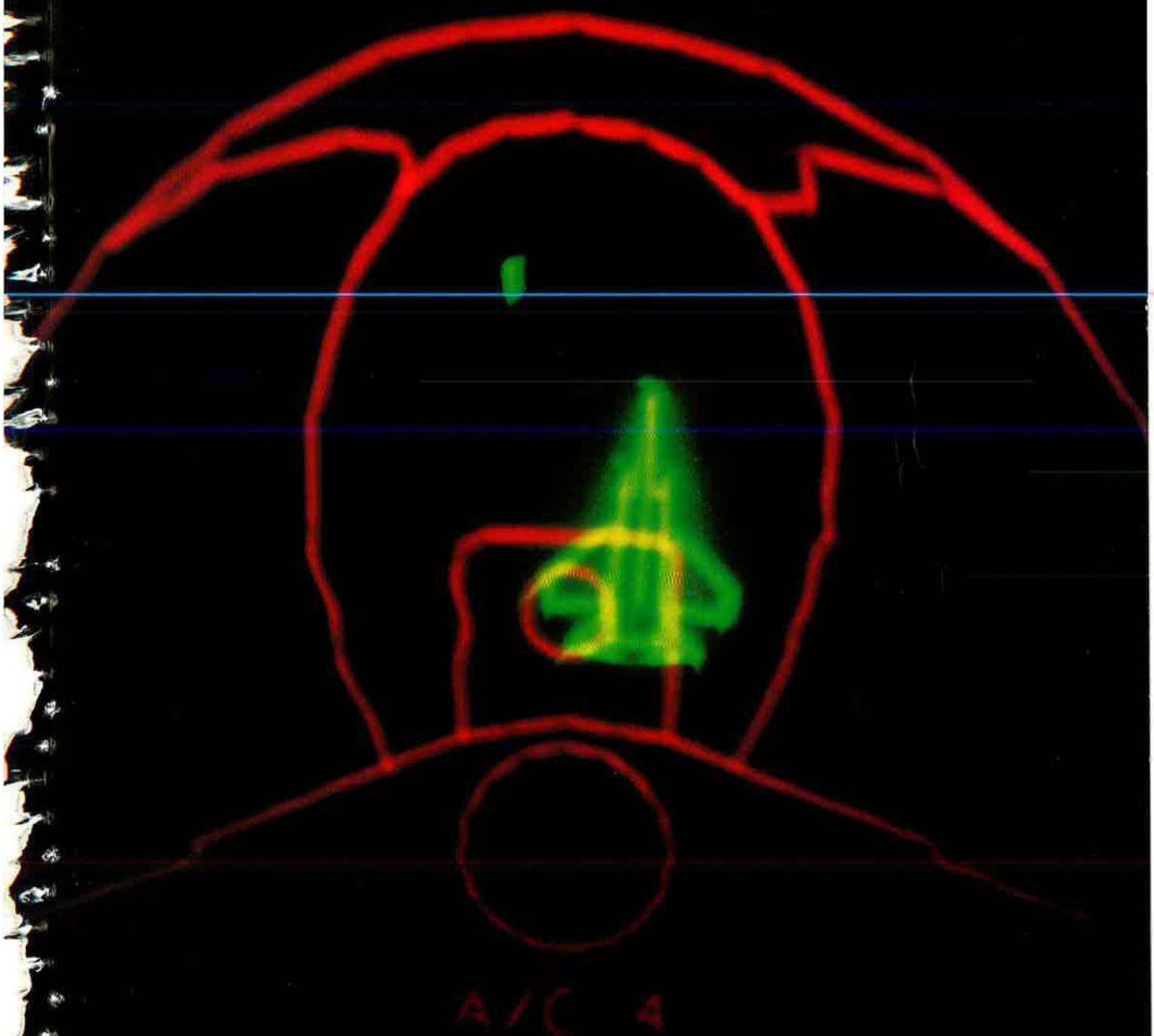
JULY 1980/$1

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION



THE ELECTRONIC AIR FORCE

Special Report: How a Promotion Board Works

Super Sabre, super target. Sperry breathes new life into 24-year-old F-100.

It takes a supersonic, afterburning, highly maneuverable full-sized target to give Air Force fighter crews realistic air combat training.

That target will be the QF-100 drone. The converted F-100 Super Sabre by Sperry Flight Systems.

Able to pull more g's than a *manned* F-100, it will be a truly challenging adversary for both operational training and evaluation of new air-to-air and ground-to-air missiles. It's the latest in a long line of Sperry aircraft drone conversions: QB-17, QB-47, QF-80, QF-86, QF-104 and, currently, PQM-102.

Sperry has delivered more than 130 PQM-102s (formerly F-102s) with more than 75 to go. The QF-100 will succeed it as the primary Air Force full-sized target.

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TROUBLE SHOOTER.

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With its lethal 30mm airborne cannon—the seven-barrel General Electric GAU-8/A—the A-10 is built to attack armor in the toughest combat zone and survive. Low-level flying tactics and superior maneuverability present the enemy with an extremely difficult target to track and hit while the A-10 attacks. Defending trouble spots the world over, the A-10 is on station in the U.S. and Europe—today!

FAIRCHILD
REPUBLIC COMPANY
Farmingdale, L.I., New York 11735

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

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

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

The question may never be totally, positively answered. But there's no dispute that air warfare has changed greatly since that memorable World War I battle. Combat in the skies has become more tightly controlled and disciplined. And of course planes have grown larger, stronger, faster...able to perform a host of missions.

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

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

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

Complex projects like these benefit from IBM's special skill: our ability to marshal many specialized systems to a common purpose. We have also applied this skill to anti-submarine warfare, navigation, and electronic support measures, plus a wide range of other fields.

In fact, the more complex the task and systems are, the more IBM can help.

IBM®

Federal Systems Division
Bethesda, Maryland 20034

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

4. May returns to base at Bertangles.

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

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

Airborne Self-Protection Jammer (ASPJ). Designation: AN/ALQ-165(V). Newest electronic countermeasures (ECM) system to confuse and deceive enemy radar.

Essential for mission success and for aircraft and air crew survival in increasingly dense and sophisticated combat environment of 1980s.

Northrop and Sanders Associates teamed to bring together innovative technology and dedicated resources required for joint U.S. Navy/Air Force ASPJ program. Sanders/Northrop one of two teams selected for full scale development.

Sanders/Northrop team. Proven experience through development, production, support of more than 20,000 ECM systems for Navy and Air Force.

Sanders produces ECM systems for most U.S. Navy carrier-based tactical aircraft and for USAF F/FB/EF-111 force.

Northrop programs include Internal Countermeasures System for USAF F-15 and ECM power management system for USAF B-52. Northrop also won industry-wide U.S. Navy competition to develop new, compact radar jammer for Navy and Army aircraft.

Northrop Corporation, Defense Systems Division, 600 Hicks Road, Rolling Meadows, Illinois 60008.

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AIR FORCE MAGAZINE
PUBLISHED BY THE AIR FORCE ASSOCIATION

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This Month

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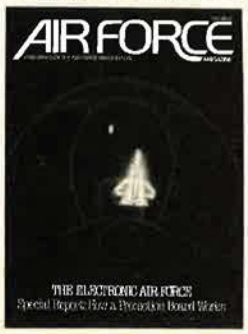
ABOUT THE COVER



The Large Screen Display, part of the Air Combat Maneuvering Instrumentation (ACMI) at Langley AFB, Va., depicts electronically a simulated air combat engagement over Atlantic ranges—one example of USAF's growing dependence on electronics, again the featured subject of the July issue, beginning on p. 41. (Photo by William A. Ford)

Departments

It Takes People To Exploit Technology

AS IN every July since 1975, this issue's theme is the Electronic Air Force. Electronics applications are so ubiquitous that the problem is not what to cover, but what to omit. In the selection process, two underlying themes become clear.

First, the wondrous applications of electronics throughout the Air Force are improving mission capabilities in ways undreamed of a few years ago. The age of electromagnetic combat is already here, whether in communications jamming, improving navigation and weapon delivery, or reducing the number of cockpit switches. The potentials may be wondrous but the pitfalls abound also, as several authors note in this issue.

Second, the benefits of recent revolutions in electronics technology have been slow to reach the field. Air Force people must operate with older-technology equipment because development cycles have been so long and new technologies could not be fitted into existing systems. Thus, F-106 and B-52 people have to grapple with 1950s electronics to keep their planes mission-ready in the 1980s.

That illuminates an important lesson about the Electronic Air Force. The electronics developments may eventually improve mission performance, but until they are fielded, Air Force people perform the missions with what they have at hand. USAF may accept a sixty percent readiness rate for a new fighter, but its men and women are expected to be ready 100 percent of the time. No matter how marvelous the electronics, their best use depends on Air Force people.

These have demonstrated continuously in the recent past their "always-ready" condition. This despite uncertain political direction, equipment failures, and the awful squeezes inflation imposes on them and their families. Whether active or reserve, the people of the Air Force and other services are a national asset, ready and able to do the dirty work of the state.

That includes war, of course, if necessary. More often it means taking on jobs that no other organization can do. Examples are many: cleanup after the Jonestown deaths; airlift of British peacekeeping forces to Zimbabwe to preserve a cease-fire; cruising record-duration months at sea in the Persian Gulf; and embarking on the rescue mission that was turned back at Desert One. Most recently, a thousand Air Force people are part of the 7,000 US military coping with the Cuban refugee deluge rapidly, competently, and compassionately, as no one else could.

Those who execute these missions short of general war are also expected to win the big one. Attracting and keeping them requires a reversal of the dismal trends so often noted and deplored by AFA. The reversal, however, requires a national consensus. Until recently that had not built up. It is heartening to note that now the awareness of this country's military inadequacies is spreading and consensus developing.

The ordeal of military families is out of the closet now. It is covered in the weekly newsmagazines and the major daily newspapers, along with comments on what needs to be done. Members of Congress have been ahead of this (and earlier) Administrations in seeking remedies. AFA has supported remedies that contribute to national power, including the income-raising approach of Armstrong-Matsunaga and the retention-oriented Nunn-Warner proposal. It is good to see President Carter supporting Nunn-Warner in a reversal of his earlier opposition.

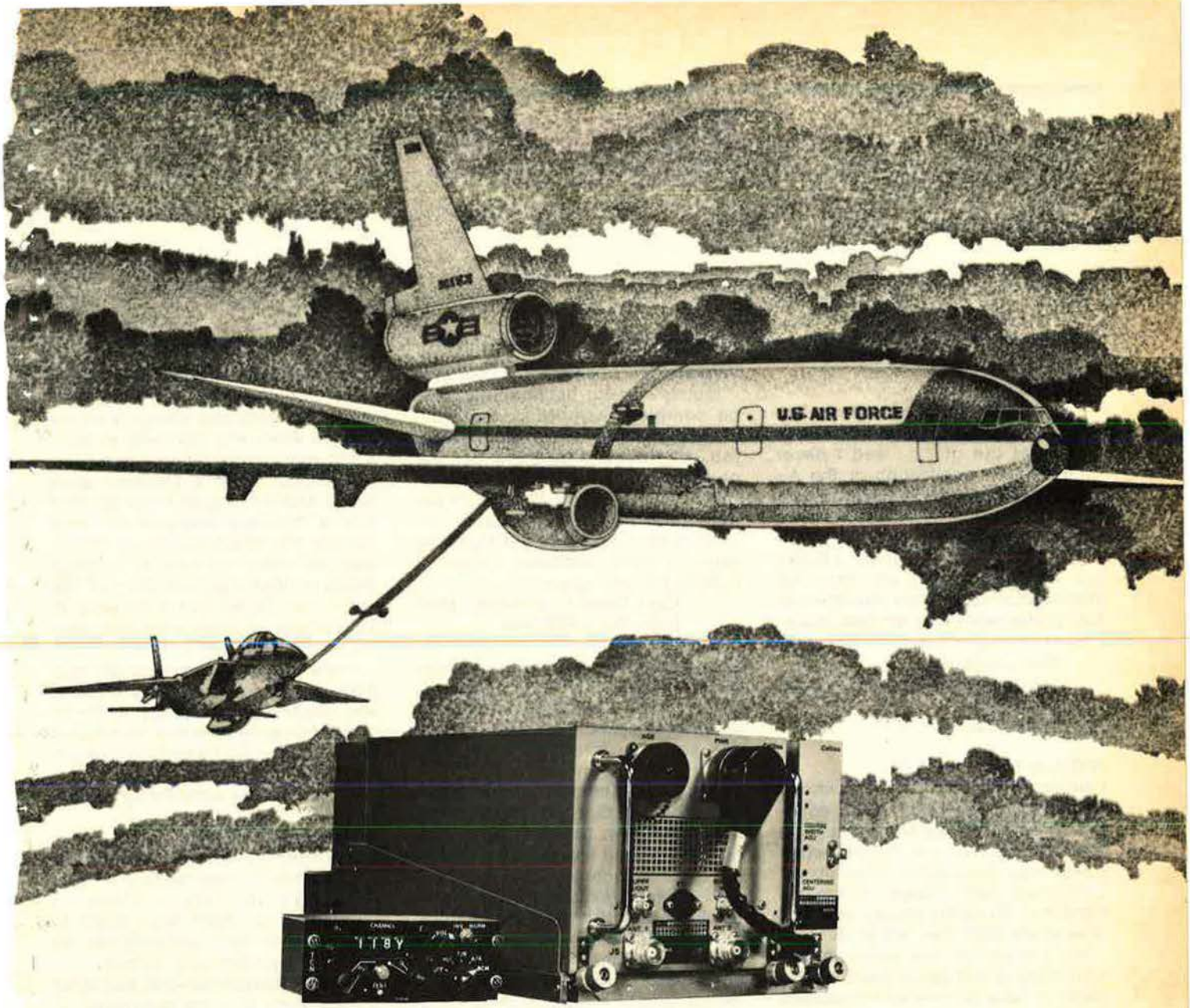
Many people can share credit for the national consciousness-raising that is building, but former Defense Secretary Melvin Laird deserves special notice. This year, he has not only identified the "people problems"; his writing has highlighted specifics in graphic, quotable human terms that reverberated through the media with impact.

As for the general defense situation, credit goes to Hon. Samuel S. Stratton (D-N. Y.) and the Joint Chiefs of Staff for candid illumination. By the rules of the game the Chiefs press their cases in private and support the Administration in public. But, in response to direct questions from Congress, they may register their personal convictions. Mr. Stratton, sitting in the chair of his investigations subcommittee, put the right questions to the Chiefs. They gave direct answers on the need for a better defense budget than Mr. Carter proposed.

Not everyone is a Sam Stratton. His questions to the Chiefs were based on an understanding of the problems, not plain heckling of the Administration. The thing now is for other lawmakers to emulate Stratton and to ask the cogent questions directly of military leaders appearing before them. This can apply to all facets of military power: hardware development, procurement, dollar levels, and people's needs.

We believe the leaders in uniform are prepared to respond directly, and with as much concern for their people as for equipment programs. The results of such candid exchanges will improve defense and preserve the national asset represented by the men and women of the Air Force. Then the full potential of the Electronic Air Force can be realized.

—F. CLIFTON BERRY, JR., EXECUTIVE EDITOR



Air-to-air rendezvous simplified: The Collins TCN-150 TACAN.

Bearing transmit and expanded ranging capabilities have been added to our widely used AN/ARN-118(V) TACAN. Result? The Collins TCN-150 — designed to take the guesswork out of airborne rendezvous.

TCN-150 bearing and range provide holding and approach capabilities similar to a ground station. An inverse function allows tankers to track flight leaders.

That's why McDonnell Douglas has selected the TCN-150 for the U.S. Air Force KC-10A Advanced Tanker Cargo Aircraft (ATCA) program.

Other TCN-150 benefits? It boasts the same size package as the AN/ARN-118(V), and utilizes a high percentage of common modules. A new solid-state power amplifier further enhances system reliability. Add the Collins 938J-1 rotating antenna and you've got a complete system.

TCN-150 is a derivative of the highly successful AN/ARN-118(V) — the U.S. Air Force, U.S. Coast Guard, and, now, a U.S. Navy standard. The AN/ARN-118(V) is also flying with over 30 international military customers, and far exceeding reliability guarantees.

The Collins TCN-150. Like to put it to work on your tanker or pathfinder program? Get in touch. Collins Government Avionics Division, Rockwell International, Cedar Rapids, Iowa 52406. 319/395-2536.

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AIRMAIL

Oops!

You finally goofed!

Yes, for one of the rare times I've seen you get into a squeeze that you'll never get out of . . . and I never thought your publication or the Air Force Association would ever get into that spot.

But, now I have!

You'll never be able to do a better job of putting out an issue as stupendous, superlative, sensational, etc., as this year's May Almanac Issue.

But I know you'll try!

Paul Goldberg
Assistant Director/Public Affairs
Hq. AFCC
Scott AFB, Ill.

Will It or Won't It Help?

I almost choked on my Certs when I saw John F. Loosbrock's May editorial, "Try Throwing Money at It." I couldn't believe our conservative editor was advocating what liberal Democrats have always been chastised for: throwing money at problems in the hope they will go away.

Mr. Loosbrock has fallen in line with many of our senior leaders who seem to have convinced themselves that our people are getting out "because they need the money and they can get it in the civilian sector." Just throw money at the military, and everything will be fine, he says.

Sure. Just like throwing money at Chrysler is going to solve their problems. And throwing money at unemployment compensation is going to solve all the problems of the jobless, and throwing money at our penal systems is going to solve our crime problems.

My guess is that even with increased pay and benefits, we will still have a retention problem. The airlines have always been a convenient scapegoat for our problems, but how many of our navigators, enlisted flyers, and nonrated folks are getting out to work for the airlines?

I certainly am not suggesting that I have the solution to our retention problems. But I don't think one needs to look far to see that throwing money at the military is not the wonderful panacea Mr. Loosbrock thinks it is.

Money will help, but no solution will be complete without considering such things as career progression, job satisfaction, performance reports, and "square fillers."

My only hope is that some of our policymakers and advocates, including Mr. Loosbrock, start tackling some of these problems instead of looking for one cure-all.

Capt. David L. Jannetta, USAF
Little Rock AFB, Ark.

After reading the editorial in your May issue entitled "Try Throwing Money at It," I must write and comment on your conclusion of how the Air Force can solve its retention problem. I agree with you in one respect: It's criminal that one-third of our enlisted force works for less than the minimum wage. These airmen guard our alert aircraft and perform maintenance on our sophisticated and complex weapon systems around the clock in all kinds of weather. To think that garbagemen and dishwashers make more money than these people do is insane. This is one area where money must be invested immediately.

However, the most elementary management textbook will tell you that pay is only one important factor to a worker. Most experts today agree and most workers today admit that job satisfaction may be the most important aspect of a job. As a SAC navigator who actually likes his job, I find that I'm being pushed out of SAC and out of the Air Force not so much by pay but by the excessive amount of time SAC keeps me away from my family. I spend the equivalent of four months each year away from my home and family just due to scheduled alerts. That doesn't even include the times I'm on alert due to substitutions, ORIs, and practice generations for upcoming ORIs or the TDY trips that take me away from my family, all of which can add up to another one to two months away from home.

Now, in return for a week on alert, SAC gives me four days off, Thursday through Sunday, as combat crew rest. Of course, Thursday and Friday make up for the weekend spent on alert and then I get the following weekend off, which everyone else also gets off except for those who just came on alert. I just don't consider that adequate compensation for a 168-hour work week. And if I happen to be on alert over a three-day weekend or major holiday like Thanksgiving or Christmas, my crew rest does not change because that was just part of the job—I can either love it or leave it. That is why so many crew members are voting with their feet.

I love my country and my job as a navigator, but I also love my family and have a responsibility to them. Until SAC recognizes this "conflict of interest," the rated retention problem won't get any better.

Name withheld by request

An Honorable Calling

After carefully reading Lt. Col. Donald R. Baucom's commentary on the American military profession ["Perspective," April '80], I begin to wonder if he truly understands the country he professes to defend.

Colonel Baucom devotes half of his commentary to a condemnation of the All-Volunteer Force (AVF) and calls for a return to conscription. He objects to the AVF on the grounds that enlistees tend to be less literate than in previous years, that the inclusion of women reduces US surge capacity, that a professional ethos no longer prevails, and that the AVF has not provided sufficient personnel. These objections deserve closer inspection.

Declining literacy among American youth is now endemic in the population, caused largely by the nonliterate environment of television and contemporary educational standards. The fact that the AVF suffers from this problem is a symptom of the times. One must consider the fact that the AVF is the only institution in this country that hires a work force for less than the minimum wage ($2.59 an hour for a buck private enlistee, vs. $3.10 for the minimum wage). If a competitive wage were offered, the services could then attract the skills

they need; who else but the illiterate would turn to the military, at these wages?

The presence of women in the services is less worrisome if one recalls that the ratio between support forces and combat forces is very high. There are many essential war-fighting functions that can be assumed by women without placing them in front-line combat. Furthermore, it is a disservice to the dedication and commitment of women enlistees to insinuate that they cannot perform their duties in an adequate and professional manner.

The absence of a professional military ethos is the responsibility of the respective services, *who alone* have elected to substitute a shallow Madison Avenue approach to recruitment for an inspiring call to public service. This has not been caused by the AVF; rather, the AVF seems to have forced the armed services to recognize that their traditional message has fallen on a skeptical audience. The problem is all-pervasive within the military, as evidenced by the constant exodus of military pilots to civilian life, prompted by deep dissatisfaction with the increasing bureaucratization of military life.

Finally, it is true that the AVF may not provide as many enlistees as some may believe necessary for national defense. But human beings are not commodities, and national defense is not a blank check on human life. If Colonel Baucom can conceive of his profession as being only that of "winning the nation's wars," then he should reconsider the very reasons this nation was formed. The military calling, in this country, is to *protect our liberties from foreign attack.* One does not abrogate these liberties in order to fight a war simply because it *is* a war.

The experience of Vietnam has, in our time, discredited the notion that our wars are always just and necessary. This lesson has been burned into the public mind. The military services cannot expect to escape this ambivalent regard, so long as it remains ready to engage in war at the behest of the Presidency. It is expected—it is *demanded*—of our military leaders that they advise the nation *against* involvement in wars that would waste our land and citizenry for no reason pursuant to the defense of our liberties. Until Colonel Baucom and his fellow officers can grasp and adhere to this patriotic responsibility, they should not complain when American youths are adverse to being used for cannon fodder.

I remain convinced that the military calling is an honorable one, and that it can regain and surpass the esteem it enjoyed in earlier times. But this will require the time and determination needed to rise above simple regimentation and blind jingoism.

Michael J. Dunn
Federal Way, Wash.

It's Time for ASALM

The United States's air-breathing retaliatory systems, as is obvious to the most casual strategic observer, are at an all-time low in combat effectiveness.

In the 1980s, the US will rely on twenty-five-year-old B-52 BUFFs (Big Ugly Fat Fellahs) and subsonic cruise missiles as the triad's air-breathing delivery systems. These marginally effective systems will face the Soviet AWACS plane, advanced interceptors with look-down, shoot-down intercept capability, and the SA-11 hypersonic SAM, which is believed to have some anti-SRAM capability. The SA-10 will be widely deployed.

It appears the Administration will finally come to its senses and develop a new manned bomber. However, it still has yet to give adequate priority to a new, remarkable weapon system . . . ASALM.

ASALM, an acronym for Advanced Strategic Air-Launched Missile, could be a strong link in an otherwise weak chain of air-breathing weapons, as well as a powerful complement to a new manned bomber. It is a high-speed, long-range, extremely maneuverable, strategic strike weapon.

Sized to be compatible with SRAM launcher constraints, ASALM would greatly enhance the survivability of the launch aircraft, thus increasing the probability of sorties success.

Because of its awesome performance, the missile would be able to destroy SAM sites that would otherwise down bombers, cruise missiles, and SRAMs. These same characteristics will permit it to strike heavily defended targets at a considerable range from both high and low altitudes. As terminal defenses move farther out from the targets they defend, this range becomes a critical factor in bomber survivability.

Its high accuracy will make the full spectrum of military targets, including ICBM silos and C^3 centers, vulnerable to strike. ASALM's range will permit attack on remote targets. In short, even remote, hardened, and heavily defended targets will be vulnerable to this awesome new missile. No center is safe.

But ASALM does not stop there. It is also capable of attacking airborne targets, such as Soviet AWACS planes and MiG interceptors. Fitting a nuclear warhead on the air-to-air model would allow a penetrating bomber to blast entire fighter formations from the sky in one hit.

The missile's performance is so incredible that it has attracted the Navy's attention. The USN recently selected the engine/airframe system of ASALM for its own SOJS (Standoff Jammer Acquisition) missile project. SOJS would, like ASALM, be dual capable: antiair and antiship. Standoff ECM platforms, Backfire bombers carrying ASMs, and Red Navy vessels (like the carrier *Kiev*) would be vulnerable to long-range attack. Previously, only carrier airpower could strike targets at SOJS's range; no longer.

But never let it be said the Congress and the Administration couldn't stop something just because the Russians couldn't. ASALM, originally scheduled for FY '84 deployment under the Ford Administration's budgets, has been pushed back to the vague generalities of "the 1989 time frame." SOJS (formerly Long-Range Dual-Mission Missile) was canceled altogether by Congress.

"The second-best Air Force is worth exactly as much as the second-best poker hand." General Arnold must be spinning in his grave.

The time for vigorous development of ASALM is now. Indeed, development is long overdue. Shall we sit complacently by, watching the capabilities of SAC dwindle? Shall we, indeed, settle for "second best"?

New Soviet air defense weapons. We'd better have ASALM in the field, ready to meet them.

Stephen C. Danckert
Quincy, Mass.

No Deterioration Here

Your "Bulletin Board" item entitled "Defense O'Sea Schools Deteriorating" in the May 1980 issue accurately reflects the school system's facility requirements. However, had many of your readers merely scanned that page, the headline intimates that the quality of education is deteriorating as well.

Contrary to that idea, our schools are not deteriorating. While it is true that we do have some renovation and construction needs in our schools, we are, in fact, making significant progress in handling those needs.

More importantly, the quality of

We suggest that readers keep their letters to a maximum of 500 words. The Editors reserve the right to excerpt or condense as required in the interest of space or good taste. Names will be withheld on request, but unsigned letters are not acceptable.

THE BRIGHTEST STAR IN NAVIGATION HISTORY JUST MADE HISTORY. AGAIN.

The sixth of an eventual system of 18 Navstar satellites has now joined the other man-made stars launched by the U.S. Air Force for the Department of Defense's history-making Global Positioning System (GPS). All six were built by Rockwell International, and we're working on the next six as well.

A useful system: Navstar GPS enables navigators to calculate their positions to within 30 feet or less, their velocities to within a fraction of a mile per hour, and the exact time. In any weather, anytime, almost anywhere on earth.

A tested system: The complete system of 18 Navstar satellites will be operational in the 1980s. Already, however, successful tests have been performed. They include: precision approach guidance for instrument landings, "blind" aircraft rendezvous for simulated in-flight refueling, ship navigation, ship/aircraft ASW simulations, maneuvers using truck-mounted manpack position locaters and many more.

A mature system: Navstar has met or exceeded most of its original specifications. Its full potential, however, has only begun to be apparent. The versatility necessary to meet a broad spectrum of future requirements has been built into the system from the outset — a legacy of Rockwell International's approach to the program.

Our kind of system: The Space Systems Group of Rockwell International is proud to be one of the prime contractors to the Space Division of the U.S. Air Force — the lead service of the DOD for GPS. Navstar is our kind of involvement, one of many Rockwell International projects designed to bring the benefits of space down to earth.

Rockwell is currently seeking qualified engineers to be part of this and other exciting programs. We would welcome the opportunity to consider your application to join us. Contact: Space Systems Group, I. A. Hopkins, 12214 South Lakewood Blvd., Downey, CA 90241.

Rockwell International

...where science gets down to business

education provided to the DoDDS students often exceeds the standards of Stateside schools. Recent evaluations by the North Central Association of Schools and Colleges (NCA) of DoD high schools show that the schools met or exceeded the standards of that prestigious association. In addition, results from the Standard Aptitude Tests (SAT) indicate that DoDDS students score consistently higher in all categories (except biology) than those students who took the SAT in Stateside schools.

DoDDS teachers and administrators are dedicated to the task of constantly improving all aspects of our program. I believe we are being successful in those efforts and would like to let your readers know that. In every area, including facilities, improvement is being made.

Anthony Cardinale, Director
DoD Office of Dependents Schools
Alexandria, Va.

Long Hauls

The article "Holloman Pilots on Long-Endurance Flight" ["Aerospace World," May issue] had a minor error. I was pleased to see the F-15 go for fourteen hours; however, when we brought the F-4 into the Air Force at MacDill AFB, Fla., I launched four F-4s on an eighteen-hour flight to prove the feasibility of going nonstop to Okinawa.

Also, while at Cannon AFB, N. M., Col. "Peachy" Salyards flew nonstop from Cannon to Turkey in a flight of four F-100s that, I recall, was sixteen hours—some go for the F-100 and the pilots! We tend to forget the great feats performed by the TAC pilots in the sixties and with the KB-50 probe and drogue at that—no INS, no buddy tankers, etc.

Congratulations to the 49th Tac Fighter Wing and its pilots for hanging in there. Keep up the good work.

Maj. Gen. Albert W. Schinz, USAF (Ret.)
Fort Walton Beach, Fla.

AFR 35-10 Again

My haircut does not conform to AFR 35-10. I am reliable, a person of integrity, and I generally exercise good judgment. I deeply resent the slurs against my character that were printed in your "Airmail" pages in the May 1980 issue. . . .

Further, I would like to have Mr. David N. Gates cite the specifics of the ". . . recent Eastern university study . . . " that damned everybody with long hair.

Still further, I would hope by all that is holy that Air Force personnel are, should be, and forever more will be representative of the populace they are sworn to defend.

There are good and sufficient reasons for keeping the hair groomed and out of the way, especially when one is working around moving machinery. Shop safety requirements generally spell that out, along with the need to remove wristwatches, rings, bracelets, and necklaces. There may even be a need, although I prefer to think of it as a preference rather than a requirement, for hair grooming standards in the military. But to insist, as Mr. Gates apparently wants to, that everybody in the service conform exactly to the letter of AFR 35-10 seems to me to be the height of folly. The USAF has far more important things to do right now than to check sideburns, the thickness of rubber heels, and the sharpness of the creases in the uniform.

The best damned electronics expert I know has hair to his shoulders. His work is fast, accurate, and never requires redoing. The military could use a few thousand like him, especially around Navy helicopters.

Sorry about Washington, Lee, Grant, Lincoln, Einstein, and Jesus Christ, whose hair and beards never would have met AFR 35-10.

David A. Anderton
Ridgewood, N. J.

AIRMAIL

Our Apologies to the 57th FIS

The members of the 57th Fighter Interceptor Squadron (Active-Duty Air Force), Keflavik, Iceland, wish to thank you for the fine photo on page 94 of the May Almanac issue, showing a pair of our F-4s escorting the E-3A aircraft. However, your caption underneath the photo left a little to be desired.

In spite of this small typographical error, we wish to let you know that we still think the magazine is great and thank you for your support of the Air Force mission.

Lt. Col. John H. Carpenter, USAF
Commander, 57th FIS
Keflavik, Iceland

Off-Scene Participators

May I add something important to the AIR FORCE Magazine 1980 Keith Ferris Military Aviation Calendar?

The March painting, "Fast Mover, Troops in Contact," shows an O-1E working a single F-4 on the perimeter of the 4/9 camp at Bo Tuc. The painting is beautifully done and quite accurate in detail, but it should be noted that there were two F-4s involved that night. Boxer 01, the flight lead on the mission, was flown by Capt. Raymond J. "Bunky" Reeves and 1st Lt. Jack Rutter, also of the 557th TFS. Boxer 01's ordnance was Mk-82 "Snakeyes" and CBU, and their use of it was equally contributory to the success of the mission.

The mechanics of the painting (angles, field of view, aircraft relative positions, etc.) did not permit inclusion of Boxer 01 in the work, but the part played by Bunky and Jack is a matter of record, and I would like for your readers to be aware of it.

Lt. Col. William F. Hughes
Holloman AFB, N. M.

Look Out Below—and Above!

When I saw Bob Stevens's "There I Was . . . " (May '80) I had to pause and reflect upon the incident. I confess—I'm the guilty party; I did it, and I'm glad; but I must also admit that I was not passed over. While the incident as portrayed is amusing, the actual circumstances were somewhat different.

At the time I was with the 9th Bomb Group (VH), checking out a new aircraft commander. We were at approximately 8,000 feet and had rolled out straight and level after performing stalls at sixty degrees of bank. I saw a burst of flak off the nose and simultaneously the tail gunner reported a similar burst behind us. I did a wingover to get out of the altitude and the area; then noticed the CV below.

I was in a dive headed away from the CV, when two more bursts, fore and aft, were observed. I was not amused and for good reason. The aircraft was in a no-fire zone within sight of the island of Tinian and the war had been over for at least a month. I continued diving for the deck away from the carrier; decided then and there that the "Squids" should be taught a lesson, and low-leveled back. When in position, I popped up to an appropriate altitude, ordered the gear and flaps down, and the bomb-bay doors opened.

I set up a short final and approached low enough to the deck that I had to break off almost immediately to avoid the ship's island. I did not see anyone go overboard, but I did see a lot of frantic hand signals!

I reported the incident to my group commander, Col. Dave Wade (now Lt. Gen., Ret.) and made out a formal after-action report. My aircraft carried the 9th Group's designation on the

tail, a circle X; and the CV in the incident carried the number 31.

The incident has never diminished my enthusiasm for flying in the least. I am currently an Army aviator stationed at the Army Aviation Center, Fort Rucker, Ala.

CW4 Michael J. Novosel
Fort Rucker, Ala.

I spent nine years of my life on aircraft carriers and I never have seen anyone try to make a right-hand approach. I believe your Mr. Stevens is a typical Air Force type. They don't fly airplanes—they just point them.

H. H. Dawson
Annandale, Va.

• *Having served several tours with Navy exchange pilots, I naturally assumed that they always did things backward!*—Bob Stevens

Flyers Are for Flying

Many words by many people have been printed in this publication concerning rated force retention. As a thirty-year retired pilot now running my own business, I have discovered that job dissatisfaction, not pay, not benefits, etc., is the major cause for job changes. For my first twenty-two years in the Air Force, love of flying kept me in. Love of the Air Force turned the trick after I reached 45/22. Money, housing, PX, etc., were incidental—helpful, but not the determining factor.

The simulator/trainer was a chore. The cockpit with all of its stimulations—feel of flying, traffic control, freedom from earthly problems, camaraderie, pride of skill, sense of accomplishment—all gave me an inner feeling of satisfaction that could be found nowhere else. The young flying officer of today is no different than he was in my day. He wants to fly!

The big difference is that we did lots of flying—in the airplanes. It is rare when today's rated officer gets to strap his butt to a real flying machine and go forth into the sky to satisfy his macho. The petrodollar limits him to only a few hours per month! The only place this breed of man with a love of flying can turn to is the airlines. There, he is assured of sixty to seventy-five hours a month. By joining the Guard, he gets a few more hours and in a tactical aircraft!

Despite the rhetoric and the computer analyses that have taken place in recent years on this problem, we, the nation, can ill afford to lose our skilled rated resources. A fledgling flying school graduate and the equipment he flies is a considerable investment. A ten-year veteran of

AIRMAIL

combat cannot be purchased at any cost. In air warfare, skill and experience are the two critical factors for success. You cannot buy victory with the dollar. You can certainly lose, however, if the dollars available are misused.

Likewise, money can't buy happiness, but money not provided to attain self-fulfillment can assure unhappiness. Our bureaucrats in Washington must recognize that fishermen like to fish, hunters like to hunt, athletes like to play, and flyers like to fly! And all will seek a place or position in life where these ambitions can be fulfilled. Physical conveniences and material rewards are secondary when it comes to satisfying one's inner self. Call it what you will—it's still job satisfaction.

Despite the scarcity of petroleum resources and our petrodollars, if we want to retain our skilled rated personnel, we must put them in a flying machine and fly them! The second thing we must do is separate the exrated officer who is flying with the airlines from the Guard. Put them in the Reserves so they will be able to meet a CRAF call-up in a national emergency. They can't fill two cockpits at the same time in an emergency. They are now able to enjoy the best of two worlds while the mission of defense suffers.

General McConnell once said, "The mission of the Air Force is to fly and fight." Let's accomplish the first, now, so we have a chance at the second when the time comes. Put them in the air and keep them in the lair!

Col. William R. Sullivan,
USAF (Ret.)
Pearl City, Hawaii

Double-Clout Dilemma

We have read so much about the great exodus of rated personnel—generals, colonels, and DoD. I feel it necessary to mention the Double-Clout Effect which is most predominant currently at the young officer level ages twenty-two to thirty-four. I believe the generals, in their efforts to deal with rated personnel retention problems, have completely left out the careers of the wives.

Over the past decade more women have become career-oriented from the economic standpoint as well as the standpoint of personal satisfaction. Women are graduating from universities with professional degrees and have rightfully taken their place in industry with excellent earnings capability.

In these inflationary times, it is an easy decision for these double-clout families to pursue their careers in industry, whereby total income and personal gratification are maximized. What I am saying is that it is not easy for a woman to experience growth in her career at some northern-tier base or by relocating every four to six years to who knows where.

Has anyone performed a survey of officers and enlisted men to ascertain the real impact of the Double-Clout Effect?

Terry Jarreau
Richmond, Va.

B-25 at War

United Kingdom publisher Ian Allan has commissioned me to write *B-25 Mitchell at War.* The Ian Allan "At War" series takes an individual WW II aircraft type and describes it through the eyes of the men who flew and maintained it in all theaters.

I would like to hear from pilots and crews who were with the Fifth Air Force's 3d, 22d, 38th, and 345th Bomb Groups, plus the 41st Bomb Group of the Seventh Air Force, and use their narratives of combat operations in a number of chapters of the book. Supporting photographs particularly welcome.

J. C. Scutts
10, Hopedale Rd., Charlton
London SE7 7JJ, England

Army in Alaska

Under a two-year research and writing grant from the State of Alaska, I am beginning work on the history of the Army (including Air Service, Air Corps, Army Air Force, and USAF) in Alaska from 1867 to 1980.

The loan or contribution of copies of correspondence, diary notes, leaflets, photos, or other material of possible use in this project will be most appreciated.

Lt. Col. Lyman L. Woodman,
USAF (Ret.)
117 Cook Ave.
Anchorage, Alaska 99501

Bailout Over Chi Kung

I am trying to locate two US flyers (one named John) who bailed out over Chi Kung mountain on mainland China during the winter of 1944 when their bomber (probably a B-29) was shot down while returning from a mission over Japan (probably over Tokyo). Chi Kung mountain is a famous resort area between Wuhan to the north and

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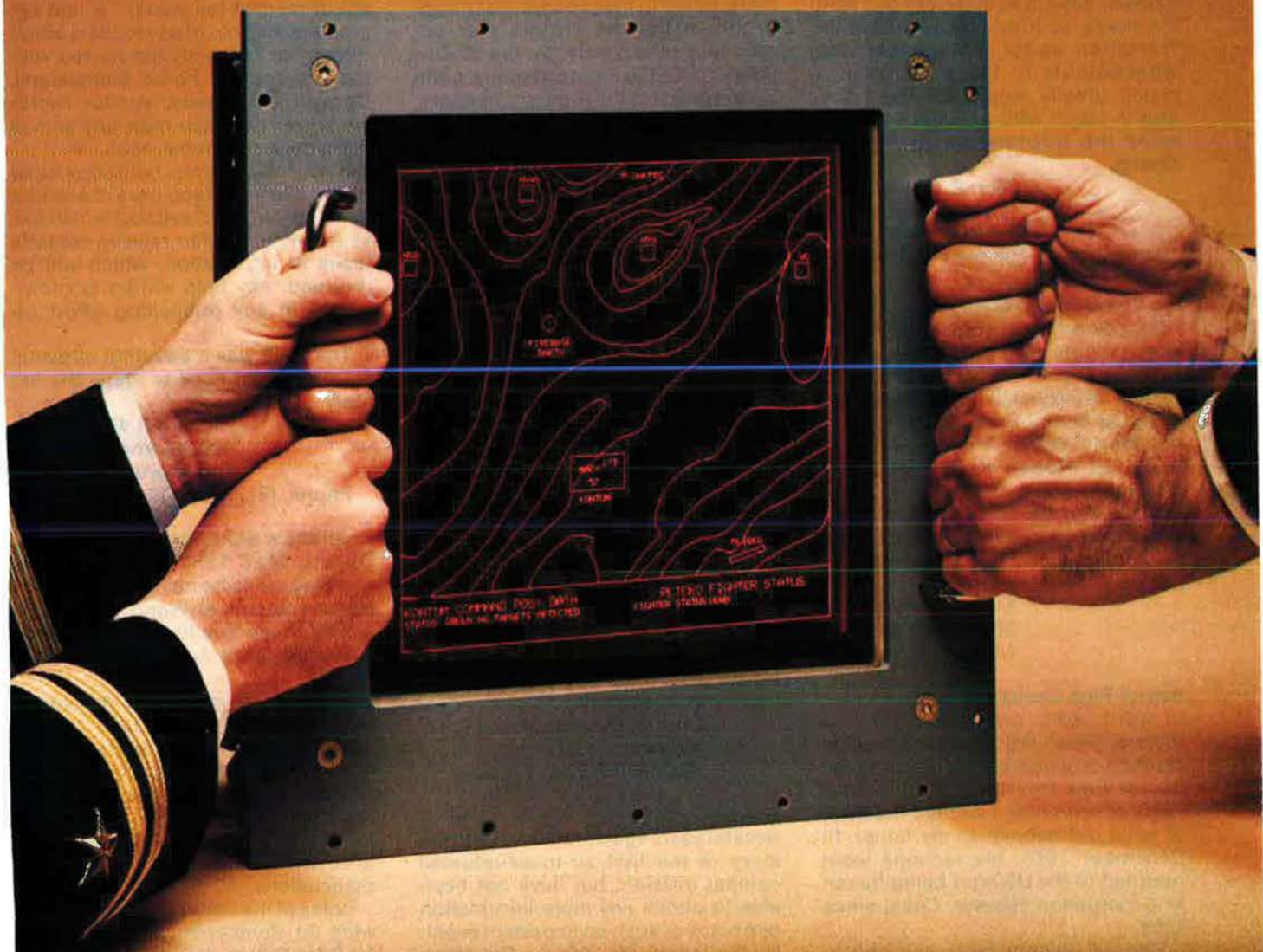

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Shingyang to the south and was surrounded by the Japanese on one side and Communist troops on the other side at the time the flyers bailed out.

The two Americans were rescued by Nationalist troops under Gen. Abraham Chang, and they remained with General Chang for two weeks before being sent back to Chungking. General Chang, who now lives in Taiwan, desires to make contact with the flyers, so if any readers have information about the identity and whereabouts of these two men, I would greatly appreciate them getting in touch with me, and I will forward the information to General Chang.

John S. Brooks
12546 Corliss Ave. N.
Seattle, Wash. 98133
Phone: (206) 367-0551

7th Photo Group Members

I am looking for anyone knowing the whereabouts of Ross Madden, a pilot with the Eighth Air Force, 7th Photo Group, 14th Photo Recon Squadron, based at Mount Farm, England, during World War II. He was with my uncle, Lt. Robert Kraft, when Bob died in the crash of a B-25.

Also, the 7th Photo Group now has an association, and would like to find Mr. Madden, and any other member not yet accounted for.

Mrs. Ron Bettin
202 S. 17th St.
Norfolk, Neb. 68701

Bay of Pigs Casualty

In April 1961, my father, Thomas Willard "Pete" Ray, was shot down in his B-26 on a bombing raid during the Bay of Pigs invasion of Cuba. After years of searching I learned the truth of what did happen to my father. In December 1979, his remains were returned to the US after being frozen in a morgue in Havana, Cuba, since 1961.

Should anyone have any photographs or information that they wish to contribute to a book I am writing, please contact my husband or me.

Janet Ray Weininger
Box 1054
APO New York 09109
or
Capt. Michael Weininger, USAF
10th TFS
Hahn AB, Germany
AUTOVON: 8-453, ext. 7491/7492

WW II Vets of Raydon AF, UK

The Parish of Raydon in the County of Suffolk, England, contains within its boundaries the site of an airfield built during World War II by US Army Engineers. Part of the village was demolished in the process. For its operational life the airfield was occupied successively by the 357th, 356th, and 353d Fighter Groups. Little now remains of the runways, hangars, dumps, and barrack complexes. The engines we hear are those of tractors and combines, not of Mustangs and Thunderbolts. Nevertheless, although there is as yet no formal memorial, we in Raydon are conscious of our historic links with the US Air Force.

Our little village church of St. Mary, built in the thirteenth century, is now in need of extensive and expensive repairs. We are launching a many-sided program to try to meet these costs. We dare to believe that many Americans who served here—and perhaps their relatives, too—remember this little corner of Suffolk with some nostalgia. If any readers or their families visit this country this year and would care to join in our fund-raising activities they will be more than welcome. Those who cannot make the trip but who would nevertheless like to help should please write to the undersigned.

A. A. Halliley
Church Farm House, Raydon
Ipswich
Suffolk IP7 5LW, England

AIRMAIL

Refueling First

Several years ago, I stumbled onto the story of the first air-to-air-refueled combat mission, but have not been able to obtain any more information or photos of such an important event. On September 28, 1951, Lt. Col. Harry W. Dorris, Jr., of the 35th Fighter Group, FEAF, spent more than fourteen hours in the cockpit of F-80C 49-755, refueling from KB-29s eight times, and completing five sorties. This mission didn't even rate a footnote in any published history of the Korean War.

I have written to Lockheed, to see if they had any photos of the modified aircraft, but they have none, so I would assume that FEAMCom (Far East Air Materiel Command) must have done the work. Do any readers have any memories or photos of this event, or know how to contact Colonel Dorris, if he is still alive?

Would also like to hear from anyone who flew F-84Es in Operation High Tide, the first group air-to-air refueling in combat missions.

David W. Menard
5224 Longford Rd.
Dayton, Ohio 45424

The Dominator

I have been assembling data regarding the B-32 Dominator program for about the last ten years. I would appreciate the help of any readers either directly or indirectly associated with the project: Air Force technicians, Convair employees, vendor representatives and tech reps, any and all flight crew personnel, *et al.*

If you have a photo, I will copy it and return it to you. If you have charts or a detailed journal of events, I would like to examine it. I can receive cassette tapes of information, which will be returned. Any help will be acknowledged in any publishing effort attempted.

The B-32 was a beautiful airplane. Aviation buffs need to know the full story.

Richard R. Pullen
4909 Morris Ave.
Fort Worth, Tex. 76103
Phone: (817) 457-4722

Australia's Salute to AAF Vets

During May 1981, special celebrations are to be held in Australia to honor veterans of World War II who served in the Southwest Pacific area and thus saved Australia from invasion.

In order to make this reunion a huge success, I wish to learn the addresses of various associations of units of the Fifth Air Force that were based in Australia during the war and, through your magazine, to ask all former members of the Fifth Air Force to advise me should they know of any associations.

Some of the units based in Australia were 3d Bombardment Group, 35th Air Base Group, 45th Air Base Group, 22d Air Base Group, 38th Bombardment Group, 36th Air Base Group, 4th Air Depot Group, 35th Fighter Group, 46th Air Base Group, 27th Bombardment Group, 808th Engineer Battalion, 51st Fighter Group, 7th Bombardment Group, 27th Bombardment Group, 14th Fighter Group, 20th Fighter Group, and 43d Bombardment Group.

The celebration, to be known as "Salute to the Veterans," is expected to be one of the largest reunions of veterans held in Australia, and tours are being designed to allow veterans to take part in the major celebrations in Melbourne and Townsville, and also to allow veterans who were

based in other areas to revisit their old bases.

Formal invitations will be issued shortly by the Patron of the Executive Committee, Sir William Hall, and this will be sent to the Editor of AIR FORCE Magazine for publication. In the meantime, I would like to hear from as many veterans groups as possible.

You can be assured of a warm welcome when you revisit Australia during May 1981.

Norman Coleman
Box 5064
Mail Centre
Cairns, Australia

Photo Books

At the present time I am working on two photo-type books and would like to contact anyone with photos or information in the following areas:

One will deal with the B-24 Liberator and its use by all branches of the service, particularly the Army Air Forces. The other will deal with the various types of armored vehicles used in Vietnam, both US and foreign. With regard to this I am especially looking for material on Air Force security vehicles.

Anyone who would be willing to help out in these projects is asked to get in touch with:

Jim Mesko
4019 LeCona Rd.
Akron, Ohio 44319

• *For a short review of Mr. Mesko's latest book,* A-26 Invader in Action, *see p. 183 of our May issue.*—THE EDITORS

F-4 Phantoms

Wanted—any information on the F-4 Phantom, including Southeast Asia records. I am interested in buying, trading, or duplicating 35-mm slides. They would be returned in perfect shape. Foreign F-4s most welcome. This includes the oldest to the newest and air-to-air. This also applies to those who know anyone having information on the F-4.

Robert C. Bush
9111 N. Oracle Rd., #172
Tucson, Ariz. 85704

POW Biography

I am very interested in acquiring a copy of USAF ace Robinson Risner's book *The Passing of the Night,* Random House, 1973. The book is now out of print, and I would like to hear from any AFA member who has a copy and might be willing to sell it.

John Ganser
110 Raven Terrace
Stratford, Conn. 06497

Air Force Association Balance Sheet

December 31, 1979

Assets	Total	General Fund	Life Membership Fund
Current Assets			
Investments at cost	$4,410,874	$4,183,634	$227,240
Cash, receivables, prepaid expenses, etc.	2,225,592	2,054,518	171,074
Other Assets (including fixed assets, funds on deposit, etc.)	1,313,216	1,313,216	
Total Assets	$7,949,682	$7,551,368	$398,314
Liabilities and Principal			
Current Liabilities (including accounts payable, accrued expenses, etc.)	$2,569,242	$2,569,242	
Deferred Credits (including advance dues and subscription income)	1,081,381	1,081,381	
Principal	4,299,059	3,900,745	398,314
Total Liabilities and Principal	$7,949,682	$7,551,368	$398,314

Air Force Association Statement of Income and Expenses

Fiscal Year 1979

General Fund	Departmental Income	Departmental Expenses	Net Income or (Loss)
Departmental			
Membership	$1,153,605	$1,206,963	$(53,358)
Patronship	76,393	81,061	(4,668)
Magazine	1,402,017	1,082,168	319,849
Industrial Associate Program	56,180	55,240	940
Data Processing Services	131,175	170,705	(39,530)
Insurance Programs—Administration	1,152,059	1,300,516	(148,457)
Annual Convention	171,788	212,345	(40,557)
Aerospace Development Briefings	309,996	151,676	158,320
Totals—Departmental	$4,453,213	$4,260,674	$ 192,539
General Operating and Administrative Expense			744,349
Net (Loss)—Departmental			$(551,810)
Other Income (commissions, royalties, misc. sales, etc.)			116,256
Net (Loss) from Operations			$(435,554)
Non-Operating Income			
Investments—Interest, Dividends, Gains and Losses on Sales			365,485
Insurance Programs—Premium Refund Retention and Interest on Reserves			505,982
Net Income—General Fund			$ 435,913
Life Membership Fund			
Income from investments			$ 24,811
Less: Transfer to General Fund for annual dues			17,050
Net Income—Life Membership Fund			$ 7,761

Treasurer's Note

The figures reflected herein have been extracted from the certified report of Alevy and Cantor, independent auditors, previously submitted to the Board of Directors of the Air Force Association.

Under Current Assets in the Balance Sheet, the item of Investments at cost of $4,410,874 may be noted. Income from these investments is utilized to partially fund Association losses from operations and to provide an essential reserve against future contingencies.

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UNIT REUNIONS

Airlift Association
National convention, October 17–19, Maxwell House Hotel, 2025 Metro-Center Blvd., Nashville, Tenn. 37228. Early reservations recommended. **Contact:** Bill Morley, Suite 418, 1750 Pennsylvania Ave., N. W., Washington, D. C. 20006. Phone: (202) 393-3880.

Air Weather Service
All Northern California retired officers, October 10–12, McClellan AFB, Calif. All ex/ret/recce/res and AD AWS officers welcome. **Contact:** Milt Simple, 2589 Dumbarton Ave., San Jose, Calif. 95124. Phone: (408) 267-2555.

Korea War Sabre Pilots
4th, 51st, 8th, and 18th. Tentative plans for reunion in early October in the Little Rock, Ark., area. **Contact:** Warren Thompson, 7201 Stamford Cove, Germantown, Tenn. 38138; or William M. Demint, 3401 Royal Oak, North Little Rock, Ark. 72116.

USS *Savannah* CL42
11th annual reunion, September 5–7, Fort Wayne, Ind. **Contact:** Murray C. Flanders, Rt. 1, Box 179, Marcella Ave., Spanish Fort, Ala. 36527.

U-Tapao Vets
All Young Tiger, Arc Light, and Bullet Shot personnel, and all others who supported SAC operations in SEA, October 10–11, at Offutt AFB, Neb. **Contact:** Maj. Dennis Ryder, 206 Sandi Court, Bellevue, Neb. 68005. Phone: (402) 292-6732 (home); Headquarters SAC, DOCFS, Offutt AFB, Neb. 68113. Phone: (402) 294-2602, AUTOVON 271-2602 (office).

17th Bomb Group
Update. Reunion will be held October 9–12 (instead of September as announced in June issue), in Dallas, Tex. **Contact:** W. D. Baird, 2301 Forest Lane, Garland, Tex. 75042. Phone: (214) 272-1591.

32d Troop Carrier Sqdn., 314th TC Gp., 9th AF
3d reunion, October 3–5, O'Hare Marriott Inn, Chicago, Ill. **Contact:** Emil R. Schmidt, 7320 North Oketo Ave., Chicago, Ill. 60648. Phone: (312) 763-2816.

36th Fighter Group
9th annual reunion, October 10–12, Arlington, Tex. Includes 36th Fighter Group Hq. & Hq., 22d, 23d, and 53d Fighter Squadrons. **Contact:** George Brooks, 4710 Marigold Ave., Louisville, Ky. 40213, or Hollie H. Slane, P. O. Box 7353, Fort Worth, Tex. 76111.

Flying Cadet Class 40-F
Proposed for October 4–5. **Contact:** Lt. Col. Leland C. Schubert, USAF (Ret.), 236 Webb St., Warner Robins, Ga. 31093.

40th Bomb Group
Kansas, India, China, Tinian, WW II, October 24–26, Marriott Hotel, New Orleans, La. **Contact:** Mrs. Flo Mallory, 513 Plaza Seville Ct., #26, Treasure Island, Fla. 33706.

Class 47-C
"Guinea Pigs," 33d reunion, October 1980, in Guatemala. **Contact:** Bob Campion, Box 1830, Richardson, Tex. 75080.

48th Fighter Sqdn., 14th FG
October 3–5, Long Beach Hyatt, Long Beach, Calif. **Contact:** Arnold Dickenson, 340 Shamrock St., Rialto, Calif. 92376.

61st Troop Carrier Sqdn., 314th TC Gp.
October 2–4, O'Hare Marriott, Chicago, Ill. **Contact:** George C. Merz, 6748 Vienna Woods Trail, Dayton, Ohio 45459. Phone: (513) 434-6728.

312th Bomb Group
"The Roarin' 20s," August 8–10, at Holiday Inn, Dayton-North, Dayton, Ohio. **Contact:** Paul Stickel, 1136 Gray Ave., Greenville, Ohio 45331.

315th Troop Carrier Group
3d reunion, October 23–25, St. Charles Hotel, New Orleans, La. 70140. **Contact:** Ed Papp, 315th TC Gp., Ross Llewellyn, Inc., 222 S. Riverside Plaza, Chicago, Ill. 60606.

320th Bomb Group (M)
4th annual reunion, October 9–11, Tampa, Fla. **Contact:** Stu Rowan, 108 Aspen, Hereford, Tex. 79045.

341st Fighter Sqdn., 348th FG, 5th AF
5th reunion, October 10–12, San Antonio, Tex. **Contact:** Albert V. Arnold, 109 Ferris St., Apt. 3, Ypsilanti, Mich. 48197. Phone: (313) 482-0164.

365th Fighter Group
"Hell Hawks," 7th reunion, July 18–20, San Antonio, Tex. **Contact:** H. J. "Buck" Rogers, 433 E. Hildebrand Ave., San Antonio, Tex. 78212.

381st Bomb Group (H)
October 10–12, on the *Queen Mary* docked in Long Beach, Calif. **Contact:** T. Paxton Sherwood, 515 Woodland View Dr., York, Pa. 17402. Phone: (717) 848-4680.

391st Bomb Group
October 17–19, Las Vegas Hilton. **Contact:** D. J. Salmon, 1060 26th Rd., Arlington, Va. 22202.

451st Bomb Sqdn., 322d BG, 9th AF
32d reunion, September 26 weekend, Dodgeville, Wis. **Contact:** Kenneth S. Cohen, 220 Madison Ave., New York, N. Y. 10016. Phone: (212) 685-9823; or Lee Hilden, 1506 Iowa Dr., Madison, Wis. 53704. Phone: (608) 241-1328.

463d Bomb Group
October 3–4, at the Air Force Museum, Fairborn, Ohio. All squadrons are invited. **Contact:** Rev. Eugene E. Parker, R. R. #2, Brookston, Ind. 47923.

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IN FOCUS...

By Edgar Ulsamer, SENIOR EDITOR

Washington, D. C., June 10

New Soviet Submarines

US intelligence satellites are just now beginning to pick up pictorial details of a huge, new Soviet submarine that has been under construction for about seven years. Purpose of the submarine, which at first was partly covered by tarpaulins but in subsequent satellite passes was fully visible, is not clear to US Navy intelligence analysts. Best bet is that the new submarine will serve as a carrier of sea-launched cruise missiles (SLCMs). US satellites detected SS-N-X-19s in the vicinity of the new vessel, giving rise to the theory that large numbers of these 300-nautical-mile-range weapons, arranged in diagonal racks, will be deployed aboard the gigantic new Soviet submarine.

The mission of the new submarine, equipped with SLCMs, would seem to be to attack US aircraft carriers with a high probability of kill. US intelligence analysts are certain that the new submarine is not a ballistic missile launcher since there is no evidence of launch tubes. There is uncertainty about whether or not a second submarine, still under construction inside the vast boatworks that spawned the first one, is of the same type or yet another new design. The boatworks, themselves, were described to this column as "larger than all of Capitol Hill" in Washington. The new submarine, the largest ever built by any country, was first spotted—apparently by happenstance—while in transit within the Severodvinsk naval yard on the White Sea. The existence of the submarine came as a total surprise to the US, thus demonstrating once again this country's inability to monitor reliably Soviet weapon development programs potentially related to SALT, even when they have been in progress for many years.

US intelligence experts estimate that the new Soviet submarine is about 480 feet long and fifty-seven feet in diameter. The US Trident SSBN is slightly longer, but has less diameter than the new Soviet submarine and thus is smaller volumetrically. Another new class of Soviet SSBN whose existence has been known for some time is the Typhoon. No Western reconnaissance photos of that submarine exist, according to congressional sources. Fragmentary evidence suggests that the Typhoon is about the size of Trident and that the newly discovered submarine is not a derivative of Typhoon.

Belated Administration Support of Nunn-Warner

Late in May, President Jimmy Carter dropped his Administration's opposition to the so-called Nunn-Warner amendment that would boost retention of military personnel in critical skill areas when he announced to the crew of the aircraft carrier *Nimitz* that he would support and sign the proposed military benefits package. The carefully staged announcement—with the *Nimitz* and her crew providing a telegenic backdrop—turned out to be grade "A" prime-time television fare. In cold cash, though, there may have been less to the media event than meets the eye. There is apprehension in Congress that the White House is capitalizing politically on tentative legislation that might not take effect for some time to come, perhaps not even until after the current congressional term—and that of the Administration—has expired. There is evidence that the Administration plans to link support of Nunn-Warner to continuation of the military pay cap. Even under the best of circumstances the crowded congressional schedule seems to preclude early passage of the benefits package, with the result that its impact on the FY '80 Defense budget is negligible. The services probably would have to pay for most of the cost of Nunn-Warner through "offsets."

The Nunn-Warner amendment was passed by the Senate this February. Action by the House Armed Services Committee's Military Compensation Subcommittee is pending. There are plans to convert Nunn-Warner from an amendment to an independent bill and to sizably increase some of its benefits, such as upping the flight-pay increase from twenty-five percent to fifty percent. Over the next five years, total cost of the benefit package, which includes a variable housing allowance and bonuses, is pegged at about $3 billion, or considerably less than across-the-board military pay increases proposed by several members of Congress.

The Congressional Budget Office, meanwhile, released a detailed study on the "Cost of Manning the Active-duty Military," which found the Administration's military pay proposals "insufficient to meet the service's needs for enlisted recruits and maintain recruit quality in 1980 and 1981. Nor would they be sufficient to stem the decline in the numbers of career personnel. If the Administration's 1981 policies were to be continued for the next five years, problems in recruiting and retention would probably continue or worsen," according to the Congressional Budget Office.

Congressional reaction to the surprising volte-face by the Administration concerning Nunn-Warner in many instances was critical. Said Rep. Marjorie Holt (R-Md.), sponsor of the recently defeated Gramm-Holt amendment to shore up defense spending: "What is notable is that [Carter] has never conveyed that message [support of Nunn-Warner] to the Congress. In fact, Congress is already far advanced toward achieving the goals he has finally decided to support. . . . The 1981 budget he proposed in January did not include additional pay and benefits he now promises. The revised 1981 budget he proposed in March did not include the necessary funds . . . but Congress has been acting on legislation to improve military compensation, so here comes President Carter with an endorsement of the package in an election year, and now this week he has announced opposition to the 1981 budget conference," alleging that by adding $6.2 billion to the Defense budget it lopsidedly favors national security and shortchanges social programs.

In a similar comment, Rep. Paul S.

Trible (R-Va.) referred to President Carter's announcement aboard the *Nimitz*, saying caustically, "There stood the President, praising the courage and dedication of those incredible Navy people, and the power of their mighty ships. And, yet, this is the same President who has the most anti-Navy, antidefense record in modern history [and who] has blocked pay increases desperately needed by our military personnel."

Nuclear Shortfalls

Chairman Melvin Price, on behalf of the House Armed Services Committee, issued on May 13, 1980, an official report on the National Security Act and Military Applications of Nuclear Energy Act of 1981 that expresses the committee's concern "about the growing malaise within the nuclear weapons complex that may soon result in actual sickness."

The Armed Services Committee fears that "this malaise is rooted in real or perceived lack of [the Administration's] commitment to a nuclear weapons program; that is, a comprehensive plan for the years ahead supported by sufficient funds to achieve the program's objectives."

The committee warned of a "shortfall in defense nuclear materials" unless a series of actions are taken in FY '81. These actions include full funding of present production requirements; conversion of the "N" production reactor at Richland, Wash., to weapons-grade plutonium production; preparation for operation of the Plutonium-Uranium Extraction (PUREX) Plant at Richland; and starting design of a new materials production facility.

In a broad, geopolitical context, the committee found that the spreading perception of "declining" US military capabilities causes allies and third-world countries to build up their own nuclear forces: "France and the United Kingdom are taking steps to bolster their independent nuclear deterrents. Several third-world nations are acquiring the wherewithal to produce nuclear weapons, while others are actively and openly seeking this capability."

Directly challenging Administration assertions to the contrary, the Armed Services Committee referred to the "occurrence of what was a statistically certain clandestine nuclear weapon test in the South Atlantic Ocean region on September 22, 1979," which may have involved a nation that heretofore did not possess nuclear weapons.

Elsewhere in its report, the House Armed Services Committee notes that this country's nuclear weapons testing program has declined every year since 1972 and that because of "underfunding" this decline continues in 1980 and 1981. These forced reductions in the testing program have reached "crisis proportions," especially in light of the Soviet testing program's steady growth. According to Swedish observations, the Soviets carried out twenty-eight underground weapons tests last year, compared to the United States's fifteen. The committee, therefore, provided an additional $45 million in FY '81 for the Department of Energy's nuclear weapons testing program.

The committee sees similar flaws in the Administration's nuclear weapons production and surveillance programs, warning that the Department of Energy won't "achieve the ambitious FY '81 program laid out for the weapons production, surveillance and maintenance, process development, and weapons retirement."

Weapons development, engineering, and certification for FY '81, according to the committee, include the following systems: an eight-inch artillery-fired atomic projectile; an air- or sea-launched cruise missile warhead; a standard (SM-2) missile for the US Navy air defense systems; a 155-millimeter artillery-fired atomic projectile; a modern strategic bomb; a ground-launched cruise missile warhead; and a warhead for the MX. Even work on such motherhood features as insensitive high explosives, which increase the safety and decrease the environmental hazards of nuclear weapons, is being cut back because of underfunding, according to the report.

The committee approved in principle funding of the Department's Inertial Confinement Fusion (ICF) program for FY '81, which serves primarily for nuclear weapons technology programs. ICF is produced by focusing intense laser particle beams on small pellets of hydrogen isotopes to duplicate the temperatures and pressures that occur in nuclear weapons detonations.

IN FOCUS...

Washington Observations

★ Secretary of Defense Harold Brown, according to senior Pentagon officials, wrote to CIA Director Adm. Stansfield Turner protesting the latter's insistence on diluting the national intelligence estimates with net assessment information. In gist, Dr. Brown suggested that the Defense Department is far more able to evaluate the capabilities of the weapon systems and forces that it manages than is the CIA. The suggestion that Admiral Turner stay out of the Pentagon's business seemingly fell on deaf ears. The recently released 11-38 NIE is strongly biased toward net-assessment information that is damaging to MX.

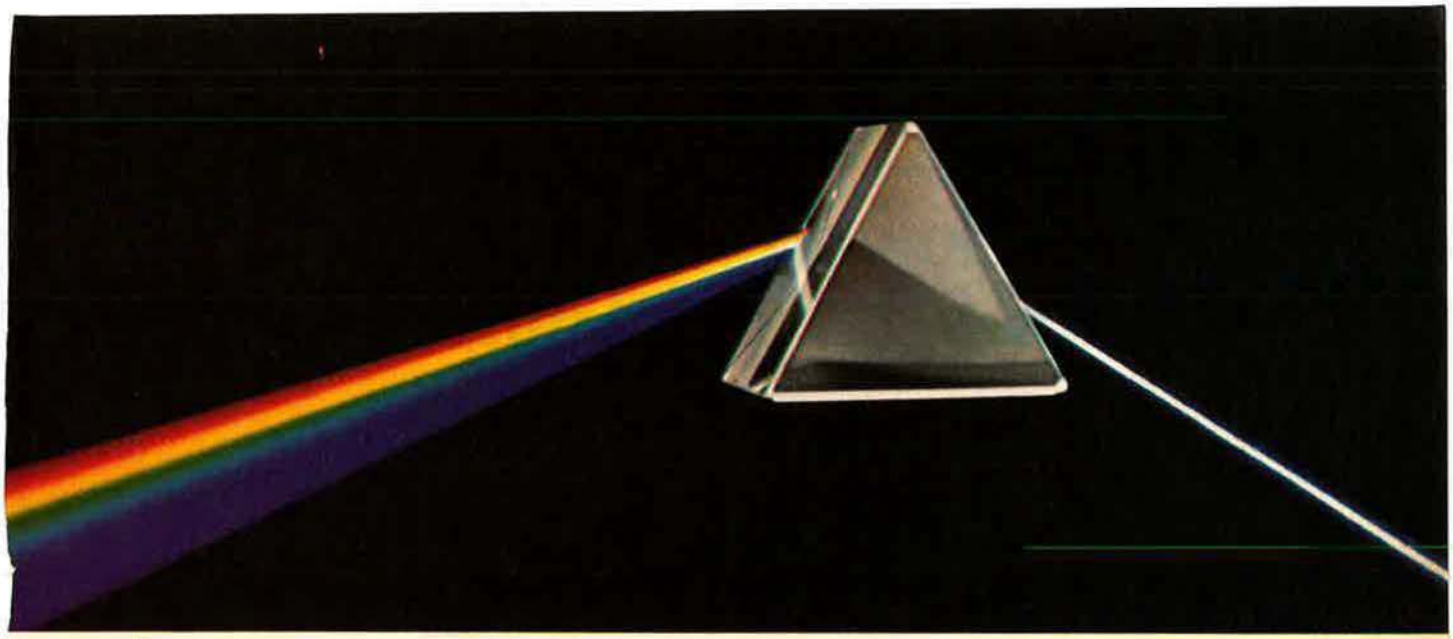
★ The Soviets appear to have completed engineering development of a fully mobile ICBM capable of accommodating between four and eight warheads, according to congressional sources.

★ Soviet military and related investments in Vietnam are increasing at a steady rate and exceed the peak reached during the US involvement in the Southeast Asian conflict. Vietnam, Pentagon analysts assert, is being transformed into a military superpower and at the same time serves as a decisive staging area for Soviet forces. The political grip on what was formerly South Vietnam is tightening, with more and more political suspects in jail. Of key concern to the US is the Soviet ASW (antisubmarine warfare) force stationed at Danang. In concert with the systematic buildup of the Soviet Pacific Fleet, including the emphasis on offensive command and control, the increasing military power of Vietnam suggests that the next round of Soviet adventurism might take place in Asia.

★ President Jimmy Carter, in response to a well-reasoned letter by House Armed Services Committee Chairman Melvin Price on the MX/MPS (multiple protective structure basing mode) program, acknowledged that "MX does involve sacrifices, but defending our freedom always has. Deterrence works for all of us or for none of us."

The new, survivably based ICBM, the President wrote Mr. Price, "is needed not just to preserve our own national security, but also to preserve the security of our friends and allies. We depend on them to help maintain an adequate balance of conventional forces, and they must depend on us to maintain an adequate balance of nuclear forces." Relating the new ICBM to the SALT process, President Carter suggested that MX "will demonstrate to the Soviets that their pursuit of

(Continued on p. 25)



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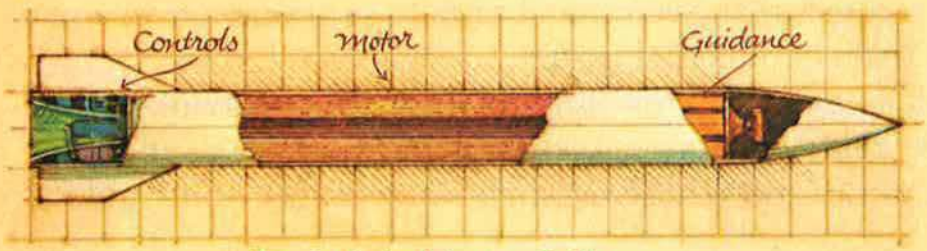
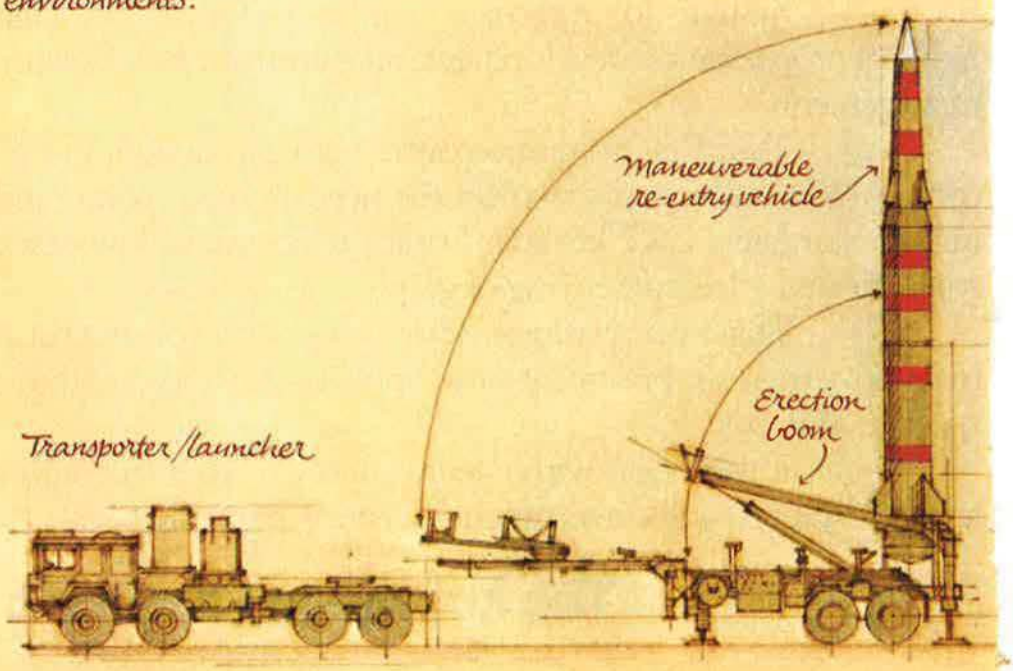
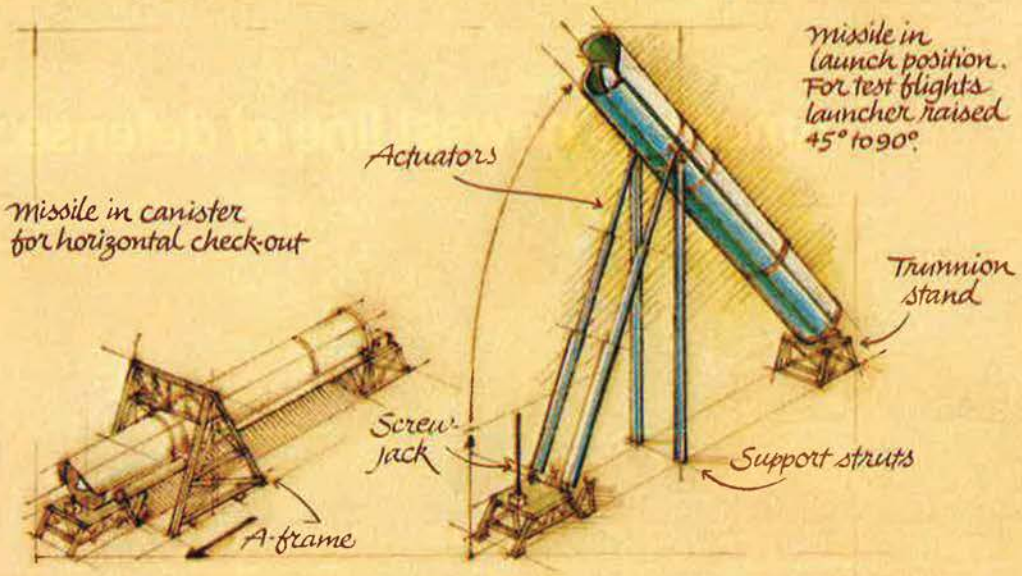


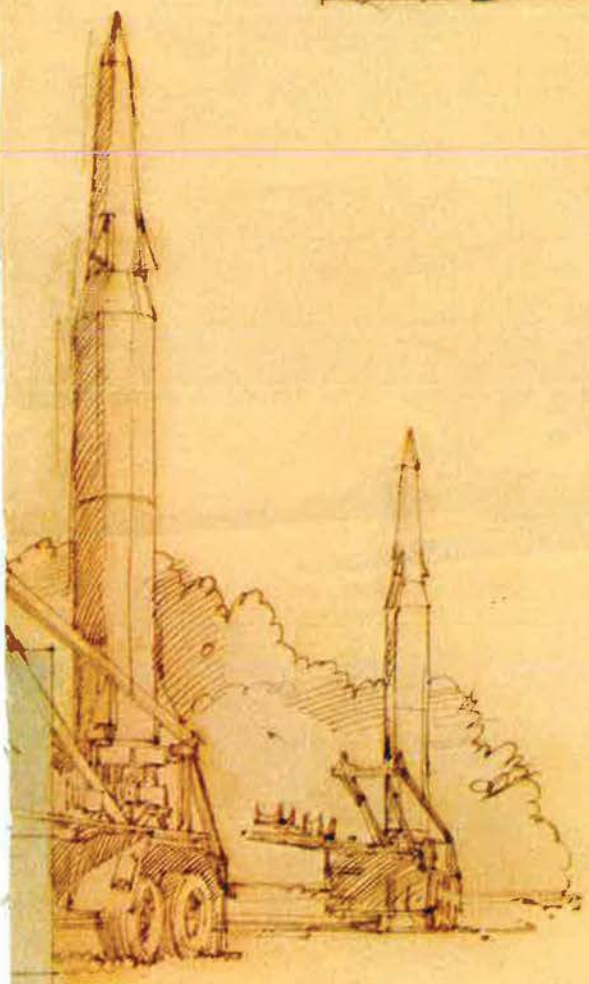
Tactical air defense missile provides increased firepower, effectiveness and survivability in hostile environments.



Pershing II



Air Force Missile X
Flight Test Facility



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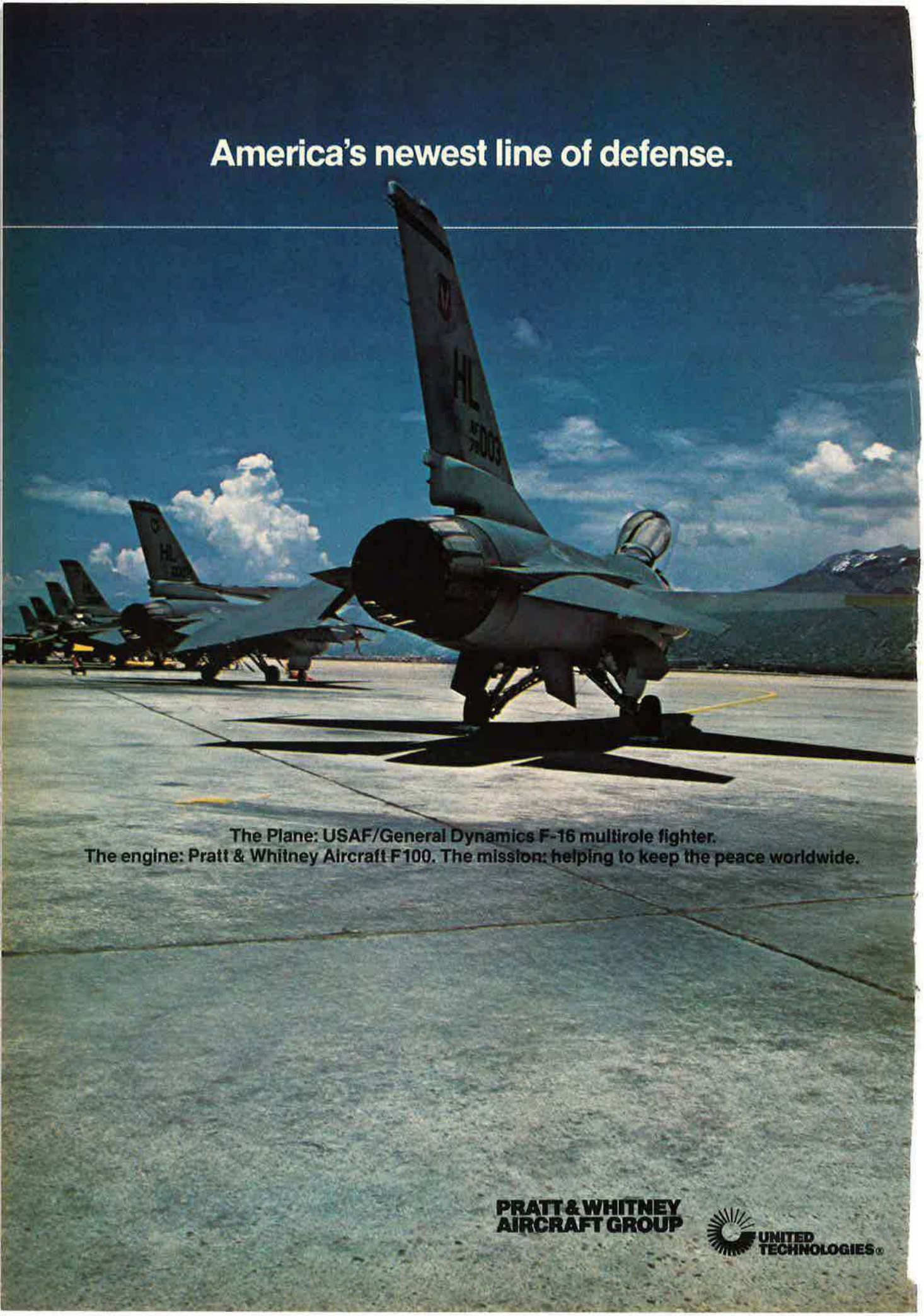

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(Continued from p. 20)

strategic superiority is fruitless; it will set a good precedent with respect to the verifiability for mobile ICBMs and it would allow reductions in the numbers of launchers without reducing survivability." Even without SALT, however, MX "remains the best choice" for assuring the continued effectiveness of the ICBM component of the strategic triad, Mr. Carter wrote.

Chairman Price, in his letter, told the President that "there are, inevitably, environmental problems that accompany a deployment of this magnitude; however, there must be a balance between the needs of national security and environmental issues. I would want to be assured that your Administration will take the lead in educating the citizens in the local deployment areas as to the compelling need for such a system, as well as assisting these areas in minimizing the possible adverse environmental and economic impact resulting from a deployment of the MX system."

★ One of the most spectacular flip-flops on defense policy of recent memory has been performed by Sen. George McGovern (D-S. D.), when he recently assumed the pose of a stalwart supporter of the proposed FB-111B/C strategic bomber. After years of faithfully opposing all major strategic weapons programs, Senator McGovern startled both his colleagues in the Congress and his military constituents back home by coming out in favor of the FB-111B/C, a stretched and reengined modification of the standard FB-111. To underscore his dove-to-hawk metamorphosis, Senator McGovern—who is facing a tough reelection fight this year—also let it be known that his support of the FB-111B/C in no way dampened his new-found enthusiasm for considering later on the development and acquisition of a completely new strategic aircraft. Cynical colleagues suggest that the Senator is engaged in diversionary tactics aimed against the MX while at the same time courting prodefense voters in his home state.

★ Congress's report on FY '81 Arms Control Impact Statements brings out important information concerning the Advanced Maneuvering Reentry Vehicle (AMaRV) program that is being carried out by AFSC's Ballistic Missile Office on behalf of the Defense Department. For one, the report disclosed that because AMaRVs carry their own inertial navigation systems, "they could be more accurate than ballistic reentry vehicles on ballistic missiles, such as MX, where only the booster possesses the inertial navigation system." Also, terminal guidance sensors are being developed for AMaRV that could yield "significant improvements in missile system accuracy by providing relative position and velocity updates for the RV's guidance system as the RV approaches the target." Terminally guided RVs would not only be extremely accurate, but they could also evade ballistic missile defenses. They must, however, be designed to minimize susceptibility to countermeasures, the congressional report points out.

IN FOCUS...

Concerning the Air Force's new Navstar Global Positioning System (GPS)—involving at least eighteen satellites at altitudes of about 10,900 nautical miles—the report finds there is a significant margin of safety from current-generation Soviet ASAT space interceptors: "The high orbits of Navstar coupled with the large number and redundancy of the satellites, and the fact that limited intercept opportunities would severely constrain chances for a successful coordinated attack, could alone discourage the Soviets from attempting to develop an ASAT capability against this system." Soviet ASATs so far have not flown above altitudes of about 600 kilometers.

★ Further slippage in NASA's Space Shuttle is causing a serious gap between close-out of the Air Force's Titan II expendable booster production capability—set for October 1981 in the FY '81 Defense budget—and the Shuttle's achieving IOC (initial operating capability) some time in 1982. Senior DoD and USAF officials will meet this summer to determine whether the continuing delays in the Shuttle program warrant stretching out production of the Titan (34)D backup booster.

★ Latest potshot at USAF's proposed survivable follow-on to the Air Force Satellite Communications System—known variously as Strategic Satellite System or STRATSAT—was taken by the Comptroller General of the United States, Elmer B. Staats. The Comptroller General reported to Congress on May 9 that the Defense Department's requirement "to initiate development of a new, dedicated system of very high altitude satellites called Nuclear Forces Communications Satellites (or referred to now as STRATSATs) has not been adequately justified." Mr. Staats added gratuitously that "the threat against our future strategic communications satellites has been apparently misinterpreted by the Department of the Air Force. . . . " Senior Defense Department and Air Force officials are at a loss to explain the *ad hominem* accusation by the Comptroller General, don't know what is meant by his charge, and point out that he has not taken up the matter with the Air Force.

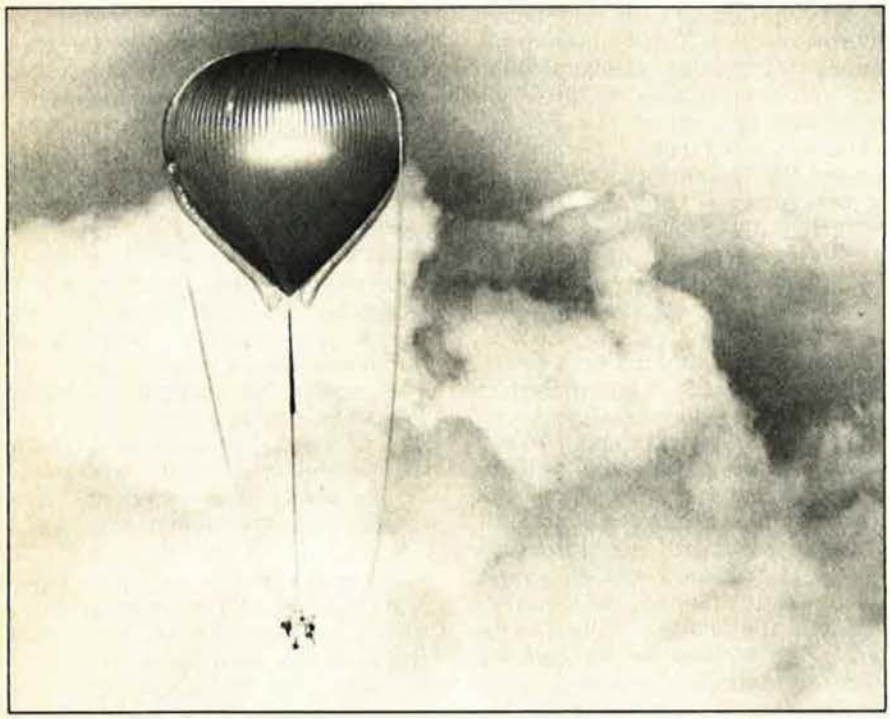
★ Sen. John Tower (R-Tex.) believes that if Congress had approved the Administration's January 1980 Defense budget as submitted "it would have been, in effect, granting a $6.4 billion cut." Because of what he terms fundamental errors in assumptions about the rate of inflation and fuel-cost growth, and the requirement that the Defense budget absorb forty percent of any pay increase, an addition of $6.4 billion is needed merely to "make whole" the President's own request, the Senator suggests.

★ Secretary of the Air Force Hans Mark, in a recent memorandum to senior Defense officials, reaffirmed the Air Force preference for the CX strategic airlift aircraft over the C-5 or a C-5 derivative. Although he believed at first that the need was for additional C-5s or C-5 derivatives, Dr. Mark said that "after looking at all the arguments with great care, I am now convinced that we need something different."

As now envisioned by the Air Force, the CX, an aircraft in the 400,000-pound gross takeoff weight class and capable of short takeoff and landing (STOL) performance, would have access to up to five times the number of foreign airfields that the C-5 can operate from. Because the CX can utilize critically important ramp space better than the C-5, Dr. Mark pointed out, a typical ramp large enough to accommodate two C-5s "could hold eight CXs. The ratio of CXs to C-5s on a ramp varies from six-to-one to three-to-one for various ramp dimensions that can accommodate at least one C-5." The House earlier this year voted down the Administration's request for CX funding. There is a strong chance, however, that the Senate will resurrect the program in modified form and that the House, subsequently, might be willing to go along with the former's decision. ■

AEROSPACE WORLD
News, Views & Comments

By William P. Schlitz, ASSISTANT MANAGING EDITOR



Above the clouds at 16,000 feet over Nevada floats the balloon Kitty Hawk, *piloted by Max Anderson and his son Kris on the historic nonstop transcontinental crossing of a balloon. See item below. (Wide World Photos)*

Washington, D. C., June 4

★ The plan was to come down in Kitty Hawk, N. C., in commemoration of the Wright brothers' early flights, but strong winds carried the helium-filled balloon north into Canada, where it settled to earth near Matane in Quebec Province on the St. Lawrence River.

Still, the eleven-story-high balloon—aptly dubbed *Kitty Hawk*—accomplished its major objective: the first nonstop crossing of North America. The flight took just under 100 hours during which *Kitty Hawk's* crew of two either eluded Midwest thunderstorms or flew above them. In fact, from northeast Utah to Maine the craft swept along at heights above 20,000 feet—jetliner cruising altitudes. Up there, at night, the temperature dropped to subfreezing levels, and the two men bundled up and were on oxygen to survive.

So Max Anderson, forty-five—accompanied by his son, Kris, twenty-three—has done it again. You'll recall that in August 1978, Max, with Ben Abruzzo and Larry Newman, was first to cross the Atlantic in a lighter-than-air craft, *Double Eagle II*. This latest flight by Max, which began from San Francisco on May 8, was deemed the more difficult because of the unpredictability of weather over the continent's landmass. Last year, attempts at continental balloon crossings by two other teams failed because of weather.

Probably, then, the success of the father-and-son team from Albuquerque, N. M., can be attributed to three factors: Max Anderson's expertise as one of the world's finest balloonists, up-to-the-minute meteorological forecasts, and that old standby—luck.

★ Tactical Air Command recently gave the 149th Tactical Fighter Group, Kelly AFB, Tex., primary responsibility for developing tactics and training programs for ANG units to employ over water.

The 149th was selected for the Tactical Air Support for Maritime Operations (TASMO) role because of the capabilities of its F-4C aircraft and proximity to the Gulf of Mexico.

According to officials, the unit's designation as primary TASMO will require greater emphasis on its ability to work with US naval forces in both maritime defense and air attack.

"The Soviet Navy is viewed as a greater threat now than in previous years," said Lt. Col. William Tomasi, Group Deputy Commander for Ops. "TAC and the Navy's Atlantic Command are relying on the Air Guard to provide a first line of defense."

In contrast to tac air support of ground forces, such units would operate over water against a high concentration of fighting ships and carrier-based aircraft. Attacking heavily armed ships requires exacting tactics and different methods of weapons delivery, it was pointed out.

Over water, aircraft must operate long range at low level without landmarks. In this, the F-4's Inertial Navigation System will come into play.

Besides over-water tactics, the 149th will be involved in researching the kinds of weaponry the F-4 will use. Other ANG TASMO units are to be named in the near future.

★ The US Army picked Vought Corp. as prime contractor for the Multiple Launch Rocket System (MLRS) program.

MLRS is a battlefield artillery system that employs a tracked, mobile launcher that can fire without reloading up to twelve rockets at a range of more than eighteen miles (thirty km). An important complement to conventional artillery systems, MLRS is manned by a crew of three; it will be able to direct massive firepower against successive enemy targets. The weapon fires highly accurate free-flight rockets.

Each launcher load of twelve rockets can bring to bear almost 8,000 M-42 submunitions on an area the

size of six football fields. The M-42 has the destructive power of a hand grenade and contains a shaped charge that will penetrate light armor.

Vought's selection followed a two-and-one-half-year validation phase of a test-firing program. Vought, LTV Corp.'s aerospace subsidiary, edged out Boeing Co. to win the MLRS award.

In what could amount to a multibillion-dollar program, Vought's initial contract was for $115.8 million to finance "maturation" research and development of the system.

Similar launcher systems being developed by the UK, France, and the Federal Republic of Germany are to be capable of firing common rounds of various types under a Memorandum of Understanding signed with the US.

MLRS production will take place at Dallas, Tex., and at Camden, Ark., where the system's rocket motors will be built by Atlantic Research Corp. Also at Camden, Brunswick Corp. will manufacture MLRS launch tubes. In all, some twenty subcontractors will supply MLRS parts.

★ USAF has discontinued the practice of foaming runways during aircraft emergencies at all but seven bases.

The decision was based on an analysis of some 292 mishaps that occurred over the last decade. Of them, 134 aircraft landed on a foamed surface while 158 aircraft landed on unfoamed runways. The study, conducted by the Air Force Inspection and Safety Center (AFISC), Norton AFB, Calif., concluded that:

- No loss or saving of life can be attributed to the use or nonuse of foam since no fatalities resulted from the landing accidents.
- The probability of fire, provided the aircraft remains on the runway, is essentially the same.
- Damage to the aircraft is essentially the same.
- During declared emergency landings, pilots with enough time to reduce or balance fuel loads landed as safely in either case. Foam or lack of it has no apparent psychological effect.

Besides the estimated annual $650,000 USAF will save by not foaming, aircraft will be returned to service sooner. Previously, engines ingesting foam had to be dismantled, cleaned, and inspected.

The seven bases that will continue to use foam are Travis AFB, Calif.; Altus AFB, Okla.; Dover AFB, Del.; Ramstein AB, Germany; Hickam AFB, Hawaii; Clark AB, the Philippines; and Yokota AB, Japan. These bases support C-5 operations and Air Force safety officials want to make a further comparison with other large military aircraft making emergency landings on nonfoamed runways before discontinuing foaming there.

★ NASA has awarded million-dollar-plus contracts to three of the nation's top aerospace firms to study the application of new technology to supersonic cruise flight of civil jetliners.

The Boeing Co., Seattle, Wash.; Lockheed California Co., Burbank; and McDonnell Douglas Corp., St. Louis, Mo., were also asked to draw on and update past studies to reduce the fuel consumption and noise of such aircraft.

Aim of the project, to be managed by NASA's Langley Research Center, Hampton, Va., is to further develop the technology base for supersonic transports and involves such advanced concepts as improved

Ave Atque Vale

This is the last issue of AIR FORCE Magazine to bear the name of John L. Frisbee on its masthead. It has been there for more than ten years. His name will be missed, but not as much as Frisbee's presence in our editorial offices where he toiled so brilliantly and effectively as Senior Editor, Executive Editor, and, since early 1978, as The Editor.

F. Clifton (Clif) Berry, Jr., who joined us in November 1979, will move from his post as Executive Editor into The Editor's chair, effective July 1.

John Frisbee joined AIR FORCE Magazine in December 1969, following retirement as a colonel from a distinguished Air Force career as fighter and bomber pilot, planner on the Air Staff and at major commands, teacher and leader of young men at West Point and the new Air Force Academy, and as speechwriter, sounding board, and mentor for a succession of senior uniformed and civilian Air Force leaders. When he joined us, we considered it not only a plus but somewhat of a coup.

We got more than we had bargained for—a multitalented person rare in any field. His multiple capabilities quickly transformed him into our resident research expert, explainer of esoteric aircraft and equally exotic defense policies, spotter of egregious errors in copy, motivator and inspirer of authors, and long-range planner for the magazine.

Frisbee's writing is elegant, spare, and precise. By itself, that is an asset to any magazine. Beyond that, his editing brings the writings of others nearer to his own standards, improving them in the process.

We wish the very best to him and his wife, Lucy (also a writer), and a long and tranquil retirement in Leesburg, Va. We hope to call upon the Frisbee talents from time to time in the future as his plans will permit, for he is a corporate asset we do not want to lose.

Meanwhile, Clif Berry brings to his new post a broad background in military affairs as an enlisted man and officer, as a defense reporter and analyst, as well as extensive experience in magazine production, management, and promotion. *(See p. 30, December 1979, and p. 22, April 1980 issues.)*

F. Clifton Berry, Jr. (left), succeeds John L. Frisbee as Editor on July 1.

Berry began his military career in the Air Force, where he took part in the Berlin Airlift. He was awarded a direct Regular Army commission in 1955 while serving as a paratrooper in the 82d Airborne Division.

During his Army career, Berry worked closely with the Air Force in developing airlift, airdrop, and close-support techniques. His Washington service included assignment as a politico-military affairs officer at the Arms Control and Disarmament Agency under Dr. Fred Iklé. He had been selected for promotion to colonel and attendance at the Army War College when he decided to follow a career in journalism. He is a master parachutist and holds the Combat Infantryman Badge. He has a bachelor's degree in mathematics from George Washington University and a master's degree in communications from Stanford.

John F. Loosbrock, Deputy Executive Director of AFA, will continue in his position as Editor in Chief and Publisher of the magazine. Richard M. Skinner, Managing Editor and Associate Publisher, remains in that position.

aerodynamics, use of lightweight titanium and composite structures, and the development of variable-cycle engines for more efficient subsonic and supersonic flight.

All three manufacturers have baseline concepts that, like those NASA has been working on, have been continuously evolving with each new development in supersonic cruise research. For example, Boeing's is a "blended-body" 270-passenger delta-wing configuration with an anticipated cruise speed of Mach 2.4. The McDonnell Douglas concept is an arrow-winged design capable of transporting 225 to 300 passengers at Mach 2.2. Lockheed has come up with a Mach 2.5 arrow-wing design to carry 290 passengers.

The studies should be completed by mid-1981.

★ The 1st Tactical Fighter Wing, Langley AFB, Va., put in a busy week in April during an exercise called "Eagle Thrust." A new sortie record was set for the wing when during the week it launched sixty-six F-15 Eagles on a total of 813 sorties, topping the previous mark by 193.

Throughout the week, as many as four of the McDonnell Douglas aircraft were scrambled every thirty minutes from 7:00 a.m. to 8:00 p.m. daily, with each sortie lasting about an hour.

In a simulated overseas deployment followed by aerial combat, the F-15s flew against such USAF, Navy, and USMC aircraft as F-4s, F-14s, A-4s, A-10s, B-52s, F-105s, and F-5Es awaiting them in training airspaces along the Eastern Seaboard. Engaged in both offensive and defensive combat, some missions included aerial refuelings by KC-135 tankers.

Throughout the exercise, an E-3A Airborne Warning and Control System (AWACS) aircraft controlled the aerial attacks.

During "Eagle Thrust," ground crews received training in protecting against simulated aircraft hijackings and terrorist attacks on the base.

AEROSPACE WORLD

★ Under an agreement with NASA, the US Coast Guard will undertake a study of lighter-than-air craft and their potential role in search and rescue, law enforcement, and other coastal patrol operations.

The agreement represents "a major step toward a long-term development program that may culminate with the deployment of Coast Guard lighter-than-air craft in the late 1980s or the early 1990s," a spokesman said.

A recent study of airships, conducted jointly by the Coast Guard and US Navy, concludes that such fuel-efficient vehicles are operationally and technically feasible for maritime patrol work, especially when used in concert with Coast Guard cutters and conventional aircraft. The report recommends that the Coast Guard proceed with additional research to design and evaluate a maritime patrol airship within the next several years.

The interagency agreement is to reduce development costs by coordinating NASA and Coast Guard programs. NASA scientists are already studying lighter-than-air vehicles to determine their capabilities for lifting heavy equipment and materials. The joint effort will broaden this research to include airships designed for coastal patrols and will lead eventually to the development of a flight research vehicle for NASA/Coast Guard testing.

★ The UK's first Nimrod Airborne Early Warning aircraft was rolled out by British Aerospace on April 30. First flight of the Nimrod AEW is expected in August.

The British have ordered eleven Nimrod AEWs; they'll provide early warning for the UK Air Defense Region, East Atlantic, and Channel—NATO areas currently patrolled by Shackleton AEW aircraft.

A Comet radar development aircraft has completed several hundred hours of development flying with the new AEW radar system since tests began in June 1977. A flight development program began earlier this year on the new AEW communication system that is compatible with both the AWACS and NATO systems.

In another European aerospace matter, UK, German, and French companies have completed a joint study to define a European Combat Aircraft (ECA) to satisfy the needs of their respective countries and designed to replace the Jaguars flown by UK and France and West German Phantoms.

The companies, British Aerospace, Avions Marcel Dassault-Breguet Aviation, and Messerschmitt-Bölkow-Blohm, have recommended that the studies continue to finalize a joint configuration of an ECA for the 1990s.

★ The 381st Strategic Missile Wing, McConnell AFB, Kan., amassed 2,747 points of a possible 3,000 to take first place at the recently concluded Olympic Arena '80 SAC combat missile competition at Vandenberg AFB, Calif.

It was the second consecutive year that a Titan missile wing won top honors, and for its efforts the 381st was awarded the Blanchard Trophy, the meet's highest award.

In second place and the best Min-

Test firing of the Multiple Launch Rocket System at the White Sands Missile Range in New Mexico. The US Army picked Vought Corp. as prime contractor to produce the mobile adjunct to conventional artillery. (See p. 26 for details.)

SCIENCE/SCOPE

Three U.S. weapons are closer to sharing common guidance systems now that Hughes has delivered advanced development models of an imaging infrared seeker. The units, developed under an Air Force contract in parallel with a seeker for the Maverick air-to-ground missile, fit the Air Force GBU-15 and Navy attack weapons. They detect heat and track the target by sensing small temperature differences, providing precision guidance capability both night and day and in low visibility conditions. All three seekers are virtually identical, and use of the common unit will considerably reduce the military's costs for development, production, training, and maintenance.

The F/A-18 Hornet strike fighter's radar passed its first test at sea during five days of trials aboard the aircraft carrier USS America. The AN/APG-65 radar was among the systems that were evaluated for effects of shock as the Hornet made 32 catapult launchings and arrested landings, and 17 touch-and-goes. The radar, which contains digital electronics that can be reprogrammed to meet new threats, serves both air-to-air and air-to-ground missions. Hughes builds it under contract to McDonnell Aircraft Company for the U.S. Navy and Marine Corps.

An infrared sensor that would detect and track ballistic missiles -- and perhaps even distinguish "live" missiles from decoys -- has proven extremely successful in initial tests. The device, a part of the Designating Optical Tracker (DOT) program, is designed to be carried by a rocket to an altitude of 100 nautical miles. There, at the outer edge of the atmosphere, it scans a wide area of space and then relays the data it gathers to the ground. The infrared sensor is much more sensitive than conventional infrared devices because it's supercooled. The device was developed by Hughes for the U.S. Army Ballistic Missile Defense Advanced Technology Center under subcontract to Boeing Aerospace Company.

A highly mobile gun system equipped with an advanced laser rangefinder will protect U.S. combat troops from air attack. The Division Air Defense (DIVAD) gun system, mounted on an M-48 tank chassis, is designed to knock out planes, helicopters, and ground targets. In combat, a crewman aims at a target and fires the laser. The time required for the beam to reach the target and reflect back determines the range. Almost instantly the fire control computer processes this information with other data -- like air temperature, air density, crosswind velocity, and ammunition ballistics -- to deliver azimuth and elevation firing commands to the turret and 40-mm guns. Hughes has delivered the first of three preproduction laser rangefinders on schedule to Ford Aerospace & Communications Corp., which is developing DIVAD competitively for the Army.

Manual tracking systems that are 10 times more precise than any previously used by the U.S. Army have been developed by Hughes through extensive research and simulation. Studies have carefully matched tracking system characteristics like inertia, sight magnification, and damping to the neuromuscular and perceptual characteristics of the human operator. The new systems have been applied to wire-guided, antitank missile launchers and laser devices used to spotlight targets for laser-homing weapons.

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AEROSPACE WORLD

Team members of the 381st Strategic Missile Wing, McConnell AFB, Kan., hold aloft Blanchard Trophy to proclaim their victory in the Olympic Arena missile competition. (See item.)

uteman wing was the 90th SMW, Francis E. Warren AFB, Wyo., with 2,700 points.

The McConnell unit won out also in the Titan munitions and communications events, while the 90th SMW garnered awards for the best Minuteman crew, best security police team, best Minuteman operations (trophy sponsored by AFA), and best single crew exercise.

A Minuteman III unit, the 321st SMW of Grand Forks AFB, N. D., finished third overall, while the 390th SMW (Titan), Davis-Monthan AFB, Ariz., edged out the 308th (Titan) of Little Rock, Ark., by a single point—2,668 to 2,667—to place fourth.

The 390th also won best maintenance, best Titan facilities team, best Titan electronics lab team, and the AFLC Titan trophy. The 308th won best operations, best crew, best Titan crew, best Titan munitions maintenance team, best Titan security police team, best civil engineering team, best Titan civil engineering team, and the trophy for Titan operations (AFA sponsored).

The 44th SMW, Ellsworth AFB, S. D., had best communications team, best Minuteman communications team, and best Minuteman civil engineering team.

For its part, the 351st SMW, Whiteman AFB, Mo., took awards for best Minuteman mechanical team and the AFLC trophy for Minuteman logistics.

The 341st SMW, Malmstrom AFB, Mont., walked away with trophies for best Minuteman electro-mechanical team and best Minuteman munitions team, while the 91st SMW, Minot AFB, N. D., had best Minuteman missile facilities team.

Only 189 points separated first place from last in the three-day meet, in which nine wings competed.

★ NASA is working with the Department of Energy to develop technology for managing, in a safe and environmentally acceptable fashion, radioactive wastes that are expected to remain "hot" for thousands of years.

NASA's Marshall Space Flight Center, Huntsville, Ala., has awarded a contract to Boeing Aerospace Co., Seattle, Wash., to study and analyze systems concepts for the possible disposal of nuclear wastes in space.

While the Boeing study is expected by December of this year, no one is rushing into anything. Its effort will be part of a joint NASA/DoE four-year

For defense against attack helicopters, airplanes, and ground targets is Ford Aerospace & Communications Corp.'s contender in the US Army's Division Air Defense competition. Mounted on an M48A5 tank chassis are two 40-mm guns produced by Bofors of Sweden.

"development and evaluation study plan detailing the activities necessary to reach an assessment of the space disposal option."

Studies will probe waste payload protection, possible space destination, types of space transport and launch sites, among other things.

★ People can be taught to suppress motion sickness, believes psychophysiologist Dr. Patricia Cowings of NASA's Ames Research Center, Mountain View, Calif.

Motion sickness, common to ship and even auto passengers, has afflicted to some degree about half the astronauts on manned space missions. In some cases, it became a severe adverse factor.

Working with a spinning chair device, Dr. Cowings and associate William Toscano taught forty-two of fifty volunteers to improve their ability to withstand motion; thirty-two learned to completely suppress motion illness symptoms. During the experiments, the trained subjects, using a biological feedback system, monitored their own bodily functions such as heart rate and respiration and learned how to suppress the onslaught of illness.

A control group of sixty people who received no training showed no improvement.

Dr. Cowings would like to test her theories in space; such an experiment is tentatively among the life science experiments planned for an early Spacelab flight aboard the Space Shuttle.

AEROSPACE WORLD

★ AFSC's Arnold Engineering Development Center, Arnold AFS, Tenn., is chiefly noted for its advances in Air Force hardware. But an important environmental sideline at the facility's 2,600-acre security area is the production of wildlife—namely deer.

It is estimated that in the entire state of Tennessee in the mid-1950s there were only from 1,000 to 2,000 deer and none at AEDC. Then in 1960 the state's Game and Fish Commission signed an agreement with the Center in an effort to develop the state's renewable recreational resources.

Sixty-four deer were let loose at AEDC, the beginning of a herd that now numbers 2,500. What's more, besides providing hunting, this is the sixth year that deer will be netted at the Center by people from the Tennessee Wildlife Resources Agency for relocation elsewhere in the state.

Today, there are more than 250,000 deer in Tennessee. Other than deer and turkey, the Center has an abundance of such small game as squirrel, dove, raccoon, opossum, and water

INDEX TO ADVERTISERS

Data acquisition in adverse environments is never simple, but Bell & Howell can make it easier.

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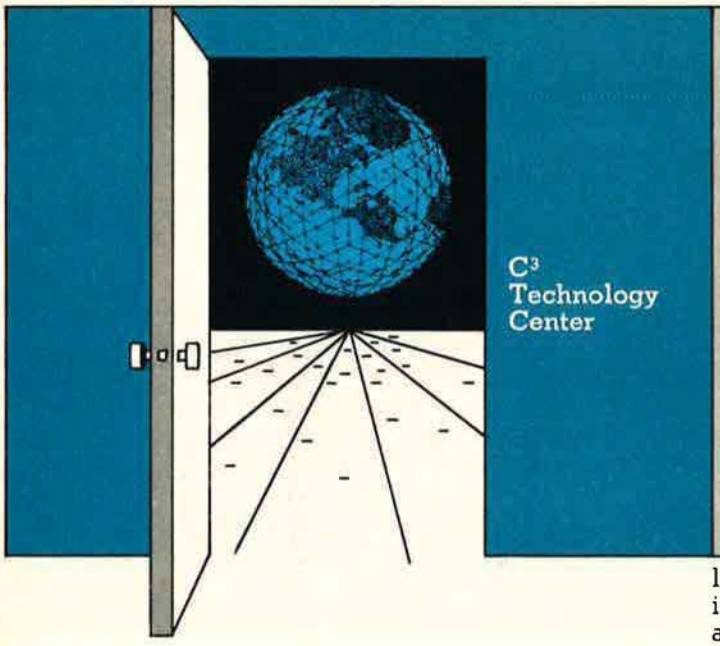

DOOR INTO TOMORROW

less distant tomorrows. This work involves C^2, C^3, and C^3I systems analysis, network simulation, interoperability, and a wide variety of specialized technical tasks in EMC, EMI, Tempest, human factors, and the "ilities"—survivability, vulnerability, reliability, maintainability, and availability.

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CHANGING THE COURSE OF MANAGEMENT

AEROSPACE WORLD

fowl. Fishing in the Center's 4,000-acre reservoir is among the best in the state.

★ A new air transportable hardwall hospital structure is undergoing tests at Langley AFB, Va., to evaluate its advantages over the older tent structures, according to the TAC Surgeon's Medical Materiel Division.

In the shape of a large rectangular box measuring twenty feet (6.09 m) by eight feet (2.4 m) by eight feet, it can be unfolded to a building two or three times the original size, depending on the model. Unlike the tent hospitals, it has its own floors and adjustable legs to allow it to be set up on uneven terrain. The ATH also has a built-in heating and cooling unit.

Following the tests at Langley, units of the hardwall structure will be shipped to bases in Europe and the Pacific for further evaluation. While currently in a hospital configuration, such air transportable hardwall structures may find additional uses throughout the Air Force and other services, TAC officials said.

Currently undergoing flight trials is the Optica ("Bug-eye") observation plane, hand-built by British civil engineer John Edgley. It can fly at fifty-seven mph, consuming fuel at four gallons an hour.

★ The tenth World Aerobatic Championships are to be held August 17–30 at Wittman Field, Oshkosh, Wis., the first time in the event's twenty-year history it will take place in the US and not in Europe.

Teams, composed of a maximum of five men and five women, are expected from nearly a score of countries; they'll fly a number of aircraft

Tests at Kirtland AFB, N. M., have demonstrated that the F-16 fighter's avionics, electrical, and flight control systems can withstand powerful electromagnetic impulses, such as those generated by nuclear detonations or lightning, and still remain operational. The F-16 survived a series of high-voltage shocks without a single electrical circuit or equipment burnout and was later flown back to the Fort Worth, Tex., plant of manufacturer General Dynamics.

never before seen in the US, especially designed to withstand the rigors of aerobatic flying. These include France's Cap 20, Czechoslovakia's 300-hp Zlin 50, and the USSR's all-new Yak 55. The US team will field, among others, the Pitts Special with which it won the world event in 1972.

In the 1976 contest, held in Kiev, USSR, the Soviet team won ten of eleven gold medals and every major title. The US team placed fourth in a field of fifteen. Questionable officiating practices by the Soviet judges brought about major changes in world contest rules.

The big winners at Ceske Budejovice, Czechoslovakia, in 1978 were the Czechs in the men's events and the Soviets in the women's, although the US was the only team to get all five of its men into the finals.

On the 1980 US women's team: Patti Johnson, Burleson, Tex.; Betty Everest Steward, Rockford, Ill.; and Paula Moore, Pompano Beach, Fla. The men: Leo Loudenslager, Sussex, N. J.; Henry Haigh, Howell, Mich.; Tom Collier, Hampton, Ga.; Kermit Weeks, Miami, Fla.; and Randall "Chipper" Melton, Brighton, Colo.

CBS has nailed down television rights to the meet and will feature it on "Sports Spectacular."

Most governments subsidize their aerobatic teams, but the US team depends on contributions, which are tax deductible. Contact Aerobatic Club of America, 2875 28th St., Boulder, Colo. 80301. Phone (303) 442-1311. ACA President Ben Lowell is also Treasurer of AFA's Flatirons Chapter, Colo.

AEROSPACE WORLD

A technician calibrates a scale model of the new F-5G fighter for wind-tunnel tests. Manufacturer Northrop Corp. estimates a requirement of more than 1,000 F-5Gs worldwide.

★ **NEWS NOTES—Lt. Col. Mike Terrill,** Public Affairs Director at Lackland AFB, Tex., has been named **top public affairs officer for 1979** by the Aviation and Space Writers Association. Colonel Terrill handled PA operations during a hectic time late last year during the stay at Lackland of the former Shah of Iran.

Aerospace industry **employment reached 1,152,000 in December 1979,** a record for the decade and a gain of twelve percent over 1978, but **only slight increases** are forecast in 1980 and 1981, the Aerospace Industries Association reported.

Maj. Rosa Lee Cook, USAF Nurse Corps and AFA member, has received the 1980 E. Ann Hoefly Award for **excellence in clinical nursing and research.** The award honors a former Chief of the NC. Major Cook was cited for her heart-disease research at USAF School of Aerospace Medicine, Brooks AFB, Tex.

China termed a success the mid-May **launch of its first ICBM** from a northern test site to a target area in the South Pacific, about 6,000 miles, range enough **to hit most targets** in the Soviet Union and the Western US. The launch signaled the beginning of a **series of test firings of Chinese ICBMs,** believed to be liquid-fueled and with three stages.

With the launch of Soyuz-36 in late May, **Soviet Cosmonaut Valery Kubasov and Bertalan Farkas, the first Hungarian cosmonaut,** successfully rendezvoused with orbiting space station Salyut-6, manned by Valery Ryumin and Leonid Popov. These cosmonauts have been aboard the station since April 10.

Died: Gen. Frederic H. Smith, USAF (Ret.),former Vice Chief of Staff who led a fighter group in the Pacific during World War II and also served as USAFE Commander, of a heart attack in San Antonio, Tex., in May. He was seventy-one. ■

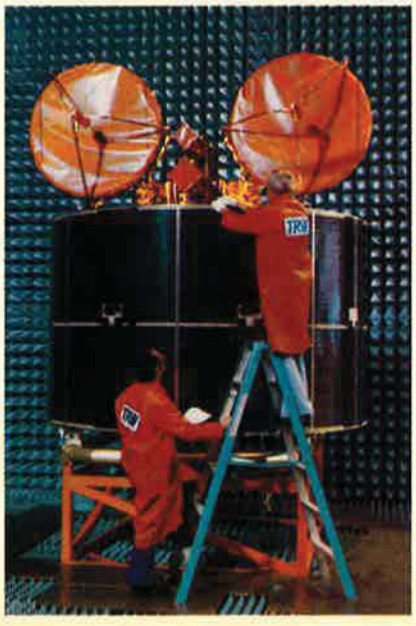
The Indonesian Air Force this spring took delivery of its first Northrop F-5E tactical air defense fighter, the twenty-seventh country to deploy the US-built supersonic aircraft. More than 3,400 F-5/T-38s have been built thus far.

Proven

Global Military Communications

With last year's launch of two more spacecraft in the Defense Satellite Communications System (DSCS II), the Department of Defense reinforced its global network of high-volume, general-purpose communication satellites. The Flight 15 spacecraft is complete. Flight 16 is in final production.

With its high power, wide bandwidth (410 MHz) and great flexibility, DSCS II has greatly increased the nation's capacity for keeping our worldwide forces in touch with strategic commanders throughout the Department of Defense.



The spacecraft are being built by TRW for the Defense Communications Agency under the management of the U.S. Air Force Space Division.

The DSCS II spacecraft can also provide valuable interim gap-filler capabilities for such users as NATO. The twin steerable antennas can be commanded to illuminate any two zones on Earth, one of 1,000 and one of 2,500 miles diameter, for communication between mobile command posts and remote headquarters units.

TRW also builds FLEETSATCOM, the most powerful satellite currently in orbit, and is developing the even more powerful Tracking and Data Relay Satellite System (TDRSS) for Western Union to serve both NASA and commercial users. We're also integrating the TDRSS ground station.

TRW was recently awarded a system requirements study on the NASA/Lewis Research Center, 30/20 GHz comsat.

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The DMTS employs a unique dual capstan/peripheral reel drive to assure precise tape control even under severe conditions. To save weight and space — and cost — it interfaces with a variety of onboard computers through a single controller. The standard DMTS communicates with CDC AN/AYK-14, IBM AN/UYS-1, and UNIVAC AN/ASQ-114. A modified version can accommodate the Rolm AN/UYK-19, Litton AN/GYK-12, Norden PDP-11M, and UNIVAC AN/UYK-20.

So if you're looking for a proven system to meet your demanding program loading or auxiliary mass memory requirements, consider the Honeywell DMTS. It offers 60 megabits of data storage per cartridge (9 tracks at 1600 bpi). And each controller can accommodate up to four tape units.

The DMTS (AN/ASH-33) is available today for use in any MIL-Spec airborne, shipboard or mobile application. But if you're looking for a custom solution to any of your recording or reproducing problems, that's all the more reason to contact us. For an immediate response, contact Chet Utt, Honeywell Test Instruments Division, Dept. AF, Box 5227, Denver, Colorado 80217. (303) 771-4700.

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CAPITOL HILL

By Kathleen G. McAuliffe, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., May 28

Budget

House and Senate conferees reached agreement on defense spending for FY '81, setting outlays at $153.7 billion. The Senate had pegged defense outlays at $155.7 billion and the House at $147.9 billion. The conference figure is surprisingly high since Budget Committee staffers expected to see final defense expenditures close to the Administration figure of $150.5 billion.

The conference report faces a tough fight in the House, where liberals will object to concessions made on domestic programs and some Republicans might link the issue to a tax cut.

McKay on MX

Despite controversy in his home state, Rep. Gunn McKay (D-Utah) gave critically needed support to MX during debate on deletion of funds for the missile and its basing mode by calling it "superior to alternatives at this time." Citing the need for strong defense, Congressman McKay, in whose state the MX would be deployed, took a position potentially damaging to his own future: "I will not take steps that may jeopardize the national security to avoid inconvenience to self, nor will I intentionally cause unnecessary delays now to avoid making a tough decision," he said.

Bomber vs. SWL

Consideration of the DoD authorization provided a forum for debate on the need for a manned penetrating bomber. While discussing an amendment to delete funds from the Strategic Weapons Launcher (SWL), a B-1 derivative designed to carry cruise missiles, Rep. Bob Carr (D-Mich.), an FB-111B/C proponent, and Rep. Robert Dornan (R-Calif.), a B-1 advocate, debated the need for a new bomber vs. a cruise-missile carrier.

Congressman Carr submitted statements by Gen. Richard Ellis, SAC Commander in Chief, on the need to develop immediately a bombing capability to affect "the near-term imbalance," and hence supporting the FB-111B/C concept as the earliest possible solution. The Congressman quoted General Ellis: "Our requirement is for a strategic penetrator for the '80s—not a new SWL."

However, funds for the SWL remained intact and $10 million was added for FB-111 modification R&D through an amendment by Rep. Jim Wright (D-Tex.).

DoD Authorization

The House approved by a vote of 338–62 a $53.1 billion procurement and R&D spending package for DoD in FY '81. This is $6.2 billion over the Administration's request.

Three separate attempts to delete funds for MX were soundly defeated: Rep. Ronald Dellums (D-Calif.) proposed deleting the entire $1.6 billion for MX; an amendment by Rep. Paul Simon (D-Ill.) would have cut the $500 million for the basing mode and left $66 million to study alternatives; and Rep. Dan Marriott (R-Utah) proposed that withdrawal of public land for MX deployment be delayed until completion of all studies on the environmental and socioeconomic impact, after detailed study of alternate basing modes, and a review of Soviet threat to all three legs of the triad.

Successful amendments included the addition of $10 million to FB-111 R&D mentioned above, a trial educational assistance program for enlistees, and special sea pay for those on duty in the Indian Ocean.

The bill also contains language providing separate authorization in FY '82 for Operations and Maintenance. This came in response to concerns over past severe cuts in O&M and the resulting decrease in readiness.

The Senate has not yet reported its authorization bill.

Draft Registration

The President's plan to register nineteen- and twenty-year-old men for the draft has one major hurdle remaining in Congress. Implementing legislation to transfer $13.3 million from the USAF personnel account to Selective Service passed the full House and the Senate Appropriations Committee. A filibuster by Sen. Mark Hatfield (R-Ore.) is expected to delay final Senate action, but the measure should pass and registration begin in July.

Armstrong Initiatives

Sen. William Armstrong (R-Colo.) has again introduced legislation to alleviate retention problems and attract higher-quality recruits.

One proposal, the GI Bill of 1980, would provide substantial education incentives for those completing two years of active duty. Participants would receive 100 percent college tuition for four years and a stipend of $300 per month.

A second measure would increase pay by removing the President's authority to cap military pay hikes; increase special duty pay by 100 percent; and, over a three-year period, increase base pay by nine percent above the GNP deflator adjustments for lower ranks and by eighteen percent for upper grades. Estimated cost would be $1.9 billion in FY '81, rising to $4.5 billion in FY '83. Reps. Paul Trible (R-Va.) and Charles Bennett (D-Fla.) introduced a parallel bill in the House.

A third Armstrong proposal provides limited educational incentives for joining the National Guard or the Reserve.

Stennis Calls for Draft

Citing a decline in recruit quality, Sen. John Stennis (D-Miss.), Chairman of the Senate Armed Services Committee, has called for registration passage followed by a return to a "realistic, but fair, Selective Service plan."

His proposal would allow full deferments only for major disability, and exemptions for bona fide religious beliefs and certain science students. Those exempted would be required to serve in some other manner, and all those drafted would receive one month of paid educational benefits for each month served. ■

MISSION: DESTROY TANKS WITH TACTICAL AIR.

The capabilities of the multi-mission A-7 continue to grow. Now with the addition of the new GE 30 mm Gun Pod, the A-7 provides still another mission capability — a day or night tank killer. And the GEPOD 30 has the same striking power as the GAU-8 cannon.

The A-7 is already operational with FLIR (Forward Looking Infrared Receiver) that enables pilots to perform 24-hour surveillance/attack missions with a proven, highly-accurate weapons delivery system.

Continued updating of the A-7's Electronic Counter Measures (ECM) suit and the addition of a standoff missile capability provide a total weapons system capable of effective around-the-clock operations well into the 1990s — and at very low comparable cost.

VOUGHT an LTV company

Electronics Takes to the Offensive

Machines that mimic the human mind show increasing potential for helping commanders manage combat forces. Yet, by reducing the imponderables and forecasting the consequences of various courses of action, sophisticated decision aids and automated command and control systems probably will increase rather than decrease the decision-maker's importance.

BY EDGAR ULSAMER, SENIOR EDITOR

"THE key areas in which our C³I (Command Control Communications and Intelligence) capabilities need improvement relate to their effectiveness in combat, survivability, and resistance to jamming and exploitation. These measures are particularly important in view of the emphasis that our potential adversaries place on destruction and disruption of our C³I capabilities," according to Defense Secretary Harold Brown's Annual Report.

In a technical sense, a recent DoD study finds, the US lead in such key areas of C³I as communications, surveillance and reconnaissance, and early warning is being diminished by Soviet advances across a broad front. In command and control as well as electronic countermeasures, the Soviets are roughly even with US technological capabilities. Only in some of the circuitry fields as well as signal processing, computer software, and telecommunications is the US holding its own, the Defense Department found.

The principal Air Force organization concerned with planning, developing, and buying the mélange of systems, sensors, processors, communications links, and other devices that, in combination, provides C³ is the Air Force Systems Command's Electronic Systems Division at Hanscom AFB, Mass.

In cooperation with the affiliated Rome Air Development Center (RADC), and two Federal Contract Research Centers—the MITRE Corp. and the Massachusetts Institute of Technology's Lincoln Laboratory—ESD acts as the key architect, systems manager, and coordinator of C³ research, development, and acquisition for the Air Force, other DoD elements, and allied air forces. The Division's annual budget is about $1.9 billion.

ESD, its Commander, Lt. Gen. Robert T. Marsh, told AIR FORCE Magazine, is facing a new problem of transcending importance: the declining retention rate of technically trained officers and young civilians. "Our biggest problem is people. About thirty-seven percent of ESD's assigned technical officers—science and engineering graduates as well as other technically trained specialists—are lieutenants," General Marsh points out. This high percentage is the result of low retention of young officers following completion of their obligatory tour of duty.

In the majority of cases, General Marsh reports, money is the reason young technical officers leave the Air Force. Industry is offering electrical engineering graduates starting salaries in the $20,000 to $23,000 range, compared to a lieutenant's pay of somewhere between $12,000–$13,000, the ESD Commander noted. The same condition is also creating serious shortfalls in ESD's young Civil Service technical experts. The financial blandishments of the private sector thus are often "overwhelming," especially in light of the fact that the present military pay and benefits structure makes life for the young officer "tough," according to General Marsh. The answer to the problem, which shows no signs of easing, could be increased pay in general and selective bonuses for Air Force people with scarce skills, he suggested.

ESD's central technical challenge is captured by the term "fusion," meaning the processing, manipulation, correlation, and synthesis of information from a welter of different sensors and systems, in order to coalesce their various products into an intelligible whole that commanders can act on rapidly and confidently. Fusion's lofty long-term goal, General Marsh said, is "to see the entire battlefield situation over great ranges and under all-weather conditions" and to provide commanders with automatically processed information that is sufficiently filtered and clarified to make rapid decisions possible. For the time being, the fact that most C³ systems provide only narrowly focused information, can't easily be made to work with each other, and are too slow to keep up with the dynamics of modern warfare militates against the rapid and comprehensive fusion of all these entities.

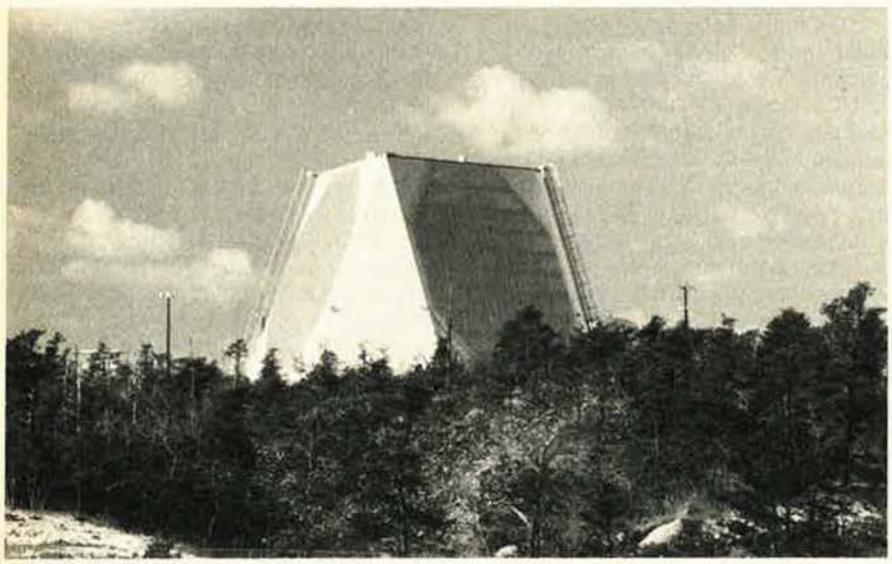
Considerable progress is being made, however, by the Air Force in conjunction with other elements of the Defense Department, in developing a "fusion" command and control system for use in Europe that might lead to the development of larger and more advanced follow-on designs.

ESD recently completed and forwarded via AFSC to the Pentagon a plan for the long-term development of USAF's C³CM (for command control and communications countermeasures), a recently evolved concept to "destroy, degrade, deceive, or exploit the enemy's C³I facilities or—to use Warsaw Pact terminology—radio electronic combat capabilities." The orientation of C³CM is offensive with key goals the neutralization or destruction of the enemy's signal intelligence, command centers, data links, tactical air control centers, and other communications nets and facilities.

The ESD C³CM plan includes three stages, beginning with an interim capability in Europe and involving the use of existing assets; a mid-term capability—to be attained by the mid-1980s—incorporating readily available improvements; and advanced, comprehensive capabilities envisioned for about 1995, according to the ESD Commander. The case for C³CM, he added, is compelling: "The best way to fight electronic warfare is to locate the enemy's jammers and destroy them, rather than having to worry about our own AJ [antijam capabilities]." Similarly, preemption of the enemy's C³ capabilities by identifying and destroying the critical nodes before he can deploy his forces makes good sense operationally.

Impetus for the current C³CM concept comes from an RADC program known as CELT, for Coherent Emitter Location Test-bed, that is being carried out in conjunction with the Defense Advanced Research Projects Agency (DARPA). CELT is premised on identifying emitter characteristics in order to pinpoint the function of the using organization—such as a Soviet Army battalion or SAM unit—so countermeasures can be used against those that represent specific, immediate threats. There is a linkage of C³CM information

THE ELECTRONIC AIR FORCE



PAVE PAWS, a dual-faced phased-array radar, shown close up (above) and from a distance (left), provides early warning of SLBM launches against the US over a 3,000-mile range.

and "fusion systems," with the latter accumulating this information, correlating it with other data, nominating individual targets, and bringing suitable forces to bear to neutralize or destroy targets.

The third broad challenge that continues to confront ESD is epitomized by the term "front-end definition"—the ability of C³I systems now being designed to adapt to unforeseeable changes in tactics, doctrines, and weapon systems encountered during their life cycle. ESD's response to the certainty of change and uncertainty of its nature is a policy of gradualism that starts with core or baseline configurations that can grow and adapt to the user's changing needs and philosophies. Equally important, General Marsh points out, is constant interaction with the users—to the extent of collocating personnel in certain circumstances—to develop systems in an evolutionary way. Starting point is a mutual effort to establish the system's enduring needs and to design the baseline configuration around them but with options for growth.

Strategic C³

Flexible operational control of US strategic forces at all levels of conflict presupposes that the associated C³ capabilities are at least as survivable, flexible, and enduring as the forces they are meant to launch and control. For the moment, Secretary Brown reported to Congress, "our ability to meet these objectives falls considerably short." A broad-gauged effort is under way, he added, to improve strategic command control and communications.

ESD is responsible for many of the programs involved—funded to the tune of about $390 million this year—including systems that provide strategic surveillance and warning. The importance of these systems is fundamental: A potential adversary who knows that the US will detect, assess, and react optimally to his attack, regardless of how his stratagem is played, may deem this capability to be deterrence of and by itself.

One of the ESD-managed programs involved is PAVE PAWS, a dual-faced phased-array radar that provides early warning of SLBM launches against the US over a 3,000-nautical-mile range and monitors satellites in low earth orbits. It soon will achieve full operational status at both East Coast and West Coast sites—Otis AFB, Mass., and Beale AFB, Calif. Both are now under

the operational direction of SAC and ADCOM, and provide improved coverage along the two coasts. Augmenting PAVE PAWS, for the time being at least, are an older FPS-85 phased-array radar and a yet older FSS-7 SLBM warning radar in Florida to cover possible SLBM launch areas southeast of the United States.

Two additional PAVE PAWS sites—one in the southeast and the other in the southwest—are under tentative consideration, but as yet have been neither authorized nor funded. ESD is examining the possibility of increasing PAVE PAWS's power to improve the system's attack assessment capabilities through better tracking and identification of SLBMs. The Soviet Union's growing MIRVed SLBM force—especially the use of seven MIRVs by the SS-N-18 SLBM—is placing high demands on PAVE PAWS.

The system detects Soviet SLBMs flying minimum-energy trajectories at distances of about 2,200 nautical miles from the US coastline—or about 3,000 miles in the case of "lofted," or high-altitude trajectories that overfly other US sensor systems. PAVE PAWS is a "soft" system that an adversary could attack or jam from standoff. Such an attack, however, would provide clear-cut warning of impending nuclear war and thus is seen as unlikely. In order to reduce the vulnerability of the communications link between the PAVE PAWS sites and the National Command Authorities (NCA), the Air Force is weighing plans to provide each site with a ground satellite center and thus the ability to transmit via space rather than by vulnerable land lines.

PAVE PAWS's prime contractor is Raytheon's Equipment Division, with IBM acting as the software developer. The system is linked to ADCOM's Cheyenne Mountain Complex, the NCA, and SAC to provide SLBM launch and raid characterization information. Space surveillance information is furnished to ADCOM.

The Enhanced Perimeter Acquisition Radar Characterization System (EPARCS) is an ICBM warning and attack assessment system involving modification of the US Army's Safeguard long-range radar developed originally for ballistic missile defense. EPARCS, located at Grand Forks, N. D., some 1,000 miles south of the Ballistic Missile Early Warning System (BMEWS) sites, was turned over to the Air Force to provide attack assessment information and for satellite tracking support functions. The system, as developed for ballistic missile defense, intrinsically has high capacity and great accuracy but is handicapped because of its location, so far as early warning is concerned. ESD, in concert with Western Electric and Bell Telephone Laboratories, therefore, reorganized the beam-forming characteristics of the radar—in the main through software changes—to focus more of the radiated energy into a smaller area and thereby stretch the range of the system. The effect is that the system's site has been moved "artificially." EPARCS, according to Secretary Brown, "will act as a backup for BMEWS coverage of ICBM attacks against central CONUS until BMEWS improvements are completed." The gains expected from this gap-filler system, he told Congress, include "more timely and accurate impact point prediction for a larger number of RVs." EPARCS's conversion is to be completed early next year.

The BMEWS modernization program is in a tentative state, due to funding problems. So far, the program is confined to replacing the basic computers and upgrading the tactical operations rooms at each site. No decision has been reached on when—or if—improvements of the BMEWS radars will be authorized. Replacing the system's computers is a matter of great urgency because the units involved—IBM 7090 models—date back to the late 1950s. IBM no longer provides spares or maintenance for this obsolete equipment. USAF, in order to maintain BMEWS, has "cannibalized" all the existing units that could be found, and is now faced with the choice of either replacing these computers or shutting down BMEWS operations.

Computer replacement for the BMEWS modernization program is in source selection at this writing. The requirement is for a family of computers that can "grow" sufficiently to accommodate potential upgrades in the BMEWS radars. The existing radars lack both accuracy and capacity since they were designed for the small-size raids postulated in the 1950s, way below the number of warheads available to the Soviets in the 1980s. The need now is for radars with improved resolution so that the system can "see" individual targets within dense clusters, not become saturated, and at the same time make accurate predictions of where the warheads will impact.

ESD's shipborne phased-array radar system (COBRA JUDY), while not a warning system as such, will support missile and space R&D activities. Other aspects of the system's mission

OTH-B experimental radar system, located at two sites in Maine, is undergoing crucial tests.

are classified. Raytheon, the manufacturer of the phased-array radar system, recently completed the program's design and development phase and will install the radar on the USNS *Observation Island*.

ESD's CONUS Over-the-Horizon-Backscatter (OTH-B) radar system, if deployed, will provide long-range surveillance of aircraft and warning of a bomber attack along coastal approaches to North America. Operational feasibility testing of the experimental system is expected to be completed by the end of FY '81. The test system has been installed and checked out at two sites—the transmitter segment at Moscow, Me., and the receiver at Columbia Falls, Me.

OTH-B uses the ionosphere to refract radar waves around the earth's curvature to provide coverage of coastal approaches from 500 to 1,800 miles offshore and at all altitudes down to the earth's surface. Key question to be answered by the OTH-B program is the feasibility of signal propagation in the auroral zone. Program officials are optimistic that OTH-B, looking either east or west, won't prove susceptible to auroral effects, but are concerned about the possibility of either no signal or a masked signal return if the system operates into the auroral zone. Tests should be completed within a year, and the results will then be examined by a Defense Systems Acquisition Review Council (DSARC) meeting. General

Electric is the OTH-B prime contractor.

If cleared for production by DSARC, OTH-B would be installed at one East Coast and one West Coast site. OTH-B is to complement the Distant Early Warning (DEW) Line in the Arctic areas. Funds for SEEK FROST, a program to upgrade or replace the obsolete and only marginally effective DEW Line, were withheld by Congress.

SEEK IGLOO replaces thirteen obsolescent Alaskan Air Command radars with modern, minimally attended, 200-mile-range equipment. The system is expected to save about $30 million annually in operation and maintenance costs over the present arrangement. GE, under a thirty-two-month contract, is building two prototype SEEK IGLOO solid-state radars that will be tested over a nineteen-month period.

SEEK IGLOO will provide replacement radars for the Alaskan portion of the Joint Surveillance System (JSS) that is intended to perform peacetime surveillance for ADTAC, the Alaskan Air Command, and Canadian Forces. The system will replace the aging and uneconomical SAGE network. JSS is to consist of forty-six radar sites in the CONUS, most of them to be operated by the Federal Aviation Administration, in addition to the Alaskan SEEK IGLOO and Canadian radar sites. Information from the system's civilian and military radars feeds into seven ROCCs (Region Operations Control Centers), where data processing, display, and command control functions are carried out. JSS's IOC (initial operational capability) is scheduled for early FY '82. If the North American continent is attacked by air-breathing strategic weapons, the E-3A AWACS will provide survivable and mobile command and control functions for air defense and augmentation fighter aircraft. AWACS regularly performs special airspace surveillance and air sovereignty functions in peacetime, augmenting the Joint Surveillance System.

Cruise missile surveillance is a long-term program formulated by RADC to provide detection, tracking, and identification of advanced tactical and strategic cruise missiles. Employing a combination of detection techniques, this program exploits "target observable" features across the entire electromagnetic spectrum. Necessitated by the fact that low-observable, low-altitude cruise missiles elude currently used surveillance and engagement techniques, the cruise missile surveillance program brings revolutionary sensor concepts to bear, including electronic support measurement (ESM) monitoring, millimeter wave technologies, resonant and near-resonant frequency radars, and radar enhancements through forward scatter techniques. This multispectral multiple sensor approach employs look-down sensor cuing and data fusion to assist in the comprehensive coverage of potential penetration corridors.

ESD's Ground-based Electro-Optical Deep Space Surveillance System (GEODSS), shown here at the experimental test site at the White Sands Missile Range, N. M., is to achieve operational status early next year.

ESD's Ground-based Electro-Optical Deep Space Surveillance System (GEODSS), when fully operational, will permit observation of satellites up to geosynchronous (20,300 nautical miles) altitudes when lighting and weather conditions are favorable. Designed for deployment at five sites to provide full coverage of the so-called "geosynchronous belt," the system has hit a geopolitical snag with two of the originally selected sites—Iran and Morocco—no longer available. For the time being, the program, whose prime contractor is TRW, is confined to three sites in New Mexico, Hawaii, and Korea. The US State Department is working on securing two additional sites in the Eastern Atlantic and the Indian Ocean areas. Allowing for the changeable character of US relations with foreign countries, ESD is exploring the potential for designing the remaining two sites in a "relocatable" manner.

The importance of deploying GEODSS at five sites results from the fact that at any given moment only one site will be operational because of the system's confinement to nighttime viewing and the configuration of the earth's shadow. In order to get full coverage, GEODSS has to move in synchrony with the earth's shadow, which dictates the need for five global sites.

GEODSS can operate in one of two principal modes: It can move at a sidereal, or stellar, speed, and thus detect satellites since they move at a different rate; or it can filter out the stellar background by moving at the rate of a particular satellite whose orbital speed is known from previous sightings.

Construction of the first GEODSS site at the White Sands (N. M.) Missile Test Range got under way this spring. This site is expected to achieve operational status early in 1981. The system consists of a sophisticated telescope and associated electro-optics, a television camera, and a digital computer as well as ancillary electronic and communications equipment.

A follow-on program to GEODSS, TEAL AMBER, is under way at RADC. This DARPA-funded program is exploring the feasibility of combining a CCD (charged-coupled devices) mosaic sensor operating in the visible wavelengths to provide greater sensitivity and higher search rates than GEODSS. A GEODSS follow-on or upgrade using TEAL AMBER technology could be either ground- or space-based, in the view of RADC Com-

mander Col. Donald J. Stukel. Feasibility of these technologies has not been proven as yet, however.

ESD's Pacific Radar Barrier Program involves modification of the US Army's Altair Y-band radar, developed by MIT's Lincoln Laboratory, and located in the Kwajalein atoll, to improve its effectiveness in detecting space launches from the Soviet Union and the People's Republic of China. This system could serve as the primary system for early warning of Soviet ASAT (space interceptor) launches, since it pinpoints launch details before the spacecraft under observation complete their first revolution. The system can also perform specialized, high-altitude surveillance of spacecraft. The Pacific Radar Barrier, as its name implies, was meant to have a number of sites—three initially—but is now confined to only one.

ESD, in concert with AFSC's Space Division, is drafting the C^3 architecture of the NORAD/ADCOM Space Defense Operations Center (SPADOC). SPADOC, according to congressional testimony, will combine in one spot the "surveillance, satellite attack warning, and the command and control functions necessary to support either a response by our satellites, or an ASAT attack of our own." All commands and agencies concerned with space will be linked directly to SPADOC to report the status of their systems and to receive information concerning threats to their spacecraft. ESD's request for proposal (RFP) concerning SPADOC's C^3 portion is to be issued to industry early next year.

Survivable Command and Control Systems

The Advanced Airborne Command Post (AABNCP) E-4B aircraft—at least six but possibly seven systems are to be acquired, depending on the outcome of a pending DSARC—will provide survivable command control and communications for the NCA and CINCSAC. "The program is designed to execute the Single Integrated Operational Plan . . . and direct the operations of our strategic retaliatory forces, even if an enemy attack destroys our fixed, ground-based command centers and communications networks. . . . Communication improvements will allow more direct and reliable communications to Minuteman and Titan wings and the TACAMO aircraft relaying execution messages [of SIOP] to our SSBNs. To assure continued operations during nuclear war, the E-4B is hardened against nuclear effects, including electromagnetic pulse. The increased capacity [compared to the EC-135] of the E-4B supports a larger battle staff and can accommodate automatic data processing equipment in the future, thus improving our capability for survivable management of our strategic forces," according to Defense Secretary Brown.

Three E-4As are now serving in the National Emergency Airborne Command Post (NEACP) role. These interim versions of the E-4—a modified Boeing 747 jetliner—use the command control and communications equipment from decommissioned EC-135 NEACP aircraft. A contract to retrofit the three "A" models to the E-4B configuration will be let shortly. This retrofit is to be completed by FY '85. Involved are such C^3 improvements as a high power (200 kw rather than the "A" model's 20 kw) VLF (very low frequency) transmitter, a communications processor, and SHF and UHF satellite terminals. These systems have antijam features and will support operations in a nuclear environment over extended ranges. The latter trait results in part from the aircraft's VLF antenna system that can reel out a lower wire up to five miles in length and an upper wire up to one mile long.

These improvements, when installed in the full complement of six or seven aircraft, also will permit substantial reduction in the currently used CINCSAC airborne relay and auxiliary aircraft of the EC-135 type. The specifications for the E-4B configuration were formulated following extensive evaluations of a test-bed aircraft. This prototype has been turned over to SAC for operational use. Procurement of two new E-4B aircraft is planned for FY '84 and FY '85, leading to full operational capability for both the CINCSAC and NEACP missions in FY '88. The possibility of accelerating the program to boost survivability of strategic command and control is being weighed by the Defense Department, however.

Nuclear hardness testing of the aircraft was completed recently and, according to ESD's Deputy for Airborne Command Posts, Col. D. J. Hall, in most instances showed greater-than-predicted EMP resistance. Depending on whether or not the program's funding for FY '80—that DoD struck from the

The E-4B Advanced Airborne Command Post (AABNCP) aircraft, a converted 747, provides survivable command and control for the NCA.

recently submitted supplementary budget request—is restored, a contract for development of the E-4B configuration could be awarded either this summer or toward the end of the year. Boeing, teamed with E-Systems, is competing against a Rockwell-Collins team for the contract. Present plans call for the eventual addition of some on-board automatic data processing (ADP) equipment to reduce the E-4B's dependence on "perishable" computer networks on the ground. The ADP equipment probably will not provide the E-4B with a fully autonomous capability but will include a "stand-alone" computer, according to Colonel Hall. The ADP is to be installed on the last E-4A to E-4B retrofit and subsequently will be installed on the first two "B" aircraft.

Concurrent with the acquisition of the E-4B, ESD is modifying the EC-135 aircraft to increase the jam-resistance of their communications systems. Included here is the addition of a 100-kilowatt VLF transmitter and new antennas. Ancillary programs are being formulated to improve strategic command and control capabilities during the transattack and postattack phases of a nuclear war. At this time, these capabilities are so fragile as to be deemed nonexistent.

The AFSATCOM/SSS/ STRATSAT Program

The Air Force Satellite Communications (AFSATCOM) system provides worldwide communications links to the strategic nuclear forces and theater nuclear weapons storage sites. The terrestrial segment consists primarily of terminals on B-52 and FB-111 bombers, EC/RC-135s, KC-10s, E-4Bs, TACAMO aircraft, ground command posts, and ICBM launch control centers. Installation of these terminals is under way, with about 100 terminals now in service.

AFSATCOM's space segment consists of several components. One of them is operational and includes transponders on Fleet Satellite Communications (FLTSATCOM) and Satellite Data System (SDS) spacecraft and other unspecified satellites. The next component will consist of improved SDS satellites and single-channel transponders on DSCS (Defense Satellite Communications System) and possibly Navstar GPS satellites. AFSATCOM achieved IOC in May 1979. The program is managed jointly by AFSC's Space Division and ESD, with the latter responsible for the development, test, and acquisition of airborne and ground terminals. ESD, Brig. Gen. K. H. Bell, Deputy for Command and Information Systems, told this writer, is about to install AFSATCOM's permanent command posts both in the CONUS and Europe. Known as consolidated ground terminals, these systems will take the place of the transportable command posts currently in use.

An intrinsic deficiency of AFSATCOM is the fact that it will lose a substantial portion of its capacity in the mid-1980s when the FLTSATCOM system reaches the end of its design life. Also, there is evidence that AFSATCOM soon will not be able to cope with the projected threat. Hence, there is a compelling need, the Air Force contends, for a follow-up system with superior jam resistance, improved availability, sufficient capacity, communications security, and increased physical survivability to provide for reliable dissemination of Emergency Action Messages and two-way communications among the NCA, the Joint Chiefs of Staff, the Commanders in Chief, and their nuclear-capable forces throughout the world. The Air Force, following DSARC approval, last year requested funds to develop such a follow-on system—the Strategic Satellite System—but Congress balked. Deleting funds for the dedicated Strategic Forces Communications Satellite (STRATSAT), Congress authorized only development of improved Single Channel Transponders on host satellites and their associated terminal subsystems.

SSS/STRATSAT, as conceived by the Air Force, would assure high survivability by placing the system's space elements at high orbital altitude—about 110,000 miles above the earth—and by providing all elements with high resistance to jamming and nuclear effects. Also, the system would eliminate the need for intermediate ground terminals, which are among the most vulnerable elements of strategic communications. SSS would use the EHF (extremely high frequency) range to achieve jam resistance several times better than AFSATCOM's. If congressional approval for SSS is given this year, the system could be fielded in the latter part of 1987. AFSATCOM and SSS are components of the Defense Department's World-Wide Military Command and Control System (WWMCCS).

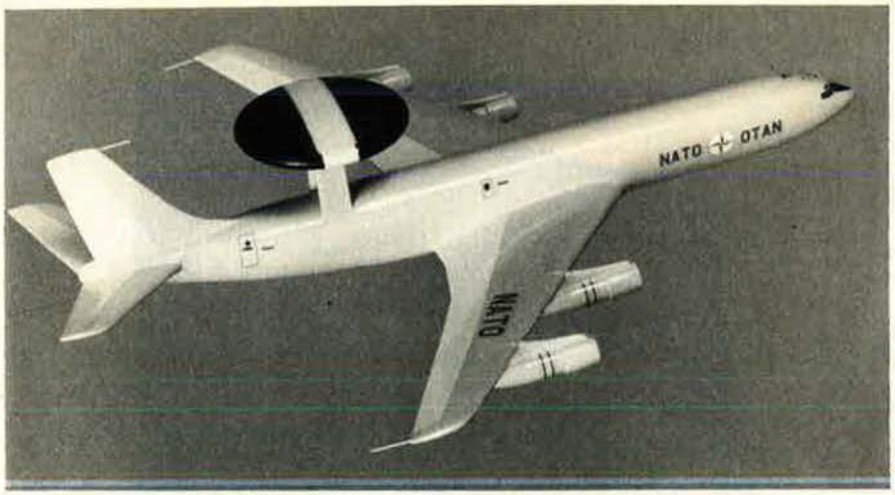
Another component of WWMCCS that ESD is developing is the SAC Digital Network (SACDIN). This communications network conveys two-way, hard-copy, secure command and control information between SAC Headquarters and subordinate SIOP elements, such as SAC missile and bomber/tanker command posts. The research and development phase of the program is to run for fifty-six months, to be followed in mid-1983 by a production decision, assuming a positive Air Force System Acquisition Review Council decision at that time. SACDIN will utilize AUTODIN II, a common-use network, as the primary transmission segment, thus eliminating the need for specialized transmission and switching subsystems.

SACDIN's primary contractor is the Defense Communications Division of ITT. Eventually, the system will link the alternate National Military Command Center at Fort Ritchie, Md., with various SAC command posts and ICBM launch control centers and will be tied in with Minuteman III's Command Data Buffer System that permits rapid retargeting. This segment of SACDIN will be hardened against nuclear effects to the degree necessary to permit operation under attack. The system is designed to diagnose and correct failures automatically and has backup links to AFSATCOM and the E-4B.

ESD's tactical satellite terminal program is a hybrid between strategic and theater communications. An extension of DSCS, these terminals—six of which have been delivered to the Air Force Communications Command—are being acquired through the US Army's Satellite Communications Agency (SATCOMA) and provide significant improvements in communications survivability, according to General Bell. These units—each equipped with its own truck and trailer—are highly mobile. "Within twenty minutes after coming off a C-130, these terminals can be set up and enable the user to talk to anybody in the world over a secure telephone hookup," General Bell told AIR FORCE Magazine. The terminals have been deployed worldwide and involved in important missions, he added. These terminals are not jam resistant. Follow-on designs will use the same spread spectrum techniques as DSCS. The system is used for inter- as well as intratheater communications. It eliminates the need for land lines. More than 100 terminals will be acquired over the next few years, according to General Bell.

The E-3A AWACS (Sentry)

ESD's E-3A AWACS (Sentry) is now operational in the Air Force and performs both North American air defense and contingency missions throughout the world. The Sentry's long-range,



A model of the E-3A AWACS shows how it will appear in its NATO colors. The first NATO AWACS will enter service in February 1982.

look-down radar surveillance and tracking capabilities and on-board computer, combined with unique communications capabilities, boost both intratheater surveillance and command and control. The system, a modified Boeing 707 jetliner equipped with an advanced jam-resistant Westinghouse radar and sophisticated data processing, now consists of a fleet of twenty-one aircraft assigned to the Tactical Air Command. E-3As have been deployed to such places as Korea, Okinawa, Iceland, Italy, Saudi Arabia, Egypt, and other areas in the Middle East. The total USAF buy is thirty-four aircraft, cost of which, including a series of enhancements, is expected to come to about $4.5 billion in then-year dollars. The last US aircraft is to enter service in May 1984, but retrofit of various improvements that are being grafted on as mission demands increase probably won't be completed until the end of this decade. The Sentry's planned lifetime is thirty years.

Development and acquisition of the US E-3As is in phase with the NATO E-3A program, involving a fleet of eighteen aircraft. If ancillary elements are included, cost of the NATO E-3A program will be about $2.3 billion. The NATO version of the system, now in full-scale acquisition, varies from the USAF "basic core" aircraft now in service. The so-called NATO enhancement roughly triples the number of target tracks—the specific number is classified—that the system can handle by installing a higher-speed computer with increased memory capacity. The E-3A Program Office is weighing the cost-effectiveness of retrofitting the more capable computer—the 4 Pi CC-2, to the twenty-four basic core aircraft of the Air Force, according to Col. D. J. Kutyna, ESD's Assistant Deputy for AWACS.

The last nine aircraft to be acquired by the Air Force plus one test article will incorporate the NATO improvements and be known as the US/NATO standard configuration. This version includes a maritime surveillance capability (MSC), that permits the detection of even small ships operating in coastal waters.

The eighteen NATO-owned aircraft are part of the Alliance's Airborne Early Warning and Control Program (AEW&C), which is designed to offset growth of the Warsaw Pact's offensive might through better C³I. AEW&C, in addition to the E-3As, is comprised of eleven British-owned Nimrods

Among the range of E-3A improvements under investigation by ESD is an increase in the number of the situation display consoles, one of which is shown above.

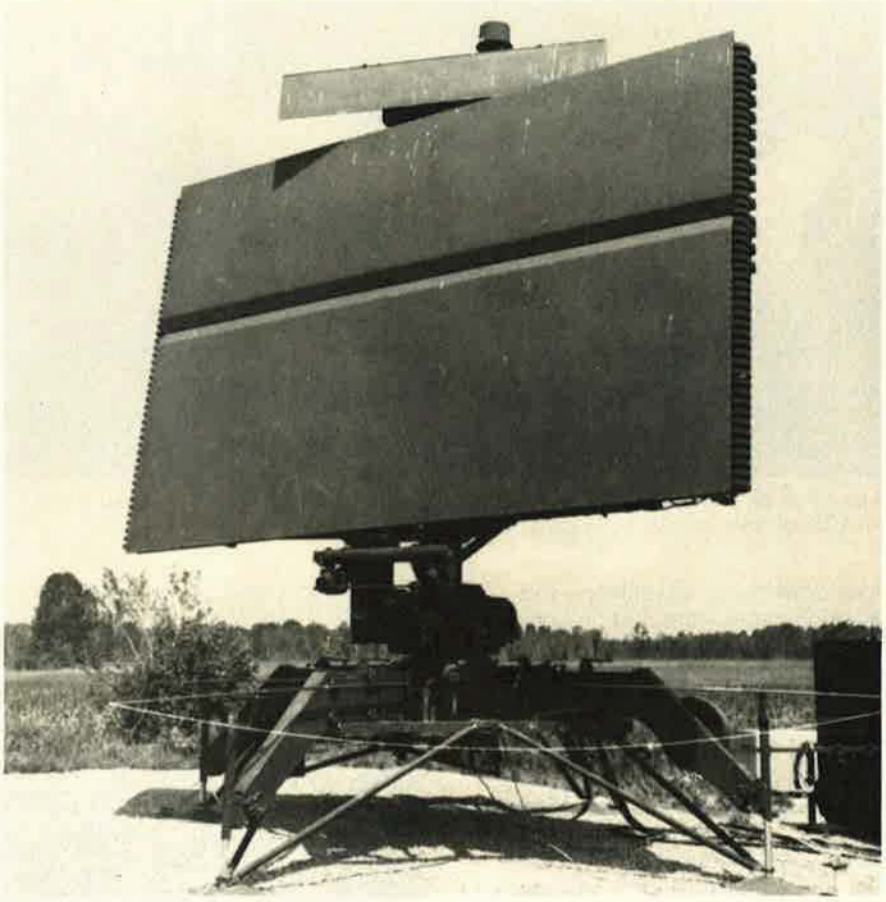
(AWACS-type aircraft), modification of up to fifty-two European ground radar sites to make them compatible with the two types of AWACS aircraft, and related improvements of air base facilities in several countries. The NATO AWACS force will be internationally manned, have a main operational base in the Federal Republic of Germany, and operate, along with the Nimrod force, under the authority of the major NATO commanders.

The "mixed force" of AEW&C aircraft will provide NATO comprehensive all-altitude surveillance, warning, and control. Also, it will make it possible to look deeply into Warsaw Pact territory, eliminate gaps in conventional radar coverage, provide accurate, near real-time information to decision-makers, and sharply reduce the chance of a surprise attack by the Warsaw Pact's conventional forces. The NATO AEW&C forces will use the US-developed Joint Tactical Information Distribution System (JTIDS) to ensure their communications systems against electronic countermeasures of the Warsaw Pact forces.

A range of other E-3A improvements is being investigated by ESD, including "display remoting," meaning a secure TV link to theater ground commanders to give them a real-time situation display of enemy and friendly sea and air forces over a large geographic area. Increasing the number of UHF radios and situation display consoles to enhance the system's flying command post features also is under study.

In order to provide AWACS with protection against advanced ECM threats in the next decade, ESD is studying various ECCM (electronic counter countermeasures) that could be retrofitted after the last aircraft comes off the line. The possibility of adding a voice encoder that digitizes voice for transmission via JTIDS is also under consideration, according to Colonel Kutyna. All USAF aircraft will be equipped with JTIDS terminals. The E-3A design incorporates considerable nuclear hardening, a feature of special importance to the CONUS air defense mission or in case of theater nuclear war in Europe.

Occasionally questions are raised about AWACS self-defense capability, which includes maneuvering at jet speeds, calling in interceptors, or directing friendly SAMs against airborne threats. Probably the mere fact that in the pulse—as opposed to the pulse Doppler—mode, the E-3A's radar can detect aircraft operating at altitude over a distance of up to 350 miles precludes surprise attack by hostile interceptors.



ESD's ultra-low side lobe antenna (ULSA) program uses technological advances developed for the E-3A radar to eliminate stray energy emissions (side lobes), thus reducing the risk of antiradiation missile attacks against ground radars.

ESD has looked at, but as yet not seriously considered, the eventual need for an air-to-air missile, an antiradiation missile, or even a laser weapon. For the time being, however, AWACS's self-defense capabilities are confined to hard-point provisions for a standard countermeasures pod—possibly ECM, chaff, or IR. This was deemed essential because of the uncertain character of future threats.

General Marsh, in looking toward the mid-1990s and beyond, sees the potential for a greatly improved follow-on airborne warning and control aircraft. The follow-on system's phased-array radar, he predicts, will be more powerful and have greater signal-processing capabilities. Its components will be much smaller, reducing overall size "by a factor of ten over those used by the E-3A." Also, by embedding its radar antenna in the aircraft's skin, the E-3A's rotodome, and the attendant aerodynamic drag, can be eliminated. As a result, such an aircraft will be able to fly at higher altitudes—where its radar will be able to "see" farther—and have longer loiter time over the battlefield.

Additionally, "its multifunction, electronically steerable radar beam will have greater agility for improved detection, identification, and tracking, thus further strengthening its ability to cope with the low-level threat of fighters and cruise missiles. And with continuing improvements in signal processing, it probably will be able to track targets on the ground, such as enemy armor."

Tactical C^3

Existing tactical communications systems are marred by a host of critical deficiencies, pivotal among them susceptibility to enemy jamming, delays in passing time-dependent information through a gantlet of communications nodes, and the basic handicap of analog as opposed to digital data transmission.

The Air Force is the lead agency for the JTIDS joint service program—predicted by DoD eventually to reach a $5 billion scope—to develop a highly jam-resistant secure data link that in-

terconnects tactical elements of all US and, later on, allied services. Terming JTIDS a "real breakthrough in terms of solving our communications jamming and channel saturation problem," General Marsh points out that JTIDS makes it possible for "several thousand users" to share a common communications network. Eventually, JTIDS will interconnect large numbers of dispersed, diverse participants, from E-3As to fighters, SAM sites, ships, and ground mobile platforms, including even manpack communications sets. A JTIDS fringe benefit is that the net also provides relative positioning and identification information to participating tactical forces.

JTIDS exploits sophisticated time division multiple access (TDMA) and other even more advanced technologies to create multiservice jam-resistant networks that can handle vast amounts of digital data. As the term implies, TDMA divides time rather than frequency to communicate with individual participants on a noninterference basis. Since it "frequency hops" across a wide spectrum, JTIDS is highly jam-resistant. Each unit of time is divided into a large number of time slots, and a precise synchronization mechanism allocates the slots to individual users for the transmission of short bursts, or encoded pulses, of digital data. The combination of frequency hopping and coding not only leads to jam resistance and security but also makes it possible to create multiple nets within the JTIDS band. When a subscriber is not transmitting, the terminal monitors all transmissions but selects for further processing only those categories of information that interest him.

ESD's JTIDS program director, Col. D. S. Watrous, said that enhanced JTIDS architectures—beyond the current version of TDMA—are being examined for DSARC review next year. This type of improvement, he said, could result in a "better than fourfold increase of the information that can be pushed through the system."

The Defense Department, last spring, committed all services to joint digital language, TADIL "J," a basic data format, for use by all JTIDS subscribers. Three classes of terminals are being developed under the JTIDS program. Class I is for large aircraft such as AWACS, surface ships, and facilities that link JTIDS to ground-based networks. Low-rate initial production of Class I terminals for the E-3A and NATO AEW&C programs will start this summer, with early development models being tested on AWACS aircraft. These units weigh about 330 pounds and are the size of a small refrigerator. Fourteen development units have been delivered.

Class II terminals are designed for small aircraft, large RPVs, and ships with volume constraints. While similar in function to the Class I design, these units are smaller—about two cubic feet—and weigh only about 120 pounds. Full-scale development authorization (DSARC IIA) for these units is expected this summer. The Class II terminals will go on F-14, F-15, F-16, and E-2C aircraft and might be used also by the F-18 and in Army vans for ground tactical missions.

The feasibility of Class III terminals, to be used by some guided theater weapons, forward air controllers, small RPVs, and manpacks, is being reexamined. The Very High Speed Integrated Circuitry (VHSIC) technology needed to get these terminals down to a weight of about ten pounds is not yet in hand. Over the long term, however, General Marsh predicts that "applying VHSIC to this type of JTIDS equipment will let us reduce the weight from eighty pounds to about ten and the size from 1.5 cubic feet to something like a tenth of a cubic foot. VHSIC could cut power requirements from a thousand watts to sixty watts, enable us to talk about mean time between failure in terms of years instead of hours, and cut costs by a factor of fifteen or more."

ASIT, for Adaptable Surface Interface Terminal—which includes a Class I terminal—is undergoing test. Purpose of ASIT is to provide an interface between the E-3A's Class I terminal and existing tactical C^3 systems. Key contractors of the JTIDS program are Hughes, IBM, ITT, and Singer-Kearfott.

Antijam Technologies

Late last year, USAF undertook a four-star level review of its own as well as other services' AJ (antijam) programs with the conclusion that these technologies require top-priority attention.

ESD's HAVE QUICK and SEEK TALK programs perform a complementary role to JTIDS in the AJ field. Both programs—the former a quick fix and the other a long-term solution—will provide an ECCM capability for the Air Force's primary ultra-high frequency (UHF) command and control communications, in the main ARC-164 radios used for air-to-air and air-to-ground operations. Impetus for both programs was the experience of the Yom Kippur War when the Israeli fighters were jammed by Egypt's Russian-made equipment from the moment they started their takeoff roll. ESD has finished the major part of HAVE QUICK's R&D phase and will soon award a production contract. Initial hardware delivery is expected late this year or early next, according to General Bell. Modification of the UHF radios is to be carried out by Air Force personnel. This system is limited to near-term EW threats.

By about 1985, ESD's advanced jam-resistant and secure voice communications system, SEEK TALK, will take over from HAVE QUICK. This spread spectrum, random-noise system will use adaptive array techniques to "null" a number of jammers at once. SEEK TALK will enable fighter and attack aircraft to operate even in the most intense EW environments imaginable. The design emphasizes survivability and economies of scale to permit installation on a large number of combat aircraft. SEEK TALK will provide a jam-resistant conferencing capability, meaning that a wingman can break into the traffic without delay to report such emergency information as SAM sightings. Full-scale development of SEEK TALK recently was moved ahead from FY '82 to FY '81, with a production decision now scheduled for the first quarter of FY '83.

ESD is working with the Army on the latter's Single Channel Ground and Airborne Radio Subsystem (SINCGARS-V) with an eye on replacing or augmenting the Air Force's VHF-FM radios with secure and jam-resistant designs. Total SINCGARS procurement will be almost 200,000 radios and 30,000 ECCM modules. USAF eventually might require between 1,500 and 5,000 SINCGARS radios for its airborne and ground-based forward air controllers.

ESD's SEEK SCREEN program provides improved ECCM for USAF's tactical air-control radars in three specific areas. The ULSA, for ultra-low side lobe antenna, program reduces drastically the vulnerability of ground-based radars to antiradiation missiles (ARMs). Using technologies developed for the AWACS radar, ULSA eliminates radar side lobes (stray energy emissions), thus confining ARM attacks to the main radar beam, which is extremely difficult. Westinghouse, the developer of the AWACS radar, is also developing ULSA. A production decision is expected in the third quarter of FY '82.

SEEK SCREEN's second element is the ARM alarm sensor, which is in fact a small radar that operates on different

frequencies from the ground-control radar to which it is connected by cable. A low-cost, unattended, compact and remotely located device, ARM Alarm detects enemy radar-seeking missiles and either warns the ground-radar operators of impending attack or shuts down the ground radar automatically. The ARM, without a radar beam to home on, is unable to find its target. No contract has been awarded on this program as yet. The Tactical Air Command wants 118 ARM Alarm sensors, beginning in FY '84.

The third element of this ECCM program involves developing decoy radars, meaning the saturation of the battlefield with devices that radiate energy like real radars. The classified techniques underlying these decoys are being developed by RADC.

The PAVE MOVER Program

The RADC/DARPA PAVE MOVER moving target indicator (MTI) radar system provides wide-area surveillance and strike capability. Its application, although mainly in tactical warfare, encompasses also the Strategic Air Command and military space operations, according to Colonel Stukel. The system is designed for low probability of intercept by enemy ELINT sensors, and will provide real-time weapons guidance data and cuing to other sensors. In the tactical arena, it is likely to become part of the TR-1 high-altitude, all-weather surveillance aircraft and of the ground target attack control system (GTACS) proposed by ESD. PAVE MOVER's core technology is an all-weather airborne MTI radar along with associated ground processing and display equipment. A key goal of the program is the detection and tracking of second-echelon targets with enough accuracy to direct strikes by manned aircraft and air-to-surface weapons against them.

PAVE MOVER will be able to perform wide-area surveillance over a 120-degree arc from the radar boresight at long distances, and guide weapons against slow-moving targets within the area under surveillance. Additionally, it will provide data links for radar target information to ground processing centers. The system can operate autonomously or in concert with other navigation grids. Two competing designs are under development by Grumman Aerospace Corp. and Hughes Aircraft Co. First demonstrations of the MTI radar are scheduled for this fall, to be followed early next year with missile and aircraft guidance tests. First weapon system to be used for PAVE MOVER tests is the T-16 standoff missile.

Both in strategic and tactical warfare, the lag between detecting targets and target nomination—often measured in hours—is a major operational impediment. A number of ESD programs focus on this challenge. One of the most promising long-term concepts that is being pursued by RADC is known as direct digital targeting (DDT). Underlying the program is the integration of digital imagery from a range of sensor systems for the purposes of target detection, classification/identification, establishing precise target coordinates, and providing this information to the strike force with a target location accuracy of fifty feet. The entire process is to be accomplished in five minutes or less. Ancillary technologies to be used by the DDT program include automatic target and camouflage detection through advanced techniques of pattern analysis and recognition, and high-speed digital image processing.

Related programs include the Computer Assisted Force Management System that according to General Marsh will "dramatically" speed up the preparation and dissemination of the Air Task Order, colloquially known as the "frag." The payoff is a "significant improvement in the flexibility of our tactical airpower to respond to rapidly changing battlefield conditions [that] frees the commander and his staff for other force management duties," he predicted.

Among the range of systems that can provide "strike-type" accuracies to fused command and control systems is BETA, for Battlefield Exploitation and Target Acquisition, a program carried out jointly by the Army, Navy, USAF, and DARPA. The program, scheduled for joint service demonstration in Europe later this year, is to prove the feasibility and value of automated centers for fusion of multisensor information. Confined to evaluation of a test-bed center, BETA streamlines the process of locating and identifying ground targets and of disseminating and depicting targeting and battlefield situation data.

BETA, according to General Marsh, will evolve into a mobile multisource correlation facility, the progenitor of future, even more versatile tactical fusion divisions. One phase of fusion, or correlating and synthesizing information from different sensors, could involve taking the data from an electronic sensor and a side-looking radar (SLR) and comparing them while capitalizing on the best features of each. For example, one type of sensor might be very reliable and precise in locating targets while another type is better in identifying targets, the ESD Commander suggests. Tied into the tactical fusion division of tomorrow will be decision aids, not to replace the commander in the decision-making process but to "log, compile, and correlate sensor information, subtract bombs when they are dropped and fuel when it's consumed, and to maintain the target list and keep track of sorties available," General Marsh believes.

Other prospective tasks for decision aids might range from automating munitions effectiveness manuals, to penetration aid analyses and war gaming. "If the commander chooses, he might also use the machine to compute the implications of specific options. He could use the machine to play his decision in fast time, and in five minutes see the next twelve hours of war as he is about to direct it. The commander would still be directing the battle, but the machine would give him another tool—a more complete one than he's ever had—to complement his own assessment of the situation."

Toward the end of this decade, the ESD Commander predicted, a prototype of such an automated decision aid system should be ready for realistic testing: "Included would be two visual displays. One would display intelligence and sensor data about possible targets, and the status of hostile and friendly forces. With automated processing, this screen will portray the changing battle situation in real time. On the second screen, the commander will be able to call up options and play them against the current battle situation. The data base will contain the collective knowledge of tactical experts and the courses of actions they would recommend in a given set of circumstances. The computer will make these options available in real time, responding for a given situation and suggesting optimal courses of action for the user to select or modify."

Eventually, perhaps by the turn of the century, battlefield commanders will be able to communicate with computers in conversational language. As a result, General Marsh predicts, commanders will gain a comprehensive portrayal of the battle situation by "talking" to the computer to obtain, in real time, an estimate of the consequences of specific responses to changing threats.

Realization of these lofty goals clearly would usher in a golden age of C^3I. ■

What's Happening in Electronics at ESD

A CHECKLIST OF MAJOR ELECTRONICS PROJECTS

YSTEM NO.	NAME AND MISSION	STATUS	CONTRACTOR
404L	**Traffic Control and Landing System (TRACALS)** TRACALS encompasses fixed and mobile ground facilities, with associated avionics, to support the USAF air traffic control function. Major systems being acquired include navigation aids, radar approach control equipment, landing systems, and simulators.	Continuing Development and Acquisition	Many
411L	**E-3A Airborne Warning and Control System (AWACS)** This system provides survivable airborne air surveillance capability and command control and communications functions. Its distinguishing technical feature is the capability to detect and track aircraft operating at high and low altitudes over both land and water. Used by the Tactical Air Command with Tinker AFB, Okla., as the main operating base, aircraft may deploy throughout the United States and overseas to provide surveillance, warning, and control in a variety of peacetime and wartime situations.	Acquisition and Operational	Boeing Aerospace Co. (Westinghouse is radar subcontractor to Boeing; Redifon for simulator)
	NATO E-3A Used by NATO forces, operating from European bases, aircraft may deploy throughout Europe to provide surveillance, warning, and control in a variety of missions during peacetime and in periods of increased tension.	Development and Acquisition	Boeing (prime). Many US and foreign contractors under industrial collaboration program
414L	**CONUS Over-the-Horizon Backscatter Radar** The program provides long-range detection of aircraft approaching North America as part of the NORAD air surveillance and warning capability. Distinguishing technical feature of OTH-B is its ability to detect targets at all altitudes and at extended ranges. The present program is to build and test a prototype radar.	Development/Validation	General Electric
427M	**NORAD Cheyenne Mountain Complex Improvements** Involves acquisition of data-processing equipment, software, displays, and communications for the NORAD Cheyenne Mountain complex. The core processing segment, modular display segment, and the communications system segment will provide NORAD with an integrated, responsive capability and a growth potential over a projected ten-year life span without major changes to equipment or software.	Operational	Ford Aerospace and Communication Corp.
428A	**Tactical Information Processing and Interpretation System (TIPI)** The USAF TIPI/USMC MAGIS (Marine Air General Intelligence System)/USA MAGIIC (Mobile Army Ground Imagery Interpretation Center) will provide more timely and accurate intelligence to tactical commanders at various echelons. Air transportable and housed in mobile shelters, segments of the system use automated aids for rapid processing, interpretation, and reporting of intelligence from airborne electronic reconnaissance, separately deployable photographic, and radar sensors.	Development, Acquisition, and Deployment	Many
450A	**Tactical LORAN Digital Avionics Systems** Development and acquisition of the AN/ARN-101(V) Navigation, Weapons Delivery, and Reconnaissance System for the RF-4C and F-4E aircraft. This digital modular avionics system combines LORAN/Inertial information and integrates radar, optical, infrared, and laser sensors to satisfy requirements for precision weapons delivery during the 1979–88 time frame.	Development and Acquisition	Sperry Gyroscope, Lear Siegler
451D	**Spanish Systems (COMBAT GRANDE)** Assistance to Spanish Air Force in maintaining and operating air defense system. Provides modifications and improvements to the network including weapon and command and control improvements, increased radar coverage, and augmentation and upgrade of communication links.	Acquisition	COMCO (Hughes Aircraft and CECSA); General Dynamics
478T	**Combat Theater Communications** A program to acquire new hybrid analog/digital and digital communications equipment both for Air Force unique tactical requirements and for the DoD Joint Tactical Communications (TRI-TAC) Program. Within TRI-TAC, the Combat Theater Communications Office carries out the development, test, and production of equipment assigned as Air Force responsibility and ensures that USAF requirements are met by all of the equipment procured through this joint service program. Also responsible for the interoperability of TRI-TAC equipment with other communications equipment within the tactical Air Force environment.	Definition, R&D, and Acquisition	Martin Marietta, ECI, Raytheon
481B	**E-4 Airborne Command Post** Provides the National Command Authorities and the Strategic Air Command (SAC) with a survivable airborne command and control system that will operate during the pre-, trans-, and postattack phases of a nuclear war. As a survivable emergency extension of the National Military Command System (NMCS) and SAC ground command and control centers, the E-4 Airborne Command Post provides high confidence in US ability to execute and control Single Integrated Operational Plan (SIOP) forces in a nuclear environment.	Development, Production/Deployment	Boeing Aerospace, E-Systems for first phases; second phase in source selection. First phase included transfer of equipment from EC-135s to E-4A and development of one E-4B. Second phase will be conversion of all to E-4B version
485L	**Tactical Air Control System Improvements (TACSI)** This program will give the Tactical Air Control System (TACS) increased operational capabilities needed for combat command and control of tactical aerospace operations. Improvements consist of mobile communications and electronic systems capable of modular worldwide deployment and interoperable with Army, Navy, and Marine Corps tactical data systems. Current projects include ECCM improvements to the AN/TPS-43E Tactical Radar, the AN/TPN-28 Dual Band Radar Bombing Beacon, a weapons controller training system, and the improved Forward Air Control Post.	Definition, Engineering Development, Production	Goodyear, Applied Devices Corp., GTE Sylvania
516A	**Air Force Support of MEECN** Upgrades the Air Force and Army Survivable Low Frequency Communications Systems (SLFCS) as part of the Minimum Essential Emergency Communications Network (MEECN). Major developments include airborne LF/VLF transmitters, new receive antennas for transverse electric mode reception, incorporation of the Navy MEECN Message Processing Mode (MMPM), and mini-LF/VLF receive terminals for bomber aircraft. This program is designed to meet the requirements of the Joint Chiefs of Staff, CINCSAC, and Theater CINCs.	Definition, Development, Production/ Deployment	Westinghouse
633B	**COBRA JUDY** Acquisition and deployment of a shipborne phased-array radar supporting missile and space research and development activities.	Acquisition	Raytheon

SYSTEM NO.	NAME AND MISSION	STATUS	CONTRACTOR
681E/ 1823	**DoD Base and Installation Security System (BISS)** An evolutionary RDT&E program to provide a DoD standard electronic security system for exterior physical security of DoD resources worldwide. This system's major components include sensor, imaging, entry control, and command and control equipments. The system concept emphasizes maximum commonality of major items and a variety of supporting subsystems. It offers a flexible choice of equipments to assemble a system tailored to the unique physical characteristics of the location and the threat.	Advanced Development/ Engineering Development	Many
968H	**Joint Surveillance System (JSS)** The JSS program is to acquire and deploy a peacetime air surveillance and control system to replace the Semi-Automatic Ground Environment (SAGE) system for the US and Canada. For Canada, the mission is expanded to include support of wartime air defense functions, and in Alaska the mission includes the performance of tactical air control functions.	Implementation	Hughes Aircraft
1136	**SAC Digital Network (SACDIN)** A program for a secure record data communications system to support the command and control requirements of the Strategic Air Command. It will replace parts of the SAC Automated Command and Control System (SACCS).	Development	ITT, IBM, ECI
1144	**Automated Technical Control (ATEC)** A Defense Communications Agency program that will provide computer-assisted performance assessment, fault isolation, and reporting on circuits, equipments, networks, and links of the Defense Communications System (DCS). It is part of the Technical Control Improvement Program to enhance technical control, increase reliability, and maximize performance of the DCS.	Acquisition and Production	Ford Aerospace a Communications ((prime). Digital Eq ment Corp. (sub fo computer equipme
1205	**Air Force Satellite Communications System (AFSATCOM)** A program for acquisition of UHF airborne/ground force terminals, airborne/ground command post terminals, ancillary equipment for operational control and communications transponders on selected Air Force satellites. The associated family of modular UHF transceivers will provide a command communications capability in the line-of-sight mode. The full-grown family of modular UHF radios will result in a common base to provide the transceiver for the satellite SIOP and force communications terminals.	Development/ Acquisition/Deployment	Rockwell, Linkabit Corp.
2059	**PAVE PAWS** Two dual-faced phased-array radars, one at Otis AFB, Mass., and one at Beale AFB, Calif. This system is being operated by SAC and will provide warning to the National Command Authority of a sea-launched ballistic missile attack against the Continental United States.	Operational	Raytheon
2121	**SEEK SKYHOOK** The SEEK SKYHOOK program has been established to acquire and deploy an aerostat (aerodynamically shaped balloon) borne radar system to provide surveillance and control over the southeastern approaches to the US and the Florida Straits.	Deployment	RCA Services Co.
2206	**Digital European Backbone (DEB)** Incremental upgrade of portions of the European Defense Communications System (DCS) from a frequency division multiplex (FDM) analog system to a time division multiplex (TDM) digital system with higher reliability components. This will provide a modern wide-band, digital, bulk encrypted capability with increased capacity between Defense Satellite Communications System Earth Terminals and major commands.	Acquisition and Deployment	Many
2283	**Joint Tactical Information Distribution System (JTIDS)** A program to develop a high-capacity, reliable, jam-protected, secure digital information distribution system that will provide an unprecedented degree of interoperability between data collection elements, combat elements, and command and control centers within a military theater of operations.	Engineering Development	Hughes, ITT, IBM, Singer-Kearfott, McDonnell Douglas
2294/ 2467/ 2486	**Pacific Radar Barrier (PACBAR)** The PACBAR system will provide space surveillance coverage and early detection of new space launches in the Central and Western Pacific areas by placing improved radars at three sites.	Development and Acquisition	GTE Sylvania (Army contract)
2295	**Ground Electro-Optical Deep Space Surveillance System (GEODSS)** The GEODSS system will extend the Aerospace Defense Command's spacetrack capabilities for detecting and cataloging space objects out to the 3,000–20,000 nautical mile range. This will be a global network of five sites to optically detect, track, and identify satellites in earth orbit.	Acquisition	TRW
2394	**Operational Application of Special Intelligence Systems (OASIS)** Improvement of tactical command control and communications capabilities through the application and interfacing of appropriate surveillance and special intelligence systems. Presently, improvements to the USAFE Tactical Fusion Center (TFC) in its support of Allied Air Forces Central Europe are being addressed. Although the OASIS program will initially concentrate on needs of the TFC, the program will, as required, develop operational applications of special intelligence systems for other commands.	Development and Acquisition	Martin Marietta
2433	**SEEK IGLOO** Upgrading or replacing all thirteen USAF long-range sites in Alaska on a Minimally Attended Radar concept with maintenance by no more than three medium-skill radar technicians and no on-site radar operators. A major objective is a large-scale reduction in the life-cycle cost of Alaskan radar surveillance systems.	Development	General Electric
2983	**BMEWS Modernization** The purpose of the BMEWS Modernization Program is to upgrade the three operational sites (Greenland, Alaska, England) operated by SAC and the Royal Air Force. The eight Tactical Operations Room consoles at each site are being replaced by four modern consoles that will improve operating efficiency and reduce personnel requirements. The Missile Impact Predictor (MIP) is being upgraded by replacing the aging computers now in use with off-the-shelf computers and translating software assembly language into a higher order language. Radar improvements are planned that will meet the 1980s' threat and give the system an attack assessment capability to meet the need of the National Command Authorities.	Acquisition	RCA (prime for Tact Operations Room u date); Kappa Syste sub to RCA for software. MIP in so selection
	Air Force SAFE Program Acquisition and deployment of commercially available and DoD BISS Program-developed physical security equipment to approximately sixty USAF bases and 130 sites worldwide. These systems will protect mission critical/high-value resources such as weapons storage sites, strategic/tactical alert aircraft areas, special mission aircraft parking ramps, and specified command posts.	Acquisition and Deployment	Many
	Air Force World-Wide Military Command and Control System (AFWWMCCS) Involves systems planning and engineering for Air Force elements of the World-Wide Military Command and Control System. Activities will focus on intersystem engineering of selected AFWWMCCS existing and planned assets.	Conceptual, Validation, and Development	None

SYSTEM NO.	NAME AND MISSION	STATUS	CONTRACTOR
	Improved Administrative Capability Test (IMPACT) Design, implementation, test, and evaluation of a prototype automated office system for Air Force Systems Command. Primary objective is to ensure the introduction of modern office technology to management and support functions for the purpose of increasing office efficiency while reducing manpower requirements and operating costs.	Prototype Demonstration	Booz, Allen, and Hamilton
	SEEK SCORE To develop and produce a radar bomb scoring system for SAC for training and evaluation of aircrews in a realistic operational environment.	Development	None
	Enhanced Perimeter Acquisition Radar Characterization System (EPARCS) The EPARCS program consists of hardware and software modification to the present PARCS system. It will include range extension of the radars, and increasing the accuracy and improvement of the traffic-handling capability in support of the launch-under-attack mission.	Acquisition	Bell Telephone Laboratories
	SEEK TALK A long-term solution to reduce the vulnerability of tactical UHF radios to enemy jamming. The objective of the SEEK TALK Program is to develop and acquire equipment for a Class V Modification program that will provide the tactical air forces (TAF) the capability to conduct air-to-air and ground-to-air-to-ground UHF voice communications in a jamming environment. The SEEK TALK capability will be attained by modifying the existing UHF voice radios, and adding a spread spectrum (SS) modem and null steering antenna array.	Development	General Electric, Hazeltine
	HAVE QUICK A program to provide a capability to reduce the vulnerability of tactical UHF radios to enemy jamming. HAVE QUICK provides the tactical air forces (TAF) an improved near-term air-to-air and air-to-ground plus air jam resistant UHF voice communications capability that will allow TAF mission accomplishment in an enemy jamming environment through 1985. The HAVE QUICK capability will be added to the present AN/ARC-164, AN/ARC-171, and AN/GRC-171 UHF radio systems.	Development and Production	Magnavox
	SPADOC SPADOC, which will be located in the NCMC, is the central Command Control Communications and Intelligence (C^3I) element of the Space Defense Command and Control System (SPADCCS). It will consist of new ADPE, displays, interface equipment, and communications upgrades. It will act as the focal point for higher echelon command and control and disseminate space related information to other US commands.	Development	RFP in preparation for mid-year release
	Space Communications Architecture To develop and annually update a time-phased plan for satisfying a critical subset of Air Force command and control information flow requirements via satellite relays. Provides basis for formulating appropriate portions of the Air Force budget submission and the Five-Year Development Plan. Analyzes current capabilities and deficiencies, projected requirements, and enemy threat; structures needed development and acquisition programs.	Continuing	None
	C^3I Interoperability Involves a process that emphasizes user/developer interaction in defining interoperability requirements for systems being developed by ESD. The Interoperability Requirements process includes a study of trade-offs between technical, operational, and procedural requirements and options so that C^3I systems will interoperate where required.	Continuing	None
	AF SINCGARS Air Force portion of the US Army Single Channel Ground and Airborne Radio System for VHF/FM communications. The purpose of the Air Force program is to provide jam resistant, secure VHF/FM communications between Air Force elements and the US Army ground forces.	Development	None
	Ground Target Attack Control System (GTACS)/Assault Breaker GTACS is a program to design and develop a near real-time capability to detect and destroy hostile second-echelon ground forces by direct attack or through remote/standoff guided munitions. Assault Breaker is a series of technology demonstrations designed to illustrate the technical feasibility of accomplishing real-time detection and attack of second echelon forces. ESD's responsibility includes coordinating and conducting the Assault Breaker demonstrations and preparing for full-scale engineering development.	Concept, Development/ Demonstration or Validation	None
	Vanguard A comprehensive planning process that measures capabilities against mission responsibilities, identifies deficiencies, and proposes solutions within each Air Force mission area. ESD is responsible for the strategic, tactical, and support C^3 plans, the ballistic missile and atmosphere surveillance and warning plans, the electronic counter-countermeasures (ECCM), command control and communications countermeasures, and correlation/fusion plans.	Continuing	None
	Command and Control Countermeasures A program designed to degrade an adversary's capability to effectively engage in combat. This would be accomplished by electromagnetic means (jamming, deception, or exploitation) or physical destruction, to inhibit use of the adversary's command control and communications for managing his combat forces.	Development	None
	ARIA Phased Array Telemetry System (APATS) A phased array telemetry system for installation on the ARIA aircraft in support of the MX and Trident test program.	Development	None
	Automated Weather Distribution System (AWDS) AWDS will enhance Air Weather Service's meteorological support for the Army and Air Force. The system will reduce labor-intensive tasks by using advanced computer technology, color graphic displays, and sophisticated meteorological and graphic presentation software. Automation of 163 base weather stations worldwide, and twenty tactical versions will interface with two communication networks for distribution of global alphanumeric and graphic meteorological data.	Development	None
	Command Management Information System/Graphics (CMIS/Graphics) Design implementation and test of an automated graphics and telebriefing system for each of the product division elements of AFSC. Includes local graphic stations within system program offices and selected functional elements; centralized photocomposition, typesetting, and graphics processing and large screen display with interbase voice and graphics connections.	Prototype, Acquisition	Booz, Allen, and Hamilton
	Competitive Acquisition for the Scientific Environment (CASE) Acquisition of computer replacements for all AFSC data processing installations. The program includes systems engineering to address inter- and intra-AFSC data-processing installations requirements and a fifteen-year program of replacement and upgrade of existing equipments.	Acquisition	Booz, Allen, and Hamilton

Computers in Manufacturing: Meeting the Productivity Challenge

For the past decade, growth in US productivity, including that of the defense industry, has trailed other major industrial nations. Our future options will depend on what we do now to regain the traditional US lead in productivity growth.

BY GEN. ALTON D. SLAY, USAF
COMMANDER, AIR FORCE SYSTEMS COMMAND

ELECTRONICS and digital computers are key effectiveness multipliers in defense systems. Never was this more true than in the weapon systems we are developing in the Air Force Systems Command (AFSC). We are embedding the products of the electronic technology "explosion" in virtually every satellite, aircraft, armament, and ground system we build. AFSC has harnessed the power of this technology explosion to satisfy real mission needs, and I'm proud of that. Electronics has become a vital factor in the equations of national power, and we must maintain and extend whatever technological edge we have over our potential adversaries.

"Buck Rogers" weapon system designs, however, can't win a war alone—especially when it takes too long, and costs too much, to get the equipment off the drawing boards and into the field. We must deploy effective, reliable weapons on time and in sufficient quantity. To do this, the United States must have a strong, flexible, and productive industrial base. Our future strategic options will depend on what we do now to ensure the vitality of the industrial arsenal—the foundation of our military capability. The touchstone for that healthy defense industry is productivity.

The Productivity Challenge

For the last decade, the United States's aggregate productivity growth has trailed that of the rest of the modern industrial world (Figure 1). Nations with the highest ratio of investment to Gross National Product have enjoyed the highest rate of productivity growth, and the United States is the last of the major industrial nations in this respect.

American industry no longer holds an unchallenged lead in technological innovation. Recent symposia in Europe indicate that foreign aerospace firms have computer-aided design tools that surpass our own. The Japanese have been the most innovative in using automatic manufacturing techniques—robots—in all types of production ranging from the assembly of microelectronic components to the operation of steel mills. Numbers paint a picture even more stark. Of the approximately 35,000 industrial robots installed in the world, the United States has about 2,000, Western Europe has 3,000, and Japan has 30,000.

During the years 1960–76, the Japanese were able to increase their manufacturing productivity by 8.5 percent per year, while the comparable annual rate of US productivity growth was 2.6 percent. In 1978, our national manufacturing productivity grew by only 0.6 percent. At current productivity growth rates, four foreign nations are expected to overtake us in production per employee between 1985 and 1990: Canada, France, the German Federal Republic, and Japan. This is the kind of competition that American manufacturing will face in the 1980s.

If immediate action is not taken to reverse our declining productivity growth rate, the US may become a second-rate industrial power. Any such weakening of our industrial base will soon affect our defense posture. Already, growing material, energy, direct labor, and overhead costs threaten the ability of the Air Force to develop and deploy the successive generations of qualitatively superior systems we need to fulfill our mission. The seriousness of the situation is indicated by the lead times for vital aerospace items. Delivery dates for landing gear, forgings, high-reliability microcircuits, connectors, bearings, and fasteners can vary from thirty weeks to more than two years.

American defense contractors are operating at the very edge of their production possibility frontiers. What little capacity we have for surge production operates beyond the point of diminishing marginal returns, as the military services compete among themselves, and with commercial buyers, to squeeze the last bit of output from an already straining system. The problem is compounded by the recent tendency to buy increasingly smaller quantities of very complex systems. This not only costs more, but it extends development and delivery time, delays production decisions, and postpones the initial fielding of combat-ready systems.

The Air Force has a major stake in improving the productivity of our industrial base; AFSC has been entrusted with $17.4 billion in Fiscal Year 1980 for research and development, goods and services. Since studies have shown that technology and capital investment together account for about eighty percent of the rate of productivity growth, AFSC is concentrating on an integrated approach to computer-aided manufacturing, and on contracting initiatives to encourage capital formation and reward excellence in contract performance.

USAF's Historic Role in Computer-Aided Manufacturing

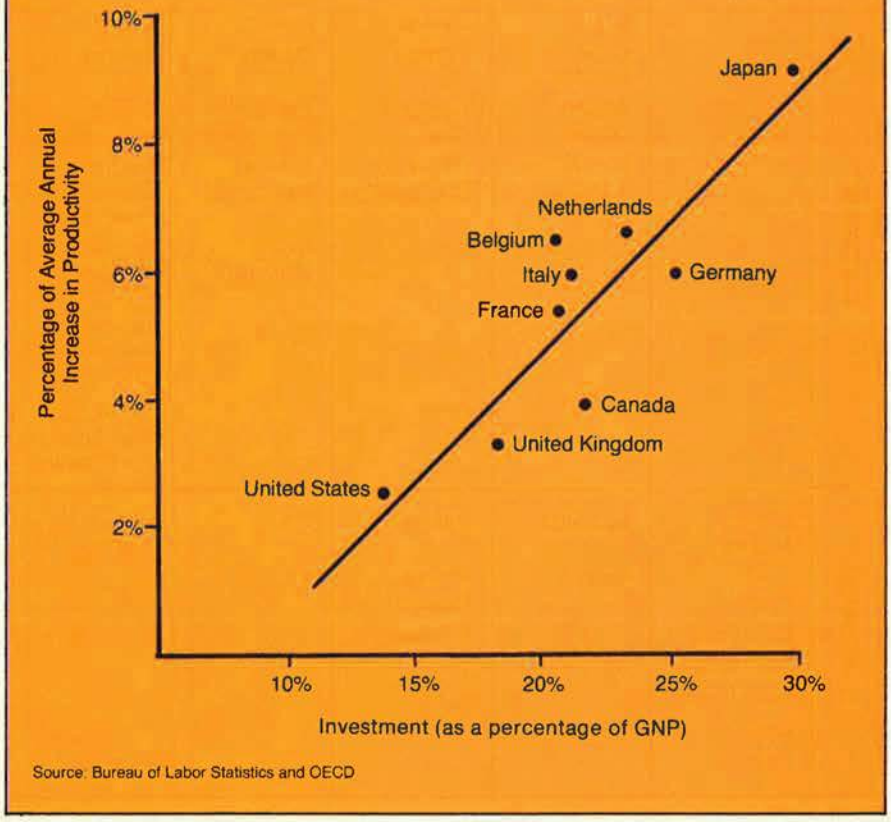
Tackling the entire job of computer-aided manufacturing is too much to ask of any single firm; the government has historically "primed the pump" in research, development, and manufacturing technology. The Air Force has

been the catalyst for advances in both computer-aided design (CAD) and computer-aided manufacturing (CAM). In the early 1950s, the Air Force funded the pioneering work in numerically controlled machine tools at Massachusetts Institute of Technology. In the 1960s, the Air Force sponsored the development of the Automatically Programmed Tools (APT) language that has become the standard language for programming numerically controlled machine tools. Air Force funding supported the start of interactive computer graphics and computer-aided drafting through the Sketchpad project at MIT. To ensure that each Air Force-sponsored thrust was then made widely available, the Air Force also arranged for additional support from machine tool manufacturers, control systems builders, and industry associations.

Our early investments in CAD/CAM are showing a real return on investment, for contractors and for individual taxpayers, as well. The results of early Air Force contributions paid off handsomely when the McDonnell Douglas Corp.'s Computer-Aided Design Drafting system went on line a decade ago to help design the F-15 Eagle. The Air Force Manufacturing Technology (MANTECH) Program has contributed further in reducing cost and enhancing productivity through such sophisticated manufacturing techniques as laser welding, superplastic forming, and diffusion bonding.

Gen. Alton D. Slay, Commander, signs AFSC's first major multiyear procurement action. Witnessing the signing at Hq. AFSC are Edward Elko (left), president, Aerojet Ordnance Co., and Dr. Matthew A. Sutton, vice president and general manager of Honeywell's Defense Systems Division.

Figure 1: Productivity Growth in the Modern Industrial World



Source: Bureau of Labor Statistics and OECD

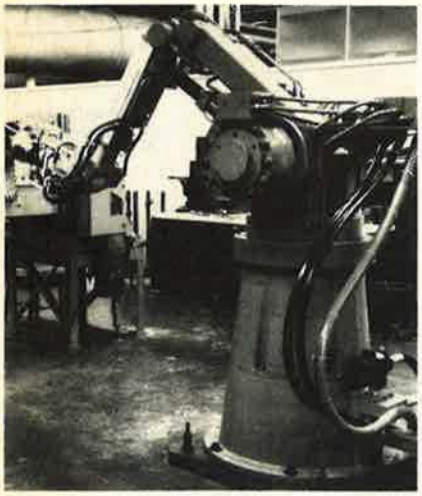
The chart shows how the nations with the highest ratios of investment to GNP had the highest rates of productivity growth for manufacturing during the period 1960–76.

While Air Force programs have been major contributors to CAD/CAM, we have not worked alone. NASA's structural analysis program, NASTRAN, has become a standard design tool for airframe manufacturers, and NASA has established an organization concerned with Integrated Programs for Aerospace Vehicle Design (IPAD). The National Science Foundation is funding grants to build a pilot production line for small motors, using robots with "vision."

These breakthroughs are encouraging, but robots and laser welding alone are not enough. Such innovations are point solutions to separate segments of the design/manufacturing process. If we are to maximize the benefit of the new technologies we must synthesize the best of our electronic, mechanical, and computational developments in a total system sense. At the heart of the productivity gains we can achieve in the coming decade must be an entirely new way of thinking about the production process.

ICAM—Integrated Computer-Aided Manufacturing

At Wright-Patterson AFB, Ohio, AFSC's Materials Laboratory manages the Integrated Computer-Aided Manufacturing (ICAM) Program as a significant portion of the Air Force MANTECH



Cincinnati Milacron's T-3 robot, now in use at General Dynamics/Fort Worth Div. as a sheet metal work station for the F-16 production line, is only a forerunner of the manufacturing systems being developed by AFSC's ICAM program.

Program. ICAM supports all areas of CAD/CAM technology, concentrating on the integration of that technology in a comprehensive automated factory system. ICAM's goal is to provide the seed money and technology for the factory of the future—an optimum blend of materials, machinery, people, and information, interacting through a distributed network of computers. ICAM will exploit all the breakthroughs I have mentioned, but our greatest payoff will come from the new way of managing the design/production process that will surely evolve as managers and engineers begin to share common data bases in real time.

To ensure this, ICAM seeks to instrument our equipment and design the factory so that information flows naturally and automatically. If we can design a "friendly" decision support system that works for us and doesn't require much care and feeding, people will use it and benefit from it. Production relationships that were previously unseen, and others that were known but could not be exploited, will become apparent. ICAM's factory of the future will yield economies in work flow, stock level control, job order control, and status reporting.

There is no magic way to improve productivity overnight, however; ICAM is a long-term program. We are funding ICAM with $100 million through Fiscal Year 1984, with $15.4 million for the current fiscal year, to establish and integrate modular factory subsystems.

I am particularly pleased with the management discipline of the ICAM program, which is based on a new architecture for manufacturing. Using a special user-oriented integrated system definition language called IDEF, ICAM managers have developed an evolutionary hierarchy of factory composition. The manufacturing process has been decomposed, top-down, into levels called: Factory, Center, Cell, Station, Process (Figure 2). Using IDEF, simple nested diagrams of three to six boxes can be used to express various phases of the production process. The IDEF language itself is automated, so that an industrial engineer can manipulate his factory architecture at a computer display terminal and communicate with other designers over a commercial computer network.

The interactive involvement possible through this automated IDEF system should improve our understanding of the manufacturing process and is expected to greatly enhance our ability to adjust production set-ups and respond to surge requirements. (A typical diagram using the automated IDEF method is shown in Figure 3, p. 59.) At appropriate times during the ICAM program, the actual factory equipment—hardware, software, robots—will be combined, demonstrating progressively greater levels of system integration in a comprehensive system that is capable of adjustment as production needs and the state of the art change.

The ICAM work is going well. An example of this progress is the T-3 robot project, in which engineers at General Dynamics Fort Worth Division set out to enhance off-the-shelf robotic technology to develop a work station—the factory subsystem level at which a number of processes are controlled. Using an industrial robot built by Cincinnati Milacron, the General Dynamics engineers adapted the computer controls to permit the storage of a variety of more sophisticated programs. This enabled the robot to conduct several processes, such as drilling and routing, at the same work station. The T-3 robot shown on this page, equipped with a 5,000-pound arm,

Figure 2: Manufacturing Stages

	PROCESS	STATION	CELL	CENTER	FACTORY
SOFTWARE		APT Cutter Selection Adaptive Control Maintenance & Diagnostics	Stations Software Material Flow Off-line Programming	Cells Software Mfg. Control Material Management Time Standards	Center Software Simulation Generative Process Planning General Modeling System Capacity Resource Allocation Energy Mgmt. Attendance & Job Reporting
HARDWARE	Milling Machine Tube Bender Brake Press Tape Layer Hydro Press Lathe Drill	NC Router Robot	Stations Material Handlers Warehouse	Cells	Centers

As ICAM technologies evolve, increasingly complex stages of manufacturing must be integrated. Each system level builds on lower-stage modules to build modern production "wedges."

Air Force Power

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CF6-50-POWERED KC-10A ADVANCED TANKER/CARGO AIRCRAFT

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Two other advanced aircraft are powered by thoroughly proven CF6-50 engines. For the McDonnell Douglas KC-10A Advanced Tanker/Cargo Aircraft, they help provide excellent mission range and payload capabilities. And for Boeing's E-4 Advanced Airborne Command Post, CF6-50 engines offer the reliability and low fuel consumption necessary to meet varied and complex mission objectives.

GENERAL ELECTRIC

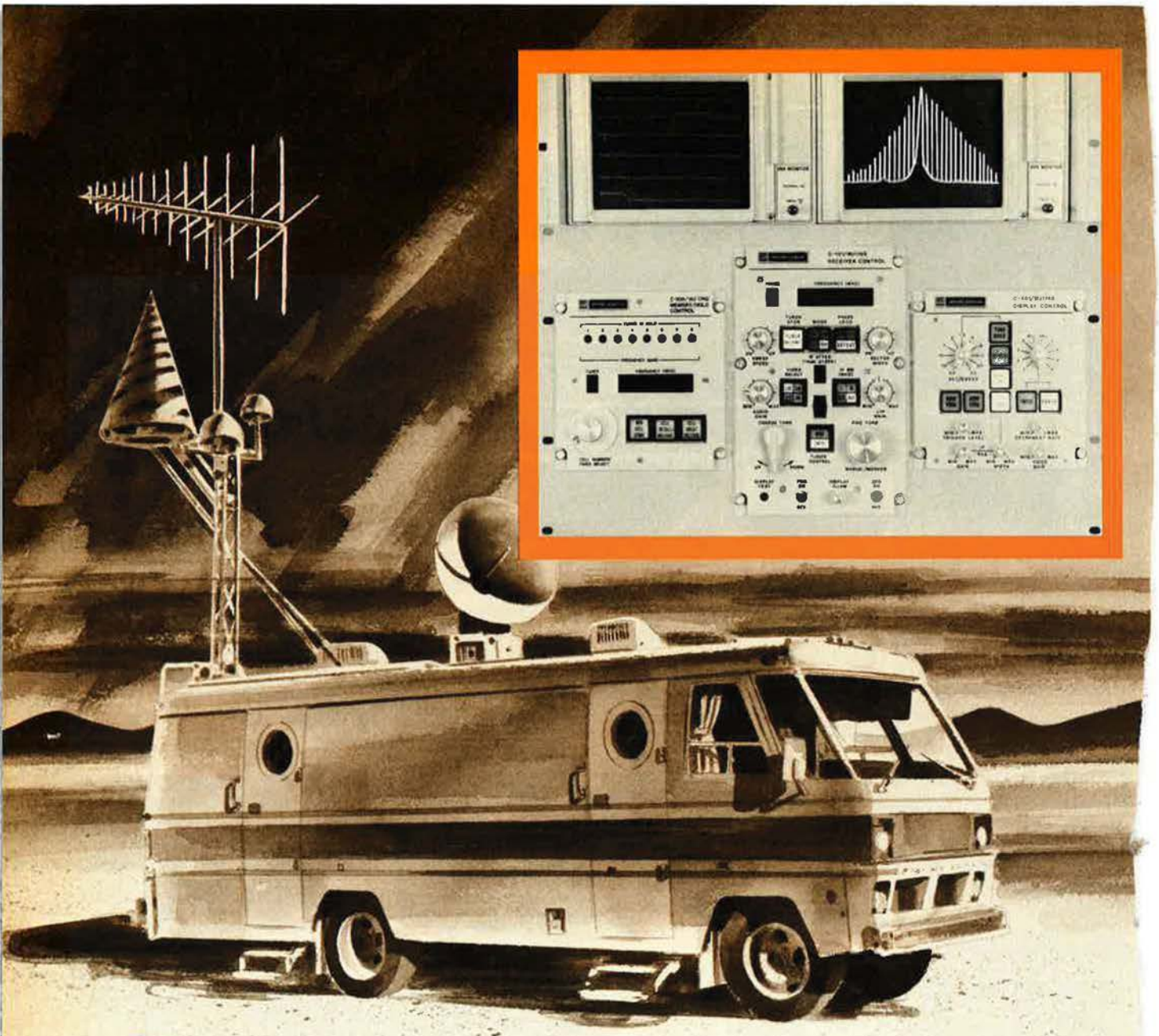

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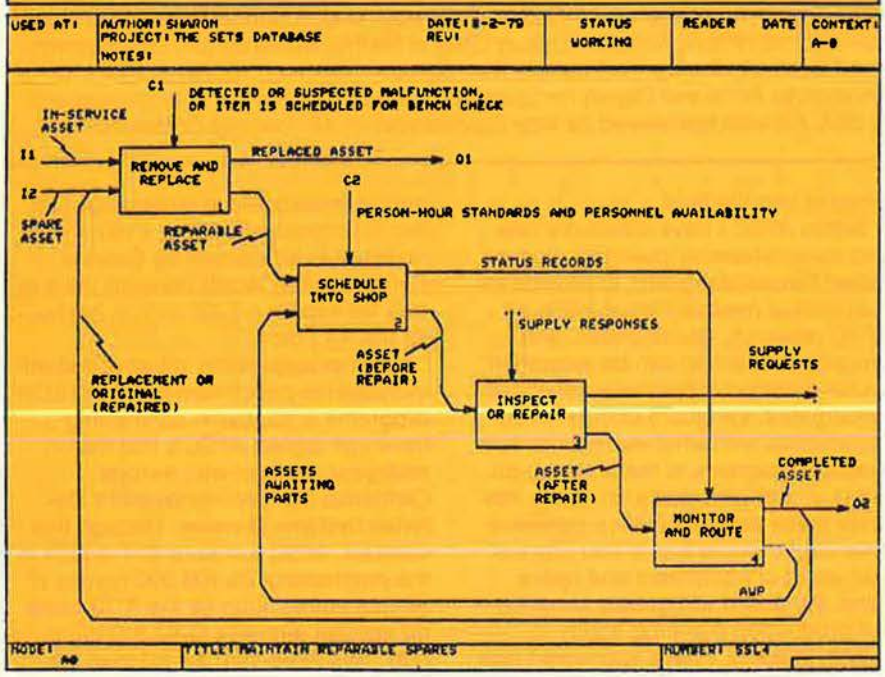
Figure 3: The Automated IDEF Method



Diagrams of nested levels of factory system operations can be automatically constructed on a computer display terminal using the automated ICAM definition language.

showed a four-to-one productivity improvement over manual production at the recent end-of-contract demonstration. But this ICAM project wasn't just a demonstration—the T-3 robot is now drilling panels and routing 250 different sheet metal parts on the production line of the F-16 fighter.

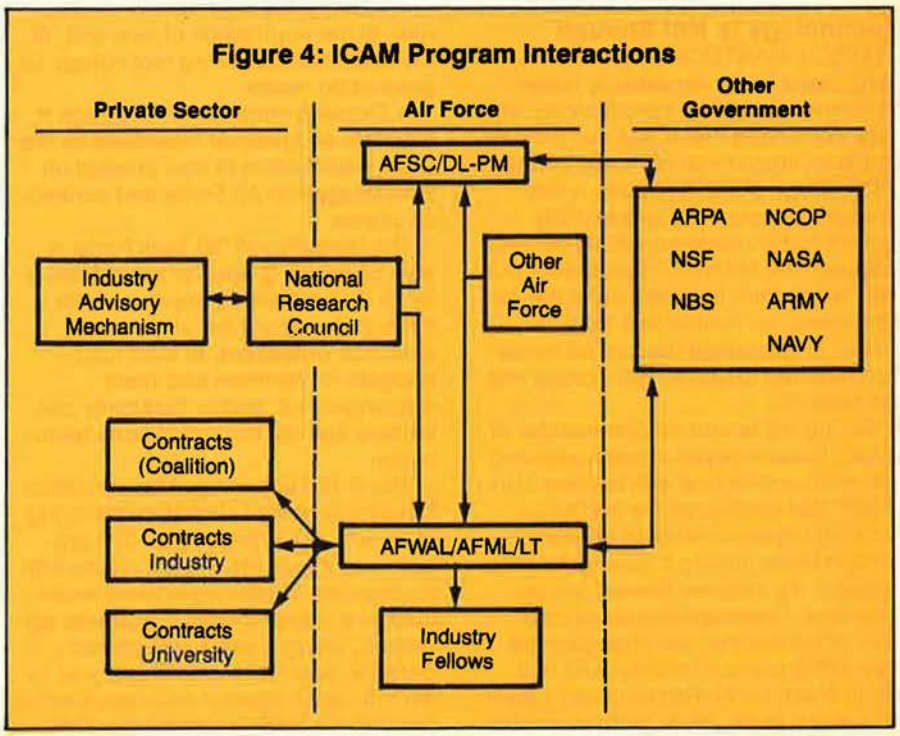
The McDonnell Douglas Corp. is pursuing an even more advanced project within the ICAM program. They are developing a complete work cell, including several stations. This robotic system will combine conveyors, parts handlers, and mechanical arms with off-line programming (based on the APT language), "vision" through the use of television, and tactile sensors.

Modules like the T-3 robot and the McDonnell Douglas work cell will be developed and individually implemented by industry, with significant return on investment benefit. The real payoff for ICAM will be achieved through the integration of several work cells, in private industry demonstrations of totally integrated manufacturing systems. This will become possible through ICAM's uniform approach to system architecture, ICAM's concentration on system interfaces, and a truly open-forum approach to information interchange (Figure 4). AFSC has contracted with more than seventy aerospace companies, universities, and software houses to develop and apply parts of the ICAM architecture in real manufacturing applications.

Private industry is also heavily involved in program coordination through the Committee on Computer-Aided Manufacturing, the Department of Defense Manufacturing Technology Advisory Group, and through the ICAM Industry Fellows Program. As Industry Fellows, industry experts are invited to work at the ICAM project managerial level for a one- to two-year period to acquaint themselves with all aspects of ICAM before returning to their own companies. Public sector involvement includes contractual efforts through the National Bureau of Standards, coordination with the Department of Commerce, and such joint program interfaces as the cooperative agreement between ICAM and NASA's IPAD program. Together, this coalition of universities, contractors, and government agencies is working to complete the sequenced phases of the ICAM plan.

ICAM's phased approach is based on combining stations, cells, and information systems into modular "wedges" cut from the architecture of manufacturing. The first wedge, which will serve as a working facility to validate ICAM concepts, will be a prototype sheet metal fabrication plant. Boeing is preparing the conceptual design for this work center, which will include a wide range of advanced manufacturing processes, computer aids, robotics, and instrumentation. Most importantly, the sheet metal work center will integrate these subsystems with shared software and data bases, providing rapid communications to all levels of management. We chose sheet metal fabrication for our first wedge because improvements here would have

Figure 4: ICAM Program Interactions



the most immediate impact on the cost of Air Force systems. This cost reduction and productivity improvement should be even more dramatic when we integrate this work center with our next planned wedge: sheet metal assembly. For the third wedge, ICAM planning points to composite materials manufacturing. Over time, ICAM will tackle other shop floor areas: welding, machining, forging.

In parallel with these wedge developments, other pilot projects are being pursued. ICAM contractors are working on a manufacturing control/material management system, analyzing human factor implications of work center design, preparing a manufacturing/design cost guide, and designing an intergrated system for materials handling and storage. After our first three wedges and these additional efforts are under way, we expect to extend the ICAM concept, under joint service sponsorship, to exploit the progress now being made in computer-aided design and manufacturing for electronics. Another project that will help integrate the factory management process is the development of manufacturing coding and classification schemes, to make more standard the data bases that should be shared among manufacturing cells. This project should enable designers, purchasers, and production planners to characterize parts and subassemblies by such factors as geometry, materials, finish, and status of work in progress.

Technology Is Not Enough

AFSC's MANTECH programs have developed some remarkable breakthroughs for improved productivity, and I am convinced that ICAM can provide us the leverage for major steps forward. Technology alone, however, is not enough to sustain the productivity growth that is vital to a credible defense posture. The MANTECH programs will only reach their full potential if the Air Force and our contractors work together to guarantee the capital formation required to get the technology into the factories.

During my tenure as Commander of AFSC, I have enjoyed a continuous and informative dialogue with leaders of industry that convinces me that we—working together—should be doing a much better job of producing defense systems. To improve the way we do business, I have sponsored several new initiatives that are changing the way AFSC plans internally, and that should help the Air Force-industry team do a much better job of getting modern systems into the field.

Gen. Alton D. Slay has commanded Air Force Systems Command since February 1978. Earlier, he served on the Air Staff as Director of Operational Requirements and Development Plans, Assistant Deputy Chief of Staff for Research and Development, and DCS/R&D. During the Vietnam War, General Slay was DCS/Operations for Seventh Air Force and Deputy for Operations, MACV. He flew 181 combat missions in SEA. He also has served as Vice Commander of Air Training Command.

Within AFSC I have initiated a new and comprehensive planning process called Project Vanguard, to provide an institutional mechanism whereby all AFSC research, development, and product acquisition can be examined and understood collectively rather than individually. Vanguard compares our capabilities with what we require, synthesizes programs to make up the difference, and provides a means to integrate these programs into a cohesive, meaningful whole that is tied into the real world of equipment and operations. Vanguard will greatly enhance our production planning ability.

With industry, I have sponsored new initiatives that will encourage capital investment in new equipment and technology, increase competition, improve productivity, and help us develop and buy things we can afford. In order to exploit the opportunities that MANTECH advances offer us, I have chartered the Have Payoff '80 Task Force to:

- Match manufacturing technology opportunities with current and future weapon system requirements,
- Identify opportunities for and barriers to the application of new and off-the-shelf manufacturing technology for production needs,
- Develop contractual language to facilitate and provide incentives for the rapid introduction of new production technology into Air Force and contractor plants.

The Have Payoff '80 Task Force is also developing ways to reward excellence in productivity improvements through the award fee and source selection processes, to front-load budgets for facilities and plant rearrangement, and to indemnify contractors against the risk of early termination.

The F-16 Technology Modernization Program is typical of what we are trying to do with Have Payoff '80. This program combines MANTECH results with appropriate capital investment incentives in a comprehensive business approach. Using shared cost/shared benefits, award fee provisions, and indemnification against early program termination, AFSC combined a $25 million investment in technology like the T-3 robot station with $100 million invested in equipment by General Dynamics Fort Worth Division. As a result, we expect a $200 million payback for the Air Force.

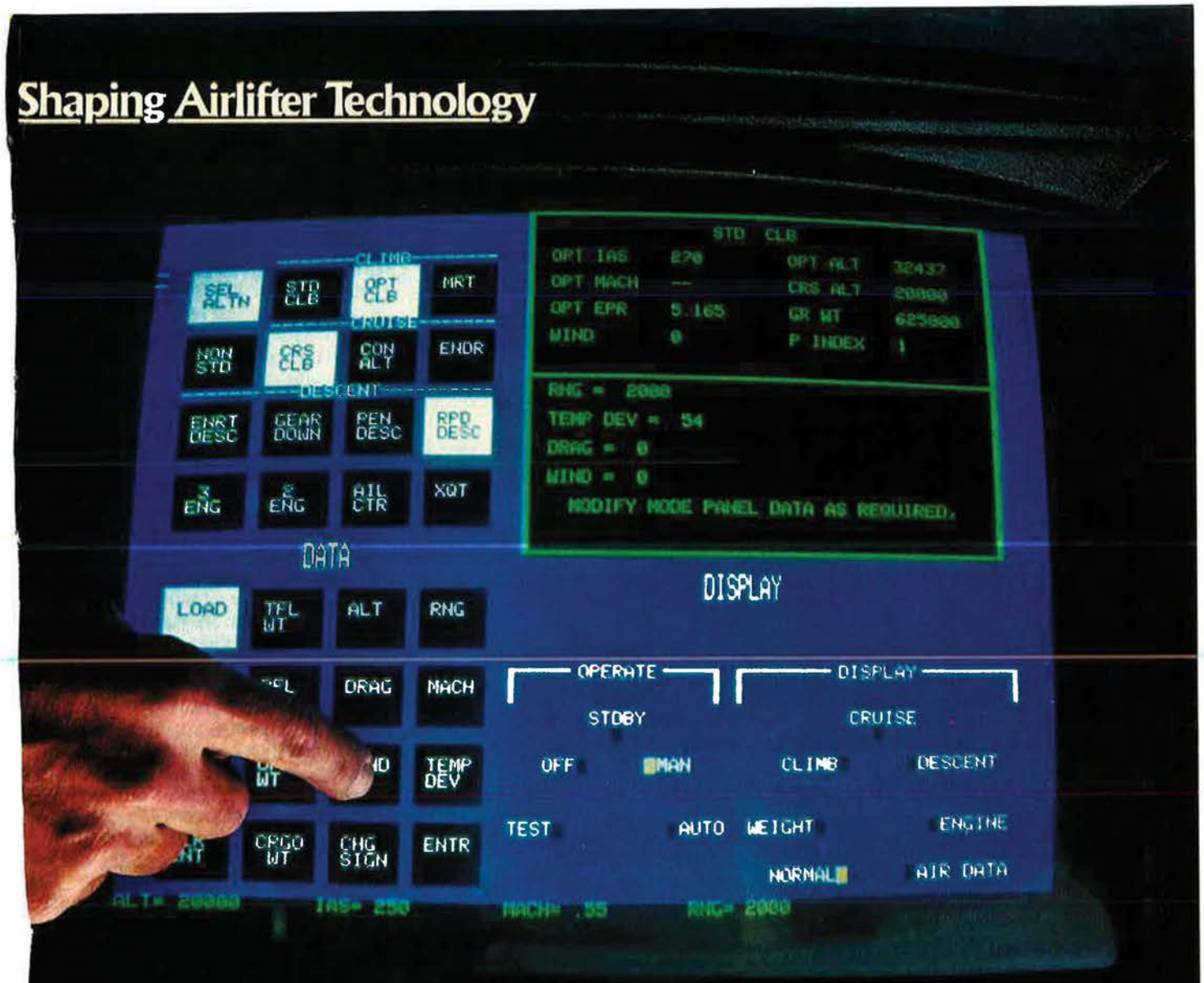
Another acquisition initiative that will increase the payoff from our MANTECH programs is multiyear contracting. I have just signed AFSC's first major multiyear contract with Aerojet Ordnance Co. and Honeywell's Defense Systems Division. Through this contract, AFSC will save $34 million in the purchase of 25,100,000 rounds of 30-mm ammunition for the A-10 close air support aircraft's GAU-8 Gatling gun. This three-year award marks a major milestone in the process of improving our way of doing business. It is exactly the sort of contracting initiative that will encourage rapid productivity growth.

To make sure the work we do is directly relevant to aerospace systems requirements . . . to be sure that the "hooks and strings" that unite various technologies, productivity advances, and planned system buys all work together . . . it is essential that we tie MANTECH and Have Payoff '80 activities with our Project Vanguard planning process and with scheduled investments in major production programs. I can assure you that AFSC will do its part to improve the productivity of our defense industries.

Answering the Productivity Challenge

We are joined in battle against the erosion of our nation's productivity. We are in competition with inflation, inertia, and with adversaries real and potential. AFSC has a major and exciting role to play in the forthcoming decade of productivity growth. The concepts and technologies of MANTECH programs like ICAM are not some crazy, far-out ideas; ICAM technology is becoming a reality, and it is already a necessity. New technology and better contracting practices can make the difference in responding to our productivity challenge, if we make up our minds to prevail. There is no doubt in my mind that—working together—we can prevail. ■

Shaping Airlifter Technology



Creating the airlifter cockpits of the future.

Today, the pilot of a large aircraft confronts a complicated array of switches, panels and displays. But new developments at Lockheed-Georgia point to a time in the not-distant future when pilots will have an easier time during their cockpit hours.

More and more, they will control their aircraft with the help of computers. More and more, they will use electro luminescent displays, liquid crystal displays or cathode ray tubes to communicate with the computers.

But these displays will be unlike those most people have ever seen. The pilot will simply place his finger on a display to call up easy-to-read information. In some cases, he will talk with the display, which will be able to recognize voices and synthesize speech.

The display you see above is a touch panel. If, for example, the pilot wants to change destinations during flight, he lightly touches the panel. It gives him his options, tells what fuel consumption will be, indicates the communications channels to use.

The picture above is deceptively simple. That display represents the linking of many technologies—the computer software specialists, the electronics and controls engineers, and display experts.

These displays will make the pilot's "office" a lot more efficient. They also will save a lot of money, both in original installation and maintenance. Forthcoming advances, such as these in cockpit technology, are what you would expect from the airlifter experts at Lockheed-Georgia, the people who have more experience, by far, than anyone else in creating and building airlifters.

Lockheed-Georgia

The Current Avionics Approach: Rational Standardization at Work

Technological revolutions in electronics haven't been fully exploited in USAF avionics because the systems were "aircraft-specific," designed to a particular aircraft type without regard to USAF-wide impact. The result: a hodgepodge proliferation of systems difficult to operate, maintain, and support economically and rationally. But now that is changing.

BY F. CLIFTON BERRY, JR., EXECUTIVE EDITOR

SUPPOSE you have had a black-and-white television set for several years. It works, but demands more service calls every year. The solution: Buy a new color television with electronic digital tuning and remote control before the football season starts.

You survey the market and select a new set. Then the trouble starts. The connections for the new TV are different from the old one and won't plug into the wall. The expert you summon says all the wiring in the wall must be ripped out and replaced. So must the connection. The cost is prohibitive. You decide to keep the old set.

That is a fanciful story insofar as home television receivers are concerned. As new sets reach the market, they can be bought and plugged into the same outlets that served their predecessors. The latest twenty-five-inch, solid-state, microprocessor color TV of 1980 plugs into the same outlet that carried electricity to the old eleven-inch, vacuum-tube Muntz of 1953. Together the wall outlet and pronged plug from the set make up a "standardized interface." Any appliance plugs into any outlet.

Not so with the avionics in military aircraft. Take the F-106 radar, for example. The first production F-106A flew in January 1957. Its radar uses technology five years older than that. The radar's mean time between failure (MTBF) is two hours, and spare components for it are increasingly hard to obtain. Yet the F-106 continues to be assigned a key role in continental air defense, both in the active force and the Air Guard.

The F-106 is only one example of the avionics plight facing the Air Force. As one expert puts it, USAF's avionics have "poor field reliability, are difficult to repair," and there is virtually no standardization. The result is proliferation of spares, technical manuals, training, and test equipment—and, ultimately, fewer aircraft ready to fly when needed or to perform as expected.

Help is coming, however, with progress under way to correct the ills of the past. The situation might have appeared near-hopeless three or four years ago, but now the trend is being reversed. The changes in management philosophy and corrective actions now afoot are the subject of this article. The approach is more what avionics will do for aircrews than in shooting a flurry of acronyms. In the second half of the article, we will sketch briefly several representative avionics programs in different levels of development.

The Problem

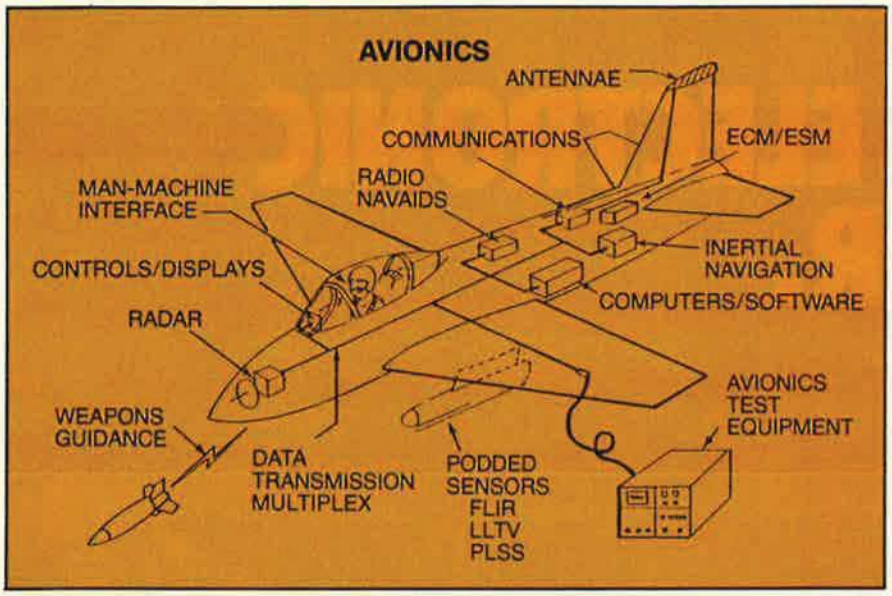
First, consider the dimensions of the problem of trying to reach even a degree of avionics standardization. The Air Force inventory of more than ninety types and series of aircraft represents a $29 billion investment (at acquisition cost). Each aircraft averages fifteen to thirty avionics subsystems on board. The total avionics subsystems in USAF use number about 200,000, estimated to have cost more than $11 billion. Very little standardization exists among those systems. The VHF radio from one type of aircraft probably will not fit into the space for a similar radio in a different type. Or, if the box fits, the connections will probably be different.

Some types of aircraft in the inventory are incapable of upgrading with modern avionics. Why? Because to do so would require virtual rewiring of the aircraft. Not so in the case of the F-16. Its multiplex data bus will allow new avionics to be added or updated without rewiring. The Air Force wants to achieve a similar capability for future aircraft and to use standards whenever feasible in upgrading its older aircraft.

The annual budget for USAF avionics research and development, acquisition, and modification is nearly $3 billion. Add to that the approximate $3 billion spent on operations and support, and it is easy to see the concern. The more standardization that can be achieved—and the more widespread the avionics applications developed—the more aircraft that can be equipped with modern, workable/supportable avionics. Put another way, the goal is simply to spend more on improvement of capability than on supporting a proliferation of out-of-date systems with poor reliability.

An important goal is being able to put new-technology avionics into existing aircraft at reasonable cost. If that can be done, the technology lag can be reduced. Former Deputy Secretary of Defense Charles Duncan once said, "By the time a system gets deployed and becomes operational, it incorporates technology which is eight to twelve years old." If a newly fielded aircraft such as the F-16 can be retrofitted in a couple of years with one-year-old technology, it can make a capability leap forward of several years. That is important because the Air Force keeps planes in its fleet longer than it used to, and even new aircraft coming off the production line will require avionics updates during their lifetimes.

For example, in Fiscal Year '64, about thirty-four percent of USAF's inventory of 15,214 aircraft were more than nine years old. By FY '78, even allowing for high production during the Vietnam War, about seventy-three percent of the USAF active, Guard, and Reserve fleet of 9,138 aircraft were more than nine years old. As reported in the May 1980 AIR FORCE Almanac Issue, at the end



This schematic drawing shows the range of avionics in today's aircraft. Most of the titles are plural, indicating multiple subsystems. Note also that the pilot is the "man-machine interface", or at least the cybernetic systems in the helmet help make that so.

of FY '79 more than seventy-four percent of the active USAF fleet had passed its ninth birthday. For the Air Guard, more than seventy-seven percent of its aircraft are older than nine years, and the comparable proportion for the Air Force Reserve is eighty percent. Average age of the active fleet is more than twelve years; the Air Guard average nears fifteen years, and Air Force Reserve average is sixteen years.

Thus, the technological revolutions in electronics so commonplace in today's society have not begun to appear in any significant way in the avionics of older USAF aircraft. An airman responsible for B-52 or F-106 avionics must regress to vacuum-tube technology on the job, while living with the fruits of solid state and microprocessor revolutions the rest of the time—handheld calculators, digital watches, and video games.

The dimensions of the problem are fairly clear. It came about, say the experts, because from the postwar years to only recently the avionics were "aircraft-specific." They were designed (or specified) to fit into a specific aircraft to meet its particular requirements without regard to the impact Air Force-wide. The result was the proliferation mentioned above. That was compounded when avionics systems were modified during service life, as often happens. (For example, USAF now has twenty-seven different kinds of Inertial Navigation Systems [INS] in its inventory.)

Toward Solutions

If the problem is so obvious, what is being done to correct it? Within the past five years or so, USAF developers and users concluded that something could be done (they knew all along that something needed to be done). In due course, Air Force Regulation 800-28 went into effect, in September 1978. It is titled "Air Force Policy on Avionics Acquisition and Support." In the July 1979 AIR FORCE, Lt. Gen. Lawrence A. Skantze, Commander, Aeronautical Systems Division, AFSC, told about the new regulation and its impact. He said it "establishes policy and assigns responsibility for acquiring and supporting all Air Force avionics components, equipment, and systems and their support suites, including those used in electronic warfare."

One practical effect of the regulation was to establish the Deputy for Avionics Control. This group is located physically at Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio. However, its forty-eight people originate both from within ASD and the Air Force Logistics Command (AFLC). The office is "deputy" to both commands. As General Skantze noted, the Deputy for Avionics Control is "the single Air Force organization responsible for focusing and controlling all Air Force avionics."

Does this create an "avionics" czar in the Air Force? Not in the traditional bureaucratic sense, with a massive new organization, burgeoning office space, and a large travel budget. As experts on the Air Staff and at Wright-Patterson told AIR FORCE, a massive reorganization was avoided intentionally when the Deputy for Avionics Control was set up. They said the object is to "keep it small, get the best people into it," and don't create a rival for money and spaces against the existing organizations. But, they say, it is vital to make the group able to coordinate and monitor all facets of avionics, and to cut across all the traditional lines to reach the user, the developer, the logistician, and industry.

The charter for the Deputy for Avionics Control is clear. It is to develop

NAVIGATION THEN . . . in 1945, it was a B-29 navigator returning to Saipan after bombing Tokyo, armed with pencil, charts, and sextant. NAVIGATION NOW . . . in 1980, it is the Standard Inertial System, whose Cockpit Display Unit is 5.75" wide, 7.125" high, and 7.5" deep. Latitude and longitude mark the position of Litton Industries' Guidance and Control Systems in Woodland Hills, Calif.

EF-111. NEWEST ELECTRONIC WARRIOR.

Eastern Europe has the densest thicket of electronic defenses in the world today.

The EF-111 Tactical Jamming System was developed by the Air Force and Grumman specifically to counter this potential threat—to provide cover for air-to-ground operations along the front line, and to support penetrating strike forces.

In a comprehensive four-year development and test program—the last six months conducted by Air Force personnel at Mountain Home Air Force Base in Idaho—the EF-111 significantly exceeded the operational reliability and "blue suit" maintainability standards set by the Air Force and Department of Defense.

Tests of the EF-111 system in a simulated Eastern European air-defense environment demonstrated its ability to detect and automatically assign jammers to counter and negate every type of threat encountered.

The need for the EF-111 is a well-established USAF requirement. EF-111 provides the capability to disrupt the Warsaw Pact radar net with support jamming in both standoff and escort roles.

The EF-111. It can do the job. And with a built-in growth capability to cope with new and more sophisticated threat radars, it will continue to do the job in the future.

The EF-111. A real answer to a real need.

Grumman Aerospace Corporation, Bethpage, Long Island, New York 11714.

GRUMMAN

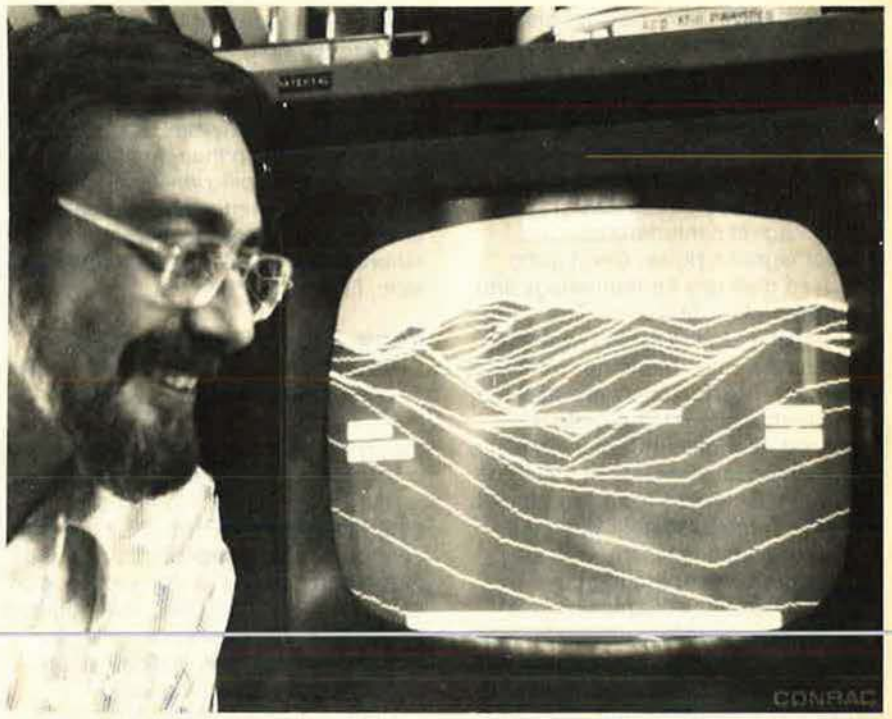
50 years

and maintain the Air Force Avionics Master Plan and the Avionics Data Base. It also reviews, approves, guides, and assists all AFSC and AFLC avionics activities, including development of avionics strategy. Then the power comes: It conducts mandatory reviews and coordinates all avionics programs. Therein lies the potential for "czarism"—the review and coordination license. That gives rise to the most-often-asked question about the office: "Will AX [the Deputy for Avionics Control] get into my business?" The answer from the AX people is, "Yes; both technically and financially."

The reason is that they aim to develop avionics standards Air Force-wide in an open forum, available to everyone, with competition at all steps. As one leader puts it, "No vendor can impose a system on the Air Force, and adoption of a system will not inhibit installing the next generation when it becomes available."

In action, the process is straightforward. Within AX, they (and the rest of USAF) have embraced the concept of a triad of system-level architectural standards for avionics. They intend to achieve standardized interfaces for the various subsystems and information flowing through an aircraft's many avionics arteries. (Remember the wall outlet and appliance plug?) They have settled on a single higher-order computer language that applies to avionics development and application (it is called JOVIAL J-73); and they have devised a single set of instructions for the computers in these systems, and incorporated the result into a Military Standard (Mil-Std-1750 and -1750A).

But the key is this: AX did not impose these criteria on the system. They were developed by all organizations involved, via the "open-forum process in a vendor-independent, technology-transparent" method. This included industry participation in reviewing draft Requests for Proposal, give and take among major command users of systems and the logisticians, and open meetings among supplying companies to thrash out the minutiae of standards that make sense.



On this Airborne Electronic Terrain Map System, an aircraft is threading its way through the Shoshone Mountains in Wyoming. Its altitude above sea level is 7,500 feet; above the terrain, 357 feet. Aircraft heading is 177 degrees, with left wing slightly low. The map's inventor, Dr. Louis Tamburino of the Air Force Avionics Laboratory, watches his creation perform. Flight tests of the system are imminent.

Standardization Resistance

Lest this sound as if the millennium just arrived, the picture is not totally rosy. Progress has been made and will continue. It is particularly effective in unobtrusive ways, such as a common Higher Order Language like JOVIAL J-73. You and I, using the system, cannot speak a word of JOVIAL, but the result of using it is that the software for our airplane can be used in others and can take on new capabilities when they are developed. But resistance to standardization exists, because not everyone has the same interests in its achievement. The user sees unique requirements for mission accomplishment, requirements that may be unmet by "standardized" systems. The scientist sees standardization leading to technology stagnation; it won't move forward. The contractors like standardization if their systems are the standard; otherwise, it is poor practice. So the problem now is to develop a policy for rational standardization, a strategy if you will.

The business strategy adopted by the Air Force for avionics allows adoption of technology as it arrives. This occurs mainly through rational standardization applied in development and in practice. The standard Higher Order Language is an example: Now it is JOVIAL J-73, and in a few years will be the Defense Department's "Ada" language. Ada is compatible with J-73. When it comes into full use, the software developed for each avionics subsystem can be assured of working with other systems. It will also be reusable. This may save up to $50 million each time. Also, when Ada is the standard, USAF will continue to support its systems developed with JOVIAL J-73.

But to standardize for standardization's sake alone is the wrong approach. That is not the tack USAF is taking. "Rational standardization" is.

Rational Standardization

Air Force research and development policy, as understood by its officers, is this: "The criterion for standardization is increased combat capability." Without that showing, they do not endorse a standardization proposal. Gen. Alton D. Slay, Commander of Systems Command, says to standardize only when it makes sense. "I know there are drawbacks to standardization. We could standardize on mediocrity, for example. Or we could standardize and make it easier for the enemy to counter our weapons, and we could standardize and stifle competition. We could even standardize and stifle inventiveness and technological advancement. To allow any of those things to happen would be dumb, and Rule One in my book is: 'Don't do anything dumb.' "

Another result of Air Force Regulation 800-28 was the establishment of an annual avionics conference that was recently expanded to include armament. The conference brings key Air Force,

Army, and Navy users, developers, and supporters of armament and avionics together to address major issues, such as how to reduce growing software costs for maintenance support, integration of sensors and weapons, feasibility of developing a common hardening specification for lightning, electromagnetic interference, and electromagnetic pulse, developing improved methods for technology and threat prediction, and so on. The results are published in the Air Force Armament and Avionics Planning Guidance Document. The document is classified, but available through the Defense Technical Information Center (DTIC) to qualified requestors. This planning effort is complementary to and supportive of the Air Force Systems Command Vanguard planning which, with assistance from the operating commands, determines the most cost-effective programs to be pursued to meet mission needs. The Armament and Avionics Planning Conference deals with issues that arise in fielding and supporting the armament and avionics developed by these programs. The goal of these planning efforts is the development and fielding of compatible, cost-effective armament and avionics. An example of the type of system these planning efforts are striving for is the LANTIRN Pod under development (*see below*), which will be fully integrated with the weapons it will control, in order to achieve multiple antiarmor kills per pass.

Additional attention is devoted to bringing the user—the command with the operational mission—and the industry provider into the avionics and armament development process earlier. Together they can discuss needs and technology available to meet them, and arrive at achievable goals now instead of later. At the same time, through formal groups and subcommittees discussing these systems in the open, common standards can be agreed upon before Requests for Proposal are issued. Additionally, industry is given the opportunity to comment on draft RFPs before they become final. Through this process, competition is enhanced, because interested parties all know the rules and conditions. In less than a month after the new Armament and Avionics Planning Guidance document was issued, USAF experts responsible for it briefed industry on its scope and nature, on the results of USAF-wide planning conferences, and on means for industry to receive and respond to the USAF planning process. (The forum was NAECON '80, the National Aerospace and Electronics Conference held in Dayton, Ohio.)

With policy discussed, several avionics programs can be highlighted now to observe how the Deputy for Avionics Control and the rest of the Air Force are practicing what they preach. The Standard Inertial Navigation System is a good place to start, since it is a rational step forward in standardizing form, fit, and function.

Form, Fit, and Function (F^3)

Recall that the Air Force has twenty-seven different Inertial Navigation Systems (INS) in its inventory. Consider the problems in maintaining that variety or of modifying them as new technology is available. In 1976 the Air Force decided to apply the Form, Fit, Function concept to a standard INS. Its objective then—and now—is to stop proliferation of medium-accuracy INS, lower their acquisition and life-cycle costs, and increase competition, as well as promoting rational standardization.

The result was a competitive flyoff among three systems meeting the standards, and award in January 1980 to Litton Industries to produce 237 Standard Inertial Navigation Units. Most are for installation in USAF A-10 close support aircraft; a few are for Army tests. The current contract is worth $33.7 million. However, as a result of the competition for the Standard INS, at least two other suppliers can compete for production of additional units: the Singer Company and Rockwell International. The total purchase could reach 2,150 systems. Besides the A-10, USAF aircraft considered candidates to take the Standard INS are the F-16, F-111, and F-4. All the Standard INS supplied will by design have a high degree of hardware and software commonality, and will fit into standard spaces with standardized interfaces to other systems on the aircraft.

For example, the inertial platform that is the heart of the Standard INS is an advanced version of the one currently in the F-15, F-5, and F-18 aircraft and the cruise missile program. Its digital computer is similar to equipment also in the F-18 aircraft.

B-52 Update

Another program that brings avionics from the 1950s into the 1980s is the update of the B-52 Offensive Avionics System (OAS). It advances the OAS in B-52G and -H model aircraft from vacuum-tube, analog technology to present-day solid-state, digital systems. Its purpose is to improve bombing navigation system reliability and maintainability, increase weapon system effectiveness, install new control and display systems, and provide a launch platform for the air-launched cruise missile while updating the electronics that work with the Short-Range Attack Missile (SRAM) and its support equipment. An underlying purpose can be simply stated: to simplify crew workload.

Lt. Gen. Kelly H. Burke, USAF's DCS/Research, Development and Acquisition, says that most of the $96.3 million programmed for B-52 research and development in FY '80 is being used for the OAS program's Phase I, and that the $142.4 million requested for FY '81 will continue ongoing projects and add a new effort to replace the B-52's autopilot.

According to program experts, flight testing of the updated B-52G begins in October 1980. By the time flight testing ends a year later, 100 OAS production sets will be in various stages of production, and the first modified B-52G aircraft delivered. This schedule compression works because the OAS update uses existing hardware, its system architecture applies "lessons learned" in the B-1 development program, and its subsystems all comply with the requirements for new multiplex system protocols (the Mil-Std-1553).

The OAS update is a high-visibility, high-payoff portion of the entire program, aimed at extending the B-52's life expectancy "well into the 1990s," as one official told AIR FORCE. Some other elements of the B-52 program include hardening against Electromagnetic Pulse (EMP) damage, designing damage tolerance assessments to predict life expectancy more precisely, designing an aircraft tracking system so that each B-52's structural integrity is continuously monitored, adding "strakelets" where the wings meet the fuselage in order to comply with SALT II provisions for identifying cruise missile carriers, and then updating the defensive avionics, adding a fuel management system, and other improvements that promise quick paybacks at low cost.

Possible Fuel Savings

Still considering applications to existing aircraft, think about the potential for fuel savings through improved avionics. Aeronautical Systems Division (ASD) is testing three commercial fuel savings advisory systems for possible use on four aircraft types: the B-52, KC-135, C-141, and C-5. This is a two-step process. First, to evaluate

(Continued on p. 71)

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APD is deeply committed to research and development of new generation avionics including the Strapdown Attitude and Heading Reference Systems (AHRS) and laser gyro based Inertial Reference Systems (IRS) designed for all operational aircraft. Development continues on advanced display panels using LED and other state-of-the-art technology.

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(Continued from p. 66)
existing commercial systems by actual flight tests. Second, if justified by fuel savings and life-cycle costs, going into production. Flight testing has been conducted on all aircraft types but the C-5. Its performance is considered similar enough to the C-141 to adapt its results.

Fuel savings advisory systems are designed to take the guesswork out of flight profiles in order to get the best fuel economy. The aircrew previously interpolated tables and charts in flight manuals to calculate optimal flight paths for fuel savings depending on mission, aircraft, and environmental conditions. With the advisory systems, the necessary information is instantaneously available, reducing crew workload while presenting them opportunities to conserve fuel.

Both ASD and the Air Force Logistics Command are participating in the current project so that the time between flight testing and system acquisition can be reduced. Also, the joint program complies with the requirements of AFR 800-28 and the initiatives mentioned earlier so that components eventually adopted will be standardized (rationally) throughout the fleet.

At this writing, the jury is still out on adoption of fuel savings advisory systems. The KC-135 evaluation was completed first. It used the Simmonds Precision system, and demonstrated a saving of about three percent in comparison flight tests. The C-141 and C-5 evaluation (using Delco Electronics) and the B-52 evaluation (with Lear Siegler's system aboard) results were compiled at the end of June. In early July, the Air Staff is being briefed on the results and recommendations. If the systems can be justified for one or more aircraft types, a final Request for Proposals for production versions will be issued in mid- to late-July. Draft RFPs went to industry in mid-March, with their comments returned to ASD at the end of May. This compresses the time schedule for responses to the final RFP. Responses are due by September 1, after which the source selection process begins. Contracts will be awarded in December 1980 for up to 1,500 sets. Production deliveries are to begin thirteen months later (January 1982) at a rate of about forty-five sets per month.

Evaluators of the project estimate that the potential for fuel and cost savings are such that the systems could pay for themselves within three years at current fuel prices.

Concurrently with flight testing of systems for the aircraft already mentioned, ASD is considering other aircraft types for possible later application of fuel savings advisory systems. They are the E-3A, E-4, VC-137, C-9, T-43, and C-130. As part of the overall project of considering fuel savings advisory systems, USAF has surveyed the commercial airlines using or contemplating such systems. According to early results, airline reactions are mixed. Some are enthusiastic, while others consider the savings only marginal and not worth the expense.

By LANTIRN Light

In an interview last autumn with AIR FORCE, Gen. W. L. Creech, TAC Commander, said that the "next big barrier" to be broken through for fighters "is the barrier posed by night and weather. We have done well on speed, altitude, and lethality. We have not done well in improving our ability to fight at night and in weather." He also said, "At the least, we need to develop on an expedited basis a night, under-weather capability with conventional munitions." (December '79 issue, "TAC: Ready to Fly and Fight.")

The response to the immediate requirement—developed on an expedited basis—is called LANTIRN. The acronym stands for Low-Altitude Navigation and Targeting Infrared System for Night.

Given the basic requirement to overcome limitations that night and weather impose on strike aircraft, one option is to design a new aircraft. Another, and faster, option is to multiply the capabilities of the force in being to perform their missions at night and under weather, and do it now instead of in the next decade. That is the LANTIRN approach. It is for the single-seat F-16 and A-10 aircraft.

In the modern single-seat attack aircraft, pilot workload is very heavy even under clear daytime conditions. The two main tasks are (a) to fly and navigate the aircraft, and (b) to acquire targets and deliver weapons on them. Difficult and complicated enough in day, the tasks become impossible at night and in weather.

LANTIRN's purpose is to create flying cues at night and under weather that are the same as daylight cues. It uses two forward-looking infrared (FLIR) sensors, one with wide and the other with narrow field of view. The wide-view FLIR displays the obscured outside world to the pilot on a Head-Up Display (HUD) that is also wide-view. It is called a video raster HUD. It shows the pilot a representation of the world ahead of his airplane that is between twenty-five and thirty degrees wide in the horizontal axis and about twenty degrees vertically. That is something less than a full daylight view, but much more than exists now.

The narrow-field FLIR is for target work. It feeds information into the system's target recognizer computer. That section is the stiffest technological challenge in LANTIRN, because it recognizes and classifies targets as they are acquired. It then places them into priority order according to the pilot's mission plans, and assigns infrared (IR) Maverick missiles to each. Consider the pilot's workload reduction in navigating and making targeting decisions; it is tremendous.

After classifying targets and setting them into priority order and matching them with Maverick missiles, the system waits for pilot consent to fire. When he consents, the system locks on and fires a Maverick at each target in priority sequence. Specifications call for the LANTIRN system to be able to handle multiple Mavericks per pass and with a kill probability (P_k) at least double the present level. As for operational hours—the amount of time an F-16 or A-10 can be expected to get to the target—the LANTIRN is planned to double the number in summer, and quadruple them in winter in the European environment. With LANTIRN, those two aircraft types are expected to be able to operate under a very low ceiling and at night more than ninety percent of the year.

As this issue went to press, source selection was imminent for two separate awards for advanced development on LANTIRN. One is for the HUDs for five A-10s and seven F-16s. It also includes bidding for production aimed at maximum commonality of Shop Replaceable Units between the two aircraft. Two contracts are being awarded for the LANTIRN fire-control pods. The winners will compete for Phase One full-scale engineering development of the pods. On the basis of competitive evaluation of that phase, a single award will be made for completion of FSED and production.

New Systems

So far we have sampled from among avionics developments applicable to existing aircraft. Now two cases are considered that will be seen on new aircraft. It is also conceivable that they could be retrofitted into existing aircraft types. First is the Airborne Electronic Terrain Map System.

Problems with paper maps are familiar. Whether afoot or in vehicle, ship, or aircraft, they are difficult and

unwieldy to unfold and read while moving along. Chances for distraction and misreading are high. In high-performance aircraft it is especially difficult to correlate continuously the aircraft position with the ground beneath.

The answer to the airman's plight is the Airborne Electronic Terrain Map System. It was invented by Dr. Louis Tamburino of Air Force Avionics Laboratory. His system produces scenes of the ground as an aircraft flies over them, generating the display from digitized terrain data stored in memory aboard the aircraft. When heading and altitude change, the picture is automatically and continuously updated many times per second. The pilot sees a perspective view of ground features displayed in proper relationship to his own position and attitude.

The system capitalizes on the digital terrain data of the world's surface compiled by the Defense Mapping Agency. (This process was discussed in the April 1980 issue, "DMA—The Cruise Missile's Silent Partner.") Dr. Tamburino's system takes the digitized terrain data and, for each "patch" of interest, generates polynomial coefficients to describe the terrain. They are stored in memory within the system. When a properly equipped aircraft flies a route, the system generates an image on a conventional cathode-ray tube that is an accurate depiction of the terrain below and ahead of the aircraft.

The system uses "state-of-the-art" components working together in ingenious ways to make use of the existing Defense Mapping Agency data base. The result, however, is unique. It gives accurate representations of the terrain that can be displayed on any cathode-ray tube in a cockpit. The pilot sees a graphic representation of terrain with essential information superimposed: aircraft attitude, heading, altitude (both above sea level and actual height above terrain), and position.

It is passive, and creates no radar or other signal for enemy systems to home on. And its display can change with aircraft maneuvers, providing aircrew with "real-world" displays instead of conventional flat vertical views.

The Electronic Terrain Map System is one case where the applications are truly limited only by the user's imagination. It can be used for terrain avoidance, for instance. Or in navigational applications it can be used to provide crosschecks with inertial navigation systems, position fixes, map-matching fixes, or in-flight route planning. In altimetry, the system permits flights at preselected heights above the terrain, or barometric adjustments en route. Before a flight, the aircrew can preview the route to be flown. Or the system can be set up to act as a cuing aid during a flight, alerting aircrew to checkpoints and targets as programmed.

The map system has been operating at Wright-Patterson in the laboratory for more than two years. It is now ready for flight tests and development for specific aircraft installations.

Cockpit of the Digital Avionics Information System (DAIS) shows how cathode-ray tube displays of essential information have replaced conventional clock-dial instruments. They are grouped around and above the pilot's right hand. The head-up display shows essential flight information to the pilot. The DAIS computer system is self-contained and operates off its own battery power independent of the aircraft power system. It contains a program for shutting off systems in priority order to conserve battery power in an emergency.

In the DAIS

Rational standardization has been cited repeatedly as a major goal of avionics management. Another goal is reduction of crew workload. As aircraft developed, so did switches, controls, and gauges proliferate. The Spad of World War I had fewer than ten switches and controls for the pilot to master. The World War II P-51 Mustang had more, about thirty-five. Today's F-15 Eagle has more than 300. The DAIS (for Digital Avionics Information System) is a major step toward reducing switches, controls, and instruments in the cockpit.

DAIS aims to overcome problems associated with past and current cockpits. Their hardware and software are not transferable from aircraft type to

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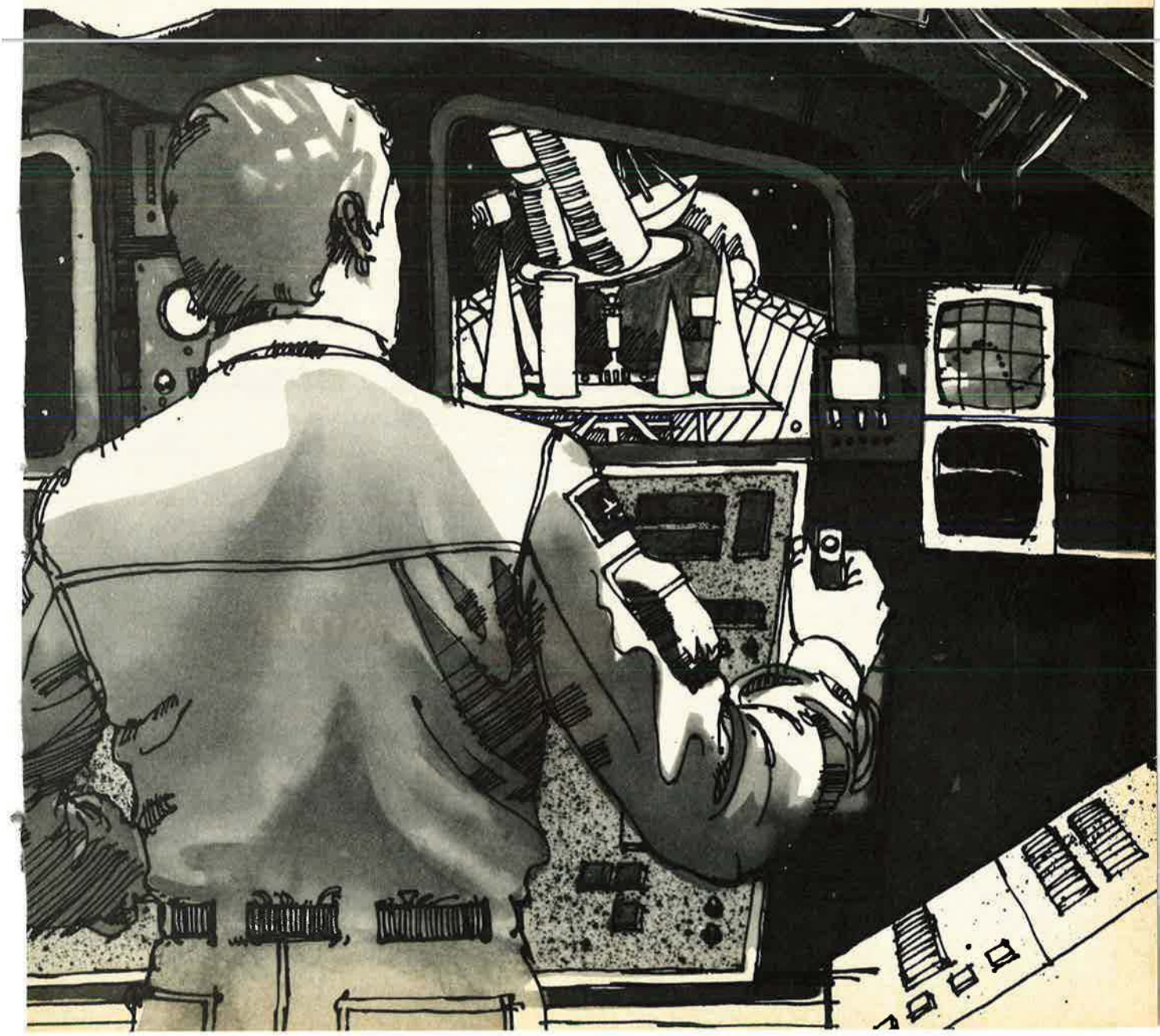

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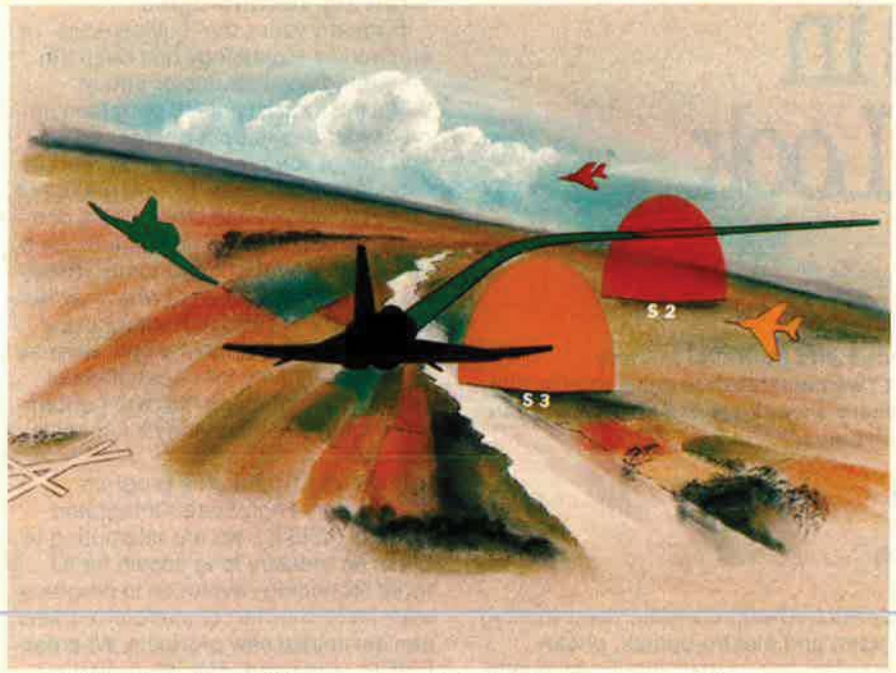


Possibilities of the Pictorial Format program include full-color representation of ground and air, with the pilot's own aircraft (in black) and a friendly wingman's plane (in green). The projected flight path is the green ribbon ahead. It avoids an enemy antiair missile threat (in yellow), but is headed for a deadly SAM site ("S2" in red). The yellow enemy aircraft is cautionary now, not a danger, but the red enemy aircraft is a hazard. This is the cockpit display of the late 1990s. Its technologies are within reach today.

other types; the systems are designed for unique installations; and they are difficult and expensive to maintain, let alone to retrofit or add capability or respond to new threats. DAIS applies the principles of rational standardization, using Higher Order Language, multiplex system protocol (the Mil-Std-1553), central control of distributed processing, and shared controls and displays.

With DAIS, information is displayed when the pilot needs it or when the system needs to alert the pilot. When displayed, information appears on a screen that is ready to display other information either before or after. Four general-purpose television displays and a Head-Up Display (HUD) show all flight and functional data, as well as the functions for on-board sensors. Checklists can be called up when needed. So can the flight route, or approach plates, or emergency procedures.

The point is, the pilot manages the system instead of the other way around. Information needed continuously is always displayed. Other information comes and goes as required, but is always available for call-up when needed.

Since the DAIS system is designed under the new avionics rules, it is open-ended. That is, new capabilities can be added or displays changed and new sensors integrated, all without redesign or modification. Another payoff: reducing development risks. Integration of new subsystems can be designed and developed within this existing standardized model.

The most important payoff is in pilot capability. With the DAIS, a pilot can perform more functions accurately with less thought and in less time, freeing time for more rational mission decisions. For example, a function that takes multiple sequenced steps now, such as bringing an INS on line, takes time and can go wrong if a step is omitted or performed out of sequence. In the DAIS cockpit, the pilot simply calls up the menu with the desired outcomes. One might be "INS up." The pilot needs only to punch the multifunction key next to that display line, and the DAIS processors execute all the steps properly while he goes on to something else.

DAIS has been evolving in the labs at Wright-Patterson since 1974. Having proved out in lab testing, it is ready for flight tests beginning within the year.

Pictorial Format Program

The cockpit of the mid-1990s and year 2000 is already evolving in the Flight Dynamics Laboratory at Wright-Patterson in 1980. DAIS is a major step in that direction, and will be applied in operation as the decade of the '90s starts. Beyond that is the Pictorial Format Program. It ties together the fruits of cascading technology progress and the avionics management strategies to create the displays that will be used by pilots born in 1980 when they fly their aircraft in 2001.

An immediate objective of the Pictorial Format Program is to design and produce full-color computer graphics formats. They are to be for six different types of aircraft electro-optical displays. Another objective is to simulate the formats and examine them dynamically to see how well they work. The approach being followed by the Flight Dynamics Laboratory is to initiate multisource procurement for each segment, format production, and simulation. The products will be evaluated by the scientists, tested by pilots, and then promising approaches followed up.

A working Pictorial Format display will do just that: It will take information from multiple sensors and produce a picture for the pilot. The picture in full color reproduces key elements of the mission and the environment the aircraft is operating within. That includes showing the pilot's own aircraft and its position and attitude, plus its projected flight path. Ground and sky are represented accurately and in perspective. Friendly aircraft might be shown in green, depicted accurately in relation to the pilot's own aircraft. Enemy threats are depicted in understandable fashion, with surface-to-air threats shown to scale. If hazardous to this pilot, they could be in red; if out of range but to be avoided, shown in yellow for caution. Enemy aircraft are similarly depicted in their correct spot in space, colored to show gradations of caution or danger.

Lest this sound like dreaming, the experts at Wright-Patterson point out that the technologies to accomplish the Pictorial Format displays are in reach today. In fact, given the recent trends in avionics development, it is possible that the program could produce results faster rather than slower because new technologies can be integrated into the development process as they arrive; it is not a static captive of technologies existing when the project starts.

That is really the point to remember about avionics developments today and tomorrow. They are no longer held back by artificial restraints. Instead, with rational standardization, avionics now promise to make the mission simpler for the aircrew, instead of more complicated. ■

Electronics in Warfare: A Look Ahead

The author describes some of the advanced and potential military applications of electronics and warns that "we must learn to maneuver in this new dimension; we must exploit an adversary's weaknesses and reduce our own vulnerabilities in this warfare of electronics."

BY THE HON. ROBERT J. HERMANN
ASSISTANT SECRETARY OF THE AIR FORCE (RESEARCH, DEVELOPMENT AND LOGISTICS)

THROUGHOUT history, the nature of military operations has been affected by the technology of the age. In today's world, one of the most dynamic forces of technological change is the electronics industry. In this age of space exploration, home computers, microminiaturized circuitry, and satellite communications, electronics technology and its innovative application are a pervasive influence on the practical problems of everyday life. These same advances are changing the way nations prepare for and conduct military operations. Our security will depend on the wisdom we display in exploiting these advances.

The Electronic Battlefield

Today, military forces can be brought to bear on an adversary at speeds and over distances that could not have been comprehended by military commanders of a few decades ago. As the reach and lethality of modern weapons has increased, so have the range, precision, and diversity of sensor systems and the speed with which we can handle information. In the future, airpower will be applied at increasing ranges because technology is providing the wherewithal. We will "see" farther, reach the target area faster, increase navigational accuracy, and place more lethal munitions on target with greater precision.

With the related introduction of new communications transmission media, the growth of data-processing capabilities and their integration into communication systems have altered and diversified the nature of information flow on the battlefield. A dynamic picture of the combat arena can now be developed with standoff, deep-looking radar, and electro-optical, photographic, and signals intelligence sensors capable of locating targets within tens of feet. Increasingly, data will be passed by digital links to processing modes that will convert raw inputs to machine-readable form for relay to decision-making command centers in a matter of seconds or minutes. Sensor data will be combined and manipulated to improve target location accuracies and correct time lines to forecast current situations as a basis for assigning target priorities. Also, using automated interfaces and communications links, target information can be passed directly to attack aircraft and updates provided while they are en route to the target area.

This scenario is not fictional. Electronic technology is making it a reality. The capabilities described already exist in limited form or are in advanced stages of development.

While the US is exploiting technological developments, the same electromagnetic spectrum and the same laws of physics are available to our potential adversary. We have seen him invest a large part of his national resources in new and more capable military systems that also have increased range, speed, and accuracy within an improved surveillance and command control communications (C^3) network.

For both sides, the functions of military force are becoming more and more dependent on electronics and the use of signals. We must learn to maneuver in this new dimension; we must exploit an adversary's weaknesses and reduce our own vulnerabilities in this warfare of electronics.

Evolving Technologies

For many years, the "cutting edge" of electronics technology has been the integrated semiconductor circuit. While the transistor itself permitted immense strides in both decreased size and power requirements compared to vacuum tube circuits, the integration of many transistors and other circuit components onto a monolithic silicon chip has redoubled that opportunity. Today we are in the early part of what may become known as the "microprocessor age." In just a few more years, we may need a new name for capabilities of semiconductor chips that will perform more functions than today's full-scale computers.

In the DoD, through a program termed Very High Speed Integrated Circuits (VHSIC), we are attempting to press an industry long known for its rapid technology evolution to progress even faster than its commercial markets can assimilate new products. Whereas today's semiconductor integrated circuits are limited to internal dimensions of a few microns, we are pursuing technologies that can produce circuits less than a micron (one forty-millionth of an inch) in dimension. Accompanying the reduction in size will be a severalfold increase in speed and the ability to put hundreds of thousands of devices on a single chip. In addition to the benefits of lower power and smaller size for a given amount of function, higher levels of integration yield fewer interconnections, and interconnections are the source of most circuit failures.

We expect to put these VHSIC circuits to work in a variety of military applications. Some of the most exciting are automatic target identification and classification systems, pinpoint guidance schemes, redundant and highly reliable control systems for missiles and aircraft, highly automated reconnaissance systems giving real-time information on hostile movements, and highly coded jam-resistant communication systems. We will continue to use these circuits to digitalize existing analog systems for flight control, propulsion control, and communications, permitting more rapid change to meet new threats and reducing needs for maintenance and adjustment. One payoff will be the ability to modernize our major systems quickly and at relatively low cost, and to conceive new systems where the limitations of environment are overcome by electronics; for example, the ability to operate aircraft in highly effective but basically unstable weight-balance condition, with electronics providing the stability.

The Airborne Warning and Control System (AWACS) uses a state-of-the-art pulse Doppler radar interleaved with a conventional pulse radar for both long-range surveillance and low-level target acquisition against ground clutter. When AWACS is on station, the commander's ability to observe enemy aerial activity and to direct his forces engaged in battle is the best in the world. (Photo by William A. Ford)

"[Navstar] means that tactical aircraft can navigate with great accuracy to a target located by reconnaissance systems with equivalent accuracy."

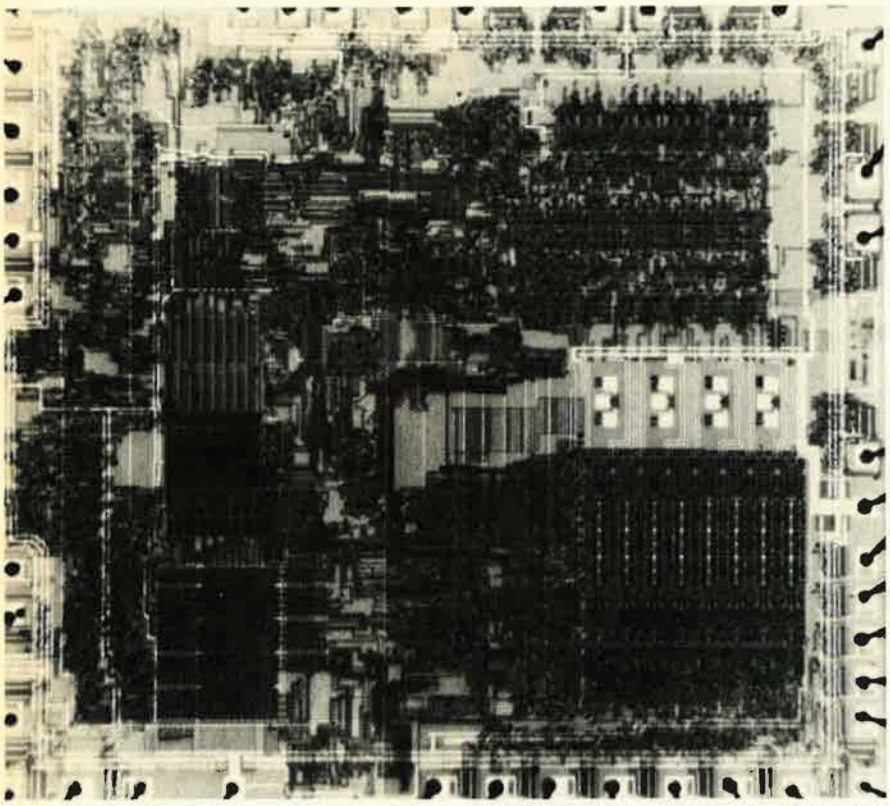
At the electronic device level, new sensors are under development that will combine both photosensitive devices and processing on a single integrated circuit. These not only will reduce the cost of high-precision missile seekers, but will permit immense arrays to be constructed covering huge surveillance areas and performing analysis and data transmission only in areas of special interest. Solid-state transmitting and receiving devices are able to span almost all of the electromagnetic spectrum, hence we will select the combination of sensors that will optimize the acquisition or targeting probabilities for almost any situation. Laser sources designate targets today; tomorrow they will permit long-range space communication. Already lasers are replacing mechanical gyros in navigation equipment, and soon they may become the most precise, rapid-acting, and long-range of all military weapons. The special characteristics of all these devices, then, lie at the heart of our systems potential.

Electronic Enhancement of Weapon Systems

The effectiveness of modern tactical aircraft such as our F-15 Eagle is highly dependent on the range and quality of its radar and its ability to guide an air-to-air missile to a target. To perform this function today in a busy electromagnetic environment, the APG-63 radar must locate and track the target, communicate guidance information to the AIM-7 Sparrow missile, and provide the illumination for a semiactive homing and end-game. This "beyond-visual-range" capability is made possible by advances in electronics technology, but it can also be vulnerable to electronic countermeasures such as jamming or deception. Thus, the cat-and-mouse game of electronic weapons has forced the major military powers to develop both electronic offensive radar and defensive ECM systems.

To manage more effectively the air-to-air battle in which the F-15 will maneuver and, in particular, to assist in using beyond-visual-range missiles, the E-3A Airborne Warning and Control System (AWACS) will play a key role. Its airborne radar can "see" over a radius of 250 miles and keep track of both friendly and hostile aircraft. This battle area picture will help command authorities make force management decisions in real time, as the action is taking place. To be useful, AWACS information must be delivered to those who need it, and communications must be available to get that job done. This communications function must also perform with security and resistance to jamming.

The E-3A's ability to provide surveil-



ABOVE: Very High Speed Integrated Circuits (VHSIC). This is an enlargement of a chip smaller than one-quarter-inch square. Today's semiconductor integrated circuit technology will further reduce this size by at least a factor of ten. RIGHT: Navstar GPS. The application of technology in space is an attractive concept. With GPS, for example, navigation could be precise for air, land, and sea forces by common access to the satellite system.

lance and the F-15's beyond-visual-range radar and missile have the effect of enlarging the size of the battle area to a radius of several hundred miles. To keep from being blinded by electronic jamming in this arena, the E-3A radar has significant antijam features to preserve its "eyes." To maintain a coherent force in this same arena, our forces require communications that are not easily negated by jamming. We are, therefore, developing antijam voice and data systems such as SEEK TALK and the Joint Tactical Information Distribution System (JTIDS).

Air-to-ground operations also have been enhanced by electronics. Offensive operations at night require unique target acquisition, recognition, and weapon-delivery capabilities without sustained exposure to enemy air defenses. Improved on-board radar or infrared sensors can perform the target-acquisition function. But to minimize aircraft exposure to enemy air defenses, navigation to the target must be precise. One way to increase accuracy is a satellite-based system called Navstar Global Positioning System (GPS). A Navstar GPS terminal on board an aircraft will measure distance from several of the Navstar GPS satellites to establish the aircraft's location with great precision. This means that tactical aircraft can navigate with great accuracy to a target located by reconnaissance systems with equivalent accuracy. This ability to locate targets, rendezvous, and strike targets with precision, at night or in weather, can have great tactical leverage. It is yet another example of a new capability, achieved through the technology of electronics, that will generate new concepts for tactical operation.

To apply tactical airpower against second echelon military units in the area beyond engaged forces, it is both useful and possible to launch weapons from a standoff position. Maverick, GBU-15, HARM, and conventional cruise missiles are examples of air-launched weapons that can perform this function. Their effectiveness is either dependent on or enhanced by accurate sensors with ranges beyond the inherent electronic capability of the aircraft. Examples of such supporting target-acquisition systems are the Precision Location and Strike System (PLSS) and PAVE MOVER, a combination of moving target indicator (MTI) and imaging radar, which are capable of directing command-guided missiles to a target with great precision.

The PLSS concept includes the accurate location of emitting targets through time-of-arrival measurements from multiple intercept systems, ground processing to develop precise locations, and the use of airborne inter-

cept vehicles as communications relays to the aircraft or weapon being guided to the target. The PAVE MOVER system fits that same concept except that the sensor is a radar for locating moving targets. These systems can have great leverage because they provide support to a large number of weapons over a much greater geographic area than can be done from a combat aircraft. Again we see that the large area sensor systems coupled with standoff weapons and longer-range penetrating aircraft have enlarged the size of the battlefield.

These new capabilities require, however, remote operation of sensors that must be jam-resistant through wideband data links. They must also provide for rapid distribution of information through secure and jam-resistant communications networks. This demands attention to the effective use of the electromagnetic spectrum as an integral part of combat operations and not as a narrow technical art.

Air operations in or near Warsaw Pact airspace also require defensive measures because of the USSR's substantial investment in ground-based air defense capabilities. The Soviets have used advances in electronics to develop better radars and improved

data-handling processes that make both detection and destruction more likely. As a counter to these Soviet capabilities, we have had to develop jamming systems to obscure or deceive these radars. The EF-111A will be the primary Air Force aircraft dedicated to jamming enemy ground-control radars. Coupled with self-protection jammers on board combat aircraft, the EF-111A will be able to greatly reduce the effectiveness of the Soviet air defense system by negating the effectiveness of their radar investment. This measure-countermeasure exchange in the combat use of the electromagnetic spectrum is increasing in intensity, both in tactics and investment strategy.

Satellite Systems

In the broader context of theater and strategic force management and direction, both East and West are using and investing in satellites for communications.

The communications satellite (COMSAT) allows us to use extremely wide bandwidths on a global basis and makes a fundamental difference in the concept of military deployment and employment. It permits the relay of sensor information, force status, and force direction with a flexibility that both sides must have to project power on a global basis. The importance of satellite communications is clearly manifested in the investments being made by both sides.

For the US, the primary global system is a constellation of geosynchronous satellites developed and acquired under the Defense Satellite Communications System (DSCS) program. These satellites provide support for both strategic and tactical forces through several different sizes of ground terminals. For supporting naval operations and some strategic forces, the FLEETSATCOM program links forces afloat and shore facilities. The system provides for somewhat lesser bandwidth capacity with the advantage of smaller earth terminals.

A major contributor to the assured control of our strategic forces is the AFSATCOM program that is presently formed by putting piggyback communication relays on many host satellites with other primary missions. This system connects ground and airborne command posts with all strategic missile and airborne forces. In the future, we plan to add a separate dedicated satellite system to the strategic force management constellation to provide increased assurance that our ability to control these forces will survive along with the forces they support.

Thus, we see that in managing and controlling forces, we depend heavily on electronics and the electromagnetic spectrum and are subject to the vulnerabilities associated with that dependence. Accordingly, we have and will continue to design into these systems the capability for security, jam-resistance, and resistance to interdiction of system control.

With both East and West fielding systems that depend so much on the electromagnetic spectrum, the value of electronic reconnaissance is increased. In order to exploit, jam, deceive, or destroy our adversary's electromagnetic capabilities, we must keep advancing our capability to intercept, identify, locate, and exploit his electronic emissions. Thus, we find large expenditures in such systems as TEREC, Wild Weasel, Guardian, RIVET JOINT, and PLSS for supporting combat aircraft, and radar homing and warning receivers on the aircraft themselves.

When Not to Use Electronics

So far the emphasis has been on the extent of electronics and signals in force management. However, it is equally important to recognize when *not* to depend on the electromagnetic spectrum. Using signals in warfare creates a new set of problems and vulnerabilities. First, a transmitter is like a beacon for your opponent's reconnaissance systems. To transmit is to increase the chances that you will be detected, identified, and located. Often you will reveal much about your capabilities and intentions as well. Your transmission can be received by your opponent and often gives him—as well as you—an advantage. So using signals doesn't come free.

There is another liability in dependence on electronics and signals. If a military system requires electromagnetic transmissions in order to function, it is vulnerable to countermeasures. Radar can be jammed and deceived, communications modes are subject to jamming and destruction, and computers will fail. Both in system design and in tactics development, care must be taken to create modes of operation that are not fundamentally dependent upon a free signaling environment.

The Challenge

From these trends and examples, it becomes clear that one of the critical elements of any modern military force will be its ability to operate in and use the electromagnetic spectrum. We must design, develop, and field systems that can intercept, identify, locate, exploit, interdict, deceive, and destroy enemy transmissions. We also must protect our own transmissions from offensive action by employing antijam techniques, communications security equipment, and proper operational procedures. This need for electromagnetic combat will require a new perspective on the part of our operational commanders. The use of the electromagnetic spectrum cannot be considered as the narrow technical province of the communicator, the radar designer, or the data-processing specialist. It must become a natural regime of military maneuver because to manage our own forces effectively and to counter opposition forces demands attention to both friendly and hostile use of signals.

One final important note on military trends pressed by technology advances. With the increased ranges, speeds, and accuracies of the weapons of each service comes the need to maintain a cohesion of forces over greater battle areas (sometimes globally) through wide use of electromagnetic signaling. Integrating the weapons and operations of the separate services will induce significant overlaps in area of impact, capability, and potential for interference with each other. The potential for both synergistic action or collateral interference poses special new requirements for cross-service coordination in system design and operation. Without continued emphasis on the combined-arms perspective of our forces, we could rob ourselves of much-needed military operational capability. ■

Dr. Robert J. Hermann served in the Air Force as an electrical engineer, assigned to the National Security Agency (NSA) from 1955 to 1957. After five years on the faculty of Iowa State University, he returned to NSA, advancing to the position of Special Assistant to the Director in 1974. From 1975 to 1977, he was Special Assistant for Strategic Warning and Combat Information Systems to Gen. Alexander Haig, SACEUR. Dr. Hermann became Deputy Under Secretary of Defense for C³I in 1977 and was appointed to his present position as Assistant Secretary of the Air Force (Research, Development and Logistics) in July 1979.

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Electromagnetic Combat

The USSR has led this country in developing concepts for fully integrated electronic warfare. Despite a late start, the USAF is making rapid progress conceptually and in the electronic systems needed for theater deterrence or for warfare in an era that is increasingly dominated by electronics.

BY MAJ. GEN. GERALD J. CAREY, JR., USAF

DURING the course of my career, I've watched dramatic scientific and technical advances affect strategies, tactics, and the professional thought of Air Force leaders. An early example was the emergence of nuclear weapons as drivers of strategic and tactical doctrines—doctrines that matured with our young Air Force of the 1950s. A second example was the reemergence of conventional war as a viable alternative to nuclear conflict, borne out by Korea. In Southeast Asia, it became clear that conventional war was not only the more likely kind of military encounter, but that it could become protracted without ultimate escalation into the nuclear realm.

Southeast Asia saw other axioms tested, such as that of Alexander P. de Seversky, who in 1942 had said: "Only airpower can defeat airpower." Over North Vietnam, we encountered the first serious challenge to that maxim—the surface-to-air missile, or SAM. Our air forces were tested, but not beaten by the SAM in North Vietnam. In retrospect, however, that environment was benign compared to Eastern Europe or the deserts of the Yom Kippur War, where one of the finest air forces in the world was very nearly beaten by SAMs. Using Soviet-provided air defense systems and doctrine, the Egyptian ground forces moved under an umbrella of mobile air defense provided by surface-based defenses, predominantly SAMs. The Israeli Air Force was devastated until Egyptian momentum stalled, and Israeli ground forces were brought to bear against the SAMs.

Today's radar, infrared, and electro-optically dependent air defense systems and the associated command control and communications (C^3) networks that support and integrate the SAMs, guns, and interceptors have again had a profound effect on contemporary military thought. Scientific and technical advances represented by modern integrated air defenses have propelled us into yet another dimension of the battlefield—electromagnetic warfare.

We do not enter the arena in a purely reactive mode, of course. Much of our attack and destruction capability relies on electromagnetic, infrared, and electro-optic capabilities. Our active and passive navigation systems, our ability to communicate with and between forces, our precision guided munitions, etc., all operate in, or rely on, this technology. But today's contest for "spectrum superiority" has become preeminent in peacetime preparation for the electromagnetic aspects of future war. Our readiness to engage the enemy and to win in this dimension is a significant contribution to both strategic deterrence and to our effectiveness in combat, should it ever come.

Another major result of scientific and technical advance is the pace of modern conflict. The Soviets have demonstrated the ability to conduct wars of rapid mobility, using their modernized forces to concentrate overwhelming mass for attack and rapid exploitation of the breakthrough. And, as we see in Afghanistan, they take their surface-based air defense systems with them as they move.

New Course of Military Thought

These observations serve as a backdrop to our growing appreciation of electromagnetic combat. That term

Soviet Ground Forces are well defended against air attack by mobile antiaircraft and missile systems. The ZSU 23-4, shown here, can fire on the move. It accounted for about a third of the Israeli aircraft losses in the Yom Kippur War.

itself is new, designed to encompass the traditional views of electronic warfare and our developing ideas on command control and communications countermeasures (C^3CM). Electromagnetic combat is a broad term that addresses all actions taken by a military commander to secure for his use the portions of the electromagnetic spectrum he needs, and deny that spectrum to the enemy. Its focus is on particular elements of modern weaponry, either as assets requiring protection or as targets to be exploited, destroyed, or otherwise neutralized. This new look signifies a profound change in military thought, in both combat and support areas.

For example, "chasing" the threat with individual specific countermeasure acquisitions as we have in the past will no longer satisfy our battlefield needs. The pace of technological development is so rapid that we can be "outbuilt" today. And, for that matter, thinking about "electronic warfare" in purely defensive terms is no longer affordable; it is an offensive weapon, too, that must be integrated into the total force. It is no longer enough to merely counter the enemy's electronic defense aids. We need to control the electromagnetic spectrum if we are to conduct effective tactical air operations.

The Soviets recognized the critical nature of this *control* more than fifteen years ago. Even a cursory review of their doctrine for Radio Electronic Combat (REC) is sobering. This is their concept for combined jamming and destruction, carefully planned and executed, and fully integrated into their offensive operations. Successful execution of the concept would have a staggering impact on an unsuspecting adversary.

The past difference between the Soviet REC doctrine and our own concept of electromagnetic combat is fundamental. They have developed an integrated offensive capability that is arrayed against our entire offensive and defensive network, including our C^3 elements. Our approach, on the other hand, has been defensive and reaction-oriented, aimed primarily at countering each new threat system as it was detected. As a result, we have spent considerable effort on a wide array of electronic warfare systems, primarily radar warning receivers and self-protection jamming systems, that are all optimized against terminal threat radars. In the past, we have not made a concerted effort against the overall system that controls these terminal threats. We have ignored the paralyzing effects a "full-court electromagnetic combat press" could have on the enemy's ability to wage war.

Evolution of Electromagnetic Combat

The genesis of the US approach to electromagnetic combat can be traced as far back as World War II. When we first discovered that the Germans were using radar, we developed countermeasures against each type as we detected it and learned how it functioned. This was a satisfactory approach because of the small number of radars and the primitive state of the electronic art that prevented rapid countering of our countermeasures. Overall, the Allied effort was highly successful, providing the beginning of what we now call "electronic warfare."

In the postwar years, however, little serious effort was spent on electronic warfare, and almost no thought was given to expanding the concepts for its employment, beyond what had been learned during the war. Korea presented us with little challenge from radar-controlled defenses. There were some primitive attempts at radar warning using aircraft navigation receivers, and some B-26s equipped with a homing receiver became the first "Wild Weasels," so to speak, but there was no catalyst for significant advances in, or extensions of, electronic warfare concepts or capabilities.

Electronic warfare development in the years between Korea and Vietnam belonged almost exclusively to the Strategic Air Command. The need to penetrate Soviet air defenses in the strategic mission provided the incentive for accelerating the state of the art. Conceptually, however, there was little change. Development and employment stressed self-protection of each

In the Vietnam War, we tended to target individual air defense sites rather than attacking the enemy's netted defense system as a whole. This Fan Song radar is part of the Soviet-built SA-2 SAM system, used extensively by North Vietnam.

penetrating aircraft against immediate threats—again a viable approach for the mission. Mutual support resulting from many penetrators was a factor, but an integrated approach for systematically attacking the air defense was not pursued.

The introduction of the Soviet SA-2 surface-to-air missile into Vietnam signaled a new era in electronic warfare for the tactical forces. We came face to face with a threat we had previously considered a "strategic" problem. We were unprepared and had to concentrate our efforts on the immediate threat. We responded with a range of capabilities—Wild Weasels, standoff support jamming, radar warning receivers, and self-protection jamming pods. But, because of the nature of the threat—basically one type of SAM, and one type of AAA fire-control radar—our efforts were again concentrated individually against these specific terminal threats. Nor did we make a serious attempt at an integrated, systematic attack on the North Vietnamese air defense network, because we viewed it as a collection of individual threat sites rather than as a netted defense system.

Vietnam triggered our awareness of the urgent need for electronic aids, and as our involvement there diminished we began to turn our attention to implications of the increasing quantity and quality of the Warsaw Pact electronic threat in Central Europe. We no longer had the freedom to employ our choice of tactics. Tactics now were dictated by the enemy's defensive environment. We could not relegate electronic warfare to the laboratories as we had after previous wars. Knowing that in any future conflict radar-controlled SAMs and AAA would be a major threat, we initiated programs to develop systems that would neutralize enemy defenses. But our countermeasures philosophy hadn't changed; our focus was primarily on improving and expanding the capabilities of radar warning, self-protection jamming, and Wild Weasel—all of which were targeted against the terminal threat.

Conceptually, we still had not made the transition to an integrated force designed to neutralize an enemy's overall air operations network. He had the lead in this area—a decided edge and almost complete freedom to control his weapon systems to his advantage.

During the '60s and '70s, the Soviets were developing and deploying in Eastern Europe the most formidable and sophisticated air defense network ever known. In subsystem density and diversity and in dependence on electromagnetic, electro-optic, and infrared systems, they were head and shoulders above our NATO allies. At the outbreak of hostilities in the NATO Central Region, we could expect to encounter more than 1,300 interceptors and 1,800 SAM launchers netted together and controlled by air battle managers using inputs from at least 1,500 early warning ground-controlled intercept, acquisition, and target-tracking radars. Overlapping coverage and redundant command and control make the capability even more formidable. It is apparent, just from these numbers, that something more than individual attacks against individual aircraft or radars will be needed to deal with this aspect of enemy military capabilities.

Today, and in the future, we must look at the threat as it really is—an integrated, redundant, and competent war machine—highly dependent on command control and communications and on operations in the electromagnetic spectrum. And we are changing. We are integrating our countermeasures systems to attack and neutralize all aspects of the command and control network. We want to turn defensive countermeasures into offensive systems that not only will protect us from the terminal effects of the enemy's air defense weapons, but will thwart his effective use of them in the first place. Furthermore, we want to exploit the vulnerabilities of our adversary as fully as possible, thus maximizing the effectiveness of our forces to deter conflict or to control it and win, if engaged.

Where We Are Going—And How

As a commander, I am acutely aware of the need for efficient, reliable command and control for effective employment of forces. Without that command and control, it just isn't possible to bring adequate forces to bear at the optimum time and place. The Soviets are even more aware of this critical need, having learned their agonizing lessons during major invasions of Russia during both World Wars. Thousands of Russian casualties and many lost battles can be directly attributed to their inability to

The MiG-23S fighter is used by Frontal Aviation and the Soviet air defense forces. About seventy-five percent of Soviet fighters and attack aircraft have entered the inventory since 1970. The MiG-23 has a variable geometry wing and Mach 2.3 speed at altitude.

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communicate effectively with deployed units, and the subsequent failure to concentrate available forces. But beyond this is the basic makeup of Soviet society. The entire structure of the Soviet state is based on centralized decision-making and requires close control of all activities. This environment discourages individual initiative. Independent judgment is not a trait that is nurtured in subordinates.

The methods of any army reflect the patterns of its parent society, and we see rigid control throughout the Soviet and Warsaw Pact forces. Left to operate unimpeded, this highly centralized organizational structure, with its numerical advantage and efficient command and control, could mount a formidable challenge. But the rigidity of the structure also creates a source of vulnerability, a chink in the armor, a hole in the line. That's where we're going electronically.

From purely defensive measures against individual threat systems, we're going to aggressive electromagnetic combat against the enemy electromagnetic complex as a whole. We are integrating our electronic countermeasures across the total force, to deny him the command and control functions critical to effective employment of Warsaw Pact air defense forces, thus increasing the vulnerability of his individual components. This offers a certain synergism as we piece together the individual parts of the solution.

Over the past decade, our electronic warfare developments have consisted primarily of improving and modernizing the basic capabilities that proved workable in Vietnam. The capabilities of our self-protection jammers and radar warning receivers have been, and will continue to be, expanded to cover the increasing variety of threats. We are equipping our aircraft with improved chaff and flare dispensers. And the Wild Weasel force is moving into the more capable F-4G, to be armed with such advanced weapons as the High-speed Anti-Radiation Missile (HARM). These are necessary qualitative improvements to provide direct protection to our attacking forces once they are engaged by an enemy air defense system.

The next several years will see the introduction of significant new capabilities designed to provide the combination of selective destruction and communications and radar jamming that we need to fully exploit the enemy's vulnerabilities. The EF-111 Tactical Jamming System will allow us to blind the radar eyes of the command and control net. By jamming the early warning radars, we will deny the enemy vital information on both our air operations and his own. Jamming his ground-controlled-intercept and acquisition radars will deny air intercept controllers vectoring information, forcing the terminal threat sites into vulnerable autonomous operation. The result will be a significant reduction in their system's engagement capability, with longer emission times, making the terminal threat more vulnerable to attack.

Among qualitative improvements in USAF electronic warfare systems is the F-4G "Advanced Wild Weasel" aircraft that can detect, identify, locate, and destroy enemy radars with a variety of ordnance. The first Gs entered service in 1978.

Considering the redundancy of the enemy's command and control network, we can't expect to do all that is needed by simply jamming radars. We must also reduce the crossflow of information within the net. Compass Call will provide a capability to jam critical communication nodes, forcing further autonomy of operation. We thus deny essential warning and vectoring of offensive and defensive air forces, further reducing engagement opportunities.

To complement our jamming efforts, the Locust Harassment Vehicle, a small remotely piloted vehicle (RPV), will provide a capability to saturate the defensive system with enough destructive capability to warrant an enemy's expenditure of weapons against it. This would further dilute and confuse the defenses that are forced into autonomous operation.

The Precision Location Strike System will give the tactical forces a significant new capability to accurately attack key radar targets in near real time over a wide area of the battlefield. With PLSS we can react to the increasing mobility of the threat while remaining relatively immune from rapidly changing technology that forces frequent updates of other electronic countermeasures systems. The fast response and precision location capabilities of this system allow us to manage our scarce, dedicated defense suppression assets with great effect.

Green Flag

All of this represents a significant investment in combat resources—an investment that demands both aggressive and coherent employment. The approach to this challenge is codenamed "Green Flag." This program, initiated by the Commander of the Tactical Air Command and administered by the Tactical Air Warfare Center at Eglin AFB, Fla., has been largely responsible for exploring and articulating the concepts highlighted here as well as diagnosing areas that need improvements *now*.

Green Flag's charter aims at the early- to mid-1980s. This focuses primary consideration on already fielded systems and the people we now have, but it also requires rapid incorporation into our field capability of the new systems I mentioned earlier. Green Flag considers the full range of these fielded options to determine force allocation guidelines, employment considerations, and tactical principles that would optimize our ability to fight and survive on the total battlefield. The Center is also tasked to simulate the conflict and to flight-test these guidelines, considerations, and principles, and to evaluate the status of our

electromagnetic combat equipment to ensure that it is working properly in the field. Our goal is to improve electronic combat capability across the board.

This approach is already paying off where it counts: increased combat capability in the field. The achievements of Green Flag—products of collective effort across the tactical air forces—include: improvements in fielded equipment, improvements in the effective use of that equipment by the combat crew and battle staff, and creation of employment concepts for electromagnetic combat operations in the defense-suppression aspects of our tactical air missions.

Two programs illustrate the determination to improve fielded electromagnetic combat systems—the Electronic Warfare Evaluation Program and the Electronic Warfare Integrated Reprogramming System.

The Electronic Warfare Evaluation Program assesses and reports the combat capability of all our electromagnetic combat systems. Originally designed to evaluate self-protection electronic countermeasures pods, its scope has been broadened to address radar warning receivers, radar attack and warning systems (the Wild Weasel), and other offensive and defensive electromagnetic combat equipment. This program has identified hardware failure trends, inadequacies in support equipment, deficiencies in aircrew training, and weaknesses in maintenance tech orders and procedures. Corrective actions have ranged from increased training emphasis to acquiring new support equipment. As the program progresses, its usefulness continues to expand.

The Center, as executive agent for combat support, plays a pivotal role for the tactical air forces (TAF) in USAF's Electronic Warfare Integrated Reprogramming System. This role applies to hardware, software, and tactics performance requirements, as well as changes in these areas to meet new missions or new threats. Its creation has resulted in significant advances in our electromagnetic combat systems' reliability and maintainability—as well as in the capability to counter the threat.

Of the several programs dedicated to improving the ability of combat crews and battle staffs to use their electromagnetic combat tools, the C³CM efforts under Green Flag illustrate the speed with which this important capability has matured. Based on experience in several command, joint, and combined exercises, Green Flag has provided a concept for the tactical employment of C³CM—a specialized function on the battle staff to analyze, allocate, direct the execution, and evaluate the results of C³CM operations. A new C³CM course at the Air Ground Operations School now provides this critical battle staff expertise in quantity to the TAF.

In addition to the conceptual framework for electromagnetic combat now being reflected in emerging tactical doctrine manuals, Green Flag has produced concepts of employment for electromagnetic combat operations in the field. These concepts are being fleshed out in Red Flag and in such JCS exercises as Bold Eagle, Gallant Eagle, and Positive Leap. They provide the initial groundwork to help our battlefield commanders, staffs, and attack units understand electromagnetic combat in terms of the mission, tactical air threat, and the objectives of the day.

This has been a tough first few months as we have grappled with our very basic military thinking about the conduct of war in the light of significant scientific and technical advances. In my judgment, we have come a long way in a short time—but we have a long way to go.

At the beginning of this article, I described a thin slice of the recent history of military thought. I would like to leave you with a broader view that is circulating in the Blue Suit community:

The eighteenth century was the era of land wars, the nineteenth of the sea. The twentieth was the era of airpower, but war will be shaped in the twenty-first century by the electromagnetic combatants.

The Air Force *must* be ready. ■

Present plans call for two squadrons of EF-111 Tactical Jamming aircraft that will support US tactical strike forces by blinding an enemy's radar eyes. First deliveries of the EF-111 are expected during 1981.

Computers in the Eighties: Opportunities or Self-Inflicted Wounds?

In the 1980s, computer hardware will advance more rapidly than the associated software. The opportunities for national security applications of the advances could be offset by the pitfalls, whose adverse impact could be reduced by proper management.

BY MAJ. GEN. JACK ROBBINS, USAF (RET.)

THE PACE quickens every year. Advances in computer technology introduce a steady stream of new capabilities. Computer systems become smaller, yet more powerful. The number of systems increases and spans greater distances. Users multiply. These are opening lines of a remarkable computer success story, but there are problems, and the decade of the '80s offers a mixture of opportunities and pitfalls.

Technological advances always excite interest, and the capabilities that they bring are welcome. But the key question is: Will computer users receive systems that improve their operations? Rapid developments are occurring in computer hardware, in digital communications, and in special support systems that multiply the usefulness of the total system. Advances in the electronics field are truly amazing and offer great promise to the embattled users. But all too often, for one reason or another, the great promises of technology's advance are very late in reaching the system users. In the past, major strides in computer technology have frequently been made without users realizing any marked improvement in their operations.

This article includes speculation on the opportunities presented by projected progress in a number of areas that support advances in computer systems and examines several problem areas that contribute to delay in getting new technology into computer systems. The effects of such delays can be observed in DoD computer systems, and in those operated by most agencies of the Federal government.

Technological advances in the decade ahead promise many opportunities for computer system users to perform a wider variety of tasks and to execute them better. In most forecasts of progress in computer systems, the near-term objectives are far too optimistic and the longer-term goals are greatly understated. The projections for the 1980s that follow are meant to be optimistic.

Technology Advances

Very Large Scale Integration (VLSI)

VLSI is one of the most promising hardware developments in a long line of technical advances that made possible the modern computer. Fifteen years of progress in integrated circuits have increased the number of devices on the silicon chip from a small figure to tens of thousands. In the '80s, VLSI technology will further increase the number of gates per chip to more than 100,000 and increase the chip density by a factor of five. These advances, though remarkable, are not at the theoretical limit, and with some yet-unknown breakthroughs, densities could progress below the one micron dimension with a still greater increase in the number of devices per chip.

VLSI uses and applications have not yet been fully determined. Without doubt, VLSI memories will provide very large storage capacities, but far more exciting uses appear likely. Complex problems in software, architecture, and interchip communications must be resolved, and will be, in order for the VLSI computer system to be assembled.

Combining the VLSI computer system with efficient software will make available extraordinarily powerful processing systems in small sizes. With VLSI application in a somewhat different mode, superpowerful and ultra-reliable processor systems may contain complex and frequently recurring problems completely solved in hardware structures. Demands for more and more computing power, for faster and faster response, and for small, energy-efficient systems will continue to push the technological progress required to market the VLSI computer system.

Many uses can be quickly identified for small, powerful VLSI processor systems. A wide range of military applications exists. Weapon system applications range from improved navigation of strike vehicles to advanced sensors with very sophisticated capabilities. Command control and communications (C^3) computer power requirements are currently large and projected to become much larger. Airborne C^3 computer requirements currently have no satisfactory solution. Powerful processor systems that are small, enduring, and flexible are required to fulfill the airborne C^3 requirement as it is adapted to the '80s.

Abundant Communications

The value of good communications has been recognized since the earliest recorded history. Communication systems are among the most important aspects of modern life and necessary to support most current activities. Communications are critical to national security in today's international environment. This fact can be easily demonstrated by noting that funding for communications-electronics R&D and procurement ranks third in the DoD budget.

In recent years, communication sys-

tems capabilities have increased greatly. The capacity of commercial and military communication systems has been increased by using computer controlled networks, by more and larger facilities, and by powerful communication satellites. Concurrent with these advances, demands for communication service in both voice and data transmission were frequently outstripping the growth in capability. Today's need for worldwide digital communications that are secure and survivable cannot be satisfied.

Abundant communications with the added features of security, survivability, and endurance will not be obtained quickly. High-quality communications are necessary to support most computer systems. The growing dependence of computer systems on communications and of communication systems on computers has become pronounced in the last few years. This trend surely will continue.

In the 1980s, many demands for expanded communications that are secure, survivable, and adaptable will be met with the aid of computers. Intersystem connectivity between dissimilar systems will be provided by processor switches and interface nodes. Security will be enhanced by combinations of data encryption and continued link encryption. Survivability of communication networks will be improved by redundancy of links and nodes, and by computer abilities to reconfigure the network. In the '80s, small powerful processors will support low-cost communication satellites, provide wide-area distribution of communication services, and handle heavy processor loads required to achieve security objectives.

Speech Processing

Speech processing and its promise for the future captures the imagination. In thinking of speech processing, it is easy to pass over routine uses to the fantasy of Mr. Spock talking to the *Starship Enterprise's* computer. But is it completely a fantasy to project speech processing at the natural language level? Speech research is most promising. Reasonable technological advances in the '80s will produce major natural language processing capabilities.

Interesting uses can be identified for processors that can accept speech inputs. With processor ability to handle larger vocabularies at the natural language level, really exciting applications arise. Voice inputs to processor systems can handle correspondence, data-base update, and information retrieval. Enormous benefits in accuracy, time, and cost occur if "third parties" are removed from the loop and the man-machine interface is achieved in natural language. With this single step, the computer would become a tool of the general public to a degree beyond all current experience.

Natural language processing in the national security arena provides some really stimulating possibilities. The combination of natural language processing and system interfaces to weapon control and sensor systems could open a completely new era for military command control. Imagine a sensor satellite with on-board advanced image processing systems interfaced to a natural language processor at command post locations. Real-time observations of critical intelligence or warnings could be broadcast immediately in natural language at command posts and other facilities. Processor systems would respond to verbal information retrieval requests, and third-party actions between the decision-maker and critical decision information would be at a minimum. With further use of natural language systems interfaced to weapon-control systems, the decision-maker would be directly connected to the weapon system.

". . . natural language processing and system interfaces to weapon control and sensor systems could open a completely new era for military command control."

This scenario may not be totally desirable, but with the computer advances expected in this decade together with progress in sensors, satellites, and communications, the scenario appears entirely feasible.

Distributed Data Base Systems

For years the Distributed Data Base System (DDBS) has been discussed and its imminent arrival forecast. However, the true DDBS has not yet arrived. Significant progress has been made in netting computers so that users interact with distance processors, but only limited developmental progress has been made with the distributed data base.

The functions necessary to support a central data base are required, with additional features to support a data base that is geographically spread among a number of processor systems. The Data Management System (DMS) of the central site system supports the user and aids in normal and failure-mode operation. Availability, reliability, and protection of data are key issues for the user of large data base systems. All these functions are necessary to support the data base user, and become very complex issues when the data base is divided and separated among a number of systems.

Data base updates and retrievals in a DDBS require more complex system communications and data management functions than does the central-type system. Failure-mode functions of the DDBS are even more complex in comparison to those of a central system. System response, data base recovery, and system restart in a DDBS

are complex activities, and may require excessive time and the use of substantial resources.

In the decade of the '80s, the true DDBS is again projected and its achievement appears likely. A more challenging objective is the Redundant Distributed Data Base System (RDDBS). The RDDBS would satisfy the requirement for storing and processing data at the source of the data, and would provide remote retrieval capabilities to all system elements. In addition, the redundancy features of the processing and storage network would provide greater reliability for normal operations and increased survivability during hostilities. The system software and network controls must meet all normal data base management requirements, provide the added functions needed to handle a distributed data base, and in addition must provide complex controls and communications to assure all redundant data processing is fully synchronized.

Further development must be realized in order to implement the RDDBS. It appears certain that enough low-cost, high-power computer and communications hardware will be available in the '80s for the RDDBS. With reasonable funding and support of software development, it should be possible to achieve in this decade a DDBS with multiple redundancies of key system elements.

* * *

Without doubt there will be great and important technological advances in the computer field during the decade of the '80s. Many will come from specific defense R&D, but even more from the competitive needs of industry. Identifying the technological area where the most useful progress will occur is difficult. Also, how fast technological growth will move into the hands of the computer system user is hard to forecast.

Significant computer technology advances occur in the short cycle of two to five years. Due to budgetary, political, and other constraints, major system acquisition cycles and system operating lifetimes extend over the long period of fifteen to thirty years. Accepting, for comparison, the most favorable figures of five-year major advance cycles and fifteen-year acquisition/operating life periods indicates that installed computer systems are behind the technology curve for sixty-six percent of their service life. Using figures that may be closer to actual experience in DoD and the Federal government of five-year technology advance cycles and twenty-year acquisition/operating life periods indicates that installed computer systems are behind the technology curve for seventy-five percent of their service life.

In the early days of computer technology—the 1950s and early 1960s—DoD and the services were pushing the computer state of the art and were clearly at the forefront as users of computer systems. Since those earliest days, DoD and other Federal computer system users have fallen further and further behind the major computer technology advances.

DoD and other Department programs for acquiring or upgrading computer systems have been delayed, canceled, and otherwise constrained by policies and procedures to the extent that many computer users are operating obsolete systems. Many Federal computer system operators have large numbers of mission requirements that cannot be satisfied. Unless significant changes are made and greater emphasis placed on rapid response to user needs, computer technology developments of the '80s will only leave DoD and Federal computer system users much further behind.

As with progress in computer technology, there are more pitfalls to system development than can be addressed in a single article. Therefore, we will examine only four pitfalls that constrain the computer user who needs system enhancement or replacement.

Maj. Gen. Jack Robbins, USAF (Ret.), was commissioned through the aviation cadet program in February 1945. He earned a BA degree in political science from U. of Alabama, an MS in mathematics at Oklahoma State University, and is a graduate of the advanced management course at the Harvard Graduate School of Business. The first half of his career was in tactical units; the latter half was in computers and communications activities at Air Force Systems Command, Communications Service, and the Air Staff. For four years prior to his retirement in July 1975, he was Director for Data Automation for the Air Force. He now operates his own consulting business with emphasis on the computer and communications fields.

Pitfalls

Corporate Thinking

There is an urgent need to rethink the entire computer issue. In too many cases, the computer system becomes a pawn in some power struggle, and the requirements of the user are submerged in a decision-making process that pays little heed to his problem. In thinking about computer systems and the service or mission support role they play, it is necessary to get close to the user and to know the job that must be done. All efforts and priorities must be aimed at meeting and promoting the needs of the user.

In many instances, the user's system needs are made second or even lower priority to some other interest. Typical corporate interests that interfere with appropriate response to the computer user's needs are: excessive standardization rules, policies that require competition to the nth degree so that the computer system is fractured into sections produced and maintained by different vendors, and arbitrary rules to force the computer system operator (frequently a service organization) to justify in minute economic detail the requirement for the computer system. Good judgment and common sense, together with knowledge of the user's requirement, can handle all of the issues, protect the corporate position, and respond to the user's needs in a proper manner. However, strong emphasis on the corporate issues at the expense of the computer system user's requirement will seriously damage the system, interfere in the delivery of quality service to users, and possibly reduce mission effectiveness in critical areas.

Organization and People

In most professional and technical activities, a good basic understanding of the problem area is essential to satisfactory performance. In the computer science field, it is important that system planners, analysts, operators, and decision-makers have a good grasp of the field fundamentals. The organization that operates the computer systems must recognize the need for professional and technical staffing, structure the organization so its professional staff can be effective, and ensure by management actions that its professional staffers know and support the prime missions of the total organization. The proper balance is total support of the organization's prime mission

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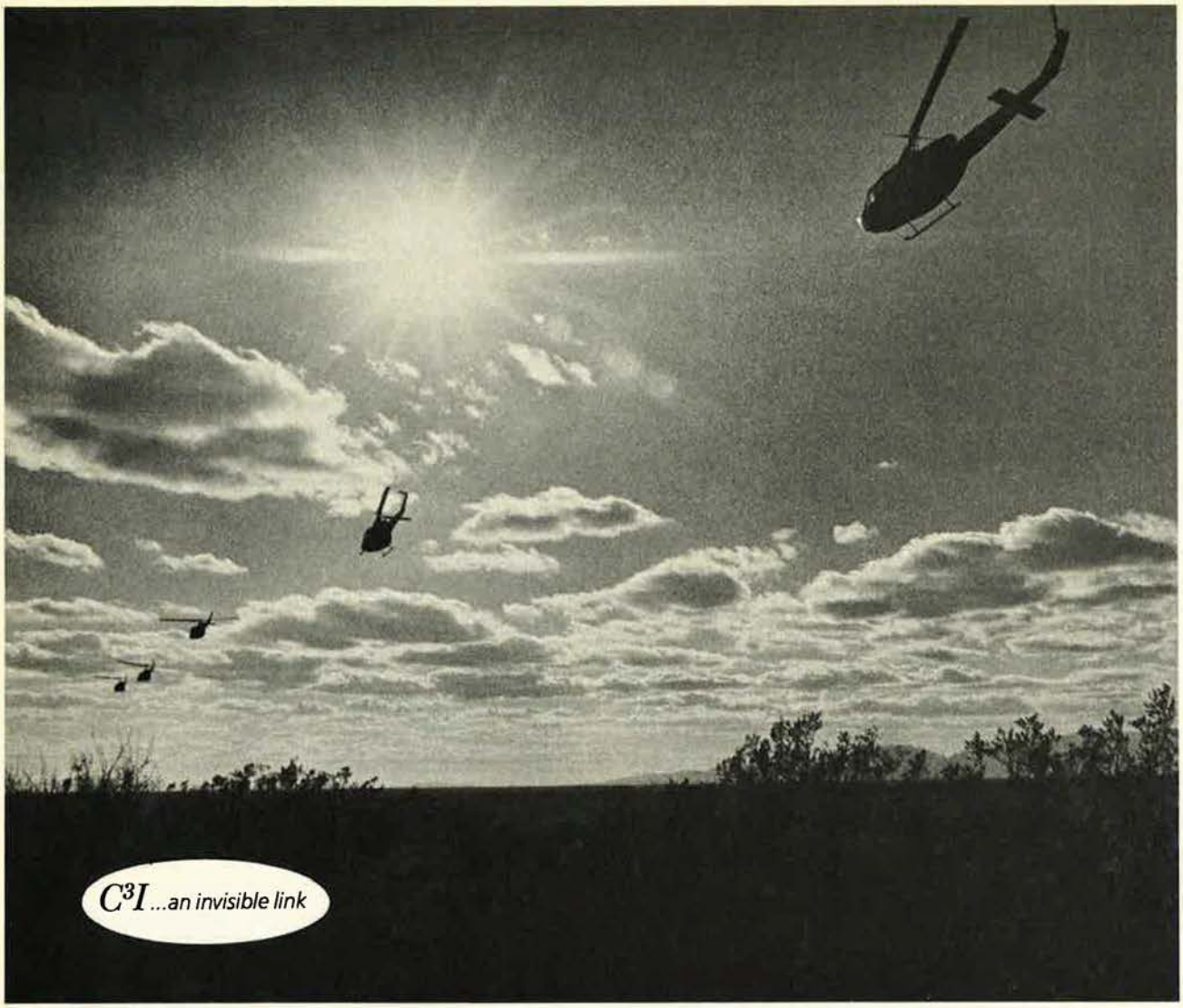

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by the professional computer staff, and senior management support of policies, procedures, and the professional staff to ensure that computer systems are efficient, effective, and technologically current.

Computer science people in most organizations are in a service role and provide support to others who occupy prime mission positions. However, it is often only an eyelash distance from the functions of the computer and the computer staff to the prime mission. In other words, the computer and the computer staff are frequently vital to the operational mission. Organization management must recognize the prime mission relationship and ensure by policy, interest, and action that this part of the organization is ready, trained, motivated, promoted, and responsive as key team members.

System Definition and Acquisition Actions

More good ideas have died in the system definition and acquisition phases of computer systems than in any other computer-related activity. Almost everything that can be said about these two important activities as now conducted is detrimental to the best interests of the organization, its mission, and the computer systems that are to be acquired.

First, and foremost, the acquisition period usually is absurdly long. Under current approaches, even a smooth-running program will require years to move from the requirement identification date to the computer system service date. This factor alone, if all other problems were resolved, would guarantee that most newly installed computer systems are outdated and that the user has new unsatisfied mission requirements.

There are a number of actions that, if taken seriously, might result in significant improvements. In the system definition phase, the user's main system problem should be addressed and unnecessary ties to other problems and other requirements avoided. Many times in staffing an originally simple user requirement, the system definition grows almost beyond recognition. This hurts, delays, and sometimes kills needed systems.

Many pitfalls can be found in the acquisition process. Three specific areas contribute to much distress in acquiring computer systems. First, too many organizations and too many levels within organizations are involved. It is not uncommon to have the acquisition process almost totally divorced from the user for whom the system is being bought. For large acquisitions, major change probably is not feasible in the near term. However, in most cases computer acquisitions should be handled with a minimum number of organizations involved and with the system user participating directly.

Second, computer acquisitions take too much time evaluating proposals, and the typical contract is overly restrictive on how the vendor and user may work together after a contract is awarded. Improvements are possible with adjustments to the procurement process. The normal computer system acquisition should be little more than obtaining a valid supplier source for the user. Eliminate the benchmark and make a technical and cost evaluation. Eliminate the seven-year or other fixed-contract period, and allow the selected source to support the user's requirement as long as the requirement exists or as long as the contractor's support is satisfactory. This approach clearly recognizes that acquisition activity is a time- and energy-consuming period, that it usually delays service to the user, and that it should not be repeated except as absolutely necessary.

> "The normal computer system acquisition should be little more than obtaining a valid supplier source for the user."

Third, almost all computer acquisitions concentrate on hardware with little attention to software. The worst software situation occurs when a user has a large amount of working software and wants to obtain a major system upgrade or replacement. When the acquisition procedure ignores existing software, the user may face a major software conversion task following hardware selection. If software conversion is part of the procurement, acquisition can cost more than is really necessary.

Two simple actions could greatly reduce the potential for cost or grief associated with existing software: Either acquire a vendor source as described earlier and retain that vendor for the life of the requirement, or allow the user to acquire a system that is compatible with his existing software.

Software

Computer software is not a pitfall to obtaining advanced technology in the same way as the issues outlined above. However, software is one of the oldest and most persistent pitfalls in achieving the level of computer service and support that is expected. In the '80s, there will be software progress, and new capabilities surely will emerge. But it is difficult to precisely pinpoint software advances that will have predicted benefits for computer users. Project Ada, DARPA's major software program, will provide significant new tools for software production and more efficient output by skilled personnel. But, if the past has any value in predicting the future, computer software will continue to be a difficult part of the computer technology scene in the '80s.

* * *

In brief summary, the 1980s will provide notable technology advances in computer-system hardware, and to a lesser degree in computer software. Other notable advances will occur in communications and in the development of special capabilities that will join with communications and computer systems to provide remarkable results. Many advances will be important both to national security and to systems and products for general use. Just as there will be opportunities, there also will be pitfalls in the pathway to orderly realization of the promised capabilities. Most of the pitfalls are created by policies, procedures, and management decisions. Many—perhaps not all—but many of the pitfalls could be removed or reduced in impact by appropriate, timely management actions. ■

In April, USAF offered AIR FORCE Magazine a unique opportunity to observe the proceedings of the Central Temporary Major Promotion Board and report on how a typical promotion board operated. This detailed account of the promotion process—too often shrouded in mystery and distorted by rumor—will answer your questions about what really goes on . . .

Inside a Promotion Board

BY MAJ. GENE E. TOWNSEND, USAF, CONTRIBUTING EDITOR

THE room was filled more than six deep and seven wide with Air Force colonels. It was a distinguished yet comfortable room, with its wood-paneled walls and blue-brown streaked carpet. Although the mood was positive, there was tension in the air. This was an important event in the career of thousands of Air Force officers. In a nearby office, other Air Force people were reviewing their briefings and double-checking to make sure that almost 5,000 records were ready.

The place: the boardroom of the Selection Board Secretariat, a unit of the Air Force Manpower and Personnel Center at Randolph AFB, Tex. The time: 7:30 Monday morning, April 7, 1980. The event: the calendar year '80 Central Temporary Major Board.

It felt strange being there, probably because I was not normally associated with the official Air Force promotion process. However, it was a unique opportunity. I was to be sworn in as an assistant recorder, allowed to observe the closed-door proceedings, and report a story from an insider's point of view.

Before this experience, my knowledge of how Air Force promotion boards worked was virtually nil. I subscribed to an almost fatalistic philosophy: Do a good job and the system will take care of you. For me, there was a strong ring of truth to that view since, so far, it had. However, my beliefs about the board process were permeated by a healthy skepticism, nourished over the years by several unsubstantiated rumors that previous articles, film reports, and briefings had not dissolved.

To put it simply, this skepticism was totally unfounded. There was not an iota of truth in any of the rumors I had heard, such as: "It helps to have a friend on the board; board members have time only to check where the blocks are marked (*i.e.*, word pictures aren't that important); the process is designed to favor select groups such as the rated or scientific career fields."

After watching a promotion board operate for almost two weeks, I walked away convinced that the Air Force has the best system possible, that every officer meeting a board receives fair and equitable treatment, and that there is no way that the deck can be stacked for or against one—or a group—of officers. Here's why:

Preparatory Activities

First, board members don't just show up and start scoring records. Neither do they catch no more than a few briefings before being turned loose on the links. Instead, considerable time is spent the first day in preparatory activities. They are briefed on their special responsibilities, provided facts about the demographics of eligibles, told the philosophy behind the whole-person concept, and provided detailed instructions on how a board operates.

Maj. Gen. Kenneth L. Peek, recently appointed Commander of the Air Force Manpower and Personnel Center, welcomed the group and told them this: "The temporary major board probably sends more signals to more people than any other board. A lot of people will make career decisions based on what they see coming out of this board. Therefore, yours is a very important task."

Col. Glenn L. Nordin, Director of Personnel Program Actions at the Center, then presented the "formal charge" and gave an overview of the next two weeks' activities. He explained that the purpose of the board was to select officers of the line, and chaplains, judge advocates, and health professionals (except physicians and dentists) in the primary and secondary zones for major. He also told the board that they would nominate some officers selected for promotion to attend intermediate service school, select Reserve officers for Regular augmentation, and choose some Reserve officers for continuation.

Other Briefing Highlights

Several other key points were explained to the board that morning. Here are some highlights:

- Since there was a maximum number that could be promoted, the best-qualified method of selection would be used. This meant that the board would arrange the eligibles in an order-of-merit listing (best to least qualified). The quota is then applied to this listing and those officers above the line where the quota runs out can be promoted. More details on quota computation and scoring records later.
- Officers would be evaluated using the whole-person concept. Board members were told to carefully review each officer's folder, especially in the areas of job performance and responsibility, leadership, breadth of experience, professional competence, and education. However, no one in the secretariat attempted to define the more subjective areas such as leadership.
- Steps were taken to put the different OER systems into their proper historical context. It was explained that the records would contain evaluations under several different systems. Board members were reminded that the controlled OERs were prepared under rules that required reviewers to apply rating controls consistently throughout the Air Force. The members were told that the controls were applied without regard to qualitative differences between review groups, the ratee's job, unit of assignment, or level of responsibility. They were asked to evaluate each of the ratings within the context of the rules under which they were prepared, and to carefully consider all OERs in the folder. "The controlled reports constitute only part of an officer's record. They

should not negate nor diminish the importance of other information," the briefer said.

- Although the selection folder reflects each officer's level of academic and professional military education, the board was to judge how these achievements enhanced performance or potential to assume greater responsibility. "Mere completion of these courses should not be given disproportionate credit, nor should officers be penalized for not obtaining advanced degrees or PME," the group was told.
- The subject of specialists and generalists was discussed. The board was informed that specialists may not have had an opportunity for career broadening and should not be penalized for that reason. "The Air Force needs both specialists and generalists," the briefer said.
- One AFMPC colonel explained that central selection boards are appointed by the Secretary of the Air Force to promote the best individuals regardless of command or assignment. "Each of you takes an oath to serve without prejudice or partiality, having in view both the special fitness of the individuals concerned and the efficiency of the US Air Force. When you enter the boardroom, you are expected to take actions which are in the best interest of the Air Force as a whole and not any one command. In this regard, your evaluation of minorities and women must clearly indicate that you have afforded them fair and equitable consideration. Equal opportunity for all is an essential element of our selection system."

When the briefing concluded, the board president, Maj. Gen. Walter D. Druen, Commander of Seventeenth Air Force (USAFE), passed on some additional advice.

"Remember, you are here to represent the Air Force, not a particular command. I have seen both ends of our promotion system and believe it is the best one possible. However, our jobs will be tough. There are more good people than promotions. Don't concern yourselves with how people that you might know are doing. Also, after the board is adjourned, information regarding selection or nonselection of officers is privileged and can't be passed on to anyone.

"The next few weeks will be some of the most important ones you will ever spend in the Air Force," he said.

The Trial Run

Following the briefings, the board members were given some practical experience before the actual selection process began. This was done through two procedures: an initial screening of ten records and a trial run—a practice scoring of fifteen records. At this time, the board members for the non-line promotion categories—chaplains, judge advocates, and health professions—moved to a separate part of the room, and began their own initial screening and trial run. Since they had far fewer records to review, their work—including selecting officers for promotion in the primary and secondary zone—was completed in only a few days. The procedures used by these panels were exactly the same as for the line, described in more detail below.

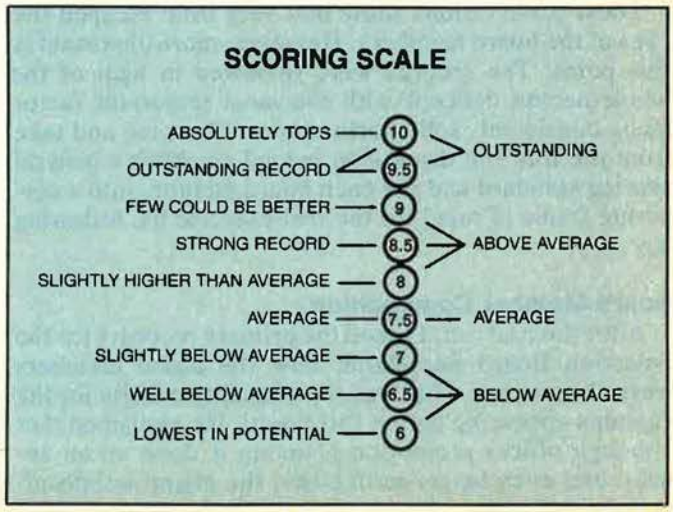
The purpose of the initial screening was to give the panel members a feel for the contents of the folders and to ensure consistency of scoring. The records contained all officer effectiveness and training reports, an official photograph, citations or orders for approved US decorations, the AF Form 11 (Officer Military Record—now a historical document last updated in April 1974), the officer selection brief, professional military education letters (either for declining to attend resident PME courses for personal reasons or for being denied the opportunity after being selected because of operation requirements), and copies of administrative requests for missing documents.

The folders were split into two sections. The left side contained all OERs, arranged chronologically with the most recent on top, and the official photograph under the stack of OERs. The right side of the folder contained all other personnel data. After the initial screening, the folders were collected and another fifteen passed out for the trial run. These records were carefully chosen to represent the full spectrum of quality, and to mirror the characteristics of the eligibles. For example, for this board the records included pilots, navigators, and about eight other career areas.

The purpose of the trial run was to provide members experience in screening records consistently, using the secret ballot concept. An important point needs to be made here. Secret ballot means just that. Although the records used in the trial run were later discussed for instructional purposes, during the actual selection process board members were not allowed to discuss records, and ballots were marked in secret.

Scoring the Records

Here is how the records were scored for both the trial run and subsequent selection process: Each panel member could vote a record in half-point increments from a low of six points to a maximum of ten (*see box*). The Selection Board Secretariat recommended 7.5 as an average score. What happened if four members voted a record 8 and one a 10? That is called a "split." A split is any difference in scores on a panel of two points or more. For example, if a record was scored 7.5, 8.0, 7.5, and 8.5, the scores would stand without further discussion since there was no split vote. However, if the variance was two points or more, the record was brought back to the same panel for rescoring. The reasons for the split rate procedure are to ensure that board members do not miss important aspects of the record, that there is no bias, or that board members are not letting personal knowledge of individuals influence their assessment. If



THE OVERALL BOARD RESULTS

PRIMARY ZONE

PROMOTION CATEGORY	TOTAL ELIGIBLES CONSIDERED	TOTAL ELIGIBLES SELECTED	TOTAL ELIGIBLES % SELECTED	NEW ELIGIBLES CONSIDERED	NEW ELIGIBLES SELECTED	NEW ELIGIBLES % SELECTED
Line	4,433	2,745	62%	3,211	2,425	76%
Judge Advocate	47	37	79%	40	33	83%
Chaplain	29	20	69%	22	17	77%
Nurse	137	72	53%	89	59	66%
Medical Service	47	28	60%	32	25	78%
Biomedical Sciences	112	75	67%	85	68	80%
TOTALS	4,805	2,977	62%	3,479	2,627	76%

*The Hq. USAF and Command Boards nominated officers of the line from the 10,338 total eligibles for further consideration by the Central Board. All eligibles in other promotion categories were considered by the Board.

necessary, the panel chief, the senior member on each panel, would arbitrate a discussion until the scores were brought within one and a half points. Resolving split votes was the only time during the selection process when discussing a record was allowed.

Back to the trial run. Each participant marked the fifteen records by secret ballot, using the 6- to 10-point scale described above. Then the ballots were collected, and the board members left for lunch. In a nearby controlled area, Secretariat personnel tallied the ballots. After lunch, scores were displayed on blackboards, board members were briefed on the results, and then they participated in a lengthy discussion about the contents of the fifteen records they reviewed. Here were some of their candid observations about those records:

"OER comments didn't reflect initiative—the blocks were all checked, but the word pictures didn't show enthusiasm; the individual had tough jobs, but didn't do them all that well; I was impressed that she actually used her advanced degree on the job; it appears he picked up a couple of 3's being the new guy in the division; this officer was eliminated from pilot training for circumstances beyond his control, yet went on to become an outstanding navigator; this person was a fast burner in the early days, but later OERs weren't as good; the officer would have been stronger with some PME or decorations; this officer has a solid record of proven performance, graduated in the top third at Squadron Officer School, and was consistently pushed for early promotion."

These observations show that very little escaped the eyes of the board members. However, more important is this point: The records were reviewed in light of the whole-person concept with the most important factor being consistent, solid performance. The give and take from the trial run discussion helped establish a general scoring standard and put each board member into a corporate frame of mind for the real exercise the following day.

Board Member Composition

After the trial run, I asked the primary recorder for the Selection Board Secretariat how the board members were chosen, and what was the eligibility criteria for the captains appearing before this board. He explained that although officer promotion planning is done on an annual, and even longer-term basis, the major actions affecting a board get under way about 120 days before it is convened. At that time, the eligibility criteria are established, eligible officers identified, and preselection briefs sent out.

For the April temporary major board, officers were eligible in the primary zone if they were line captains, chaplains, or members of the health professions with a date of rank of December 31, 1972, or earlier. To be eligible in the primary zone, judge advocates needed a date of rank of December 31, 1973, or earlier. Line officers and health professions with a date of rank from January 1, 1973, through December 31, 1976, were eligible for the secondary zone. Judge advocates with a date of rank from January 1, 1974, through December 31, 1976, and chaplains from January 1, 1973, through December 31, 1975, also were eligible for the secondary zone.

The primary recorder noted that about sixty days before the board met, the Secretariat received a list of eligibles by career area, major command of assignment, and aeronautical rating. Then the primary recorder requested selection of board members from the Assistant for General Officer Matters and the Assistant for Colonel Assignments, as appropriate. Board members were then assigned from the major commands and other agencies to mirror insofar as is possible the characteristics listed above of the officer population being considered for promotion. That's right. The senior officers chosen to work this board, as is true of all promotion boards, actually reflected roughly the same distribution of career areas and commands that the eligibles being considered for promotion display. In addition, appropriate minority and Reserve officer representation was provided. To reflect the characteristics described above, colonels were chosen from fourteen major commands and special operating and other agencies. Line and component board members consisted of twelve pilots, five navigators, and twenty-eight nonrated colonels from sixteen career areas. Non-line members came from the chaplain, judge advocate, nurse, medical service, and Biomedical Sciences Corps.

The Panel Concept

Both Title 10 of the US Code and Air Force policy require promotion boards to provide each officer fair and equitable consideration. Title 10 also requires that permanent promotion boards consist of at least five officers

SECONDARY ZONE

ELIGIBLE	NOMINATED	SELECTED	% SELECTED
10,338*	552	145	1.4%
204	204	2	1.0%
73	73	0**	0
521	521	4	0.8%
134	134	1	0.7%
326	326	2**	0.6%
11,596	1,810	154	1.3%

**Elected not to use the full secondary zone quota based on a quality assessment.

who are senior, in both temporary and permanent grade, to the most senior officer being considered. Air Force policy has been to use five-member panels on all temporary and permanent promotion boards. To ensure fairness and equity, and to comply with all requirements of law and policy, the Air Force normally uses only colonels as panel members for temporary and permanent promotion boards from captain through lieutenant colonel (*see box*). Brigadier generals serve as panel members for temporary and permanent colonel promotions.

Each panel has a fair distribution of the characteristics of the board. For example, if there are twelve pilots, and six line panels, each panel would have two pilots scoring records.

On captain and major temporary and permanent promotion boards, the senior colonel on each panel doubles as panel chief. For temporary and permanent lieutenant colonel promotion boards, each panel consists of four colonels with a brigadier general as the panel chief. On the corresponding colonel boards, a major general serves as panel chief with four brigadier generals rounding out each panel. Basically, the panel chief works as any other member with the exception of monitoring discussion over split votes.

Specifically, the recent temporary major board had six five-member panels scoring line officer records and three five-member panels scoring the chaplains, judge advocates, and health professions. About three days into the selection process, one of the line panels was chosen to score the secondary zone, leaving from that time on five scoring the primary zone. Since component panels had fewer records to consider, they scored all records in both the primary and secondary zone.

Panel Operations

Tuesday morning, the second day of the board, the panels were ready to score records. Nine panels were dispersed throughout the boardroom, the five members of each panel at one table, which was large enough for working in private. The boardroom was designated a controlled area, with no one entering without permission. I noticed that panel members did not use any one system for reviewing records. Some looked at the personnel data on the right side of the folder, then the official photograph, and up the stack of OERs from the earliest to the most recent. Others flipped to the photograph, then to the personnel data, working their way back through the OERs from the most recent. The only noise in the boardroom was the shuffling of papers. Finally, someone jotted down a score, followed by another, and another.

The board was fully in operation. Although the process was based on routine, it was an impressive situation; on each panel more than 100 years of experience reviewing ten years of performance. The career advancement of thousands of officers was hanging in the balance. Once the panel members found their scoring rhythm, they marked between 100 and 140 records a day. Most arrived early in the morning and stayed until late evening.

Records Flow

Contrary to what you may have heard, the records were not distributed among panel members in groupings such as by career area or major command. Rather, they were distributed using a true random method. Here's how: Once the files were received from the Records Service Branch at MPC, they were filed in sequence by reverse Social Security account number, and in stacks of twenty. Ballots were prepared for each panel member with twenty names corresponding to each stack of twenty records. The records were then loaded on carts and wheeled into the boardroom. The first stack of twenty records was given to Panel One, along with the ballots, the second stack to Panel Two, and so on.

After a record was scored, the ballot was marked, and another record scored until all five panel members finished scoring the stack of twenty records. As each member finished a ballot, an assistant recorder removed it from the table and took it to the administrative area. When all five panel members thus finished scoring a stack of records, the ballots were checked for splits by Secretariat personnel. If there were none, the scores were fed into the computer.

The computer tracks both individual and composite scores for each record, and is programmed to reject split votes. The composite score is simply the sum of all five panel members' marks. For example, if three scored a particular record 8.5 and two 9.0, the composite score is 43.5. All data is double-checked before being entered in or retrieved from the computer.

Only the records with split votes were brought back for arbitration. After the splits were resolved, those scores

COMPOSITION OF THE BOARDS

BOARD	PRESIDENT	PANEL CHIEF	PANEL MEMBERS
Temporary Colonels Regular Colonels	Lt. General	Maj. General	Brig. Generals (4)
Temporary Lt. Cols. Regular Lt. Cols.	Maj. General	Brig. General	Colonels (4)
Temporary Majors Regular Majors	Maj. General	Colonel	Colonels (4)
Temporary Capts. Regular Capts.	Brig. General	Colonel	Colonels (4)
Regular Appointment	Brig. General	Colonel	Colonels (4)

Boards consist of five-member panels. In each case the chief doubles as a panel member.

were then fed into the computer. I was told that less than one percent of the records scored had split votes.

Let's consider a hypothetical example. Since the records are distributed by reverse Social Security number, record number one could have been a pilot assigned to MAC, record number two a personnel officer in the Pentagon, and record number three an engineer assigned to Systems Command. In this example, since they are the first three records, they would have been in the first stack of twenty records and scored by Panel One. This process was repeated with the seventh stack also going to Panel One (there were six panels scoring line records the first day) and the eighth to Panel Two, until all the records were thus scored.

Remember, panel members only score records—they do not say "promote or don't promote." If, using the

News regarding Air Force officer promotions is expected to remain good for the next several years because of more stable requirements, smaller year groups, and shorter "pin-on" times. The result is a . . .

View From the Top—Mostly Optimistic

Since the accompanying article dealt primarily with promotion board operations and procedures, a few senior Air Force officers were invited to address some broader issues of promotion policy and outlook. For the most part, the view from the top is optimistic.

Lt. Gen. Andrew P. Iosue, DCS Manpower and Personnel, Hq. USAF, said that promotion opportunity for all grades is projected to remain high for the next several years. He cites two main reasons: "First, smaller year groups are coming along. In addition, since retention has fallen, the phase points [pin-on times] are dropping—that is, people are being promoted sooner."

However, he notes that the Senate version of DOPMA somewhat clouds the picture. "[It] proposes a tremendous reduction in the grade tables, but we do not believe the House will go along with the Senate proposal."

General Iosue also pointed out the lessening impact of "up-or-out" and his frustration with some who don't fully understand the concept. "I'd like to remove the 'out' from up-or-out and call it 'up-or-in' or 'up-or-continued.' On the one hand, we must have a competitive promotion process to ensure quality throughout the officer corps. However, with selective continuation, a very high percentage of Reserve officers in all career fields is being offered the opportunity to remain on active duty," he said.

Turning to the subject of promotion boards, General Iosue stressed that the Air Force never skews promotion opportunity to favor a particular group, or dictates what percentage of a particular career field will be promoted.

"I know that some believe a computer or some other mechanized system scores all the records with everyone above a certain line automatically promoted. That just isn't so. Every officer competes on an equal basis with every other officer. Our promotion system is equitable, it can be scrutinized, and serves the purpose of both the Air Force and the individual well."

General Iosue was asked what—if any—lingering effects still remain from the controlled OERs?

"There are still some; however, as time passes, the more diluted they will become. We find that the most recent OERs carry the most weight with a promotion board. It is important, however, to maintain a consistent record of good ratings. Records reflecting erratic performance don't fare too well," he said.

He also noted that people writing OERs equivocate too much. The General suggests that raters be clear, concise, and say exactly what they mean. "If they want a person to be promoted, they should say 'promote.' If they think a person should be augmented in the Regular Air Force, or attend a service school, it should be clearly stated in the evaluation. One problem promotion boards have is trying to read between the lines," he said.

The General has some advice for those trying hard, but worried about being promoted. "Hang in there," he said. "Promotion opportunity looks good for at least the next five years. Do the best job you can. Show initiative, seek responsibility, and you will be recognized as the type of officer the Air Force needs and wants to promote."

The Commander of the Air Force Manpower and Personnel Center, Maj. Gen. Kenneth L. Peek, Jr., underscored the importance for the Air Force of maintaining a competitive promotion system.

"Competition provides incentive for people to achieve or excel. If you take it away, you could remove the edge from an individual's motivation," he said. General Peek noted that it is "the American way" to have competition and recognize people who are a cut above. However, he recognized that many people who are performing well can't be promoted because of grade restraints. "There is a continuation program for many of those individuals," he said.

There is another important aspect of this issue. General Peek observes that if the Air Force promoted on a seniority instead of best-qualified basis, people would not be promoted to major until about seventeen years, lieutenant colonel about twenty-one years, and colonel about twenty-eight. "If you don't have a best-qualified system, you are talking about significant changes to the promotion phase points," he said.

Maj. Gen. William R. Usher, Director of Personnel Plans, at Air Force Headquarters, raises an even more basic issue about Air Force promotion policies. "It is easy to overemphasize the career progression aspects of our promotion system. True, that is important, but the Air Force promotes people to meet its needs." He explained that the Air Force goes through an extensive process to determine manpower spaces and the grades necessary to sustain them.

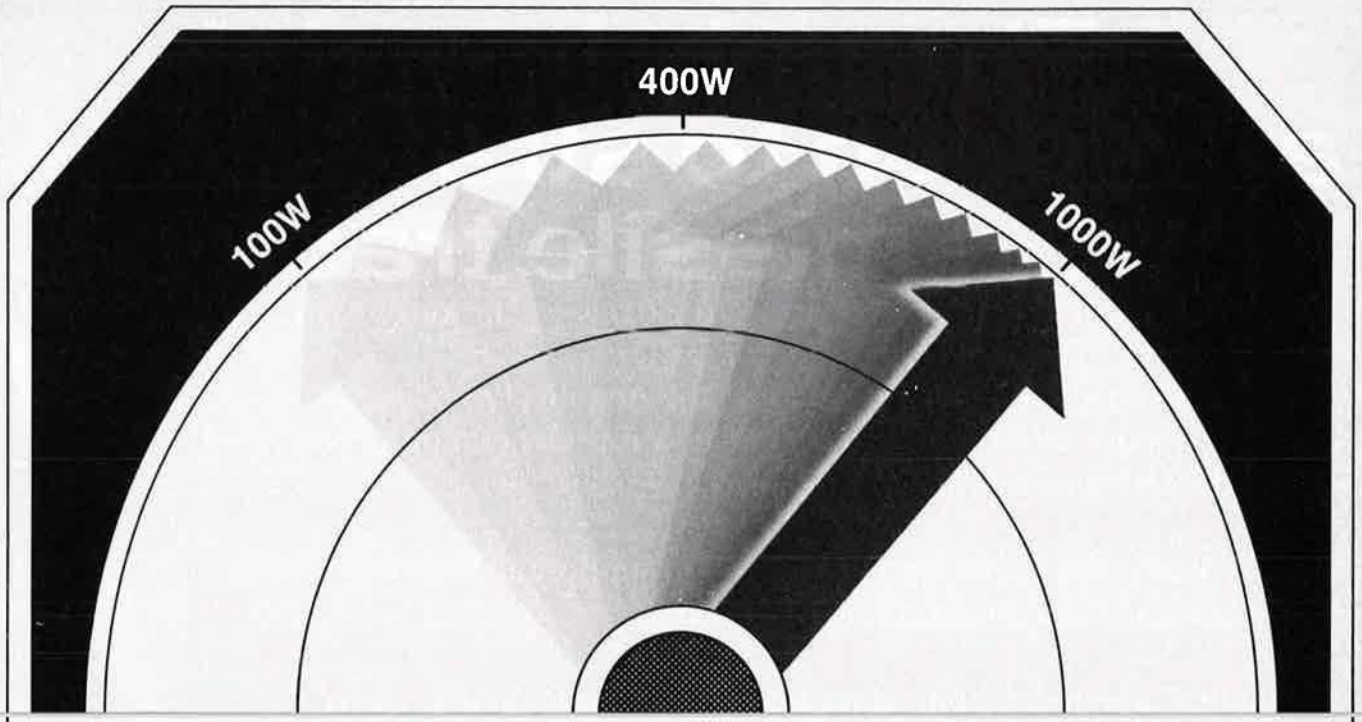
"We don't throw darts at a board to determine our grade requirements. We establish standards for each function, the total of which are our aggregate needs. From there we determine how those needs compare to our authorized grade structure. Therefore, while the promotion process does provide career progression, it is important to remember that it is also tied to our required grade structure," he said.

General Usher also described the relationship between promotion opportunity and phase points (pin-on times). He noted that the extent to which phase points can be reduced is a function of the year-group size, coupled with retention. Normally, the Air Force tries to keep promotion opportunity stable and, if adjustments need to be made, they are made to the phase points.

"If we have both improved promotion opportunity and improved phase points, that means that retention isn't as good as it should be, with an attendant loss of experience. It is important to have both good retention and promotion opportunity. Also, if promotion opportunity and phase points are poor, that will affect retention negatively. Our promotion policies are designed to maintain an appropriate balance between the needs of the Air Force for experienced officers in the various grades and the needs of the individuals for career progression," he said.

General Usher further explained that the reason the quota for the temporary major board was increased to ninety percent, and selective continuation boards convened, was because the force moved from a declining strength following Vietnam to the current more stable one. "Throughout much of the '70s, declining Air Force requirements led to force reduction programs and restrictive promotion quotas. Now, our more stable requirements and emphasis on retention and preserving experience enable us to improve promotion opportunities, offer continuation to Reserve captains, and let other Reserve officers serve beyond twenty years. These changes weren't made lightly. We realize it is important to maintain consistency so everyone has a fair and equitable promotion opportunity. While there is always some uncertainty about the future, we believe we can maintain the higher promotion opportunities and continuation programs for the years to come," he said.

—By Maj. Gene E. Townsend, USAF



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example cited above, the engineer's record was clearly outstanding, it might have received scores ranging from 9.0 to 10. If the personnel officer's record was solid, but not quite as good, it would have scored slightly lower, and so on. It is important to note that people assigned to the Selection Board Secretariat take care of all the administrative details during the selection process to include posting scores. In short, panel members don't even know how another member voted, much less what composite score was given a particular record. Nor do they know what mark will be necessary for promotion since that isn't computed until after the scoring is completed.

At this point, some may be wondering whether or not a record might have received a higher, or lower score, if reviewed by a different panel. The answer is yes, but that really doesn't matter. Panel-by-panel scores do run pretty close to each other, but may vary a point or two. Therefore, a record could receive a different score if reviewed by a different panel. However, it must be remembered that people are not promoted based on a raw score. They are promoted based on the order-of-merit listing resulting from *the panel scoring the record.* In other words, any score is relative only to other scores generated by the same panel. To better understand this, let's describe how the quota is broken out.

Overall Quota Breakout

When discussing promotion opportunity and how the quota is generated, there are a few things to keep in mind. First, only *new* eligibles generate quota. For example, 3,211 *new* eligible line officers met the recent temporary major board. Promotion opportunity was ninety percent of that number, or 2,890 officers. However, five percent of the 2,890 (145) could be promoted in the secondary zone. Yes, secondary zone promotions come out of the primary zone quota. Therefore, subtract 145 from 2,890 to leave 2,745 promotions for the primary zone. But new or first-time eligibles and secondary zone nominees aren't the only officers meeting a board. Each board also has several hundred previously considered, nonselected officers. Therefore, this figure must be added to find the total eligible. Since there were 1,222 previously considered officers, the total number of officers eligible on this board came to 4,433. To find the percentage of officers that could be promoted out of the total eligible, divide the number of promotions allowed—2,745—by the total eligible—4,433—and the figure comes to slightly less than sixty-two percent. In other words, about sixty-two percent of the total eligible line officers meeting this board could be promoted.

Many officers think that the ninety percent promotion opportunity from captain to major means that ninety percent of the officers meeting the board get promoted. It doesn't break out that way. However, there is another way to look at the issue. If a captain considers his cumulative chances for promotion in the secondary and primary zones (both as new and previously considered eligible) it will approximate ninety percent—that is, about ninety out of 100 will be selected. Just remember, though, that each board generates a quota similar to that described above.

Panel Quota

By Tuesday evening of the second week, the line panels had finished scoring records, and on Wednesday morning received their share of the overall quota based on the number of records scored. For example, one panel had scored 826 records. Independent studies have proven that when a panel has scored 240 or more records, it has seen the full spectrum of quality. Since about sixty-two percent of the officers reviewed by each panel could be promoted, this panel could promote 512. Here's how the Secretariat actually figured out the math: They divided the 826 records scored by the total officers eligible (4,433) for 18.63 percent. Then they took 18.63 percent times the total promotions possible (2,745) for 511.47 (rounded up to 512). The other panels received a proportionate share of the quota using the same procedures.

The main point is this: It doesn't matter if one panel scored slightly higher or lower than another, or if there were slight differences in the number of records reviewed among panels. Because each panel has received a random selection of records, the distribution of quality among panels is the same. Each panel received an exact share of the quota based on the number of records it scored and promoted from its own order-of-merit listing. However, it is likely that the quota cutoff will fall at a point where several officers have identical scores. When this happens, each panel goes through an exercise called "resolving the gray."

Resolving the Gray Area

For this board, there were 425 officers in the gray area, but only 103 of these officers could be promoted. To see how the gray is resolved, let's again use the panel that scored 826 records of which 512 could be promoted. When their order-of-merit listing was completed, everyone with a score of 40.5 and above—470 in all—were clearly above the gray and could be promoted. Since their quota was 512, another forty-two could be promoted. Going down another half-point on the order-of-merit listing included 109 people. Now comes the

PROMOTION BOARD SAFEGUARDS

- Board and panel membership reflects characteristics of eligibles, *e.g.*, aeronautical rating, major command, career area.
- Eligible officers review and verify accuracy of their selection brief before it is included in selection folder.
- Board members are thoroughly prepared for task via briefings and trial run exercise; take oath to consider the legitimate interests of both the individual and the Air Force.
- Records are randomly distributed to panel members without regard to career area, aeronautical rating, or other characteristics.
- Each panel member independently evaluates each record and records his score on a secret ballot.
- Significant variance between panel member scores on a given record requires reevaluation of that record.
- Board president performs extensive review of panel members' work to assure consistency among panels and to assure each record is appropriately scored relative to all others. Has record reviewed by another panel if appropriate.
- Records are updated and rescored as long as board is in session.
- Each panel gets proportionate share of total board quota.
- Each board member signs the Board Report certifying that the best-qualified officers were selected.

tough part. How do you promote forty-two out of 109 whose scores are identical, or virtually so?

Again, to ensure fairness and equity, all 109 records were rescored. The same was true for the gray area of the other panels. After the records were rescored, a separate order-of-merit listing was prepared for them and 103 officers were selected out of the 425 for all panels.

Secondary Zone Selections

For this board, major commands and Air Force Headquarters nominated 552 to be considered for promotion below the zone. Officers are selected in the secondary zone basically the same as for the primary. As mentioned earlier, about the third day of the board, one of the line-officer panels was chosen to score the secondary zone. Remember, the quota for the secondary zone came to a maximum of five percent of the primary zone quota, or 145. After the records were scored, an order-of-merit listing was prepared. The secondary zone panel conducted a gray area resolution similar to the primary zone.

However, there was an additional quality check. Each promotion board is required to certify that the quality of the secondary zone is superior to the primary zone officers who will be displaced. Each panel made this determination by comparing the records of the lowest scoring officers that could be selected from the secondary zone, to the records of the highest scoring officers that would be displaced from the primary zone. In each panel's judgment, the quality and potential of the secondary zone candidates was clearly better than those being displaced, so the full secondary zone quota was used. Finally, the board had completed its primary task—that of selecting people for promotion. However, it still had some work to do.

Selective Continuation, Regular Augmentation, and School Selection

Of course, the big question coming out of a promotion board is: Did I get promoted? On this board, the news was good for the majority, yet not totally bad for those that didn't make it. For the second consecutive year, the Air Force decided to offer a significant number of Reserve officers who twice failed promotion a chance to extend on active duty for three years. To provide the board members some background, a special briefing was given highlighting Air Force needs. In short, the board was told that the Air Force has shortages of captains in all areas, but especially in the pilot, navigator, and engineering skills. They were told that there was no limitation on the number that could be offered continuation, but to exercise judgment to ensure that the Air Force retained fully-qualified officers. Separate panels were then formed to review all the eligible officers for continuation. The result was that a very high percentage—about ninety-five percent across the board—was selected.

In past years, the percentage of Reserve officers selected for promotion to major who were also offered a Regular commission was very small. To determine which officers should be offered Regular, the records were rescored, an order-of-merit listing prepared, and a certain percentage nominated. This year that wasn't necessary. The Air Force decided that the board could offer Regular appointments to all Reserve officers selected for promotion if otherwise eligible. Therefore, the board decided it wasn't necessary to rescore the 761 records in this category. Panel members simply reviewed each record to ensure that each individual met high standards of quality. As a result of the review, each one is being offered a Regular commission.

Finally, the panel's order-of-merit listing was used to help board members decide which officers should be nominated to attend intermediate professional military schools. All the secondary zone selections as well as twenty-five percent of the primary zone selectees from the top of the order-of-merit listing were nominated.

A Few Final Points

A few general observations round out this report on the promotion process. First, the board president. This experience showed me how important his role is. General Druen did not just serve as a figurehead. He actively monitored all the panels throughout the process. Stacks of records were continually being piled on his desk for review. He told me his job was to act as a leveling influence to ensure fairness, consistency, and equity.

"I looked at more than twenty percent of all the records near the cut point to make sure that the quality in this area was about the same among the panels. Since it was, I knew they were doing their job," General Druen said. He pointed out that records are reviewed by a promotion board a lot more than people realize. He said many records had been evaluated by as many as three panels to ensure they were scored appropriately. General Druen also said that many officers with controlled 3's on OERs were selected by the board for promotion.

Second, the role of the Selection Board Secretariat. They were around the office working from 6:00 a.m. until midnight—a heavy schedule when you consider that AFMPC holds about thirty-five central selection boards a year. One day I saw the NCOIC of the Secretariat, a chief master sergeant, inserting a document into a record. That prompted me to ask him how late additional information—*i.e.*, OERs, citations for decorations, or notices of completing PME or an advanced degree—could be inserted into a record for board review. "Until the last record has been scored and that phase completed," he told me. If a record has already been scored and new documentation comes in, the record will be pulled, the document inserted, and the record given back to the panel to be rescored. The Chief recommends that each officer do everything possible to ensure that his record is up to date well in advance of the board.

Finally, the professionalism of the board members. They approached their tasks with complete seriousness and dedication. When it was all over, I asked several for their impressions of the process. Here's what they said:

"In spite of rumors to the contrary, it is impossible to be an advocate for someone, affecting selection or non-selection. . . . I personally spent several minutes on each record as did all other members of my panel. . . . We didn't just flip through a record, look at the picture, mark a score, and move on to the next one. . . . We didn't decide performance or potential—the individual did—along with the raters and reviewers."

One colonel put it this way: "The most important thing is to do your job well. There is no substitute for performance. How a person performs in the past is a good indicator of how he will perform in the future." ■

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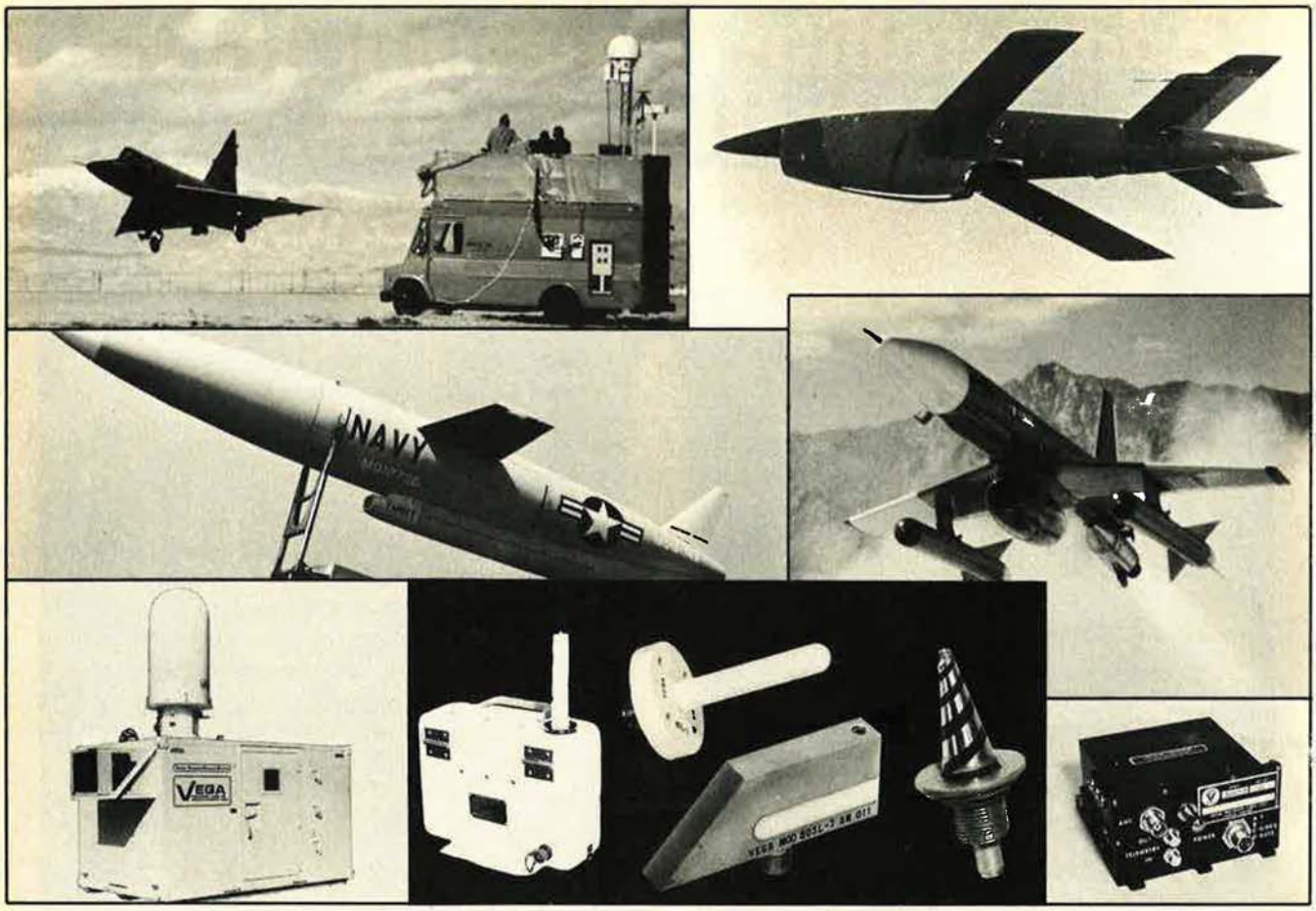

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Has the military let the nation down in crises of the last two decades, as some critics claim? Look at the record and the nation's response, and ask yourself . . .

Who Has Failed Whom?

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

AS WE stumble from one crisis to another, there is a natural desire to pin our troubles on some tangible source. One popular view has the Carter Administration at fault. There are, in fact, some fairly compelling arguments for that particular judgment, what with erratic NATO leadership, a defense budget that seems out of touch with the times, and the general air of uncertainty, if not downright incoherence, that marks our policymaking apparatus.

Another view has located an easier mark. The military, we are told, has once again failed the Commander in Chief, just as it failed other Commanders in Chief at the Bay of Pigs, Son Tay, the *Mayaguez* rescue, and during all the long years in Vietnam. The Bay of Pigs has become, of course, part of our American folklore. As is the case with folklore, the facts about that bungled affair have little to do with the tale. It is enough to remember that a cautious President forbade the use of military airpower and thus sealed the fate of the CIA-directed amphibious assault. The Joint Chiefs of Staff had little to do with that amateur performance.

The Son Tay raid was brilliantly carried out and was thoroughly professional in every respect. The fact that our prisoners had been moved out of Son Tay a few days before was bad luck, though not entirely a surprise. Our intelligence was not all that bad. The raid itself, precise and deadly in its execution, was a welcome signal to our POWs that they had not been forgotten. That, and its unsettling effect on the North Vietnamese, was reason enough for the mission.

Maybe there was a bit of overkill in the *Mayaguez* affair, and certainly there was too much supervision from Washington, but the intent was to avoid another *Pueblo* ignominy, where indecision and a reluctance to use force cost us a great deal of respect in the Far East, where face counts.

When we get to Vietnam, what can we say? It has all been said so many times and yet the fable of a US military defeat lives on. Never mind the clear and indisputable fact that the original enemy, the Viet Cong, was thoroughly defeated in the First Vietnam War. And never mind that North Vietnam, in the Second Vietnam War, was on the verge of defeat when our own troubles here at home brought an end to any further sensible military measures. Never mind all that, the folklore has it that our military let the nation down. Now we have Desert 1 and the humiliation that followed the helicopter collision with the C-130.

There is no way of assessing the probable chances for success of the plan to free the hostages. We are told the mission was recalled because three of the helicopters had failed, and that will have to do. What is not quite so persuasive are the reasons given for not laying on more choppers, although clearly a lot of thought went into the planning, and eight choppers seemed to be the right number until all those gremlins went to work.

Space-age communications have introduced, probably forevermore, high-level oversight into any military operation. No longer can an Admiral Nelson turn his blind eye to a telescope as a way of ducking an order to withdraw. Nowadays he would have too many people in London looking over his shoulder. This is not to infer there would have been any other decision if the colonels at Desert 1 had been alone with their thoughts. It is just meant as a melancholy observation. We are now in the era of His-eye-is-on-the-sparrow command and control, and there is no way to turn that clock back.

At any rate, there were some reassuringly professional activities before the thing came apart. Getting to a spot on the road to Tabas, undetected and in the middle of a black night, is more difficult, shall we say, than flying a 727 from Denver to Chicago. It is no job for fainthearted or run-of-the-mill aviators. Had the accident not happened—and it did happen after the recall—the rescue effort might still be just one of those unconfirmed rumors floating around the press clubs of the world. In all the weeks of preparation, there had seemingly been no leak, a remarkable commentary on the ability of several hundred military types to keep their mouths shut in this era of total revelation.

Desert 1 does not matter anymore, of course. It is finished, the whole scheme blown higher than the Washington Monument. What does matter are the tests that lie ahead. Whoever is President of this land of ours in the years just down the road, he is going to be faced with some very tough decisions. Unless he has faith in his military, and, more importantly, reason for that faith, his options are going to be severely limited. So far, despite the claims of those who would have it otherwise, the military has not let the nation down. All things considered—the miserable pay, the shrinking benefits, the lack of spares and other wherewithal to do the job, the general attitude toward things military—it is the other way around. ■

One of the authors of the basic plan for the World War II strategic air campaign describes how four AAF officers drafted that remarkable document in seven days, how it was executed in Europe, and how it might have ended the war sooner.

The Plan That Defeated Hitler

BY MAJ. GEN. HAYWOOD S. HANSELL, JR., USAF (RET.)

First priority under AWPD-1 was defeat of the German Air Force, essentially completed by the spring of 1944 through combat attrition and strategic attacks on supporting elements of the economy. At war's end, there were hundreds of scrap piles like this throughout Germany.

This article is reprinted from the forthcoming Volume IV of IMPACT, an eight-volume series of books in which are republished all thirty issues of the formerly classified World War II IMPACT, a monthly pictorial account of the air war prepared by the AAF's Assistant Chief of Staff for Intelligence during the war years. To each volume have been added retrospective essays on various aspects of the air war, written by wartime military leaders or observers of the combatant nations.

—THE EDITORS

As HITLER's armies cut their paths of victory through Europe, a mounting wave of apprehension engulfed the Administration in Washington. Programs for expansion of the armed forces were presented to a reluctant Congress. One such program called for expansion of the Army Air Corps to fifty-four groups. It was presented to Gen. George C. Marshall, Chief of Staff, early in 1940. On conclusion of the presentation by Maj. Laurence S. Kuter, General Marshall asked a penetrating question: "Why is this a fifty-four group program? Why not fifty-six, or sixty-four?"

As usual, General Marshall had gone directly to the root of the problem. What purpose was to be sought? What was the objective? Did it require fifty-four groups to attain that objective? Why? What was the strategic plan?

When the next opportunity arose for presentation of a major program, General Marshall's lesson was remembered. The planners asked themselves, what was expected to be achieved with the force? What was the purpose?

The next major program was the result of a presidential inquiry almost a year later. On July 9, 1941, some two weeks after Hitler had launched his massive attack on Russia, President Roosevelt addressed a letter to the Secretaries of War and the Navy, asking them to prepare an "estimate of overall production requirements required to defeat our potential enemies." There was, as usual, a short deadline for a reply.

The Joint Board of the Army and Navy was unable to agree upon an operational strategy, so each Department proceeded to prepare its own requirements.

The burden of preparing the War Department's reply fell upon the War Plans Division of the War Department General Staff. The War Plans Division proposed to estimate air requirements, which were coordinated with ground requirements, and to append the air details to its report as "Annex 2—Air Requirements." Col. Harold Lee George, who had just been appointed Chief of the Air War Plans Division of the Air Staff, authorized three weeks earlier, asked that the responsibility for preparation of the Air Annex be placed upon his Division. Gen. Henry H. Arnold made the necessary arrangements.

The War Plans Group of the infant Air War Plans Division consisted of two people: Lt. Col. Kenneth N. Walker as Chief of the Group, and myself, Chief of the European Branch. Two chiefs and no Indians at all. Harold George devoted his full time to the project, and that made three. He succeeded in having Larry Kuter, on duty with G-3 of the General Staff, temporarily assigned to his Division. The four of us were faced with the task of preparing a strategic air plan for the conduct of war on a worldwide scale, and determining the forces that were needed to carry out such a plan. We would be constrained only by the physical capability of the United States to produce the recommended forces.

In this latter regard we had the benefit of advice and counsel from the Air Materiel Command, with Maj. Max Schneider serving as a priceless liaison. By the time we got authority to proceed, there were only seven days left for submission of the plan and report. We had one valuable asset going for us: We had spent years together as instructors in Bombardment and Air Force at the Air Corps Tactical School. We embraced a common concept of air warfare, and we spoke a common language. I had spent the past year as head of the Strategic Air Intelligence Section of the Office of the Chief of Air Corps, amassing and analyzing economic and industrial intelligence on the Axis powers. That intelligence now proved a priceless asset.

Strategic Alternatives

Harking back to General Marshall's comments as well as our own teachings, we realized that the first requirement for our plan was a statement of purpose—a strategic objective. What should the air force try to achieve? What was the overall purpose? That was the fundamental keystone to plans, requirements, and operations. But that purpose was not only missing from our instructions; it was also exceedingly hard to define.

The President's letter had called for defeat of our potential enemies. This was important guidance. Although he did not specify who our potential enemies were, there could be little doubt that they were the Axis powers. His call for defeat cleared the air of any compromise objective. And we had two other guidelines that were significant. In passing the air requirement responsibility to the Air Staff, Gen. Leonard T. Gerow of the War Plans Division had stipulated that the provisions of ABC-1 and Rainbow 5 should be followed. ABC-1 (American-British Conference No. 1) had taken place the previous February, and its conclusions were incorporated in Rainbow 5 war plan in May of 1941. ABC-1 called for strategic offensive operations against the European Axis powers as a maximum effort and strategic defensive operations in the Far East, with minimum diversion of forces from the main effort. And ABC-1 specifically stated:

> Offensive measures in the European area will include a sustained air offensive against German military power, supplemented by air offensives against other regions under enemy control which contribute to that power.

But what should be the relationship of airpower to the achievement of the national purpose and to the other forces? Air forces are flexible, but special types of aircraft are best suited to specific roles, and the selection and provision of aircraft would depend upon the major role to be assumed by airpower. Even in regard to the defeat of the European Axis powers there was a wide range of strategic air purposes to be considered:

(1) Should the "sustained air offensive against German military power" seek to crush the war-making capability of the Third Reich by air warfare alone? If so, it would be necessary to destroy not only the industrial structure that supported the German armed forces, but also the industrial and economic structure that sustained the state itself. Or

(2) Should the "sustained air offensive" seek to pave the way for invasion of the continent, with subsequent strategic air operations to continue to weaken the German ability to fight, in a continuing strategic air effort that was coordinated with the land campaign? Or

(3) Should the sustained air offensive seek only to guarantee the success of the invasion, and devote its entire strength to the support and success of the land operations, which would become the sole reliance for final victory? And

(4) What were the requirements for home defense?

The targets, the type and number of aircraft, and the organization of the air forces would vary with each of these options. Selection of a basic overall strategy was the *sine qua non* of air planning. And the problem was further compounded by the knowledge that the plan would have to take up the gauntlet of the War Department General Staff, culminating in a presentation to General Marshall. If General Marshall did not approve, the whole scheme simply would be discarded.

General Marshall was himself a farsighted, broad-minded leader who had shown strong support for airpower. But many Army officers still adhered to the official statement of Army doctrine, which stated that the sole mission of the Army Air Forces was the furtherance of the mission of the mobile army.

We knew that a strategy oriented solely to invasion and air support of ground warfare involved troublesome prospects, including long and perhaps disastrous delays. We knew that the War Plans Division had concluded that it would take two years to build a merchant marine capable of transporting and supplying the necessary ground forces. And it would take another six months to prepare them for invasion. An air offensive could be launched in half the time. Furthermore, the War Plans Division was frank in admitting that Hitler's seasoned war machine would have to be seriously weakened before we could

hope to defeat the Wehrmacht on the ground. In any event, the German air forces would have to be defeated before an invasion could be undertaken. There was general agreement that a successful air offensive, which would include defeat of the Luftwaffe, must precede invasion. There was less unanimity as to what other purposes that air offensive should seek to accomplish.

The Air Mission and Objectives

We wrestled, as a group, with this basic and fundamental problem. The final solution was a statement of objective and a plan that leaned heavily toward victory through airpower, but which provided for air support of an invasion and subsequent combined operations on the continent *if the air offensive should not prove conclusive.* If the air offensive succeeded in destroying the German ability to support the war or in bringing about capitulation, so much the better. The closer the air offensive came to finality, the greater the ease and the less the cost of invasion.

In the Air Plan we described the overall objective—the Air Mission—in these terms:

> A. To wage a sustained air offensive against German military power, supplemented by air offensives against other regions under enemy control which contribute toward that power.
>
> B. To support a final offensive, if it becomes necessary to invade the continent.
>
> C. In addition, to conduct effective air operations in connection with Hemisphere Defense and a strategic defensive in the Far East.
>
> . . . there is a very high drain on the social and economic structure of the [German] state. Destruction of that structure will virtually break down the capacity of the German nation to wage war. The basic conception on which this plan is based lies in the application of airpower for the breakdown of the industrial and economic structure of Germany. This conception involves the selection of a system of objectives vital to continued German war effort and to the means of livelihood of the German people, and tenaciously *concentrating all bombing* toward the destruction of those objectives.
>
> . . . it is improbable that a land invasion can be carried out against Germany proper within the next three years. If the air offensive is successful, a land offensive may not be necessary.

The plan acknowledged that the German air force, especially the German fighter force, would have to be defeated before an invasion could be contemplated, and that such a defeat might also be necessary to the prosecution of the air offensive itself. Hence, defeat of the German air force was accorded first priority among air objectives—an "intermediate objective of overriding importance," to take precedence over the Primary Air Objectives themselves.

As for Primary Objectives, the plan called for destruction and disruption of:

> A. **Electric power:** disruption of a major portion of the German electric power system.
> "Literally all the wheels of industry—civil as well as military—turn by electric power. The German electric power system, the second largest in the world, is known to be strained by the war effort. It is operating at 50% greater rate than that of Great Britain. All the armaments industries, including aircraft and engine plants, are directly dependent upon electric power." The electric power system might be likened to the neuro-muscular system of the human body. Disruption would vitiate controlled action. It was estimated that destruction of fifty targets would bring about collapse.
>
> B. **Transportation**
> "72% of German transportation is carried out by the railroads, 25% by canals and waterways, 3% by long-haul truckage." The transportation system bore the same relationship to the German corporate body as the bloodstream to the human body. Without a free flow of transportation, raw materials could not reach processing plants, manufactured parts and supplies could not reach factories and assembly plants, and finished products could not reach consumers, whether they be armed forces or civilian institutions. Forty-one targets, consisting of marshaling yards, bridges, canal locks, and inland harbors were set up for the accomplishment of this objective.
>
> C. **Petroleum and Synthetic Oil**
> "German motorized forces, the German Air Force, the German Navy, and a large block of German industry are dependent upon petroleum products. The blockade has cut off external sources other than Romania, leaving the Reich heavily dependent upon a group of synthetic oil plants." Twenty-seven synthetic plants plus the refineries at Ploesti in Romania were set up to accomplish this objective.

In summary, the plan called for destruction of the following target systems and targets:

German Air Force	18	airplane assembly plants
	6	aluminum plants
	6	magnesium plants
Electric Power	50	generating plants and switching stations
Transportation	47	marshaling yards, bridges, and locks
Synthetic Petroleum	27	synthetic plants
TOTAL	**154**	**targets**

How Many Planes—How Many People?

Bombing requirements for the destruction of each target, including repeat attacks to prevent restoration, were computed, using target dimensions and characteristics and tables of bombing probability.

Allowances were made for "aborts" and losses. The monthly rate of operations from British bases, based on weather records, was taken at five.

Finally, the total number of bomber sorties was computed, and the number of bombers needed to accomplish the entire task in six months at the rate of five missions per month was determined.

The key element in the entire plan was the proviso that the full bomber force should devote its entire strength to these targets for six months, after it had reached maturity. Invasion would follow if necessary. Requirements for hemisphere defense were also estimated.

The allowances for the defensive measures needed in

More than a quarter of the bombs dropped in the campaign were on transportation targets, disrupting the economy.

the Far East were skimpy, to say the least. It was presumed that the US Navy would be the primary agency for this requirement.

The air plan called for the offensive to be carried out primarily from bases in England, using B-17s and B-24s, and from bases in Northern Ireland and the vicinity of Cairo, Egypt, using B-29s. But the plan took cognizance of a contingency that bordered on disaster. Hitler's armies were slashing into Russia and soon would approach the gates of Moscow. If Russia should be defeated, Hitler could mass his forces for a final assault on Britain. And Britain might also succumb. In that case the British air bases would no longer be available. To meet that contingency, the plan called for development and production of forty-four groups of 4,000-mile bombers—B-36s—to continue the war from bases in the Western Hemisphere. But the strategic plan presumed that British bases would, in fact, continue to be available.

As a last resort, if these operations against industrial targets were not conclusive, the plan recommended direct attack on cities. But we never accepted attack on civilian populations as the primary method of air warfare.

Four percent of Germany's synthetic oil came from this plant at Rothensee, destroyed by Eighth Air Force and RAF bombers.

We made provision for air support of an invasion of France if the air offensive should not be conclusive after six months of undiluted effort. The air plan provided additional air forces for air support of an invasion and for subsequent combined operations on the continent.

To carry out this strategy, the plan (referred to as Air War Plans Division I, or AWPD-1) called for some 63,000 operational aircraft, 180,000 officers, and 1,920,000 enlisted personnel—a total of 2,200,000 men and women. Although strategic air operations could begin on a limited scale about a year after the outbreak of war, it was not expected that the air offensive force would be in place at full strength until about nine months later. Thus, the full six months of strategic air warfare would end about two and a quarter years after the outbreak of war. The invasion force should be in place and ready to go by that time, if invasion should then be necessary. Even if effective German resistance were broken by the air offensive, an occupying force would be necessary in order to establish order, support an interim government, and ensure adherence to peace terms. The opposition to such an occupying force might be considerable, but the enemy capacity for massive, organized resistance should be broken by that time.

The plan was completed, checked with General Arnold and Assistant Secretary of War for Air Robert Lovett, and submitted to the War Department War Plans Division at literally the eleventh hour. It was not an impressive-looking document. The pages were typed and mimeographed. Corrections were made in ink. The charts were black and white, hastily prepared and crudely pasted together. The entire War Plans document, including AWPD-1, was bundled off to the Government Printing Office.

Then followed a period of feverish preparation for presentation. We four were the presenters, and Harold

George drove us relentlessly in quest of perfection. We gave our presentations without notes, standing by charts and maps. A number of presentations were made to various staff organizations.

Finally, on August 30, we faced the crucial test. General Marshall, with Averell Harriman, the President's representative to Russia, General Arnold, Gen. Muir S. Fairchild, several members of the General Staff, and officials from war production listened to the presentation. There were questions, and some expressions of dissent, but General Marshall reserved his comment until all the others had been heard. Finally, he said, "I think the plan has merit. I should like the Secretary and the Assistant Secretaries to hear it."

That statement by General Marshall to General Arnold was a crucial turning point in the evolution of American airpower.

Henry Stimson, the Secretary of War, was briefed on September 1 with General Marshall present. He showed a gratifying appreciation of the strategic concept. General Marshall offered encouraging comments. At last Mr. Stimson turned to Colonel George and said, "General Marshall and I like the plan. I want you gentlemen to be prepared to present it to the President."

A Crucial Opportunity Missed

A tentative date for the meeting with the President was set and intensive preparations for the presentation were under way when Pearl Harbor threw all arrangements into disarray. Loss of the opportunity to present to the President the detailed plans for strategic air warfare was a cruel disappointment. It is quite likely that the President's quick intelligence would have prompted him to make detailed inquiries, perhaps to have embraced the scheme with the same comprehension that characterized the reactions of General Marshall and Mr. Stimson. Lacking that presentation, Mr. Roosevelt never fully grasped the war-winning potential of airpower.

Nonetheless, AWPD-1 became the basic blueprint for the creation of the Army Air Forces and the conduct of the air war. After the attack at Pearl Harbor, the Air War Plans Division hastened to amend AWPD-1. The principal changes included requirements for additional air forces for the Pacific, to help compensate for the loss of US capital ships, and the addition of a large number of air transports, since it was apparent that a heavy burden of overseas communications would have to be met by air. The new estimate was called AWPD-4.

Pearl Harbor brought two attendant consequences of immense importance. The Army-Navy war plans, which relied heavily upon the US Fleet, had to be scrapped, leaving only the Air Plan, which was adopted almost by default. And British Prime Minister Winston Churchill immediately cabled President Roosevelt and proposed a conference on Allied strategy. He proposed to bring with him the three British Chiefs of Staff and their key supporting staff members.

The President initially considered having the Joint Army-Navy Board meet with the British Chiefs of Staff Committee. But the Joint Board had no supporting Joint Staff, and there were only two primary members—the Chief of Staff of the Army and the Chief of Naval Operations. There were three members for Britain—the Chief of the Imperial General Staff, the First Sea Lord, and the Chief of Staff of the Royal Air Force. Air Chief Marshal Sir Charles Portal needed an "opposite number" on the American side. General Marshall proposed that the Commanding General, Army Air Forces, Gen. H. H. Arnold, be appointed the American Air Chief as a full partner in the American Joint Chiefs of Staff. Arrangements were also made for a supporting Joint Staff with four principal staff divisions: Joint Plans, Joint Intelligence, a Joint Strategic Committee, and a Joint Logistics Committee.

Later, General Marshall recommended that Adm. William D. Leahy, a past Chief of Naval Operations, be appointed Chairman of the Joint Chiefs of Staff. The inclusion of Leahy completed a superb organization with which the President could work in his two wartime roles: As Commander in Chief he could work intimately and directly on the military conduct of the war; and as architect of national policy he could seek military advice and consultation on matters of international political scope. In the latter function, the President did not bypass his principal civilian secretaries, the Secretaries of War, Navy, and State. But he customarily included the Joint Chiefs in all meetings in which a military aspect, or the influence of military capability, might be considered. With the country at war, this meant virtually every important meeting both at home and abroad.

When the British arrived in Washington, the "Arcadia" Conference was carried out between December 22 and the end of the year. The grand strategy finally recommended by the Combined Chiefs of Staff, including provision for a combined British-American air offensive, was substantially that proposed by the Joint Chiefs, and the Combined Staff recommendations were adopted by the President and Mr. Churchill. The Arcadia Conference established the pattern for all the succeeding Allied conferences: Military proposals were worked up by the Joint Chiefs, generally after discussions with the President; broad and rather loose approval was obtained; final agreements were reached with the British Chiefs; and final approval was given by the President and the Prime Minister. The Chiefs of Staff carried out the approved directives.

Distressing Diversions

The first threat to the air offensive against Germany came distressingly soon. The Prime Minister vigorously advocated an invasion of North Africa. This invasion would have to be supported with heavy bombers at the expense of the air offensive against Germany.

The Joint Chiefs took the position that an invasion of North Africa was militarily unwise. As General Marshall pointed out, it was a tangential thrust, at right angles to the proper axis of attack—the assault of Germany itself. The North African venture would swallow up vast military resources at the expense of the main effort, while accomplishing very little toward defeating the Reich in Europe. General Arnold vigorously supported this position with special emphasis on the strategic air offensive against interior Germany. Adm. Ernest J. King, Chief of Naval Operations, believed that the margin of priority of Germany over Japan was very small and that any diversion of resources away from Germany should go to the Pacific, not to the Mediterranean.

The President weighed both the military arguments

Maj. Gen. Haywood S. Hansell, Jr., graduated from flying school in 1929. During World War II, he commanded an Eighth Air Force bomb wing and a bombardment division, and later the XXI Bomber Command in the Pacific. He retired shortly after the war, but was recalled to be the senior Air Force member of WSEG's Studies and Analysis Division. He is the author of a book, The Air Plan That Defeated Hitler, *and of many articles on military affairs. General Hansell is careful to point out that in both Europe and the Pacific, victory was achieved through joint and combined operations in which airpower was only one, though the decisive, element.*

against diversion to North Africa and the political arguments for some visible evidence of military success. The air offensive against Germany was not well enough understood to meet political demand, nor were its true dimensions really understood by the President. The invasion of France was out of the question in 1942 and probably 1943. The President decided for the North African venture.

The Joint Chiefs protested vigorously, but, having assured themselves that the President fully understood their military counsel and advice, they accepted the final decision and put their full energies behind the conduct of the military campaign. The whole episode was in the best tradition of American civilian/military relationship.

In August of 1942, the President asked for "an estimate of requirements to obtain air ascendancy over our enemies." The answer was prepared in the Air Staff and became known as AWPD-42. The strategy remained the same as that of AWPD-1, but there was a minor change in targets. Submarine pens and bases were listed and given a high priority. This was eloquent testimony to the deadly threat of the German submarine campaign. In addition, there was a dramatic shift in the requirements for hemisphere defense. The threat to the Western Hemisphere had subsided somewhat, and the large bomber and fighter forces that were to go into hemisphere defense were largely reassigned to the strategic air forces and the tactical air forces.

The P-47 Thunderbolt, with its 2,000-horsepower engine, was found to have superb capabilities as a fighter-bomber. It became the mainstay of the Tactical Air Forces and Tactical Air Commands in Europe and the Mediterranean. The requirement for the B-36s was deemphasized, reflecting the growing confidence in the security of the British Isles; and the B-29s were consigned to the Pacific, where their range would be needed in the air offensive against Japan.

The Casablanca Directive

Secretary Stimson, Assistant Secretary Lovett, and Presidential advisor Harry Hopkins played important roles in the projection of airpower as a war-winning strategy, and supported General Arnold with respect to AWPD-1 and AWPD-42. The culmination of high-level policy in air warfare came with the policy statement known as the "Casablanca Directive."

The primary concern of the Casablanca Conference in January of 1943 initially pertained to surface operations, and the strategic air offensive was nearly submerged in the arguments concerning a cross-Channel invasion, recapture of Burma, and Pacific strategy.

General Arnold learned that the Prime Minister proposed to recommend to the President that the Eighth Air Force be directed to abandon daylight operations as too costly and to join RAF Bomber Command in night attacks on industrial areas of Germany. General Arnold sent for Gen. Ira C. Eaker, Commanding General of the Eighth Air Force in England. General Eaker vigorously protested the abandonment of daylight bombing of selected targets. General Arnold arranged for General Eaker to meet with the Prime Minister.

In a singular and vital exposition, General Eaker persuaded Mr. Churchill to withdraw his opposition to daylight selective bombing by the Eighth Air Force, thus retaining the American concept of decisive strategic air warfare through destruction of selected vital targets.

Although the daylight attack of selected targets was provoking bitter air fighting and producing heavy losses, General Eaker never wavered in his courageous support of the American strategy. He was a tower of strength in a sea of doubts.

The Casablanca Conference adopted a directive describing the objectives and strategy of both the RAF Bomber Command and the Eighth Air Force in a combined effort. The directive was prepared by one of the most gifted air strategists of the war, Air Vice Marshal Sir John Slessor, RAF.

The objective of the Combined Air Offensive was described in these terms:

> To bring about the progressive destruction and dislocation of the German military, industrial, and economic system and the undermining of the morale of the German people to a point where their capacity for armed resistance is fatally weakened.

This air strategy was a joint product of British and American airmen, and it was approved by the Combined Chiefs and signed by both Mr. Churchill and Mr. Roosevelt at Casablanca on January 19, 1943. The Combined Chiefs of Staff finally agreed upon the Combined Bomber Offensive, the capture of Sicily, and the postponement of further invasion until 1944. The President and the Prime Minister approved.

The Casablanca directive prompted preparation of an operational plan to carry it out. The operational plan for the Combined Bomber Offensive was prepared in General Eaker's headquarters. The target list was based upon target priorities prepared in Washington by the Committee of Operations Analysts and coordinated with the British Ministry of Economic Warfare. The new target list included all of the previous target systems except one, and added a vital new one: ball bearings.

The one that was dropped was, unfortunately, electric power. The Committee of Operations Analysts had dropped electric power to priority thirteen, apparently on the grounds that it was beyond our capability to destroy and that its effects would not be felt on the invasion beaches. Subsequent analysis shows that it probably would have been within our capability after the force reached maturity if strategic airpower had not been unwisely diverted. Subsequent German testimony indicated that the operations initially planned against electric power would have produced catastrophic results.

The operational plans were sound enough, but the strategic air operations were constantly drained by the

demands of theater commanders for air support of ground-force campaigns. The resultant delay and diversion threw the strategic air war off schedule, with the result that only one of the strategic air objectives was attained before the invasion: defeat of the German air force. It was the *sine qua non* of all effective operations, both land and air.

Gen. Dwight D. Eisenhower demanded and received control of the US Strategic Air Forces and RAF Bomber Command for support of the invasion. This was a reasonable requirement for a brief, critical period while the invasion forces established themselves firmly in Normandy. But General Eisenhower retained control of those forces for six crucial months when they could have been most effective against systems in interior Germany. As a result of these delays and diversions, the massive air offensive against the selected primary targets did not really begin until September of 1944—ten months late and three months *after* the invasion. This diversion of strategic air forces from their assigned mission was the more regrettable in light of the fact that General Eisenhower had ample tactical air forces for support of his land campaigns. The Ninth Air Force alone was larger than the entire Luftwaffe, which was fighting desperately on four fronts, and had already suffered a severe defeat.

The Ninth Air Force was superbly equipped, organized, and led, and it did a magnificent job of providing air-ground support. The strategic air forces were equipped, trained, and dedicated to an entirely different mode of air warfare, and they made their greatest contribution in the field of their own peculiar capabilities. The strategic air forces were finally returned to their primary objectives in October. In the next four months, the strategic air forces completed all the remaining strategic purposes originally proposed.

Effects of the Strategic Air War Against Europe

Following are brief digests of the effects of the air strategy, including pertinent extracts from the Report of the US Strategic Bombing Survey (USSBS), the civilian organization set up by General Arnold after the war to appraise the effect of the strategic air offensive.

The German Air Force

The long and bitter battle for control of the skies over Europe culminated in victory in the spring of 1944. There was no German air opposition to the landings in Normandy, and the strategic air forces struck targets deep in Germany at will. The causes were destruction of plants, combat attrition, disruption of training, and loss of aviation gasoline from attacks on the Romanian oil fields and the synthetic plants in Germany. The intensity of the bitter fighting in the air is reflected in combat and operational losses. Excluding the Russian front, the Germans lost more than 22,000 day fighters. The US losses came to over 12,000 bombers and a like number of fighters.

Ball Bearings

The target was right; the bombs were too small. There were two attacks in the fall of 1943. Factory buildings were demolished, but heavy machinery survived. Albert Speer, the German Minister of Armaments Production, was asked after the war what would have happened if there had been concerted and continuous attacks on the ball-bearing industry with heavier bombs. He replied:

> Armaments production would have been crucially weakened after two months and after four months would have been brought completely to a standstill. In those days, we anxiously asked ourselves how soon the enemy would realize that he could paralyze the production of thousands of armaments plants merely by destroying five or six relatively small targets.

Flak was still heavy over Ludwigshafen in September 1944, but fighter opposition and bomber losses had dwindled.

Synthetic Petroleum

This target system received thirteen percent of total bombs dropped, almost all of it in late 1944 and early 1945. However, the system was extremely sensitive. An attack on May 12, 1944, sent production plummeting from 180,000 metric tons a month to zero by the spring of 1945.

The oil campaign affected both the German air forces and ground forces. Gen. Omar Bradley comments:

> With the debut of the German gamble in the Ardennes, lack of oil, which the strategic bombing campaign had enforced upon the enemy, told handsomely. The withdrawal of Sixth SS Panzer Army, begun in daylight on January 22, 1945, was marked mainly by successes of US fighter-bombers against its tanks and trucks. These successes, however, took place against a background of painfully exiguous oil reserve—with supply trucks being drained to fill the tanks of fighting vehicles—and a long pull to the distant loading stations.
>
> When the Allied breakthrough followed west of the Rhine in February, across the Rhine in March, and throughout Germany in April, lack of gasoline in countless local situations was the direct factor behind the destruction or surrender of vast quantities of tanks and trucks and of thousands upon thousands of enemy troops.
>
> The effect spread to the Eastern Front as well; German forces restricted by lack of gasoline were unable to cope with the Russian onslaught. At the Baranov bridgehead, 1,200 German tanks, which had been massed to hold the position, were immobilized because they had no gasoline and were overrun by the Russians. Even Marshal Stalin agreed that the strategic air offensive against the oil resources played a vital part in making possible Russian victories in the East.

Transportation

This system received twenty-seven percent of total bombs dropped. Although the attacks came late in the war, they were decisive.

The USSBS describes the situation as follows:

> After the September and October attacks, it became entirely impossible for the railroad system to meet . . . transportation requirements. The evidence indicates that the supply of critical components in the hands of manufacturers was quickly exhausted, with a resulting severe impact on virtually all munitions and other finished products at roughly the same time in late November and early December.
>
> The loss of transportation facilities completely disorganized the flow of basic raw materials, components, and semifinished materials, and even production was no longer possible.

The effects of the strategic air attacks upon rail and water transportation were almost exactly as envisioned in AWPD-1 and AWPD-42. Coal could not be moved to the steel plants and power stations, and the coal shortage interfered with rail movement. Component parts could not be moved to the assembly plants, and the assembly plants themselves could not operate.

The level of coal stocks for the railroads dropped to eighteen days in October 1944, to four and a half days in February 1945, and to less than one day in March. Under these conditions, orderly production was no longer possible. Steel production, for example, dropped from more than 9,000,000 tons in the first quarter of 1944 to just over 1,000,000 tons in the first quarter of 1945. The available capacity for economic traffic in Germany could no longer even hope to sustain war production, or to meet the needs of civil operations.

The Strategic Bombing Survey gave as one of its major conclusions:

> Even if the final military victories that carried the Allied armies across the Rhine and the Oder had not taken place, armament production would have come to a virtual standstill by May. The indications were convincing that the German armies, completely bereft of ammunition and motive power, would have had to cease fighting—any effective fighting—within a few months.

This was the intent of the strategic air plans. It should have been produced before the invasion. The diversion of the strategic air effort and the subsequent delay in effect were a tragic mistake.

In his report to Hitler on March 15, 1945, Albert Speer stated flatly: "The German economy is heading for an inevitable collapse within four to eight weeks." Some time later, looking back at the strategic air assault, the US Strategic Bombing Survey also concluded: "*Allied airpower was decisive in the war in western Europe*" (emphasis added). Noting that airpower might have been employed more effectively at various times and places, the Survey's final report still emphasized:

> Its power and superiority made possible the success of the [Normandy] invasion. *It brought the economy which sustained the enemy's armed forces to virtual collapse* (emphasis added), although the full effects of this collapse had not reached the enemy's front lines when they were overrun by Allied forces.

As for electric power, the target system that was dropped, there is no doubt of its importance, which was confirmed by the USSBS. From that point of view it should be noted for the future. But the feasibility of disrupting the system cannot be confirmed, since it was not attacked directly, and conclusions are necessarily speculative. Certainly it could not have been disrupted until the strategic air forces had finally reached their planned size, the German fighters had been defeated, and the available airpower was literally overwhelming.

Speer has this to say on the subject:

> . . . according to the estimates of the Reich, a loss of sixty percent of the total power production would have sufficed to lead to collapse of the entire network. The destruction of the power plants would be the most radical measure, as it would at once lead to a breakdown of all industry and public life. Destruction of fifty-six targets would produce this effect.

The chief electrical engineer in charge of design of the system volunteered this information:

> The war would have been finished two years sooner if you concentrated on the bombing of our power plants.

Strategic Air War in the Pacific

AWPD-1 and AWPD-42 both contemplated a decisive strategic air offensive against Japan after the defeat of Hitler had been assured. Target systems were suggested. But there was a dearth of sound strategic intelligence about Japan's internal structure. Japanese security had been very tight. There was no detailed strategic air plan for Japan comparable to the strategic air plans against Germany.

The theater air forces in the Pacific and Far East were literally starved initially because of the need to build up air forces for operations in the area of top priority—Axis Europe. Naval air forces fared much better. In spite of the European priority, the Navy was able to build a very large carrier-based air force for operations in the Pacific, including more than a hundred carriers of various sizes.

The Pacific area witnessed one surprising innovation of great importance: surface forces conducting a major campaign in support of airpower. The Mariana Islands and Iwo Jima were captured as bases for the strategic air offensive of the B-29s. It was a new experience in military strategy, and it bore the fruits of victory—a victory that came without the need of invasion.

Actually Japan had been beaten into a hollow facade by the Twentieth Air Force before the dropping of the atomic bombs.

The US Strategic Bombing Survey has this to say on the subject of the defeat of Japan:

> The bombing offensive was the major factor which secured agreement to unconditional surrender without an invasion of the Home Islands, an invasion that would have cost hundreds of thousands of American lives. . . . Even without the atomic bombing attack, air supremacy over Japan could have exerted sufficient pressure to bring about unconditional surrender and obviate the need for invasion. ■

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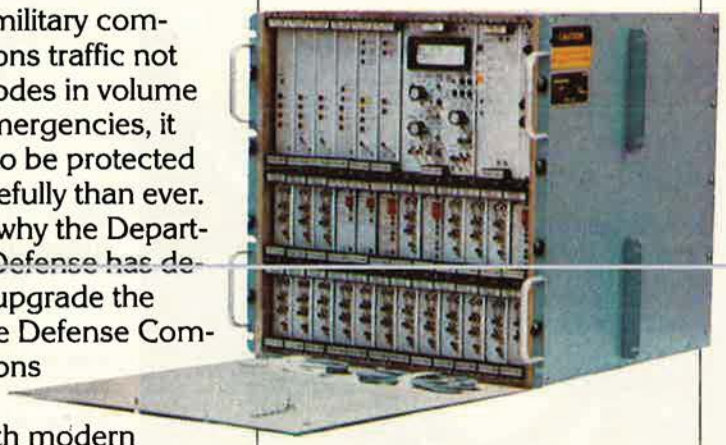

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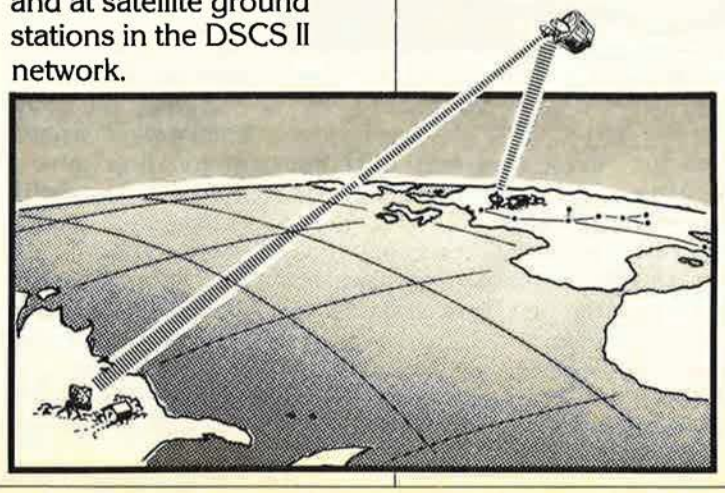

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A Norwegian-born pioneer in polar aviation, he played a major role in the AAF's Arctic operations during World War II and in developing a postwar appreciation of the strategic importance of the Far North.

Col. Bernt Balchen

BY PETER J. ANDERSON

MANY foreign-born airmen have been pioneers in the development of American airpower. Tony Fokker and Igor Sikorsky are two who immediately come to mind. But one of the most accomplished foreign-born airmen to serve in the United States Air Force, and a true aviation pioneer, was Bernt Balchen.

Balchen was a man at home in the extreme environments of the polar regions. He was also a participant when post-World War I aviation made tremendous advances in technology in the 1920s and 1930s. To Balchen belongs much credit for the successful cold-weather operations of the US Air Force.

Bernt Balchen was born in 1899 in southern Norway. Before he learned to fly in 1921, he had already served in the French Foreign Legion at the Battle of Verdun and in the Finnish White Army in its fight against the Russian-supported Red army.

He graduated first in his class at the Royal Norwegian Naval Air Force flying school and was assigned to the Horton Naval Air Force Factory, where he made a name for himself as a test pilot and maintenance engineer.

When Norway's Roald Amundsen, the discoverer of the Northwest Passage and the South Pole, disappeared on a flight to the North Pole in 1925, Balchen was one of two pilots sent to Spitzbergen to search for Amundsen. Returning safely, Amundsen secured Balchen's assignment to his planned flight in the Italian-built dirigible *Norge* from Spitzbergen over the North Pole to Alaska. At the last minute, Balchen was bumped from the flight crew and was assigned to help the Americans, Richard Byrd and Floyd Bennett, repair their Fokker trimotor ski-plane for the first flight to the North Pole.

Col. Bernt Balchen at Kitty Hawk in 1953. The previous year he had been awarded the Harmon International Trophy. (National Archives Photo)

Byrd, just beginning his career as a polar explorer and organizer of large-scale expeditions, convinced Balchen to come to the United States to work for Tony Fokker as a pilot. In 1927, Balchen joined Byrd's transatlantic flight from New York to Paris. Originally the second pilot Balchen took over the plane's controls during the dangerous flight through storm-filled skies over the Atlantic and France. After hours of instrument flying and searching for a break in the weather that would allow them to land at Paris Balchen flew the plane back to the French coast and landed in the surf at Ver-sur-Mer in Normandy to save the lives of the five men on board.

In 1928, Byrd left on a two-year expedition to Antarctica with Balchen as chief of his aviation section. Balchen was responsible for the maintenance and operation of Byrd's three airplanes that successfully carried out long-range exploratory flights. On November 28–29, 1929, Balchen was at the controls of the Ford trimotor *Floyd Bennett* for the treacherous flight up the Liv Glacier and over the South Pole.

During the 1930s, Balchen worked in a succession of aviation jobs. He developed friendships with the greats of American aviation, Jimmy Doolittle, Hap Arnold, Tooey Spaatz, and others. His courage and skill as an instrument pilot became legend.

Balchen returned to Norway in 1935 to develop

civilian aviation in his native country even though he was made a US citizen by special act of Congress in 1930. He often made trips to Germany to buy spare parts for his airplanes. He met and talked with German aviators both in and out of the government and the Nazi movement. He became concerned about the threat to Norway that a rearming Nazi Germany posed and strongly encouraged the Norwegian government to improve its military preparedness. It was not until after Germany invaded Poland that his warnings were taken seriously. Balchen was sent to the United States to buy aircraft and armaments, but on April 9, 1940, Germany invaded Norway and Denmark.

The AAF's Arctic Expert

Before the Norwegian government fled to London, Balchen was named the government's military representative in the United States. He was able to keep the military contracts he had arranged, even though no money could be sent out of Norway in payment. Also, he helped to organize "Little Norway," the Free Norwegian pilot training base at Toronto, Canada.

Anxious to be involved in the war, Balchen signed on with the Royal Air Force Ferry Command and delivered military aircraft to British forces in England, Africa, and the Far East. During one delivery in Manila, Balchen was tracked down by the FBI for Maj. Gen. Hap Arnold, Commanding General of the US Army Air Forces. Balchen was asked to report immediately to Washington, where General Arnold offered him a commission in the AAF and an assignment to build and command a secret air base on the west coast of Greenland at Søndre Strømfjord.

Balchen accepted Arnold's offer and went to work as a civilian technician while his commission was being processed. By late summer 1941, Balchen was en route to Greenland with a force of ships, men, supplies, construction material and equipment, and sledge dogs. When Pearl Harbor was attacked and the United States declared war, Balchen's men had completed the initial construction of the base and its airfield.

With the declarations of war, large numbers of airplanes that had been gathered in New England began to fly to Greenland en route to England. They stopped at Balchen's base—Bluie West-8—and at other Greenland bases to refuel and for maintenance, then flew the "Bolero" route over the Greenland ice cap to Iceland and finally to airfields in Scotland and England.

From his earlier experience, Balchen knew there would be in-flight problems with so many airplanes flying the Bolero route. He scouted the coast and the interior ice cap extensively to familiarize himself with the area. He also trained rescue teams skilled in over-ice travel on snowshoes, skis, and with dog teams.

Balchen's preparation paid off when in June 1942 a B-17 disappeared southeast of Bluie West-8, somewhere over the ice cap. The aircraft was one of four en route to BW-8 from Goose Bay, Labrador. Severe weather closed in over Greenland while the flight was under way. One plane landed at BW-8. Two others crash-landed along the coast, and the crews were rescued, but the remaining B-17 disappeared. Finally, hours after the last radio contact, the missing B-17 called in. The pilot, a Lieutenant Stinson, after making a wheels-up landing on the ice cap, had his crew cut off the blades of one propeller so the engine could be used to generate power for the radio. They were in good condition and in no immediate danger.

When the weather finally cleared, Balchen, in a Navy PBY Catalina flying boat, homed on the B-17's radio transmission until he located the plane. About twelve miles from the crash scene, Balchen found a meltwater lake in which he landed. Accompanied by Sergeant Healy—a man Balchen had worked with in the Antarctic—he led the way to the B-17 survivors, an all-night journey. After resting during the day, the thirteen crew members were led by Balchen and Healy back to the lake. The PBY returned to pick the men up, and none too soon. A few hours later the lake disappeared when a large crevasse opened and drained the water.

Balchen, right, and Lincoln Ellsworth in the cockpit of the Northrop aircraft Polar Star, *in which they made two unsuccessful attempts to fly across the Antarctic continent. (National Archives Photo)*

Since 1973, Peter J. Anderson has been Assistant Director of the Institute of Polar Studies at Ohio State University. Prior to his present appointment, he served in the Air Force for ten years, primarily in survival training. Other assignments were with the US Naval Support Force, Antarctica, and at the Division of Polar Programs of the National Science Foundation. He is an AFRES major, assigned to the Office of Air Force History, where he is writing a history of the Air Force in Antarctica.

Balchen's rescue efforts became legend. He led missions to recover crews from several crashed airplanes during the next months, including the B-17 "PN9E" lost while searching for a C-53 with six men on board. It took more than five months—from November 9, 1942, to April 18, 1943—to rescue the survivors of this crash in a severely crevassed area, and involved Balchen's landing a Navy Catalina on the surface of the ice cap.

Soon after the PN9E survivors were rescued, a German weather station was discovered at Sabine Island on the northeast coast of Greenland. Balchen was given responsibility for destroying the station with a flight of B-17s and B-24s from Iceland. With the successful completion of this mission, his two-year tour in Greenland ended.

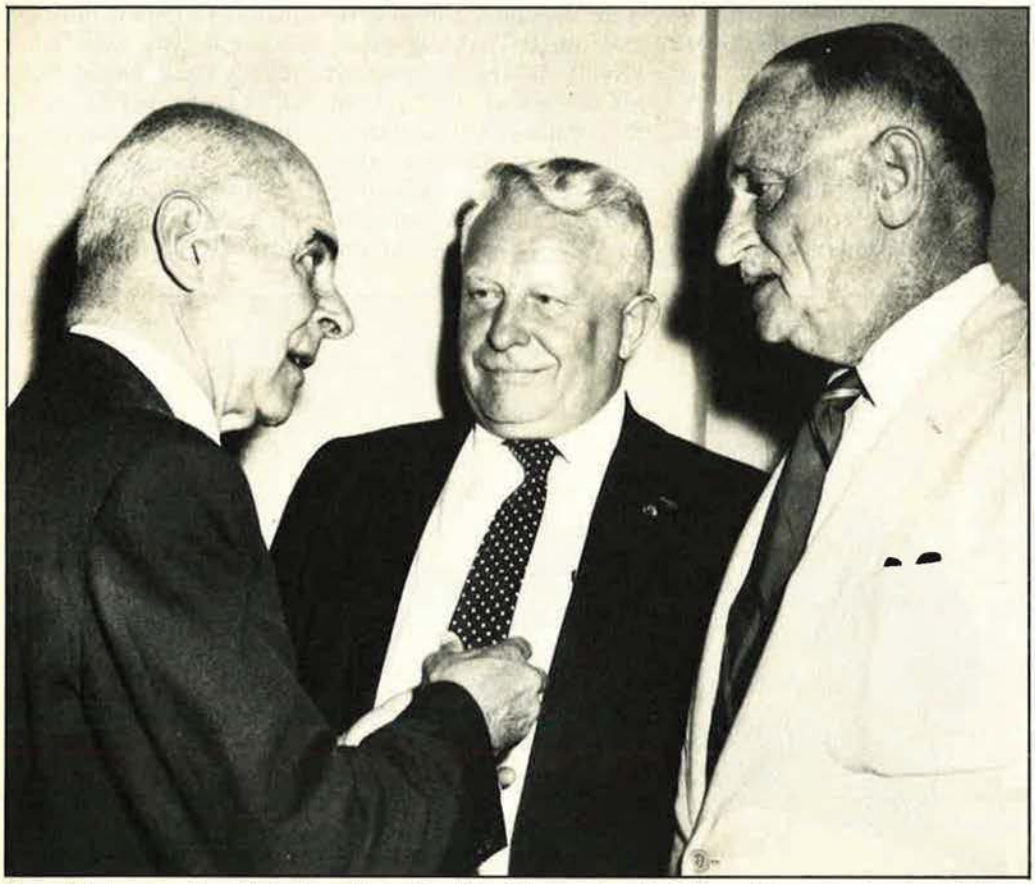
Scandinavian Missions

In September 1943, Balchen returned to the US to work on General Arnold's staff. By November, however, he was en route to Eighth Air Force in England, specifically requested by both the Eighth's commander, Maj. Gen. Ira Eaker, and Bill Donovan, commander of the OSS. Balchen was given command of an OSS operation—Project Sonnie—to fly unarmed and unmarked B-24 Liberators between Scotland and Sweden. His cargo back to Scotland was Norwegians on their way to Free Norway forces and American aircrews who had been interned in Sweden.

By mid-1944, Balchen's operations had expanded to include the "Ball Project," flying arms, munitions, and supplies to the Norwegian Resistance Movement in lonely and isolated mountain valleys. Balchen's squadron became known as the "Ve do it" unit, from Balchen's response to the challenge of a new project. And they *did* do it, from resupplying the Resistance in Norway to flying out of Sweden an early test version of the German V-2.

As World War II ground to an end, Balchen accepted the surrender of German forces at Bodö airfield in Norway and freed the 70,000 Russian POWs in the area. He had to rearm the German guards to keep the Russians from looting the Bodö countryside.

Upon his return to the United States after the German surrender, Balchen left active duty to accept a special mission for General Arnold. He re-



Bernt Balchen, center, with Lt. Gen. Jimmy Doolittle, left, and Gen. Carl "Tooey" Spaatz at the annual dinner of the National Pilots Association in 1957. General Doolittle presented the Association's Outstanding Aviator Award of the year to Balchen. (Wide World Photos)

turned to Norway as a c
vilian with joint Norwe
gian-US citizenship to re
build civilian aviation. A
president of DNL, th
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in Sweden and Denmark t
establish the trinationa
Scandinavian Airline
System. This success wa
especially sweet for Bal
chen after years of bein
frustrated by British oppo
sition to the merger.

In late 1948 Balchen re
turned to the US and the Ai
Force. He commanded th
10th Rescue Squadron i
Alaska for three years be
fore reporting to Air Forc
Headquarters as Specia
Assistant for Arctic Affair
He was the project office
for the construction o
Thule Air Base in Gree
land, and worked on th
development of the DEW
Line. In 1952, he wa
awarded a Harmon Inter
national Trophy for hi
many contributions to avi
ation. The following year
the Air Force put Balche
on detached duty with th
National Science Founda
tion to develop plans fo
Arctic and Antarctic ac
tivities during the Interna
tional Geophysical Year.

Upon his retirement fro
the Air Force in 1956, Ba
chen turned to publi
speaking on the strategi
importance of the Arctic
He continued to serve th
Air Force as a consultant.

Bernt Balchen died o
cancer in 1973 and wa
buried at Arlington Na
tional Cemetery on hi
seventy-fourth birthday
He was eulogized by many
for his contributions to th
development of aviation i
the polar regions and for his
work in creating an aware
ness of the strategic im
portance of the Arctic. I
was Lowell Thomas wh
gave the most fitting tri
ute: "He was the last of th
great Norsemen."

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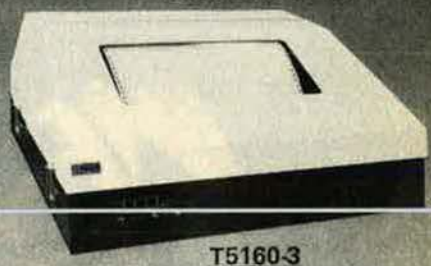

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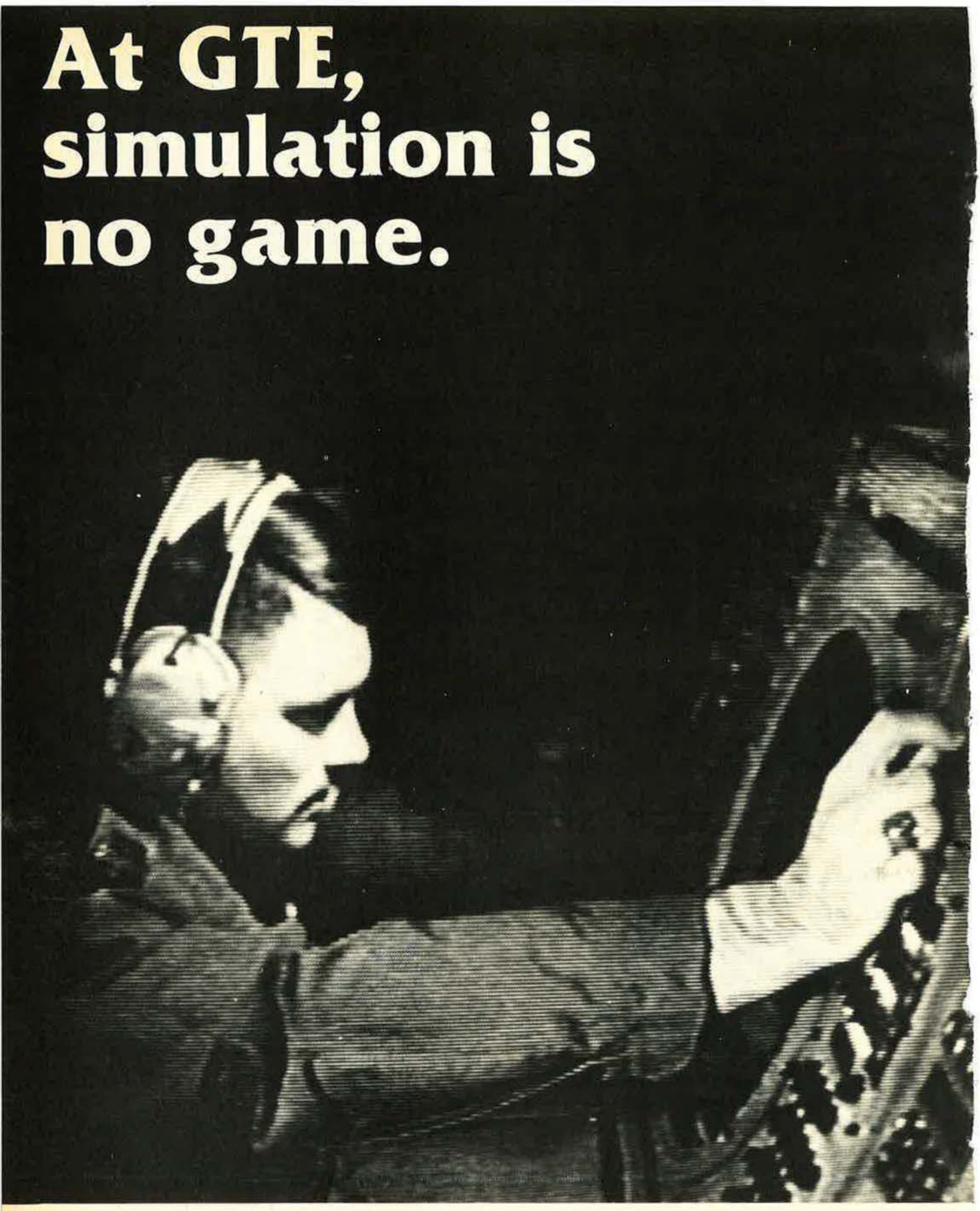

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SPEAKING OF PEOPLE

Retirees–An Emergency Resource

By Ed Gates, CONTRIBUTING EDITOR

AN event of some months ago passed almost unnoticed. The Air Force retiree population for the first time scooted past that of the active force. Today, there are about 600,000 retired members, including retired Reservists, a figure that will continue to rise rather steadily. This compares with about 558,000 active-duty members, whose numbers are slated to rise just a tad (to 564,500) in the next fifteen months.

The ballooning retiree force provides the country some distinct dividends. It means more persons available to participate in base retiree programs to enhance community relations. It means more of the right kind of people to promote military careers, to help with recruiting, to counter antimilitary feelings, and to plug for adequate defense funds.

More retirees also means a larger pool of trained manpower available for recall in time of mobilization. Not that an emergency would result in massive call-ups of retired members; it certainly hasn't in the past. But the Air Force is getting a handle on its bulging retiree population. It is finding out how long people have been retired, how far they live from the nearest base, how many work, the number of dependents, who would volunteer, how many would seek reporting delays, etc.

The action is leading to an early 1981 target when the service expects to operate an automated retiree recall system at the Manpower and Personnel Center, Randolph AFB, Tex. It will be geared to identify, by specific skill, the most recent retirees. They might be in big civilian demand, but three years or less in retirement status could well mark a retiree for possible recall during an emergency. Longer separation from active service figures to pretty much assure no recall, though the Air Force lists persons retired for up to ten years as "potentially usable."

Military members, in discussing the X factor (the frequent uprooting, on call twenty-four hours a day, etc.), often note that they remain vulnerable to recall, maybe for a lifetime—something the ordinary citizen doesn't have to put up with.

In actuality, of course, military retiree recalls have been almost nonexistent for decades. World War II saw a good many of them, but since then recalls have been limited to an occasional hard-to-fill specialist, or perhaps a general officer returning to uniform to head a special panel for a brief period. Usually, they have volunteered to return.

While this pattern of virtually no involuntary recalls seems likely to continue, the services want to be prepared.

The Air Force's retired rolls consist of about 480,000 Regulars and 120,000 Reservists. But USAF, as of a recent date, considered that only 219,068 Regulars and 26,440 Reservists—a total of 245,508—constituted a "viable resource." The others don't qualify because of age, health problems, and dulled military skills. Allowing for delays and exemptions in recall, the Air Force reckons that 226,768 retirees—that's thirty-eight percent of all of them and 92.3 percent of the "usable" retirees—are actually available for recall.

The Air Force recently surveyed 2,000 randomly picked nondisability retired members on their availability. Twenty-three percent of the respondents said they were ready right now, twenty-six percent would volunteer if given an M-Day assignment, and thirty-eight percent would report only during a national emergency. The other thirteen percent said they would require direct orders and request a delay or exemption.

The Army, meantime, is handing out M-Day assignments and call-up orders to many of its retirees, to be executed when and if the President declares an emergency. The Air Force hasn't followed suit, though it isn't closing the door on "preassignment" of retirees. An authority at Hq. USAF said, "We support it [preassignment] in selected cases, such as medics, for M-Day spots that can't be filled from the active or the Reserve Forces."

But he noted that it would be impossible to maintain a current match of supply with demand by position when much of the obligor population turns over every year, and retirees age and become unfit. Orders would have to be constantly changed. Wholesale preassignments, he said, would generate a big paper-mill that would hurt assignment flexibility.

On the drawing board is a second USAF retiree survey, of people who have been out thirteen months. Later those with thirty-seven months in retired status may be surveyed. These probes will check such things as military skill retainability, accuracy of the subjects' addresses, and their physical status.

There is some feeling that retirees believe they may be in better physical shape than they really are. In the recent survey, only four percent said they were unfit, though some acknowledged they could pull only limited duty. That may represent excessive optimism. But overall the early stats in the "retired-response" project clearly indicate that there is a large, seasoned group ready and willing to respond if the Chief Executive issues the order. ■

THE BULLETIN BOARD

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

Air Force Village, the service's haven for elderly retired officers and their spouses, near San Antonio, Tex., is undergoing a major expansion that officials say will increase the resident population from 274 to 600 by mid-1981. Contracts worth $16.1 million were signed recently. The architect's plan shows the sixty-eight-bed, single-story nursing home in the left foreground. The mid-rise building and one-story cottages will accommodate the increase in the number of residents.

USAF Tries to Ease Members' Money Woes

Air Force Headquarters is moving in several directions to reduce the financial problems it says mounting numbers of its members are facing, particularly at PCS time.

The new "initiatives" assure that everyone will get at least ninety days' notice of new assignments and, in some cases, an extra sixty days in reporting. Heretofore, the ninety-day PCS notification rule was frequently ignored. "Short notice assignments . . . can create financial hardships," Hq. USAF told commands in ordering a stop to the practice.

If, during the transfer process, a member faces financial problems in selling a house, moving his household goods, or settling his family, he now can request up to a two-month delay in reporting to the new station. A rather elaborate verification process is involved, and approval is not automatic. However, Headquarters says that if valid delays mean short-term manning deficits at the new stations, so be it. Commands must accept it.

This appears to be a major personnel policy change, as the service for years has insisted that Air Force needs will take precedence over personal requirements. The new delay authority may not be permanent. The Air Force says it will "assess the feasibility of continuing this program no later than 1 October '80."

Other steps aimed at "alleviating cost and turbulence" at PCS time are slated to take effect soon. They include a more liberal overseas tour extension policy (to help reduce PCS), a priority for parents to use child-care centers at both the losing and gaining base, and more flexibility for members to choose the type of travel when completing training prior to a PCS move.

Other proposals to ease financial crunches that inevitably surface at PCS time are in the works. What's really needed, of course, is governmental approval of more realistic travel, trailer, and dislocation allowances.

In related developments:

• The USAF Commissary Service said the use of food stamps in Air Force commissaries is increasing rapidly. The report was promptly picked up by the USAF News Service and flashed to bases worldwide. It's

Cadet Terence P. Bull receives AFA award in ceremonies at Clemson University, S. C. Presenting the award is Col. Edwin F. Rumsey, Professor of Aerospace Studies at Clemson. Bull graduated this semester and is being assigned to Undergraduate Pilot Training at Columbus AFB, Miss. He is a past commander of Clemson's Arnold Air Society Squadron, winner of a Vice Commandant's award at AFROTC field training, and previous commander of the Cadet Group at Clemson. Bull's degree is in Mechanical Engineering. He is the son of retired Air Force Col. and Mrs. Leonard Bull of Columbia, S. C.

interpreted as a strong Hq. USAF nudge to all members eligible for stamps to use them. According to recent government figures, USAF commissaries redeemed $4.7 million worth of food stamps in FY '79, an increase of thirty percent over the previous year.

An estimated 21,000,000 persons, including military, draw food stamps.

• Headquarters has told wing, base, and hospital commanders to work out with local authorities plans to bring needy military families into the Federal government's WIC (for women, infants, and children) program. WIC provides nutrition education and supplemental food for certain of these people. "I believe [the WIC program] may help some of our junior people," Maj. Gen. William R. Usher, the Hq. USAF Director of Personnel Plans, said in an all-commands message.

EM Retention Rate Improves a Tad

Airman retention, one of USAF's most critical problems, improved ever so slightly recently. Official figures provided AIR FORCE Magazine disclose that the October 1979–March 1980 period found second-termer retention improving from 53.0 to 55.6 percent while the career retention rate went from 61.9 to 63.0 percent. The first-termer retention rate remained unchanged at 21.5 percent.

The retention rate is the percentage of re-ups to total exits, including dropouts for physical, unsuitability, disciplinary, and other reasons. It differs from the reenlistment rate, which is the percentage of re-ups to the number of members eligible to sign on again. As the chart notes, the reenlistment rates for first-half FY '80 are about the same as those for the previous full year.

None of the figures, of course, reveals critical skill areas, but the results raise hopes that the airman manning slump may have bottomed out. Some officials fear, however, that many airmen are on the fence about staying in and will call it quits if the government fails to lay on new benefits soon.

DoD, meanwhile, reported that the Army, long in the manpower doldrums, experienced a whopping 11.8 percent increase in its re-up rate during the same period.

Also during the first-half of FY '80, the Air Force signed up 35,300 recruits, or 101 percent of quota, a turnaround from the recruiting deficit recorded a year earlier. The new figures reveal, however, that only 27,100, or seventy-nine percent, of the new nonprior-service accessions are high school graduates.

USAF's retention picture for first-half FY '80 and all of FY '79 is shown in the accompanying table:

	First Term		Second Term		Career	
	FY '79	FY '80	FY '79	FY '80	FY '79	FY '80
Eligible to Re-up	41,892	20,475	13,852	7,531	30,605	14,539
Reenlistments	15,918	7,726	8,328	4,718	27,884	13,217
Reenlistment Rate	38.0%	37.7%	60.1%	62.6%	91.1%	90.9%
Retention Rate	21.5%	21.5%	53.0%	55.6%	61.9%	63.0%

Arlington Columbarium Filling Up

A new columbarium, which will hold 5,000 cremated remains, has been opened at Arlington National Cemetery and early response for space has been reported heavy. The ashes of nearly 100 persons were inurned in the structure's niches within a few days following the dedication. Nine more columbariums will be built at Arlington.

Cremation is the only way many veterans can "get in" the cemetery; because Arlington is overcrowded, burial is limited to active-duty service members, retirees, some but not all disabled veterans, and dependents. Most veterans are ineligible for burial at Arlington, but they are eligible at other national cemeteries where there is space.

Hopefully, the new columbarium will allow more interments at Arlington and open burial eligibility to more vets.

The columbarium with landscaping covers three-quarters of an acre. It is a structure where cremated remains are placed in urns in niches. Each niche holds two urns so a service member and a next of kin can be placed together. All niches will be covered with a permanent plate containing the information usually put on a tombstone.

The potential savings in space is tremendous. Below-ground burials allow 600–650 graves per acre compared to the 5,000 cremated remains the new facility can accommodate. Arlington National Cemetery is operated by the US Army. For more information, write Superintendent, Arlington National Cemetery, Arlington, Va. 22211, or call (202) 695-3253 or 3250.

USAF, Officers Blast Senate DOPMA

USAF leaders and officers from second lieutenant up have called the Senate version of DOPMA, which slashes field-grade billets, slows and curtails promotions, and further reduces general-officer spaces, a disaster. Not quite in those terms, of course, but they made it clear the Senate handiwork, performed late last year by the Senate Armed Services Committee, is entirely unacceptable. It is "irreconcilable" with the basic DOPMA advanced by the Pentagon nearly seven years ago and twice approved by the House, Lt. Gen. Andrew P. Iosue told a House Armed Services subcommittee studying S. 1918, the Senate-passed version. General Iosue is USAF's Deputy Chief of Staff for Manpower and Personnel.

Assistant Air Force Secretary Joseph O. Zengerle (Manpower, Reserve Affairs and Installations) backed him up four-square. "The proposed reductions in S. 1918 could not have been more poorly timed because they would severely alter the opportunities and expectations of our young officers during a period when we are experiencing serious difficulties attracting and retaining a highly qualified officer force," Secretary Zengerle added.

Prior to the subcommittee hearing, the Air Force, on May 8, polled 1,055 Air University officers in grades O-2 through O-5 on their views of S. 1918. The survey was composed mainly of officers who intended to make the Air Force a career. However, more than half said they would probably change their minds, and twenty-three percent said flatly that they would separate, if the Senate DOPMA prevailed. Responses to other questions were equally negative.

DOPMA, officially the Defense Officer Personnel Management Act, may be nearing a final resting place.

"Frocking" Ahead for USAF Troops?

After years of opposition to the practice of "frocking," Hq. USAF has disclosed that it is "reviewing" its position and will announce a decision soon. The review follows in the wake of a Navy move to frock nearly everyone in that service on promotion-selection lists. Earlier, only some Navy people were frocked.

People who are frocked wear the insignia of the selected grade but don't draw the extra money until the promotion is official. Except for the

2d Lts. Pat Marckesano, right, and Mike Fennessy of the 94th TFS, Langley AFB, Va., recently became TAC's lowest ranking pilots by completing F-15 training and becoming mission ready in minimum time.

extra pay, they enjoy all the privileges of the higher grade.

AFA's Junior Officer Advisory Council in 1978 urged Hq. USAF to adopt frocking as a "no-cost" opportunity to recognize performance and possibly help retention. Since then, of course, retention has worsened, and Headquarters is eyeing all sorts of personnel policy changes that might improve conditions of service life. Frocking could well be one of them. Some officials feel that many members undoubtedly would look favorably on wearing their higher selected grade instead of sweating out a list for many months.

USAF previously held that frocking might create "turbulence and confusion" among the troops and could be viewed by Congress as violating the intent of grade limitations.

The Navy formerly required that persons chosen for promotion must, to be frocked, be serving in billets calling for the higher grade. That no longer applies. Except for a few Navy members serving in joint-service assignments, all on selection lists are now eligible for this little morale-booster.

THE BULLETIN BOARD

Educational Aid Held Key to Snagging Troops

"I am convinced that providing educational assistance is the key to making service in the military attractive," declared Rep. Richard C. White (D-Tex.) in launching a new GI Bill-type plan designed to attract and keep manpower. Many lawmakers seem to agree with him.

The measure was promptly cranked into the FY '81 military authorization bill and approved by the full House. Unlike other educational incentive-type plans, this one is given a chance of going all the way, perhaps because it need not carry a large price tag.

The contributory educational program known as VEAP, which has been open to military people entering service in 1977 and since then, probably would give way if the White plan or something like it is adopted.

The House-approved education aid scheme would provide up to $1,200 a year for tuition and fees and $300 a month in subsistence for nine months of each year, in exchange for a stated amount of service. Four years of benefits is the maximum. So as not to discourage reenlistments, a participant on reenlisting could transfer his earned educational assistance to a member of his family. Each Service Secretary would operate the program and could restrict participation to those skills he chooses. A more generous education aid bill has been introduced in the Senate by Sen. William Armstrong (R-Colo.). It would pay up to $3,000 a year in tuition plus subsistence, though it appears to be much too expensive for the government to swallow.

In reporting the authorization measure to the House floor, the Armed Services Committee scored the Pentagon for its failures with the All-Volunteer Force and its inability to get recruiters into high schools and to get a handle on the criminal records of potential recruits. Manpower problems "are serious, and a commitment of resources and initiatives must be forthcoming. A sense of urgency is needed," the report said.

At another point the report said elimination of GI Bill benefits "has left the military incapable of reaching [recruiting from] a large segment of society." It failed to note, however, that it was Congress, not the Pentagon, that killed the GI Bill for post-1976 enlistees.

A new Senate bill of Sen. Alan Cranston (D-Calif.) would raise GI Bill educational and vocational training payments for those still eligible. A full-time student without dependents, for example, would receive $342 a month, instead of the present $311. With one dependent the rate would rise from $370 to $407. Senator Cranston heads the Senate Veterans Committee, which normally reigns supreme over veteran education legislation.

However, the Armed Services Committee took charge of the White plan, calling it a recruiting incentive measure.

Howard Davis, right, recipient of the Exceptional Civilian Service Medal, with Rome, N. Y., Mayor Carl Eilenberg, center, and Maj. Gen. John C. Toomay, USAF (Ret.), at the Rome Air Development Center's recent annual awards banquet. Davis, retiring technical director of RADC's Intelligence and Reconnaissance Division, was presented USAF's highest civilian award for contributions to US intelligence data exploitation. Former RADC Commander General Toomay was the guest speaker.

This new logo for the Air Force Retiree Involvement Program, put out by Air Force Retiree Affairs Offices, should be showing up on letterheads, base retiree newsletters, office signs, etc. It was adopted by the USAF Retiree Council at its meeting last November.

DoD: Registration Yes, Draft No

The Defense Department again has denounced a peacetime draft while welcoming the recent congressional action leading to early registration of eighteen- and nineteen-year-olds. The full House and the Senate Appropriations Committees have approved the $13.3 million the President has requested to set registration in motion. A Senate vote was pending at press time.

Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics) Robert D. Pirie said peacetime conscription is onerous and that requiring no more than two years of service would do nothing for the services' slumping experience level. After lengthy and expensive training, a draftee would have very little active-duty mileage left, he said.

A draft now would not stem the departure of experienced members and it might "lull the American people into believing all is well for military personnel, result in no pay adjustment . . . and further exacerbate the problem," he stated.

But peacetime registration would "revitalize" the Selective Service System, "help us to increase our preparedness, assure our ability to respond, and further demonstrate our resolve," Mr. Pirie said.

USAF Limited to 123,000 Kin Abroad

Starting in October, USAF cannot allow more than 123,000 command-sponsored dependents overseas, but this should cause no severe problems because the kin population abroad has been running close to, even below, that figure. Last fall, at the end of FY '79, for instance, Air Force command-sponsored dependents overseas numbered 121,296. An additional 9,089 noncommand-sponsored USAF dependents also were abroad.

The new ceilings, effective October 1, 1980, apply only to command-sponsored persons. Defense-wide this ceiling is 325,000. The breakdown by service, recently worked out by DoD, is Army 168,000, Air Force 123,000, and Navy and Marine Corps 34,000.

The Air Force at press time was running a special audit to provide a late count of kin overseas. The expectation is that tough measures, like forced early return to the States, won't be necessary. "Any actions are expected to be moderate," Hq. USAF told AIR FORCE Magazine.

Officials also said policies related to noncommand-sponsored kin won't be changed. Their benefits vary by location, but generally they are not eligible for base housing or government travel funds, and there are restrictions on their use of commissaries and base exchanges. Congress came close last year to denying all benefits to noncommand-sponsored dependents.

Defense Department figures show that there were 869,290 USAF dependents altogether at the end of FY '79. West Germany led the overseas contingent with 45,607, followed by 25,570 in the UK, 17,545 in Japan and Okinawa, 12,091 in the Philippines, and 7,683 in Spain.

Congress for several years has been pressuring the Pentagon to reduce dependents overseas, claiming they would be in the way and their safety impaired should an emergency arise.

THE BULLETIN BOARD

Short Bursts

Lt. Gen. Paul W. Myers, the USAF Surgeon General, returned to the House Appropriations Committee recently seeking relief from the group's earlier **refusal to let Air Force commission new physician assistants** (PAs). The committee had also slapped a rank ceiling of major on existing PAs. These adverse actions, General Myers told the committee, have gutted the PA program, dried up applications, and threaten to cripple USAF's ability to care for "Air Force families in peacetime."

GI **home-loan interest rates** plunged from the record high fourteen percent on April 3 to 11.5 percent on May 15. For a veteran or service member buying a home with a thirty-year, $50,000 GI loan, the decrease will lower the monthly payment almost $100. The change does not affect existing loans whose interest rates remain the same for the life of the agreement.

Since 1972 twenty-five percent of the **AFROTC units** have folded because of **low enrollments.** That's being turned around. In FY '79 some 16,900 students were enrolled, but this year's expected student average enrollment is nearly 19,300 and next year's is forecast at 20,640. Furthermore, **twelve new AFROTC units** are slated to open in the fall of 1981, giving the service a total of 150 detachments.

Agent Orange bills are proliferating. They would extend service-connected disability benefits to veterans who were exposed to the herbicides sprayed in Vietnam. Meanwhile, Air Force's long-pending study of its **former "Ranch Hand" members** who sprayed Agent Orange still hasn't gotten off the ground. There's an intragovernment agency flap over who should conduct the probe.

When the Air Force member of a family living in government quarters dies, his wife and children can stay on for two months rent-free. Correct? No, not correct. They can stay in the quarters for sixty days but must pay a **daily rental charge** equal to 1/30th of the quarters allowance. Why this **seemingly hardhearted policy?** A recent *TIG Brief* item explains that allowing the family to stay in the housing rent-free would be unfair to families in the same situation who live in private housing and whose rent or mortgage payments are not likely to be stopped. According to the *Brief,* published by the USAF Inspector General, very few people know about this policy.

When USAF offered an **extra stripe or two to certain enlistees,** it ran into problems among recruits at basic training. Seems that some of them, who didn't rate a stripe, were miffed when they discovered the special enlistees, such as JROTC and CAP graduates, were displaying their E-2 and E-3 insignia. The solution Air Force arrived at: **Prohibit wearing of any stripes by basic trainees.** The favored ones get the higher pay, but can't pin on their stripes until graduation from basic. ■

SENIOR STAFF CHANGES

PROMOTIONS: To be **Lieutenant General:** Thomas H. **McMullen.**

To be **Major General:** William J. **Campbell.**

To be **ANG Major General:** Robert J. **Collins;** Grady L. **Patterson,** Jr.

To be **ANG Brigadier General:** Justin L. **Berger;** George J. **Dowd;** Ralph E. **Leonard;** Dan C. **Mills;** Robert H. **Neitz;** William H. **Neuens;** Glenn W. **Osgood,** Jr.; Raymond V. **Palmer;** Henry C. **Smyth,** Jr.; John H. **Stennis;** Paul M. **Thompson;** Donald J. **Tressler;** Thomas J. **Turnbull;** Herbert L. **Wassell,** Jr.; John A. **Wilson** III; Russell A. **Witt.**

RETIREMENTS: M/G Van C. **Doubleday;** B/G Robert W. **Kennedy;** B/G William L. **Strand;** M/G Charles L. **Wilson.**

CHANGES: Col. (B/G selectee) James T. Boddie, Jr., from Cmdr., 51st Comp. Wg., PACAF, Osan AB, ROK, to Dep. Dir., Nat'l Military Command Center (#5), OJCS, Washington, D. C. . . . **M/G Bill V. Brown,** from Vice Cmdr., 8th AF, SAC, Barksdale AFB, La., to DCS/Plans, Hq. SAC, Offutt AFB, Neb., replacing B/G (M/G selectee) William J. Campbell . . . **B/G Richard A. Burpee,** from IG, Hq. SAC, Offutt AFB, Neb., to Ass't DCS/Ops., Hq. SAC, Offutt AFB, Neb., replacing M/G Patrick J. Halloran . . . **B/G (M/G selectee) William J. Campbell,** from DCS/Plans, Hq. SAC, Offutt AFB, Neb., to Dir. of Prgms., DCS/Prgms. & Evaluation, Hq. USAF, Washington, D. C.

L/G Philip C. Gast, from Vice Cmdr., Hq. TAC, Langley AFB, Va., to Dir. of Ops., J-3, OJCS, Washington, D. C. . . . **M/G Patrick J. Halloran,** from Ass't DCS/Ops., Hq. SAC, Offutt AFB, Neb., to Dep. Dir. for Strategic C^3 Systems, JCS, Washington, D. C., replacing retiring M/G Van C. Doubleday . . . **B/G William L. Kirk,** from IG, Hq. PACAF, Hickam AFB, Hawaii, to Dir., Electromagnetic Combat, DCS/OP&R, Hq. USAF, Washington, D. C., replacing retiring B/G Robert W. Kennedy . . . **M/G (L/G selectee) Thomas H. McMullen,** from DCS/Systems, Hq. AFSC, Andrews AFB, Md., to Vice Cmdr., Hq. TAC, Langley AFB, Va., replacing L/G Philip C. Gast.

B/G Richard W. Phillips, Jr., from Dep. Dir., General Purpose Forces, DCS/RD&A, Hq. USAF, Washington, D. C., to Joint Test Dir., EW/CAS, Joint Task Force, Arlington, Va., replacing retiring B/G William L. Strand . . . **B/G Walter H. Poore,** from Cmdr., 319th BW, SAC, Grand Forks AFB, N. D., to Ass't DCS/Log., Hq. SAC, Offutt AFB, Neb., replacing B/G Harold J. M. Williams . . . **Col. (B/G selectee) Bernard P. Randolph,** from Prgm. Dir., Space Defense Systems, Space Div., AFSC, Los Angeles, Calif., to Vice Cmdr., Warner Robins ALC, AFLC, Robins AFB, Ga., replacing B/G Marvin C. Patton . . . **B/G Walter C. Schrupp,** from Cmdr., 40th AD, SAC, Wurtsmith AFB, Mich., to Vice Cmdr., 8th AF, SAC, Barksdale AFB, La., replacing M/G Bill V. Brown.

B/G Click D. Smith, Jr., from Cmdr., 322d Airlift Div., MAC, Ramstein AB, Germany, to Dep. Dir., General Purpose Forces, DCS/RD&A, Hq. USAF, Washington, D. C., replacing B/G Richard W. Phillips, Jr. . . . **Col. (B/G selectee) Robert D. Springer,** from Cmdr., 435th TAW, MAC, Rhein-Main AB, Germany, to Cmdr., 322d Airlift Div., MAC, Ramstein AB, Germany, replacing B/G Click D. Smith, Jr. . . . **M/G Wayne E. Whitlatch,** from DCS/Ops. & Intelligence, and Senior US Rep., AFCENT, to Cmdr., Hq. AFTEC, Kirtland AFB, N. M., replacing M/G (L/G selectee) Howard W. Leaf . . . **B/G Harold J. M. Williams,** from Ass't DCS/Log., Hq. SAC, Offutt AFB, Neb., to IG, Hq. SAC, Offutt AFB, Neb., replacing B/G Richard A. Burpee. ■

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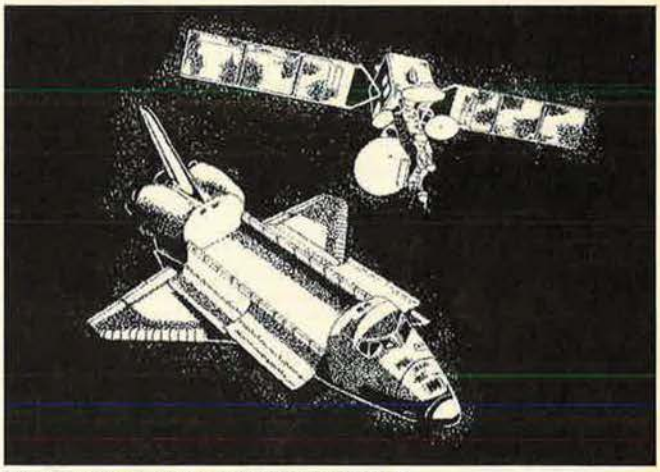

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The Association provides an organization through which free men may unite to fulfill the responsibilities imposed by the impact of aerospace technology on modern society; to support armed strength adequate to maintain the security and peace of the United States and the free world; to educate themselves and the public at large in the development of adequate aerospace power for the betterment of all mankind; and to help develop friendly relations among free nations, based on respect for the principle of freedom and equal rights for all mankind.

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Casselberry, Fla.

James H. Straubel
(ex officio)
Executive Director
Air Force Association
Washington, D. C.

Rev. Msgr. Rosario L. U. Montcalm
(ex officio)
National Chaplain
Holyoke, Mass.

Gen. David C. Jones, USAF
(ex officio)
Immediate Past USAF C/S
Washington, D. C.

Robert D. Gaylor
(ex officio)
Immediate Past CMSAF
San Antonio, Tex.

CMSgt. Robert W. Carter
(ex officio)
Chairman, Enlisted Council
Lackland AFB, Tex.

Capt. Robert M. Murdock
(ex officio)
Chairman, JOAC
Scott AFB, Ill.

Thomas C. Lennep, Jr.
(ex officio)
National Commander
Arnold Air Society
Hattiesburg, Miss.

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Information regarding AFA activity within a particular state may be obtained from the Vice President of the Region in which the state is located.

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New York, New Jersey, Pennsylvania

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Farmington, Utah 84025
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Rocky Mountain Region
Colorado, Wyoming, Utah

AFA's 1980 National Convention and Aerospace Development Briefings and Displays

September 14–18 • Washington, D.C.

AFA's 1980 National Convention and Aerospace Development Briefings and Displays will be held at the new Sheraton Washington Hotel, a $100 million facility which has been erected on the site of the old Sheraton-Park Hotel. The new main entrance and the convention entrance are on Woodley Road. The old Motor Inn, now called the Park Tower, and the Wardman Tower are being completely renovated.

We have reserved additional blocks of rooms at the Connecticut Inn and the Normandy Inn at substantially lower rates than the Sheraton Washington. Both properties are on the Connecticut Avenue Metrobus route with frequent Metrobus service.

All reservation requests for rooms and suites at the Sheraton Washington should be sent to: Sheraton Washington Hotel, 2660 Woodley Road, N.W., Washington, D.C. 20008. Reservation requests for the Connecticut Inn and Normandy Inn should be sent to: Connecticut Inn, 4400 Connecticut Avenue, N.W., Washington, D.C. 20008; Normandy Inn, 2118 Wyoming Avenue, N.W., Washington, D.C. 20008. We urge you to make your reservations as soon as possible. To assure acceptance of your reservation requests, please refer to the AFA National Convention.

The new Sheraton Washington Hotel.

Arrivals after 6:00 p.m. require a one-night deposit or major credit card number guarantee. Guaranteed reservations must be canceled by 4:00 p.m. on the date of arrival to avoid being charged for that night. We urge you to make your hotel reservations as soon as possible.

Convention activities will include AFA Opening Ceremonies, Business Sessions, luncheons honoring the Secretary of the Air Force and the Air Force Chief of Staff, Aerospace Education Foundation Awards Luncheon, the annual AFA Salute to Congress, Annual Reception, and the Air Force Anniversary Reception and Banquet. The Annual Reception and the black-tie pre-banquet reception will both be held in the newly expanded Sheraton Washington's 100,000 square foot Exhibit Halls which are already sold out.

ADVANCE REGISTRATION FORM

Air Force Association National Convention and Aerospace Development Briefing & Displays

September 14-18, 1980 • Sheraton Washington Hotel • Washington, D.C.

Type or Print

Name _____

Title _____

Affiliation _____

Address _____

City, State, ZIP _____

Note: Advance registration and/or ticket puchases must be accompanied by check made payable to AFA. Mail to AFA, 1750 Pennsylvania Ave., N.W., Washington, D.C. 20006.

Reserve the following for me:

☐ Advance Registrations $_____
@ $65 per person (includes credentials and tickets to the following Convention functions. Value $75.) AF Chief of Staff Luncheon; Annual Reception *OR* Salute to Congress;* AF Secretary's Luncheon

Tickets may also be purchased separately for the following:

☐ Aerospace Ed. Foundation Luncheon @ $20 $_____
☐ Outstanding Airmen Dinner @ $40 $_____
☐ AF Chief of Staff Luncheon @ $25 $_____
☐ Annual Reception @ $25 $_____
☐ Salute to Congress* @ $25 $_____
☐ AF Secretary's Luncheon @ $25 $_____
☐ AF 33d Anniversary Reception and Dinner Dance @ $55 each $_____
Total for separate tickets $_____
Total amount enclosed $_____

Advance Registration Fee before September 5—$65 (After September 5—$75)
*Tickets to Salute to Congress available only to AFA Convention Delegates accompanied by their Congressman.

AFA NEWS

Chapter and State Photo Gallery

By Vic Powell, AFA AFFAIRS EDITOR

Congressman Bob Wilson (R-Calif.), right, senior minority member of the House Armed Services Committee, has been honored by the San Diego Chapter for his support of US airpower. The unique plaque containing a Machmeter was presented to Representative Wilson at the Chapter's dinner meeting by Chapter President Howard J. Fry, left.

AFA's Mid-Ohio Chapter began its membership drive by enlisting as a three-year member the Hon. Mary Lusk, Mayor of Newark, Ohio. At left is Roy Haberlandt, Chapter President. John Bakos, Chapter Vice President, at right.

An AFA Presidential Citation recently was presented to Carol A. Nuetzel, long-time AFA volunteer and secretary to the Chairman of the Joint Chiefs of Staff, on her reassignment to the Department of Energy. JCS Chairman Gen. David C. Jones presented the award in his capacity as a member of AFA's Board of Directors. At right is Mrs. Jones.

CALENDAR OF EVENTS

Missouri State AFA Convention, July 12, Whiteman AFB . . . **New Hampshire State AFA Convention,** July 19, Pease AFB . . . **Oklahoma State AFA Convention,** July 25–26, Tinker AFB . . . **Massachusetts State AFA Convention,** August 9, Lexington . . . **Colorado State AFA Convention,** August 15–16, Boulder . . . **AFA Board of Directors Meeting,** September 14, Washington, D. C. . . . **AFA's 34th Annual National Convention,** September 15–18, Washington, D. C. . . . **AFA's Aerospace Development Briefings and Displays,** September 16–18, Sheraton Washington Hotel, Washington, D. C.

At a "Blue Suit" awards banquet held by the Alamo Chapter in San Antonio, Tex., the AFA Medal of Merit was presented to retired Maj. Gen. Abe Dreiseszun, far left; P. D. Straw, second from left; and CMSgt. Robert Carter, far right. AFA National Director Gen. William V. McBride, USAF (Ret.), center, and Chapter President retired Lt. Gen. Walter Galligan, second from right, presented the awards.

Clare Boothe Luce, playwright, novelist, and former congresswoman and US Ambassador to Italy, addressed a luncheon meeting of the Hawaii Chapter, attended by more than 300 guests. Following her address, Chapter President William B. Taylor, right, presented Mrs. Luce, center, with a lei. At left is Maj. Gen. Hoyt S. Vandenberg, Jr., Vice Commander in Chief of Pacific Air Forces.

Rep. James M. Collins (R-Tex.), right, was one of many AFA members attending a recent banquet of the Dallas Chapter at the University of Texas, Dallas. Included in the program was a performance of the Air Force Academy Cadet Chorale. Chapter President George Schulstad, left, reports that AFA members headed a successful community effort to obtain funding and transportation for the Chorale. Academy Cadet Lynn Donaldson, center, is a member of the Chorale.

AFA NEWS PHOTO GALLERY

Cadet leadership awards, sponsored by the Colorado State AFA, were presented recently by Steve Brantley, center, State President. The ceremony marked a milestone when Cadet Kathy Utley became the first Air Force Academy woman cadet to receive the Outstanding Squadron Commander award. Recipients included, from left to right: C1C Philip R. Glotfelty, Outstanding Element Leader, Squadron 3; C1C Kathy Utley, Squadron 17; C2C Raymond G. Torres, Outstanding First Sergeant, Squadron 23; C2C John Severence, Outstanding Flight Sergeant, Squadron 23; and C2C Curtis R. McIntyre, Outstanding Element Sergeant, Squadron 18.

The AFJROTC unit at Berkeley High School, Moncks Corner, S. C., has been judged Best Air Force Unit and best overall JROTC unit competing in the Tiger Drill meet at Clemson University. Here Cadet Lt. Col. Steven E. Head, a senior at Berkeley, accepts the Best Air Force Unit trophy for his school from Col. Edwin F. Rumsey, Commander of Clemson's AFROTC detachment. The award is sponsored by the South Carolina State AFA. Twenty-two JROTC units competed in the meet.

A joint meeting of AFA's Tulsa, Okla., Chapter and the Tulsa Division Management Club of McDonnell Douglas Corp. was addressed by Maj. Gen. J. J. Murphy, Commander of Ogden ALC, Hill AFB, Utah. Greeting guests at the affair were, from left, Chapter President L. S. Allen; General Murphy; Larry Lewis, President of the Division Management Club; and AFA National Director Harold C. Stuart.

Dave Vergason, center, FAA senior controller at Tampa International Airport, participated in a seminar conducted by the Jerry Waterman Chapter regarding the possible designation of the Tampa-MacDill AFB area as a terminal contro zone for aircraft traffic. At left is Chapter Vice President Lee Harrington, who has been reelected for the coming year. Mike Fallon, right, is Chapter President-elect for 1980–81.

Col. Richard Wallace, center, Commander of the 305th Air Refueling Wing, Grissom AFB, Ind., was the speaker at a meeting of the Gus Grissom Chapter, Lafayette, Ind. Chapter President Richard Ortman, left, Professor of Aviation Technology at Purdue University, looks on as retired Brig. Gen. John Bradshaw greets Colonel Wallace. General Bradshaw led the movement to revitalize Chapter support of the AFROTC detachment at Purdue.

Lt. Gen. Kenneth L. Tallman, Superintendent of the US Air Force Academy, spoke at a recent meeting of the Greater Seattle Chapter. Sharing a lighter moment are, left to right, retired Maj. Gen. William C. Burrows, Chapter President; National Director Sherman W. Wilkins; Mrs. Burrows; National Vice President Margaret A. Reed; General Tallman; and Mrs. Rosemary Lloyd, wife of Chapter Vice President A. T. Lloyd.

Canadian Forces Air Attaché to the United States, Brig. Gen. Ronald B. Button, holds a copy of the book Between Friends, which he presented to Jones E. Bolt, left, President of AFA's Grand Strand Chapter in South Carolina. The presentation was made during the first annual joint meeting of the Air Force Association and the Royal Canadian Air Force Association, attended by more than 100 persons. Future plans call for a golf tournament as part of the Canadian-American gathering.

20% Dividend paid for 1979 calendar year

SEE NEW BENEFITS FOR FAMILY COVERAGE!

NOW AVAILABLE TO

CURRENT BENEFIT TABLES

Insured's Attained Age	STANDARD PREMIUM: $10 per month Basic Benefit*	HIGH OPTION PREMIUM: $15 per month Basic Benefit*	HIGH OPTION PLUS PREMIUM: $20 per month Basic Benefit*
20-29	$85,000	$127,500	$170,000
30-34	65,000	97,500	130,000
35-39	50,000	75,000	100,000
40-44	35,000	52,500	70,000
45-49	20,000	30,000	40,000
50-54	12,500	18,750	25,000
55-59	10,000	15,000	20,000
60-64	7,500	11,250	15,000
65-69	4,000	6,000	8,000
70-74	2,500	3,750	5,000
Aviation Death Benefit*			
Non-war related	$25,000	$37,500	$50,000
War related	$15,000	$22,500	$30,000
Extra Accidental Death Benefit*	$12,500*	$15,000*	$17,500*

*The Extra Accidental Death Benefit is payable in addition to the basic benefit in the event an accidental death occurs within 13 weeks of the accident, except as noted under AVIATION DEATH BENEFIT (below).

*AVIATION DEATH BENEFIT: The coverage provided under the Aviation Death Benefit is paid for death which is caused by an aviation accident in which the insured is serving as pilot or crew member of the aircraft involved. Under this condition, the Aviation Death Benefit is paid in lieu of all other benefits of this coverage. Furthermore the non-war related benefit will be paid in all cases where the death does not result from war or an act of war, whether declared or undeclared.

OTHER IMPORTANT BENEFITS

COVERAGE YOU CAN KEEP. Provided you apply for coverage under age 60 (see "ELIGIBILITY") your insurance may be retained at the same low group rates to age 75.

FULL TIME, WORLD WIDE PROTECTION. The policy contains no war clause, hazardous duty restriction, combat zone waiting period or geographical limitation.

DISABILITY WAIVER OF PREMIUM. If you become totally disabled at any time prior to age 60 for at least a 9-month period, your coverage will be continued in force without further payment of premiums as long as you remain disabled.

FULL CHOICE OF SETTLEMENT OPTIONS. All standard forms of settlement options, as well as special options agreed to by the insured and United of Omaha, are available to insured members.

CONVENIENT PAYMENT PLANS. Premium payments may be made by monthly government allotment (payable to Air Force Association), or direct to AFA in quarterly, annual or semi-annual installments.

DIVIDEND POLICY. AFA's primary policy is to provide maximum coverage at the lowest possible cost. Consistent with this policy, AFA has provided year-end dividends in all but three years (during the Vietnam War) since the program was initiated in 1961, and basic coverage has been increased on six separate occasions.

ADDITIONAL INFORMATION

Effective Date of Your Coverage. All certificates are dated and take effect on the last day of the month in which your application for coverage is approved, and coverage runs concurrently with AFA membership. AFA Group Life Insurance is written in conformity with the insurance regulations of the State of Minnesota. The insurance will be provided under the group insurance policy issued by United of Omaha to the First National Bank of Minnesota as trustees of the Air Force Association Group Insurance Trust.

EXCEPTIONS: There are a few logical exceptions to this coverage. They are:

Group Life Insurance: Benefits for suicide or death from injuries intentionally self-inflicted while sane or insane will not be effective until your coverage has been in force for 12 months.

The Accidental Death Benefit and Aviation Death Benefit shall not be effective if death results: (1) From injuries intentionally self-inflicted while sane or insane, or (2) From injuries sustained while committing a felony, or (3) Either directly or indirectly from bodily or mental infirmity, poisoning or asphyxiation from carbon monoxide, or (4) During any period a member's coverage is being continued under the waiver of premium provision, or (5) From an aviation accident, either military or civilian, in which the insured was acting as pilot or crew member of the aircraft involved, except as provided under AVIATION DEATH BENEFIT.

ELIGIBILITY

All members of the Air Force Association are eligible to apply for this coverage provided they are under age 60 at the time application for coverage is made.

*Because of certain restrictions on the issuance of group insurance coverage, applications for coverage under the group program cannot be accepted from non-active duty personnel residing in either New York or Ohio. Non-active duty members residing in Ohio, however, may request special application forms from AFA for individual policies which provide coverage quite similar to the group program.

OPTIONAL FAMILY COVERAGE

(new benefit schedule effective 6/30/80)
PREMIUM: $2.50 per month

Insured's Attained Age	Life Insurance Coverage for Spouse	Life Insurance Coverage for each Child*
20-39	$20,000.00	$4.000.00
40-44	15,000.00	4,000.00
45-49	10,000.00	4,000.00
50-54	7,000.00	4,000.00
55-59	5,000.00	4,000.00
60-64	3,000.00	4,000.00
65-69	2,000.00	4,000.00
70-75	1,000.00	4,000.00

*Children under six months are provided with $250 coverage once they are 15 days old and discharged from the hospital.

Upon attaining age 21, and upon submission of satisfactory evidence of insurability, insured dependent children may replace this $4,000 group coverage (in most states) with a $10,000 permanent individual life insurance policy with guaranteed purchase options.

Please Retain This Medical Bureau Prenotification For Your Records

Information regarding your insurability will be treated as confidential. United Benefit Life Insurance Company may, however, make a brief report thereon to the Medical Information Bureau, a nonprofit membership organization of life insurance companies, which operates an information exchange on behalf of its members. If you apply to another bureau member company for life or health insurance coverage, or a claim for benefits is submitted to such company, the Bureau, upon request, will supply such company with the information in its file.

Upon receipt of a request from you, the Bureau will arrange disclosure of any information it may have in your file. (Medical information will be disclosed only to your attending physician.) If you question the accuracy of information in the Bureau's file, you may contact the Bureau and seek a correction in accordance with the procedures set forth in the federal Fair Credit Reporting Act. The address of the Bureau's information office is P.O. Box 105, Essex Station, Boston, Mass. 02112. Phone (617)426-3660.

United Benefit Life Insurance Company may also release information in its file to other life insurance companies to whom you may apply for life or health insurance, or to whom a claim for benefits may be submitted.

ALL AFA MEMBERS (under age 60)

APPLICATION FOR
AFA GROUP LIFE INSURANCE

United of Omaha

Group Policy GLG-2625
United Benefit Life Insurance Company
Home Office Omaha Nebraska

Full name of member _____
Rank Last First Middle

Address _____
Number and Street City State ZIP Code

Date of birth (Mo. / Day / Yr.)	Height	Weight	Social Security Number

This insurance is available only to AFA members

☐ I enclose $13 for annual AFA membership dues (includes subscription ($9) to AIR FORCE Magazine). Please send membership application.

☐ I am an AFA member.

Name and relationship of primary beneficiary

Name and relationship of contingent beneficiary

Please indicate below the Mode of Payment and the Plan you elect:

Plan of Insurance

Mode of Payment	Standard Plan		High Option Plan		High Option PLUS Plan	
	Member Only	Member And Dependents	Member Only	Member And Dependents	Member Only	Member And Dependents
Monthly government allotment (only for military personnel). I enclose 2 month's premium to cover the necessary period for my allotment (payable to Air Force Association) to be established.	☐ $ 10.00	☐ $ 12.50	☐ $ 15.00	☐ $ 17.50	☐ $ 20.00	☐ $ 22.50
Quarterly. I enclose amount checked.	☐ $ 30.00	☐ $ 37.50	☐ $ 45.00	☐ $ 52.50	☐ $ 60.00	☐ $ 67.50
Semi-Annually. I enclose amount checked.	☐ $ 60.00	☐ $ 75.00	☐ $ 90.00	☐ $105.00	☐ $120.00	☐ $135.00
Annually. I enclose amount checked.	☐ $120.00	☐ $150.00	☐ $180.00	☐ $210.00	☐ $240.00	☐ $270.00

Names of Dependents To Be Insured	Relationship to Member	Dates of Birth Mo. Day Yr.	Height	Weight

Have you or any dependents for whom you are requesting insurance ever had or received advice or treatment for: kidney disease, cancer, diabetes, respiratory disease, epilepsy, arteriosclerosis, high blood pressure, heart disease or disorder, stroke, venereal disease or tuberculosis? Yes ☐ No ☐

Have you or any dependents for whom you are requesting insurance been confined to any hospital, sanatorium, asylum or similar institution in the past 5 years? Yes ☐ No ☐

Have you or any dependents for whom you are requesting insurance received medical attention or surgical advice or treatment in the past 5 years or are now under treatment or using medications for any disease or disorder? Yes ☐ No ☐

If YOU ANSWERED "YES" TO ANY OF THE ABOVE QUESTIONS, EXPLAIN FULLY including date, name, degree of recovery and name and address of doctor. (Use additional sheet of paper if necessary.)

I apply to United Benefit Life Insurance Company for insurance under the group plan issued to the First National Bank of Minneapolis as Trustee of the Air Force Association Group Insurance Trust. Information in this application, a copy of which shall be attached to and made a part of my certificate when issued, is given to obtain the plan requested and is true and complete to the best of my knowledge and belief. I agree that no insurance will be effective until a certificate has been issued and the initial premium paid.

I hereby authorize any licensed physician, medical practitioner, hospital, clinic or other medical or medically related facility, insurance company, the Medical Information Bureau or other organization, institution or person, that has any records or knowledge of me or my health, to give to the United Benefit Life Insurance Company any such information. A photographic copy of this authorization shall be as valid as the original. I hereby acknowledge that I have a copy of the Medical Information Bureau's prenotification information.

Date _____, 19 ____ _____
Member's Signature

FORM 3676GL App. REV. 10-79

Application must be accompanied by a check or money order. Send remittance to:
Insurance Division, AFA, 1750 Pennsylvania Avenue, NW, Washington, D.C. 20006 7/80

Bob Stevens'

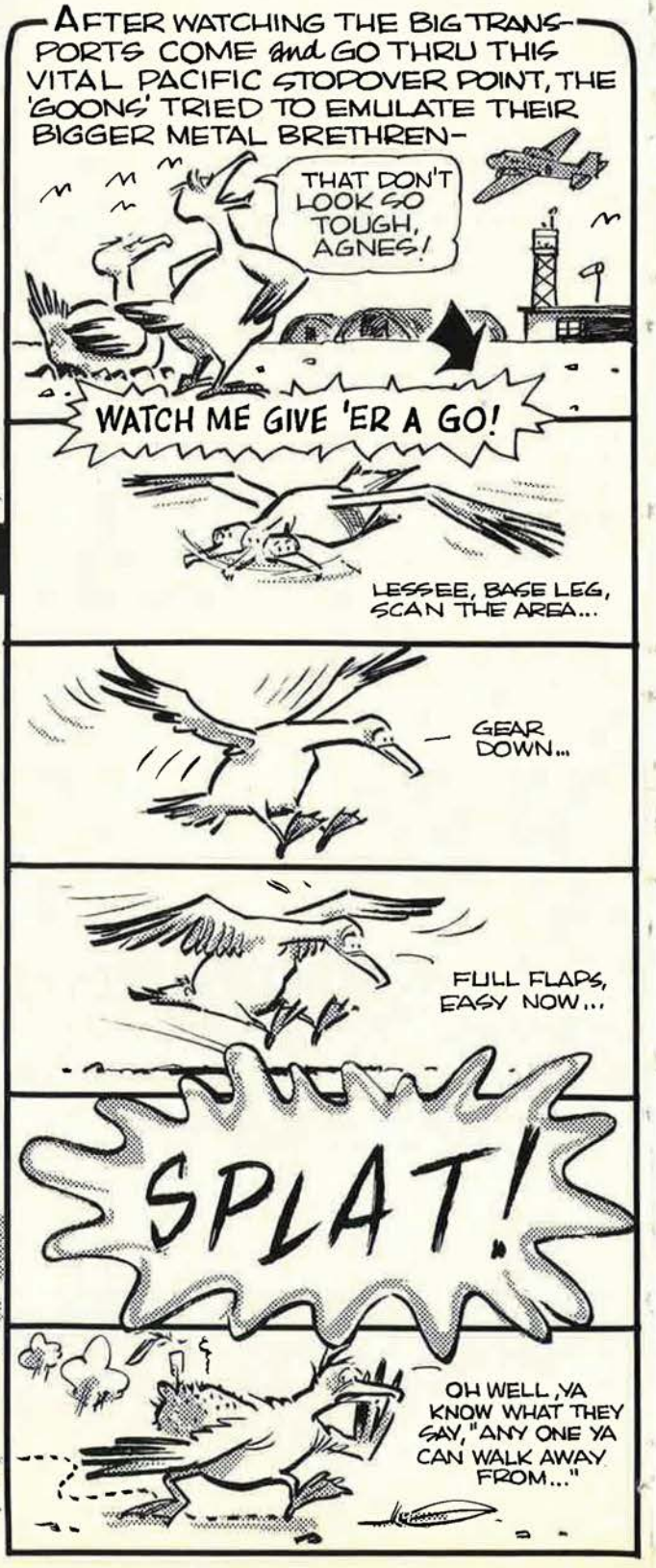
"There I was..."

THE STORY OF THE GOONEYBIRDS OF MIDWAY ISLAND IS LEGEND and LONG OVERDUE FOR EXPOSURE IN THIS SPACE. THE VENERABLE C-47 GOT ITS NAME FROM THESE PROLIFIC FEATHERED CLOWNS-THEIR FLIGHT CHARACTERISTICS WERE SIMILAR.

MOVING THE THOUSANDS OF EGGS FROM RUNWAYS, TAXIWAYS, ETC. MADE THE BIRDS MAD AS HELL... THEY'D MOVE 'EM RIGHT BACK!

ATTEMPTS TO TAKE OFF AFTER A FULL MEAL WERE AN ABSOLUTE RIOT TO WATCH! NO ONE EVER TOLD 'EM ABOUT LIFT-OVER-WEIGHT OR C.G.s—

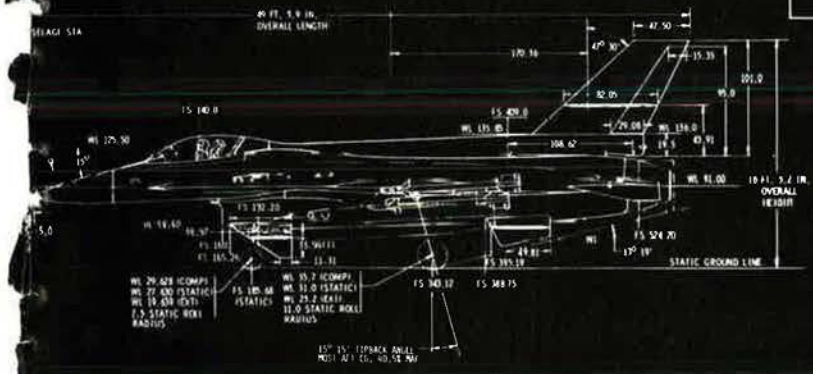
AFTER WATCHING THE BIG TRANSPORTS COME and GO THRU THIS VITAL PACIFIC STOPOVER POINT, THE 'GOONS' TRIED TO EMULATE THEIR BIGGER METAL BRETHREN—

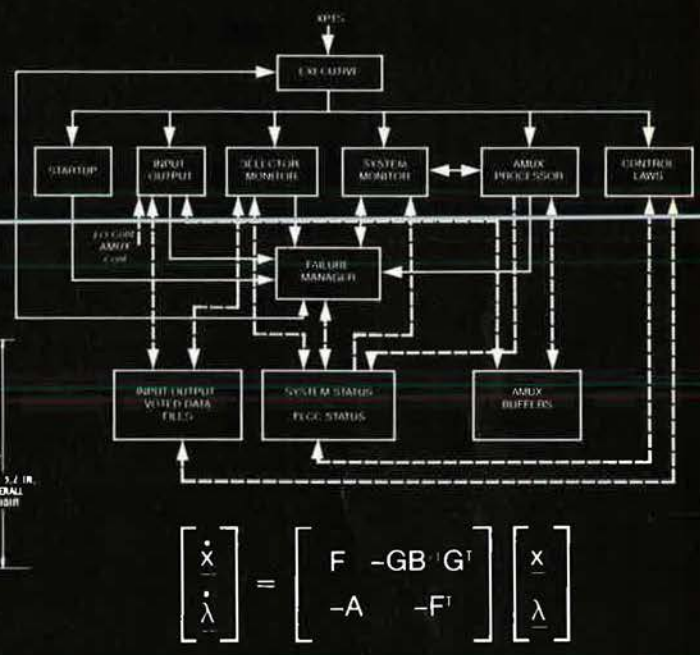


Our engineers are developing, integrating, demonstrating and validating advanced fighter technologies for the AFTI program.

"The Advanced Fighter Technology Integration (AFTI) program at General Dynamics is a pure, technical, research project designed to advance the state of the fighter aircraft art. It's a learning situation. Working on the AFTI program, engineers have the opportunity to do unrestrained technical work in redundancy management, digital computer self-test, control law synthesis, avionics systems architecture and systems hardware integration."

Larry Lydick
AFTI-F-16 Chief Engineer





$$\begin{bmatrix} \dot{x} \\ \dot{\lambda} \end{bmatrix} = \begin{bmatrix} F & -GB^{-1}G^T \\ -A & -F^T \end{bmatrix} \begin{bmatrix} x \\ \lambda \end{bmatrix}$$

e Advanced Fighter Technology Integration FTI) program now underway at General namics' Fort Worth Division will explore mising technologies for future tactical nter options. Says Larry Lydick: "We're king at a triplex digital flight control system at will give required redundancy while lding significant improvements in air-to-air d air-to-ground combat effectiveness." nodified F-16 will be used as a test vehicle demonstrate digital-controlled flight refinements and integrated flight and fire control (IFFC). Featuring task-tailored multi-modes which include weapon line pointing and direct force control, the digital flight control system plus IFFC will improve lethality and survivability in the air-to-ground mode. In air-to-air combat scenarios it will provide faster, more accurate target alignments over a wide range of encounter geometries. Lydick and other AFTI engineers see this program as more than just an opportunity to participate in flight test synthesis. They also feel it is "a firsthand chance to advance the state-of-the-art." AFTI key disciplines include electronics reliability, control laws, avionics integration, digital processors, redundancy management, self-test, software aerodynamics and more.

Interested? Write:
R. H. Widmer
Vice President, Science and Engineering
1519 Pierre Laclede Center,
St. Louis, MO 63105

erospace Group

lectronics Division
an Diego, Calif. 92103
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Fort Worth Division
Fort Worth, Texas 76108
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Pomona, Calif. 91766
Phalanx, Standard Missile, Stinger, Sparrow AIM-7F, DIVAD, Viper, RAM

GENERAL DYNAMICS

The KC-10 rolls out... to double the reach of rapid deployment.

The Air Force's new KC-10 Extender advanced tanker cargo aircraft is on its way to active duty. With it, our fighter squadrons and their support equipment will soon be able to go almost any place on earth without regard to enroute basing or overflight rights. The KC-10 refueling capability nearly doubles the non-stop reach of a fully-loaded C-5 transport.

The KC-10 can deliver 200,000 pounds of fuel as far as 2,200 statute miles and return to its takeoff point. With its advanced, longer boom, it can refuel other aircraft at rates up to 1,500 gallons per minute.

Or, the KC-10 can carry 170,000 pounds on its huge cargo deck more than 4,400 statute miles on a cargo mission.

Global security is dependent on America's ability to deploy tactical forces to trouble spots at a moment's notice. The KC-10 is a valuable new extension of Free World defense.

KC-10 Extender

MCDONNELL DOUGLAS