by the crews on the record runs *(see January '89 issue, p. 88).* Three of the

Assembly of the new Space Shuttle orbiter is well along at Rockwell's facility in Palmdale, Calif. Here, workers install surface insulation tiles on the lower midfuselage of OV-105. The tiles protect the orbiter from the extreme temperatures encountered during reentry. First flight of the new orbiter is set for 1992.

records were previously held by a Soviet Yak-42 airliner. The remaining thirteen time-to-climb records were unclaimed.

A crew from the 19th Air Refueling Wing at Robins broke the Soviet marks and added two more in Class C-1.M (jet airplanes weighing between 99,207 and 132,276 pounds). The crew, Capt. David Glisson (aircraft commander), 1st Lt. Scott Neumann, Capt. Marc Moss, and SSgt. Randy Seip, climbed to 3,000 meters in 1:39.22 minutes; to 6,000 meters in 2:56.97; to 9,000 meters in 4:23.51; to 12,000 meters in 5:50.94; and to 15,000 meters in 8:15.20.

A 340th AREFW crew from Altus AFB, Okla., set four records in Class C-1.N (jet aircraft weighing between 132,276 and 176,368 pounds). Maj. Stan Yarbough (aircraft commander), 1st Lt. Don Colbacchini, 1st Lt. Dave Wisenand, and SSgt. Dave Passey climbed to 3,000 meters in 1:42.52 minutes; to 6,000 meters in 2:58.21; to 9,000 meters in 4:29.28; and 12,000 meters in 5:43.71.

The 319th Bomb Wing at Grand Forks AFB, N. D., sent the crew that established four records in Class C-1.O (jet aircraft weighing between 176,368 and 220,460 pounds). Capt. Robert Locke (aircraft commander), Capt. Steve Wabrowetz, Capt. Mike Cloyd, and SSgt. Jim Hackworth climbed to 3,000 meters in 2:12.10 minutes; to 6,000 meters in 3:46.41; to 9,000 meters in 5:40.33; and to 12,000 meters in 7:49.19.

The final three records were set by a crew from the 384th Bomb Wing at McConnell AFB, Kan. Maj. Rod Bell (aircraft commander), Capt. Jim Melancon, Capt. Julie Keck, and MSgt. Stan Sears climbed to 3,000 meters in 2:48.34; to 9,000 meters in 7:13.62; and to 12,000 meters in 10:14.80. These three records were set in Class C-1.P (jet aircraft weighing between 220,460 and 330,690 pounds).

The National Aeronautic Association (NAA), the official sanctioning body for record attempts in the US, has certified the flights as US records. The Paris-based Fédération Aéronautique Internationale (FAI), of which the NAA is a member, will certify the records as world marks.

★ The 101st Congress has virtually the same percentage of members who served in the armed forces as its predecessor had. Sixty-seven Senators have seen military service, and just under half (49.3%) of the House has spent time in uniform.

Of the sixty-seven Senators, thirty-two were in the Army (including the Army National Guard or Army Reserve), eighteen in the Navy (including the Naval Reserve or Coast Guard), nine in the Marine Corps (or the Marine Corps Reserve), and eight in the Air Force (including the Air National Guard or Air Force Reserve).

On the House side, 217 of the 440 Representatives and Delegates helped defend the country. Of that total, 103 (23.4% of the entire House) were in the Army (including the Army National Guard or Army Reserve), fifty-three (12.0%) were in the Navy (including the Naval Reserve or the Coast Guard), thirty-nine (8.9%) served in the Air Force (including the ANG or Air Force Reserve), and twenty-two (5.0%) were in the Marine Corps or Marine Corps Reserve.

Thirty Senators served during World War II or the Korean War (although they may not have seen combat), while seven Senators saw combat in Vietnam. Ninety-nine Representatives served during World War II or the Korean War (again, not necessarily in combat), one served during Korea and Vietnam, and eleven members served in Vietnam. Nine Representatives are still in Guard or Reserve units.

—USAF photo by A1C Paul Parker

Lt. Gen. Zhu Guang (left), political commissar of the Chinese People's Liberation Army Air Force, is escorted through a cordon of US Air Force Honor Guardsmen by then-Secretary of the Air Force Edward C. Aldridge, Jr., during a recent welcoming ceremony at Bolling AFB in Washington, D. C. Zhu, one of the two most senior leaders of the Chinese Air Force, is responsible for personnel management and training.

Air National Guardsmen from the 105th Military Airlift Group at Stewart ANGB, N. Y., airlifted more than 140,000 pounds of food and medical and building supplies after Hurricane Gilbert devastated Jamaica last fall. Here, TSgt. Vidal Chevere-Matos (center) works with members of the Jamaica Defence Force in unloading the New York ANG C-5. Sergeant Chevere-Matos works on the engineering staff at West Point in civilian life.

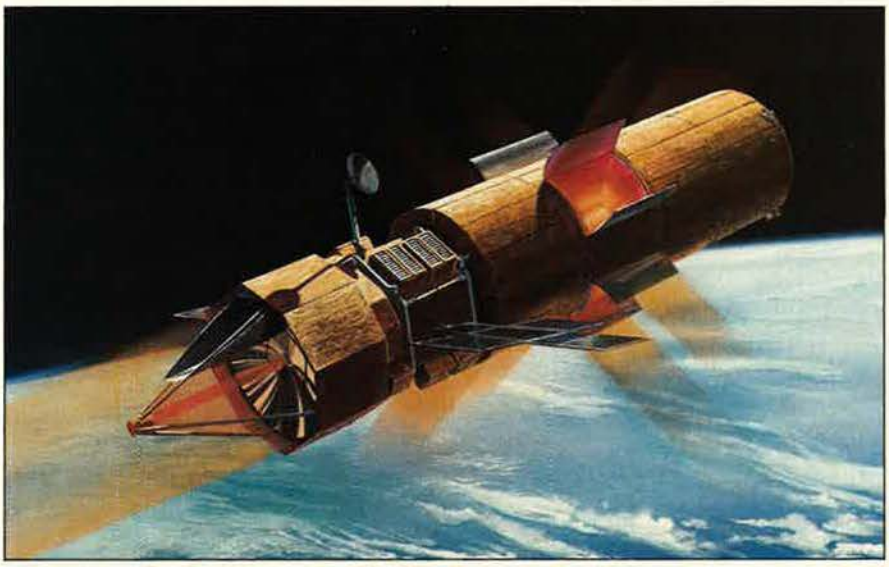
★ **VCR ALERT—The Discovery Channel** (TDC), a cable TV network offering documentary entertainment, **is going to air a series entitled "Great Planes,"** which chronicles the history and development of thirteen US airplanes. Each hour-long program profiles a single aircraft. The XB-70, F-111, B-29, F-14, B-52, P-51, B-17, B-24, P-38, F-86, P-47, F-16, and B-36 are the subjects. Programs will be shown on Wednesdays at 9:00 p.m. EST, with rebroadcasts on Fridays at 4:00 p.m. EST and Sundays at 1:00 a.m. EST, from February 1 to April 26.

★ **APPOINTED—Dr. Connie Lee,** a professor of history, government, and human relations at the York Technical College in Rock Hill, S. C., has been appointed **to chair the Defense Advisory Committee on Women in the Services (DACOWITS).** Dr. Lee, who began her two-year term on January 1, was appointed to DACOWITS in 1986 and headed the subcommittee on career development. She succeeds Dr. Jacquelyn Davis in the nonsalaried post. Established in 1951, the thirty-five-member committee assists and advises the Secretary of Defense on policies and matters relating to women in the armed forces.

★ **HONORS—Raloid Corp.,** a designer and manufacturer of engineered electrical and mechanical products for the Army, **was named as the 1988 Department of Defense Small Disadvantaged Business Contractor of the Year** in Pentagon ceremonies on November 28. Started in a converted two-horse stable in 1964, the Reisterstown, Md., company now employs more than ninety people in a modern, 90,000-square-foot building and uses the latest computer-controlled equipment. Other firms recognized in the ceremony were Daedalean, Inc. (a Navy contractor), A-Bear Janitorial Services, Inc. (Air Force), and Integrated Microcomputer Systems, Inc. (Defense Logistics Agency).

When Brig. Gen. Harold C. Earnhardt (third from left) made his last flight as commander of the Air National Guard's 145th Tactical Airlift Group in Charlotte, N. C., last fall, the crew assembled for the flight had a combined flying time of 49,118.3 hours, which may be an all-time record. What made the flight even more unusual is that (left to right) SMSgt. Kenneth H. Roberts, Col. James A. Melvin, General Earnhardt, Lt. Col. Paul A. Webb, Jr., and CMSgt. Billy F. "Dad" Furr routinely fly together. Crew chief MSgt. David Dale is on the far right.

★ **PURCHASES**—On December 5, the Strategic Defense Initiative Organization (SDIO) awarded **Martin Marietta Denver Aerospace a $347 million contract for Phase IIIA work on the Zenith Star** space-based laser experiment. The thirty-month Phase IIIA contract covers the final design of the experiment and laboratory testing of Zenith Star's chemical laser and its optical and tracking systems. Phase IIIB, expected to begin by 1991, will deal with the fabrication and ground test of various systems. Phase IIIC, currently scheduled for 1994, will involve integrating the entire experiment, launching Zenith Star, and operating it in space. Principal subcontractors on the project are Lockheed and TRW. Directed-energy technologies, like those of Zenith Star, are among several being studied by SDIO to provide a ballistic missile defense.



This Martin Marietta artist's concept depicts Phase IIIC of the Zenith Star space-based laser demonstration that would be conducted as part of the Strategic Defense Initiative program. The Zenith Star program will demonstrate the operation of a medium-power chemical laser in space and investigate how it would acquire, track, and point at a target. Phase IIIA was recently funded; Phase IIIB is expected to begin by 1991 and Phase IIIC by 1994.

Is it real or is it Durodyne? That is a question enemy pilots could be asking themselves soon. **Durodyne,** a small Tucson, Ariz., company, was selected over Brunswick **to build F-16 decoys.** Under a $1 million contract awarded by Air Force Systems Command's Aeronautical System Division, Durodyne will produce twenty-five F-16 decoys, which consist of an aluminum frame with a fabric skin. The decoys, packed in special containers, can be assembled in less than two hours by untrained personnel. If the Air Force exercises all of its contract options (worth nearly $25 million), production will last four years. Options are also included for F-15 decoys.

The **Barnes Engineering Division** of EDO Corp. has received a $1 million Air Force **contract for 5,000 helmet visors that will provide eyesight protection from laser beams.** Made of polycarbonate and treated with spe-

Marine Helicopter Squadron 1 (HMX-1) at Quantico, Va., recently received the first of nine Sikorsky VH-60 executive-configured helicopters for use in White House support missions. The new helicopters differ considerably from standard UH-60 Black Hawks. The unit's VH-3D Sea Kings will still be used as **Marine One.**

cial materials, the new visors will absorb low-intensity laser light while allowing normal light to pass through. Barnes has been working on the visor for the past eight years. A Navy EP-3 copilot was temporarily blinded by a laser designator fired from a Soviet aircraft recently when the two planes came in close proximity during operations over the Pacific.

★ **DELIVERIES**—The **first** of nine **Sikorsky VH-60 Black Hawk helicopters** to be used for White House support missions was delivered to Marine Helicopter Squadron 1 (HMX-1) at Quantico, Va., on November 30. The new helicopters feature an improved durability gearbox, a flight control system and airspeed indicator from a Navy SH-60B, soundproofing, a cabin radio operator's station, a VIP-configured cabin, electromagnetic-pulse hardening, and extensive avionics upgrades. The VH-60s will replace the squadron's VH-1Ns in the executive transport mission. The unit's VH-3D Sea King helicopters will still be used to transport the President.

The **Army is transferring twenty-six Bell UH-1H Huey helicopters** to the State Department's **Bureau of International Narcotics Matters** for use in the war on drugs. Six of the surplus UH-1s have already deployed to Bolivia, and six more were to have been refurbished by the end of 1988. The remaining aircraft will be put into service as funds allow. US military personnel will not be involved in the operation of these helicopters in foreign countries.

Texas Instruments delivered the first Block IV guidance section for the AGM-88C high-speed antiradiation missile **(HARM)** in early November. This marks the first performance hardware change in HARMs since 1978. Captive flight tests and launches of the missile with the new guidance section were scheduled to be completed at the Naval Weapons Center at China Lake, Calif., before the end of 1988. Despite the improved accuracy incorporated in the Block IV guidance section, fifty-seven percent of its hardware subassemblies remain unchanged from the present configuration.

The **1st Battalion, 111th Aviation Regiment,** the Florida Army National Guard unit based at Craig Field in Jacksonville, became the **third Guard unit to receive** the McDonnell Douglas **AH-64 Apache** attack helicopter in November as the unit accepted the first four of its eighteen aircraft. Personnel from the unit will train at Fort Hood, Tex., for three months and will then begin training the rest of the unit at Craig. The entire unit will return to Fort Hood in July 1990 for final unit training and evaluation. Among other Apache units, North Carolina's 1st Battalion, 130th Aviation Regiment, is combat-ready, while South Carolina's 1st/151st is in unit-level training. Utah's Army Guard will begin receiving its AH-64s in 1989.

Greece became the fourteenth country to receive F-16s when the Hellenic Air Force accepted the first of its forty aircraft on order in ceremonies at the General Dynamics plant in Fort Worth, Tex., on November 18. The HAF will receive thirty-four F-16Cs and six two-seat D models by this October. Greek pilots are being trained at Luke AFB, Ariz., while Greek mechanics are training in Fort Worth.

★ **MILESTONES**—The **sixtieth and last McDonnell Douglas KC-10A Extender left the Douglas plant** in Long Beach, Calif., on November 29. The

The last of sixty McDonnell Douglas KC-10A Extender tanker/cargo aircraft built left the Douglas plant in Long Beach, Calif., recently for testing at the company's Yuma, Ariz., facility. The last KC-10 is the first of the fleet to be equipped with wingtip refueling pods for probe-equipped aircraft. The Extenders are based at Seymour Johnson AFB, N. C.; Barksdale AFB., La.; and March AFB., Calif.

tanker/cargo aircraft, which had already been accepted by the Air Force, is the first KC-10 to be fitted with wing-mounted aerial refueling pods, allowing it to refuel three probe-equipped aircraft (or two probe- and one receptacle-equipped aircraft) at the same time. The fifty-eight remaining Extenders (one was lost in a ground fire) will be retrofitted to accept the pods, and the Air Force plans to order thirty-nine additional shipsets of the pods. The modified KC-10 will be tested at the company's facility at Yuma, Ariz., before being turned over to the Air Force. KC-10 procurement began in 1977.

Air Force Communications Command celebrated its fiftieth anniversary on November 11 with a reunion of former command personnel in Santa Maria, Calif. The Army Air Corps established the Army Airways Communications System in 1938. In 1946, AACS was redesignated the Airways and Air Communications Service. That organization evolved in 1961 into the Air Force Communications Service, which in turn became a major command in 1979.

TSgt. Donald Watson (left) of the 3901st Strategic Missile Evaluation Squadron at Vandenberg AFB, Calif., checks a Minuteman III reentry system as Sgt. Benjamin Haugh of the 394th ICBM Test Maintenance Squadron looks on. The reentry systems for Minuteman IIs and IIIs, as well as Peacekeeper ICBMs, are now assembled by Vandenberg's own technicians prior to test and evaluation launches from the base.

—USAF photo by SrA. Martin Johanneck

February Anniversaries

- *February 24, 1914:* In the wake of a rash of accidents, an Army investigative board condemns all pusher-type airplanes.
- *February 5, 1924:* 2d Lt. Joseph C. Morrow, Jr., qualifies as the twenty-fourth and last "Military Aviator" under the rules set up for that rating.
- *February 10–11, 1929:* Evelyn Trout sets a women's solo flight endurance record of seventeen hours, twenty-one minutes, and thirty-seven seconds in a Golden Eagle monoplane.
- *February 19, 1934:* President Franklin D. Roosevelt issues an Executive Order canceling all existing air mail contracts because of evidence of fraud and collusion. The Army Air Corps is then designated to take over air mail operations.
- *February 15, 1944:* The abbey of Monte Cassino, Italy, is destroyed by 254 American B-17s and B-25s attacking in two waves. The ruins of the abbey would not be captured by the Fifth Army until May 18, 1944.
- *February 4, 1949:* The Civil Aeronautics Authority sanctions the use of ground-controlled approach radar as a "primary aid" for commercial airline crews.
- *February 15, 1954:* President Dwight D. Eisenhower nominates Charles A. Lindbergh to be a brigadier general in the Air Force Reserve.
- *February 24, 1954:* President Eisenhower approves the National Security Council's recommendation for construction of the Distant Early Warning (DEW) Line. Operational control of the DEW Line would be transferred from the Air Force to the Royal Canadian Air Force on February 1, 1959.
- *February 12, 1959:* The Air Force grounds the last operational Convair B-36 Peacemaker at Amon Carter Field in Fort Worth, Tex.
- *February 3, 1964:* Four airmen locked in a simulated spaceship for six weeks suffer no apparent ill effects after exposure to a pure oxygen atmosphere for thirty consecutive days. The tests were conducted at Brooks AFB, Tex.
- *February 29, 1964:* President Lyndon B. Johnson publicly announces the existence of the Lockheed A-11 (YF-12A), which "has a cruising speed in excess of Mach 3 at altitudes in excess of 70,000 feet." The plane, designated A-12 by Lockheed, had been ordered as a single-seat reconnaissance aircraft for the Central Intelligence Agency in 1960. Only three YF-12A interceptors are built, as the SR-71 program for the Air Force takes precedence.
- *February 3–11, 1984:* Navy Capt. Bruce McCandless becomes the first human satellite as he takes the self-contained Manned Maneuvering Unit out for a "spin" while in earth orbit on Space Shuttle Mission 41-B. *Challenger* also becomes the first spacecraft to return to its launch site when Vance Brand and Lt. Cmdr. Robert Gibson land the orbiter on the 15,000-foot-long runway at the Kennedy Space Center.

A team from the 91st Strategic Missile Wing at Minot AFB, N. D., successfully carried out the 134th operational test launch of a Boeing LGM-30G **Minuteman III** intercontinental ballistic missile from Vandenberg AFB, Calif., on October 27. What made this test unusual was the missile's **reentry system—assembled for the first time by technicians from Vandenberg's 394th ICBM Test Maintenance Squadron.** This change came about as the result of a suggestion by SSgt. John Brantly, a nuclear weapons specialist with the unit. By having a permanently assigned team at Vandenberg to assemble the reentry system rather than sending a team from the unit conducting the test launch, USAF saves more than $45,000 a year in temporary duty funds and airfare. The 394th ICBM TMS's twenty-person team is also certified to reassemble reentry systems for LGM-30F Minuteman II and LGM-118A Peacekeeper missiles.

The Bell-Boeing **Pointer,** the world's first tilt-rotor unmanned aerial vehicle (UAV), **made its first flight** on November 21 at Bell Helicopter's facility in Fort Worth, Tex. The first flight was limited to forward, backward, and sideways maneuvers to test the vehicle's flight control system in the hover mode. Eventually, the Pointer will be flown at speeds of up to fifty knots in the helicopter mode and, after progressively tilting the rotors forward to the airplane mode, will

reach speeds in excess of 100 knots. Based on the V-22 Osprey, the Pointer is suitable for aerial reconnaissance, targeting, battle damage assessment, or electronic countermeasures.

McDonnell Douglas Missile Systems Co. (formerly McDonnell Douglas Astronautics Co.) **delivered the 5,000th AGM-84 Harpoon** antiship missile to the Navy on December 2. Operational since 1977 with the Navy, Harpoons are also used by the Air Force and twenty international customers. Harpoon flight reliability stands at nearly ninety-three percent in 374 launches, including a 100 percent success rate in eighty-one launches since 1982. With a range in excess of sixty miles, Harpoons can be launched from aircraft, surface ships, submarines, and land-based trailers.

It's 369 T-38s down, 369 T-38s to go. The **longeron,** or backbone, **portion of** the Air Force's **Pacer Classic modification effort reached the halfway point** recently. It takes roughly 1,500 man-hours to replace the fourteen-foot-long, contoured-steel longeron on each T-38. The new longerons are much stronger and less susceptible to stress and fatigue than the original. Lear-Siegler, Inc., is installing them at Randolph AFB, Tex. The San Antonio Air Logistics Center at Kelly AFB, Tex., is managing the three-phase Pacer Classic program, which is expected to cost around $447 million total and is scheduled to be finished in 1996.

After a delay of over a year, Sweden's new indigenous fighter, the Saab **JAS-39 Gripen, finally flew for the first time** on December 9. Software problems relating to the aircraft's fly-by-wire control system caused the delay. Saab Chief Test Pilot Stig Holstrom put the aircraft through a fifty-one-minute flight at the company's Linköping facility. The plane will undergo a full test program and is still scheduled to enter squadron service in 1992.

In two Intermediate-range Nuclear Forces (INF) Treaty milestones, **Belgium became the first country to have all** of the BGM-109G Gryphon ground-launched cruise missiles **(GLCMs) deployed within its boundaries removed.** The twenty missiles (including four spares) at Florennes AB were withdrawn on December 13. **Pueblo Army Depot, Colo., became the second site for destruction of Pershing II missile sections** when officials started burning more than 450 rocket motors there on December 5. Similar disposal has been conducted at the Longhorn Army Ammunition Plant near Marshall, Tex., since September.

★ **NEWS NOTES**—The **Navy successfully carried out the sixteenth test** of the Lockheed UGM-133A **Trident II,** or D5, sea-launched ballistic missile on November 7 from a flat pad at Cape Canaveral AFS, Fla. This was the thirteenth successful test. Two tests were failures, and one test missile was inadvertently destroyed. On September 19, it has been learned, an Air Force range safety officer ordered the missile to self-destruct after it appeared to have veered off course. In fact, it hadn't.

The Rockwell **AGM-130** rocket-powered glide bomb **scored its third consecutive direct hit** on its fifth and final developmental launch from an F-4E at Eglin AFB, Fla., on November 25. The target was more than eleven miles from the launch point. The Air Force will begin testing the AGM-130 from an F-111F aircraft later this year.

On January 1, the **Department of Defense began offering hefty reenlistment bonuses to physicians** with skills in critically understaffed areas such as surgery. A bonus of up

Senior Staff Changes

PROMOTIONS: To be **Lieutenant General:** Ronald W. **Yates.**

To be **Brigadier General:** George K. **Anderson;** William J. **Ball;** Charles C. **Barnhill,** Jr.; Billy J. **Bingham;** Jay D. **Blume,** Jr.; Fredric N. **Buckingham;** Hiram H. **Burr,** Jr.; Patrick P. **Caruana;** James L. **Cole,** Jr.; Stephen P. **Condon;** Roscoe M. **Cougill.**

Gary L. **Curtin;** William B. **Davitte;** William M. **Douglass;** Robert W. **Drewes;** Lawrence P. **Farrell,** Jr.; Phillip J. **Ford;** Carl E. **Franklin;** Ralph H. **Graham;** Ronald D. **Gray;** John C. **Griffith.**

Thomas R. **Griffith;** Otto K. **Habedank;** Gerald E. **Hahn;** Travis E. **Harrell;** James F. **Hinkel;** Patricia A. **Hinneburg;** James L. **Hobson,** Jr.; C. Jerome **Jones;** John J. **Kelly,** Jr.; Robert E. **Linhard.**

John G. **Lorber;** James E. **McCarthy;** Lawrence A. **Mitchell;** Richard B. **Myers;** John M. **Nauseef;** Everett H. **Pratt,** Jr.; Glenn A. **Profitt** II; Harold H. **Rhoden;** Teddy E. **Rinebarger;** Donald B. **Smith.**

Paul E. **Stein;** Edwin E. **Tenoso;** Michael J. **Torma;** Robin G. **Tornow;** Ralph G. **Tourino;** Michael G. **Vergamini;** James L. **Vick;** Donald R. **Walker;** John D. **Wood;** Frederick A. **Zehrer** III.

To be **AFRES Major General:** Richard A. **Freytag;** Angelo J. **Perciballi;** John D. **Riddle;** Julio L. **Torres;** Duane A. **Young.**

To be **AFRES Brigadier General:** Lawrence B. **Anderson;** Larrie C. **Bates;** Joe L. **Campbell;** Charles B. **Casson;** Robert T. **Cetola;** Gerald R. **Chancellor;** Wayne E. **Delawter.**

William W. **Didlake,** Jr.; George A. **Hall;** Thomas L. **Neubert;** Thomas E. **Penick,** Jr.; Robert L. **Tate;** Vernon R. **Tate;** William F. **Willoughby.**

To be **ANG Major General:** Donald F. **Ferrell;** Cecil W. **Greene;** John M. **Hafen;** James R. **Mercer;** Fred D. **Womack.**

To be **ANG Brigadier General:** Gordon M. **Campbell;** James W. **Chapman;** Donald L. **Coleman;** Joseph E. **Copenhaver;** Stephen P. **Cortright;** John F. **Flanagan,** Jr.; Richard W. **Godfrey;** Hugh S. **Harris,** Jr.; Talmadge R. **Howell;** James A. **Melvin** III; Raymond E. **Moorman;** Scott L. **Philbrick;** Darrel D. **Thomssen.**

RETIREMENTS: L/G James A. **Abrahamson;** B/G E. Daniel **Cherry;** B/G Frank S. **Goodell.**

CHANGES: M/G John A. Corder, from DCS/Ops., Hq. USAFE, and Dep. Dir., Ops., EACOS, Ramstein AB, Germany, to Cmdr., TAWC, TAC, Eglin AFB, Fla., replacing M/G John E. Jaquish . . . **B/G Timothy D. Gill,** from Dep. Cmdr., Joint Task Force Middle East, USCENTCOM, Navy Mobile Units, to Spec. Ass't to CINC, Hq. PACAF, Hickam AFB, Hawaii . . . **B/G Donald G. Hard,** from Dir., Office of Space Sys., OSAF, Washington, D. C., to Dep. Cmdr., AFCOS; Dep. Dir., Ops., DCS/P&O, Hq. USAF; and Dep. Dir., Office of Mil. Support, Hq. DAMO/ODZ (Army), Washington, D. C., replacing B/G Philip W. Nuber . . . **M/G John E. Jaquish,** from Cmdr., TAWC, TAC, Eglin AFB, Fla., to Dir., Tac. Prgms., Ass't Sec'y of the Air Force for Acq., OSAF, Washington, D. C., replacing M/G (L/G selectee) Ronald W. Yates . . . **B/G Philip W. Nuber,** from Dep. Cmdr., AFCOS; Dep. Dir., Ops., DCS/P&O, Hq. USAF; and Dep. Dir., Office of Mil. Support, Hq. DAMO/ODZ (Army), Washington, D. C., to Dep. Cmdr., Joint Task Force Middle East, USCENTCOM, Navy Mobile Units, replacing B/G Timothy D. Gill . . . **M/G (L/G selectee) Ronald W. Yates,** from Dir., Tac. Prgms., Ass't Sec'y of the Air Force for Acq., OSAF, Washington, D. C., to Principal Dep. Ass't Sec'y of the Air Force for Acq., OSAF, Washington, D. C., replacing L/G George L. Monahan, Jr. ■

W. Stuart Symington, 1901–88

W. Stuart Symington, the first Secretary of the Air Force, died in his sleep at his home in New Canaan, Conn., on December 14. He was eighty-seven.

Long a champion of airpower, he defended the fledgling Air Force during the roles-and-missions arguments with the Navy and with Secretary of Defense James V. Forrestal during the late 1940s. He installed a comptroller in the Air Force bureaucracy to control costs and vigorously enforced President Harry S. Truman's order banning racial segregation in the military. Mr. Symington resigned as Secretary in 1950 in a dispute over cuts in the Air Force budget.

An Army private in World War I, he later attended Yale but left without a degree and went into business. After a series of jobs, he became president and chairman of the board of Emerson Electric in 1938, serving in that capacity until 1945. Yale awarded him a bachelor's degree in 1946.

Mr. Symington came to Washington as chairman of the Surplus Property Administration and later became Assistant Secretary of War for Air. As a candidate from Missouri, he won election to the Senate in 1952 and served until 1977. He served on both the Armed Services and Foreign Relations Committees. He ran for President in 1956 and again in 1960. He became an outspoken critic of the Vietnam War in the late 1960s. After retirement from the Senate, he worked on his memoirs and played golf.

Senator Symington is survived by his second wife, two sons, six grandchildren, and six great-grandchildren.

to $20,000 a year will be paid to doctors who reenlist for four-year hitches, bringing their total monetary compensation to roughly $112,500 a year. Congress approved the bonus program in DoD's FY '89 authorization and earmarked $30 million for the effort. The medical specialties have been divided into seven groups for calculating the bonuses.

The **Navy launched the fleet oiler USS *Leroy Grumman*** (T-AO-195) on December 3 at the Avondale Shipyard in New Orleans, La. The ship's name honors Leroy Randle Grumman (1895–1982), the famed aircraft designer and industrialist, whose company built the F4F Wildcat, F6F Hellcat, and TBF Avenger (among others) for the Navy in World War II. Today, Grumman builds the F-14 Tomcat, A-6 Intruder, EA-6B Prowler, and E-2 Hawkeye for the Navy. Other Grumman efforts have included the HU-16 Albatross and EF-111 Raven for the Air Force, the OV-1 Mohawk for the Army, and the Lunar Module for NASA.

The **Department of Defense, the services, the Environmental Protection Agency, and contractors** du Pont, Digital, AT&T, General Dynamics, IBM, and others **have joined forces to develop a program to find alternatives to** using chlorofluorocarbon-113 **(CFC-113)** to clean metal parts and electronics components used in a variety of weapons programs. Phases I and II of the three-stage program to find and use alternatives to CFC-113 are scheduled to be completed in early 1990, with Phase III to begin shortly after that. CFC-113 is a major ozone-depleting chemical. More than 130,000,000 pounds of CFC-113 were used in 1986.

The **conceptual, full-scale model of the B-2 bomber** that American Honda used in its "For the record, ours was first" advertising campaign, **has been donated to Ellsworth AFB, S. D.**, where it will be put on display. The automobile manufacturer received a number of requests for the 20,000-pound steel model that cost $20,000 to build. Honda had the plane disassembled and paid the $8,000 shipping costs to get the "B-2" to the Black Hills.

★ **DIED**—Retired **Maj. Gen. Haywood S. (Possum) Hansell,** who helped draft the fundamental war requirements plan (called AWPD-1) for the Army Air Forces in World War II, November 14 at a hospital in Hilton Head, S. C., of heart failure brought on by pulmonary edema. He was eighty-five.

General Hansell graduated from Georgia Tech in 1924. He joined the Army Air Corps in 1928 and in 1932 flew with Capt. Claire Chennault as a member of the Air Corps Aerobatic and Demonstration Team known as "The Three Men on a Flying Trapeze." Sent to England as a planner on Gen. Dwight D. Eisenhower's staff at the start of World War II, General Hansell later commanded Eighth Air Force's 3d Bomb Wing and 1st Bomb Division. In 1943, he was named Deputy Commander in Chief of the Allied Expeditionary Air Force.

After a stint on the Joint Planning Staff, General Hansell was appointed commander of XXI Bomber Command. He flew the first B-29 to Isley Field, Saipan, where he then directed operations against the Japanese. He retired in 1946, but was recalled to active duty during the Korean War, and he served in several capacities. He retired for good in 1955. An author (most notably of *The Air Plan That Defeated Hitler*), General Hansell contributed several articles to this magazine. ■

Index to Advertisers

Here are the weapon systems that the Air Force envisions for the twenty-first century.

The Shape of Things to Come

BY ROBERT S. DUDNEY
SENIOR EDITOR

Air Force technologists, the wizards in charge of conjuring up weapons for the next century, are coming under pressure to work their magic.

Leaders of the Air Force's 8,000 scientists and engineers working at fourteen major laboratories are marshaling forces to take on a massive array of projects that will shape the service well beyond the year 2000.

They say that a drive to develop "revolutionary enabling technologies" within the next several years will undergird the Air Force's apparent plans for generating new military weaponry on an awesome scale.

The scope of the ambitions embraced by the Air Force is evident to those familiar with USAF's "Science & Technology and Development Planning Program," a thirty-two-page list of arms concepts produced by Air Force Systems Command (AFSC) officers.

Their concepts for the far future—that is, beyond the turn of the century—include robotic air vehicles, automated attack systems, advanced air-superiority missiles, autonomous antiarmor weapons, hypervelocity munitions, high-altitude long-endurance vehicles, and automatic image interpreters.

In addition, planners envision multimedia radios, laser communication systems, high-power microwave weapons, stealthy transport airplanes, long-range conventional cruise missiles, laser satellite links, and hypersonic aircraft.

Even the weapons envisioned for deployment within the next decade pose formidable challenges. Examples of such "next-generation" concepts include the Advanced Tactical Fighter, multimission drones, noncooperative aircraft identification systems, millimeter-wave ground-attack missiles, long-range optical sensors, automatic target recognizers, and space-based radars.

Overall, AFSC's list of prospective twenty-first-century systems to meet the Air Force's stated operational requirements contains no fewer than 224 high-technology concepts in mission areas ranging from armament to space.

AFSC leaders, aware that every weapon concept entails development of many costly technologies at a time of harsh budgetary pressures, are concentrating on those that promise a high payoff. Says Gen. Bernard Randolph, AFSC's commander: "The challenge is to focus valuable science and technology resources into areas that can achieve the greatest increase in combat capability."

Across thirteen general areas such as air vehicles, avionics, and the like, officers have selected ninety-one key "major technology thrusts" for emphasis, each containing a number of individual technologies. Specific examples of these technologies include:

- Photonics technologies that would permit a massive increase in capacity of military computers and reduce vulnerability to electronic warfare.
- High-temperature materials capable of retaining strength in temperatures as high as 4,000 degrees Fahrenheit.
- Nonlinear optics technologies in which light could be used in radically new ways for automatic tracking or elimination of atmospheric interference.
- High energy density propellants, chemically bound materials that might greatly increase fuel powers while reducing weight.
- Smart skins, surfaces whose embedded transmitting and receiving functions would eliminate today's need for pods and domes, which increase radar signatures.
- Knowledge-based systems that would use artificial intelligence to perform human-type logic exercises in avionics and weapons.

Notwithstanding the promise of these and many other technologies, Air Force officers acknowledge the magnitude of the weapons challenge ahead. What follows is a full picture of the task, based on AFSC's analysis of possible ways to meet Air Force needs in ten key mission areas.

Tactical Fighter Forces

THE MOST clear-cut ambition focuses on improvements to the tactical fighter forces that form the bedrock of Air Force combat power.

The service's technological establishment envisions new air supremacy and attack vehicles of unparalleled strength—stealthy, agile, far-seeing, and resilient, yet possessing an abundance of power. All these attributes and more, it is thought, will be needed to meet, in what promises to be a harsh twenty-first-century environment, requirements set by Tactical Air Command officers.

These requirements do not only include the capability to fight at night and in foul weather, locate and destroy mobile tactical targets, conduct airfield attack, survive in aerial combat, go after the hardest of hard targets, and carry out long-range interdiction. In addition, the systems must be reliable and easy to support.

At present, those needs are filled, with a greater or lesser degree of success, by such aircraft as the F-15, F-16, F-4, F-111, A-10, and A-7, based on earlier technologies that have led to improved reliability, secure communications, tactical decision aids, and integrated information processing. A need is foreseen for aircraft of greatly increased powers.

Some are expected to emerge in the "next generation" of weapons to be in service around the turn of the century. For the air-superiority role, the Advanced Tactical Fighter receives top billing. The Agile Falcon makeover of the F-16 fighter, along with an all-weather version of that versatile General Dynamics aircraft, are foreseen as the most likely multimission complements to the ATF itself.

AFSC is also working toward new aircraft for the close-air support, long-range attack, and defense suppression missions. Proposals include the possible development of a multimission, remotely piloted drone for various uses.

These air vehicles are expected to boast major advances in avionics. One example: so-called "noncooperative" aircraft identification systems able to perform the vital identification task by passive means. Next-generation aircraft could have links for instantaneous transmission of strike data, avionics suites capable of reconfiguring while in flight, and integration of sensors and other functions on a grand scale.

Success in these areas is contingent on a number of key technologies now emerging in AFSC labs. Chief among them are stealth properties that help to reduce aircraft signatures across the board. Technologists are striving to develop and perfect head-steerable target systems, multispectral and multimode sensors, sensors hardened against radiation, self-repairing flight controls, lightweight structures, and internetting of various communications systems. Also in prospect are faster and greatly simplified cockpit displays and night-vision devices.

For beyond the turn of the century, tactical aircraft concepts pose greater technological challenges. Among those concepts are robotic air vehicles for varied combat functions. Ultrasophisticated interdiction aircraft and a new multirole fighter are also being studied. Backing these up are such concepts as high-altitude/high-Mach protective equipment for crews, the Super Cockpit of multiple, integrated functions, and a fully automated attack system based on futuristic computer systems.

Making these concepts come to life will not be easy. The Air Force will have to master technologies now in the earliest stages of development. They include acoustic signature reduction, "few vs. many" air-to-air automated engagement systems, and flight decision aids based on artificial intelligence—systems that permit computers to conduct exercises in human-type logic.

The tactical force of the future also would benefit from successful development of the High-Performance Turbine Engine, a powerplant envisioned as having twice the thrust of, and far less weight than, today's most advanced engines, as well as short- and vertical-takeoff and landing technologies, in-flight thrust reversers, and robotic servicing of aircraft. An all-aspect head-up display and new systems that provide finely honed target discrimination will also be required.

Aircraft Armament

—Photo courtesy of Lockheed Corp.

To arm new fighters, USAF is developing advanced weapons, particularly for ground attack. Under review are powerful hard-target warheads, "stealthy" motors, lightweight structures, multirole warheads, and "brilliant" guidance.

TO COMPLEMENT what promises to be a greatly strengthened aircraft force in the future, the Air Force is mapping improvements in armament over the full range of combat missions.

The weapons now under study address requirements of extraordinary magnitude. Air Force users, for example, want the capability to employ weapons confidently at night and in poor weather. They want extreme standoff range, resistance to electronic countermeasures, capability to destroy heavily fortified targets, and greater ease of maintenance and handling. They want to be able to "launch and leave," achieve multiple kills with a single pass over a target, and yet be able to reduce the pilot's work load.

In addition, the new weapons will have to be stealthier, approach near-perfect accuracies, and have utility across a wider spectrum of engagement conditions.

Today's weapons fall short of these requirements. Based on older technologies of laser guidance, electronic fuzing, imaging infrared seekers, and the like, they include such air-to-air weapons as the AIM-9 Sidewinder and new AIM-120 Advanced Medium-Range Air-to-Air Missile, as well as a host of air-to-ground systems. While such weapons are effective today and for the near term, the future will pose problems for them.

As a result, technologists are focusing on highly advanced concepts, particularly for ground attack. Possibilities for relatively near-term usage include a version of the Maverick missile that incorporates millimeter-wave guidance. Also listed is an "autonomously guided weapon" able to carry out its mission with no instructions from a pilot after launch.

Planners are also investigating new forms of conventional cruise missiles, hard-target weapons, modular standoff weapons, munitions containing advanced inertial guidances, and hypervelocity missiles capable of traveling at least five times the speed of sound.

For air-to-air combat, the next generation of weapons is expected to include the AIM-132 Advanced Short-Range Air-to-Air Missile and an upgraded version of the AMRAAM weapon.

With respect to these next-generation arms concepts, technology development has become particularly active. Work is proceeding on autonomous guidance systems, powerful hard-target warheads, "stealthy" rocket motors, lightweight and stealthy structures, and multirole warheads. Also being pressed are new advances in algorithms that would permit microcomputers to "recognize" targets within a mass of data, as well as "smart" fuzing and low-cost components. Computational fluid dynamics, a computer-aided means of optimizing aerodynamic shapes *(see "The Electronic Wind Tunnel," p. 62)*, is expected to play a major part in weapons design.

Then come weapons for the distant future. For the time period beyond the turn of the century, the Air Force is pursuing a different set of technologies in hopes of achieving a big payoff in combat power. Now getting major attention within the laboratories are technologies of "brilliant guidance," which include such techniques as laser radar sensors and exploitation of infrared and millimeter-wave signatures of targets to enhance recognition.

Other key technologies pertain to development of materials and design of hard-target penetrators and high-energy "insensitive" high explosives—materials that resist accidental detonation due to fire or blast. A family of technologies—hypersonic separation aerodynamics, high-temperature materials, and hypersonic guidance integration—is obviously germane to development of ultrahigh-speed missiles.

Based on the expectation that these and other technologies will mature reasonably well, USAF has postulated some remarkable weapons for the inventory of the early twenty-first century. It envisions development of an "Advanced Air Superiority Missile" far superior to even the AMRAAMs of tomorrow. For the air-to-ground mission, future forces might well be able to call on fully autonomous antiarmor weapons, autonomous "high-value target" missiles, hypervelocity submunitions, and advanced mines dispersible over a wide area after release from an aircraft.

Reconnaissance/Intelligence

IN THE AREA OF reconnaissance and intelligence gathering, the level of sophistication that the Air Force seeks in its future systems is evident in the performance goals that the service is setting for itself.

Stated Air Force requirements, although few in number, are extremely challenging. Operational commands say they must greatly expand the visual and electronic spectrum within which they are able to work, with particular emphasis on passive detection measures. They seek highly advanced, computerized correlation and fusion of reconnaissance data to provide, among other things, instant, automatic recognition of targets.

In addition, USAF's operational users are asking technologists to provide means for decentralizing full intelligence stations to the unit level and for setting up robust, secure communications with a low probability of enemy intercept.

This, the Air Force makes plain, will require systems considerably more advanced than those deployed in its current generation of reconnaissance and intelligence forces, which are based on earlier technologies of digital data links, electro-optical sensors, digital recorders, multisensor fusion, clutter rejection, and rapid software prototyping. Today's collection platforms such as the RF-4C, TR-1, and SR-71, sensors such as the Joint Surveillance and Target Attack Radar System (Joint STARS) multimode radar, and associated processing and dissemination systems will have to give way to more advanced concepts.

For the next generation, Air Force planners foresee development of an advanced and possibly "stealthy" platform, known as the FX-R, to take up the tactical recce duties of the RF-4C. To meet near-term requirements, attention is also being given to a vast array of new, highly sensitive sensors. Among them: a very-long-range optical sensor, advanced electronic-intelligence-gathering systems, systems to provide time-correlation of signal intelligence, advanced radar locators, and laser-detection systems.

At the same time, systems used to both process and pass along vital intelligence data are due for upgrading over the next several years. Processing concepts being studied include systems that manipulate images in three dimensions, devices for mass storage and recording in wide bands, correlators of cartographic images, and systems that perform as automatic target "recognizers." Distribution of the final product will be enhanced by antijam, high-frequency communications and integrated voice/data switches.

The technologies that will form the basis of these systems are among the most highly classified anywhere—parallel computer processing, pattern recognition, photonics, low observables, and laser communications, to name only the most obvious. Perfecting them is viewed as a major challenge.

Even more challenging will be the development of technologies required for those reconnaissance systems that come later.

In the twenty-first century, the intelligence-gatherers may well be deploying fleets of hypervelocity vehicles, capable of tremendous speed and range. Other concepts include use of low-cost tactical drones and high-altitude, long-endurance aircraft as collection platforms. Sensors are expected to move into advanced-frequency domains and even become expendable.

On the ground, collected data may be analyzed by automatic, expert image-interpreters and language translation and transcription machines. Wideband, high-frequency radios, radios that convey data in multiple media, and advanced, secure laser communications would be the means of transmitting the product to combat commanders.

These devices would be the offspring of technologies now glimmering in the distance. The laboratories will have to come up with the keys to not only hypersonic and high-altitude aerodynamics, but also hypersonic and high-altitude engines, instantaneous target recognition, and machines that think like humans. Also required, in the view of AFSC planners, will be so-called "smart" aircraft skins capable of precise sensing in all directions and communications that are impervious to compromise and jamming.

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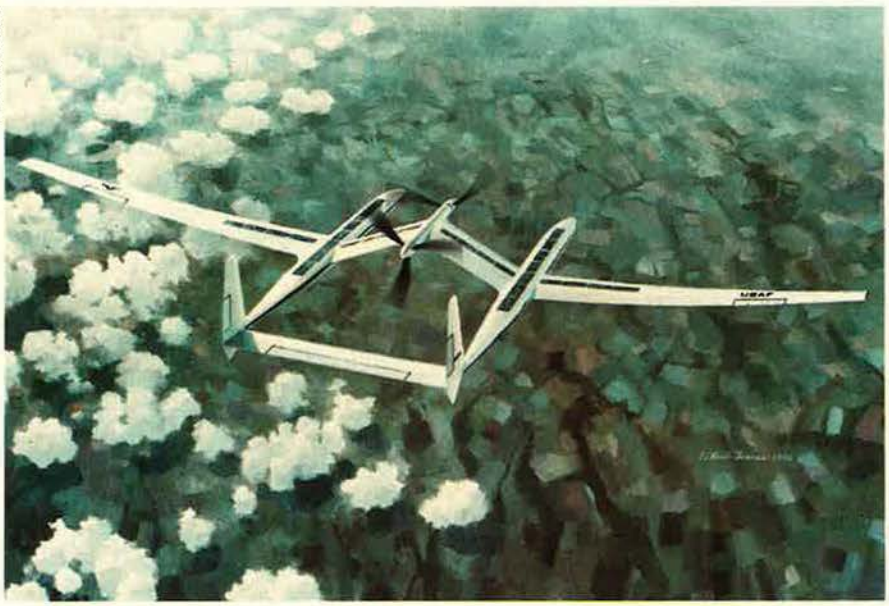


In the future, reconnaissance units may deploy high-altitude, long-endurance aircraft as collection platforms, as well as low-cost tactical drones. USAF seeks to develop highly advanced, secure communications to transmit data.

Electronic Combat

IF THE proposals of Air Force technologists give an accurate glimpse of what the future holds, USAF's multifaceted electronic combat forces are due for a major strengthening.

Already, scientists and engineers are proposing concepts that promise great advances over such systems as the F-4G Wild Weasel aircraft, High-Speed Antiradiation Missiles (HARM), jammers, and a plethora of other systems that make up the EC force of today. The concepts are intended to meet expanding requirements of tactical users across a broad front, from self-protection of combat aircraft to realistic simulation and training, from destruction of enemy electronic combat forces to disruption and suppression of these threats.

Within the next decade, for example, new concepts in self-protection systems are likely to be introduced. Proposals include warning and assessment systems such as millimeter-wave devices, infrared search and track systems, and laser scanners capable of giving precise range and bearing of enemy aircraft. Such missile-thwarting systems as automatic chaff dispensers and towed decoys are in the works, as are internal jammers capable of going against all enemy signals.

In the same time period, the Air Force wants to begin introducing new systems for demolishing enemy electronic threats. Planners see a need for new aircraft to perform the "Wild Weasel" radar-killing mission now carried out by an aging fleet of F-4G aircraft. The HARM would be updated and strengthened with a new dual-mode antiradiation seeker suited to missions against the most sophisticated Soviet radars. Destructive drones are being studied for missions against enemy electronic warfare, ground-control-intercept, and target acquisition systems as well as Soviet communications jammers.

Finally, plans call for stiffening the electronic-disruption powers of US forces by expanding the frequency coverage of the EF-111A electronic warfare aircraft, providing self-defense for the EC-130H Compass Call aircraft, and deploying jamming drones in abundance.

Making such systems possible are a number of key technologies now in various stages of development. Scientists are working hard, for example, on new millimeter-wave, electro-optical, and laser-sensing technologies. They are also working on parallel processors that expand the speed and capacity of computers used for processing threat signals.

Development of antennas that conform to the shape of aircraft, thereby reducing radar signatures, is of key importance. The so-called "fail-soft, fault-tolerant" generation of electronics—layered systems that continue to work even if a single component breaks—is critical. So is the technology of integrating various electronic warfare functions into a single, robust system.

Technologists are working equally hard on the key technologies for systems now on the far horizon. Those the Air Force considers vital are means to detect stealthy or low-signature airborne threats, high-power microwave technologies, and artificial intelligence for monitoring and keeping track of vast amounts of data emanating from enemy aircraft and emitters. These and other technologies will be used to feed an entirely new generation of electronic combat hardware after the year 2000.

Among such futuristic concepts are totally integrated situational displays for friendly aircraft, multispectrum expendables, directional automatic dispensers, protection from lasers and high-power microwaves, full-spectrum jammers, and radio-frequency weapons—all for aircraft self-protection.

US capability to destroy enemy systems would be expanded by concepts such as highly advanced signal processors and drones able to locate, home in on, and destroy enemy sensors, whether they be microwave, millimeter-wave, electro-optical, or laser in nature. For disruptive activity, USAF may choose to pursue development of low-band advanced jammers, unmanned air vehicles against all types of signals, and high-power countermeasures to enemy electronic systems. Advanced communications deceptions also are being conceptualized.

—Staff photo by Guy Aceto

In electronic combat, future defense suppression missions could feature destructive drones going against Soviet radars and jammers. Millimeter-wave, electro-optical, and laser-sensing technologies also are being studied.

Mobility Forces

Special operations forces will benefit from advanced airlifters. Air Force technologists are working on providing the means for better intertheater and intratheater transports, better and more numerous combat rescue aircraft, and improved transports and gunships for small-scale SOF activities.

STRENGTHENING the military air transport arm, too, is emerging as a preoccupation of Air Force planners. In fact, airlifters and associated support equipment that provide high mobility for conventional and special operations forces (SOF) could undergo striking change.

What Air Force operators require seems clear enough: a fifty percent increase in intertheater airlift, up to a minimum capacity of some 66,000,000 ton-miles per day; intratheater transports capable of hauling heavy, outsize cargoes; better and more numerous combat rescue aircraft; improved long-range transports and gunships for small-scale SOF activities; and greatly expanded meteorological capabilities.

While the requirements are prosaic, some concepts for meeting them are not. New, high-technology equipment seems destined to replace or supplement the mobility force of today, which is built around C-5, C-141, and KC-10 long-range lifters, C-130 intratheater lifters, and the various fixed-wing and helicopter craft assigned to special operations duty.

At the heart of the "next generation" of transport systems lies the proposed C-17 lifter, capable of performing both long-haul and short-distance missions with equal effectiveness. Air Force plans now call for producing 210 of these aircraft by 1998, although the outlook is clouded somewhat by budget pressures.

Like the huge C-5 Galaxy, the C-17 will be able to carry outsize cargo such as M1 Abrams tanks. Unlike the Galaxy, the new lifter will also be able to deliver such cargo directly to small, austere airfields. C-17 plans call for a capability to land on a runway 3,000 feet long and ninety feet wide. Thrust reversers will give it the ability to back up on the runway. About fifteen percent of the C-17 will be made of lightweight composite materials.

Another new transport, the CV-22 Osprey tilt-rotor aircraft, is aimed at improving the Air Force's ability to support special operations. Able to hover like a helicopter and cruise with the speed of a fixed-wing aircraft, it is designed to ease clandestine insertion and extraction of forces behind enemy lines.

The next generation of meteorological systems—critical to effective worldwide flying operations—is expected to bring major advances over those of today. Concepts include an automated weather-data distribution system, highly advanced radars, and a new, block upgrade to the existing Defense Meteorological Satellite Program structure.

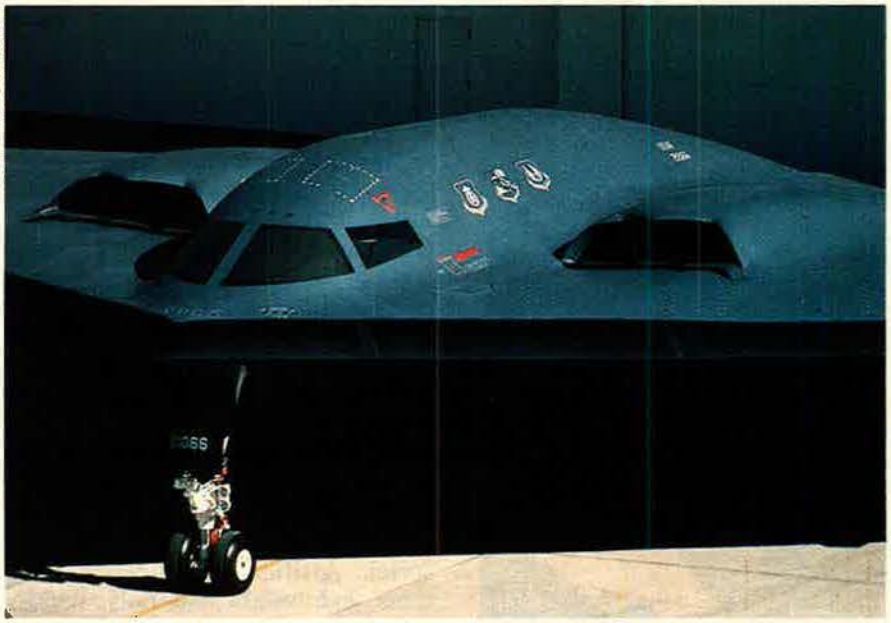
All these systems will draw heavily on key technologies that have been, and still are, under development in numerous Air Force laboratories. Artificial-intelligence systems, lightweight materials, multispectrum sensors, parallel processors, reduction of infrared signatures, and high-power engines are but a few of the technologies that will find their way into mobility forces of tomorrow.

Beyond the next generation of aircraft will come systems based on even more advanced technologies. Entirely passive means for reliable, low-level navigation, techniques for autonomous landing, passive self-protection devices, and ultralightweight materials are all being pursued. High-performance turbine engines of greatly increased thrust, short and vertical takeoff and landing capabilities, and, especially, advanced low-observable technologies will come into play.

These types of technologies and others now in their infancy are expected to permit the Air Force to develop and deploy, in the early twenty-first century, what it calls the "Advanced Strategic Airlifter" and the "Advanced Tactical Transport." Additional concepts include new, high-technology versions of transports and gunships for SOF missions. The latter could carry highly advanced forms of weaponry. These aircraft are expected to inherit virtually everything Air Force technologists have achieved in applying STOL and even stealth technologies to other planes.

Strategic Offense

—USAF photo by Bob Simons



Northrop's B-2, a stealthy, radar-foiling flying wing, heads the list of USAF "next-generation" strategic weapon systems. Other future concepts include ICBM upgrades, hypersonic aircraft, and advanced bomber-borne weapons.

NOWHERE IS THE magnitude of long-range Air Force ambitions—and the difficulty USAF will encounter trying to achieve them—more evident than in the realm of strategic nuclear weaponry.

What service leaders want to accomplish over the next decade or so seems challenging indeed. They hope to overcome present deficiencies and achieve true capability to rapidly find and strike strategic relocatable targets such as Soviet mobile ICBMs and to strike deeply buried targets such as hardened Soviet command bunkers.

In addition, they say they want to strengthen the survivability of USAF's penetrating bomber fleet, deploy new ICBMs in ways that make them relatively secure against surprise attack, and increase the refueling capacity of the USAF tanker force. They are calling for ICBM warheads able to penetrate layered defenses, should Moscow choose to deploy them. They assert a need to integrate conventional munitions into strategic forces in a big way.

But the premier weapons for achieving the goals—new manned bombers and superaccurate, mobile ICBMs—are expensive, politically controversial, or both, especially in an arms-control era marked by calls for deep reductions of superpower arsenals. Congressional approval is far from certain.

Even so, planners believe they have the proper systems concepts to strengthen a strategic armory now reliant on silo-based Minuteman and Peacekeeper missiles, B-1 and B-52 bombers, KC-135 and KC-10 tankers, and first-generation air-launched cruise missiles and gravity bombs.

Heading the list of "next-generation" nuclear systems: Northrop's B-2 Advanced Technology Bomber, the stealthy, radar-foiling flying wing rolled out last November in Palmdale, Calif. USAF wants to buy 132 B-2s, at an average cost of $516 million per copy, to confront future Soviet air defenses. The B-2 currently remains in the development stage.

Concepts for strengthening the ICBM leg of the strategic triad include Peacekeepers deployed in rail-garrison basing, single-warhead Midgetmen based on mobile launchers, and movable Minuteman IV/V intercontinental weapons. Also to be made available are new, earth-penetrating warheads to dig out heavily defended bunkers.

Plans call for a new generation of bomber-borne weapons, such as an upgraded short-range attack missile—SRAM II—and the radar-deceiving Advanced Cruise Missile, both of them nuclear. New conventional cruise missiles and "hard target munitions" also are in sight.

Underpinning these systems is a host of key technologies brought into being in recent years—low observables, radiation-hardened devices, enhanced chemical propellants, advanced materials, multimode sensors, automatic target cuing, multisource data processing, and technologies that reduce telltale signatures of nuclear reentry vehicles. None has reached full maturity, though many are nearing that stage.

Beyond the next-generation systems, the ICBM leg of the triad begins to seem problematic. Systems Command planners forecast no new ballistic missile concept, only "enhancements" of the existing force, presumably some combination of Peacekeeper, Midgetman, and Minuteman.

The future looks very different when it comes to manned bomber aircraft. The lineal descendent of the B-2, in the Air Force's conceptual view, may well be some form of hypersonic air vehicle capable of traversing long distances and zooming from an airstrip into space and back again.

Supporting such a breathtaking aircraft would be a new aerial tanker now known as the KC-X. Superseding the bomber missiles and munitions of the next generation: hypersonic attack weapons.

To make these a reality, Air Force technologists will have to score breakthroughs in hypersonics, combined cycle propulsion, ultra-high-speed computer processing, high energy density propellants, Super Cockpit technologies, superconductors, high-temperature and high-strength materials, fast-burning propellants, and active cooling techniques.

Strategic Defense

As it surveys the military requirements for effective strategic defenses—that is, protection of US territory from nuclear attack or coercion—the Air Force perceives a broad array of needs.

In its view, large-scale improvements are in order for some capabilities such as the ability to gain tactical warning of ballistic missile attack, rapid assessment of the scope and nature of an attack, and the like. Other needs—to conduct atmospheric and space surveillance and tracking, to protect US space vehicles from attack, to intercept threatening aircraft at long ranges and to intercept small air vehicles—are new.

At present, the Air Force bases its strategic defense effort on a narrow array of systems whose utility is limited almost exclusively to warning. The Satellite Early Warning System, Ballistic Missile Early Warning System (BMEWS), Pave Paws radars, and the Nuclear Detonation Detection System would provide notice of an ICBM attack and some assessment of its scale. The North Warning System, Over-the-Horizon Backscatter Radar network, and Distant Early Warning Line would alert Washington to a bomber or cruise missile assault. Ground-based deep space surveillance systems and space surveillance radars would keep track of US and Soviet space assets. With the exception of a few air defense fighters, no active means for resisting attack currently exist.

A large number of emerging technologies is cited as the basis for altering what is deemed an inadequate posture. Primary among them are means to detect stealthy air vehicles, lightweight structures, sophisticated multispectral sensors, radiation-hardened microelectronics, survivable solar panels, parallel processors, adaptive optics, improved atmospheric transmission codes, and clutter rejection techniques.

What kind of systems could emerge from these technologies? For the next generation, concepts for ballistic missile defense systems include a new system to replace the Satellite Early Warning network and major modifications designed to improve the BMEWS network and Pave Paws radars.

For defense against air-breathing threats, the Air Force foresees deployment of space-based radars, upgrades to the OTH radars, upgrades to the air defense fighter fleet, upgrades of E-3C AWACS aircraft, and use of an advanced aerial platform to monitor air corridors.

Space defense activities are focusing on concepts such as Deep Space Surveillance Radar, a Satellite On-Board Attack Reporting System for warning, and an air-launched antisatellite weapon to help deter the Soviet Union from initiating use of its own "satellite killer" weapons.

The real leaps in strategic defense capability, however, would not come until some time after the next generation of systems had been deployed.

In the conceptual view of Air Force planners, new technologies would enable the US in the far future to confront missile attacks in a more effective fashion. They envision advanced directed-energy weapons—lasers, neutral particle beams—taking on waves of missiles and warheads. It might also be possible to build highly accurate and effective kinetic-energy weapons able to hurl projectiles great distances at high speeds. Feeding in

To achieve effective strategic defenses, USAF would have to exploit the "high ground" of space. Possibilities include directed-energy weapons—lasers, neutral particle beams—and effective kinetic-energy weapons, able to hurl projectiles great distances. Key to this effort are technologies such as "brilliant" guidance, precision pointing and tracking, hypersonics, and artificial ionospheric mirrors.

target data would be the Space Surveillance and Tracking System, a network of satellites envisioned as having unprecedented abilities to detect and pinpoint small objects in space. The Boost Surveillance and Tracking System would serve a similar purpose with respect to missiles in the first minutes after launch.

Other concepts are advanced as possible answers to the long-term threat of attack through the atmosphere. Long-range hypersonic arms, able to close rapidly on attacking aircraft, are one possibility, as are interceptor missiles that could cruise at supersonic speeds. Another option for the future: an advanced interceptor fighter.

Protection of satellite assets would get a boost. Maneuvering "defensive" satellites, ground-based lasers to shoot down hostile space vehicles, and space-based interceptor vehicles are but a few of the possible options.

These systems will require technologies such as "brilliant" guidance, noncooperative target recognition, precision pointing and tracking, hypersonics, artificial ionospheric mirrors, directed energy, and high-power microwaves.

Space Vehicles, Operations, and Services

FROM ALL appearances, the great advances that the Air Force foresees for its earthbound forces might be replicated in space. The service is signaling that improved space systems will be required if the US is to exploit the possibilities of this high frontier to the fullest extent.

The increasing US reliance on space-based technology for national security and civilian functions, USAF maintains, has upped the ante for developers of space systems. Both the immediate and far future will require more responsive operational launch processing, improvements in on-orbit control of space vehicles, better space services, strengthened space contributions to worldwide navigation, and more precise environmental monitoring capabilities.

Already at hand are a number of key technologies that hold the promise of providing the capabilities the Air Force maintains that it needs. Key among these are those that focus on control of large space structures, advanced orbit transfer propulsion, microelectronics hardened against radiation, lightweight structures, spacecraft charge control, and antennas for transmission of extremely-high-frequency signals. Also getting strong laboratory attention are high-efficiency solar power cells, autonomous guidance systems, and wideband communications links.

One projected result of the technological explosion: advanced vehicles for launching payloads into space. That function is now performed in large part by the fleet of space shuttles and various Titan, Centaur, and Delta rockets. The next generation of systems, however, will include projects such as the Advanced Launch Vehicle, a new and more effective orbital maneuvering vehicle, expendable orbital transfer vehicles, and reusable orbital transfer vehicles.

The next-generation technologies hold out hope for much-improved on-orbit control of space vehicles. The up-and-down communications and control links between earth-based facilities and operating satellites will become more survivable. Also possible are effective cross-links between satellites.

In the area of space services, Air Force technologists foresee developing, within the next decade or so, new and survivable forms of solar panels for production of power as well as highly advanced nickel-hydrogen batteries. A sharply upgraded version of today's Global Position System, known as GPS IIR, will afford more precise and responsive navigation powers to military forces on earth around the turn of the century.

Beyond the year 2000, improvements in the Air Force's ability to conduct space operations will hinge on a variety of new technologies now attracting the attention of scientists and engineers in a big way. The object is to develop more effective technologies for spacecraft, space power, propulsion, microelectronics, and communications.

Key among these will be what is termed robotic telepresence, which is the use of dexterous manipulators such as mechanical hands controlled and directed from great distances by humans. High energy density propellants, which could yield up to sixteen times the energy density of existing propellant materials such as liquid and solid fuels, might bring about a twofold increase in launch vehicle lift capacity as well as a three- to fivefold increase in upperstage orbit transfer capability.

Also in store are so-called "fail-soft, fault-tolerant" computers, meaning that an individual failure within the system will not inhibit continued operations. Photonics—the use of basic particles of light as an agent of transmission—could dramatically increase the speed and capacity of information transfer in computers while reducing heat generated in the system.

The promise held by these and other futuristic technologies leads service scientists to postulate remarkable, far-future space system concepts. The current mixed launch force of manned space shuttles and unmanned rocket boosters, for example, might be supplemented by manned, single-stage-to-orbit vehicles that would be at home either in the atmosphere or in space. On-orbit control would be enhanced by fleets of autonomous, self-directing satellites and by survivable, jam-proof laser crosslinks tying together numerous independent satellites. Also foreseen are on-orbit repair and servicing of spacecraft and installation of microelectronics resistant to radiation damage.

Command and Control

THE FUTURE foreseen by the Air Force implies an obvious need for improvements to its command and control system—the nervous system of radios, computer stations, and communications satellites that enables civilian and military decision-makers to instruct the nation's strategic and general-purpose forces in a timely fashion.

The service projects a menu of clear-cut requirements for the decades ahead. It wants technologists to improve the Air Force battle management powers that are based on information processing and decision aids; reduce vulnerability of communications to electronic countermeasures, electromagnetic pulse, and physical attack; integrate tactical warning and assessment of missile, atmospheric, and space attack; and strengthen theater surveillance functions such as detection, tracking, and identification.

For the relatively near future, USAF will base its efforts on specific technologies already identified as critical. The laboratories will push to perfect new breeds of parallel computer processors that are secure from interference at multiple levels. They are at work on "smart," self-directing workstations involved in battle management. Laser communications, artificial intelligence processing techniques, photonic devices, processors for wideband extremely-high-frequency communications, and passive sensors capable of recognizing targets at great distances all are considered essential.

The promise of these technologies leads the Air Force to propose new system concepts across the board. In the area of strategic command and control, USAF foresees the possibility of a sweeping strategic war planning system, a center for rapid processing and correlation of target data, an adaptive planning system for Strategic Air Command, and a mobile system capable of providing warning, processing, and display of attack information. In addition, USAF believes it will need to replace its present national emergency airborne command post aircraft, devise tactical data-processing stations, and come up with a command and control system for the mobile Midgetman missile, should Washington choose to build it.

For next-generation general-purpose forces, the Air Force has conceptualized an automated advanced planning system. The new Joint Tactical Information Distribution System would permit multifunction dissemination of target and other data across a wide range of forces. Adding to conventional command and control would be a new combat identification sensor, a network management processor, and a specialized mission support system.

A number of concepts are proposed to meet the needs of strategic and conventional forces on a common basis. These include an upgrade to the Defense Satellite Communications System, to the level known as DSCS IIIC, plus antijam high-frequency communications, integrated voice/data switches, and systems to provide multilevel security for communications and gateways to multiple command and control networks.

The technologies of artificial intelligence and photonics also will be vital in developing far-future systems. The Air Force sees high potential in other technologies such as high-rate burst radio transmission, "smart" aircraft skins, three-dimensional situation displays, and detection and tracking of advanced, stealthy platforms, all of which are now under review.

The systems concepts that these technologies would support include ultrasophisticated command centers for ballistic missile defense forces, command and control networks to manage the antimissile battle, and airborne centers to provide processing and display of warning information.

That's in the strategic weapons field. For general-purpose forces, what the Air Force is looking for are radios that can transmit in multiple media, advanced airborne surveillance radars, and advanced tactical surveillance radars. Conventional forces also would benefit from multisatellite networks, an advanced, secure satellite communications terminal, and wideband high-frequency radios.

In the area of C³, USAF envisions upgrading the Defense Satellite Communications System to DSCS IIIC, antijam high-frequency communications, integrated voice/data switches, and multilevel security for communications.

Air Base Operability

—USAF photo by TSgt. Kit Thompson

Keeping USAF air bases operating in wartime will require new vehicles to assist in rapid runway repair and clearing unexploded ordnance. Also being developed are new substances to patch craters in runways, special munitions storage systems, and handheld data-burst systems for base communications.

As IT CHARTS its many future requirements and their associated systems, the Air Force has not neglected the critical need to keep its air bases operating in time of war. This "mission," like electronic combat, strategic offensive action, and other wartime business, carries with it a demand for specialized, top-flight "weapons."

In an age of expanding Soviet long-range airpower, American forward bases in Western Europe and Asia can no longer be viewed as sanctuaries from which the Air Force could operate free from interference. The upshot, in the view of Air Force planners, is a new requirement to prevent air base damage by actively defending against the Soviet air and ground threat, increasing the base's ability to survive an attack by providing passive defensive measures, enhancing the base's ability to recover from an attack and get back into action, strengthening its post-attack powers to generate combat sorties, and bolstering the infrastructure that supports base operations.

Helping the Air Force to relieve the danger in the next decade will be such technologies as survivable base communications systems, easy-to-handle polymer concretes, means of detecting the presence of plastic explosives, and systems to contain the effects of chemical and biological warfare agents.

These and other technologies underlie a number of new system concepts proposed for possible future use. They will enhance the defensive fighting positions from which US base-defense troops would try to ward off commandos seeking to disable a base. To help the base survive an attack, there would be infrared reflectors to confuse Soviet attack pilots, high-strength shelters to protect base personnel, and personal cooling systems to use in protective suits.

In addition, the Air Force is working on transparent patches to repair cockpit canopies damaged in an attack, new substances to patch craters in runways, and vehicles called Oracle, Flail, and MARV/SMUD that would be used to clear runways and taxiways. Revetted shelters and special munitions storage systems would help the base start operations quickly after an attack. Underlying the entire process are redundant utility cables and pipelines and precise, easy-to-use, handheld data-burst systems for base communications.

Even greater advances are sought in the far term, by which time technologists are expected to have mastered rapid repair of advanced aircraft materials, robotic operations in hostile environments, and other base repair techniques. Forthcoming advances in short takeoff and landing technologies will greatly ease the task of keeping an air base functioning after attack. Aircraft will simply need less to land on.

For the twenty-first century, concepts include advanced intrusion barriers that could supplement or replace manned fighting positions. New forms of deception, the ability to relocate high-value base targets, and a new, impermeable protective suit will all contribute to the survival of base systems and personnel. After an attack, the base and its aircraft might be brought back to life by using self-repairing avionics systems along with robotic and remotely controlled systems to disarm and dispose of unexploded ordnance. New treatments for biological agent contamination are in the works.

Other concepts to help base personnel weather an attack include collocation of fuel tanks within aircraft shelters, development of weapons containing "insensitive" high explosives, and other advances. Throughout the air base, currently vulnerable infrastructure would be replaced with hardened utilities, hardened vehicles, robotic fire-fighting systems, and fiber-optic communications cables armored for protection against blast. ■

The B-2 is built for penetration. It will be a while before a Soviet long-range radar is good enough to detect it.

On Stealthy Wings

BY JEFFREY P. RHODES
AERONAUTICS EDITOR

THE Air Force has removed some of the secrecy that had veiled the Northrop B-2 Stealth bomber. In ceremonies at Palmdale, Calif., on November 22, the rollout of the B-2 gave the public its first look at the flying wing, which has been in development for nearly ten years.

Air Force Secretary Edward C. Aldridge, Jr., one of the principal speakers at the ceremony, said that the B-2 "represents a stabilizing system in time of crisis and [is] an essential component of our strategic nuclear force as we progress down the path of nuclear arms reductions" and that the bomber "would promote deterrence."

The Secretary explained that the aircraft will begin flying soon and that, since "we are not just going to fly [the B-2] at night or in remote locations," the supersecret bomber would have been seen anyway. Another, unspoken, reason for the rollout was to show Congress and the public what they're getting for their money.

Security was tight, as many details about the program are still classified. Attendance at the rollout was limited to 500 invited guests (including thirteen members of Congress), approximately 2,000 employees of Northrop and its subcontractors who work at Air Force Plant 42 (many of whom had not seen the completed airplane), and sixty representatives from the media. Two hundred plant and Air Force security guards, some tending police dogs around the aircraft, were present.

The ceremonies were beamed live via satellite TV to other Northrop and subcontractor plants, as well as to several Air Force organizations that have already played, or will play, a part in the B-2's development.

Fifteenth Air Force band played an original composition titled "Stealth Fanfare" as the gray-and-black airplane was towed out of its hangar. Guests were kept almost 200 feet away and were not allowed to see the aft end of the B-2. The aft end incorporates features that mask the plane's infrared (or heat) signature and help it avoid detection by enemy radar.

Knowns and Unknowns

"This aircraft combines all the best attributes of a penetrating

bomber—long range, efficient cruise, heavy payload, all-altitude penetration capability, accurate delivery, and reliability and maintainability," said Air Force Chief of Staff Gen. Larry D. Welch, who was also one of the speakers at the ceremony. "Added to that is the greatly enhanced effectiveness and versatility provided by its Stealth characteristics."

The B-2 will have a crew of only two, but there are provisions for a third crew member if needed "for whatever reasons," said Secretary Aldridge. The cockpit is believed to have flat-panel displays and is thought to be controlled by fighter-type sticks, rather than yokes or wheels.

All weapons carriage will be internal, with the stores attached to the Boeing-built advanced applications rotary launcher. Elimination of external carriage will greatly reduce drag and will also improve the B-2's ability to avoid radar detection. The plane's primary payload will be nuclear weapons (missiles and/or gravity bombs), but the B-2 will have a conventional capability. The weapons payload is classified, but is known to be less than the 134,000-pound designed payload of the B-1B.

The B-2, which looks something like a manta ray, has a wingspan of approximately 172 feet. It is roughly sixty-nine feet long and seventeen feet high.

The B-2's wingspan, interestingly, is the same as that of the Air Force's first flying wings, the Northrop XB-35 and YB-49. These aircraft, which first flew in 1946 and 1947, were regarded as ahead of their time. Both encountered many problems in flight. Only a handful of these planes was built, and both YB-49 prototypes eventually crashed. The B-2 is longer (by sixteen feet) than the earlier flying wings.

The B-2's four engines are General Electric F118-GE-100s, nonafterburning derivatives of the F110 used in the Air Force's F-16 and the Navy's F-14A (Plus) and F-14D aircraft. The engine is in the 19,000-pound-thrust class. The B-2 will be subsonic. The absence of a supersonic "footprint" will enhance its ability to slip into a target area unnoticed.

The B-2's main aids in avoiding detection are its shape and the materials it is made of. Since the B-2 has no sharp edges or vertical surfaces exposed during flight, radar beams have nothing to bounce off. Beams that do find the B-2 will be absorbed by the aircraft's structure of what is believed to be carbon fiber or other composite materials.

"The airplane is not invisible," noted Secretary Aldridge. "It's just that radars can't see it until it's at close range. And we don't anticipate the Soviets developing a [long-range radar] system in the near future that will be able to see it. The B-2 has a very low [radar cross section] that will allow it to get to any target it needs to." Those targets include mobile missiles and high-value command and control centers.

The airplane has an in-flight refueling receptacle. The flying wing shape is very fuel-efficient, however, so the B-2 will need less tanker support than B-52s or B-1Bs do. Experts have estimated the unrefueled range of the B-2 at between 6,000 and 7,500 nautical miles.

Although guests at the rollout were prohibited from viewing the B-2's aft end, *Aviation Week* magazine enterprisingly obtained aerial photographs without the Air Force's cooperation. These photos show the trailing edges of the saw-toothed wing to be fitted with long control surfaces that could act as elevons (elevator/ailerons) or flap-

erons (flap/ailerons) for directional and lift control.

Asked if the plane made use of "fly-by-light," or fiber-optic control linkages, which are impervious to electromagnetic interference, Secretary Aldridge replied with an emphatic, "I'm not going to answer that." The B-2's huge main landing gear doors may also function as an empennage and provide some lateral stability for the aircraft, especially in crosswind takeoffs and landings.

The B-2 Program

"The B-2 is the first computer-age airplane," said Thomas V. Jones, Northrop's chairman of the board and chief executive officer, "but the airplane wasn't built by computers. And computers didn't replace people. Computers brought people together and gave them the tools they needed to make the most of their individual skills and imagination."

Indeed, the B-2 is the first aircraft to be designed and built with a three-dimensional integrated database. This computer network electronically linked Northrop's engineering, tooling, and manufacturing segments with contractor logistics support, the Air Force, and the major subcontractors (Boeing Advanced Systems Co., LTV Aircraft Products Group, and General Electric's Engine Group).

The other major subcontractors (Link Flight Simulation Corp., Hughes Radar Systems Group, and Boeing Military Airplane Co.) and more than forty known subcontractors *(see box, p. 46)* were also in constant contact with Northrop.

The network resulted in a ninety-seven percent success rate for first-time fit of tubing, fluid systems, and mechanical systems. This compares with a sixty percent success rate for a conventional design process. Northrop invested more than $1 billion in the system, which includes 400 terminals and thirty computer graphics rooms at the company's 3,300,000-square-foot Pico Rivera, Calif., facility (where the B-2 was designed and engineered) alone.

The avionics system has already been tested for 44,000 hours. Engineering development testing took another 16,000 hours, and the flight-control system has logged 9,000 hours on the test bench. Strategic Air Command flight crews (the eventual users) have accumulated 6,000 hours in the B-2 simulator.

The airplane was also designed for high reliability and maintainability. Crew chiefs and line maintenance troops were consulted about access to components, and Air Force Logistics Command officials provided input on sustainability.

Eliminating Contrails

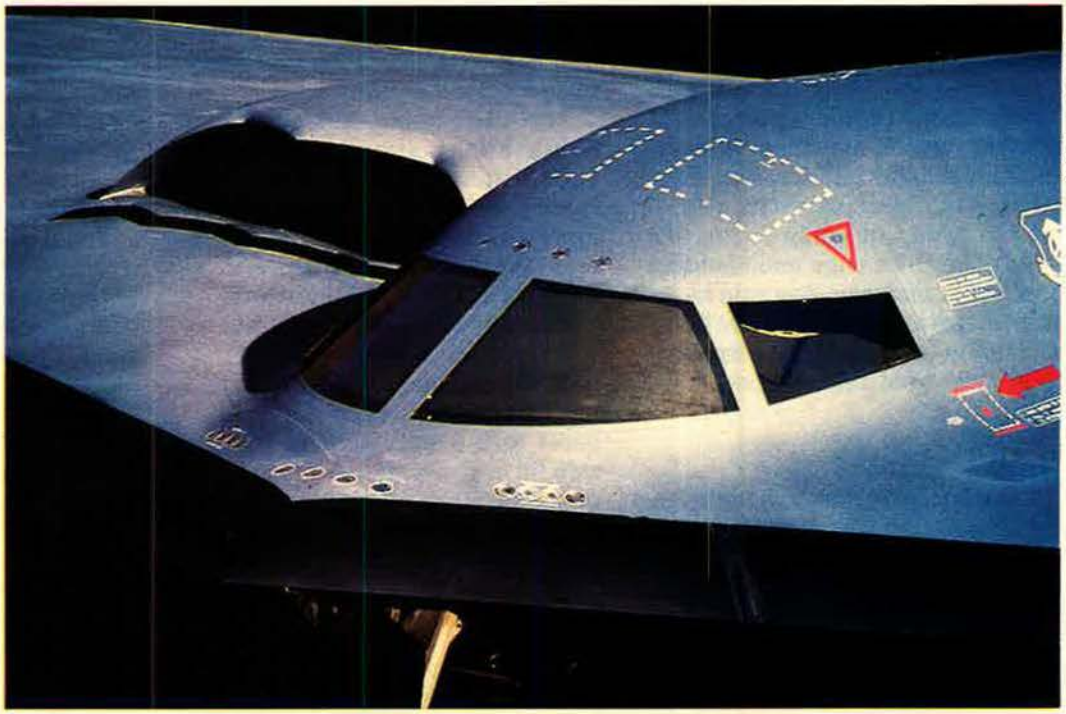
The B-2 was originally conceived as a high-altitude bomber, and that created the problem of eliminating contrails, which would give the airplane's position away to mankind's oldest sensor—the human eye.

At the rollout, though, Secretary Aldridge announced that "the contrail problem has been solved, but I'm not going to tell you how." Two possible solutions: a fuel additive, or a baffle system on the rear of the aircraft that mixes cold air with the hot engine exhaust to eliminate the formation of the telltale vapor trails.

Sometime around 1983, a reassessment of the threats the B-2 would encounter resulted in a redesign (mostly in the carry-through structure, where the wing halves meet in the center of the aircraft and distribute aerodynamic loads) to help the aircraft withstand the stress of low-level flight. The redesign cost approximately $1 billion.

John K. "Jack" Northrop, the de-

The Northrop B-2 looks particularly sinister in this head-on shot, taken at the rollout ceremonies at Palmdale, Calif. The B-2's wingspan of approximately 172 feet is roughly thirteen feet shorter than that of a B-52. At sixty-nine feet long and seventeen feet high, the B-2 is about six feet longer than an F-15 and the same height as an FB-111.



—USAF photo by Bob Simons

Despite the public rollout, many B-2 details are still classified. The plane's two-person cockpit was shrouded during the ceremonies, and guests were prevented from getting a close look at the aircraft's aft end, whose shape and materials help the B-2 avoid detection. Evident in this picture are some of the many compound curves that help reduce the B-2's radar signature.

signer who pioneered the flying-wing concept in the 1920s and built the first practical flying wing (the N-1M) in 1940, was given a specially arranged briefing on the B-2 before he died in 1981 at the age of eighty-five. One of Mr. Northrop's sons, John, his granddaughter, Janet Northrop, and a grandson, Jere Johansing, were present at the rollout.

The first B-2's serial number (82-1066) indicates that money to build the aircraft was authorized in FY '82. Construction was done on "hard," or production, tooling, instead of the "soft" prototype tooling. This method resulted in a cost savings, but the redesign of the airplane necessitated changes to the tooling and delayed development.

"Costs for the program now will be determined and given in the January budget submissions to Congress," noted Secretary Aldridge at the rollout. "The [airplane's development and production] schedule is causing some revisions [to the estimated costs]." The $36.6 billion cost estimate for 132 aircraft has escalated by sixteen percent into the neighborhood of $68.1 billion, or about $42.5 billion in 1981 dollars. That figure works out to $516 million per plane in current dollars.

After the rollout, the B-2 was scheduled to undergo engine and high-speed taxi tests and other final checkouts. The aircraft was scheduled for its first flight about the time this article appears. It will make the short hop from Palmdale to Edwards AFB, where it will undergo a full test program. It will be flown by one Northrop and one Air Force pilot on that first flight.

The B-2 and the first five B-2As will be assigned to the flight-test program at Edwards, with five of the aircraft eventually going to the operational fleet. A 171,000-square-foot hangar and two additional buildings have been built at the Air Force Flight Test Center to support the B-2 test program.

The first operational B-2s will be assigned to Whiteman AFB, Mo. Currently home to the 351st Strategic Missile Wing, Whiteman will eventually receive thirty-four B-2s, which will be housed in individual hangars. Over the past two fiscal years, $144.3 million in construction has been authorized for the base, which has no fixed-wing flying mission. The B-2's initial operational capability is expected to be reached by early 1993.

If the B-1B deployment schedule is an accurate guide, the B-2s will likely be assigned to wings at four other bases, not yet identified. The primary depot facility for the new bombers will be the Oklahoma City Air Logistics Center at Tinker AFB, Okla. ■

The B-2 Industrial Team

The B-2 industrial team is headed by prime contractor Northrop Corp. Boeing Advanced Systems Co., LTV Aircraft Products Group, and General Electric Engine Group are key members of the contractor team. Other major subcontractors include Link Flight Simulation Corp., Boeing Military Airplanes, and Hughes Radar Systems Group.

The Air Force has also declassified a partial list of other members of the B-2 industrial team. They include Abex Corp., Adams-Russell Co. Inc., Allied Signal Corp., Arkwin Industries Inc., Bell Systems Engineering, Collins Defense Communications, Continental Microwave and Tool Co., Eldec Corp., E-Systems Inc., Fairchild Communications and Electronics Co., Fanwal Inc., G. E. Aircraft Control Systems Department, G. E. Instrument Products Operation, Gull Inc., Hercules Inc., and Honeywell Inc.

Others are Kaman, Kearfott Guidance and Navigation Corp., Lockheed Corp., McDonnell Douglas Aircraft Co., Miltope Co., Moog Inc., OEA Inc., Parker-Hannifin Corp., PDA Engineering, Raychem Corp., Raytheon Corp., Resdel Engineering Corp., Rockwell International Corp., Rosemount Inc., Sanders Associates Inc., Smith Industries Aerospace and Defense Systems Inc., Sundstrand Corp., Teledyne, TRW Inc., Unisys Corp., United Aircraft Products Inc., United Technologies Corp., Vaga Industries, Vickers Inc., and Whittaker Corp.

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The Air Force reaches some difficult decisions about pilot retention, readiness, and other problems.

Tough Choices for Hard Times

BY JAMES W. CANAN, SENIOR EDITOR

ILLUSTRATIONS BY MICHAEL DAVID BROWN

THE Air Force is drawing the line on offering pilots better deals to keep them in uniform. It has gone as far as it is willing to go with bonuses and other blandishments aimed at persuading them not to depart for better-paying jobs with the airlines.

Now USAF is taking a different approach to solving or alleviating its pilot-retention problem. It is reexamining its methods of selecting pilot trainees in the first place.

The idea is that the problem may have its roots in a screening process that pays too little attention to each candidate's willingness to make a long-term commitment to the Air Force, rather than just seeing it as a means of learning to fly.

Pilot retention was a hot topic among many taken up at an Air Force Association symposium titled "The US Air Force—Today and Tomorrow" held late last year in Los Angeles, Calif. Air Force goals and concerns were discussed in the context of the stunted growth of defense spending and the continuing need to face up to a Soviet threat that remains as forbidding as ever, the speakers agreed, despite some appearances to the contrary.

USAF faces the future bedeviled by a persistent pilot-retention problem.

Symposium speakers were Air Force Chief of Staff Gen. Larry D. Welch; then-Secretary of the Air Force Edward C. "Pete" Aldridge, Jr.; Gen. Duane H. Cassidy, Commander in Chief of US Transportation Command and Military Airlift Command; and Gen. John L. Piotrowski, Commander in Chief of US Space Command and North American Aerospace Defense Command.

Also participating were Gen. Bernard P. Randolph, Commander of Air Force Systems Command; Lt. Gen. Thomas G. McInerney, Commander of Alaskan Air Command; Lt. Gen. Jimmie V. Adams, Vice Commander of Tactical Air Command; and John Meinhardt, Deputy Assistant Secretary of Energy for Planning and Resources.

Readiness and Modernization

General Welch discussed the pilot-retention problem in response to questions. He described it as "a tragedy for the country" in that only about forty-three percent of pilots in the prime of their careers—eight to fourteen years of service—are choosing to stay in the Air Force when their tours are up.

"We can't continue to put up with the hemorrhage of pilots leaving the Air Force and maintain our readiness," General Welch asserted.

Readiness figured heavily in symposium discussions. Clearly, the Air Force leadership will always give it high priority and will guard against any regression to the conditions of the late 1970s, when underfunding of operations and maintenance left all too many units and weapon systems unfit to fight.

But readiness is by no means untouchable in this time of tight budgets. General Welch made it plain that USAF has no intention of shortchanging modernization in order to keep O&M funding at utopian levels.

The Chief of Staff declared: "It's always very popular to say that we're going to take care of the force that we have today before we take care of our future force. But that's irresponsible, and we've reached the point where we can't take that attitude any longer."

As to modernization, the strong message at the symposium was that USAF will fiercely defend against any moves to stop or unduly stretch such blue-ribbon programs as the B-2 Stealth bomber, the Advanced Tactical Fighter, and the production and rail-garrison deployment of Peacekeeper ICBMs.

Those programs "just happen to be at the core of our future capability" and "are not on anybody's cut list," General Welch declared.

The C-17 airlifter got a vote of confidence too. It keeps coming up in speculation about major programs that may have to be cut or killed in the budgetary bloodbaths anticipated through this year and coming ones.

But General Welch forcefully described the C-17 program, now in the early stages of production, as enjoying "very high priority with all the services, not just the Air Force."

General Cassidy also promoted the C-17 and presented his case in behalf of airlift in general. He said that "there has been a continuing and insatiable appetite" for airlift ever since the Berlin Airlift of 1948 underscored its value as "a powerful instrument of our national policy."

General Cassidy warned against exaggerating the extent of problems caused by tight defense budgets, saying: "We'll wind up blaming the weather on the budget crunch if we're not careful. There's nothing wrong with some belt-tightening. Some of it is healthy."

Even so, this does not mean that military leaders should accept deep cuts without protest, he said. "I hear everybody saying that we're just going to have to live with less money. Well, I don't think we should, and I think we should stand up and say that to the right people."

The Energy Department's Mr. Meinhardt had a sobering message for the symposium audience in the context of the future costs of nuclear warhead production and maintenance.

His point was that the nation's nuclear plants and reactors "needed to sustain the Air Force mission and the nuclear deterrent" are badly in need of costly upgrading and replacement. The money for this will have to be provided in the portion of the Energy Department budget that "falls beneath the ceiling that's placed on defense spending," he warned.

To the Air Force, nothing is more important than maintaining the nuclear deterrent. General Welch emphasized that USAF will remain intent on this by means of its strategic modernization program, one that has been a clear success in its production of such systems as the Peacekeeper ICBM and the B-1B bomber, which USAF claims is being unjustly maligned.

"An Elegant Logic"

General Welch called the B-2 Stealth bomber the most recent example of "the significant results of our efforts at leveraging high technology" for strategic deterrence. And he came down hard in favor of deploying fifty Peacekeepers on railroad trains that would be dispersed from various military bases throughout the US.

This deployment mode has "an elegant logic," the Chief of Staff told the symposium, because the trains with the missiles would move out too quickly for the Soviets to target them.

Such mobile deployment "would not send the wrong message in a crisis," General Welch declared. Rather, he said, it would "provide enduring survivability" of the Peacekeeper force—"and, in a crisis, survivability of the land-based ICBM force is stabilizing."

The Chief of Staff is "absolutely convinced" that USAF will be permitted to follow through on its rail-garrison deployment plan despite "lots of political opposition to that approach."

But "we are seeing less and less opposition," and "we are proceeding down that [rail-garrison] path with great progress and technical success," he asserted.

Noting that the Air Force must tend to its responsibility for tomorrow's capability as well as today's, General Welch said that the service may have let modernization slip a bit too much in favor of readiness and will redress the imbalance.

He explained that the Air Force budget divides about half and half between investment accounts, or modernization, and operations accounts, or readiness. Eighty to ninety percent of budget cuts in the last three years have impinged on modernization, the relatively minuscule remainder on readiness, he

said, adding: "We are quickly approaching the point where we are not going to be able to sustain quite the level we have sustained in all those operating accounts."

General Welch recalled that the Air Force chose to "cut readiness to the bone" in the 1970s in order to come up with the money to resume modernization, which had been arrested during the Vietnam War. That approach evoked "a lot of criticism," he said, but paid off handsomely in such new systems as the F-15, the F-16, the B-1B, the Peacekeeper, the C-17, and the B-2 and in upgraded B-52s, KC-135s, C-141s, and C-5s.

There will be no great imbalance between modernization funding and readiness funding in the tough times ahead, the Chief of Staff said, adding:

"We're in our twelfth year of substantial modernization after eight years of virtually no modernization. We're also in our eighth year of substantial concentration on readiness. So while you'll see some drawdown in readiness and some further stretches in [modernization] programs that ought not to be stretched, we are not starting from levels that will lead to the drastic changes that were associated with the last time we went through this cycle. So there is no cause for despair, for thinking that we're headed for that kind of a downhill slide in readiness."

The Chief of Staff acknowledged, however, that one aspect of readiness—keeping pilots and keeping them happy—is extremely troublesome.

"We now have congressional approval to pay a $12,000-a-year bonus to pilots between their eighth and fourteenth year," General Welch said, "and we asked for that bonus with some distaste.

"It represents a marketplace approach, and we traditionally have not used a marketplace approach to persuade people to serve an institution like the United States of America."

General Welch said that the Air Force does "not believe that we can buy a pilot for a $12,000-a-year bonus" or that "we have any hope of competing with the airlines on that basis." The airlines, he said, "will pay whatever it takes to get the pilots and pass that cost on to the consumer, and we can't do that."

In granting bonuses, General Welch explained, "we're after the marginal group who really wants to stay with us, who would much prefer to serve as Air Force pilots, but who can't quite bring themselves to do that, because of family pressures or for whatever reason."

Surveys show, he said, that the Air Force should be able to retain "about twelve percent more" pilots a year under the new system of bonuses. This, he said, "would get us very near to where we want to be" in terms of enough retention to maintain an adequate force.

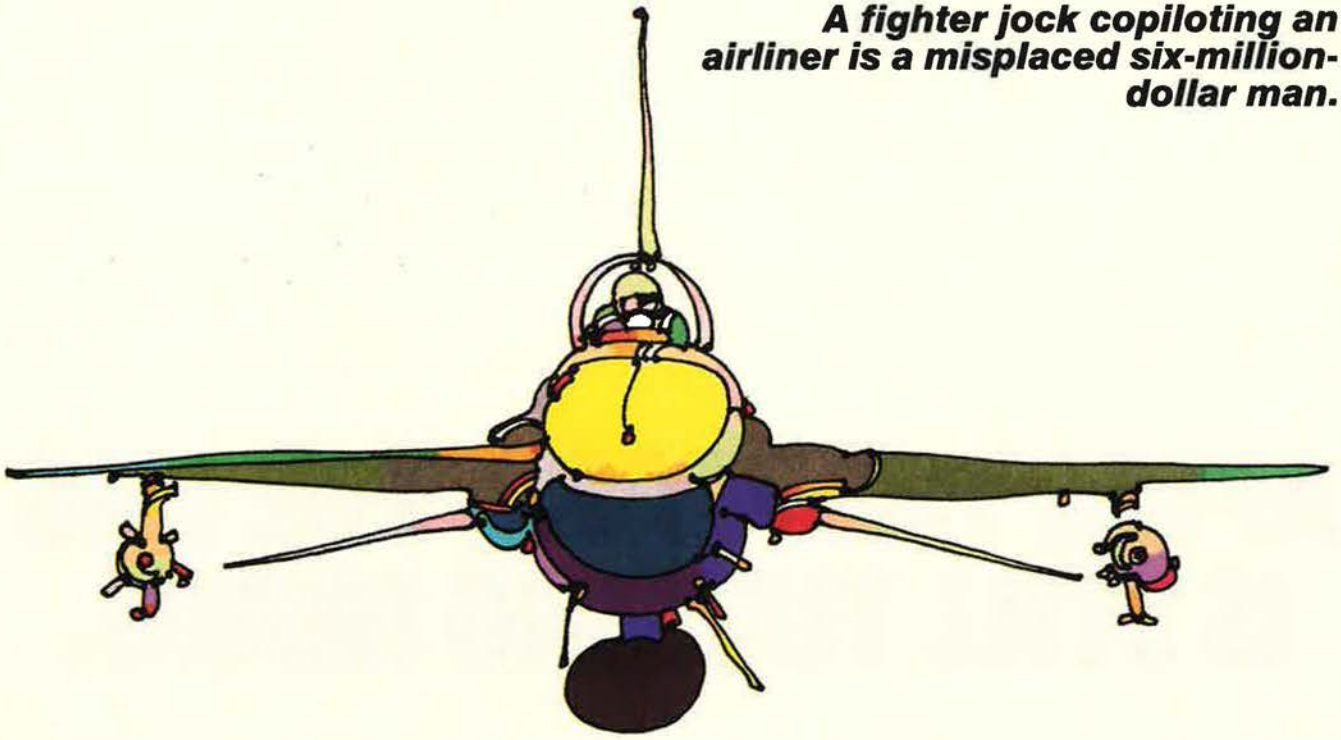
Six-Million-Dollar Man

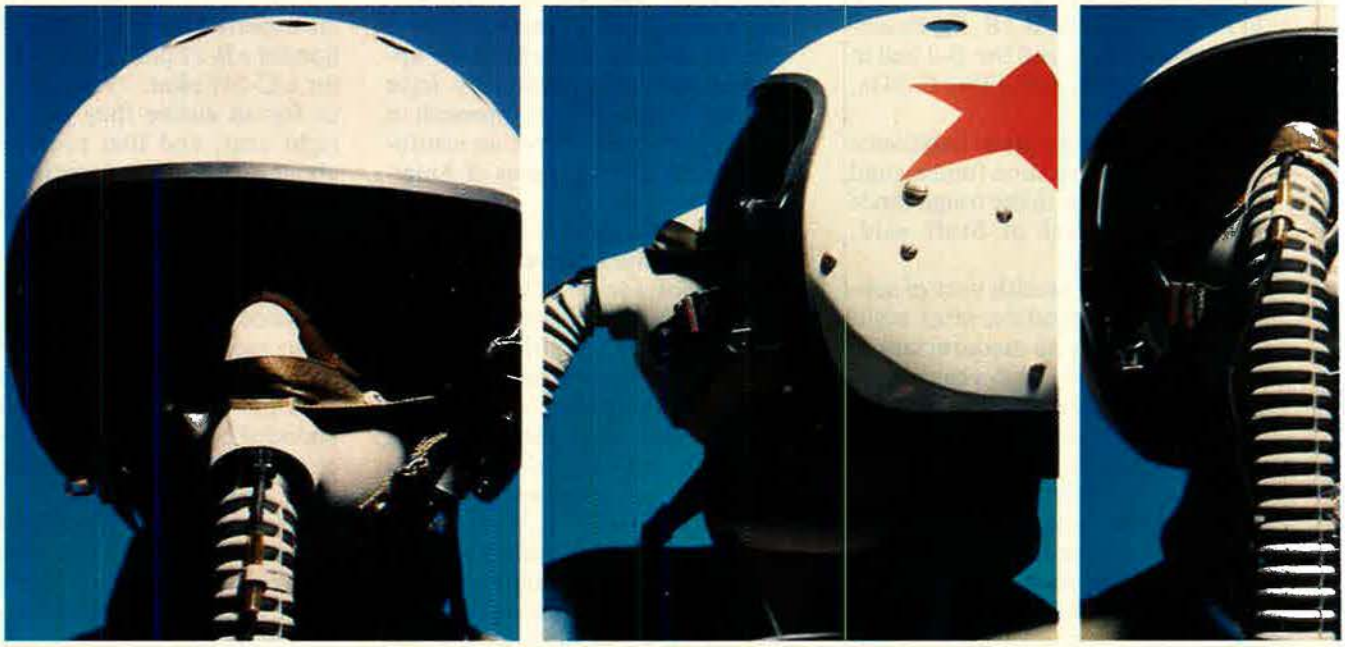
General Welch noted that it costs the Air Force $6 million to develop an experienced F-15 pilot, $5 million for a B-52 pilot, and $3.5 million for a C-141 pilot. "When they leave us for an airline they go sit in the right seat, and that requires only about a $100,000 education. So we provide a six-million-dollar man for a $100,000 job."

He said that the Air Force has "listened intently to all of the announced reasons why pilots leave us to move from a compelling, uplifting job into the right seat of an airborne bus." The service has responded by "doing all the things we could" to address such reasons, he said, adding:

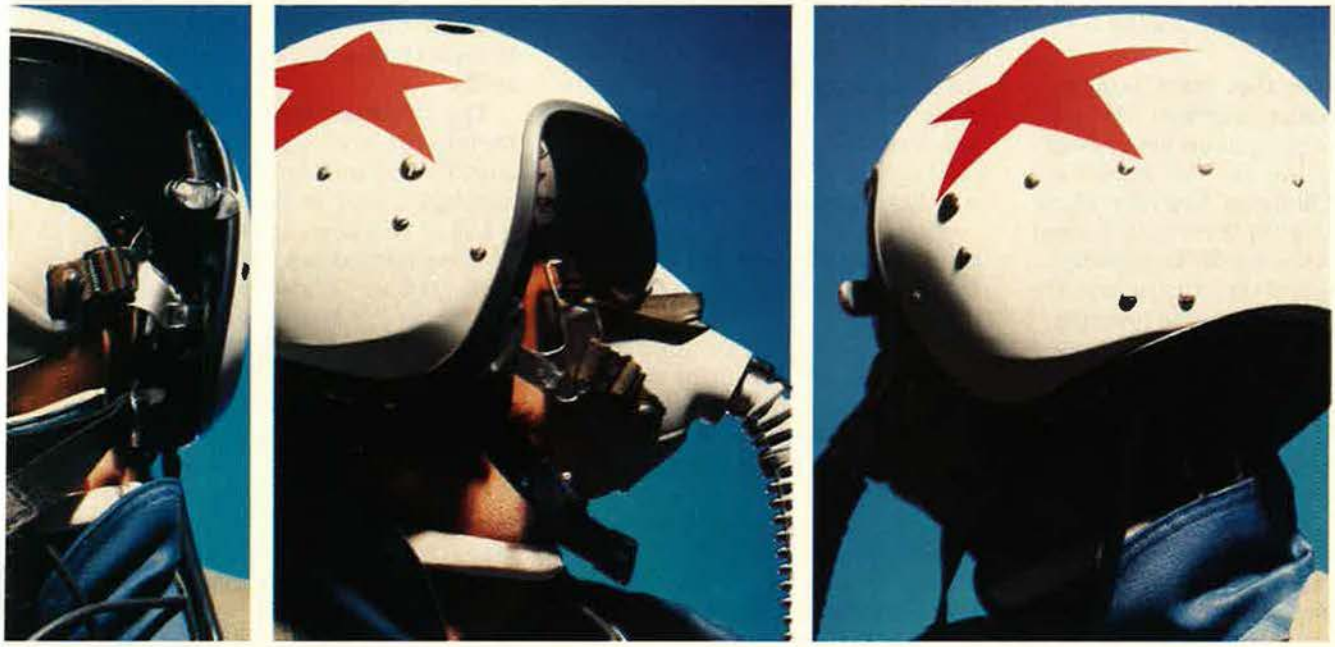
"Nonetheless, the pilots keep leaving us and in very significant numbers. We have reached the point where we are about to decide that there may be something funda-

A fighter jock copiloting an airliner is a misplaced six-million-dollar man.





AFTER TEN YEARS, THE F-16 IS STILL TURNING HEADS.



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GENERAL DYNAMICS

mentally wrong with our approach to picking people."

USAF may require people selected for pilot training to make "a longer commitment" to the Air Force, he said, because "that would have an impact on the kind of people who elect this six-million-dollar education in the first place."

General Cassidy took exception to the suggestion in a question from the audience that the pilot-retention problem centers on flyers of heavy multiengine aircraft, most especially those of Military Airlift Command.

"I disagree that there is only a nonfighter-pilot problem," he said. "There is a pilot retention problem throughout the US Air Force and the United States of America. There is a serious pilot shortage problem throughout the world. For example, the British and the Australians are struggling with the same problem."

That problem, he said, "may be with us always," given its pervasiveness in military and commercial arenas.

Asked how he feels about acceding to the wishes of many pilots by exempting them from nonflying duties and tours of duty, General Cassidy replied that "the Air Force would be well served to be very cautious about establishing a corps of people who do nothing but fly airplanes."

He went on: "We've heard it for a long time, particularly from the young pilots. They say, 'Just let me fly the rest of my life, and I'll be happy as a clam.'

"We've resisted that. The person who says that is a person with limited objectives, quite frankly, who is going to have a hard time competing in this Air Force of ours with the quality people we've got. He's going to have a tough time with his self-esteem."

General Cassidy also pointed out that pilots who would like to eschew everything but flying during their military service "now have the ability to do that, to some degree, in the Air Force reserve program."

Military Airlift Command "needs those people in the reserve just as badly as we need them on active duty," he said, "because half of our total airlift force resides in the reserves."

General Cassidy expressed hope that the nonflying burdens on pilots will be alleviated somewhat by "some of the officer professional development policy changes we're making at this moment," all aimed at seeing to it that "captains do captains' work, majors do majors' work, and so forth."

Policy changes now being made "will make it possible for a pilot in our Air Force today to go right up to lieutenant colonel in the cockpit and retire with his head held high and his self-esteem intact and then go fly with an airline."

Changes being made by the airlines also accommodate such a scenario, General Cassidy said. He noted that airlines "have begun hiring [military] retirees . . . all the way through the late forties in age."

As to flyers who want to do nothing but fly throughout their Air Force careers, General Cassidy had this to say:

"I've known a lot of those guys. They're wonderful to be around. But I'm not so sure they're the kind of guys from whom we'd extract the great leadership our Air Force will need in the future."

Much of that leadership will be devoted to airlift, he implied, declaring: "I believe strongly that the United States will have to maintain a substantial conventional military establishment on and around the Eurasian landmass. Airlift will be crucial to our ability to quickly deter some regional rearrangement that would be contrary to our best interests."

The CINC of US Transportation Command and MAC said that today's world "has become dependent on regional balances of power and, thus, on our own mobility and flexibility.

Tool of Diplomatic Statecraft

"Diplomacy is all the more important, and airlift is, above all else, a primary tool of diplomatic statecraft today. . . .

"Airlift is like the cavalry. No matter what happens around the world, people expect MAC to be there, because MAC always *is* there."

General Cassidy noted that MAC has been "flying camouflaged airplanes into the heart of the Soviet Union for the first time in our lives" in transporting US inspectors and other officials as a result of the Intermediate-range Nuclear Forces (INF) treaty. Such flights will continue through the mid-1990s. "The changing US-Soviet relationship" that they signify will lead to "a redistribution of our [US] forces within the next decade," the General predicted.

"There are lots of pressures now to bring some of our forces back from Europe or change them around, wherever they are," he said. "But no matter how they change, they will rely heavily on transportation and specifically on airlift."

The Department of Energy's Mr. Meinhardt also signaled changes ahead in the nuclear arena. But his harbingers had to do with getting nuclear weapons built, not with drawing them down, and they were presented as somewhat ominous.

To meet Air Force requirements, Mr. Meinhardt said, DoE is presently producing such modern weapons as the Tactical Air-to-Surface Missile (TASM) warhead, the new short-range attack missile (SRAM II) warhead, the Peacekeeper ICBM warhead, and the B83 bomb that is often described as the cornerstone of the Air Force's strategic bomber force.

In addition, he said, DoE is working on a warhead that could be applied to existing and future land-based strategic missiles and is updating such older weapons as the B61 tactical bomb to assure its compatibility with modern safety, security, and command and control requirements.

"We also have a role," Mr. Meinhardt said, "to provide a technology base from which we can respond to the changing threat. For example, we are studying the feasibility of an earth-penetrating weapon to hold at risk deeply buried targets."

All such DoE studies are outgrowths of a document called "New Dog" (Nuclear Weapons Development Guidance), which the services compile each year on nuclear systems and technologies to be required as far as twenty years into the future.

"Meeting those future needs will be increasingly difficult," Mr. Meinhardt told the AFA symposium.

A major reason for this is the con-

Production and maintenance of nuclear warheads is becoming ever more worrisome.

dition of DoE's weapons production complex, described by Mr. Meinhardt as "a single-thread system of aging, World War II-vintage, specialized plants."

All produce nuclear materials and components that are assembled into weapons at DoE's Pantex plant in Texas, and "if any one of them is interdicted, for any reason, the entire production system could be halted," Mr. Meinhardt said.

The threat of this is all too real, he noted, in view of the "series of challenges in the safety and environmental regimes" now besetting the nuclear-weapons complex.

"Many facilities that were built in the 1950s will require major and very costly modernization or replacement to meet current standards," Mr. Meinhardt said. "Of critical importance are the reactor systems we use to produce materials that sustain the life of the nuclear stockpile."

At the time of the AFA symposium, the three reactors at the Savannah River plant in South Carolina, which produce all plutonium and tritium for US nuclear weapons, were shut down because of safety concerns. Upgrades were under way, and DoE has begun working on two new nuclear materials production reactors, one at the Savannah River plant and one in Idaho.

The new ones should begin coming on line in 1999, after which the existing Savannah River reactors can be retired. Meanwhile, however, maintaining continuity of nuclear weapons production may be a close call for DoE.

Arms-control agreements shape up as troublesome for the department's work in testing, stockpiling, and maintaining the technologies of nuclear weapons. As Mr. Meinhardt put it: "The agreements may limit both the numbers and types of warheads in the stockpile. These limits may in turn require the weapons to have greater built-in versatility to accomplish specialized missions."

Mr. Meinhardt expressed concern that "limits on nuclear weapons testing may force us to develop a family of 'wooden bombs' or bombs that could be remanufactured and certified without testing. That would be a real challenge. A nuclear weapon placed in the stockpile and maintained there must work if called upon."

He paused and pointedly asserted: "And the weapon must *not* work if *not* called upon."

Nuclear weapons are "almost all designed to the very limits of the technology that existed when they were first produced" and are "almost without exception kept in the stockpile for decades," Mr. Meinhardt said.

This, he said, makes it "very difficult to maintain the technology during the time the weapons are in the stockpile." Restrictions on "confidence testing" of such weapons would cause great uncertainty as to their reliability as nuclear deterrents and would require DoE to take "a new look at design margins, design complexity, and component life" of its new nuclear bombs and warheads.

"And this in turn could radically alter or reverse the existing process for designing and developing nuclear warheads to conform to the requirements of delivery vehicles," Mr. Meinhardt said.

In the end, he said, "delivery systems may have to be built to conform to existing weapons," not the other way around. ■

Did anybody tell the Soviet Air Force about Mr. Gorbachev's peace offensive?

Pressures on the Northern Frontier

BY JAMES W. CANAN
SENIOR EDITOR

KEEP an eye on Alaska. It is where the Soviets have been flaunting their air threat to North America in apparent contradiction of General Secretary Gorbachev's goodwill overtures and force-cutting plans.

Alaska is also where the US Air Force is frequently called on to fly into the teeth of that threat, represented by Soviet armed bombers aloft, just in case it ever suddenly becomes the real thing.

Important as it is now, the vast northernmost state of the US will probably be even more prominent in USAF's future scheme of things. Its strategic location and sparsely populated, wide-open spaces make it attractive for the basing and training of some USAF units now tenuously situated overseas.

These points were made by Lt. Gen. Thomas G. McInerney, Commander of Alaskan Air Command, at the Air Force Association symposium on the topic, "The US Air Force—Today and Tomorrow," late last year in Los Angeles, Calif.

There is ample evidence around Alaskan airspace that "Soviet long-range aviation hasn't got the word yet" about Gorbachev's seemingly peaceful intentions and major moves to rein in the Soviet military, General McInerney said.

The symposium took place prior to Gorbachev's visit to the US last December, when the General Secretary said he would sharply cut Soviet troop strength and draw down numbers of tanks and other equipment.

Gorbachev did not project the Soviet Air Force as figuring in his cuts, however, and its presence across the way from Alaska is expected to remain ominous.

Alaska, said General McInerney, is "where more than fifty percent of Soviet long-range aviation would penetrate in a global war" with the US.

"Over the past few years," he continued, "we've seen an increase in the number of Soviet strategic aircraft near Alaska. The majority of flights we now intercept are long-range nuclear-strike training missions, not the reconnaissance missions that we intercepted in the past."

He noted that Alaskan Air Command fighters intercepted only ten

In cold-weather garb, TSgt. Harry Jones of the 5th Combat Group, Robins AFB, Ga., contends with sub-zero temperatures during a 1987 Cobbler Freeze combat exercise in Alaska, where the Air Force confronts the increasingly evident Soviet strategic threat.

—USAF photo by TSgt. Edward Boyce

to fifteen Soviet aircraft each year through the early 1980s and that most were benign electronic-intelligence and ice-reconnaissance aircraft. From 1980 through 1984, only ten strike aircraft, all Bear bombers, were headed off.

Then the activity began picking up. It jumped sharply in 1987 when fifty-six Soviet aircraft were intercepted. Fifty were Bears, and twenty-six of them were H models capable of carrying strategic-range cruise missiles.

Before 1988 was three-fourths over, AAC fighters had already intercepted forty-five Soviet aircraft, thirty-six of which were Bear G or H bombers.

"The threat is real, and it's close," General McInerney told the symposium audience.

Severe Threats to the US

He described the Soviet AS-15 subsonic cruise missile and newer AS-19 supersonic cruise missile as standard weapons in the Soviet strategic air arm. Both pose severe threats to the US.

As to Soviet flight plans for putting such missiles into play, if it comes to that, General McInerney told his audience:

"Draw an arc around the Arctic basin, and that's where they would drop them off—and that's where they come out and train on a monthly basis."

The AAC Commander expressed confidence in the systems at his disposal for detecting and confronting the threat in both the strategic and tactical arenas. These systems include various land-based and airborne radars, KC-135 tankers, F-15C fighters with conformal fuel tanks, and A-10 aircraft for the close support of US Army units in Alaska should an invasion ever come.

In that connection, General McInerney noted that AAC and North American Aerospace Defense Command (NORAD) "did not have to think much about Soviet conventional fighter forces in the past," but certainly do now.

The reason, he said, is that the Soviets "could do a fighter sweep over Anchorage" with modern Su-27 and MiG-31 fighters from their mainland and that such fighters "could easily reach" Aleutian islands on which the US military operates missile-monitoring, space-watching, and other equipment.

General McInerney also discussed Alaska in the context of USAF's growing problems with forward-basing units and training aircrews in realistic combat regimes overseas. Environmental, political, and safety pressures on USAF have been mounting, most markedly in western Europe, Greece, and the Philippines.

If such pressures build to the point that USAF must renounce low-level fighter training in Europe or must pull out of bases there and elsewhere, Alaska may save the day, the General said.

Alaska offers the Air Force "a most strategic location nearly equidistant from Japan, Europe, and the west coast of the US." Air Force units stationed there on force-projection missions "would be much closer to the Orient and Europe" than they would be in the CONUS, he said.

General McInerney also serves as Commander of the Alaskan NORAD region and Commander of Joint Task Force Alaska, a combination of USAF fighter and close-air-support units and US Army infantry and light-armor units responsible for defending mainland Alaska.

At the AFA symposium, he took note of a plan then afoot within the Joint Chiefs of Staff to establish what he called "a sub-unified command in Alaska under CINCPAC [Commander in Chief, Pacific]."

JCS approval of this plan, which was proposed by CINCPAC, would make the AAC Commander responsible for the Aleutians, which now fall under CINCPAC, and would make Alaska more readily available to CINCPAC for basing air units and others.

Such basing may become necessary if the US is ever pushed out of places like the Philippines and Korea.

"Alaska's strategic location for force bed-down will play an extremely important role in CINCPAC's strategies as we go into the 1990s, and that's the primary reason why we're becoming a sub-unified command," General McInerney declared.

He claimed that the Air Force and Army units in Joint Task Force Alaska exemplify the "near-perfect positioning" that all American units would enjoy in taking advantage of Alaska as a strategic staging base.

For example, he said, AAC's A-10s at Eielson AFB are 3,000 miles closer to Korea than are the A-10s at England AFB, La., the westernmost CONUS base of such aircraft, and 800 miles closer to Norway than are the A-10s at Myr-

US infantrymen under Commander in Chief, Pacific Command, get their bearings during a combat exercise that exemplifies CINCPAC's continuing emphasis on air and ground readiness. For such training, CINCPAC and the Air Force itself are expected to rely more and more on Alaska because of its wide-open spaces and sparse population.

tle Beach, S. C., the easternmost A-10 base in CONUS.

Unmatched Attributes

Alaska is alluring to USAF in other ways as well, General McInerney claimed. It could accommodate many additional military people, and its existing facilities could easily be upgraded to that end.

Moreover, said the AAC Commander, Alaska offers "unmatched, outstanding" attributes for training and "has some of the best and most unrestricted airspace available in the US for training in air-combat operations. Just ask the units that have visited us to fly against our F-15s. Our air-to-air ranges equal in size the entire state of Nevada. They're vast areas in which to train and try out new tactics."

He also recommended AAC's air-to-ground, gunnery, and electronic-warfare ranges for their modernity and scope.

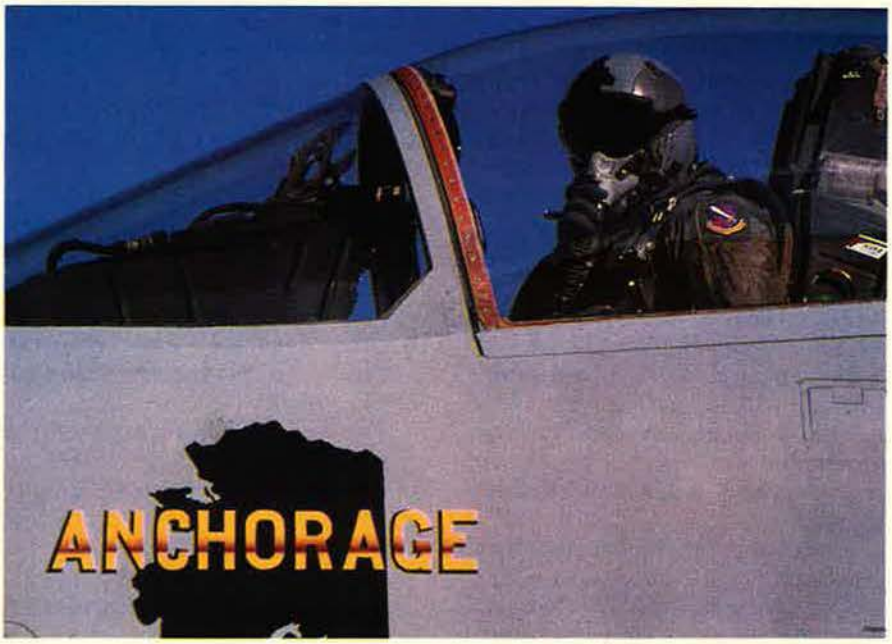
Alaska, he said, would be "ideal" for training attack-fighter crews to use the LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) system. He noted that Strategic Air Command turned to Alaska for the "rapid-reaction training" of its B-52 crews in nonnuclear warfare.

Alaska's availability as a USAF training arena will be exploited rather soon, General McInerney predicted: "With the pressures that are on us in Europe and that we're now seeing in Japan and Korea, it is probable that, within the next six months to a year, we'll be seeing our forces coming out of central Europe to train in Alaska—and potentially out of Korea and Japan."

Isn't Alaska's weather detrimental to air training much of the time? Asked this question at the symposium, General McInerney replied:

"That's one of the big myths. We fly up there year-round and at the same rates as the rest of the TAF [tactical air forces]. Eielson gets only about twenty inches of snow a year, or somewhat less than Ramstein [AB, Germany]. It's a little colder in Alaska, but we've shown that that can be handled quite easily."

At the symposium, Lt. Gen. Jimmie V. Adams, Vice Commander of Tactical Air Command, joined General McInerney and Gen. John L. Piotrowski, Commander in Chief of US Space Command and NORAD, in emphasizing the need of the US for better air defenses against the increasingly menacing Soviet threat.



Lt. Col. Al Guarino of the 21st Tactical Fighter Wing, Elmendorf AFB, Alaska, prepares for taxi-out in his F-15. Alaskan Air Command fighters are frequently called upon to fend off Soviet bombers probing Alaskan airspace and practicing cruise missile launches around it. Soviet activity, especially flights by Bear G and H bombers, has picked up sharply in the region since 1987.

General Adams noted that the Soviet Union has deployed more than sixty Bear H cruise-missile bombers and that the Blackjack bomber, which resembles the B-1B but is somewhat larger, has reached operational capability.

"We expect to see the cruise-missile threat grow to 1,000 missiles and 150 bombers by 1995," General Adams declared. The Soviets, he added, are rapidly building up the capability to "stand outside the range of our current surveillance systems and launch these missiles. Their training programs emphasize this capability."

Around North America, US and Canadian air defense forces intercepted Soviet bombers on more than 250 occasions in 1987 and had carried out nearly 200 such interceptions in 1988 by the time of the AFA symposium in late October, General Adams said.

"We observed that some of their mission profiles were typical ALCM [air-launched cruise missile] profiles," the TAC Vice Commander added, "and we have several programs to improve our capability against this threat."

General Adams reminded the audience that strategic air defense of the CONUS is one of TAC's three main missions, the others being air superiority and attack of surface targets in support of the Army.

The key to air defense, he said, is "to be able to see the aircraft before they launch the cruise missiles" and intercept them before they do. This is why the Air Force in recent years has upgraded its Distant Early Warning (DEW) Line radars and North Warning System radars and is developing OTH-B radars for long-range circumferential coverage of the North American continent.

TAC operates those radars and is also in charge of air defense interceptors everywhere but in Alaska. Its air defense fighter force is steadily being filled out with F-16As, which will have replaced all F-4s in the force by 1991, General Adams said.

Modernizing the Force

The F-16As "will carry us for a while, but we see continued emphasis on that part of the air defense mission, modernizing the force," the TAC Vice Commander said.

"Our primary job in air defense is to provide integrated warning and attack assessment, but we also want

to limit the damage as much as possible," he declared.

General Adams noted that the Soviet cruise-missile threat extends to submarines. Those boats "off our coasts in a rather stealthy mode" would team with Bears and Blackjacks as part of an integrated attack, described in three possible forms by General Adams as follows:

"The Soviets would lead with a ballistic missile laydown and follow with cruise missiles, or use cruise missiles as the leading edge of the attack to decapitate our National Command Authorities, or carry out a joint cruise- and ballistic-missile attack."

However it might happen, TAC "has to be sure that we would have air sovereignty against the air-breathing threat," General Adams asserted.

He noted that USAF's Air Defense Initiative (ADI) program to develop future systems for that mission has settled into a "modest research and development" mode at a funding level of about $50 million a year. ADI should be considered "evolutionary" in its approach to bringing on new air defense systems, General Adams said, because TAC has no intention of "throwing away what we have now" in such systems.

He included space-based radars among ADI systems under study but was noncommittal about them. The SBRs were heartily endorsed at the symposium, however, by Generals McInerney and Piotrowski and then-Secretary of the Air Force Edward C. "Pete" Aldridge, Jr., who has since left the Pentagon to return to private industry.

The caveat with SBRs, as the speakers noted, is that the Air Force may not be able to afford their cost in the current budget crunch. For example, General McInerney said: "How we'd pay for them is the big question, but there's no doubt that space-based radar would be a very valuable addition to our capability to see what the Soviets are going to do with their long-range aviation."

General Piotrowski, who has led the fight for SBRs, told the symposium audience that SBRs "should clearly be part of tomorrow's Air Force."

For one thing, said the CINC of US Space Command and NORAD, "space-based radar offsets billions of dollars invested by the Soviet Union and other countries on offensive systems that could threaten US forces."

For the US warfighting CINCs, SBRs "would essentially remove the horizon," General Piotrowski declared. "They would expand a commander's vision beyond the horizon to include his entire theater and more. His perspective could become global."

The General took note of the Navy's interest in SBRs. "Fleet operations would be more efficiently conducted if aggressor aircraft or vessels could be exactly located—within a mile or less—and tracked," he said. Keeping tabs on hostile aircraft from their points of origin "would greatly improve the survivability of Allied forces in the Norwegian Sea," for example.

General Piotrowski continued: "Imagine the impact of being able to track a small aircraft flying an unscheduled flight plan from northern Colombia to southern Texas. Drug interdiction could be done more effectively and with fewer resources by using space-based radars."

SBR's Role in Airlift

Among his other proposals for SBRs, the General cited airlift: "With space-based radar it would be possible to send images of all air traffic in a contested area to the lead aircraft of an air-cargo or transport fleet flying into that area. The crew could see where the air threat was—and also see the locations of ships with surface-to-air missiles that might shoot at them [the airlifters] en route. They would be given tremendous capability to avoid those threats."

In the past, General Piotrowski has often expressed confidence that SBR technology was sufficiently mature to justify an Air Force decision to package it into systems and put it into space in the form of a cost-effective constellation of radars. He has acknowledged, however, that confirmation of his confidence would have to come from the Air Force/Navy/industry study of SBR then being undertaken.

At the AFA symposium, he indicated that the study had borne him out. He said it had concluded that "the technology is available for radar based in space to provide near-real-time, all-weather global coverage." Such radar would be capable of "detecting and tracking fighter-size aircraft and detecting, tracking, and classifying ships," he declared.

The SBR satellites could also come equipped with infrared sensors to give them additional prowess, the General said.

Addressing the symposium, Mr. Aldridge seemed more upbeat about the possibility of deploying space-based radars than in the past.

Such deployment is "a matter of 'when' not 'if,'" he declared. "I believe the Air Force and the country need space-based radar. There is no doubt that it would provide us with a significant improvement in our capabilities. We love AWACS [Airborne Warning and Control System], and space-based radar is just AWACS at an orbital altitude."

Noting that "enthusiasm for space-based radar is growing by leaps and bounds," Mr. Aldridge told the audience that the problem remains one of finding funds for it amid austerity.

"It is clear," he said, "that the budgets we're currently facing will not permit us to make a serious start on space-based radar for the next year or so."

The Defense Acquisition Board was expected to decide near the end of 1988 or early this year whether to take the first steps toward committing the Department of Defense to a space-based radar program. Officials believed that such a program could become part of a space-based surveillance system emerging from Strategic Defense Initiative (SDI) research.

Much of the emphasis at the AFA symposium was on the Air Force's role in space. Mr. Aldridge predicted that "in the Air Force, space power will become just as important as airpower" in years to come.

General Piotrowski declared: "We need many things in the way of space capabilities for tomorrow. Among the most important are an antisatellite capability to counter the ASAT capability that the Soviets already have, a ballistic missile defense, and a space-based radar.

"Space power will become as critical to future military operations as sea power and airpower are today." ■

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New regimes of flight become possible as supercomputers unlock the doors to their simulation and development.

The Electronic Wind Tunnel

BY JOHN RHEA

COMPUTATIONAL fluid dynamics—a technology that has emerged within the past decade because of the availability of ever more powerful supercomputers—is completely changing the way aerospace vehicles are developed.

This new technology represents as significant a milestone in flight as the invention of the wind tunnel, which it complements. Just as the wind tunnel was the essential first step toward heavier-than-air vehicles, the new computer-based analytical techniques will make possible the high-performance vehicles of the future.

The role of the wind tunnel is often overlooked. Everybody knows of the Wright brothers' success at Kitty Hawk, N. C., on December 17, 1903. What is not widely known is that three years earlier, back in their shop in Dayton, Ohio, the two bicycle-makers achieved the breakthrough that made that flight possible and ushered in the age of aviation. They built the first crude wind tunnel to test their designs before they flew them.

Until then there was only one way to test aircraft: Fly them. That's what all the other aviation pioneers did. Many of them, like Otto Lilienthal, died in the process. Others, like Samuel Langley, suffered a series of embarrassing failures.

The Wright brothers correctly guessed that the key to powered flight was the way the cross-section shape of the wings provided lift. Birds don't fly simply by flapping their wings; birds fly because their wings are remarkably efficient airfoils.

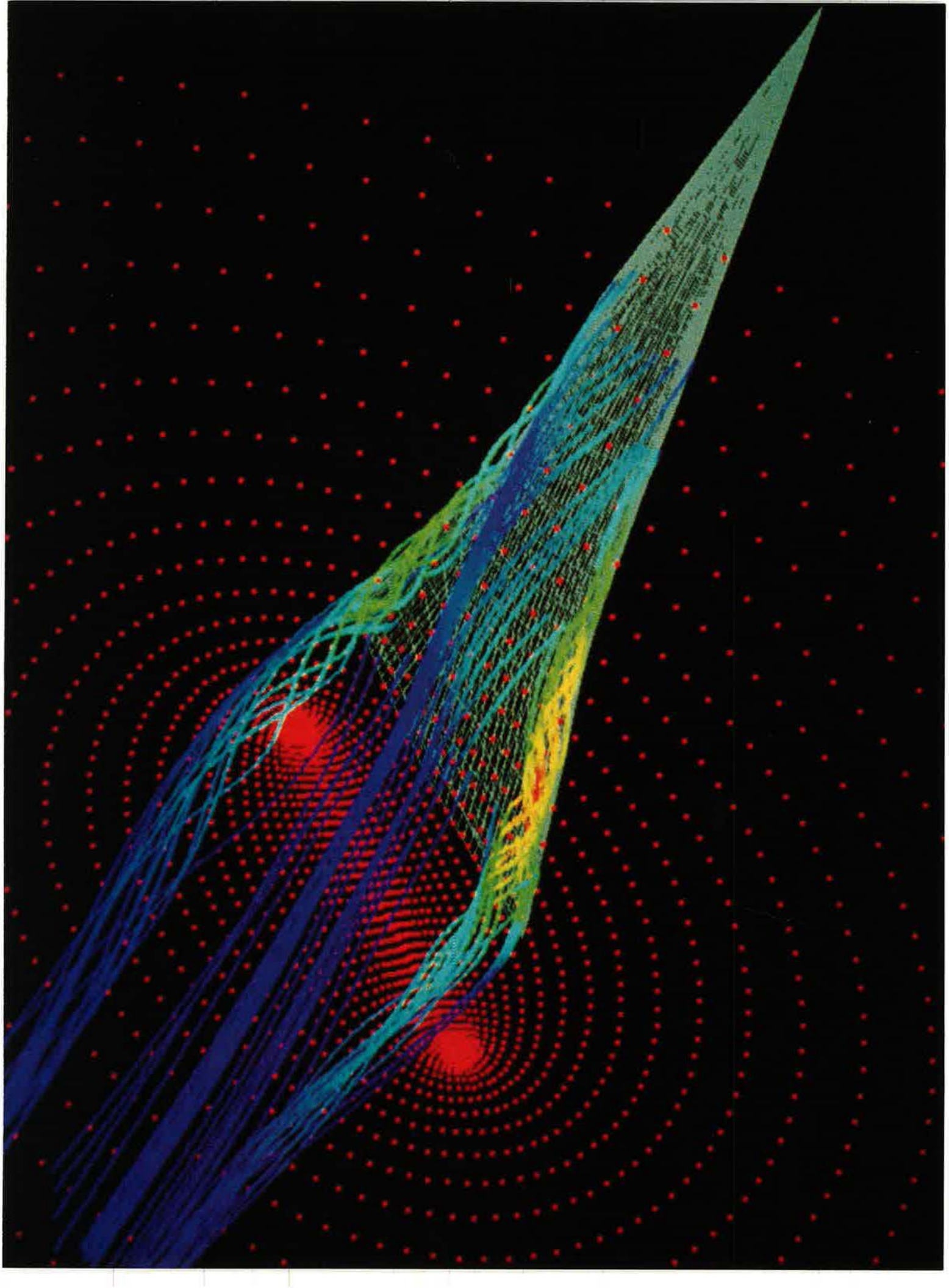
Once that principle of lift had been established in ground-based testing, the first flight was, scientifically speaking, almost an anticlimax. Nearly ninety years later, aircraft designers still base their work on this principle as they expand the flight envelope to ever greater speeds and altitudes.

Testing the Next Generation

Air Force Systems Command operates the world's largest aerospace ground-test facility, the $3 billion complex of wind tunnels and environmental chambers at the Arnold Engineering Development Center (AEDC) near Tullahoma, Tenn. Since it opened for business

Flight conditions of an AMI-X test vehicle at Mach 0.8 with an eight degree angle of attack and six degrees of sideslip are simulated by a Cray X-MP, using McDonnell Douglas data. Using a graphics program developed by NASA's Ames Center, the computer then shows particle traces, colored by density (right), around the aircraft.

—Photo courtesy NASA Ames



in 1951, this facility has tested most of the Air Force's new aircraft and missiles along with such NASA vehicles as Gemini, Apollo, and the Space Shuttle.

This also is where the Air Force will test its next generation of vehicles, including the Advanced Tactical Fighter and the X-30 National Aerospace Plane. These new vehicles will operate in a much more demanding environment and therefore will require much more complex testing. This is where computers become a critical factor.

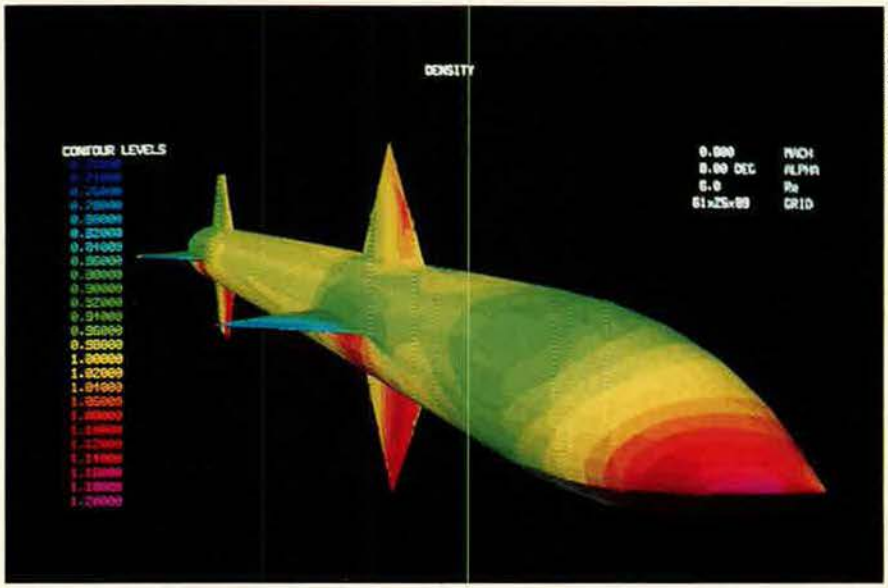
Computerized simulation of aerodynamics is not new. The idea of "flying" an airplane in a computer before undertaking dangerous flight tests emerged after World War II from pioneering work by the Air Force, the National Advisory Committee for Aeronautics (NACA, the predecessor to NASA), and the aerospace industry.

What is new is the power of today's supercomputers, which can analyze the airflow around aerodynamic vehicles with sufficient precision to enable them to operate in the more demanding flight regimes of the future. Although the Wright brothers were the first to demonstrate ground testing, they made a fundamental error: They thought the flow of air *under* the wing provided the lift. Today aerodynamicists know that it is the partial vacuum created *above* the airfoil that is responsible for lift. An error like that was no problem for an aircraft with the performance of the Wright Flyer. It would be fatal for today's aircraft.

All new flight programs will rely on computational fluid dynamics. Breaking the term into its component parts makes it easier to understand. The *computational* part is obvious. This is a technology based on the use of computers to do calculations that were heretofore impossible. A *fluid* is what airplanes fly in; it's called air. The key to the concept is the third part—*dynamics*. By knowing the dynamic interaction of a vehicle with its environment, developers can optimize its performance.

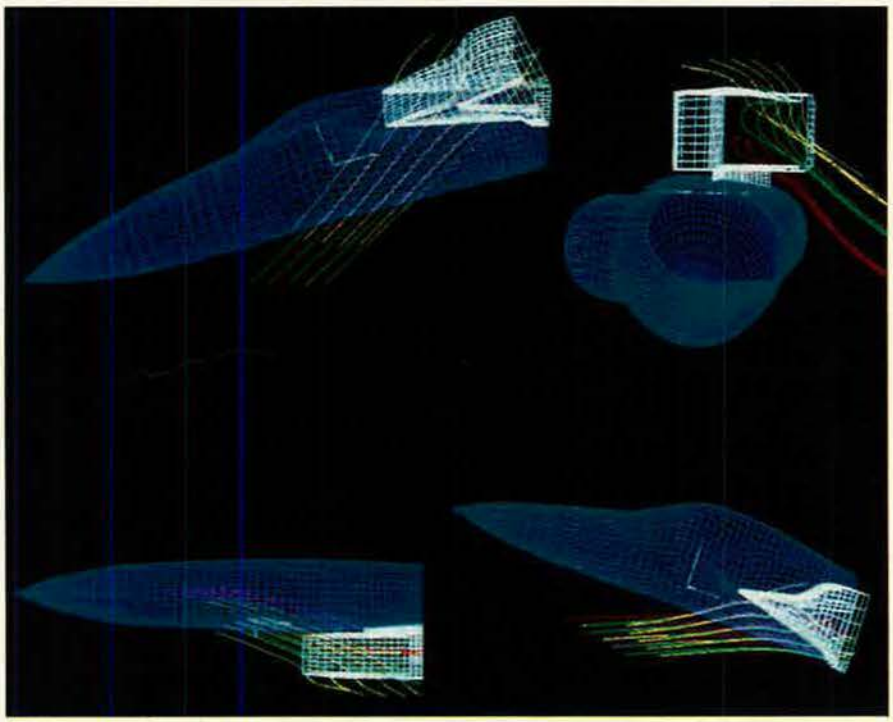
Thus, CFD, as it's known, is essentially a set of software techniques that takes advantage of trends within the computer industry to build much more powerful machines for a variety of demanding applications.

At its Ames Research Center near San Francisco, for example, NASA has just put into operation a Cray Y-MP supercomputer capable of more than a billion computations a second. NASA is shooting for a trillion computations per second at its Numerical Aerodynamic Simulation Facility there by the end of the century.



—Photo courtesy NASA Ames

Given the same flight conditions simulated in the picture on the previous page, a Cray supercomputer calculates and displays the pressure contours around a generic missile. The pressure contours, varying with the changes of contour along the missile's surface, were calculated using BOD57 software, and the display was created using Ames Center's RIP graphics.



CFD prediction of the airflow around an F-15 forebody flying at Mach 0.6 with a thirty degree angle of attack and ten degrees of sideslip is shown from different angles with computed particle traces. Test engineers use the particle traces to determine what happens when airflow enters the engine inlet.

New Tools at Tullahoma

At the Arnold test site, the Air Force operates two smaller Cray supercomputers, an X-MP and an earlier model Cray 1, both linked to each other and to a larger Cray 2 at Kirtland AFB, N. M. These are the

hardware tools of AEDC's CFD efforts.

The critical software tools have evolved over the past ten years, recalls Dr. Donald C. Daniel, chief scientist at the Arnold center. They consist of two parts: gridding, which is a mathematically generated picture of the air vehicle that he calls "a sophisticated checkerboard," and the algorithms that the computer uses to calculate the airflow over the simulated vehicle (or through it, in the case of a propulsion system). The more grid points that can be analyzed and the more sophisticated the algorithms (actually partial differential equations) used to analyze them, the more accurately the vehicle's performance can be calculated.

Furthermore, these calculations only begin on the vehicle's surface. They must be extended outward from the vehicle's body with emphasis on flow gradients (changes of flow) that affect vehicle performance. This would be a simple process if all aerospace vehicles were perfect spheres or cylinders. They aren't.

Because of the complex shapes that have to be tested, according to Dr. Daniel, the software engineers' task is to develop equally complex adaptive grids incorporating a feedback loop between the solution and the grid. This is a tedious process, and Dr. Daniel notes that it took a year to initially set up the grid and solve the flow field for the F-16 fighter.

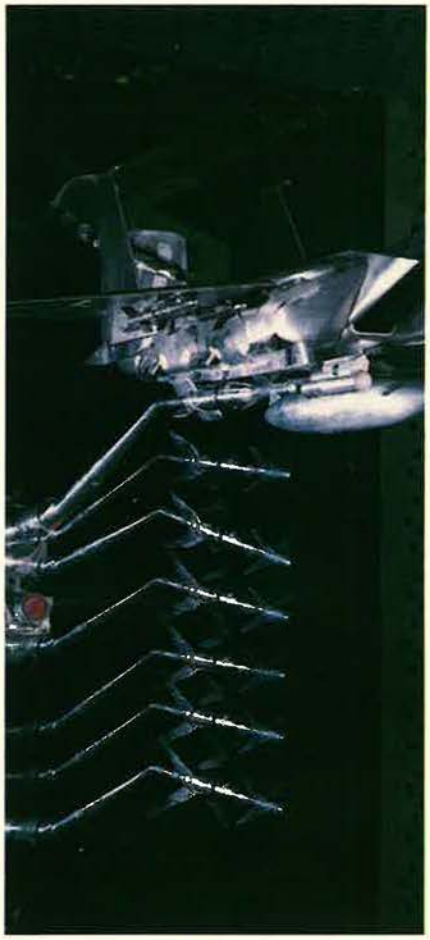
Questions at Mach 15

Further complicating the process is the need for a better understanding of the basic aerodynamic processes. "We still don't understand turbulence," Dr. Daniel says. "It's more or less random, and we can't model a random event well." He expects there's enough research to be done in this area to keep scientists busy for the rest of this century.

The problem isn't so bad at subsonic and supersonic speeds. It's the transonic regime that worries scientists like Dr. Daniel. He calls that "the most nonlinear part" of the flight envelope, or the one in which the relationship between flow fields and vehicle performance is least understood. When it comes to hypersonic vehicles like the X-30 operating at Mach 15 at 300,000 feet, Dr. Daniel can only shrug, "What's your guess?"

Nonetheless, the basic principles of CFD are in place to handle future flight programs. Dr. Daniel pays tribute to Boeing for its pioneering work on its 757 and 767 commercial jetliners, adding that the Air Force will get maximum benefits from the technology on the ATF, "where the tools were there from the inception of the aircraft."

Dr. Edward M. Kraft, manager of the technology and analysis branch of the Calspan Corp. contractor team operating the wind tunnel test facilities at Arnold, describes the synergistic relationship among the three facets of vehicle testing: ground testing (in which the wind tunnel is the traditional tool), flight testing, and CFD. "Each tool has its limitations," he says, "but the other tools overlap and accommodate them."



This time-lapse photograph shows a laser-guided bomb separating from an F-15E in a wind tunnel. Such testing, in conjunction with CFD analysis, enables USAF to reduce actual flight testing by up to fifty percent.

Ground tests can't duplicate all conditions, particularly in the case of a spacecraft, but they are less costly and less dangerous. Flight tests are still essential because they represent the "truth," according to Dr. Kraft: "What you see is what you get." CFD is now entering the picture as part of an effort to do the diagnostics first and thus minimize ground testing and certification changes later in the program. As Dr. John H. Fox, a principal engineer with the Calspan technology and analysis branch, puts it, "We fly the aircraft on the computer."

"The name of the game is optimizing," adds Ralph E. Graham, chief of the aeronautical systems division at Arnold's directorate of aerospace flight dynamics test. "We're looking for the last one percent of performance."

Certifying Stores Release

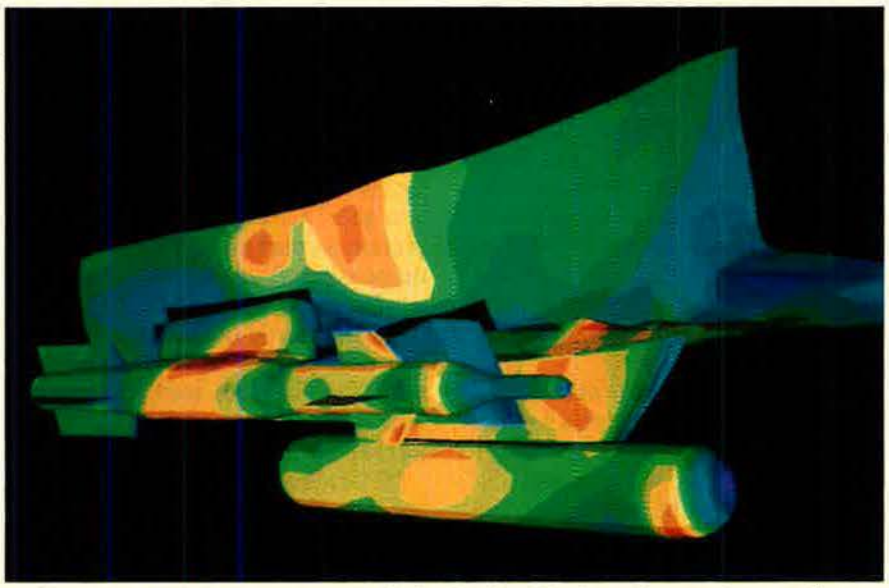
Graham cites a very practical application of CFD that is paying off for the Air Force right now: certifying the release of stores. The Air Force has 110 kinds of stores (fuel tanks, bombs, missiles) in its inventory, he explains, and they're used with a variety of different aircraft. This adds up to thousands of possible combinations, so certifying a particular store for a particular aircraft can be a lengthy, costly process.

Instead, by using CFD in conjunction with wind tunnel test and analysis to determine the basic aerodynamic behavior of the stores and their host aircraft, the Air Force will be able to greatly reduce flight testing—in some cases by fifty percent—and "mix and match" the two. To do this entirely in a wind tunnel could take up to three years.

With CFD, wind tunnel testing and analysis, according to Graham, the process at AEDC can be cut to three months. How much money could this save? "The cost of an F-15," Graham quips. There's also a potential performance improvement in better circular error probable (CEP) for air-to-ground and air-to-air missiles.

Tracy Donegan, a Calspan senior engineer, describes a typical CFD project completed last August for the F-15 fighter: The entire aircraft (except its tail) with its seven pylons, a store, and pod was computa-

—USAF photo by Gary Bartoh



A computer at Wright-Patterson AFB, Ohio, displays Mach number contours on the surface of the F-15E Conformal Fuel Tank, attached LANTIRN pod, and GBU-12. The colors represent changing Mach numbers of the airflow as it follows the shapes of the stores. Cool colors represent low Mach numbers, and warmer colors represent higher Mach numbers.

tionally simulated with 1.1 million grid points. It took four engineers six months working part-time to develop all the algorithms for the grids and boundary conditions.

The initial purpose was to determine the aircraft/store flow field, but the program became much broader than that, Donegan explains. For the first time it gave the Air Force a picture of the flow field around a complete aircraft. That picture is available on demand at a video computer terminal in three dimensions and color-coded to show flow field gradients. This technology is now available to airframe prime contractors, and Donegan estimates the X-30 would require about the same number of grid points.

"CFD hasn't been extensively applied from cradle to grave," says Col. Dale F. Vosika, Arnold's deputy for operations, "but it does give us a level of expertise when integrated with ground and flight tests." In the case of the X-30, he notes, the lack of ground-test facilities will require a lot of computer simulation. This program, as well as the ATF, will require coordination with the Air Force's Aeronautical Systems Division (particularly the Flight Dynamics Laboratory) and the Air Force Flight Test Center. Colonel Vosika cites the complexity of the aircraft—higher performance, speeds, and maneuverability. The supercomputer complex at the NASA Ames Center will also be heavily involved in CFD studies to support the X-30.

Smarter Tests

John Rampy, technical director of operations at Arnold, praises CFD for enabling the Air Force to do what he calls smarter tests. "By understanding the external flow and the internal flow we can predict the baseline and reduce testing," he says. This leads to databases that are later updated with empirical data.

Reducing test time by using the electronic analog known as CFD has a major impact on costs, according to Rampy, who estimates that electrical power requirements eat up seventy percent of all test costs. That's cheaper than the operating costs of test aircraft, but it is still a cost to be avoided if possible.

In fact, this voracious appetite for electrical power is why the Arnold center is located in the heart of Tennessee Valley Authority territory. The availability of relatively low-cost power—plus water for cooling the test facilities—reduces overall costs.

They are still hefty. Col. (Brig. Gen. selectee) Stephen P. Condon, Arnold's Commander, has an electricity bill that would make most homeowners blanch: $2 million a month. That amounts to nearly 500,000 megawatt-hours a year—enough, he says, to provide power for a city of more than 50,000.

CFD Saves Money

Dr. Keith L. Kushman, chief of the center's facility technology division, has pinpointed some of the cost savings attributable to CFD. He figures the computational costs at Arnold at about $4 million a year, of which half is salaries and most of the rest is the amortized cost of the supercomputers. He has documented more than $2 million in cost savings to the center's customers (principally other elements of the Air Force Systems Command), but he estimates there is another $8 million in intangible savings from reduced risks to conventional ground-test equipment by doing the tests in a computer instead of wind tunnels. Furthermore, he maintains, half of the tests his team has conducted couldn't be done at all without CFD.

His colleagues at Wright-Patterson AFB, Ohio, agree. "Computational aerodynamic simulation now is a valid, inexpensive alternative to wind tunnel testing of new aircraft and aerospace designs," according to a statement by Dr. Joseph J. S. Shang, a technical manager at the Flight Dynamics Lab, after a series of simulations four years ago using the X-24C lifting body. The computed results duplicated the results of earlier wind tunnel tests for flow fields and aerodynamic forces on the vintage 1974 experimental reentry vehicle.

As supercomputers become even more powerful, the technology of CFD can be extended even further, according to Arnold chief scientist Dr. Daniel. He is more concerned about memory capacity than about multibillion-operation speeds and says even the 256-million-word memory of the top-of-the-line Cray 2 "won't be nearly enough" for some of the projects he has in mind.

"The great thing about supercomputers is that they unlock the mind," Dr. Daniel concludes. ■

John Rhea is a free-lance writer in Woodstock, Va., who specializes in technology issues. He is the author of SDI—What Could Happen: 8 Possible Star Wars Scenarios, *published in 1988 by Stackpole Books.*

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The team from Holloman AFB, N. M., won the big air-to-air competition this time—but even those with the lowest scores weren't losers.

The Sharpshooters of William Tell

BY JEFFREY P. RHODES, AERONAUTICS EDITOR

LEGEND says that William Tell, a medieval Swiss patriot, was ordered to shoot an apple off his son's head with an arrow after refusing to bow to the hat of a dictator. He split the apple neatly, thus making his name synonymous with spectacular feats of marksmanship.

At Tactical Air Command's William Tell air-to-air competition, the "apple" is a supersonic, radio-controlled QF-100 drone, and the marksmen employ Sparrow and Sidewinder missiles.

Like the original William Tell, the twelve Air Force, Air National Guard, and Canadian F-15, F-4, and CF-18 fighter units who came to the two-week competition last October at Tyndall AFB, Fla., put on quite a display of sharpshooting.

The 49th Tactical Fighter Wing, based at Holloman AFB, N. M., claimed the overall team title and saw its number-three pilot, Capt. Teddy Varwig, become the meet's individual top gun.

"The crews here represent the best fighter units, and the pilots are the best of the best," said Maj. Gen. John E. Jaquish, Commander of the Air Force's Tactical Air Warfare Center at Eglin AFB, Fla., and chief judge at William Tell. "The crews are competing in a worldwide meet. The person with the lowest score here is not a loser. This is the all-star game."

The competition covers more than launching missiles, however. Weapons control, weapons loading, and maintenance events are included to make it a complete test of the skills required by an air-to-air unit.

Missiles and Guns

Attention at William Tell centers on the five "profiles," or flying events, each of them testing fighter pilots' basic skills.

Profiles I and II—airborne missile employment—are combined into a single sortie. In a front-aspect shot, the pilot launches a radar-guided AIM-7E/F Sparrow at a QF-100, which is flying at a medium altitude. After the drone and the shooter pass each other, the pilot turns and positions his aircraft for a tail-aspect shot with a heat-seeking AIM-9L Sidewinder against the drone, which is now maneuvering. This William Tell was the first time all the

Capt. Ted Varwig, 49th TFW, Holloman AFB, N. M., made the highest "Individual Top Gun" score and was also among the top five aerial gunners (see boxes on the following pages). In picture at right, SSgt. Gary Smith, 33d TFW structural maintenance specialist, cleans the canopy of an F-15 before William Tell '88 begins.

competitors used the improved AIM-9L.

The AIM-7 shot (Profile I) is graded on miss distance, or whether the drone would have passed within the missile's blast area had it carried a live warhead (which it doesn't in the competition). The AIM-9 launch (Profile II) is graded on miss distance and elapsed time from when the drone and fighter pass each other to when the missile is fired.

A direct hit obviously earns full points. F-4C crews of ANG's 142d Fighter Interceptor Group from Portland, Ore., got a perfect 10,000-point score when all four of their Sparrows either hit the drone or passed within the lethal zone.

The pilot's proficiency with the M61A-1 20-mm cannon is checked in Profile III. Two aircraft attack a towed target. The first shooter attempts to score a fast "snapshot" hit in the first thirty seconds of the fifty-five-second time limit. Once he is clear, the second shooter tries for the maximum number of hits in the time remaining. The shooters then reverse roles.

Capt. Mark Ekanger, an instructor pilot with Tyndall's 325th Tactical Training Wing, is among those towing the targets. "The target is 2,000 feet behind you, but it's not great being shot at," he says.

Each competitor got 400 rounds of ammunition at this competition, a more realistic wartime load than the 200 rounds carried in 1986. Using F-15s as tow ships was another change, as was the use of the AGTS-36 (aerial gunnery target system) target. The AGTS-36 determines hits with a radio frequency scoring device. As a round passes through the scoring zone, "hits" are recorded in the towing F-15's cockpit and relayed to ground terminals.

—USAF photo by MSgt. Boyd Belcher

Members of the 147th FIG, Texas Air National Guard, race to their aircraft during the scramble event, the last profile of the competition. Two elements of two aircraft each have five minutes to clear a specific airspace of four intruders. Teams are scored on speed and accuracy.

The top individual gunnery score, 1,319 (of 2,500 possible) points, scored by Capt. Scott L. Fahsholtz of the 33d TFW at Eglin, was sixty-nine points higher than the 1986 winner's score. The new gun director sight, a software upgrade to the F-15's central computer, probably helped. Although most individual gun scores were up, the 33d TFW's winning team score was below the top score from 1986.

Profile IV may be the toughest for both the pilots and the ground controllers. Four fighters must defend a designated area against a coordinated mass attack for forty minutes. Each fighter is responsible for his fourth of the "hostiles," which may employ electronic countermeasures (ECM), chaff, flares, and limited evasion techniques. There are also "friendly" aircraft in the area, so the shooters have to be careful.

The "unfriendlies" at this William Tell included F-16s, F-111s, Strategic Air Command B-52s, and Canadian T-33s. Flight International, Inc., used five of its Lear 35B "Smart Crow" aircraft to provide the ECM threat. The aircraft have equipment that simulates a standoff jamming platform such as an EF-111. The aircraft can deploy chaff (hairlike aluminum strips that cloud a radar return) by the bale.

The final profile begins with a scramble takeoff. Four aircraft op-

Individual Top Gun Top Five

COMPETITOR	UNIT (AIRCRAFT)	TOTAL POINTS (12,500 Possible)
1. Capt. Teddy T. Varwig	49th TFW (F-15A)	11,112
2. Lt. Col. Melvin Copeland	21st TFW (F-15C)	10,766
3. Capt. Christopher Rich	18th TFW (F-15C)	10,550
4. Capt. Gregory G. Clasen	1st TFW (F-15C)	10,422
5. Capt. Bruce A. Netardus	33d TFW (F-15C)	10,333

Top Aerial Gunner Top Five

COMPETITOR	UNIT (AIRCRAFT)	TOTAL POINTS (2,500 Possible)
1. Capt. Scott L. Fahsholtz	33d TFW (F-15C)	1,319
2. Capt. Jeffrey Moersch	36th TFW (F-15C)	1,306
3. Capt. Christopher Rich	18th TFW (F-15C)	1,250*
4. Capt. Stanley T. Kresge	18th TFW (F-15C)	1,250
5. Capt. Teddy T. Varwig	49th TFW (F-15A)	1,242

*Awarded third place on basis of less time taken.

William Tell '88 Box Score

UNIT	BASE	AIRCRAFT	AIRCREW PROFILES (50,000 Possible)	AERIAL GUNNERY (10,000 Possible)	WEAPONS CONTROL TEAMS (10,000 Possible)	MAINTENANCE TEAMS (4,000 Possible)	WEAPONS LOAD TEAMS (3,000 Possible)
1. 49th TFW	Holloman AFB, N. M.	F-15A	39,834*	3,446	8,750	3,530	2,621.5
2. 18th TFW	Kadena AB, Japan	F-15C	37,597	2,966	9,550*	3,047	2,645.5
3. 57th FIS	NAS Keflavik, Iceland	F-15C	37,326	1,400	9,250	3,815*	2,161.0
4. 21st TFW	Elmendorf AFB, Alaska	F-15C	37,262	1,356	9,250	3,165	2,311.5
5. 36th TFW	Bitburg AB, Germany	F-15C	37,064	2,052	8,940	3,324	2,454.0
6. 33d TFW	Eglin AFB, Fla.	F-15C	36,806	3,506*	9,350	3,100	2,927.5*
7. 142d FIG (ANG)	Portland, Ore.	F-4C	36,485	725	9,200	3,025	2,520.0
8. 1st TFW	Langley AFB, Va.	F-15C	34,892	1,027	8,500	3,531	2,810.5
9. 441 Sq.	CFB Cold Lake, Alberta, Canada	CF-18A	33,365	1,177	9,400	3,635	2,770.0
10. 116th TFW (ANG)	Dobbins AFB, Ga.	F-15A	31,347	3,002	9,400	2,820	2,274.5
11. 147th FIG (ANG)	Ellington ANGB, Tex.	F-4D	28,972	0	8,850	3,536	2,678.5
12. 107th FIG (ANG)	Niagara Falls, IAP, N. Y.	F-4D	27,387	0	7,100	3,315	2,650.0

*Highest scoring team in each category.

erating in two elements have five minutes to clear a specific airspace "lane" of four intruders. The defending fighters may use beyond-visual-range rules of engagement, and each is allowed four simulated missile or gun shots. Points are awarded for both speed and accuracy.

The judges use in-flight gun camera film or videotape recorder playback in scoring all the profiles.

The scoring process also draws on telemetry data from scoring sensors in the drones in Profiles I and II. In addition to on-board tapes, Air Combat Maneuvering Instrumentation—the computer-based system that gives a complete recreation of the airborne battle—is used in scoring Profile V. In-cockpit audiotape recordings provide further backup.

"The judges have an average of twenty years of experience," said Lt. Col. James Barnhardt, the senior combat servicing judge. "We get the people we want—the ones

—USAF photo by TSgt. Kit Thompson

A Canadian Air Force CF-18A from 441 Sq., CFB Cold Lake, Alberta, taxis to position on the ramp at Tyndall AFB, Fla., during William Tell '88. In the foreground is an F-15C from the 57th FIS, NAS Keflavik, Iceland. Canadian CF-18 teams in future William Tells may well include women fighter pilots; CFB Cold Lake is training some now.

we know are fair and accurate—or we get them handpicked from the [participating] commands. It's a fairly big honor for them to come here too."

Competition on the Ground

The judges also work on the ground. "There are some subjective things in judging GCI [Ground-Controlled Intercept], but there are certain things that have to be done—either a competitor did them or he didn't," noted Col. Bill Van Meter, the chief Profile III judge.

Each weapons controller (WC) team consists of two weapons controller elements (WCEs), each comprising one officer and one enlisted member. They track the unfolding air battle in broad perspective and keep an eye out via radar for bandits the pilots may not have spotted yet.

WC teams begin with 10,000 points and are "dinged" (points deducted) for procedural errors in getting information to the pilots, in battle management practices, in radio procedures, and in following safety guidelines. Intercept success is defined as getting the fighter or fighters in a position that will enable the aircrew to acquire the target with the aircraft's radar or by visual means, so the pilots can engage the target.

The controllers have either a manual or an automatic GCI system available. The automated system works well for directing maneuvers requiring accurate timing, but the manual system works better when the aircraft and crews being controlled get close to their targets.

Another segment of William Tell scores the weapons loaders, the combat service teams, and the maintenance crews.

Combat servicing consists of two parts—a static load and an integrated combat turnaround (ICT). The ICT gets the aircraft ready to fight again as quickly as possible after landing.

"The ICT emphasizes speed, precision, and teamwork," said Colonel Barnhardt. During an ICT, five-person crews for F-4s and F-15s (the CF-18s require a sixth technician) load four AIM-7s, four AIM-9s, 100 rounds of 20-mm ammunition, and refuel the aircraft, all within twenty-one minutes (for F-15s) or twenty-nine minutes (for F-4s). Even the pilot helps during an ICT by inspecting the aircraft for damage and its suitability for further combat operations.

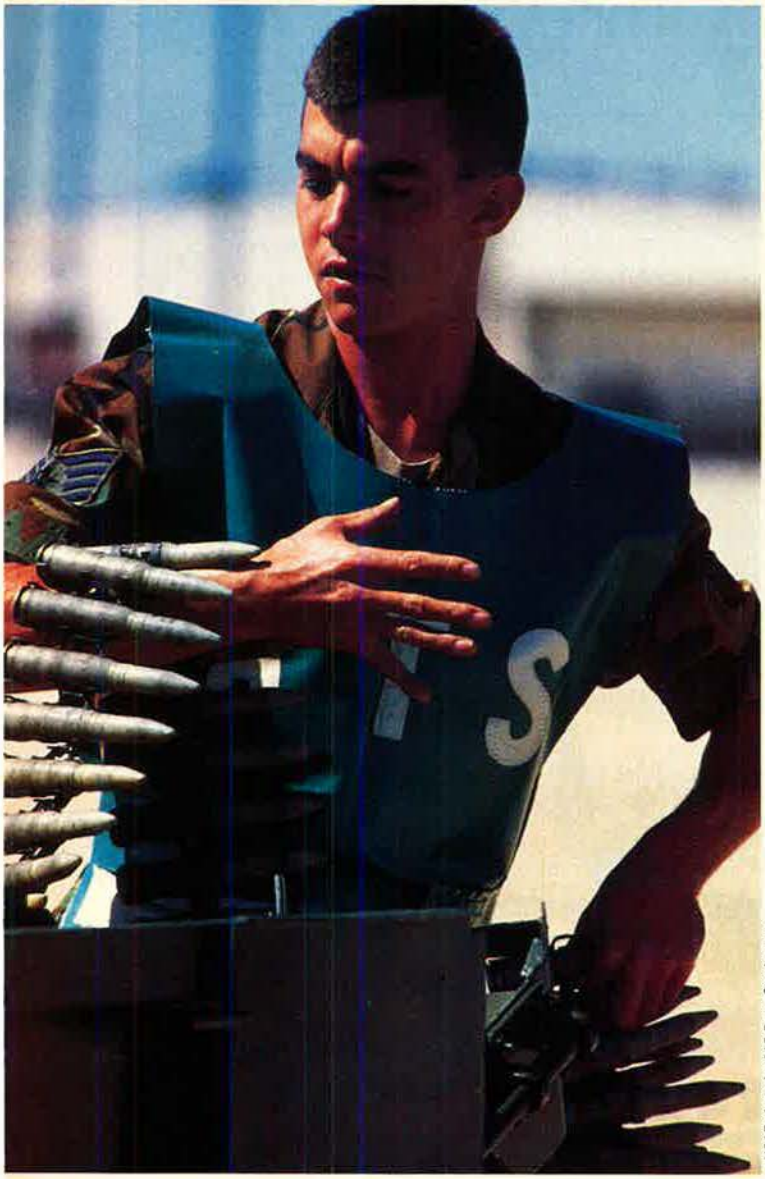
The static load does not include refueling. It concentrates more on strict adherence to procedures. Although not so fast as an ICT, it isn't leisurely, either. The F-15 crews get only twenty-eight minutes, and the F-4 crews get forty-seven.

The aircraft mechanics are evaluated on their sortie generation and regeneration techniques (the aircraft must be returned to mission-capable status two hours after the wheels are chocked following a sortie) and on how well the aircraft perform.

The mechanics are also graded on the appearance of their aircraft (cleanliness and evidence of leaks or corrosion). The F-4Ds from ANG's 107th FIG at Niagara Falls, N. Y., were so well prepared for William Tell that the unit won the appearance competition despite a seventy-five-point "ding" for an unauthorized marking (a rhinoceros head painted on the nose).

Additionally, the ground crews are graded on the use of tech data, the condition of their tools and equipment, conformity to AFR 35-10 (personal appearance standards), and professional conduct. The senior maintainers are also evaluated for leadership.

"We are forced by the age of these aircraft [twenty-five years for the F-4Cs] to give them a little more TLC," said Lt. Col. Bill "Witch" Doctor, the team chief for the 142d FIG. "The active-duty units have the luxury of new airplanes, but the Guard has the luxury of having peo-



SSgt. Dennis Mark, 18th TFW, Kadena AB, Japan, prepares 20-mm munitions for loading on an F-15 during the integrated combat turnaround segment of the competition. F-15s' five-person crews must load weapons and ammunition and refuel the aircraft within twenty-one minutes.

—USAF photo by A1C Dana Stephenson

—USAF photo by A1C Dana Stephenson

Lt. Col. Michael Fain, Team Captain, 33d TFW, Eglin AFB, Fla., shuts down his F-15 after arriving at Tyndall for the competition. Members of the 33d TFW team made "Top Five" in all three awards categories (Top Scope, Individual Top Gun, and Top Aerial Gunner).

ple around for twenty or thirty years. There is continuity of maintenance, and you can't beat that."

Lessons and Benefits

Units send only their best pilots, controllers, loaders, and maintainers to William Tell. The teams can bring four aircrews (plus a spare), two WCEs (plus a spare), and a ground force of no more than sixty people.

Preparing for William Tell has some obvious advantages. "For the last three months, the William Tell team has been working in the same building," noted the 33d TFW's Captain Rick Tollini. "I've gotten to know the maintenance people a lot better, and I've gotten to see firsthand how much work they do. There are an awful lot of people needed to get you into the air."

The size of the teams promotes cross training. Specialized technicians learn each other's jobs so they can serve as backups. Moreover, techniques that work at William Tell often work in the field, so everybody benefits.

Maintenance crews bring a Mission Support Kit (MSK), which has only enough spares and equipment to support a short-duration deployment such as William Tell. Unlike the full War Readiness Spares Kit, which requires a great deal of airlift support, the MSK can be packed in one C-141. Competitors sharpen their knowledge of what to pack—very worthwhile information to have.

William Tell '88 also marked some milestones. This was probably the last competition for F-4s, which have been competing since 1976. Several F-4s on the ramp had seen combat in Vietnam. "Miss Piggy" (as it's now called), an F-4C (serial number 64-0776) assigned to the 142d FIG, was used by then-Lt. Col. Robert F. Titus to shoot down two MiG-21s in one day in 1967.

The 116th TFW from Dobbins AFB, Ga., was the first Guard unit to compete with F-15s at William Tell. The General Dynamics F-16 will break up the current McDonnell Douglas monopoly in the 1990 competition, when the first air defense F-16 units will be eligible to participate. Another new player will likely be the QF-106 drone, as the supply of QF-100s is dwindling.

There may be women fighter pilots at a future William Tell. The Canadian Minister of National Defence, Perrin Beatty, opened all jobs in the Canadian Air Force to women in 1987. Two women, Capts. Deanna Brasseur and Jane Foster, are now in basic training at CFB Cold Lake. After graduation, they will be assigned to an operational CF-18 squadron.

"We learn a lot from William Tell," concluded General Jaquish. "For example, the data from the missiles fired here become a part of the weapon's database that will be distributed to all the units that use Sparrows and Sidewinders. Nothing done here is wasted." ■

Top Scope Top Five

CONTROL ELEMENT	UNIT (AIRCRAFT)	TOTAL POINTS (5,000 Possible)
1. Capt. Bruce R. Sturk SSgt. William H. Fitzgerald	1st TFW (F-15C)	4,900*
2. Capt John J. Kennedy, Jr. TSgt. Robert R. Nichols	18th TFW (F-15C)	4,900
3. Capt. David Newman SMSgt. Robbie T. Terrell	116th TFW (ANG)(F-15A)	4,900
4. 1st Lt. Scott Fischer TSgt. Greg Bendle	21st TFW (F-15C)	4,800
5. Capt. Jeffrey A. Nickerson Sgt. Edward Chisholm	33d TFW (F-15C)	4,800

*Ties broken on the basis of element's score in Profile IV (Mass Raid) and in Profile V (Fighter Scramble).

European governments buy their weapons a different way, but do they do it better?

Defense Procurement, European Style

BY F. CLIFTON BERRY, JR.

JUST as the sun rises in the east and sets in the west, so does the clamor for a civilian weapons procurement agency occur with predictable regularity. In the last year or so, the demand for a single weapons-buying agency run by civilians has sharpened once again. Cost overruns, allegations of waste and subpar performance, and downright criminal actions in the procurement process have stimulated the most recent suggestions for changing the way the Department of Defense manages its weapons-acquisition business. The suggestions are familiar and have been voiced before: Change the system from a decentralized one dominated by the military; in its stead, establish a centralized civilian agency to run the weapons contracting business on behalf of the military services.

David Lockwood, a defense-business expert at the Library of Congress, has examined the recurring suggestion. In World War I, "President Woodrow Wilson and his secretaries of the military departments unconditionally opposed the civilian supply agency concept," he says. In World War II, a civilian agency was created to direct the mobilization effort: the War Production Board (WPB), chaired by Donald M. Nelson.

According to Lockwood, Nelson had sweeping authority, "a virtual blank check." One of his early major decisions was whether to let the War Department and the Navy Department continue their military procurement roles or have a civilian group such as the WPB take over. Nelson rejected the civilian agency route, leaving the military departments to manage weapons procurement while his WPB coordinated and set policy. This was an unpopular decision on Capitol Hill, Lockwood notes, but Nelson firmly believed that it was the only decision he could have made. In the press of war emergency, setting up a

—Photo by Erik Simonsen

After schedule slippages of many years and cost overruns of more than a billion pounds sterling, the Thatcher government scrapped the government-managed Nimrod airborne early warning program and bought the USAF Boeing E-3A AWACS system. In a November 1988 report, Parliament's Public Accounts Committee called for marked improvement in the defense procurement process.

new civilian agency would have delayed production, and no delay could be tolerated, even one of a few weeks.

In the relative calm of peacetime, such as during the post-Vietnam era, Lockwood notes, the impetus for procurement reform has been economic—seeking ways to improve efficiency and reduce costs. The General Accounting Office (GAO) concluded somewhat glumly in late 1988 that "the problems being experienced today in the weapons-acquisition process are similar to those of the past. It is unclear whether today's problems are more or less serious than those of the past. . . . This is indicative of the high level of difficulty in developing lasting solutions to the seemingly intractable problems of affordability and stability."

Congressional Proposals

Bills were introduced in both the House and Senate in 1988 aimed at changing the structure and, in the process, creating a civilian procurement corps. Sen. William V. Roth, Jr. (R-Del.), proposed establishment of a Defense Acquisition Agency to buy weapons for DoD. Over in the House, Rep. Dennis M. Hertel (D-Mich.) proposed a streamlined civilian acquisition corps. Senator Roth gained the support of two dozen colleagues in August 1988 for his bill, and Representative Hertel had sixty-five cosponsors. Neither bill was passed in 1988.

The object, of course, is to provide for the national security with weapons that work at prices the country can afford. The 101st Congress and President Bush will consider again the notion of changing the weapons-buying structure. The heat is even higher this time. The towering budget and trade deficits have squeezed maneuvering space and time, and the country cannot afford spillage and waste, much less weapon systems that do not work.

In the quest for a better way to buy weapons, advocates of a civilian superagency usually point across the Atlantic. European governments do it that way, so why don't we?

Senator Roth planned to reintroduce his bill to create the Defense Acquisition Agency (DAA) when the new Congress began its work last month. He would approach the establishment of the DAA in two steps. First, a blue-ribbon panel of experts would develop a plan and draft the necessary legislation. Second, Congress would enact the legislation that would create the new agency.

During the first phase, the panel of seven experts would review the experience of selected European nations and evaluate how effective their experience has been. Senator Roth points out that most European nations have independent agencies to buy weapons for all their military needs and that such agencies are usually led and staffed by civilians.

It is too early to predict the fate of Senator Roth's and other bills to set up a civilian weapons-buying agency. But it is not necessary to wait for congressional action to see how selected European allies go about the process. The examples of France, West Germany, and the United Kingdom should suffice to introduce the difference between them and the US. In all three cases, a separate agency within the defense ministry carries out the weapons-acquisition function for all services. Details of these organizations are drawn from recent studies by the General Accounting Office and the Congressional Research Service.

French Organization

In France, the DGA *(Délégation Generale pour l'Armement)* runs all armament programs. It conducts research, development, and production and is responsible for all phases of the acquisition process. This includes monitoring the public and nationalized companies of the defense industrial base.

Besides R&D and acquisition, the DGA conducts industrial-level repairs for the armed services and actually owns and operates industrial establishments such as arsenals, test centers, and laboratories. It is also responsible for arms exports and collaborative projects with foreign industry and countries.

Top executives of the DGA are all professional engineers trained by DGA technical schools. They are not military officers in the sense of commanding fighting units, but they are granted military officer status. DGA officials told GAO researchers that all other civilians in the DGA are in subordinate roles to the professional engineers. The engineers return to DGA courses for postgraduate education and training in such specialized fields as armaments engineering and armaments administration.

Project managers, who "orchestrate" the day-to-day functions of weapons projects, are always armaments engineers and graduates of

advanced technical training. They typically serve for five years on a particular project and are responsible for all aspects, including cost, schedule, and performance. Before reaching project-manager status and authority, they have served earlier as civilian workers in DGA arsenals and test centers.

With regard to contracting, in France the close relationship between the Ministry of Defense and industry means that contracts are less formal than in the United States. This does not imply a looser rein, however. Profit rates are set by the DGA and range from four to eight percent, says GAO. Contractor performance, actual costs, and profits are measured at completion and taken into account in negotiating future contracts.

Costs are estimated and controlled by a five-year program. The military services identify their requirements for new weapon systems. These requirements are plugged into the fifteen-year Defense Plan. The next step is the annual Defense Programming Law, which estimates the resources that will be available over the five-year period immediately ahead. This allows the DGA to plan and commit to the life of a project. Actual funds are authorized in each annual budget. Parliamentary committees ask questions about the budget, after which it is approved in total.

The steps in the French acquisition process are distinct and totally independent. They are:

- Definition—research.
- Realization—development and production.
- Utilization—use by the services.

In executing its responsibilities, the DGA coordinates with the Chief of the Joint Staff and the chiefs of the services. The military services are involved in all phases of program life, from defining requirements through development and production, to operating and maintaining systems in use. But R&D and procurement are the DGA's province, not theirs.

The multinational Tornado program is often cited as a model development program. Although the aircraft was technically successful, its cost escalated far above early estimates. The Tornado nations are now committed to the European Fighter Aircraft program, already running over cost and behind schedule before any metal has been cut.

How the UK Does It

The Ministry of Defence (MOD) estimates costs for the medium and long terms (out to ten years). Requirements for weapon systems come from the defense staff, with input from the three services. The defense staff within MOD determines overall priorities for programs and allocating resources. Details of expenditure priorities are developed by the centralized Office of Management and Budget (OMB), a part of MOD.

A centralized Procurement Executive is also part of MOD. It is headed by a civilian political appointee and performs the acquisition function for all services. About ninety percent of its staff are civilians (7,560 of 8,402 in 1985). Within the Procurement Executive are three systems controllerates, one for each of the land, sea, and air services. Under their administration are the project managers, many of whom are civilians. However, unlike the French DGA, which provides total career progression, the Procurement Executive has set up a separate career program for its people.

Project managers take their projects through the entire cycle from initiation through production. Steps in the acquisition process are:

- Concept formulation.
- Feasibility study.
- Project definition.
- Full development.
- Production.
- In-service.
- Disposal.

The armed services play roles in developing requirements and in testing new equipment. They are otherwise unencumbered by the acquisition process (except as valued customers). Their chiefs are thereby freed to be responsible for the war-fighting efficiency and morale of their services.

As for legislative oversight, Parliament approves the total amount allocated for defense. According to MOD, Parliament does not make detailed changes. Committees of the House of Commons may investigate policy and program issues and question the way the money is spent. The National Audit Office, a counterpart of our General Accounting Office, conducts audits and reviews. (Its 1986 report on twelve development projects was a searching and detailed analysis of the management process.) Parliament's Public Accounts Committee periodically scrutinizes MOD's procurement performance. In a report released in late November 1988, the Committee cited cost overruns and delays in several projects and said it expected MOD to show marked improvement.

In contracting and competition, MOD's recent trend is toward more competition when possible. It prefers fixed-price contracts. When noncompetitive or sole-source contracts are necessary, it writes an incentive contract of some kind. Cost-plus-profit contracts are a last resort and are subject to review by an independent board.

The Case of the Costly Frigates

Cost and schedule slippages in defense procurement are not new. According to the US Congressional Research Service study *Cost Growth in Weapon Programs* by Bert H. Cooper (December 1974), in 1794, Congress authorized construction of six frigates for the new United States Navy. Delivery was to take place the next year, and the ships were to cost $114,815 each (in 1794 dollars). More than four years later, only three of the ships had been delivered, and the cost per ship had soared to nearly three times the original projection—to $315,000!

For long-range planning of research and development, the West German Ministry of Defense (MOD) develops proposals that look fifteen years into the future. More details appear in the armed forces plan, with five-year and ten-year projections. Closer to real time, the MOD prepares the "Bundeswehr Plan" each year, which specifies weapon systems to be developed. It is submitted to the German legislators for review and evaluation and is the basis for the annual budget.

Weapons acquisition in West Germany is centralized at the ministerial level. Within the MOD, responsibility for weapons acquisition is under the State Secretary for Armaments, a political appointee. Under him is the Armaments Division, which provides ministerial-level guidance and policy direction for the process. The Armaments Division also controls weapons research, which is usually contracted out to industry. Actual implementation is performed by the Federal Defense Technology and Procurement Agency. Its acronym is BWB, for *Bundesamt für Wehrtechnik und Beschaffung*.

The service staffs determine military requirements and participate with BWB in the process. They support, test, and maintain the systems and also provide system managers, who represent the users. The System Manager's Working Group is the vehicle for coordination between the users and the procurement experts of the BWB.

BWB project managers handle all contracting and deal with industry for definition, development, and production. Cost estimates are developed by the project managers and reviewed regularly by the Systems Manager's Working Group.

Phases of the acquisition process in West Germany are:

- Definition.
- Preconcept.
- Concept.
- Definition—further refining the concept.
- Development—from development contract to approval for fielding.
- Procurement—production and delivery to the user.
- In-service—operated and maintained by the service.

BWB contracts with German industry to develop and produce the weapon systems that have made it through the hurdles of the definition reviews. The MOD prefers to award contracts based on competition, with two to six contractors bidding. Once a contractor is selected, it is responsible for selecting subcontractors and ensuring their performance. However, the MOD controls the prime through all phases of the process. Allowable profits range from 2.5 to eleven percent on sole-source negotiated contracts.

Similarities and Differences

The French DGA appears most closely to resemble an autonomous civilian weapons procurement agency and differs most from the US system. The British Procurement Executive is similarly independent and civilian-led, but includes a small percentage of military people (ten percent). Like its French and British counterparts, the West German BWB develops and acquires systems for all of the armed services on a centralized basis.

These brief descriptions of three European weapons acquisition systems tell how they are organized to do business. Each operates systems that are more centralized than the US systems. However, not all NATO countries operate central procurement systems. In Norway and Turkey, the military services do their own procurement.

Do these European centralized systems work better than the US model? Michael Rich and Edmund Dews, authors of a 1986 Rand Corp. report on the military acquisition process, said, "Weapon program outcomes in Europe are generally less satisfactory than those in the United States, especially in terms of schedule length and slippage during the development phase."

Lockwood said two years earlier, about those three countries and Canada: "It is not clear if these countries have had greater success than the United States in controlling costs or if such success can be attributed with any degree of certainty to their different procurement structures. A great deal of comparative analysis remains to be done in order to answer these questions." That is as true in 1989 as it was in 1984.

Lockwood's colleague Andrew Mayer has studied the European systems in detail. He is equally cautious in rendering judgment. While observing that the trend over the past twenty-five years is toward centralization, he says, "There is probably no way to prove that centralization has produced substantial cost savings. However, it may be regarded as significant that no country [that] has moved in the direction of centralization has seriously considered reversing this direction."

So before leaping to emulate the centralized, civilian European acquisition systems, Congress and the Department of Defense should examine those systems with great care and make sure that comparative analyses are valid. Otherwise, the odds are high for making the situation worse instead of better. ■

F. Clifton Berry, Jr., is a former Editor in Chief of AIR FORCE *Magazine. He has written on international security topics for some twenty years. He saw USAF service in the Berlin Airlift, 1948–49. Later, he was a paratrooper and an officer in the 82d Airborne Division. He commanded airborne and infantry units in the US and Korea and saw Vietnam combat as operations officer of a light infantry brigade. He is a principal of FCB Associates, an information service on international aerospace topics. His most recent article for* AIR FORCE *Magazine was "Defeating Red Armor" in the October '88 issue.*

This proposed change to the Defense Production Act would force the Pentagon to buy from domestic suppliers—even if the cost is staggering.

The Push to Buy American

BY BRIAN GREEN, CONGRESSIONAL EDITOR

THE Defense Production Act (DPA) has not been used much in recent years. Although watered down considerably from the original 1950 version, the Act still grants the government strong powers to control the activity and output of the defense industry.

This session of Congress may see the DPA emerge from its relative obscurity. The Act is up for renewal, and Rep. Mary Rose Oakar (D-Ohio) is proposing changes to it that could have a stunning effect on both the US economy and national security policy. Representative Oakar chairs the Economic Stabilization subcommittee of the House Banking Committee, which oversees the DPA. Her amendment would force the Defense Department to "buy American" except when the reasons to buy overseas are compelling.

Even advocates of this measure agree that it would add $10 billion or more to the cost of the defense program, and cost is only one of the arguments raised against Representative Oakar's proposal. The Defense Production Act is at the center of a controversy that spans issues as diverse as international trade, the competitiveness of US industry, and the nation's ability to meet its wartime obligations.

The DPA of 1950 was passed to facilitate mobilization during the Korean War. Today, it serves as the primary legal basis for government intervention to provide for defense industrial readiness. Peacetime aspects of mobilization include "preparing to prepare" by attending to the economic assets required—defense industry preparedness, viability of other industries critical to defense, availability of critical minerals, and so on. The DPA can also be a means of addressing even broader economic problems, such as the US balance of trade.

The fundamental concern expressed in Representative Oakar's amendment is US dependence on foreign sources. Such dependence for key minerals and raw materials has long been recognized. But, as the Air Force Association and the USNI Military Database warned last fall *(see "Lifeline in Danger," November '88 issue, p. 74),* US dependence on foreign sources for critical components of military hardware is a growing problem as well, exacerbated by insufficient capital investment in the US, declining R&D funding, and an adversarial government-industry relationship.

Straightforward Solution

Representative Oakar's solution is straightforward. Her bill would dictate that "the President . . . shall limit, to the maximum extent practicable, the . . . production of . . . weapons and their systems, including all parts and components, to domestic manufacturing and assembly sources within five years" of enactment.

The measure attempts to elimi-

nate the problem of foreign-source reliability. These sources are militarily vulnerable in some cases. Japan, for example, is only a few minutes' flying time from Soviet air bases in the Far East. But the concern goes deeper than that.

In a supply shortage, a foreign manufacturer might attend to its domestic needs first, leaving the US empty-handed. With the US Merchant Marine in bad shape and control of the seas in a crisis or during wartime uncertain, the continued flow of foreign goods could not be guaranteed. Advocates of change further contend that the US has no assurance of quality on components manufactured overseas. They cite the large number of "counterfeit" fasteners—nuts and bolts that did not meet DoD specifications—imported in the early 1980s. They suggest that foreign sources will allocate top-quality goods to their domestic markets and cannot be trusted to provide their best to the United States.

But fundamentally, the objective of Representative Oakar's bill is to force the modernization of US plants and equipment by restricting the ability of the Pentagon and its prime contractors to buy from foreign manufacturers. Supporters of the measure point with alarm to a long list of US industries in decline—fasteners, electronics, computer chips, machine tools, and ball bearings, to name a few. Such a decline, they argue, cries out for a dramatic solution. The benefits of DoD investment would be highly leveraged, they believe, because modernized US industry will compete more effectively in commercial markets.

Skeptics—and there are many—are not impressed by these arguments. "Totally unworkable," declares one Senate staffer. "Foreign dependency is a legitimate concern, [but] it is impractical to come to a simple bottom-line fix," says Gen. Robert T. Marsh, retired Commander of Air Force Systems Command and chairman of AFA's Science and Technology Committee.

One basic concern is money.

There are no good estimates of what the Oakar proposal would cost or save overall, but the cost to DoD would be substantial. One critic has estimated it at $10 billion or more. Some guesses range from $10 billion to $30 billion. US goods almost always cost more than similar items purchased abroad. The revival and reconstitution of American industries would add still more cost—all at a time when defense budgets have been cut sharply.

Costs Would Rise

Even enthusiastic supporters concede that DoD costs would rise. But, says Norman Cornish, who has served as a senior consultant to Representative Oakar and her subcommittee and who helped draft the bill, "if the aim of [the defense] exercise is to save money, hell, we ought to buy all this stuff overseas and save a bundle. . . . At what point do you stop depending on overseas sources for absolutely vital items?" Mr. Cornish and others say that DoD could reduce the cost impact by cutting force structure and overseas troop strength, moving missions to the Guard and Reserve, and revamping the procurement system. They admit that weapon systems production may have to be cut, too.

They maintain, however, that the Oakar measure provides, in the short run, sufficient waiver authority to mitigate serious consequences, while in the long run it will save money. The cost of buying overseas is in general greatly understated, they believe. When an American firm loses business to an overseas competitor, the government in turn loses revenues from taxes and contributions to Social Security and other funds. According to one study, the cost of foreign goods must be forty-two percent cheaper than comparable domestic goods to make buying abroad a good idea. Moreover, the Oakar camp says, the loss of business and profits to foreign competition inhibits R&D and the modernization of plants, which are necessary to maintain competitiveness.

The bill would permit a waiver for systems and components if the demand for them can be met by domestic industry for six months after an outbreak of hostilities. That determination would have to be certified in writing by the Secretary of Defense. The waiver would also permit the President to exclude other contracts from the "buy American" directive, "but only after considering in each case the results of a written economic and defense production assessment" that examines the effect of a waiver on US industrial capability, the actual costs of buying overseas, and the "estimated costs [incurred by domestic industry] of complying with US laws, including occupational health and safety, workmen's compensation, quality assurance and verification, and the environment." Proponents argue that the waiver authority would suffice to avoid the multibillion dollar price tag critics fear.

Opponents look at the same waiver provisions and gasp. "The management burden it would impose in the effort to find, rejuvenate, build up, promote, or support weak or perhaps even nonexistent industries that are critical to defense would be very, very great," says General Marsh.

Eliminate Dependencies

Everyone agrees that critical dependencies must be eliminated, but there are different views about what is critical. "To a soldier in the mud with no boots, boots are a critical item," says Norm Cornish. The Oakar bill is based on a similarly broad interpretation of criticality.

Others narrow the definition and focus on specific industries and technologies, such as semiconductors, fiber optics, and machine tools. These industries, and the R&D and manufacturing capacities they represent, are so central to the effectiveness of US weapons that domestic capability must be protected and, if need be, promoted.

General Marsh suggests stockpiling critical components, designing systems around dependencies, and developing alternate designs to eliminate dependency should the need arise. He and others point to specific initiatives such as Sematech, the consortium that hopes to revive the US semiconductor industry, and the National Center for Manufacturing Sciences (NCMS), which will focus on manufacturing technology.

"DoD is going to have to make some tough technology choices," says another Senate staffer—choices that the Oakar bill avoids.

Some perceive the Oakar bill as

motivated by a desire to help depressed industries in the rust belt. The protectionist tone of the legislation and the open hostility to some US trading partners expressed during the subcommittee's hearings suggest that the international trade repercussions of the measure would be severe. The bill clearly runs counter to the trend of recent US defense policy—the push toward a viable "two-way street" in weapons procurement connecting the US and its allies. Current memoranda of understanding and offset agreements would be undermined—a prospect that Oakar supporters do not necessarily find disturbing.

Perhaps most basic of all, the critics contend that the Oakar bill ignores the reality of an interdependent global economy.

"It would be a mistake for the United States to seek complete independence for its defense industrial base," the AFA/USNI Military Database study concluded. Such an approach is unaffordable and undesirable, the two organizations said. Some foreign dependence is an inevitable consequence of a coalition strategy that assumes allied participation, a commitment to free-trade policies, limited resources, and an increased emphasis on low cost in procurements.

Some activists disagree with Representative Oakar's approach but still see the DPA as a means of rejuvenating American industry. They argue that the fundamental problem is a lack of focus, both in policy and administration. The DPA, they suggest, could well be the focal point.

The centerpiece, in this view, is DPA's Title III. This title authorizes grants, loans, loan guarantees, and purchase agreements to stimulate production of key materials and components. After many years of disuse, Title III was revived in 1985. Air Force Systems Command was designated the executive agent for the program and currently operates a small (eight staffers and $33.6 million in FY '89) but active program office at the Industrial Materials Division at Wright-Patterson AFB. Title III, its proponents say, provides just the kind of effort that is needed and could readily be expanded.

Developing Capacity

The Title III program office is limited to use of purchase guarantees (a result of an agreement among the Office of Management and Budget, DoD, and Congress) to boost production. It focuses on developing production capacity for materials with generic (*i.e.*, nonprogram-specific) uses and encouraging designers and manufacturers to make use of the new capacity. Typical programs under Title III have developed pitch-base carbon fiber (used in space structures and heat management) and very high purity polysilicon (a precursor to single-crystal silicon used in infrared detectors and high-power switching devices).

Title VII provides the authority the government needs to collect data to determine the exact nature and extent of critical foreign dependencies. The Department of Commerce is using Title VII to collect data on offset arrangements between US and foreign industry (a study required by a recent DPA amendment) and on the national security impact of imports.

Yet another body of opinion holds that the DPA is a poor vehicle for defense industrial base reform under any circumstances. The Federal Emergency Management Agency (FEMA), hardly a bureaucratic powerhouse, is responsible for DPA policy formulation, coordination, and resolution of interagency conflict. Oversight is by the House and Senate Banking Committees. This puts the DPA at a disadvantageous distance from the Defense Department and the House and Senate Armed Services Committees, who work defense issues full time.

Not Worth Reauthorizing?

In fact, some suggest that the DPA may not be worth reauthorizing. Even some DPA enthusiasts say that DPA Title I authority is an ineffective way of influencing industrial priorities and that DoD has many other tools to influence contractors. No one argues that the DPA alone is now sufficient to facilitate wartime mobilization; draft legislation has been prepared to permit rapid expansion of government authority should war break out. Indeed, there was little activity or interest in the DPA throughout the 1970s, and in the early 1980s it came very close to expiring.

Renewed interest in the DPA makes its expiration unlikely now. Supporters of the Oakar initiative admit that the prospects are poor for passage in the Senate, and the bill may not even clear the House. DPA reauthorization in the Senate, where Sen. John Heinz (R-Pa.) and Sen. Alan Dixon (D-Ill.) are expected to be the prime movers, is not likely to share the strong protectionist flavor of the Oakar bill. Even if the House passes the Oakar proposal, it could be significantly modified in a conference compromise.

What the Oakar bill has done, however, is put the DPA on the agenda as a measure that demands close scrutiny. ■

What's Left of the DPA

As originally passed, the Defense Production Act had seven titles. Four were repealed or allowed to lapse shortly after the end of the Korean War. These provided presidential authority to requisition resources needed for national defense, ration goods, stabilize wages and prices, settle labor disputes that could interfere with the war effort, and regulate consumer and real estate credit.

Three titles remain in force:

- Title I provides presidential authority to order private industry to give priority to US government purchases of defense-related products or materiel. The Defense Priorities and Allocation System (DPAS) assigns priority to almost all defense orders. A company that receives such an order must structure its own schedule and use of resources to meet DoD demands.
- Title III authorizes the President to expand industrial production and the supply of materials to meet anticipated defense needs through government grants, loans, loan guarantees, and purchase agreements.
- Title VII is something of a grab bag. It permits voluntary industry cooperation without running afoul of the antitrust laws, sets up the National Defense Executive Reserve, and authorizes collection of data needed to perform functions authorized in the DPA. DPA authorities expire unless reauthorized periodically by Congress.

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Planning is under way for a memorial to honor women who have served in the armed forces.

A Memorial to Military Women

BY COLLEEN A. NASH, STAFF EDITOR

NEARLY 2,000,000 American women have served in the US armed forces. They have swabbed cannons, packed parachutes, ferried airplanes, and fixed engines. Women have been decorated, wounded, and imprisoned. Many have died for their country. Today, women make up more than ten percent of the armed forces, and there are more than 1,000,000 women veterans.

The story has largely gone untold, but plans are finally under way to construct a major national memorial to military women. The memorial will also honor such women as Mary Ludwig—known to history as Molly Pitcher—and Lucy Brewer, who were not eligible to join the military in their day.

In 1986, Congress authorized a national memorial to women in the military services. The Women in Military Service for America Memorial Foundation, Inc., is the nonprofit organization charged by Congress with the responsibility for funding and constructing the memorial.

Planning is well along, and a site for the memorial has already been approved—the memorial gate area at the end of the entrance to Arlington National Cemetery, across the Potomac River from Washington, D. C. The major structure in this area, known as the Hemicycle, was built more than a half century ago. The Hemicycle was never formally completed and is now in need of repair. "The main entrance to Arlington National Cemetery is crumbling—there's a big restoration cost," said Foundation president Brig. Gen. Wilma L. Vaught, USAF (Ret.). Construction of the memorial would restore, complete, and enhance the Hemicycle and surrounding area.

Mary Rose Nelson, a retired Navy nurse who spent more than three years as a POW in the Philippines during World War II, listens to the Foundation's design competition announcement at ceremonies at the memorial gate area of Arlington National Cemetery.

According to the Foundation, the purpose of the memorial is to pay tribute to the women who have been or are now in our armed forces; tell the story of their dedication, commitment, and sacrifice; make their historic contributions a visible part of our national heritage; illustrate their partnership with men in the defense of the nation; and inspire others to follow, emulate, and surpass them.

The Foundation's Board of Directors includes military and civic lead-

ers as well as veterans' group representatives. The National Sponsors Committee is made up of three former US Presidents, eight past Secretaries of Defense, and former Chairman of the Joint Chiefs of Staff Gen. John A. Vessey, USA (Ret.). The Foundation receives advice and counsel from a forty-member National Advisory Committee composed of retired military leaders, members of Congress, and other influential supporters.

Progress and Planning

Plans call for the construction of an entire memorial complex, including commemorative works; a reception area with souvenirs, books, and displays; and a small auditorium featuring a movie about the history of women in the military and their contributions. An essential part of the memorial will be the registration room. There, a computer register will simultaneously display career highlights and other information and photos (when available) of servicewomen who have registered with the Foundation.

The memorial design competition is open to any US citizen eighteen or older, and competitors may enter as individuals or in teams. Three finalists will be selected and invited to participate in the second phase of competition, in which they will develop their schemes. The winner will be announced on November 10, 1989.

Historically, there have been difficulties in identifying many women who have served. The registration process aims at identifying every woman who is serving or who has ever served. The register would be the first and only permanent record for women of the US armed forces.

What's Involved?

Registering involves completion of a short form giving personal military history and payment of a fee. The minimum fee is $25. It is possible to sponsor an eligible woman as well. The register will list such data as name, place and date of birth, pertinent service information, highest rank/rating and decoration, and career highlights.

According to Foundation staffer Col. Diane E. Ordes, USAF (Ret.), some 3,000 women have already registered. The events they list as the highlights of their service reflect the changing roles that women have had in serving the nation.

During World War II, for example, Doris Vollbrecht Zeile, a WAC at Fort Sheridan, Ill., outside Chicago, recalls hearing the announcement that the war had ended, and Barbara Cooperrider Dorn says that the high point of her two years in the Navy was "working as a Link Trainer Instructor with pilots back from the Pacific for refresher courses."

"You start seeing a lot of firsts coming out in the '60s and '70s—the highlights are more career-oriented," said Diane Ordes. For instance, Lt. Col. Arminta J. Harness, USAF (Ret.), was the first woman engineer in the Air Force and the first woman awarded Senior and Master Missileman Badges. Cheryl Tyson Charles lists participating in the military exercise Gallant Knight '84 as one of the highlights of her time in the Marine Corps. Col. Nancy H. Buzard, USAF, was selected as the first woman military aide to the President and was the first woman faculty instructor at Air Command and Staff College.

Making the Memorial a Reality

Although authorized by Congress, the memorial must be funded solely through private donations. The cost is estimated to exceed $12 million. By law, the Foundation must have funds to cover construction by mid-1990, and work must begin by November 1991. Otherwise, the authority to build the memorial might lapse.

Contributions or requests for information may be sent to Women in Military Service Memorial, Dept. 560, Washington, D. C. 20042-0560. The telephone number is (703) 533-1155. ■

Foundation President Brig. Gen. Wilma L. Vaught, USAF (Ret.), and Sen. John Warner (R-Va.) discuss the memorial project at the design competition announcement event. Senator Warner, whose mother served during World War I in hospitals as a volunteer caring for the wounded back from France, was one of the guest speakers at the event.

Other guests (from left): Maj. Gen. Jeanne Holm, USAF (Ret.), the first woman two-star; Brig. Gen. Anna Mae Hayes, USA (Ret.), the first woman one-star in the US armed forces; Brig. Gen. Margaret Brewer, USMC (Ret.), the first woman one-star in the USMC; Brig. Gen. Mildred C. Bailey, USA (Ret.); and retired Rear Adm. Fran McKee, USN, the Navy's first woman one-star.

BEST ON THE LINE

AFA honors the Crew Chief of the Year.

BY MSGT. ALAN PROCHOROFF, USAF (RET.)

TSgt. Timothy Carroll wasn't born with a silver wrench in his hand, but from early childhood, he was destined for greatness.

He always had a knack for taking things apart and putting them back together. As a youngster, he tinkered with Tinker Toys and erected Erector Sets. When he was in the eighth grade, he taught himself auto mechanics by working on an old car in his parents' driveway.

He didn't teach himself jet-engine mechanics, though. The Air Force took care of that. Along the way, he's made the most of his knowledge, rising to the top of his profession.

"I don't think of myself as the best crew chief in the whole Air Force," Sergeant Carroll said. Maybe not, but others do. The B-52 crew chief from Barksdale AFB, La., was honored as the 1988 Air Force Crew Chief of the Year at September's Air Force Association Convention. The eight-year veteran of the flight line sees the award, not as recognition of his own abilities, but as the result of the hard work of others.

"I can't take all the credit, because I'm just the guy they chose to carry the flag," he said when he learned of the award. "It's really more of a squadron achievement when anyone wins an award like this."

He set the tone for impressive accomplishments when, right out of tech school, he earned his five level in minimum time with a ninety-eight-percent average. Later, he was promoted to senior airman below the zone, and he made tech sergeant in less than eight years. He's been Barksdale's 2d Bomb Wing NCO of the Year, a SAC finalist for the Air Force's Twelve Outstanding Airmen of the Year program, and a nominee for the Air Force Outstanding Maintenance Technician of the Year Award.

"Exemplary Skill"

Maj. Gen. Charles J. Searock, Jr., SAC's Deputy Chief of Staff for Logistics, said Sergeant Carroll "clearly demonstrated individual excellence," and Col. John F. Manno, the General's counterpart at Eighth Air Force, cited his "exemplary skill, job knowledge, and dynamic leadership."

Col. John D. Ventress, 2d Bomb Wing's Deputy Commander for Maintenance, is even more impressed. "As a crew chief he is without equal. His performance [which included leading the fleet in on-time takeoffs and having the lowest discrepancy rates at Barksdale] has been phenomenal. His contributions have been a factor in every success and award [we've] attained this year. Above all else, he is *the* recognized expert on the B-52G," Colonel Ventress said.

With those credentials, it was logical for the 2d Bomb Wing to turn to Sergeant Carroll to head an intensive training program for 150 air-

craft technicians in its bomber-maintenance branch.

How confident are the 2d Bomb Wing bosses in his ability? Very. In test after test, Sergeant Carroll has proven "without equal." Before 2d Bomb Wing's 1988 Operational Readiness Inspection, Sergeant Carroll conducted an Emergency War Order training class for other crew chiefs that resulted in outstanding results and helped the bomber branch and squadron earn their best ratings ever.

Before a Maintenance Standardization and Evaluation Team visit, he trained seven airmen "in minimum time and with outstanding results," Colonel Ventress wrote, "and he earned an award for technical excellence from the inspection team."

His résumé is even more impressive when you consider that Carroll's airplane—57-6520—has been around longer than the twenty-six-year-old mechanic.

"We keep a close eye on our airplanes because of a wartime necessity," Sergeant Carroll said. "Nobody knows when we may have to go to war, so we keep them ready all the time."

How ready is that? Many would say Sergeant Carroll's airplane is one of the most ready in SAC. After he spent months stripping, repainting, and refurbishing the inside of 57-6520, it was judged the best B-52 in SAC for 1987. That massive effort won first place in SAC's 1987 Glossy Eagle competition, a program designed to spruce up SAC's older aircraft through self-help. Glossy Eagle emphasizes cleaning, repairing, repainting, standardizing, and improving the overall condition of the aircraft.

"I think keeping an airplane clean and ready to fly makes the maintenance workers want to take care of it on the ground and the pilots take care of it in the air," he said.

Sergeant Carroll, as you might expect, is as ready as his airplane. When he represented Barksdale in SAC's 1987 Combat Weapons Loading Competition, he tied for the best academic score, had the fastest time and the fewest discrepancies in the post-loading competition, narrowly missed winning the preloading, and finished second overall in judging for the best bomber crew chief in SAC.

That performance led to his heading the 2d Bomb Wing maintenance team for SAC's Bombing and Navigation Competition. The results were up to Sergeant Carroll's standards—the best aircraft in the fleet and one of the highest ratings ever achieved by Barksdale B-52Gs in the contest.

Sergeant Carroll also earned praise for his quick actions during a 1987 flight-line fire and was credited with helping to avert possible loss of life and of millions of dollars in equipment.

Carrying on a Tradition

Although he doesn't come right out and say it, there's a sense in Sergeant Carroll's work of carrying on a tradition started by the people who worked on the plane before his tenure. "They've done a hell of job on it," he said in quiet admiration.

One of the people whose standard he talks about living up to is his first supervisor, MSgt. Steve Nichols. "It wasn't so much what he did, as how he did it," Sergeant Carroll said.

"I don't remember him for any way he explained a job or any specific guidance. He was just a good supervisor who set a good example. The things he valued made sense to me; they were, I realized, the things I valued. Things like being honest, giving everything you have in a situation, and taking advantage of opportunities. That last one is important because Sergeant Nichols always said that you're not just cheating yourself when you let opportunities slip away; you're also cheating other people who didn't get the chance you got."

He's even more vocal when talking about the people he really aims to please. "The aircrew has enough to do without having to worry about this airplane," Sergeant Carroll said. "I don't want them to be concerned about the airplane and whether it is going to be able to do what they want it to do. I want them to *know* the plane will perform, so they can concentrate on flying the mission and putting their bombs on the target."

What's next for Timothy Carroll? Once again, he's looking opportunity square in the eye and making plans to take advantage of it. While he's in no hurry to leave the world of the B-52, Sergeant Carroll admits there would be a certain element of excitement in moving from the Air Force's oldest bomber to its newest. "I've wanted to be a part of the B-2 program ever since I heard rumors about it.

"I'm also taking a long-range view of my career, looking at people who are in positions I want to fill in a few years, and I'm seeing what they've done to get there."

At this point, he said, it's more important to have the goal than to reach it. "Whether or not I reach the goal isn't as important as having the goal to reach for. Even if I fall short, I'll probably go farther in the long run."

For now, the man who brought greatness to the greasepit will have his hands full keeping Barksdale's BUFFs flying. "The B-52 is an old airplane," he admits, "but it's reliable, and I have a lot of respect for older things. Sure, this airplane is older than I am, but I have a lot of confidence in it. Besides, this airplane is being counted on to do a big job, and I'm going to make sure it can do it." ■

MSgt. Alan Prochoroff, USAF (Ret.), is a free-lance writer in the Washington, D. C., area. His by-line appeared most recently in AIR FORCE *Magazine with the November '88 issue feature "With Dignity and Honor."*

A Gambit That Worked

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

The promised reduction in Soviet troops is of limited military significance—but it may succeed where hostile measures failed in undercutting the defense of NATO.

Whatever other reasons he might have had—and there is little doubt that the bankrupt Soviet economy was one of them—Mr. Gorbachev's announcement of troop reductions was a brilliant stroke. The wonder is that it took so long for someone in Moscow to think of it.

Once the brief euphoria of V-E Day had passed, elimination of US influence in Europe became a principal Soviet objective. In 1948, Stalin officially began the Cold War with the Berlin blockade, presumably confident that our feeble occupation forces could offer no serious resistance. Our unexpected response was oblique—a giant airlift backed up by the atomic bomb—and we won that round, but the Cold War was on. NATO emerged from the Treaty of Brussels as an allied organization for the collective security of Europe. In reality, it was a collective statement of reliance on the United States to prevent Soviet aggression.

From the strategic standpoint, NATO's first years were simple. Its forces were admittedly inferior, but that didn't matter. They were really meant to be a trip wire, a burglar alarm. Once those forces were overrun, American nuclear weapons would rain down on Russia. That took care of strategy.

Meanwhile, the US troop contingent in Europe, both ground and air, once considered by General Eisenhower to be a temporary deployment, somehow became permanent. Although the size of that contingent was not the result of tactical calculation but rather a reflection of what was manageable at the time, the numbers became sacrosanct—the visible United States commitment to NATO. Any proposed reduction in those forces, until now at least, has set off European alarms.

In past years, whenever Europe's enthusiasm for collective security has flagged, the Soviets have come to the rescue. Berlin, Hungary, Czechoslovakia, Poland, Afghanistan, not to mention ham-handed espionage and general antisocial behavior, have proven the need to be on guard. Nevertheless, there has long been a wistful hope, on the part of at least some of our allies, that the USSR would mend its ways and become a friendly neighbor.

It was my dubious luck, almost twenty years ago, to be enmeshed in a reflection of that wishful thinking. The politicians of the Alliance decided that the time had come to consider Mutual and Balanced Force Reductions. As a necessary preliminary step, a committee of second-tier diplomats was created. Next, to the outraged dismay of certain ambassadors, I was made chairman of this polyglot group. My boss, a British admiral, was uneasy about the mischief this bunch might cause without the steadying hand of a military man and arranged the deal with the connivance of NATO's Secretary General.

We eventually came up with a database that, in turn, became a basic document for the marathon Vienna debates on Mutual and Balanced Force Reductions. If those feckless Vienna sessions can be credited with an achievement, it has been the exposure of Soviet obduracy in response to any reasonable proposals, an attitude that tended to keep the softer allies more or less in line.

The Gorbachev announcement comes at a time when Alliance resolve has been weakening in some countries, most alarmingly in the Federal Republic of Germany. A generation reaching early middle age without hearing a shot fired has difficulty believing in the Soviet threat, especially when Gorbachev tells them what they want to hear. Never mind that the proclaimed demobilization of 500,000 Soviet troops will not be subject to verification and was probably necessary anyhow, or that the 10,000 tanks will doubtless include a good many museum pieces from the 1950s. The Soviet conventional force facing NATO will continue to be dominant, if somewhat less threatening.

In all fairness, however, that sort of argument is beside the point. With its internal troubles, the USSR is in no shape to threaten the West, and no one really believes a Soviet attack, in the present climate, is even a remote possibility. What is at stake is the future of NATO, suddenly threatened by a seemingly reasonable and charismatic Russian politician. For all its shortcomings, that Alliance has been the indispensable key to European peace and stability for forty years.

There will almost surely be rising pressure here at home to reduce US troop strength in Europe. The Gorbachev gambit has sent waves of ecstasy through segments of Congress—and then, for cooler heads, there is the deficit and Gramm-Rudman-Hollings.

The Armenian disaster has made public what experienced USSR watchers have always known: Nothing works very well, if at all, in the Soviet civilian sector, and the Soviet bureaucracy is stifling. According to responsible accounts, Mr. Gorbachev is determined to fix the decrepit Soviet economic apparatus, with the military taking a few lumps in the process. Nevertheless, Gorbachev is a transient force on the scene. Whether one man, however charismatic and politically gifted, can change the historic aims decreed by Lenin remains a long shot. Healthy skepticism is still a justifiable attitude.

Meanwhile, Mr. Gorbachev has severely shaken NATO. If ever the old Alliance needed a thorough overhaul, this would seem to be the moment. A good place to start would be in the area of military cohesion, now dependent on the uncertain political whims of its member countries. ■

1988 SCAMP Scholars Named

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THE seventeenth annual AFA Air Force Ball in Los Angeles commemorated the fortieth anniversary of the Berlin Airlift. Held in late October 1988, the Ball again raised thousands of dollars for AFA's Aerospace Education Foundation and SCAMP (Scholarships for Children of American Military Personnel). SCAMP has committed more than half a million dollars for scholarships in the past fourteen years. Seventy-four young Americans have received 212 grants during that time.

This year, thanks in large measure to the continuing success of the Ball, SCAMP increased the initial scholarship awards from $3,000 to $3,500 each and raised the number of annual awards from five to eight. There are currently thirteen ongoing awards. Scholars continue to receive annual stipends as long as they remain academically eligible.

Eight students were awarded SCAMP scholarships for 1989:

• **Stacey Ann Curran,** daughter of Maj. Patrick R. Curran, USMC, who was declared MIA in September 1969. Stacey is a sophomore at the University of Iowa, where she is pursuing a bachelor's degree in English and Spanish.

• **Robert Bruce Bloodworth Nolan,** son of Capt. Donald Bruce Bloodworth, USAF, who was MIA in Southeast Asia in July 1970 and was presumed KIA in May 1974. Robert is studying molecular genetics and biochemistry at the University of Notre Dame.

• **Adrian Basil Rudloff,** son of Cmdr. Stephen A. Rudloff, USN (Ret.), who was taken prisoner in Southeast Asia on May 10, 1972, when he was an ensign. Adrian is attending the State University of New York at New Paltz, where he is majoring in dramatic arts.

• **Heather B. Young,** daughter of Capt. Robert M. Young, USA, who was declared MIA in May 1970, named as a POW in October 1971, and presumed KIA in January 1973. Heather currently attends Hood College in Maryland, where she is majoring in journalism.

• **Shannon Michele Cuthburt,** daughter of Maj. Bradley G. Cuthbert, USAF, who was MIA in November 1968 and was presumed KIA in May 1975. Shannon is pursuing a degree in writing and editing at the University of Iowa.

• **Jody Ann Fowler,** daughter of Lt. Col. James A. Fowler, USAF. Colonel Fowler was listed as MIA in June 1972 and was presumed KIA in September 1980. Jody is aiming at a career as a travel consultant and is majoring in hotel management at Florida State University.

• **Thomas Roy Latendresse,** son of Capt. Thomas Bennett Latendresse, USN, who was a POW in 1972–1973. Thomas graduated from Washington University in St. Louis, Mo., and is now enrolled in the University of St. Louis Medical School, specializing in family medicine.

• **Michael Alan Mateja,** son of Maj. Alan Paul Mateja, USAF, who was MIA from April 1972 until February 1980, when he was presumed KIA. Michael attends Centre College, Danville, Ky., and is majoring in mathematics and science.

At the Ball, honor was paid to Col. Gail S. Halvorsen, USAF (Ret.), the noted "Candy Bomber" of Berlin Airlift fame who, as an airlift pilot, dropped candy and chewing gum to the children of that blockaded city. In recognition of this gesture and as a salute to USAF, the Consul of the Federal Republic of Germany announced that the city of Berlin will award a one-year grant for study at the University of Berlin. The scholarship winner, to be selected from the SCAMP nominees, will receive tuition, a monthly stipend, and transportation to Berlin.

This year's Ball will be held November 3, 1989.

—JAMES A. MC DONNELL, JR.

At the seventeenth annual AFA Air Force Ball, James M. Keck, President of AFA's Aerospace Education Foundation, meets four winners of Scholarships for Children of American Military Personnel. From left to right: Stacey A. Curran, Heather B. Young, James Keck, Robert B. Bloodworth Nolan, and Adrian B. Rudloff.

Valor en Masse

No group of American military men has suffered longer or more heroically than the Vietnam POWs.

BY JOHN L. FRISBEE

SIXTEEN years ago this month, Hanoi opened the gates of its dungeons and the first American prisoners of war began a euphoric flight to the freedom some had been denied for almost nine years. This country's longest and most controversial war had come to an end at last.

During the latter years of that war, the only issue of the Vietnam experience that united supporters and opponents of the war was mistreatment of the POWs, first brought to public attention by an article in the October 1969 issue of AIR FORCE Magazine. Louis R. Stockstill's "The Forgotten Americans of the Vietnam War," reprinted by *Reader's Digest,* became the catalyst that focused worldwide censure on the government of North Vietnam. That censure was a very long time in coming.

The first American POW in Vietnam is believed to have been Green Beret Capt. Floyd Thompson, captured on March 26, 1964. He, like an unknown number that followed, spent most of his years as a prisoner in a series of remote jungle camps under appalling conditions. The prisoners were kept in bamboo cages, provided neither clothing nor blankets, denied medical treatment, frequently abused by their captors, and grossly undernourished. How many died in the hell of the jungle camps may never be revealed.

Somewhat better known to the world was the system of prisons in and around Hanoi, centered on Hoa Lo, "The Hanoi Hilton." The first American to inhabit that infamous place was Lt. j.g. Everett Alvarez, shot down on August 5, 1964. It was seven months before downed airmen from the bombing attacks on targets in North Vietnam began to fill the dank cells of Hoa Lo. Alvarez no longer was alone.

While living conditions in the prisons were only marginally better than in the camps, up to late 1969, there were important differences. As the prison population grew, the POWs set up a military organization, devised means of communication, and disseminated regulations and policies based on the Military Code of Conduct. Organization provided a sustaining web of unity and purpose.

Unlike their counterparts in camps, prison authorities in late 1965 sanctioned systematic physical torture, often administered by professionals in that grisly business. Many POWs who didn't show "the right attitude" were beaten with rubber belts until, as one prisoner put it, their buttocks looked "like raw hamburger." The rope treatment, suffered many times by the most determined resisters, inflicted excruciating pain, often dislocating the victim's shoulders and breaking ribs. Injuries that had been sustained in a bailout gave no immunity from torture.

Solitary confinement, sometimes for months, in tiny, unventilated cells infested with rats was a common punishment. Some "offenders" were chained to a slab for days at a time, not released even to attend to natural functions. Starvation and dehydration of those undergoing torture or solitary confinement were routine.

Torture was not used primarily to obtain military information, but to break a prisoner's will, force him to betray his comrades, and extort letters or tapes condemning US policy and praising the leniency of his captors. The prisoners were viewed by North Vietnam as a propaganda tool to fan the flames of antiwar sentiment in this country. To some extent that scheme backfired when the barbarism engulfing the prisons became known in 1969. Only then did POW life begin to improve, slowly and with many reversions.

Most of the Americans captured before late 1969 were abused to varying degrees. The toughest and bravest suffered the most, among them Air Force pilots Larry Guarino, Don Storz (who apparently died in torture), John Flynn, Robbie Risner, George "Bud" Day, and Jim Kasler, and the Navy's James Stockdale, Jeremiah Denton, John McCain, and Rodney Knutson. Every man who had met the torturers knew there was a point beyond which he could no longer resist. All but a few held out far beyond what seems the limit of human endurance, then by phrase or intonation made a statement that the outside world would know had been extorted under extreme duress.

The Vietnam Memorial speaks eloquently of those who gave their lives in Southeast Asia. There is no memorial to the men who suffered and survived Hanoi's prisons. North Vietnam's calculated program of mental and physical brutality was without parallel in the annals of "civilized" nations at war. The heroism of the great majority of POWs went beyond anything we who were not there can conceive. Their stubborn resistance to the demands of their captors brought honor to themselves and to their profession. These extraordinary men wrote a chapter in the history of this nation that must not be allowed to fade from memory. They should be publicly commemorated as a symbol of patriotism and of the unconquerable spirit that inspires the best in free men.

The most detailed account of the POW experience is John G. Hubbell's book P.O.W., *published by Reader's Digest Press in 1976.* ■

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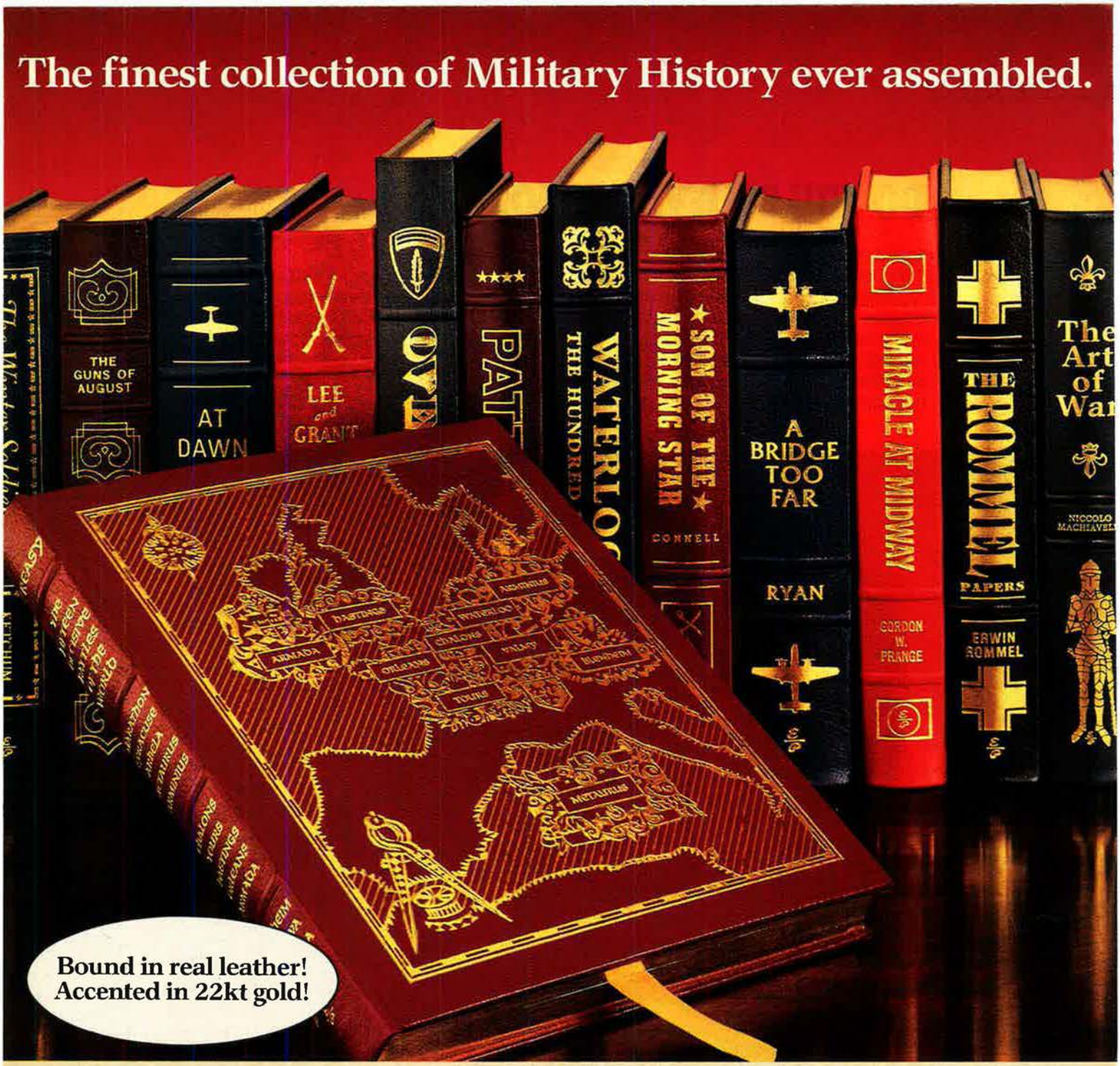

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Airman's Bookshelf

Costly Real Estate

Hamburger Hill, by Samuel Zaffiri. Presidio Press, Novato, Calif., 1988. 304 pages with photos, maps, bibliography, and index. $18.95.

On the maps, it's called Ap Bia Mountain. The Montagnards called it "The Mountain of the Crouching Beast." The official Army designation was Hill 937. To the Americans who fought there nearly twenty years ago, it's still Hamburger Hill.

Situated in the A Shau Valley, some 3,000 feet high, Hill 937 was occupied by two North Vietnamese battalions in 1968. From this high ground, they posed a threat to a number of coastal cities, including Hue. Using after-action reports and personal interviews, author Zaffiri describes in unforgettable detail the fighting that took place there.

The first assault by US forces took place on May 11, 1968, by the 3d Battalion, 187th Infantry. Attack after attack was repulsed by the NVA for ten long days as Americans and North Vietnamese went toe-to-toe for a piece of jungle real estate. Before it was over, the "meat grinder" was known around the world as Hamburger Hill. Lt. Col. Weldon Honeycutt, Commander of the 3d Battalion, says, "My tactics at Hamburger Hill were aggressive. . . . How many enemy are you going to kill sitting around and waiting . . . ? Nobody ever won a war trying to avoid combat."

On May 20, with 241 US soldiers dead, the 187th finally overran Hill 937. Intelligence experts put the NVA dead at 633. The remnants of the NVA units escaped to Laos. The mountain, however, was soon abandoned by the US.

The author asserts that this battle altered the course of the Vietnam War, judging by the political and military aftermath.

On the floor of the Senate, Sen. Edward Kennedy called the battle "senseless and irresponsible." The Nixon Administration was quick to mount a rhetorical counterattack with statements such as, "If our military are told to contend for a hill, it is part of the strategy which is essential to maintaining the military posture while we talk about peace."

Military brass debated both the tactics and strategies. "I don't know how many wars we have to go through to convince people that aerial bombardment alone cannot do the job," said one US Army general, responding to questions as to why the hill wasn't hit with massive B-52 strikes.

Up until the battle for Hill 937, American commanders in Vietnam had operated under a strategy that called for them to keep maximum pressure on the enemy while negotiations with the North Vietnamese continued in Paris. Shortly after reports and photos of the battle reached the American public, commanders were ordered to avoid such large-scale battles.

After Hamburger Hill, a new word appeared in American jargon: "Vietnamization." A new US strategy for fighting the war was labeled "protective reaction"—fight only when threatened by the enemy. The new strategy was designed to hold down casualties. In conjunction with the new policy, President Nixon ordered 60,000 troops withdrawn by early December 1969. The troop reduction dramatically reduced the allies' ability to conduct operations beyond the outer fringes of the populated areas. Thus, the A Shau Valley was conceded to the North Vietnamese. A tragedy, author Zaffiri implies, after such a costly US victory.

In the final chapter of the book, the men who were there offer their thoughts. One Army rifleman says, "I didn't know what kind of tactics we were using up there. All I knew was that I was following the guy up ahead of me." One infantry captain says, "There's nothing in our military tradition—and especially in the infantry—concerning retreat. They don't even teach retreat in the military schools."

Zaffiri served as a mortarman in Vietnam with the 1st Infantry Division in 1969. While in an Army hospital in Japan, he became interested in writing about the battle of Hamburger Hill after listening to numerous wounded men describe their experiences there. In order to make the book as authentic as possible, he traveled around the US and taped interviews with veterans of the battle.

The book will appeal to the serious student of military history. The accounts of those who lived through Hamburger Hill are painful to read, but they are crucial to understanding warfighting from the soldier's perspective. Readers should note this ominous caution in a letter home from a soldier on Hamburger Hill: "I am writing it in a hurry. I see death coming up the hill."

—Reviewed by Lt. Col. Michael B. Perini, USAF. Colonel Perini is Deputy Director of Public Affairs, Hq. PACAF, Hickam AFB, Hawaii, and a former Contributing Editor to this magazine under the Air Force's Education With Industry program.

Airplanes in Art

The Air Combat Paintings of Robert Taylor, by Robert Taylor and Robert Weston. Distributed by Howell Press, Charlottesville, Va., 1988. 128 pages. $45.00.

As coffee-table books go, *The Air Combat Paintings of Robert Taylor* will not remain for long on many. This book is sure to be picked up and read again and again. Rather than detailing every piece of art that Mr. Taylor has produced over the past twenty years, the authors have chosen forty-eight of Robert Taylor's most important and—as it turns out—most interesting paintings.

His prolific passion for drawing is evident in the sketches that illustrate the "story" behind each painting. These pencil drawings give the reader a greater understanding of the event that Mr. Taylor has chosen to paint. They also give an insight into exactly the way the artist works—the incredible amount of planning involved in each piece and the hours of inter-

views with the people who were actually there.

It all draws the reader much nearer to each piece presented. The more that is known of the story behind the painting, the more it becomes not only a beautiful work of art, but also an entire exciting event placed neatly onto a single canvas.

The book is a good size, fourteen and a half by eleven and a half inches, which shows off each painting very well. The originals are large, and there are several details of paintings at full size, showing off Taylor's skill with a brush. The paintings are full, not just "pretty airplane pictures," and you can see the environment of these men and machines.

The pictures do exactly what great paintings should do—make the viewer come away feeling something. Whether it is the sense of apprehension as a Sea King helicopter hovers above a stricken support ship during the Falklands war or the biting cold yet invigorating wind in the face of a Sopwith Camel pilot in 1918, readers come away with much more than just a visual impression.

The book contains forty-eight color (twenty-four full-page) paintings and more than eighty black-and-white drawings. The impressive foreword is by Air Vice Marshal J. E. "Johnny" Johnson, the top scoring British fighter pilot of World War II. This book is a must for any aviation buff.

—Reviewed by Guy Aceto. Mr. Aceto is Art Director of AIR FORCE *Magazine.*

Dull and Borman

Countdown: An Autobiography, by Frank Borman and Robert J. Serling. Silver Arrow Books/ William Morrow, New York, N. Y., 1988. 448 pages with photos. $19.95.

Christmas Eve, 1968. Three US astronauts transfixed the listening Planet Earth with a remarkable message: "In the beginning God created the heaven and the earth. And the earth was without form, and void; and darkness was upon the face of the deep."

Those words from the Book of Genesis, literally beamed down from the heavens, were delivered by the crew of *Apollo-8,* the first manned craft to orbit the moon. To the American public, this was a mission suffused with more than the usual measure of space-program magic. There was something powerful in the thought that during the holiday season, our men were up there—circling the moon—higher even than the pilot who had reached out and "touched the face of God."

To those of us awaiting the arrival of Santa Claus that long-ago Christmas Eve, the reading from Genesis stirred a spirit not often found in children during mid-December. The astronauts reminded us, in a way our parents could not, that "the true meaning of Christmas" is very rich indeed.

Twenty years later, it is nearly impossible to forget the words of *Apollo-8* commander Frank Borman as his spacecraft disappeared behind the moon:

"And from the crew of *Apollo-8,* we close with a good night, good luck, a merry Christmas, and God bless all of you on the good earth."

These readings are recounted in detail in Borman's autobiography; I dwell on them here because they are a distinct high point in an otherwise disappointing piece of work. It is important to note here that Borman occupies an uncontested place of importance in the US space program. Unfortunately, his autobiography serves to detract from, rather than underscore, his achievements.

The problem is that the book is too faithful to its genre. An autobiography is supposed to tell the story of a life, but not in every trivial detail, and not without a sense of priorities.

Borman winds up paying attention to undeserving events and handing short shrift to major topics, including his fascinating space career. The result appears not as an insightful look at a man's life but more as a diary designed for members of Borman's immediate family.

We learn at the start that Borman's paternal great-grandfather, Christopher Borman, came to the US from Germany in 1860 and that he worked as a tuba player in a traveling circus. Then we learn about Borman's father—what position he played on his college football team, why he went to college, where he met Borman's mother, what her father did for a living, and what her father did for a living before he came to this country.

By the time we get to the part about Borman's first toy, we start flipping the pages. Is there really any need to read on and on about Borman's first book, his chronic childhood sinus infections, or his favorite subject in elementary school? What about the fact that his wife's mother is a dental hygienist?

Things start to pick up when Borman enters West Point, and for a while we are treated to some good anecdotes and a few juicy tidbits. Borman warms us up with a few jabs at Chuck Yeager, followed by an outright swipe at NASA: "The space agency began to slide downhill until the *Challenger* tragedy became almost inevitable."

Borman then gets down to what most readers come for: his work as an astronaut. After his setup with the comment on *Challenger,* we are willing to forgive him for making us wait nearly 100 pages for his insider's view of NASA.

The missions are recounted in painstaking detail. Space aficionados will devour such information as the fact that the epoxy on the windows of *Gemini-7* caused outgassing, making the craft's windows fog up with annoying regularity.

The NASA tales build up to the *Apollo-8* mission and then, suddenly, the astronaut days are gone. Borman never follows up on his comment on the problems with *Challenger.* This is particularly disappointing, since he could probably add to our understanding of the disaster. Instead, he tells us about his *Apollo-8* whirlwind victory tour, during which, he says, he was "feted by rulers throughout the civilized world." Then it's on to the Soviet Union. Next stop, civilian life.

Shortly after Borman leaves NASA, his wife, Susan, suffers a nervous breakdown and is hospitalized. This event comes as a shock to Borman, but we are puzzled. Here's a man who describes in minute detail the build of the quarterback on his high school football team. Obviously, he has great powers of observation and memory. How could he have failed to notice his wife's increasing dependence on alcohol and her mounting mental problems?

Borman never tackles this question, although surely it must have bothered him. For the remainder of the book, he focuses on his days at Eastern Air Lines—a rough ride, indeed.

The former astronaut was shocked by what he found at the airline. "Eastern's management style was a long way from what I was used to at NASA, where the guy who had all the information and knowledge was directly involved in staff meetings, answering questions fast. At Eastern, the man who knew all the answers had to sift his expertise through three levels of management. Eastern seemed unable to make decisions rapidly."

As with the family and childhood minutiae, the details of life at Eastern are significant only for the people involved. The rest of us are at a loss: Internal memos and well-placed cups of coffee tend to blur into a sea of extraneous information.

Nevertheless, the Eastern Air Lines

portion of this book takes up the largest of the work's three parts. The author devotes almost 100 more pages to the airline than he does to NASA. Borman seems to give more weight to the traumas of corporate life than he does to the workings of the space program. This is really the reader's loss. There is so much he could have told us.

—Reviewed by Susan Katz-Keating. Ms. Keating is a writer for Insight *Magazine.*

New Books in Brief

Encyclopedia of the World's Air Forces, by Michael J. H. Taylor. Most coffee-table books tend to be filled with beautiful full-color pictures and little factual information. Most reference books have facts by the spadeful but only cursory illustration. This "coffee-table reference" combines the best of both genres. Each of the 150 nation listings offers a map location, a color illustration of its national insigne, facts about its air arm, a description of the country's military structure, and a list of types and numbers of aircraft. There is also at least one color photo for each country. So if you ever want to find out how big the air force of Comoros is (one Cessna 402B) or how many EH-1s the US Army has (forty), this is the resource to turn to over and over again. Facts on File, New York, N. Y., 1988. 211 pages with aircraft specifications, glossary, and index. $35.00.

Gadget Warfare, by F. Clifton Berry, Jr. Easily the most interesting volume in the *Illustrated History of the Vietnam War* series, this book looks at some of the weapons and solutions devised to fight battles that frequently strayed out of the bounds of "conventional" warfare. Chapters include discussions of such things as high-intensity light banks or, conversely, Starlight scopes that allowed troops to see in the dark; sensors that could sniff ammonia in the perspiration of ground troops; and a "combine" that crushed forests as if they were stands of wheat. Complicated operations such as defoliation and electronic surveillance are also included. This book is valuable for the information it contains, but especially for the pictures and illustrations of these "gadgets." Bantam Books, New York, N. Y., 1988. 158 pages with glossary. $6.95.

Harnessing the Genie: Science and Technology Forecasting for the Air Force 1944–1986, by Michael H. Gorn. Unlike the other services, the Air Force has technology at the core of its existence as an institution. The Air Force and its predecessor organizations have always recognized the importance of science to their survival. Dr. Theodore von Kármán's USAF Scientific Advisory Group established the model for Air Force science and technology forecasts in 1945 with the publication of *Toward New Horizons.* Since then, the Air Force has issued four similar attempts to look into the future of aerospace technology, but each successive report has differed increasingly from von Kármán's original. *Harnessing the Genie* describes and analyzes the methodologies and conclusions of the five main forecasts of the past and traces the evolution of the changes that have occurred. Office of Air Force History, Washington, D. C., 1988. 207 pages with photographs, notes, glossary, and index. $9.

Revolution in the Sky: The Lockheeds of Aviation's Golden Age (Revised Edition) by Richard Sanders Allen. The 1920s and early 1930s were considered aviation's "Golden Age," with records being set almost daily, and a whole cast of characters such as Jimmy Doolittle, Amelia Earhart, Wiley Post, and Roscoe Turner expanding aviation's frontiers. Much of that expansion was done in Lockheed monoplanes with names like Vega, Orion, and Sirius. This book, newly revised, traces the history of the planes and the people who designed, built, and flew them. In addition to many rare photographs, this book also contains line drawings (complete with marking details) of famous individual aircraft, a complete manufacturing history, registration list, specifications, and even a section on how owners named their Lockheeds. Orion Books, New York, N. Y., 1989. 255 pages with bibliography and index. $27.95.

Signed With Their Honor: Air Chivalry During the Two World Wars, by Piet Hein Meijering. There are many stories of the "knights of the air" image pilots had during World War I—the full military honors accorded to Manfred von Richthofen by Australian Flying Corps troops, for instance. While the image was not as prevalent during World War II, it reappeared a number of times on both sides. Author Meijering, a Dutch glider pilot born five years after "The Great War," not only gives examples of the new chivalry in both wars, but also takes a look into why World War I was such a fertile ground for the rebirth of "knighthood." The author does not try to show that chivalry had an impact on the course of the war, but rather that it revealed a bit of the character of the men who fought it. Paragon House Publishers, New York, N. Y., 1988. 191 pages with photos, notes, bibliography, and index. $18.95.

Soviet Helicopters: Design, Development and Tactics (Revised Edition), by John Everett-Heath. If someone were to ask how to write a reference book, this volume could well serve as a model. It not only gives complete descriptions of each type and model of Soviet helicopter, but also a photograph, line drawing, and specifications for each. In many cases, the specifications of a certain Soviet type's US or NATO counterpart are given for comparison. Additionally, this book offers a history of Soviet helicopter developments, Soviet design philosophy, how the Soviets procure helicopters, and the evolution of helicopter tactics in the USSR. Biographies of such Soviet designers as Mikhail Mil and Nikolai Kamov are also included, as are tables of records held and foreign users. Jane's Information Group, Alexandria, Va., 1988. 235 pages with glossary, bibliography, and index. $37.50.

Terror in the Skies: The Inside Story of the World's Worst Air Crashes, by David Grayson. Airliner crashes always generate great media interest when they happen, but by the time the investigation is wrapped up, the crash has become a back-page story. This book looks at eighteen cases and presents not only the "what" but the "why" as well. The chapters show that while pilot error is often the ultimate cause of many accidents, there is usually a chain of events leading to the final lapse in judgment. While the book is generally a very interesting read, there are a couple of minor flaws. First is the author's style—he treats readers as though they were in a classroom, rather than letting the accounts speak for themselves. Second, the subtitle is misleading. Not all the crashes resulted in multiple deaths. A couple of them were actually "near-run things," in which the passengers and crew survived. Citadel Press, Secaucus, N. J., 1988. 215 pages. $16.95.

—Reviewed by Jeffrey P. Rhodes, Aeronautics Editor.

Intercom

By John R. "Doc" McCauslin, CHIEF, FIELD ORGANIZATION DIVISION

AFA's National Committees

The makeup of AFA's National Committees for 1988–89 has been determined. The following members have been named to serve on the committees.

Executive Committee: Jack C. Price (Chairman), Sam E. Keith, Jr., Thomas J. McKee, William N. Webb, Charles G. Durazo, George D. Hardy, Martin H. Harris, William V. McBride, and Charles L. Donnelly, Jr., *ex officio* (nonvoting).

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Membership Committee: Walter E. Scott (Chairman), Richard Scott Cain, Amos L. Chalif, Raymond D. Chuvala, Joseph R. Falcone, William J. Gibson, Jan M. Laitos, Bryan L. Murphy, Jr., J. Michael Phillips, Maureen G. Reyling, James E. "Red" Smith, Michael E. Stansell, Everett E. Stevenson, Kenneth Thayer, and Jack C. Price, *ex officio* (voting).

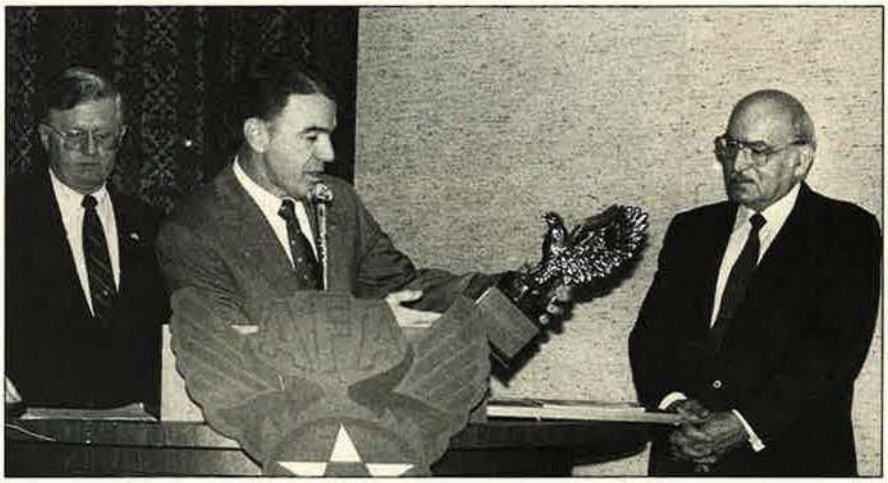
Constitution Committee: Edward J. Monaghan (Chairman), Joseph A. Zaranka (Vice Chairman), Anthea L. Germano, Lee C. Lingelbach, Paul G. Markgraf, Mary Ann Seibel, Herbert M. West, Jr., and Jack C. Price, *ex officio* (voting).

Resolutions Committee: Thomas J. McKee (Chairman), Jack C. Price, Sam E. Keith, Jr., William N. Webb, Charles G. Durazo, George D. Hardy, Martin H. Harris, William V. McBride, and Charles L. Donnelly, Jr., *ex officio* (nonvoting).

Audit Committee: George M. Douglas (Chairman), Gerald V. Hasler, Arthur McFadden, Jack Powell, Hugh Stewart, A. A. West, and Sam E. Keith, Jr., *ex officio* (nonvoting).

Communications Committee: Jack Flaig (Chairman), Donald D. Adams, Joseph E. Assaf, Daniel F. Callahan III, Robert L. Carr, Toby J. duCellier, Mary K. Readly, William A. Solemene, Harold A. Strack, George A. Vaughn, Bernard A. Walters, and Roy P. Whitton.

AFA Medals of Merit go to Larry Yanotti, second from left, Curator of the Hill AFB, Utah, Heritage Museum and Aerospace Park, and to his assistant, Carol Comeau. AFA President Jack Price makes the presentation. At far left is Glenn Lusk, Utah State AFA President, and at the right is AFA National Director Nate Mazer.



A "Golden Eagle," AFA's award for Outstanding Citizens, goes to the Mayor of Westfield, Mass. George A. Varelas, at right, was cited for his "extraordinary efforts and support of AFA." Making the presentation is David R. Cummock, President of the Major John S. Southrey Chapter, as Leo O'Halloran, far left, then Massachusetts State President, looks on.

Long-Range Planning Committee: James M. McCoy (Chairman), Richard H. Becker, Gerald S. Chapman, E. F. Faust, Cheryl L. Gary, Frank M. Lugo, Craig R. McKinley, Ellis T. Nottingham, Philip G. Saxton, William J. Schaff, William W. Spruance, Bruce R. Stoddard, Walter G. Vartan, Jack C. Price, *ex officio* (voting), CMSgt. Deborah S. Canjar, USAF, *ex officio* (nonvoting), and Capt. Paul A. Willard II, USAF, *ex officio* (nonvoting).

Science and Technology Committee: Robert T. Marsh (Chairman); Dr. Thomas E. Cooper, Charles G. Durazo, Charles A. Gabriel, David Graham, H. B. Henderson, Vic Reis, Wayne Schroeder, Henry C. Smyth, Jr., Charles Stebbins, George R. Weinbrenner, and Jack C. Price, *ex officio* (voting).

Third Party Financing Advisory Committee: George H. Chabbott (Chairman), Earl D. Clark, Jr., Jan M.

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Two members of the General Daniel "Chappie" James, Jr., Memorial Chapter of New York were recently honored by USAF's Recruiting Service for their help in finding qualified minority applicants for an AFROTC Engineering and Science Scholarship program. Here, Lt. Col. John M. Callen presents Certificates of Appreciation to Dorothy B. Wadsley, Chapter President, and Allen G. Harris, Vice President.

Laitos, and Lt. Gen. Stanley M. Umstead, Jr., USAF (Ret.).

In the Field

The **West Jersey (Camden) Chapter** is now the **Brigadier General Frederick W. Castle Chapter.** General Castle was killed in action on Christmas Eve, 1944, over Liège, Belgium, while flying lead for more than 2,000 B-17s and 800 fighter aircraft. He was posthumously awarded the Medal of Honor and was recently inducted into the New Jersey Aviation Hall of Fame and Museum.

Mobile (Ala.) Chapter members and their Community Partners toured Eglin AFB, Fla., and were briefed on missions supporting Eglin's Armament Division. The forty-two-member group visited the Climatic Hangar, the Armament Museum, the Gatling Gun Test Facility, and other flight-line points of interest. The Chapter was recently honored with an AFA Presidential Citation for having the greatest ratio of Community Partners to chapter members.

Maj. Gen. Russell V. Violet, USAF (Ret.), recently addressed members of the **Tucson (Ariz.) Chapter** during a chapter meeting. General Violet told of his recent experiences as Chief of the Joint US Military Training Mission in Saudi Arabia. Also at the meeting were the new 836th Air Division Commander, Brig. Gen. Walter Worthington and Mrs. Worthington; Brig. Gen. Larry Keith, USAF (Ret.); and Brig. Gen. A. Lurie, USAF (Ret.), and Mrs. Lurie. Tucson Mayor Tom Volgy presented the City of Tucson Copper Letter to outgoing chapter president Jack Sherlock for his outstanding contributions to the community during his tenure as president of the Tucson Chapter.

Bataan Memorial (Philippines) Chapter sponsored the Annual Air Force Anniversary Ball at the NCO Club at Clark AB, Philippines, taking as its theme "Bataan—Philippine and American Sacrifices Together." Maj. Gen. Donald Snyder, Thirteenth Air Force Commander, was guest speaker. Eight Philippine and US survivors of the Battle of Corregidor and Bataan, honored guests at the Ball, toured the base, including Bataan's Historical Center and various other historical sites; viewed F-15 aircraft on the flight line; and placed Philippine and US flags on the graves of Unknown Soldiers at the base cemetery. A highlight was narration of Lt. Gen. Jonathan Wainwright's "Surrender Speech" and Gen. Douglas MacArthur's famous "I Shall Return" and "Landing at Leyte" speeches.

The **Heart of the Hills (Tex.) Chapter** held its annual election dinner meeting with Lt. Gen. Murphy Chesney, USAF (Ret.), a local resident and longtime AFA member, as guest speaker. General Chesney was the Air Force Surgeon General from August 1, 1985, until his retirement in August 1988.

State and Regional Activities

The Heart of the Hills Chapter also hosted the **Texas AFA State Convention** in Kerrville, Tex. Aerospace Education Foundation President Lt. Gen. James R. Keck, USAF (Ret.), spoke at the convention luncheon. Other noted speakers were Gen. John L. Piotrowski, Commander of US Space Command and CINC North American Air Defense Command, who spoke at the convention banquet, and Brig. Gen. Charlie Duke, USAF (Ret.), who led church services the morning after the banquet. General Duke walked on the moon as a member of the Apollo-16 mission in April 1972.

AFA regional workshops were recently conducted in Roanoke, Va. (Central East Region), St. Augustine, Fla. (Southeast Region), Fargo, N. D. (North Central Region), and Kansas City, Mo. (Midwest Region), to famil-

The main entrance to Keesler AFB, Miss., has a new and patriotic look, thanks in part to AFA's John C. Stennis Chapter. Flags and poles for the "boulevard of flags" were purchased with funds raised from area business leaders, units at Keesler AFB, the Company Grade Officers' Council, and private donations.

The Rocky Mountain Region recently held a workshop in Salt Lake City with National President Jack C. Price (front row, second from left) and AFA national headquarters staff members present. Shown are representatives of the AFA chapters in Utah, Colorado, and Wyoming, along with National Vice President Jack Powell and National Director William "Hoot" Gibson.

iarize chapter and state AFA officials with AFA operations. The workshops were hosted by local chapters in conjunction with state presidents and national vice presidents. Among the many subjects addressed were planning and budgeting, programming activities, membership recruitment and retention, community and legislative involvement, and communications.

At a recent **Michigan State AFA** meeting at Phelps Collins ANG Base in Alpena, Mich., the former Commander of Air Force Logistics Command, Gen. Earl T. O'Loughlin, USAF (Ret.), was guest speaker. Rep. Robert Davis (R-Mich.) also addressed the members, and state president William L. Stone presented an AFA clock to Representative Davis and an Ira Eaker Fellowship to General O'Loughlin.

The Golden Triangle (Miss.) Chapter sponsored the **Mississippi State AFA Convention** at Columbus AFB, Miss. Among those participating were Columbus Mayor Jim Trotter, Starkville Mayor Bill Stacy, Starkville Chamber of Commerce President Ann Mitchell, Starkville Military Affairs Committee Chairwoman Mary Howard, and 14th Flying Training Wing Commander Col. John Marr. Guest speaker was Lt. Gen. Gordon E. Fornell, then the Senior Military Assistant to the Secretary of Defense.

In Support of Education

San Bernardino (Calif.) Chapter has supported six Young Astronaut chapters in local school districts by establishing a repository of teaching materials and obtaining items from Hq. Civil Air Patrol, NASA, the USAF Audiovisual Service, and the San Diego Aerospace Museum. The Chapter's Partners in Education program has been very successful, in part through the efforts of AFA member CMSgt. Robert L. Schenck of Norton AFB, Calif. Chief Schenck was presented a California State AFA Award for his contributions to aerospace education.

The **Thomas B. McGuire, Jr. (N. J.), Chapter** continues to support the Military Airlift Command NCO Academy East graduations. New Jersey State AFA president Bob Gregory and former chapter president Esther B. Gregory attended graduation ceremonies for classes 88-5, 88-6, and 88-7 and presented an AEF Scott Associate Award to the Honor Graduate of each class. The new honorees are TSgt. Daniel Snow (Class 88-5), TSgt. Timothy Gravelle (88-6), and MSgt. Sherliene R. Smith (88-7).

AFA National President Jack C. Price participated in graduation ceremonies at the Montgomery, Ala., Civic Center for the **USAF Senior NCO Academy** (SNCOA). More than 1,000 people attended the event. Mr. Price presented the Academy with the original artwork from the cover of AFA's special publication, *The Chiefs,* and gave a copy of that publication to all in attendance. AFA continues to receive outstanding support from the SNCOA Commandant, CMSgt. Frank Guidas, and his staff.

Senior Enlisted Advisors

Congratulations to these newly appointed Senior Enlisted Advisors: CMSgt. **Ronald I. Blank,** 602d Tactical Air Control Wing, Davis-Monthan AFB, Ariz.; CMSgt. **Wayne T. Fuson,** 314th Tactical Airlift Wing, Little Rock AFB, Ark.; CMSgt. **Theodore D. Whitson,** 475th Air Base Wing, Yokota AB, Japan; CMSgt. **Steven B. Crowder,** Hq. Fifteenth Air Force, March AFB, Calif.; and CMSgt. **Gary R. Pfingston,** Hq. PACAF, Hickam AFB, Hawaii.

Contributions to "Intercom" should be sent to J. R. "Doc" McCauslin, AFA Headquarters, 1501 Lee Highway, Arlington, Va. 22209-1198. ■

Unit Reunions

AFROTC Det. 510
AFROTC Detachment 510 will hold a fortieth-year reunion in honor of the University of New Mexico's centennial in October 1989. **Contact:** Capt. Dennis R. Ochocki, USAF, or Mrs. Wymer, 1901 Las Lomas N. E., Albuquerque, N. M. 87131. Phone: (505) 277-4230. AUTOVON: 246-4926.

Berlin Airlift
Members who participated in the Berlin Airlift in troop carrier groups or the Military Air Transport Service will hold a reunion in September 1989. **Contacts:** Don Hopkins, Galaxy Tours, Box 234, Wayne, Pa. 19087-0234. Phone: (800) 523-7287. Sgt. Maj. Shelby T. Clark, USA (Ret.), American Military Retirees Association, P. O. Box 893, Riverhead, N. Y. 11901. Phone: (516) 369-2825.

Glider Pilots
World War II glider pilots will hold their annual reunion September 20–23, 1989, at the Holiday Inn Central in Omaha, Neb. **Contact:** Lt. Col. John W. Hancock, USAF (Ret.), 1111 Hillcrest Dr., Bellevue, Neb. 68005.

Holloman AFB, N. M.
A reunion is planned for April 1989 for personnel who served at Holloman AFB, N. M., during the late 1950s and the early 1960s. **Contact:** Col. Robin Hansen, USAF (Ret.), 11 St. Charles St., Boston, Mass. 02116.

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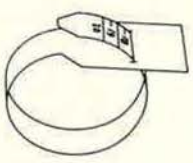

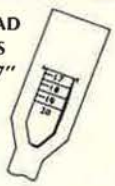

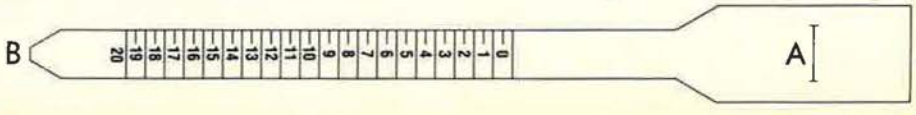

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Unit Reunions

SAC Communicators
Communicators assigned to Hq. SAC from the 1940s through the 1970s will hold a reunion May 19–20, 1989, at Offutt AFB, Neb. **Contact:** Mick Bloom, 1510 Wall St. Plaza, Suite 106, Bellevue, Neb. 68005. Phone: (402) 292-4000.

Santa Ana AAB
The fourteenth annual reunion of the Santa Ana Army Air Base Wing (SAAAB) will be held on March 11, 1989, at Orange Coast College in Costa Mesa, Calif. **Contact:** Alvin E. "Bud" Anderson, SAAAB, Costa Mesa Historical Society, P. O. Box 1764, Costa Mesa, Calif. 92628. Phone: (714) 631-5918.

Wheelus AB
Personnel assigned to Wheelus AB, Tripoli, Libya (1948–51), will hold a reunion October 19–21, 1989, at the Menger Hotel in San Antonio, Tex. **Contact:** H. D. Grover, 3524 S. Perry St., Montgomery, Ala. 36105. Phone: (205) 264-8643.

Williams AFB, Ariz.
Personnel assigned to Williams AFB, Ariz., during the 1950s are planning to hold a reunion in October 1989, in the Phoenix, Ariz., area. **Contact:** Lt. Col. Asa A. Adair, USAF (Ret.), 309 River Oak Dr., Seguin, Tex. 78155.

A-1 Skyraider Ass'n
Former Navy and Air Force A-1 Skyraider aviators will hold a reunion September 15–16, 1989, in Phoenix, Ariz. **Contact:** Mel Elliott, P. O. Box 1592, Glendale, Ariz. 85311-1592. Phone: (602) 931-1117.

1st Fighter Control Squadron
Members of the 1st Fighter Control Squadron are planning to hold a reunion this spring. **Contact:** Chester W. Driest, 687 E. Wacker St., Hernando, Fla. 32642. Phone: (904) 489-5067.

BAD 2 Ass'n
BAD 2 (Base Air Depot) members who were stationed in Warton, Lancashire, England, during World War II will hold a reunion September 21–24, 1989, in Minneapolis, Minn. **Contact:** Ralph G. Scott, 228 W. Roosevelt Ave., New Castle, Del. 19720.

2d Ferrying Group
Air Transport Command's 2d Ferrying Group (now the Wilmington Warriors Association), which was based at New Castle AAB, Del., during World War II will hold a reunion May 11–13, 1989, in Dayton, Ohio. **Contact:** Ray Kuhlman, 7 Springwood Lane, Kinston, N. C. 28501. Phone: (919) 522-0356.

5th Air Force Memorial Foundation
Committee members of the 5th Air Force Memorial Foundation are planning to hold a reunion in October 1990. They would also like to hear from others who served in Fifth Air Force regarding their future reunion dates and persons to contact. **Contact:** Jules Teck, 1601 Cabana Dr., Lake Havasu City, Ariz. 86403-1033. Phone: (602) 855-1776.

12th Bomb Group
Members of the 12th Bomb Group, which operated in the Middle East as well as in Sicily, Italy, and India, will hold a reunion September 14–16, 1989, at the Marriott-Bloomington in Minneapolis, Minn. **Contact:** Jim Griffith, 4532 Vandervork, Edina, Minn. 55436.

13th Bomb Squadron
Members of the 13th Bomb Squadron who served in World War II will hold a reunion May 31–June 4, 1989, at the Sheraton Hotel in New Orleans, La. **Contact:** Vernon J. Main, Jr., 1024 Harding Dr., New Orleans, La. 70119. Phone: (504) 488-4848.

26th Photo Recon Squadron
The 26th Photo Reconnaissance Squadron (World War II) will hold a reunion August 30–September 2, 1989. **Contacts:** Don Esmond, 5245 Longton Rd., Lyndhurst, Ohio 44124. Phone: (216) 449-0311. Lt. Col. H. C. McCullough, USAF (Ret.), P. O. Box 2141, Lafayette, La. 70502. Phone: (318) 235-0302.

Class 52-C
Pilot Class 52-C will hold a reunion May 11–14, 1989, at the Crystal City Marriott in Arlington, Va. **Contact:** John Cottingham, 8600 Beaver Pond Lane, Fairfax Station, Va. 22039. Phone: (703) 250-4557.

Class 57-B
Members of Class 57-B (Marana) will hold a reunion February 17–19, 1989, in Tucson, Ariz. **Contact:** Bob Poor, P. O. Box 276, Cloverdale, Ind. 46120. Phone: (317) 795-4614.

57th Bomb Wing
Members of the 57th Bomb Wing will hold their reunion July 17–23, 1989, at the Red Lion Motor Inn in Salt Lake City, Utah. **Contact:** Bob Evans, 1950 Cunningham Dr., Speedway, Ind. 46224-5341. Phone: (317) 247-7507.

73d Bomb Wing
Members of the 73d Bomb Wing and all assigned and attached units of the 73d that served on Saipan during World War II will hold their reunion May 11–14, 1989, at the Galt House in Louisville, Ky. **Contact:** Glenn E. McClure, 105 Circle Dr., Universal City, Tex. 78148.

83d Fighter Interceptor Squadron
Officers of the 83d Fighter Interceptor Squadron, stationed at Hamilton AFB, Calif., from early 1950 through deactivation in 1963, are planning to hold a reunion in late 1989. **Contact:** Robert A. Rayford, Sr., P. O. Box 1112, Alexandria, La. 71309.

90th Bomb Group
The 90th Bomb Group (Western Division) will hold a reunion May 4–7, 1989, in Salt Lake City, Utah. Please send a legal-size, self-addressed, stamped envelope for information. **Contact:** Daniel Kravet, P. O.

Box 336, Riverton, Utah 84065. Phone: (801) 254-0418.

95th Tactical Fighter Training Squadron
Retired and active-duty personnel of the 95th Tactical Fighter Training Squadron will hold a reunion March 10–12, 1989, at Tyndall AFB, Fla. **Contact:** Capt. Phil Irish, USAF, or Lt. Col. Bill Yantiss, USAF, 95th Tactical Fighter Training Squadron (TFTS/CC), Tyndall AFB, Fla. 32403-5086. Phone: (904) 283-3113 or (904) 283-2658.

96th Bomb Wing
Members of the 96th Bomb Wing who served at Dyess AFB, Tex., from 1957 through 1963 will hold a reunion October 26–29, 1989, in Abilene, Tex. **Contact:** R. E. "Dick" Hobson, 3108 San Jacinto, Dallas, Tex. 75204. Phone: (214) 823-4754.

315th Fighter Squadron
Members of the 315th Fighter Squadron, 324th Fighter Group (World War II), will hold a reunion May 25–28, 1989, at the Marriott Hotel in San Antonio, Tex. **Contact:** Eugene J. Orlandi, 311 Third St., East Northport, N. Y. 11731. Phone: (516) 368-9193.

Reunion Notices

Readers wishing to submit reunion notices to "Unit Reunions" should mail their notices well in advance of the event to "Unit Reunions," AIR FORCE Magazine, 1501 Lee Highway, Arlington, Va. 22209-1198. Please designate the unit holding the reunion, a time and location, and a contact for more information.

316th Fighter Squadron
Members of the 316th Fighter Squadron, 324th Fighter Group, will hold a reunion November 11–13, 1989, in Point Clear, Ala. **Contact:** George Cohen, 37 Briarwood Dr., Athens, Ohio 45701. Phone: (614) 592-2292.

325th Fighter Group
The 325th Fighter Group "Checkertails" will hold a reunion May 11–14, 1989, at the Orlando Marriott Hotel in Orlando, Fla. **Contacts:** Dan Penrod, 69 Keswick Ave., Pittsburgh, Pa. 15202. Phone: (412) 766-6190. John L. Gaston, 1402 Mears Dr., Colorado Springs, Colo. 80915. Phone: (719) 596-5556.

340th Fighter Squadron Ass'n
Members of the 340th Fighter Squadron will hold a reunion in September 1989 in Rochester, N. Y. **Contact:** James F. Yealy, 331 Yacht Club Dr., Fort Walton Beach, Fla. 32548. Phone: (904) 244-3954.

364th Fighter Group
Members of the 364th Fighter Group and support units who served in Honington, England, during World War II will hold a reunion October 12–15, 1989, in Fort Walton Beach, Fla. **Contact:** Dan Leftwich, 6630 Caldero Ct., Dayton, Ohio 45415. Phone: (513) 890-3641.

444th Fighter Interceptor Squadron
The 444th Fighter Interceptor Squadron will hold a reunion April 21–22, 1989, at the Airport Holiday Inn in North Charleston, S. C. **Contact:** Wallace E. Mitchell, 535 Mimosa Rd., Sumter, S. C. 29150. Phone: (803) 469-3297 (home) or (803) 775-1281 (work).

461st/484th Bomb Groups Ass'n
Members of the 461st and the 484th Bomb Groups will hold their reunion August 31–September 3, 1989, at the New Orleans Marriott Hotel in New Orleans, La. **Contact:** Bud Markel, 1122 Ysabel St., Redondo Beach, Calif. 90277. Phone: (213) 316-3330.

475th Fighter Group
The 475th Fighter Group "Satan's Angels" will hold a reunion October 12–15, 1989, at the Clarion Hotel in Ontario, Calif. **Contact:** John or Alice Babel, 1921 Lupine, Monterey Park, Calif. 91754. Phone: (213) 728-3946.

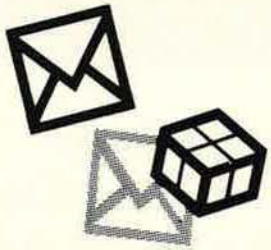
British Flying Schools
I am trying to organize a US or UK reunion for former British flying schools and would like to hear from instructors, students, and civilian support personnel of Royal Air Force pilot training schools (1941–45) that were located in Arizona, Florida, Oklahoma, and Texas.
Please contact the address below.
Col. Harry Witt, USAF (Ret.)
4207 Cliffwood Cove
Austin, Tex. 78759-7307
Phone: (512) 345-0005

25th Bomb Group Ass'n
I am trying to locate former members of the 25th Bomb Group who served in Watton, England, during 1944–45. I would like to organize a reunion.
Please contact the address below.
Robert Herzog
4 Colonial Lane
Larchmont, N. Y. 10538

Class 50-E
I would like to hear from members of Class 50-E who would be interested in holding a reunion in September 1990.
Please contact the address below.
Henry Stengel
903 Pickett Lane
Newark, Del. 19711

Class 55-Q
I am planning a reunion for Pilot Training Class 55-Q and would like to hear from former members.
Please contact the address below.
Ernest A. Boehler, Jr.
3012 Sun Lake Dr.
St. Charles, Mo. 63301

76th MAS Ass'n
A reunion is in the planning stages for active-duty and retired members of the 76th Military Airlift Squadron assigned to Charleston AFB, S. C.
Please contact the address below.
Darrell R. Parker
P. O. Box 61101
North Charleston, S. C. 29419-0101



Mailing Lists

AFA occasionally makes its list of member names and addresses available to carefully screened companies and organizations whose products, activities, or services might be of interest to you. If you prefer **not** to receive such mailings, please copy your mailing label **exactly** and send it to:

Air Force Association
Mail Preference Service
1501 Lee Highway
Arlington, Va. 22209-1198

MOVING?

Let us know your new address six weeks in advance so that you don't miss any copies of AIR FORCE.

Clip this form and attach your mailing label (from the plastic bag that contained this copy of your magazine), and send to:

Air Force Association
Attn: Change of Address
1501 Lee Highway
Arlington, VA
22209-1198

Please print your NEW address here:

Please fasten your mailing label here

NAME

ADDRESS

CITY, STATE, ZIP CODE

AFA's CHAMPLUS® . . . With the

Exceptional Basic Benefits

1. Four year basic benefit. Benefits for most injuries or illnesses are paid for up to a four-year period.

2. Up to 45 consecutive days of in-hospital care for mental, nervous or emotional disorders. Outpatient care for these disorders may include up to 20 visits by a physician or $500.00 per insured person each year.

3. Up to 30 days per year for each insured person confined in a Skilled Nursing Facility.

4. Up to 30 days per year (to a 60-day life-time maximum) for each insured person receiving care through a CHAMPUS-approved Residential Treatment Center.

5. Up to 30 days per year (to a 60-day life-time maximum) for each insured person receiving care through a CHAMPUS-approved Special Treatment Facility.

6. Up to five visits per year for each insured person to Marriage and Family Counselors under conditions defined by CHAMPUS.

And the New 'Expense Protector' Benefit

While CHAMPUS Supplement coverage was originally intended to cover the cost of medical services not provided by CHAMPUS, practitioners and service institutions may charge fees that are considerably greater than those approved for payment by CHAMPUS. And, because Supplement policies traditionally base their payments on the amount paid by CHAMPUS, the insured can be left with sizable out-of-pocket expenses. AFA's ChamPLUS® coverage includes a special feature which places a limit on these out-of-pocket expenses.

Called the 'Expense Protector' Benefit, this program limits out-of-pocket expenses for CHAMPUS covered charges in any single calendar year to $1,000 for any one insured person (or $2,000 for all insured family members combined). Once those out-of-pocket expense maximums are reached, ChamPLUS® will pay 100% of CHAMPUS covered charges for the remainder of that year.

An example of the way the 'Expense Protector' works follows. Assume you are hospitalized for 35 days, that the hospital charges you $330 per day and that this is $75 per day *more* than allowed by CHAMPUS. This would mean that you have an out-of-pocket expense of $2,625. With AFA's 'Expense Protector' benefit, your cost would be limited to $1,000. All covered costs over this amount—for the whole calendar year—would be paid by ChamPLUS®!

It's an important benefit that can mean significant savings to you and your family.

CALIFORNIA and HAWAII RESIDENTS—If you would like details on AFA's supplement to CHAMPUS Prime, please contact AFA's Insurance Division at 1/800/858-2003.

Who Is Eligible?

1. All AFA members under 65 years of age who are currently receiving retired pay based upon their military service and who are eligible for benefits under Public Law 89-614 (CHAMPUS), their spouses under age 65 and their unmarried

AFA ChamPLUS® Benefit Schedule

Care	CHAMPUS Pays	AFA CHAMPLUS® PAYS
For Military Retirees Under Age 65 and Their Dependents		
Inpatient civilian hospital care	CHAMPUS pays the balance of the Diagnostic Related Group (DRG) allowance after the beneficiary's cost share* is deducted.	CHAMPLUS® pays the 25% of allowable charges not paid by CHAMPUS . . . plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year.
Inpatient military hospital care	The only charge normally made is a daily subsistence fee, not paid by CHAMPUS.	CHAMPLUS® pays the daily 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 paid by CHAMPUS after the deductible has been satisfied . . . plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year.
For dependents of Active Duty Military Personnel		
Inpatient civilian hospital care	CHAMPUS pays all covered services and supplies furnished by a hospital less $25 or the total of daily subsistence fees, whichever is greater.	CHAMPLUS® pays the greater of the total subsistence fees, or the $25 hospital charge not paid by CHAMPUS
Inpatient military hospital care	The only charge normally made is a daily subsistence fee, not paid by CHAMPUS.	CHAMPLUS® pays the daily 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 paid by CHAMPUS after the deductible has been satisfied . . . plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year.

NOTE: Outpatient benefits cover emergency room treatment, doctor bills, pharmaceuticals, and other professional services. There are some reasonable limitation and exclusions for both inpatient and outpatient coverage. Please note these elsewhere in the plan description.

*The beneficiary cost share is the lesser of 25% of CHAMPUS-allowable billed charges or a daily fixed amount. For fiscal year 1989, the daily limit is $210.

New 'Expense Protector' Benefit!

dependent children under age 21, or age 23 if in college.

2. All eligible dependents of AFA members on active duty. Eligible dependents are spouses under age 65 and unmarried dependent children under age 21 (or age 23 if in college). (There are some exceptions for older age children. See "Exceptions and Limitations.")

Renewal Provision

As long as you remain eligible for CHAMPUS benefits and the Master Policy with AFA remains in force, termination of your coverage can occur only if premiums for coverage are due and unpaid, or if you are no longer an AFA member. Your certificate cannot be terminated because of the number of times you receive benefits.

Exceptions and Limitations

Coverage will not be provided for conditions for which treatment has been received during the 12-month period prior to the effective date of insurance until the expiration of 12 consecutive months of insurance coverage without further treatment. After coverage has been in force for 24 consecutive months, pre-existing conditions will be covered regardless of prior treatment. Children of active duty members over age 21 (age 23 if in college) will continue to be eligible if they have been declared incapacitated and if they are insured under CHAMPLUS® on the date so declared. Coverage for these older age children will only be provided upon a) notification to AFA and b) payment of a special premium amount.

Plan 1
For Military Retirees and Dependents
QUARTERLY PREMIUM SCHEDULE

In-Patient Benefits Only

Member's Attained Age*	Member	Spouse	Each Child
Under 50	$22.97	$ 45.12	$16.34
50-54	$34.33	$ 56.21	$16.34
55-59	$50.32	$ 60.17	$16.34
60-64	$62.98	$ 69.27	$16.34

In-Patient and Out-Patient Benefits

Under 50	$33.90	$ 61.02	$40.84
50-54	$46.59	$ 69.87	$40.84
55-59	$64.41	$ 96.11	$40.84
60-64	$77.38	$102.15	$40.84

*Note: Premium amounts increase with the member's attained age

Plan 2
For Dependents of Active Duty Personnel
ANNUAL PREMIUM SCHEDULE

In-Patient Benefits Only

	Member	Spouse	Each Child
All Ages	None	$ 9.68	$ 5.94

In-Patient and Out-Patient Benefits

All Ages	None	$38.72	$29.70

Coverage After Age 65

Upon attainment of age 65, the coverage of members insured under CHAMPLUS® will automatically be converted to AFA's Medicare Supplement program so that there will be no lapse in coverage. Members not wishing this automatic coverage should notify AFA prior to their attainment of age 65.

Exclusions

This plan does not cover and no payment shall 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 thereof
- 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)

APPLICATION FOR AFA CHAMPLUS*

Group Policy GMG-FC70
Mutual of Omaha Insurance Company
Home Office: Omaha, Nebraska

Full name of Member _____
Rank Last First Middle

Address _____
Number and Street City State ZIP Code

Date of Birth _____ Current Age ____ Height ____ Weight ____ Soc. Sec. No. _____
Month/Day/Year

This insurance coverage may only be issued to AFA members. Please check the appropriate box below:

☐ I am currently an AFA Member.

☐ I enclose $21 for annual AFA membership dues (includes subscription ($18) to AIR FORCE Magazine).

PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (Check One)	☐ AFA CHAMPLUS* PLAN I (for military retirees & dependents) ☐ AFA CHAMPLUS* PLAN II (for dependents of active-duty personnel)	
Coverage Requested (Check One)	☐ Inpatient Benefits Only ☐ Inpatient and Outpatient Benefits	
Person(s) to be insured (Check One)	☐ Member Only ☐ Spouse Only ☐ Member & Spouse	☐ Member & Children ☐ Spouse & Children ☐ Member, Spouse & Children

PREMIUM CALCULATION

All premiums are based on the attained age of the AFA member applying for this coverage. Plan I premium payments are normally paid on a quarterly basis but, if desired, they may be made on either a semi-annual (multiply by 2), or annual (multiply by 4) basis.

Quarterly (annual) premium for member (age ____) $_____

Quarterly (annual) premium for spouse (based on member's age) $_____

Quarterly (annual) premium for ____ children @ $ $_____

Total premium enclosed $_____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Dependents to be Insured	Relationship to Member	Date of Birth (Month/Day/Year)

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such pre-existing conditions will be covered after this insurance has been in effect for 24 consecutive months.

Date _____, 19 ____ _____
Member's Signature

Form 6173GH App.
2/89

Application must be accompanied by a check or money order. Send remittance to: Air Force Association, Insurance Division, 1501 Lee Highway, Arlington, VA 22209-1198

Bob Stevens'

"There I was..."

A "FREE" CHINESE PILOT (READ THAT TAIWANESE) IS ON A NIGHT FLIGHT SOMEWHERE OVER WEST TEXAS—

SPOTTING A LIGHTED RUNWAY *WAY* BELOW, THE PILOT SPIRALS SILENTLY DOWN FOR A SQUEAKER LANDING...

* SOURCE: LOCKHEED U-2 BY JAY MILLER, AEROFAX INC. LIBRARY OF CONGRESS CAT. CARD # 83-072828.

IT WAS NOT WIDELY KNOWN-*BUT* A PUBLISHED FACT *-THAT THE U.S. "SOLD" A FEW U-2 RECON BIRDS TO THE NATIONALIST CHINESE IN 1959. CHINESE PILOTS TRAINED UNDER AF SUPERVISION AT DEL RIO, TX (LAUGHLIN AFB). THE FOLLOWING TRAINING MISSION GLITCH DID NOT MAKE HEADLINE NEWS, AS WE WEREN'T ON EXACTLY FRIENDLY TERMS WITH THE "RED" CHINESE.

SUDDENLY THE FIRE GOES OUT!

...and SCARES THE BEJEEBERS OUT OF TWO OLD CRONIES HAVIN' COFFEE IN THE LINE SHACK.